Integration of African Countries in Regional and Global Value Chains: Static and Dynamic Patterns

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***Working Paper* GVC-007**

AFRICAN ECONOMIC RESEARCH CONSORTIUM
CONSORTIUM POUR LA RECHERCHE ÉCONOMIQUE EN AFRIQUE

Bringing Rigour and Evidence to Economic Policy Making in Africa

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AERC Working Paper GVC-007
African Economic Research Consortium, Nairobi
July 2022

THIS RESEARCH STUDY was supported by a grant from the African Economic Research Consortium. The findings, opinions and recommendations are those of the author, however, and do not necessarily reflect the views of the Consortium, its individual members or the AERC Secretariat.

Published by: The African Economic Research Consortium
P.O. Box 62882 - City Square
Nairobi 00200, Kenya

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List of abbreviations and acronyms

AfCFTA	African Continental Free Trade Agreement
DVA	Domestic Value-Added
EBA	Everything But Arms
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GVCs	Global Value Chains
IMF	International Monetary Fund
IO	Input-Output
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
RTA	Regional Trade Agreement
TiVA	Trade in Value-Added
UNIDO	United Nations Industrial Development Organization
VAX	Value-Added Export
WIOD	World Input-Output Database

Abstract

We study the geographic concentration of trade flows of African countries using information on the global input-output structure from the Eora database. Most countries show a similar concentration between close-by vs. long-distance trade in their foreign input sourcing as in their export sales. However, changes over the last two decades indicate that many countries increasingly focus their long-distance trade on only one of these two dimensions. This trend is most pronounced in manufacturing industries with stronger global value chains. In line with the learning-by-exporting hypothesis, export success on distant markets is a leading predictor (Granger causes) of regional export success. Only in light manufacturing do we find some evidence of a reverse pattern, i.e., regional exports preceding global exports.

Key words: *GVC; Upgrading; Granger causality.*

JEL classification codes: *F14; R11.*

Acknowledgements

We thank Jaime de Melo, Dominique Njikeu, Marcelo Olarrega, and workshop participants at the African Economic Research Consortium (AERC) for useful comments. Financial support by the AERC, the IGC, KU Leuven Methusalem Project on the Granular Economy, and the Fonds Wetenschappelijk Onderzoek—Vlaanderen (FWO) and the Fonds de la Recherche Scientifique—FNRS under EOS Project No. G0G4318N (EOS ID 30784531) and Project No. G073619N is gratefully acknowledged.

1. Introduction

International trade provides a potent development path for at least two reasons. Exporters face a highly elastic import demand for their output and importers can source from a highly elastic supply of inputs (Rodrik, 2016). As a result, successful firms can expand without facing the adverse price changes that would hamper growth in the domestic market. At the same time, trade with developed countries provides access to advanced technology and exposes firms to international competition. It allows and forces firms in developing countries to improve productivity and product quality.

Historically, developing countries needed extensive capabilities, and had to master all activities necessary to produce a finished product before they could export much more than raw materials or simple goods (Whittaker et al., 2010). Such capabilities were often acquired by shielding the domestic 'infant industry' from foreign competition using import tariffs or a dual-exchange rate regime. Trade in manufacturers featured international product cycles as products were first introduced in developed countries and only as they matured did production shift to developing countries (Feenstra & Rose, 2000). Exports progressed only gradually from simple goods and light manufacturing to more sophisticated industries (Van Biesebroeck & Zaurino, 2019).

The situation is markedly different for late developing African countries. Nowadays, the manufacturing process of many goods has fragmented and production of individual activities is increasingly spread across several countries (Antràs & Chor, 2022). By integrating in such global value chains (GVCs), African countries can participate in the global production network after mastering only a narrow range of capabilities. In this paper, we study two challenges for countries to insert themselves successfully in this process: specialization and upgrading.

The first challenge for firms is to specialize and develop a comparative advantage in a specific activity. By relying on support services and trade linkages with other firms, they can then integrate efficiently in a broader production network. While firms access global technology and demand through a GVC, they also tend to be integrated closely in local production networks. Especially given high transportation costs in Africa, it will rarely be cost-effective to incur long-distance shipping costs twice.[1] Firms can engage in long-distance trade to source inputs from remote locations or to send their output to remote destinations, but they rarely do both. Ma et al. (2009) document a clear specialization in the long-distance processing trade of Chinese provinces.

We will investigate whether African countries have chosen to exploit global versus regional trade linkages differently for inputs and outputs and how this specialization has evolved over time.

The second challenge is that activities performed in a GVC need to be performed immediately at "world-class" level. Final products will be sold around the world, and product quality needs to be higher than what would be optimal if products were tailored to the domestic market. In most industries, the required knowledge and technology will come from interacting with clients, suppliers, or competitors in more developed markets. We will use a Granger causality approach (Granger, 1969)[2]—i.e., comparing the time dependency of close-by (regional) trade and distant (global) trade—to study which of the following two upgrading strategies is most successful.

On the one hand, firms can gradually expand their activities and enter successively more advanced export markets as they gain experience and advanced capabilities (Eaton et al., 2011). On the other hand, firms can learn from export activities on advanced markets and gain access to advanced technology (Van Biesebroeck, 2005). Even if those activities are not immediately profitable, firms can earn a return on the accumulated knowledge as it improves their regional competitiveness, which in turn will lead to higher regional exports.

Naturally, the current pattern of trade specialization is shaped by previous experiences, and past trade is a first place to look for dynamic effects. Fafchamps et al. (2007) provides a theoretical framework and empirical evidence to explicitly link export market entry to the upgrading process. Some firms achieve low marginal costs, grow large and can afford the fixed cost associated with foreign market entry. Learning-by-doing that accrues with production, irrespective of whether it is for domestic, regional or global markets, is one way to lower marginal costs. Sourcing inputs from high-income countries is another way to lower production costs in developing countries (Kasahara & Rodrigue, 2008). It provides a natural connection between global input imports and regional export success. Other firms have been able to come up with products that appeal to foreign consumers, possibly through past export experience in advanced markets. The two ways that firms can concentrate more on long-distance than on regional trade, either on the import or on the export side, naturally relate to the two alternative upgrading processes that we consider.

We study the distance-proximity trade-off and the time dependency between regional and global trade using the multi-region input-output (IO) table that is part of the Eora database. It is the only global IO table that separately identifies the African countries.[3] In particular, it provides information on bilateral flows of final products and inputs between all African country pairs and with countries outside the region broken down by sector. It provides an unprecedented wealth of information on the regional production network in Africa and its connections with the Rest of the World economy. We will use it in particular to calculate bilateral transfers of value-added at the sectoral level. Naturally, the more disaggregate country dimension comes at the cost of greater reliance on proportionality assumptions and imputations.[4]

As in Van Biesebroeck and Mensah (2019), we reduce the dimensionality by aggregating the global IO table to a set of 51 country-specific IO tables. The sample includes all African countries, i.e., the five countries in North Africa, all of sub-Saharan Africa, and a number of islands. We aggregate their trading partners into eight regions. Some of these differ across the country-specific IO tables to allow alternative definitions of regional trade. In particular, we distinguish neighbours, countries that belong to the same Regional Trade Agreement (RTA), and other African countries.

In terms of geographic focus of African trade, the pattern in the cross-section differs from the change over time. Most African countries show a similar concentration of regional versus global trade for exports and imports. This pattern is particularly strong for landlocked countries. In contrast with the pattern observed across Chinese provinces in Ma et al. (2009), only a few African countries concentrate their trade with distant partners mostly on one dimension (export or import), while trading mostly within the region on the other dimension.[5] However, over the last two decades, many African countries have markedly increased their regional trade concentration for exports or imports, but not both. This is especially true for the "Other Manufacturing" sector which has more differentiated products and intermediate inputs play a more important role.

In terms of the time dependency between local and long-distance trade, we find only a weak relationship in most cases. Only in the "Light Manufacturing" sector do we find local exporting success—defined as trade with neighbouring countries, RTA partners, or all African trade—to be a leading indicator for long-distance export success. This is consistent with theories of selection into exporting, while the learning-by-exporting hypothesis predicts causality going in the reverse direction, from global to local export success. We find no evidence for the latter pattern when countries are pooled and a uniform effect is imposed. However, when we estimate separately by country, pooling across sectors, long-distant export success tends to precede regional export success in the majority of countries. Even omitting the year controls in the pooled regression already leads to strong Granger causality from distant trade to regional trade.

Our findings relate to several literatures. A number of papers have advanced theories why firms engage in long-distance trade on imports or exports, but rarely on both dimensions simultaneously. In the model of market-seeking FDI in Ma et al. (2009), minimization of transportation costs provides a straightforward mechanism. In the context of the automotive industry, Gereffi et al. (2008) shows product differentiation to be another mechanism for the same specialization. Even though global automakers have developed platforms that underpin a range of products, specific models tend to be tailored to regional markets. As a result, most final assembly is regionally organized and exports of finished vehicles outside of the region are a minor share of output. This customization extends to sub-assemblies that are produced just-in-sequence in supplier parks near the assembly plant (Schmitt & Van Biesebroeck, 2013). A significant portion of the value-added of automotive components does not cross any borders anymore. Long-distance trade in automotive component is nevertheless rising, but is made up of either highly specialized, often electronic, parts or unsophisticated parts produced in low-wage countries.

A number of studies have considered whether integrating in a GVC provides firms in developing countries with upgrading opportunities, e.g., Humphrey and Schmitz (2002) and Giuliani et al. (2005). Pahl and Timmer (2020) show a positive effect of GVC participation, constructed from national IO tables, on labour productivity growth and employment growth measured using UNIDO industry statistics. Amighini and Sanfilippo (2014) specifically evaluate the upgrading potential in Africa. They show that South-South import flows and R&D FDI flows have the potential to generate positive spillovers and induce structural transformation. They emphasize the importance of appropriate technology as well as diversification.

