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Industrial similarity, diversification and the promotion of intra-African trade

Abstract

Recent research indicates that the level of intra-African trade is low relative to what is observed in other continents and relative to the potential of African economies. The continent's weak regional trade performance has been ascribed to factors ranging from limited supply capacities and multiple non-convertible national currencies to high trade barriers and infrastructural bottlenecks. While the impacts of these factors have been studied in the literature, the roles of product concentration and similarities in industrial structures across countries in explaining intra-African trade have not been addressed using a suitable econometric methodology. The present paper fills this gap. It finds that product concentration impedes intra-African trade while similarities in industrial structures between country pairs enhance it.

Key words: *Intra-African trade; industrial similarity; diversification; product concentration*

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1. Introduction

Regional integration has been a prominent and noteworthy feature of Africa's economic development over the past decades as evidenced by the relatively high number of regional economic groups, trade agreements and other initiatives launched by the continent (UNECA 2010; WTO 2018). Since independence, integration arrangements in Africa have underscored the need to boost intra-African trade to foster sustained growth and development and facilitate integration of the continent into the global economy.[1] The small size of African economies both in terms of population and income makes integration appealing because it provides access to a larger export market and permits exploitation of economies of scale in production. Regional cooperation in trade also diminishes exposure to global shocks and reduces trade costs, particularly for the 16 landlocked countries on the continent. Furthermore, regional cooperation contributes to the goal of export diversification of African economies because the composition of intra-African trade is skewed toward manufactured goods compared to Africa's trade with the rest of the world, which is dominated by primary commodities.

Notwithstanding the high potential benefits of intra-African trade, and the vital role of regional integration in the achievement of Africa's development goals, very modest trade takes place among African countries. In 2017, intra-African exports accounted for about 17 percent of Africa's total trade and intra-African imports accounted for about 13 percent. These numbers are small relative to what is observed in regional groups in other parts of the world. They are also small relative to the potential of African economies. Africa's weak regional trade performance has been ascribed to factors ranging from the low level of diversification and lack of productive capacities to high trade barriers, infrastructural bottlenecks, and existence of multiple national currencies that lack convertibility (UNECA 2010). UNCTAD (2013) suggests that the level of intra-African trade is far below potential, notably because the African regional integration agenda is focused more on the elimination of trade barriers rather than on the development of supply capacities for trade. In the same vein, Geda and Seid (2015), and Seid (2015) note that the realization of the large potential for intra-African trade is hampered by lack of diversification, which reflects the fact that most African countries export a small number of primary commodities while their imports are predominantly manufactured goods (UNCTAD, 2007; Limão and Venables, 2001).

This paper examines the role of product concentration and similarities in the sectoral structure of production across African countries in understanding intra-African trade. Traditional trade theories, such as the Ricardian and Heckscher-Ohlin models, suggest that similarities in the sectoral structure of production between two countries should lead to less bilateral trade. However, the more recent trade theories suggest that such similarities in production structure should lead to more bilateral trade (Baxter and Kouparitsas, 2006; Helpman and Krugman, 1989). The main message from these models is that there is a fundamental difference in predictions of trade theories regarding the relationship between economic similarities between country pairs and bilateral trade. A widespread view in the discourse on intra-African trade is that African countries trade less among themselves because they have similar production patterns. Yet we are not aware of any studies that have addressed this issue using a suitable econometric methodology applied to African data. To fill this gap, we use gravity-type models to examine the roles of product concentration and similarities in the production structures of African economies in explaining intra-African trade performance.

In a related paper Longo and Sekkat (2004) examined, among other factors, the role of similarities in living standards (or levels of development) between countries in explaining intra-African trade. However, the measure of economic similarity used in their paper was similarity in income per capita rather than similarity in production or industrial structures. Oramah and Abou-Lehaf (1998) also examined the extent to which the export structures of African countries match their import patterns and found that the potential for intra-African trade is modest. While Oramah and Abou-Lehaf (1998) focused on the correspondence of exports and imports of African countries our paper focuses on the effects of product concentration and similarities in the sectoral

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[1] There are many regional trade arrangements in Africa, ranging from the Lagos Plan of Action and the Abuja Treaty to the African Union's Agenda 2063 and the African Continental Free Trade Area (AfCFTA) agreement signed by African Heads of State and Government in Kigali in March 2018.

patterns of production on intra-African trade. Furthermore, Oramah and Abou-Lehaf (1998) estimated their gravity equations by ordinary least squares (OLS), which yields biased and inconsistent estimates in the presence of zero observations and heteroscedasticity. To circumvent these problems the present paper adopts the Pseudo Poisson Maximum Likelihood (PPML) estimation technique, which accounts for zero observations and heteroscedasticity.

The paper is organized as follows. Section 2 discusses Africa's trade performance and structure while section 3 describes the estimation methodology and the data used in the study. Section 4 presents and discusses the regression results. Section 5 concludes the paper.

2. Africa's trade performance and structure

African countries are heavily reliant on trade for development as evidenced by the fact that they have high trade ratios.[2] Over the past few decades there has been a significant increase in the value of Africa's global trade. For instance, the value of the continents global exports increased from $16.1 billion in 1970 to $413.8 billion in 2017 and the value of its global imports increased from $14.5 billion to $534.3 billion over the same period. Interestingly, this increase in the value of the continent's trade has gone hand in hand with a decrease in its share of global trade from 4.4 percent in 1970 to 3 percent in 2017 (table 1). There has also been a significant change in the destination of Africa's exports. In 1995 Europe was Africa's main trading partner, accounting for about 52 percent of the continents total trade, followed by America with 18 percent, and Asia with 15 percent (figure 1). Unlike the situation some decades ago, Asia is now Africa's most important trading partner, accounting for 35.5 percent of the continent's total trade, followed by Europe with 35 percent and Africa with 17 percent. The increase in Asia's role in Africa's trade is largely due to the rapid increase in China's engagement with Africa which has seen its share of Africa's total trade rise from 1.3 percent in 1995 to 12 percent in 2017.

Table 1. Value and global share of Africa's merchandise trade											
YEAR		1970	1980	1990	2000	2010	2013	2014	2015	2016	2017
Measure	Flow										
US Dollars at current prices (in millions)	Exports	16129	121378	104877	147905	521435	602322	553130	389783	355425	413836
	Imports	14538	96490	94444	129914	479324	640538	644698	555143	496311	534262
Percentage of total world	Exports	5.1	5.9	3.0	2.3	3.4	3.2	2.9	2.4	2.2	2.3
	Imports	4.4	4.6	2.6	2.0	3.1	3.4	3.4	3.3	3.1	3.0

Source: UNCTADstat Database.

[2] For instance, in the period 2013-2017, the average ratio of merchandise trade to GDP in sub-Saharan Africa was about 55 percent.

Figure 1. Destination of Africa's exports, 1995 and 2017, (percentage)
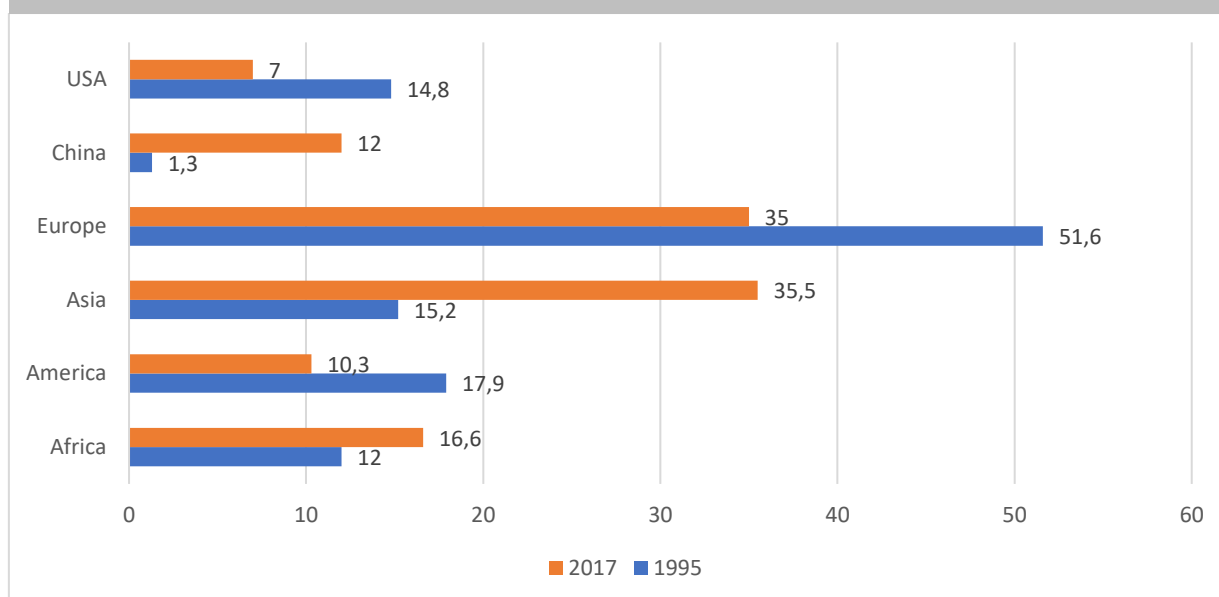
Source: compiled using data from UNCTADstat Database.

Another interesting feature of Africa's global trade is the fact that its exports are highly concentrated on a few products, particularly when compared to the exports of other developing regions. Table 2 presents the product concentration and diversification indices of Africa's merchandise exports. Both indices lie between 0 and 1 and are constructed in such a way that values closer to 1 imply more product concentration and high deviation of a country's exports from the global pattern. The table shows that the product concentration index for Africa in 2017 was 0.24 compared to 0.09 for developing economies in America and 0.10 for developing economies in Asia. It is also interesting to note that the value of this index for Africa in 2017 was about the same as it was in 1995, indicating there has not been any significant progress made in reducing the product concentration of the continent's exports. A look at the export diversification index also shows that Africa's export structure differs significantly from the world pattern, which reflects the fact that African countries have very low levels of diversification.

Table 2. Product concentration and diversification indices of Africa's merchandise exports							
ECONOMY		Developing Africa	Developing America	Developing Asia	Africa excluding South Africa	Northern Africa	Sub-Saharan Africa
YEAR	MEASURE						
1995	Concentration Index	0.25	0.09	0.09	0.34	0.36	0.21
	Diversification Index	0.59	0.36	0.32	0.68	0.71	0.59
2005	Concentration Index	0.43	0.12	0.12	0.52	0.47	0.42
	Diversification Index	0.60	0.33	0.27	0.66	0.69	0.60
2013	Concentration Index	0.41	0.13	0.12	0.49	0.41	0.42
	Diversification Index	0.54	0.34	0.23	0.60	0.61	0.58
2014	Concentration Index	0.36	0.12	0.11	0.44	0.31	0.39
	Diversification Index	0.54	0.34	0.23	0.60	0.58	0.58

2015	Concentration Index	0.26	0.09	0.10	0.33	0.23	0.28
	Diversification Index	0.53	0.34	0.24	0.61	0.57	0.58
2016	Concentration Index	0.22	0.08	0.10	0.29	0.21	0.24
	Diversification Index	0.54	0.34	0.24	0.61	0.57	0.58
2017	Concentration Index	0.24	0.09	0.10	0.31	0.23	0.26
	Diversification Index	0.54	0.35	0.23	0.61	0.57	0.59
Notes: The product concentration index lies between 0 and 1, with higher values indicating a higher degree of export concentration. The diversification index measures the absolute deviation of a country's trade structure from the world pattern. It also lies between 0 and 1 and higher values indicate more deviation of a country's export structure from the global pattern.							

Source: UNCTADstat Database.

Regarding intra-African trade, available data indicate that there has been an increase in its share of Africa's global exports from 12 percent in 1995 to about 17 percent in 2017. Nevertheless, intra-Africa trade is still quite low relative to the intra-group trade of other continents. For example, in 2017, the share of intra-group exports in total exports (of the group considered) was 66.7 percent in Europe, 53.1 percent in developing Asia and 30.6 percent in developing countries in America (Table 3). The aggregate figures for Africa masks wide variations across the regional trade blocs on the continent. Among the eight regional economic communities recognised by the African Union, the Southern African Development Community (SADC) and the East African Community (EAC) had the highest percentage of intra-group trade in 2017, with about 20 percent and 19 percent respectively. The Arab Maghreb Union (AMU) is the regional economic community with the lowest intra-group trade in 2017 (about 3.5 percent). An examination of intra-group imports also leads to the same conclusion that African countries trade less among themselves relative to the rest of the world. In 2017 intra-group imports in Africa was about 13 percent compared to 63 percent in Europe, 55 percent in developing countries in Asia and 19 percent in developed countries in America (table 4). Another approach to assessing the performance of African countries in regional trade is to compare the actual trade among African countries to potential trade derived from estimation of bilateral trade equations. By this measure, the extant literature also suggests that intra-African trade is low relative to potential (Geda and Seid, 2015; UNCTAD 2013; and Longo and Sekkat, 2004).