Both upgrading mechanisms that we discussed have support in the literature. Van Biesebroeck (2005) provides evidence for the learning-by-exporting hypothesis for manufacturing firms in nine sub-Saharan African countries. Firms are shown to improve their productivity more rapidly than other firms after they start exporting. De Loecker (2007) further shows that Slovenian exporters only raise their productivity if they trade with more advanced economies, not in response to trade with neighbouring countries.

In the canonical heterogeneous firm models, export market entry is explained by self-selection based on productivity. Firms enter the more easily accessible export destinations first and only penetrate more challenging markets when the productivity distribution shifts up. Hence, strong regional export success is expected to precede long-distance trade. Eaton et al. (2011) shows that, indeed almost all French exporters enter the same destination market first and only the more productive firms enter a second market and so on.[6] However, in the model of Regolo (2017) with multi-product firms, export diversification is accompanied by regionalization of trade. The probability of market entry is still negatively associated with distance, but firms start exporting products in which they do not have a strong comparative advantage at a later time, increasingly focusing on nearby markets. It highlights the importance of controlling flexibly for time trends.

Finally, Granger causality has been used in several applications in the international economics literature, but results are often inconclusive. For example, Reuveny and Kang (1996) find a reciprocal effect of international trade and political conflict, i.e., causality seems to go both ways. Seyoum et al. (2014) also find two-way causation between FDI and trade openness in a panel of sub-Saharan African countries. Jenkins and Katircioglu (2010) find long-run causation going from real GDP to the monetary base and trade flows, but not the other way around. In the short run, they do find a positive, unidirectional effect of the monetary base on imports and banking credit has two-way causation with imports.

The remainder of this paper is organized as follows. In Section 2, we describe the Eora database and the construction of country-specific IO tables. The next three sections that follow contain the empirical results. First, in Section 3, we provide some summary statistics on the extent that African countries engage in international trade and GVCs. Second, in Section 4, we investigate to what extent African countries specialize in long-distance trade on the import or exports side, or both. Third, in Section 5, we investigate the dynamics in regional versus global exporting. In particular, we perform a Granger causality test to investigate whether distant trade causes regional export success or vice versa. In Section 6, we draw some conclusions and discuss the policy implications.

2. Data

EORA global input-output table

The multi-region input-output (IO) table that is part of the Eora database provides a detailed window on GVC integration of African countries. There exist two alternative IO tables, but Eora is the only one with information on all African countries individually.[7] Unavoidably, this level of detail comes at a cost, which is the greater reliance on imputations and proportionality assumptions to complement the relatively sparse data for some countries. The underlying data that we use is freely downloadable and the construction of the various components is described in detail in Lenzen et al. (2012, 2013).[8]

It contains information for 190 countries over the period 1990–2015 for a simplified set of 26 harmonized sectors. These dimensions imply that, just the matrix of bilateral input coefficients at the country-industry level is a (190*26) by (190*26) square matrix that contains more than 24 million coefficients. In addition, there are columns for six final demand components that add another 5.6 million pieces of information. Moreover, this information is available for 26 years.[9] Clearly, in order to learn something from this gigantic source of information, we need to aggregate and zoom in on particular areas of interest. Along the three dimensions—time, industry, country—we made the following choices.

(a) Time

We observe a different IO table for 26 consecutive years, but the structure of the economy and the bilateral trading relationships only change gradually. Therefore, we only used the information for three equidistant years: 1995, 2005, and 2015. We will look both at the current composition of input-output relationships using the most recent IO table and document changes over time.

(b) Industries

There are a total of 26 harmonized industries, which we combine in six more broadly defined sectors (in brackets are the numbers of the original industries included in each aggregate):

1. Agriculture (2): Agriculture; Fishing.

2. Mining and quarrying (1).

3. Light manufacturing (3): Food & beverages; Textiles & wearing apparel; Wood & paper.

4. Other manufacturing (5): Petroleum, chemical & non-metallic mineral products; Metal products; Electrical & machinery; Transport equipment; Other manufacturing.

5. Trade and business services (7): Maintenance & repair; Wholesale trade; Retail trade; Hotels & restaurants; Transport; Post & telecommunications; Financial intermediation & business activities.

6. Other services (8): Recycling; Electricity, gas & water; Construction; Public administration; Education, health & other services; Private households; Others; Re-export and re-import.

We aggregate all six components of final demand into a single final demand vector[10]; that is, we do not distinguish between final demand stemming from consumers or governments, nor whether it represents consumption or capital formation.

(c) Countries

We construct a separate IO table for all 51 African countries, which includes North Africa, sub-Saharan Africa, and a few islands. Table A1 (in the appendix) contains the full list of countries.

Breaking-up the global IO table into a series of country-specific tables is a more efficient way of maintaining some regional detail than working with a single IO table that includes all 51 African countries and the five global regions. Such an IO table would still contain approximately 150,000 coefficients and it would be difficult to distil useful insights from it. Moreover, it would be very sparse due to the very limited bilateral trading relationships between many individual African countries.

Because many input coefficients in the Eora global IO table are estimated or interpolated and all calculations need to be performed for a large number of countries and sectors, some problems are inevitable. In some analysis, we omit a few countries where the data shows some suspect patterns, or where changes over time seem implausible: Ethiopia, Somalia, South Sudan, and Sudan.[11]

(d) Trading partners

For each of the 51 countries, we group its trading partners into seven exhaustive groups. In particular, all African trading partners are classified into two groups that vary by country:

1. OWN: Domestic transactions

2. CLO: African countries that neighbour the country considered

3. FAR: Remaining African countries[12]

4. EU: 28 EU countries

5. USA: United States

6. OECD: Remaining OECD countries

7. CHN: China, including Hong Kong and Macau

8. ROW: Rest of the World; there already is a ROW category in the original Eora database, but we enlarge this group, adding all countries not in regions 2 to 7.

Each country-specific IO table contains approximately 3,000 coefficients. While the total amount of information across all 51 tables with these dimensions is comparable to the single, regional alternative, most of the information in the different tables is identical and will not be used in the analysis.[13] We will primarily look at the interactions between the country of interest and the various regions of trading partners which is captured in the first six rows and columns of each country-specific IO table.

Finally, we also constructed an alternative set of country-specific tables splitting the African trading partners not by geography, but by membership of the same Regional Trade Agreement (RTA) as the country which IO table we are constructing. We distinguish RTA and non-RTA partners using the Mario Larch's Regional Trade Agreements Database (Egger &Larch, 2008). This only changes the allocation of countries across regions 2 and 3:

2. RTA: African countries that are members of an RTA with this country
3. Non-RTA: Remaining African countries

(e) Variables

The only information contained in the Eora database is the value of good flows between all country/region-sectors. Because domestic transactions are included, it is possible to calculate total output of each sector. The difference between total output and total input used—either sourced domestically or imported—is a sector's value-added. Intermediate input demand is distinguished from final good demand.

3. International trade intensity in Africa

The information in the Eora database confirms the well-documented pattern in the literature that the trade intensity of African countries is remarkably low. de Melo and Twum (2021) highlight that the content is not very well regionally integrated and in particular lags the rapid integration that took place in South-East Asia over the last few decades. In this section, we highlight a few patterns regarding Africa's value chain integration.

First, Table 1 shows summary statistics regarding average input sourcing of the manufacturing sector across all African countries using population weights. It shows that sourcing is mostly domestic and a large share of imported inputs comes from distant countries, showing very limited regional integration. In 1995, neighbouring countries accounted for only 0.4% of the total production value and more distant African countries for another 1.8%. These shares grew significantly over the next two decades, but given the low initial base they were still only 0.7% and 2.0% by 2015.

Imports from non-OECD countries outside of Africa, i.e., from China and the Rest of the World, grew even more rapidly. In contrast, imports from all three groups of developed countries declined slightly in importance, with their combined share falling from 8% of the total value of African manufacturing in 1995 to 7.7% in 2015. In the final year, the share of imports coming from non-OECD countries, including Africa, had caught up to imports from OECD countries.

While regional sourcing is relatively unimportant on average, the coefficient of variation is far higher for the two groups of neighbouring and other African countries. The share of inputs imported from within the continent varies a lot more across countries than the other import shares. Expressed as a share of total imports, the weighted average of within-continent sourcing reached 17.9% in 2015, but given the greater openness of smaller countries the (unweighted) average was 22.5%. Moreover, the share has a long right tail with a 75th percentile of 25.6% and a 90th percentile, i.e., the top-5 country cutoff, of 70.7%. Most countries with the highest shares are located in the southern part of the continent and trade intensively with South Africa.

Of course, there is also cross-country variation in the extent to which sourcing has changed over time. One pattern, i.e., the rising importance of imports from China, is particularly broad-based. Not a single African country reduced its reliance on Chinese inputs, as shown in Figure C1 (in the appendix).

Table 2 summarizes information on the export intensity and composition of the different sectors. The first four sectors are considered tradeables and the share of their output that is directly exported is indeed larger than in the last two sectors. Note that even in the two manufacturing sub-sectors, more than 85% of output is for domestic use. Further note that 42% of the domestic sales of the "Trade and Business services" sector are intermediate inputs, which means that some of this service output will be exported indirectly embodied in tradeable goods.

Table 1: Input sourcing in manufacturing by origin (% of total production value)

	1995	2015	Change	Coefficient of Variation (2015)
Domestic VA	30.6	36.2	+5.7	0.49
Domestic inputs	56.4	48.7	-7.8	0.35
Imported inputs	13.0	15.1	+2.1	0.49
- Neighbours	0.4	0.7	+0.2	1.57
- Other Africa	1.8	2.0	+0.3	1.75
- Europe	6.8	6.6	-0.2	0.42
- USA	0.6	0.5	-0.1	0.60
- Other OECD	0.6	0.6	-0.0	0.67
- China	0.2	1.1	+0.9	0.64
- ROW	2.5	3.6	+1.0	0.97

Notes: All averages are population-weighted. The coefficient of variation is the standard deviation normalized by the mean.