Table 3. Intra-group exports (percentage of total group exports)								
	1995	2005	2010	2013	2014	2015	2016	2017
Developing Africa	12.01	9.51	13.88	14.51	15.47	17.81	17.60	16.65
Developing America	20.50	18.66	19.98	19.61	18.31	17.20	16.25	16.59
Developing Asia	42.22	46.59	51.41	54.68	54.14	53.60	52.99	53.07
America (developed economies)	35.87	40.78	32.39	31.82	32.36	31.13	30.66	30.61
Europe	66.34	71.76	69.03	65.52	66.37	66.06	66.82	66.69
AMU (Arab Maghreb Union)	3.90	1.97	2.39	3.55	4.11	4.11	4.10	3.45
CEN-SAD (Community of Sahel-Saharan States)	7.44	6.32	6.03	7.18	7.03	8.22	8.73	8.26
COMESA (Common Market for Eastern and Southern Africa)	5.70	5.30	7.15	9.09	9.93	11.47	9.74	11.50
EAC (East African Community)	17.50	18.98	18.69	19.55	21.17	22.52	19.76	19.35
ECCAS (Economic Community of Central African States)	1.39	1.17	2.03	1.67	1.51	2.08	1.92	2.24
ECOWAS (Economic Community of West African States)	9.43	9.63	7.69	9.18	8.29	9.97	11.23	10.18
IGAD (Intergovernmental Authority on Development)	11.81	10.47	9.07	13.31	14.50	16.31	16.01	16.01

SADC (Southern African Development Community)	14.66	10.73	18.04	18.67	19.27	21.71	20.83	19.83

Source: UNCTADstat Database.

Table 4. Intra-group imports (percentage of total group imports)								
	1995	2005	2010	2013	2014	2015	2016	2017
Developing Africa	10.76	13.66	14.66	14.38	13.68	13.40	12.95	12.93
Developing America	18.99	21.17	20.04	19.05	17.68	16.07	15.67	16.05
Developing Asia	37.92	51.43	52.74	53.55	54.27	54.94	52.49	55.18
America (developed economies)	27.60	23.18	20.41	20.84	21.20	19.34	18.72	18.70
Europe	64.88	66.23	62.82	62.92	63.16	63.13	63.29	62.84
AMU	3.62	2.99	2.86	3.45	3.27	2.65	2.51	2.33
CEN-SAD	5.59	6.91	5.98	6.65	5.87	5.62	5.44	5.47
COMESA	4.16	6.15	6.49	6.60	6.12	5.91	5.40	6.31
EAC	10.54	10.43	8.29	7.43	7.40	6.75	6.97	6.94
ECCAS	2.61	3.38	5.05	5.47	2.68	4.45	4.59	5.63
ECOWAS	8.40	12.50	9.41	11.30	9.73	9.11	8.88	8.68
IGAD	7.01	5.53	4.86	4.09	3.71	3.54	3.18	3.77
SADC	14.99	17.20	20.22	19.67	19.42	20.41	21.33	20.99

Source: UNCTADstat Database.

UNCTAD (2013) underscores the importance of low supply capacities in explaining observed levels of intra-African trade. But Africa's low level of regional trade is also a consequence of the prevalence of high tariff and non-tariff barriers that impede trade. African exporters generally face higher levels of restrictions when trading within the continent than when trading with the rest of the world. In 2017, the average tariffs facing an African exporter in sub-Saharan African countries was 3.1 percent compared with 0.4 percent for those exporting to developed countries, 1.7 percent for those exporting to East Asia, 1.9 percent for those exporting to Latin America, and 2.6 percent for those exporting to West Asia and North Africa (Table 5).

Table 5. Matrix of tariffs imposed on trade flows between regions in 2017 (%)							
Importing Region	Developed Countries	East Asia	Latin America	South Asia	Sub-Saharan Africa	Transition Economies	W.Asia & N.Africa
Developed Countries	1.6	2.6	1.2	2.1	0.4	1.7	0.6
East Asia	4.9	2.7	5.4	3.2	1.7	3.8	1.8
Latin America	3.8	8.0	1.1	10.9	1.9	2.0	2.9
South Asia	10.7	10.4	17.8	6.8	5.7	8.1	9.2
Sub-Saharan Africa	7.4	11.6	9.0	8.3	3.1	8.6	5.4
Transition Economies	3.4	1.9	2.0	4.0	0.6	0.4	4.7
W.Asia & N.Africa	3.2	5.5	6.4	4.0	2.6	8.7	1.9

Source: UNCTAD (2019).

With import tariff rates of 5.7 percent, South Asia is the only region where exporters in sub-Saharan Africa face higher levels of restrictiveness than at home. In general, countries in South Asia and sub-Saharan Africa had the highest tariff trade restrictiveness for imports in the period 2008-2017 (Figure 2). In addition to the existence of high tariff and non-tariff barriers, the other factors that have been suggested as explanations for the poor performance of African countries in intra-African trade include infrastructure bottlenecks, lack of diversification of African economies, the existence of multiple non-convertible national currencies, production structure similarities, threats to peace and security, and the lack of implementation of regional agreements (AfDB 2019; AFREXIMBANK, 2018).

Figure 2. Tariff trade restrictiveness index for imports, by region 2008-2017 (%)
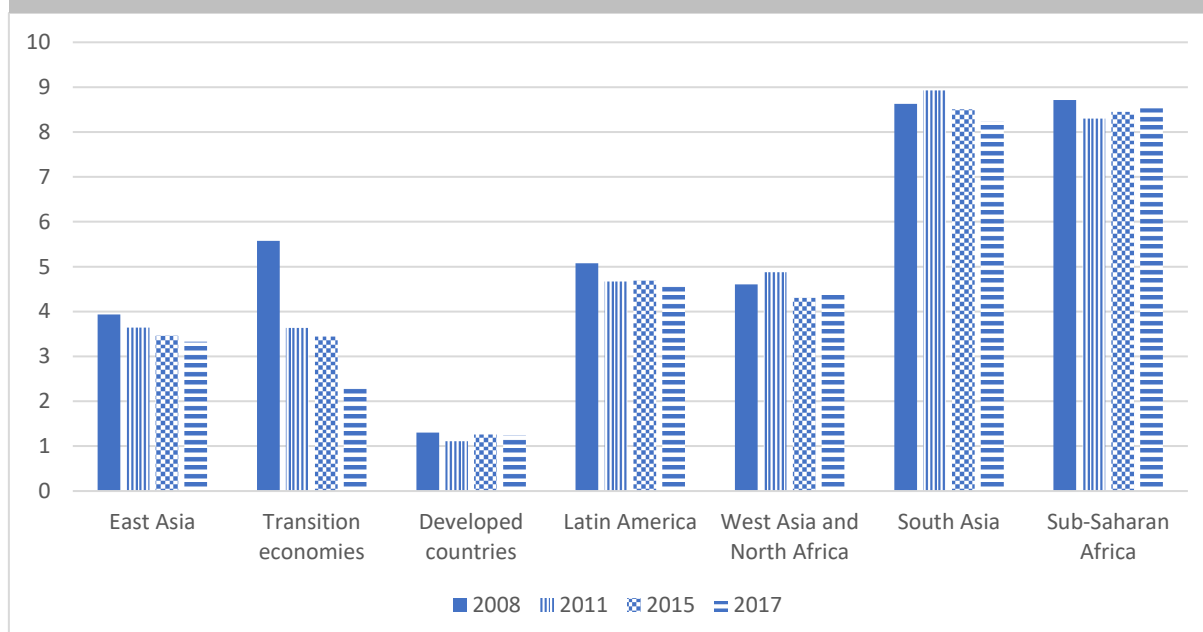
Source: computed by UNCTAD.