The first column of Table 2 shows the relative size of each sector in GDP. The relatively low productivity of workers in agriculture leads to a share for the "Agriculture and Fishing" sectors that is lower than its share in employment.[14] As the sectors in successive rows tend to be larger, but export a smaller share of output, the fraction of national exports that each sector accounts for is relatively similar. The four tradeables sectors account for 60% of all direct exports, which amounts to 3.6% of GDP in the average country. The 40% remaining direct exports by the two, much larger, services sectors account for another 2.5% of GDP. Even without relying on the full input-output relationships between sectors to include indirect exports in the calculations, it highlights that services are increasingly tradeable, as well and the tradeables/non-tradeables distinction does not really hold anymore. Direct exports of services have become non-negligible and Ariu (2022) and Shepherd (2022) provide a recent analysis of trade in services in Africa.

A final notable pattern is the composition of exports. They contain a higher fraction of intermediate goods versus final demand sales than domestic sales in all sectors, except for Agriculture and Fishing. The difference is especially pronounced in the two service sectors. The high average share of intermediates in exports, around 75%, indicates that most international sales are integrated in GVCs and not destined to final consumers. The strong pattern of forward integration in GVC for African countries, documented in de Melo and Twun (2021) at the aggregate level, is clearly not limited to exports of unprocessed, raw materials.

Table 2: Export intensity and composition by sector

	VA Share of GDP	Direct Exports		Fraction Intermediates in	
		Share of Output	Share of GDP	Domestic Sales	Exports
Agriculture; Fishing	5	24	1.1	78	72
Mining	2	59	1.2	96	99
Light manufacturing	4	15	0.5	41	57
Other manufacturing	9	9	0.8	57	74
Trade; Business services	54	4	2.0	42	70
Utilities & construction; Social & household services	27	2	0.5	13	68

Notes: Statistics for 2015. All averages are population-weighted. The coefficient of variation is the standard deviation normalized by the mean.

Johnson and Noguera (2012) have argued that standard trade statistics often provide a misleading picture of the importance and evolution of international trade. This is because countries' relative or absolute trade exposure is influenced by intermediate inputs that are often imported, but later leave the country embedded in exports. They propose to calculate the VAX ratio, dividing the domestic value-added consumed by a trading partner by the directly observed bilateral gross export flow. This ratio will be less than one when exports contain imported inputs—either sourced abroad directly or embedded in inputs sourced from other sectors in the country—or when exports are not consumed by a trading partner but exported in turn.

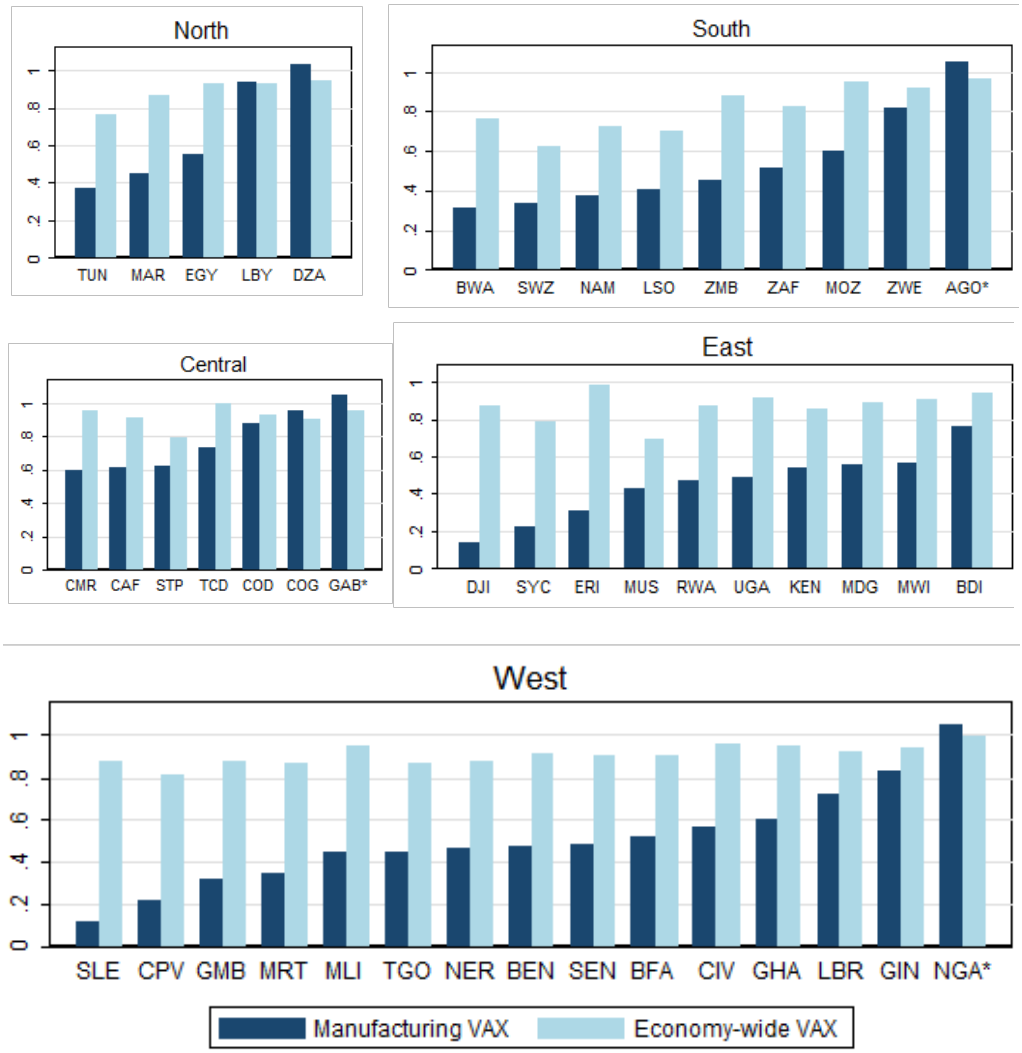
International integration of production chains tends to raise gross export flows more than the amount of value-added consumed abroad, lowering the VAX ratio. The finding that many sub-Saharan African countries have a relatively high VAX ratio as documented by the International Monetary Fund (IMF, 2015) is taken as evidence of limited GVC integration. However, the small size of the manufacturing sector in most African countries makes the high VAX ratios calculated for the aggregate economy less informative.

Figure 1 shows the VAX ratio for all African countries, both at the aggregate level (light bars) and for manufacturing alone (dark bars), which combines the Light and Other manufacturing sectors. Countries are shown by region and sorted by rising manufacturing VAX.[15] Appendix B describes how the domestic content of trade is calculated using the hypothetical extraction method of Los et al. (2016).

Two findings are worth highlighting. First, the range of manufacturing VAX ratios that we find across African countries span the entire range of values found in other regions. For a few small countries, more than 80% of the value of their exports consists of value-added that is sourced from abroad, i.e., the VAX ratio is less than 20%. Several Northern African countries are tightly integrated in European value chains, and the same is true at the southern end of the continent. Several island economies or small

enclaves are also closely integrated in the economies of the African continent. At the same time, some other countries, even some non-oil exporters, source more than 80% of the value of their exports domestically. VAX ratios are especially high for several Central African countries, but also for fragile economies like Libya and Zimbabwe.

Figure 1: VAX ratio for manufacturing and the aggregate economy



Notes: Statistics for 2015. The manufacturing VAX for countries marked with * is top-coded at 1.

Second, in many countries, there is a large difference between the VAX ratios for the aggregate economy and the ratio for manufacturing. With few exceptions (most notably the oil producers) and in line with expectations, VAX ratios are lower for manufacturing. The extent to which this is the case reflects both varying importance of manufacturing in the overall economy across countries and variation in the share of manufacturing in countries' exports.

Figure 1 shows the VAX ratios for 2015, but there is only a weak time trend in the sample. The population-weighted average over all countries, excluding the three oil-producers, only declined slightly over the last two decades: from 0.911 to 0.906 for the economy-wide measure and from 0.609 to 0.604 for manufacturing VAX. The average changes little because the largest declines are registered by small countries. Another factor is that small or moderate declines in many countries are balanced by very large increases in some countries that suffered severe economic crisis, like Liberia and Zimbabwe.

4. GVC specialization: Long-distance vs. close-by trade

Methodology

To investigate whether a country specializes in long-distance trade on its imports or exports or both, we construct two indicators for regional export and import concentration using the country-specific IO tables. Figure 2 illustrates for a generic Country 1 which values are used in their calculation.

Recall that all trade partners are classified into seven country groups of which the first two, neighbouring and other African countries, are specific to Country 1. These seven groups are further collapsed in 3 groups of "close", "far", or "other" countries, as illustrated in Figure 2. In the benchmark calculations, we use broad definitions, counting all African countries as close and all OECD countries as far. In a robustness check, we use more narrow definitions, counting only neighbouring countries as close, and only EU countries as far. In a final specification, we include countries that belong to a RTA with Country 1 in the close group and all other African countries in the far group.

Figure 2: Input-output table for Country 1

Country:		Country 1		Countries close to Country 1		Countries far from Country 1		Other countries		Ctry 1	Close	Far	Other	
	Sector:	S1	S2	S1	S2	S1	S2	S1	S2	FD	FD	FD	FD	Total
Ctry 1	S1	·	·	·	·	·	·	·	·	·	·	·	·	·
	S2	·	·	X_1^{close}	X_1^{close}	X_1^{far}	X_1^{far}	·	·	·	X_{FD}^{close}	X_{FD}^{far}	·	·
Close	S1	·	M_1^{close}	·	·	·	·	·	·	·	·	·	·	·
	S2	·	M_1^{close}	·	·	·	·	·	·	M_{FD}^{close}	·	·	·	·
Far	S1	·	M_1^{far}	·	·	·	·	·	·	·	·	·	·	·
	S2	·	M_1^{far}	·	·	·	·	·	·	M_{FD}^{far}	·	·	·	·
Other	S1	·	·	·	·	·	·	·	·	·	·	·	·	·
	S2	·	·	·	·	·	·	·	·	·	·	·	·	·
	VA	·	·	·	·	·	·	·	·					
	Total	·	·	·	·	·	·	·	·					

Notes: The relevant import (M) and export (X) values used to calculate importance of trade by distance are indicated from the perspective of Sector 2 (S2) in Country 1. Only a single "close", "far", and "other" country/region is shown, in practice there will be several countries or regions in each group. There are really six sectors, but only two are shown. The columns labelled FD represent final demand, the row labelled VA represent the value-added produced locally.

The two (regional) concentration indices divide trade with the close group by trade with the far group. In the benchmark calculations, we count all exports, i.e., summing intermediate input and final demand. In the index for imports, however, we

only include intermediate inputs used in Sector 2 of Country 1, summing over inputs coming from all foreign sectors. The two measures of interest are thus:

$$\text{Regional export concentration: } \ln\left(\frac{\sum_{k=1}^{S} X_I^{close}[Sk] + X_{FD}^{close}}{\sum_{k=1}^{S} X_I^{far}[Sk] + X_{FD}^{far}}\right)$$

$$\text{Regional import concentration: } \ln\left(\frac{\sum_{j=1}^{S} M_I^{close}[Sj]}{\sum_{j=1}^{S} M_I^{far}[Sj]}\right)$$

The sectoral index *k* in the export indicator is used to sum over all foreign sectors that may use output from Sector 2 of Country 1. In contrast, the sectoral index *j* in the import indicator is used to sum over all foreign sectors that supply Sector 2 of Country 1 with inputs.

In a robustness check, we include only intermediate input in exports. For sourcing decisions that optimize over transportation costs, it is immaterial whether exports are purchased by final consumers or by other firms using them as inputs. However, input supply chains might be more sensitive to transportation costs. In a second robustness check, we include Country 1's final demand imports of products from the sector under study in the import indicator, i.e., adding $M_{FD}^{close}[S2]$ and $M_{FD}^{far}[S2]$ in the numerator and denominator. In principle, these imports should not be counted as they will not leave Country 1 anymore. However, some trade flows might be misclassified and some imported inputs might be recorded in the IO table as imported final goods.

Finally, in addition to results for a single sector S2, e.g., Manufacturing, we can also sum over all sectors in Country 1 and calculate the two indicators for the entire economy.

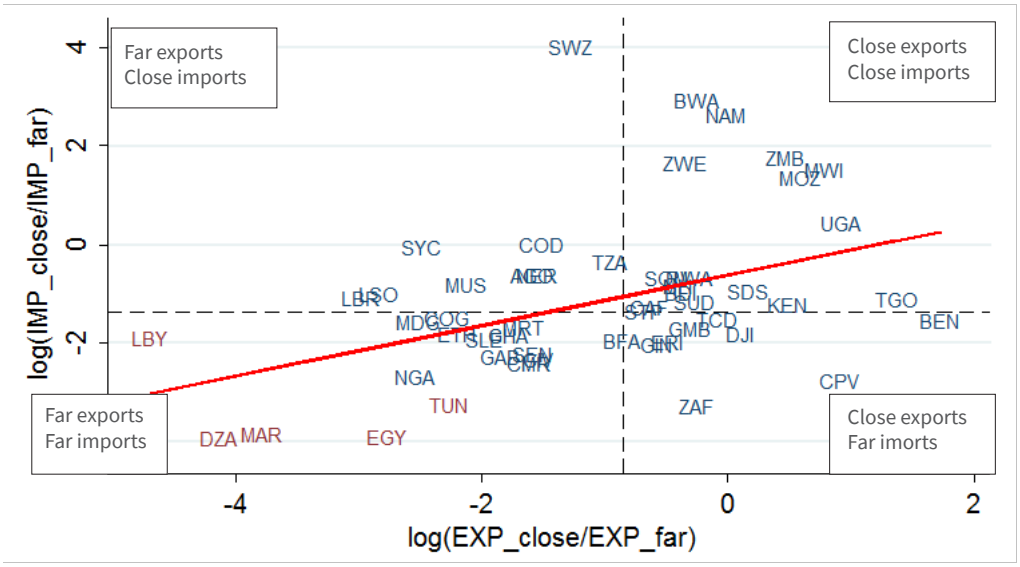
Results

Figure 3 shows the specialization pattern using the benchmark assumptions. It is based on all manufacturing exports for 2015, using all African countries in the group of "close" destinations and including final demand in exports, but not in imports. The vertical and horizontal dashed lines show the median values for the two trade ratios and the solid red line is the regression line. Table A1 (in the appendix) shows the country associated with each label.

The pattern is rather dispersed, but there is a moderate positive relationship between local concentration in imports and exports. The majority of countries are in the upper-right or the lower-left quadrants. Countries towards the right that export a lot to close destinations also tend to import a lot of intermediates from close countries. Malawi, Zambia, and Mozambique are among the most pronounced examples. At the other extreme, the five North African countries (shown in red) show the opposite

pattern as they mostly trade with Europe. If they are excluded, the regression line becomes only half as steep and the slope is no longer significantly different from zero (at 5% level).

Figure 3: Specialization in close or far trade on imports and/or exports (2015)



Notes: The dashed lines indicate the median values for the relative importance of close to far imports (on the vertical axis) and close to far exports (on the horizontal axis). Values above zero indicate that close trade (within the continent) is larger than far trade (outside the continent). The solid red line indicates the best-fit regression line.

There are a number of countries that show a negative relationship between the regional concentration of their exports and imports, mirroring the pattern for processing trade of China's provinces (Ma et al., 2009). At the top-left are countries such as Eswatini (formerly Swaziland), Seychelles, and Cote d'Ivoire that trade much more within Africa for imports than for exports. At the bottom-right are countries such as South Africa, Benin, Djibouti, and Cape Verde that export much more intensively to other African countries than they import from them. For some of these countries, the difference in regional concentration between imports and exports is very pronounced, which is masked by the log-scale. For example, Cape Verde's exports to other African countries represent approximately 75% of the sum of African and OECD trade. In contrast, only 5% of imports come from Africa.

The above pattern is quite robust to changes in the specification. Each statistic in Table 3 represents the slope of a regression line like the one shown in Figure 3 for a different sample or change in the calculation of relative trade ratios. All point estimates are positive, but the variation in absolute magnitude and statistical significance reflects variation in the strength of the relationship.

The benchmark results in the first line show the pattern for manufacturing in 2015 for sub-Saharan Africa. As mentioned, excluding the North African countries leads to a flatter regression line. Results are similar for 1995 (shown in the third line) or any of

the intervening years (not shown). Results are almost entirely invariant to changing the type of trade included in the aggregates. It strongly suggests that the patterns would be unchanged if forward and backward trade linkages were used instead of only direct trade flows.

Table 3: Robustness of the close v. far trade pattern

	Dependent variable is $\ln\left(\frac{IMP^{close}}{IMP^{far}}\right)$ and the explanatory variable is $\ln\left(\frac{EXP^{close}}{EXP^{far}}\right)$		
Close is defined as:	**Neighbouring countries**	**RTA partners**	**All African countries**
	(1)	**(2)**	**(3)**
Benchmark estimates	0.233*	0.550***	0.311
	(0.135)	(0.179)	(0.197)
Observations	46	46	46
Including North Africa	0.496***	0.603***	0.490***
	(0.111)	(0.157)	(0.157)
1995	0.361***	0.627***	0.276
	(0.124)	(0.203)	(0.234)
Excluding final demand exports	0.286*	0.580***	0.314
	(0.144)	(0.187)	(0.215)
Including final demand imports	0.241	0.553***	0.346*
	(0.148)	(0.188)	(0.211)
Aggregate trade	0.119	0.578***	0.360**
	(0.125)	(0.152)	(0.165)
Other manufacturing (excludes light manufacturing)	0.089	0.326*	0.097
	(0.130)	(0.175)	(0.206)

Notes: Each statistic reports the coefficient on the export indicator in a regression with the import indicator as dependent variable. Benchmark estimates are for 2015, all manufacturing, using only imports and exports of intermediate goods, and excluding the (five) North Africa countries. Each column uses a different definition of close trade in the numerators, indicated in the column heading. The definition of far trade in the denominators is always trade with OECD countries. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Most importantly, the three columns use different definitions for close trade that appears in the numerator of the dependent and explanatory variables. The definition of far trade in the denominator is always trade with all OECD countries.[16] The coefficient is almost always smallest for the narrowest definition of close trade, i.e., only counting geographical neighbours. Defining close trade as all trade within the African continent, shown in column (3), the slope loses statistical significance entirely in the benchmark sample and also in 1995.

The pattern tends to be the reverse if close trade is defined as all trade with partner countries within a Regional Trade Agreement (RTA), in column (2). This definition always leads to the strongest positive relationship between regional specialization in exports and imports. Successful RTAs that lead to a tighter integration of production

networks between partner countries make both exports and imports more regionally concentrated. It is consistent with tariffs remaining important deterrents of trade, in particular for GVC trade where goods might cross borders multiple times (de Melo & Twum, 2021).

Finally, in the sub-sector of "Other manufacturing", which are industries where intermediate inputs are more important and more differentiated, the coefficient is almost zero in absolute magnitude and entirely insignificant in column (1) and column (3). In that case, stronger regional specialization of exports is no longer a predictor of a similar regional specialization for imports.

As manufacturing sectors in different countries become integrated in GVCs, there are reasons to expect that reliance on long-distance trade will be concentrated on either exports or imports, but not both simultaneously. The lack of such a pattern likely reflects that African countries are much less integrated in GVCs than Chinese provinces.