A striking feature of intra-Africa trade, which speaks to its potential for fostering development in African countries, is the observation that its composition is skewed towards manufactured goods and so is favourable to advancing the continents quest for diversification and transformation. Using the Standard International Trade Classification (SITC), the UNCTAD Secretariat has grouped exports into five main product categories: All food items; Agricultural raw materials; Fuels; Manufactured goods; and Ores, metals, precious stones and non-monetary gold. Table 6 presents the contributions of these product categories to Africa's exports to main trading partners in 1995 and 2017. It shows that in 1995 manufactured goods accounted for 52.3 percent of intra-African trade and in 2017 it accounted for 45.4 percent. This is interesting because it is quite different from the composition of Africa's trade with the rest of the world, which tends to be dominated by either "Fuels" or "Ores, Metals, Precious Stones and non-monetary Gold." For instance, in 2017, fuels accounted for 55.7 percent of Africa's trade with the America continent, 43.3 percent of trade with Asia, and 39 percent of trade with Europe. In addition to "Fuels," the product category "Ores, Metals, Precious Stones and non-monetary Gold" also plays an important role in Africa's trade with Asia, with the latter accounting for about 28 and 30 percent of the continents trade with Asia in 1995 and 2017 respectively. The dominance of fuels and other primary commodities in Africa's external trade is also reflected in the continent's trade with individual countries. For example, in 2017, fuels accounted for 55 percent of the continents trade with China and 52 percent of trade with the United States. In the same year, the share of manufactured goods in Africa's trade with China was 4.3 percent and for trade with the United States it was 24.4 percent. In sum, the current pattern of Africa's trade with external partners is not conducive to the development of manufacturing and needs to change for trade to have a catalytic effect on diversification and transformation of African economies.

Table 6. Shares of product categories in Africa's exports to main partners (%)							
	Year	Africa	America	Asia	Europe	China	United States	World
All food items (SITC 0 + 1 + 22 + 4)	1995	18.98	4.34	15.40	18.12	4.49	4.03	15.16
	2017	20.83	8.69	10.68	15.26	4.22	9.52	13.61
Agricultural raw materials (SITC 2 less 22, 27 and 28)	1995	5.30	1.90	11.14	5.10	24.61	1.13	5.38
	2017	1.62	1.15	4.51	2.21	5.44	1.19	2.79
Fuels (SITC 3)	1995	19.22	65.34	23.36	37.75	20.91	67.37	38.30
	2017	21.35	55.73	43.25	39.13	55.07	52.15	38.92
Manufactured goods (SITC 5 to 8 less 667 and 68)	1995	52.48	16.46	22.40	23.36	21.53	15.30	25.80
	2017	45.35	22.85	11.13	28.27	4.34	24.38	24.28
Ores, metals, precious stones and non-monetary gold (SITC 27 + 28 + 68 + 667 + 971)	1995	4.01	11.97	27.69	15.68	28.46	12.16	15.36
	2017	10.85	11.59	30.43	15.14	30.92	12.76	20.40

Source: computed using data from UNCTADstat Database.

3. Empirical methodology and data

This section adopts the gravity-model approach to investigate the relationship between product concentration and similarities in production or industrial structures, on the one hand, and intra-African trade, on the other hand. In the estimations, we use an augmented version of the standard gravity model as specified below:

$$log(X_{odt}) = \alpha_0 + \alpha_t + \alpha_1 \log(\text{GDP/Pop}_{ot}) + \alpha_2 \log(\text{GDP/Pop}_{dt}) + \alpha_3 D_{odt} + \alpha_3 RTA_{odt}$$
$$+ \alpha_4 Concentration_{ot} + \alpha_5 Concentration_{dt} + \alpha_6 Similarity_{odt} + \alpha_7 \varepsilon_{odt}$$

Where $log(X_{odt})$ is the amount of exports from country o (origin/ exporter) to country d (destination/ importer) in year t. GDP/Pop represents the per capita GDP of a country. α_t is the time fixed effect. α_k are unknown parameters to be estimated. D_{odt} measures the distance between trading partners, be it geographical, social or institutional (e.g.: Shared Border, Common Colonizer, Shared Currency, etc.).[3] *RTA* is a dummy variable that takes value 1 if a country pair is part of a Regional Trade Agreement. *Concentration* is a variable measuring the degree of product concentration and *Similarity* is a measure of the extent to which the industrial structures of two countries are similar. Finally, ε_{odt} is the error term.

The intra-African trade data used in the estimations comes from the International Monetary Fund's Direction of Trade Statistics (IMF DOTS) database and includes 48 countries as reported in Table 7. The income per capita variable GDP/Pop is from the World Development Indicators (WDI) online database. The variables capturing distance (that is, Geographical Distance, Shared Border, Common Colonizer, Shared Currency, and RTA) are taken from the CEPII[4] distance database.

Table 7. List of countries in the sample				
Algeria	Comoros	Lesotho	Namibia	Sudan
Angola	Djibouti	Liberia	Niger	eSwatini
Benin	Equatorial Guinea	Libya	Nigeria	Tanzania
Botswana	Eritrea	Madagascar	Rwanda	Togo
Burkina Faso	Ethiopia	Malawi	Senegal	Tunisia
Burundi	Gabon	Mali	Seychelles	Uganda
Cabo Verde	Ghana	Mauritania	Sierra Leone	Zambia
Cameroon	Guinea	Mauritius	Somalia	Zimbabwe
Central African Republic	Guinea-Bissau	Morocco	South Africa	
Chad	Kenya	Mozambique	South Sudan	

To measure production concentration and industrial similarity, we computed a Herfindahl-Hirschman Index (HHI) and an Industrial Similarity Index (ISI) respectively, using WDI data on sectoral value added as a percentage of GDP (Agriculture, Manufactures, Other industries and Services). The similarity index is built as in Baxter and Kouparitsas (2006) and Shea (1996). It can be expressed as:

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[3] These variables capture bilateral trade costs between trading partners *o* and *d* as discussed in the literature (Yotov et al 2016).