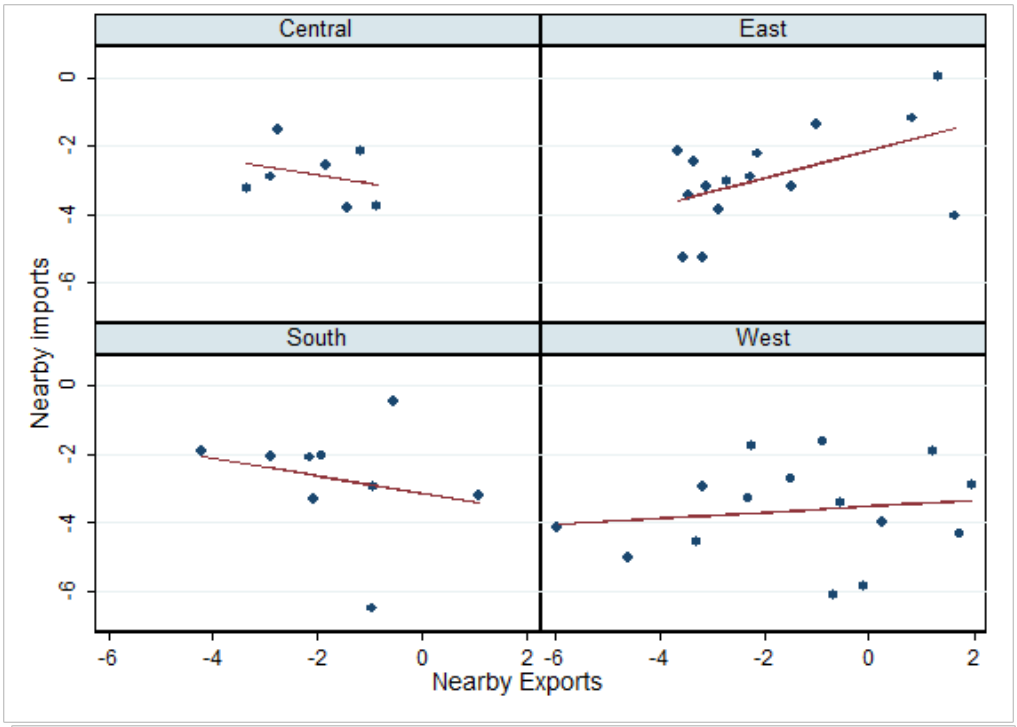
However, we do find some evidence for such a specialization when we focus on certain sub-groups of countries. To illustrate instances of specialization in close exports or close imports, we focus on a specification where this is most likely. We use the most recent year and the narrow definition of close trade. Given the comparative advantage of African countries, we also expect GVC integration to be most relevant in the "Other manufacturing" sector. African firms might be able to perform some of the activities and produce some of the components, but their capabilities are unlikely to be sufficiently developed to produce the entire product domestically.

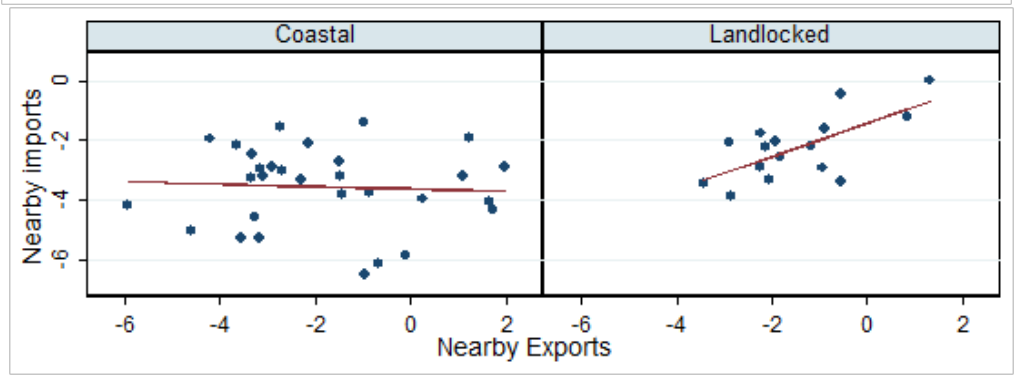
Figure 4 shows the trade concentration separately for a few sub-groups of countries. The top panel shows that within Central or within Southern Africa[17] different countries do a specialization of their long-distant trade on exports or imports. The regional concentration for the two trade flows shows a weak, but clearly negative relationship. The relationship also turns negative for West Africa if the broader definition of close trade is used (not shown). Within each of these broad geographical regions, trade with neighbouring countries is specialized to input sourcing or market seeking.

The second panel shows a marked difference in regional concentration between coastal and landlocked countries.[18] The overall pattern of a positive relationship documented in Figure 3 is especially strong in landlocked countries. The much higher cost of long-distance trade affects imports and exports similarly and countries' trade has a stronger regional focus on both dimensions. It is also intuitive that the regional focus is higher also in absolute terms. Their location makes it harder for these countries to integrate in GVCs, and lowers incentives to specialize.

Coastal countries, on the other hand, show a very wide dispersion in regional concentration, especially on the export side. The negative relationship becomes more pronounced with population weights, although still not statistically significant. The importance of landlocked countries in Africa—about one-third of the sample—as well as difficulties reaching inland regions even in coastal countries, seems to be one contributing factor for the lack of negative relationship and specialization in African long-distance trade.

Figure 4: Specialization in sub-groups of countries





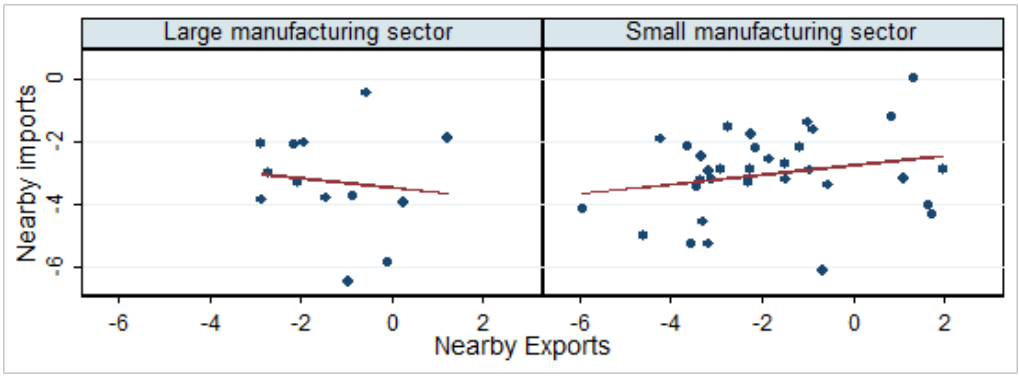


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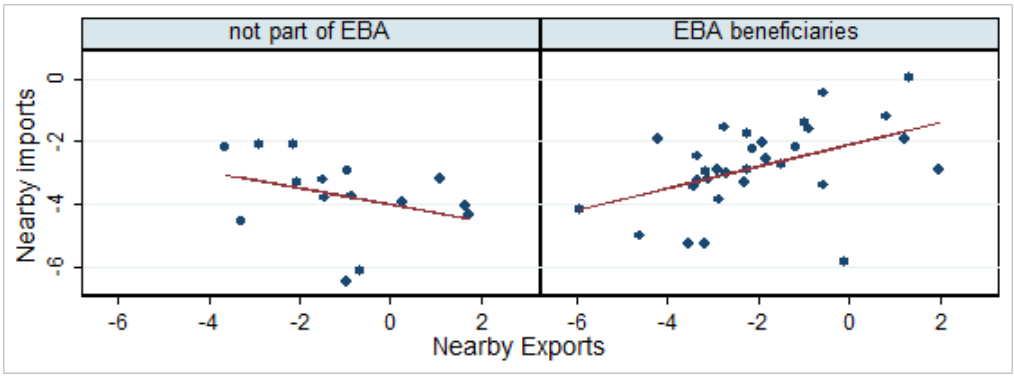
Figure 4 Continued



Note: Results are for "Other manufacturing", 2015, the narrow definition of close trade, and excluding North Africa.

The next panel of Figure 4 shows that the relationship also turns negative for countries where "Other manufacturing" makes up at least 10% of total GDP. Countries with a more developed and successful manufacturing sector are likely to have more trade success and more incentives to specialize.

Finally, the bottom panel distinguishes between countries that are part of the Everything But Arms (EBA) programme that grants virtually all imports from the poorest countries in the world duty and quota free access to the EU. Excluding the North African countries, there is a clear negative pattern for non-EBA beneficiaries. Countries that have to take trade protectionism into account focus their faraway trade either on the export or the import side, but not both. It is impossible to tell from this aggregate analysis whether this is due to the presence of trade barriers or because non-EBA countries are generally more developed and their economies are organized more efficiently.

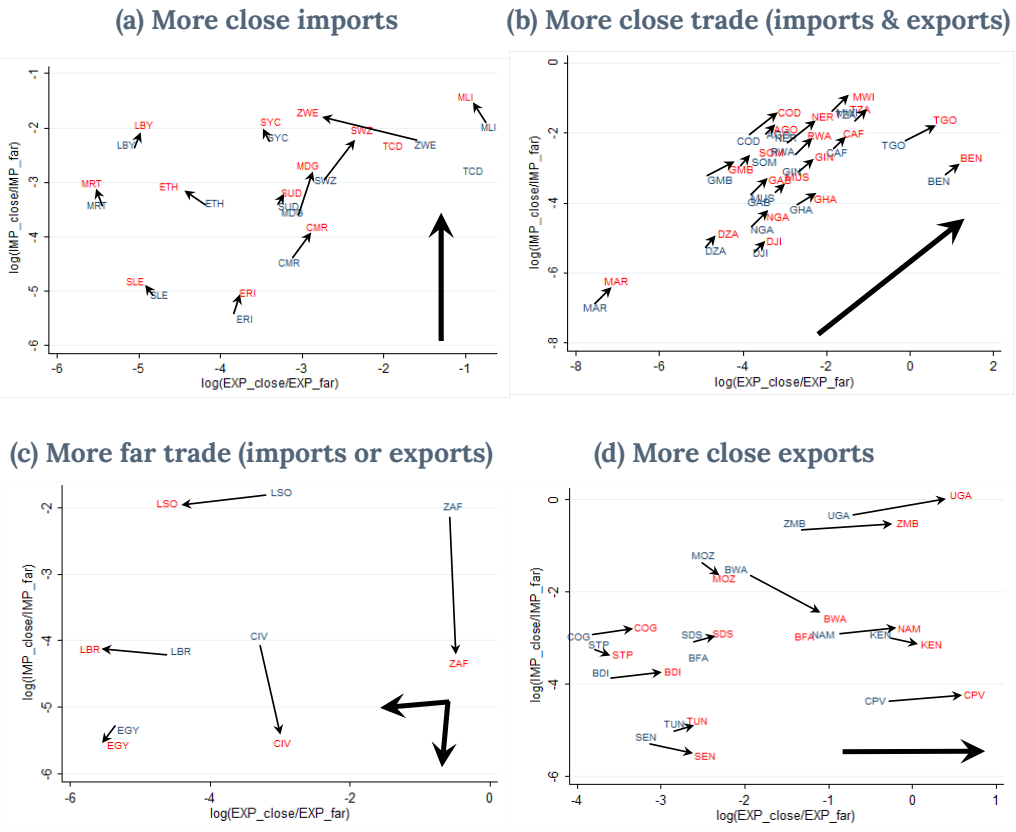
A second place to see some evidence of specialization is in the changes over time. In Figure 5, we partition all countries in four groups. We show the position of each country twice: for 1995 (in blue) and for 2015 (in red). The small arrows indicate how each country's regional specialization has evolved over the 20 year period.