[4] CEPII stands for Centre d'Etudes Prospectives et d'Informations Internationales.

$$ISI = \frac{\sum s_{on}s_{dn}}{\sum s_{on}^2 \sum s_{dn}^2} = \frac{\sum s_{on}s_{dn}}{HHI_{on}HHI_{dn}}$$

Where s is the share of a particular sector, o stands for origin (exporter) and d stands for destination (importer); n is the number of sectors. Based on the definition of the ISI, there is clearly a link between the ISI and the product concentration indices. Given this link between the ISI and the concentration indices, it seems reasonable not to assess their effect on intra-African trade simultaneously in the same model, but to include them in different regressions. The sample used in the estimation covers the period 2000-2015. Table 8 and Table 9 present the summary statistics and the correlation matrix respectively.

A standard approach to estimating gravity models is to use the panel data fixed effects (FE) technique. We follow this practice by estimating the model with Pooled Ordinary Least Squares (POLS) with time FE[5]. By so doing, we address the omitted variable bias and the problem of unobserved heterogeneity associated with these types of models. We also estimate the model using the Poisson Pseudo-Maximum Likelihood (PPML) estimator, to account for heteroscedasticity, which is often present in trade data, and most importantly to account for zero trade flows (Santos Silva and Tenreyro, 2006). The Tobit estimator is an alternative solution that has been proposed for dealing with the problem of zero trade flows (Martin and Pham, 2008). As a robustness check, we also estimated the equations using the Tobit estimator. However, it is not our preferred estimator because the Tobit thresholds are unknown, and results are generally sensitive to the choice of a threshold.

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[5] As noted by Piermatini and Yotov (2016), country pair FE, exporter-time and importer-time FE absorb explanatory variables (in our model, ln GDP/pop, HHI). That is why we do not use them. Time-invariant bilateral trade costs are proxied by bilateral distance variables, rather than country pair FE.

Table 8. Summary statistics

Variables	(1) N	(2) Mean	(3) Std. Dev.	(4) Min	(5) Max
Shared Border	34,592	0.0749	0.263	0	1
Common Colonizer	34,592	0.274	0.446	0	1
Shared Currency	34,592	0.0666	0.249	0	1
RTA	34,592	0.160	0.367	0	1
lnTrade	34,720	7.101	6.743	0	22.42
ln Dist (avg)	34,592	8.047	0.658	5.089	9.187
ln GDP/Pop	33,722	6.898	1.182	4.713	10.03
HHI	34,720	16.77	2.493	1.144	34.41
Manuf_va	26,693	0.110	0.0668	0.00237	0.366
Agri_va	29,729	0.245	0.162	0.00892	0.790
Services_va	29,545	0.484	0.131	0.133	0.915
Other_ind_va	26,509	0.164	0.144	0.000452	0.773
ISI	20,146	0.527	0.099	0.079430	0.864

Notes:
Lntrade: logarithm of trade between country pairs
Ln GDP / Pop: logarithm of per capita GDP
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise
Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
agri_va: Agriculture value added as a percentage of GDP
manuf_va: Manufacture value added as a percentage of GDP
other_ind_va: Industrial but non-manufacture value added as a percentage of GDP
services_va: Services value added as a percentage of GDP
HHI: Herfindahl-Hirschman Index
ISI: Industrial Similarity Index for country pairs

Table 9. Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) lntrade	1.000																		
(2) ln GDP/Pop_o	0.148	1.000																	
(3) ln GDP/Pop_d	0.096	0.077	1.000																
(4) ln Dist (avg)	-0.315	0.110	0.110	1.000															
(5) Shared Border	0.281	-0.034	-0.034	-0.558	1.000														
(6) Common Colonizer	0.203	-0.026	-0.026	-0.153	0.109	1.000													
(7) RTA	0.324	-0.040	-0.040	-0.529	0.351	0.154	1.000												
(8) Shared Currency	0.109	-0.019	-0.019	-0.327	0.192	0.219	0.183	1.000											
(9) agri_va_o	-0.147	-0.758	-0.004	-0.122	0.022	-0.025	0.010	0.066	1.000										
(10) agri_va_d	-0.083	-0.004	-0.758	-0.122	0.022	-0.025	0.010	0.066	-0.020	1.000									
(11) manuf_va_o	0.136	0.228	-0.049	0.093	-0.037	0.029	0.057	0.019	-0.400	0.019	1.000								
(12) manuf_va_d	0.010	-0.049	0.228	0.093	-0.037	0.029	0.057	0.019	0.019	-0.400	-0.008	1.000							
(13) nonmanuf_vao	-0.037	0.478	0.011	-0.031	0.012	-0.022	-0.037	0.041	-0.438	0.006	-0.318	-0.000	1.000						
(14) nonmanuf_vad	-0.018	0.011	0.478	-0.031	0.012	-0.022	-0.037	0.041	0.006	-0.438	-0.000	-0.318	-0.019	1.000					
(15) services_va_o	0.129	0.316	0.022	0.134	-0.037	0.023	0.014	-0.110	-0.549	0.007	0.361	-0.023	-0.395	0.011	1.000				
(16) services_va_d	0.072	0.022	0.316	0.134	-0.037	0.023	0.014	-0.110	0.007	-0.549	-0.023	0.361	0.011	-0.395	-0.006	1.000			
(17) HHI_o	-0.082	0.031	0.014	0.088	-0.038	-0.045	-0.049	-0.016	0.041	0.004	-0.042	-0.008	0.077	0.020	-0.083	-0.037	1.000		
(18) HHI_d	-0.078	0.014	0.050	0.089	-0.028	-0.048	-0.043	-0.029	0.011	0.012	-0.012	0.001	0.016	0.083	-0.035	-0.067	0.780	1.000	
(19) ISI	-0.000	-0.020	-0.020	-0.051	0.081	0.058	0.102	0.022	-0.058	-0.058	0.072	0.072	-0.338	-0.338	0.386	0.386	-0.097	-0.08	1

Notes:

Lntrade: logarithm of trade between country pairs
Ln GDP / Pop_o: logarithm of the per capita GDP of the exporter (origin)
Ln GDP / Pop_d: logarithm of the per capita GDP of the importer (destination)
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise

Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
agri_va_o: Agriculture value added as a percentage of GDP of the exporter (origin)
agri_va_d: Agriculture value added as a percentage of GDP of the importer (destination)
manuf_va_o: Manufacture value added as a percentage of GDP of the exporter (origin)
manuf_va_d: Manufacture value added as a percentage of GDP of the importer (destination)
nonmanuf_va_o: Industrial but non-manufacture value added as a percentage of GDP of the exporter (origin)
nonmanuf_va_d: Industrial but non-manufacture value added as a percentage of GDP of the importer (destination)
services_va_o: Services value added as a percentage of GDP of the exporter (origin)
services_va_d: Services value added as a percentage of GDP of the importer (destination)
HHI_o: Herfindahl-Hirschman Index of the exporter (origin)
HHI_d: Herfindahl-Hirschman Index of the importer (destination)
ISI: Industrial Similarity Index for country pairs

4. Estimation results

Product concentration and trade

Table 10 presents the results of the OLS estimations of our gravity model with time fixed effects. In general, the standard variables used in gravity models have the expected signs, except for the dummy variable for sharing a common currency. As expected, countries' income per capita, has a positive effect on intra-African trade. The coefficient of the geographical distance variable [lnDist (avg)] also has a negative sign as expected. Furthermore, having a common colonizer, sharing a border and being part of a free trade agreement have a positive effect on intra-African trade. It is worth noting that the variables *RTA* and *Shared Border* have the largest coefficients throughout all the estimations.

Regarding the key variables measuring product concentration, we find that both "*HHI, exporter*" and "*HHI, importer*" have a negative effect on trade in column (1), Table 10. This suggests that African countries trade less among themselves because their economies are not diversified. This result is statistically significant at the one percent level. This result makes sense given that in our sample, the share of manufacturing value added in GDP is on average 11 percent (Table 8), which is quite low. In subsequent columns of Table 10, instead of the concentration index, we use as regressors each component used to compute *HHI*. Column (2) reports the results for the share of agriculture value added in GDP. It shows that the higher the share of agriculture in GDP, the lower is intra-African trade. Column (3) indicates that the higher the share of manufacturing value added in GDP, the more African countries trade among themselves. Column (4) reports the results for the share of the value added of "other industries" in GDP. As is the case with the agriculture sector, this variable has a negative effect on intra-African trade. Finally, as shown in column (5), the higher the share of value added in services the higher is intra-African trade.

In sum, Table 10 suggests that production concentration in African countries reduces intra-African trade. The result that the higher the share of agriculture in GDP the lower is intra-African trade is interesting given the importance of agriculture and "other industries" (including the extractive sector) in African economies. This implies that to boost intra-African trade, African countries have to undergo a process of structural transformation involving a shift in the structure and composition of output away from agriculture and towards manufacturing activities and services.

To check the robustness of these results, we estimated the equation using alternative estimation methods[6]. The results obtained using the PPML estimator (Table 11) are very similar to those discussed above. The key difference is that the coefficient of the variable *Common Colonizer* is now negative. Interestingly, distance variables such as *RTA* and *Shared Border* are still significant and of the expected sign. Concerning our concentration measures, a slight difference is observed in the variable capturing the role of the manufacturing sector: we note that "*Manuf_va, exporter*" has the expected sign and is statistically significant, while "*Manuf_va, importer*" has a negative sign and is insignificant. Similarly, the product concentration index for the exporter has the expected sign and is significant while the index for the importer does not have the expected sign.

Table 12 presents the results of the regression obtained using the Tobit estimator. The results are similar to those obtained using the OLS estimator with FE. For most of the standard gravity equation variables the results of the Tobit estimation are in general also similar to those of the PPML. However, there are differences in the results for some of the variables capturing product concentration. For example, in the PPML estimation, the results suggest that increases in manufacturing and services value added in the exporting country boost intra-African trade while the Tobit model suggests they reduce intra-African trade. Nevertheless, both the PPML and the Tobit estimators indicate that an increase in agricultural value added has a negative effect on intra-African trade. This is consistent with the widely held view that African countries should reduce dependence on

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[6] We also ran regressions with the Gini concentration index and obtained similar results.

agriculture and primary commodities to promote regional trade and lay the foundation for robust economic growth (UNCTAD 2013; Geda and Seid 2015).

Table 10. Intra-African trade, POLS (dependent variable: 1+LnTrade), 2000-2015					
Variables	(1)	(2)	(3)	(4)	(5)
ln GDP/Pop, exporter	0.906***	0.495***	0.749***	1.461***	0.789***
	(0.0296)	(0.0539)	(0.0381)	(0.0423)	(0.0352)
ln GDP/Pop, importer	0.570***	0.389***	0.464***	0.806***	0.504***
	(0.0296)	(0.0539)	(0.0381)	(0.0423)	(0.0352)
ln Dist (avg)	-1.683***	-1.805***	-1.839***	-2.062***	-1.996***
	(0.0697)	(0.0815)	(0.0927)	(0.0935)	(0.0830)
Shared Border	3.016***	2.525***	2.652***	2.357***	2.416***
	(0.152)	(0.170)	(0.190)	(0.191)	(0.171)
Common Colonizer	2.459***	2.469***	2.127***	1.991***	2.416***
	(0.0767)	(0.0863)	(0.0955)	(0.0959)	(0.0866)
RTA	3.167***	2.768***	2.767***	2.704***	2.574***
	(0.105)	(0.120)	(0.134)	(0.133)	(0.121)
Shared Currency	-1.048***	-0.852***	-0.409**	-0.142	-0.676***
	(0.139)	(0.159)	(0.192)	(0.191)	(0.159)
Agri_va, exporter		-4.129***			
		(0.376)			
Agri_va_importer		-1.877***			
		(0.376)			
Manuf_va, exporter			13.52***		
			(0.660)		
Manuf_va, importer			2.406***		
			(0.660)		
Other_ind_va, exporter				-7.824***	
				(0.334)	
Other_ind_va, importer				-4.811***	
				(0.334)	
Services_va, exporter					5.224***
					(0.310)
Services_va, importer					3.007***
					(0.310)
HHI, exporter	-0.111***				
	(0.0257)				
HHI, importer	-0.111***				
	(0.0261)				
Time Fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	32,672	25,380	20,434	20,146	25,070
R-squared	0.219	0.227	0.245	0.254	0.232