Countries depicted in the top-right graph have increased their regional concentration for both exports and imports. This is the largest group of 18 countries, but almost all show relatively minor changes which is consistent with a gradual, broadly-based increase in regional trade. Countries in the bottom-left graph, in contrast, increased their concentration on long-distance trade on either exports or imports, without an opposite change on the other dimension. There are only five countries in this group and most of them have experienced important domestic turbulences, such as the end of the Apartheid regime in South Africa or the war in Liberia. In four of the five cases, the increase in long-distance trade is very pronounced.

The majority of countries, however, fall in either of the two off-diagonal graphs. At the top-left are 14 countries for which the most important change is increased input sourcing from within Africa (close imports). They move upward in the graph.

Some also increase the regional share of exports but to a much lesser extent, while others even shift left which indicates relatively more long-distance exports. The 14 countries in the bottom-right graph show a reverse specialization. They increasingly export within Africa, but show no corresponding increase in regional input sourcing. For many of these countries, the shift to the right is very pronounced.

Figure 5: Change in the pattern of close vs. far trade specialization (1995 - 2015)



Note: Similar to Figure 3, but position of countries in 1995 is indicated in blue, and in red for 2015. Countries are categorized into four groups based on their evolution.

We conclude that the overall pattern of trade in Africa still shows a similar reliance on close trade for exports and imports, but this is changing over time. Within certain regions and for industries with more GVC potential, there is evidence that some African countries mostly focus on trade with developed countries for sourcing of advanced inputs, while other countries mostly send exports to developed countries, but few countries do both simultaneously. Changes over time further show that the majority of countries have experienced a notably larger change in long-distance trade on one of the two dimensions, i.e., they start to specialize more. Next, we further explore the dynamic implications of long-distance trade.

5. GVC upgrading: Effects of past long-distance and close-by trade

Methodology

As discussed in the introduction, the trade literature contains two predictions on the upgrading process and their implications for the sequencing of close and long-distance trade. On the one hand, the learning-by-exporting hypothesis predicts that firms gather expertize regarding production technology and product quality from long-distance trade with advanced economies. These capabilities raise productivity and lead to general export success, including in close-by markets. On the other hand, heterogeneous firm models predict market entry from changes in fixed or variable trading costs, with constant firm-level productivity. Selection into exporting happens first in easy to reach (close) destinations. As the country develops and the entire productivity distribution shifts up, more distant markets become accessible for the most productive firms. Here it is more natural for close exports to precede long-distance exports.

We use a Granger causality test to study the direction of causality. If exports to far destinations help firms to upgrade, it will raise exports to close destinations with a lag. Alternatively, if exports to easily accessible, close destinations develop the manufacturing sector, it can shift up the entire productivity distribution and make far destinations accessible in a later period. The Granger causality test is informative about which upgrading process dominates.

The core idea is to evaluate in a regression framework whether lagged values of one variable have predictive power for a second variable once lagged values of the second variable are already controlled for. That is, if xt-k is a significant predictor of yt (after controlling for yt-k), but yt-k is insignificant in a regression with xt as dependent variable, we say that x causes y, but not the other way around.

The regressions we estimate take the following form:

$$ln\, X_{cst}^{close} = \rho_s\, ln\, X_{cst-5}^{close} + \alpha_s\, ln\, X_{cst-5}^{far} + \gamma_c + \gamma_t + \epsilon_{cst} \quad (1)$$

$$ln\, X_{cst}^{far} = \bar{\rho}_s\, ln\, X_{cst-5}^{far} + \bar{\alpha}_s\, ln\, X_{cst-5}^{close} + \bar{\gamma}_c + \bar{\gamma}_t + \bar{\epsilon}_{cst} \quad (2)$$

The dependent variables are exports to either type of destination and we control for lagged exports to the same destination. We estimate by sector s, but pool across countries c and years t. To control for comparative advantage and differences in export growth by level of development, we include country fixed effects. Year fixed effects control for the global or regional business cycle that influences exports to all countries.

Most applications of the Granger causality framework use relatively high frequency data, i.e., quarterly or even monthly time series. Even though the theoretical framework does not pin down or limit what time interval to use, given that the identifying assumption exploits the sequencing over time, it is important to carefully consider what time lag is appropriate in the specific economic setting. In applications on the impact of price changes on quantities or of advertising on consumer demand, it is natural to use relatively short time intervals. Similarly, changes in the money demand on prices are likely to show up after one or at most a few quarters.

In our setting, we are interested in structural changes that are likely to require several years. The process of firms learning from their export experience in faraway markets, improve the productivity level in their operations, and then enter new markets close-by, is bound to take several years. Similarly, the reverse causal channel of firms entering close-by markets first and gradually expanding their operations to more difficult-to-reach destinations will also not happen overnight. Firms need to discover their own productivity level or learn how to export efficiently even in cases where fixed or variable trade costs are sizeable. To allow for real changes in operations and costs structures to materialize, we look for an impact after five years.

The coefficient of interest is the one on 5-years lagged exports to the region that differs from the dependent variable. Equation 1 tracks the evolution of close exports and the coefficient α_s captures whether lagged far trade predicts close trade once the lagged dependent variable and fixed effects are controlled for. Equation 2 performs the corresponding exercise for faraway trade and the coefficient of interest $\bar{\alpha}\_s$ capture the predictive value of lagged close trade.

We also estimate a specification that pools observations across all sectors. In that case, we include country-sector interaction fixed effects to capture the baseline export level. A final specification pools across sectors to estimate a different pair of α_c and $\bar{\alpha}\_c$ coefficients for each country. In that case, we include sector and year fixed effects.

The Granger causality test is only valid for stationary or cointegrated time series. We performed the standard unit root tests, but the small sample produced highly imprecise test statistics. Moreover, different versions of unit root tests for panel data produce different results. At the level of our six broad sectors and for our time period of 25 years, we could reject that regional and global export flows are non-stationary using the Levin-Lin-Chu and Fisher-Phillips-Peron unit root tests. However, the Harris-Tzavalis test indicates that this is not the case for each and every panel category (country).

As exports of individual countries to different regions are likely to grow at similar rates in the very long run, it is highly likely that the time series of close and far exports are cointegrated. In that case, the Granger causality test is valid as well. To err on

the safe side, we have included country and time fixed effects in all regressions. Performing the regressions in first differenced form would be an even more flexible way to guarantee stationarity, but with the relatively short time dimension in the panel, those results are extremely imprecisely estimated. Given that the underlying Eora data is constructed using a lot of assumptions to impute many input coefficients, it would not add a lot of independent information if all intervening years were used.

As a sensitivity check, we include results in Appendix C that omit the year fixed effects from the regressions. Most coefficient estimates are a lot larger and also estimated more precisely, but the results are also quite different in many cases. It suggests that some caution is warranted in interpreting the results.

Results

Estimates by sector are in rows 1 to 6 of Table 4, and the corresponding results pooling across all sectors are in the bottom row. Results for Equation 1 and Equation 2 are, respectively, in the odd-numbered and even-numbered columns. As before, we use three alternative definitions for close trade, gradually broadening the category, but far trade is always defined as transactions with OECD countries.

Table 4: Granger causality between long-distance on close-by trade

Close is defined as: Coefficient on lagged exports to:	Neighbouring countries		RTA partners		All African countries	
	Close	Far	Close	Far	Close	Far
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture	0.003	-0.238*	-0.003	-0.223	-0.033	-0.158
	(0.087)	(0.138)	(0.100)	(0.148)	(0.119)	(0.151)
Mining	0.106	-0.138	0.134*	-0.151	0.166*	-0.127
	(0.071)	(0.116)	(0.083)	(0.129)	(0.099)	(0.140)
Light manufacturing	0.053	-0.076	0.273**	-0.166	0.291**	-0.198
	(0.114)	(0.125)	(0.132)	(0.132)	(0.143)	(0.133)
Other manufacturing	-0.067	-0.018	0.006	0.016	0.009	-0.014
	(0.080)	(0.116)	(0.095)	(0.111)	(0.112)	(0.117)
Business services	0.001	-0.027	0.057	0.042	0.060	0.042
	(0.132)	(0.186)	(0.146)	(0.197)	(0.171)	(0.216)
Personal services	-0.032	0.037	0.046	0.080	0.017	0.113
	(0.129)	(0.161)	(0.141)	(0.173)	(0.167)	(0.183)
All sectors	0.017	-0.121**	0.069*	-0.100**	0.086*	-0.086
	(0.037)	(0.051)	(0.042)	(0.054)	(0.051)	(0.057)

Notes: Each reported statistic is estimated using a separate regression. They are the coefficients on the lagged export value for the region that differs from the dependent variable. For example, results in column (1) are for exports to faraway destinations as dependent variable and control for lagged exports to faraway and close destinations, but only the last coefficient is reported. Regressions by sector use year and country fixed effects; regressions pooling all sectors, with results in the bottom row, use year and country-sector interaction fixed effects. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

For most sectors, there is no predictive power in either direction. Most coefficients are statistically insignificant and the point estimates are often negative. This is consistent with evidence in Van Biesebroeck and Mensah (2019) that exports to different destinations are closer substitutes with each other than with domestic sales. The results for Mining and Light manufacturing are the exception. They show a causal effect of close trade on far trade, but not the other way around. The effects are strongest if exports to all African countries are considered in the regional trade definition, but results are almost indistinguishable using RTA trade. The same pattern also appears in the results pooling all sectors, but absolute magnitudes are smaller.

It is interesting that in the "Other manufacturing" sector, which contains more sophisticated goods, there is no effect of far exports on subsequent regional export success for any of the three definitions. All point estimates are highly insignificant and even very small in absolute magnitude. Regional export success seems to prepare firms well for competition in high-income countries in Light manufacturing, but not in more sophisticated industries.

The results in Table 4 assume that effects are the same for all countries, although it is likely that countries have heterogeneous experiences. If we are willing to pool across sectors, we can estimate country-specific variants of Equation 1 and Equation 2.

The estimates by country in Figure 6 show a rather distinct pattern from before. Classifying countries in four cells according to the statistical significance of the two coefficients (at the 5% level), the most crowded cell is the bottom-left using both definitions of close trade. In the first case, 23 of the 49 countries show a positive and statistically significant coefficient on global trade in Equation 1, but an insignificant coefficient for regional trade in Equation 2.[19,20] Only four countries show the opposite pattern of a significant regional and insignificant global coefficient. For a single country, the causation goes both ways; and for 21 countries, the effects are significant in both directions. Effects are broadly similar using the more expansive definition of regional trade.

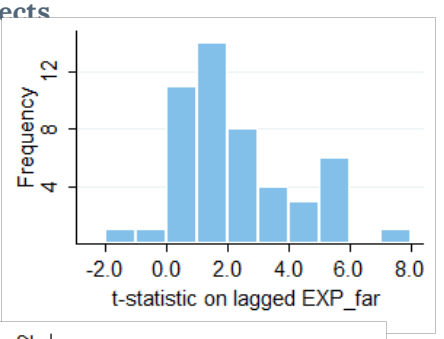
The full distribution of the t-statistic for the coefficient on faraway trade, shown in the histograms on the right, indicates that, often, the effects are quite strong. Negative coefficients are rare, but positive effects with a t-statistic exceeding even 3 or 4 are not.

The results in Table 4, not only impose the same effect on all countries, but they also control for a uniform cyclical time pattern that applies to all countries. In Table 5, we investigate whether heterogeneous country experiences can be linked to country characteristics. To avoid imposing the uniform time pattern, we omit the year fixed effects. These results are only valid if the two types of trade are stationary in levels or if they are cointegrated. This is not certain to be valid, but it is interesting that the results are now more closely aligned with the country-specific results in Figure 6.

Figure 6: Distribution of country-specific effects

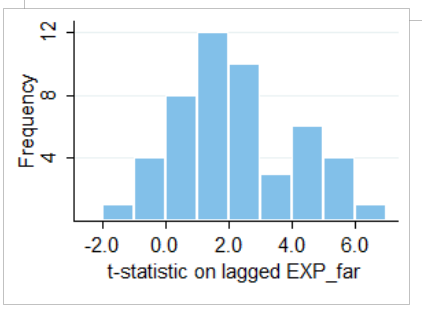
(a) Narrow definition for close (neighbours)

		t-statistic CLOSE	
		< 1.96	> 1.96
t-stat. FAR	<1.96	21	4
	>1.96	23	1



(b) Broad definition for close (all of Africa)

		t-statistic CLOSE	
		< 1.96	> 1.96
t-stat. FAR	<1.96	19	5
	>1.96	25	0



In countries with a high manufacturing VAX ratio, the causation goes from far to close trade in both manufacturing sectors. The same holds in countries with a large manufacturing sector, but only in "Other manufacturing" sector is the effect significant. In coastal countries, the causation depends on the sector: in Light manufacturing, they are more likely to achieve global export success after being successful in regional trade, but the reverse holds in "Other manufacturing". Finally, results in the last two columns that pool all sectors are strongly supportive of a causal link from far trade to close trade in each of the sub-groups.

Table 5: Granger causality results by country type without time fixed effects

Lagged exports to:	**Light manufacturing**		**Other manufacturing**		**All sectors**	
	Close	**Far**	**Close**	**Far**	**Close**	**Far**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
(a) Split countries by manufacturing VAX: below/above median						
High VAX	0.107	0.301*	0.021	0.386**	-0.034	0.567***
	(0.135)	(0.191)	(0.118)	(0.164)	(0.171)	(0.084)
Low VAX	0.373**	-0.086	0.229*	0.013	0.119*	0.285***
	(0.166)	(0.147)	(0.130)	(0.140)	(0.065)	(0.078)
(b) Split countries by size of their manufacturing sector: below/above 15% of DVA						
Large sector	-0.025	0.270	0.005	0.390**	-0.070	0.565***
	(0.126)	(0.238)	(0.109)	(0.193)	(0.055)	(0.092)
Small sector	0.328*	0.024	0.181	0.083	0.100	0.346***
	(0.171)	(0.135)	(0.132)	(0.125)	(0.066)	(0.073)

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Table 5 Continued

Lagged exports to:	Light manufacturing		Other manufacturing		All sectors	
	Close	Far	Close	Far	Close	Far
	(1)	(2)	(3)	(4)	(5)	(6)
(c) Split countries by sea access						
Landlocked	0.024	0.112	0.176	0.009	0.070	0.253**
	(0.214)	(0.216)	(0.218)	(0.287)	(0.094)	(0.122)
Coastal	0.424***	0.015	0.122	0.251***	0.014	0.534***
	(0.130)	(0.117)	(0.085)	(0.092)	(0.045)	(0.056)

Notes: Always using the broad definition of "close" exports, counting all African trade. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

6. Conclusion

The newly ratified African Continental Free Trade Agreement (AfCFTA) is widely expected to be an impetus for greater trade integration and economic collaboration in Africa. While certainly a step in the right direction, this policy initiative will not automatically improve African countries' integration in GVCs. To accomplish that, it is important that firms and/or countries specialize and carve out unique roles in the global production network. Our results have shown that, in contrast with Chinese provinces, few African countries currently have a clear specialization in terms of relying on long-distance trade for input sourcing or for export sales. An encouraging sign is that, together with greater regional integration overall, the majority of African countries have seen their concentration in long-distance trade between imports and exports diverge in recent years.

Our analysis shares with Ma et al. (2009) the disadvantage of working with aggregate trade information—Chinese provinces for them and African countries for us—while the specialization pattern is likely to be strongest at the firm-level. Given that comparative advantage induces similar specialization for firms located in one country (or province), it is not surprising that we still find systematic patterns. However, it would be very interesting to replicate our analysis using more detailed, firm-level data, in case studies focused on the manufacturing sector specialization for individual countries. That is something we leave for future work.

An appropriate specialization in long-distance trade is important because trade with more advanced economies is an important channel for developing countries to gain access to technology and stimulate productivity improvements. Embedding firms in GVCs and strengthening forward and backward linkages is one way for firms to upgrade their capabilities and activities. We find some evidence for the relevance of this upgrading channel in Africa. In particular, a Granger causality test shows that countries can leverage past export success in global, faraway markets into higher regional exports to neighbours and other African countries at a later time. This is in line with the learning-by-exporting hypothesis. Interaction with clients and competitors in developed-country markets lifts productivity levels and improves firms' competitiveness in all export markets.

A natural next question is which policies can further stimulate this process. The relative lack of specialization in landlocked countries or in countries with a smaller manufacturing sector suggests that investments in infrastructure to lower

trade costs would be valuable. Stimulating the development of clusters would be another example. If firms can source more inputs and more sophisticated inputs locally, they will be in a better position to compete on final goods markets. Also, if firms of the same industry co-locate, foreign knowledge would more easily spread and generate spillovers from firms not trading long-distance themselves. If regional trade barriers are removed, there is no reason why such clusters should fall entirely within one country. However, abolishing tariffs should be accompanied by regulatory harmonization and lower administrative burdens on international trade.

Notes

1. When distinguishing between close and far trade flows, our focus on goods trade naturally leads us to consider physical distance between countries. The growing importance of service trade increases the relevance of other dimensions of distance, e.g., online connectedness, but such considerations go beyond our study.

2. The Granger causality test evaluates, in a regression framework, whether lagged values of a first variable have predictive power for a second variable once lagged values of the second variable are controlled for. If this predictive power goes one way, but not the other, one says that the first variable 'Granger causes' the second one.

3. Two other widely-used global IO tables are the World Input-Output Database (WIOD), maintained by researchers at the University of Groningen, and the Trade in Value-Added (TiVA) database of the OECD. In those databases, almost all African countries are not observed separately, but included in the Rest of the World aggregate.

4. The underlying assumptions are discussed in Lenzen et al. (2013). The Appendix of Kowalski et al. (2015) compares the characteristics and results on forward and backward integration for the three global IO tables.

5. In this context, it is important to highlight that, in African countries, the bulk of manufacturing output—respectively 85% and 91% of the two broad manufacturing sectors considered in Table 2—is destined for domestic use or domestic consumption. This fraction is far higher than in China or in more developed economies.

6. The ordering of different export destinations is determined by a combination of market size and ease of access, which is itself a function of the fixed costs of entry and variable trading costs.