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

LnTrade: logarithm of trade between country pairs
Ln GDP / Pop_o: logarithm of the per capita GDP of the exporter (origin)
Ln GDP / Pop_d: logarithm of the per capita GDP of the importer (destination)
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise
Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
agri_va_o: Agriculture value added as a percentage of GDP of the exporter (origin)

agri_va_d: Agriculture value added as a percentage of GDP of the importer (destination)
manuf_va_o: Manufacture value added as a percentage of GDP of the exporter (origin)
manuf_va_d: Manufacture value added as a percentage of GDP of the importer (destination)
nonmanuf_va_o: Industrial but non-manufacture value added as a percentage of GDP of the exporter (origin)
nonmanuf_va_d: Industrial but non-manufacture value added as a percentage of GDP of the importer (destination)
services_va_o: Services value added as a percentage of GDP of the exporter (origin)
services_va_d: Services value added as a percentage of GDP of the importer (destination)
HHI_o: Herfindahl-Hirschman Index of the exporter (origin)
HHI_d: Herfindahl-Hirschman Index of the importer (destination)

Table 11. Intra-African trade, PPML (dependent variable: Trade), 2000-2015					
VARIABLES	(1)	(2)	(3)	(4)	(5)
ln GDP/Pop, exporter	0.822***	0.641***	0.762***	0.974***	0.681***
	(0.0301)	(0.0466)	(0.0331)	(0.0376)	(0.0271)
ln GDP/Pop, importer	0.337***	0.172***	0.266***	0.344***	0.248***
	(0.0346)	(0.0458)	(0.0369)	(0.0452)	(0.0293)
ln Dist (avg)	-0.291***	-0.210**	-0.127	-0.366***	-0.469***
	(0.0815)	(0.0880)	(0.0900)	(0.0875)	(0.0773)
Shared Border	1.433***	1.672***	1.629***	1.646***	1.642***
	(0.125)	(0.134)	(0.142)	(0.149)	(0.132)
Common Colonizer	-0.663***	-0.741***	-1.004***	-0.927***	-0.635***
	(0.0721)	(0.0738)	(0.0802)	(0.0802)	(0.0734)
RTA	2.096***	1.810***	1.964***	1.544***	1.377***
	(0.115)	(0.119)	(0.140)	(0.140)	(0.124)
Shared Currency	0.0914	0.0388	0.0243	-0.173	0.00193
	(0.127)	(0.129)	(0.152)	(0.131)	(0.113)
Agri_va, exporter		-1.685***			
		(0.556)			
Agri_va_importer		-1.330***			
		(0.448)			
Manuf_va, exporter			1.530***		
			(0.443)		
Manuf_va, importer			-0.0258		
			(0.564)		
Other_ind_va, exporter				-3.485***	
				(0.264)	
Other_ind_va, importer				-1.126***	
				(0.307)	
Services_va, exporter					3.712***
					(0.291)
Services_va, importer					1.759***
					(0.310)
HHI, exporter	-0.0632**				
	(0.0251)				
HHI, importer	0.05011***				
	(0.0289)				
Constant	9.423***	11.98***	9.106***	9.950***	9.851***
	(0.665)	(0.988)	(0.697)	(0.685)	(0.621)
Observations	32,672	25,380	20,434	20,146	25,070
R-squared	0.274	0.322	0.332	0.400	0.407

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
LnTrade: logarithm of trade between country pairs
Ln GDP / Pop_o: logarithm of the per capita GDP of the exporter (origin)
Ln GDP / Pop_d: logarithm of the per capita GDP of the importer (destination)
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise
Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
agri_va_o: Agriculture value added as a percentage of GDP of the exporter (origin)
agri_va_d: Agriculture value added as a percentage of GDP of the importer (destination)
manuf_va_o: Manufacture value added as a percentage of GDP of the exporter (origin)
manuf_va_d: Manufacture value added as a percentage of GDP of the importer (destination)
nonmanuf_va_o: Industrial but non-manufacture value added as a percentage of GDP of the exporter (origin)
nonmanuf_va_d: Industrial but non-manufacture value added as a percentage of GDP of the importer (destination)
services_va_o: Services value added as a percentage of GDP of the exporter (origin)
services_va_d: Services value added as a percentage of GDP of the importer (destination)
HHI_o: Herfindahl-Hirschman Index of the exporter (origin)

HHI_d: Herfindahl-Hirschman Index of the importer (destination)

Table 12. Intra-African trade, Tobit (dependent variable: Trade), 2000-2015

VARIABLES	(1)	(2)	(3)	(4)	(5)
ln GDP/Pop, exporter	1.430***	1.088***	1.317***	2.152***	1.239***
	(0.0477)	(0.0791)	(0.0559)	(0.0617)	(0.0534)
ln GDP/Pop, importer	0.998***	0.932***	0.997***	1.354***	0.885***
	(0.0478)	(0.0792)	(0.0559)	(0.0618)	(0.0535)
ln Dist (avg)	-2.584***	-2.694***	-2.682***	-3.069***	-3.023***
	(0.116)	(0.128)	(0.142)	(0.142)	(0.129)
Shared Border	3.441***	2.623***	2.731***	2.400***	2.439***
	(0.244)	(0.261)	(0.287)	(0.287)	(0.261)
Common Colonizer	3.913***	3.699***	3.042***	2.887***	3.586***
	(0.127)	(0.135)	(0.147)	(0.147)	(0.135)
RTA	4.234***	3.588***	3.548***	3.228***	3.202***
	(0.171)	(0.184)	(0.202)	(0.200)	(0.186)
Shared Currency	-1.608***	-1.425***	-0.445	-0.188	-1.001***
	(0.228)	(0.247)	(0.289)	(0.286)	(0.247)
Agri_va, exporter	-0.273***				
	(0.0578)				
Agri_va_importer	-0.426***				
	(0.0591)				
Manuf_va, exporter		-3.910***			
		(0.586)			
Manuf_va, importer		-1.372**			
		(0.586)			
Other_ind_va, exporter			14.91***		
			(1.003)		
Other_ind_va, importer			-0.945		
			(1.022)		
Services_va, exporter				-11.45***	
				(0.519)	
Services_va, importer				-7.913***	
				(0.522)	
HHI, exporter					7.650***
					(0.493)
HHI, importer					5.257***
					(0.495)
Constant	16.47***	12.89***	8.407***	8.114***	7.346***
	(1.138)	(1.383)	(1.190)	(1.180)	(1.085)
Observations	32,672	25,380	20,434	20,146	25,070
R-squared	0.274	0.322	0.332	0.400	0.407