7. A widely-used alternative is the World Input-Output Database (WIOD) (http://www.wiod.org/home) maintained by researchers at the Groningen Growth and Development Centre. The 2016 release covers 43 individual countries (including the 28 EU member states) and a rest-of-the-world aggregate, the period 2000–2014, and a decomposition into 56 sectors and 5 final demand components. Another alternative is the Trade in Value-Added (TiVA) database of the OECD (http://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm). The most recent 2016 edition of this resource covers more countries (63) but at a lower sectoral detail (34) for the period 1995–2011.

8. http://worldmrio.com/

9. In total, the entire database consists of almost 770 million values, most of which are almost indistinguishable from zero, but not exactly zero.

10. The six final demand components are final consumption by households, non-profit institutions, and government, as well as gross fixed capital formation, changes in inventories, and the net change in valuables.

11. Not all these countries necessarily have data problems for all indicators, but when unsure about the data accuracy we erred on the side of caution and omitted these countries.

12. Van Biesebroeck and Mensah (2019) limited their analysis to sub-Saharan African countries and divided the FAR category into two distinct groups: (1) Non-neighbouring sub-Saharan Africa, (2) "Other African countries": South Africa and the five North African countries (Morocco including Western Sahara, Algeria, Tunisia, Libya, and Egypt).

13. The national IO structure in the five regions (4-8) and the bilateral interactions between these regions is identical in each of the 51 tables.

14. Undercounting informal sector output in national accounts could also contribute to this low average share.

15. For three important oil producing countries—Angola, Gabon, and Nigeria—we obtain aggregate VAX ratios above 1 (for Gabon far above 1) and we have top-coded these values at 1.05 to make them fit on the figure. Results for Tanzania are omitted due to data problems.

16. Limiting the denominator to trade with the EU or expanding it to trade with China has very little impact on any of the regression coefficients.

17. We use the World Bank definition for the five African regions.

18. The slope coefficient for landlocked countries in Figure 4 is statistically significant at the 1% level and also significantly different from the slope for coastal countries. This finding also holds in earlier years (back to 1995).

19. All results in this section use 49 countries, excluding South Sudan and Sudan, because the domestic value-added in exports are extremely low and unreliable due to data concerns.

20. Using a 10% significance level as threshold, the first group grows to 26 countries.

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Appendixes

Appendix A: Countries and labels

Table A1: Sample countries

Country	ISO Code	Landlocked	Region
Algeria	DZA	0	North
Angola	AGO	0	South
Benin	BEN	0	West
Botswana	BWA	1	South
Burkina Faso	BFA	1	West
Burundi	BDI	1	East
Cameroon	CMR	0	Central
Cape Verde	CPV	0	West
Central African Republic	CAF	1	Central
Chad	TCD	1	Central
Comoros	COM	0	East
Congo	COG	0	Central
Côte d'Ivoire	CIV	0	West
Dem. Republic of the Congo	COD	0	Central
Djibouti	DJI	0	East
Egypt	EGY	0	North
Equatorial Guinea	GNQ	0	Central
Eritrea	ERI	0	East
Ethiopia	ETH	1	East
Gabon	GAB	0	Central
Gambia, The	GMB	0	West
Ghana	GHA	0	West
Guinea	GIN	0	West
Guinea-Bissau	GNB	0	West
Kenya	KEN	0	East
Lesotho	LSO	1	South
Liberia	LBR	0	West

continued next page

Table A1 Continued

Country	ISO Code	Landlocked	Region
Libya	LBY	0	North
Madagascar	MDG	0	East
Malawi	MWI	1	East
Mali	MLI	1	West
Mauritania	MRT	0	West
Mauritius	MUS	0	East
Morocco	MAR	0	North
Mozambique	MOZ	0	South
Namibia	NAM	0	South
Niger	NER	1	West
Nigeria	NGA	0	West
Rwanda	RWA	1	East
Sao Tome and Principe	STP	0	Central
Senegal	SEN	0	West
Seychelles	SYC	0	East
Sierra Leone	SLE	0	West
Somalia	SOM	0	East
South Africa	ZAF	0	South
South Sudan	SDS	1	East
Sudan	SUD	0	East
Swaziland	SWZ	1	South
Togo	TGO	0	West
Tunisia	TUN	0	North
Uganda	UGA	1	East
United Republic of Tanzania	TZA	0	East
Zambia	ZMB	1	South
Zimbabwe	ZWE	1	South

Appendix B: Calculating domestic value-added content in trade

Los et al. (2016) propose an intuitive way to calculate the domestic value-added content in exports using a hypothetical extraction method. The idea is to set the final demand for one country's output in the rest of the world equal to zero, but leave the entire production structure, both domestically and internationally, unchanged. Foreign sectors will still use inputs from this country in their production structure, but they will no longer have direct final demand for its output. We can solve this modified IO system for the counterfactual vector of GDP values in each country-sector. The difference between the actual GDP of a country and this counterfactual GDP equals the domestic value-added contained in a country's exports.

The domestic value-added content of trade can also be calculated on a bilateral-country basis, but we are only interested in each country's total domestic value-added, summing up across all of its export destinations. We start from the country-specific IO tables that we discussed in the data section and collapse them one step further, combining all export destinations. This leads to the following IO system that we represent here in simplified form:

$$GO = A * GO + \sum_{i=\{c,row\}} FD_i \quad \longrightarrow \quad GO = (1 - A)^{-1} * \sum_i FD_i$$

The GO vector stacks the gross output vector of both countries, first the country under study and below the rest of the world aggregate. The number of rows is twice the number of sectors S in the IO table. The FD_c vector similarly stacks the final demand of country c for both types of products: the first S elements is demand for output of country c itself and the next S entries is demand for output produced in the rest of the world. The FD_{row} vector similarly stacks all final demand from the rest of the world, again with demand for output from country *c* in the first *S* rows of the vector. The matrix *A* is the global IO matrix that has dimensions (2*S*) x (2*S*). Using the input coefficients in matrix *A*, we can calculate value-added once we know the gross output of a country-sector.

As discussed above, we then replace the observed final demand from the rest of the world for products from country *c*, i.e., the first *S* elements in the FD_{row} vector, by zeros. We then solve for a counterfactual *GO* vector that will imply lower equilibrium output from all sectors. It is likely that the brunt of the adjustment will fall on industries from country *c*, but even output in the rest of the world will decline as less production in country c will lead to lower demand for imported intermediates, etc. The Leontief inverse $(1\text{-}A)^{-1}$ takes into account all interactions in the global production network. As we keep technology constant, the counterfactual *GO* vector can be used to calculate counterfactual value-added in all sectors and counterfactual GDP.

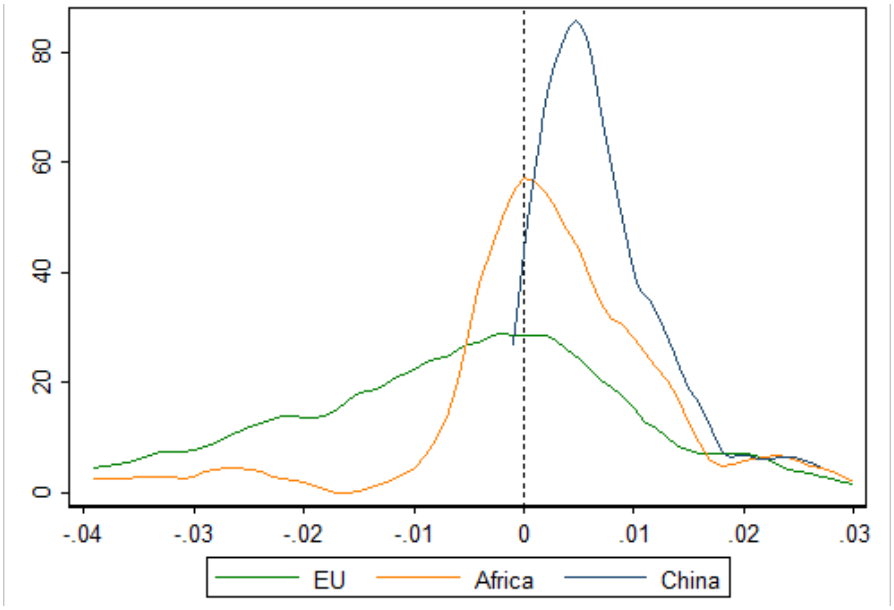
The algorithm can be used to calculate the domestic value-added for the aggregate economy or specifically for a single sector. In the latter case, we simply set the demand for the rest of the world for output from a particular sector to zero and solve the system as described above.

Of course, this type of mechanical calculations needs to be interpreted with caution. The objective is to calculate how much domestic value-added is embedded in actual trade flows using the existing structure of production and specialization. Naturally, if foreign demand would not be there, the entire trade and production network would adjust and this is not a calculation how that adjustment would take place.

Appendix C: Cross-country distribution of changes in input sourcing

Just as there is a distribution across countries in the import shares, there is variation in the extent to which sourcing has changed over time. Some patterns, however, are more widespread than others. The rising importance of imports from China is particularly broad based. Not a single African country reduced its reliance on Chinese inputs. Figure C1 shows the smoothed histograms of the cross-country distribution of change in input sourcing from various regions. The blue line for the change in Chinese share in total production value is entirely in the positive region. Changes are also relatively concentrated showing an increase everywhere, but no huge increase anywhere.

Figure C1: Distribution across African countries of change in input sourcing intensity



Notes: Percentage point change between 1995 and 2015 in the share of intermediates sourced from each of the three regions/countries. Lines show the smoothed distribution (histogram) across all African countries.

Almost two-thirds of countries increased their sourcing from Africa. The average increase by 0.5 percentage points, reported in Table 1, is mostly due to one-quarter of countries showing an increase of more than one percentage point. The increases and decreases for the remaining three-quarters of countries more or less cancel out. The decline in sourcing from Europe, on the other hand, is much more dispersed. For a non-negligible share of countries, the fraction of value coming from Europe declined by more than two percentage points, while more than one-third of countries increased their EU sourcing.

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