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
LnTrade: logarithm of trade between country pairs
Ln GDP / Pop_o: logarithm of the per capita GDP of the exporter (origin)
Ln GDP / Pop_d: logarithm of the per capita GDP of the importer (destination)
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise
Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
agri_va_o: Agriculture value added as a percentage of GDP of the exporter (origin)
agri_va_d: Agriculture value added as a percentage of GDP of the importer (destination)
manuf_va_o: Manufacture value added as a percentage of GDP of the exporter (origin)
manuf_va_d: Manufacture value added as a percentage of GDP of the importer (destination)
nonmanuf_va_o: Industrial but non-manufacture value added as a percentage of GDP of the exporter (origin)
nonmanuf_va_d: Industrial but non-manufacture value added as a percentage of GDP of the importer (destination)
services_va_o: Services value added as a percentage of GDP of the exporter (origin)
services_va_d: Services value added as a percentage of GDP of the importer (destination)
HHI_o: Herfindahl-Hirschman Index of the exporter (origin)
HHI_d: Herfindahl-Hirschman Index of the importer (destination)

Similarities of industrial structures and trade

To investigate the impact of similarities in production or industrial structures on intra-African trade, we also estimated the basic equation using an index of industrial similarities. Table 13 presents the results of these estimations across different estimation techniques: POLS FE, PPML, and Tobit. Before discussing the impact of the Industrial Similarity Index (*ISI*) variable, capturing the role of similarities in production or industrial structure, let us look at the behaviour of the standard gravity variables. The variables capturing income per capita, geographical distance, contiguity and trade agreements behave as expected throughout all estimations (and they are significant at one percent level). The variable *Common Colonizer* is significant and of the expected sign in four of the five specifications. Regarding the variable *Shared Currency,* it has the expected sign but is significant in only two of the five specifications.

The estimation results suggest that our main variable of interest, *ISI*, has a positive and strong statistically significant effect on intra-African trade. An increase in similarities of production or industrial structure between two pairs of countries increases intra-African trade and the results are robust across all estimation techniques used in the analyses. The result is interesting because it goes against the predictions of traditional trade theories and provides support for the "new trade theories" emphasizing the pivotal role of consumers "love for varieties" or "differentiated products" as a basis for trade (Helpman and Krugman, 1989). The results also provide evidence against widely held beliefs that the reason for Africa's weak regional trade performance is because of the similarities in production or industrial structures across African countries (World Bank, 1991). Trade, particularly in similar products, can take place between countries at low levels of development and with similar production structures if consumers have a "love for varieties" or "differentiated products."

5. Conclusion

Regional integration has been an important component of the economic development strategies of African countries since the 1960s. Given the small size of their domestic economies and low levels of income, regional cooperation is seen as an important mechanism to access export markets and exploit economies of scale in production. It is also expected to enhance the continent's integration into the global economy. The Lagos Plan of Action, the Abuja Treaty, the African Union's Agenda 2063 and the African Continental Free Trade Area Agreement launched in Kigali in March 2018 are some of the key initiatives adopted by African governments to promote economic development through regional integration.

Boosting intra-African trade has been the focus of Africa's integration agenda. However, there has been very limited progress made on this aspect of integration as evidenced by the very low shares of regional trade in Africa's global trade. This paper examined the factors responsible for the continent's weak regional trade performance with a focus on the roles of product concentration and similarities in the production or industrial structures of African economies. Using a gravity model and a variety of estimation techniques, we find that income per capita, regional trade agreements, and a shared border have a positive impact on intra-African trade while a higher distance between countries impedes intra-African trade. We also find some evidence that product concentration has a negative effect on intra-African trade. Furthermore, our results indicate that similarities in the production structures of African economies foster rather than impede intra-African trade. These findings lend support to the "new theories" of international trade and indicate that trade can still take place between countries at low levels of development and with similar production structures if consumers have a love for varieties or "differentiated products." The key implication of these findings is that Africa's weak regional trade performance is not so much a result of the similarities of production or industrial structures but has more to do with the low level of diversification of African economies. In this regard, there is the need for African governments to strengthen efforts to transform the production and export structures of their economies towards manufactured goods and modern services.

Table 13. Estimation using the indices of industrial similarity, 2000-2015

Dependent variable	1+ln Trade	Trade	Trade	1+ln Trade	1+ln Trade
VARIABLES	(1) POLS	(2) PPML	(3) Tobit	(4) POLS	(5) POLS
ln GDP/Pop, exporter	1.039***	0.752***	1.583***	1.070***	1.708***
	(0.0371)	(0.0324)	(0.0547)	(0.0344)	(0.0992)
ln GDP/Pop, importer	0.568***	0.196***	0.986***	1.291***	0.619***
	(0.0371)	(0.0388)	(0.0547)	(0.104)	(0.0329)
ln Dist (avg)	-1.737***	-0.181**	-2.622***	-2.035***	-2.454***
	(0.0926)	(0.0857)	(0.141)	(0.0927)	(0.0890)
Shared Border	2.228***	1.484***	2.122***	1.942***	1.750***
	(0.193)	(0.138)	(0.290)	(0.182)	(0.175)
Common Colonizer	1.968***	-0.991***	2.828***	2.083***	2.259***
	(0.0967)	(0.0776)	(0.148)	(0.0961)	(0.0923)
RTA	2.830***	1.783***	3.367***	2.258***	1.621***
	(0.134)	(0.121)	(0.201)	(0.135)	(0.130)
Shared Currency	0.231	0.0356	0.414	0.564***	0.417**
	(0.193)	(0.133)	(0.289)	(0.193)	(0.185)
ISI	9.285***	3.901***	15.78***	6.124***	5.354***
	(0.442)	(0.391)	(0.693)	(0.466)	(0.448)
Constant		8.248***	-0.549		
		(0.679)	(1.231)		
Fixed effects	Yes (Time)	No	No	Yes (Exporter)	Yes (Importer)
Observations	20,146	20,146	20,146	19,736	19,736
R-squared	0.244	0.362		0.350	0.401

Notes: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

LnTrade: logarithm of trade between country pairs
Ln GDP / Pop_o: logarithm of the per capita GDP of the exporter (origin)
Ln GDP / Pop_d: logarithm of the per capita GDP of the importer (destination)
ln Dist (avg): logarithm of the geographical distance between country pairs
Shared Border: dummy variable taking value 1 if a country pair shares a border, and 0 otherwise
Common Colonizer: dummy variable taking value 1 if a country pair was colonized by a same colonizer, and 0 otherwise
RTA: dummy variable taking value 1 if a country pair is part of a free trade area, and 0 otherwise
Shared Currency: dummy variable taking value 1 if a country pair uses a same currency, and 0 otherwise
ISI: Industrial Similarity Index for country pairs

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