Influencing Factors of China-Africa Intra-Industry Trade

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Abstract:

Intra-industry trade (IIT) is prominent to have potential benefits to improve the economic prospects of countries and has gradually been pivotal in understanding developing countries' trade, including those in Africa.

This study evaluates the extent of IIT between China and 18 major African trading partners across 10 Standard International Trade Classification (SITC) industries, and examine the influencing factors of China-Africa IIT between the periods 2007 – 2018. Using a non-weighted Grubel–Lloyd index, the overall level of China-Africa IIT remains low but has certain level of potential between some partners. Among the 10 SITC classified industries, SITC 0 (Food and live animals), SITC 2 (Crude materials, inedible, except fuels), SITC 5 (Chemicals and related products, *n.e.s.*) and SITC 6 (Manufactured goods classified chiefly by material) had potential for IIT. In addition, the influencing factors of China-Africa IIT were examined using an improved gravity model estimated by Feasible Generalised Least Squares (FGLS) in a panel data framework. The main empirical regression model results reveals that, China's IIT with major African trading partners are significantly influenced by gross domestic product (GDP), foreign direct investment (FDI), real exchange rate, trade intensity, distance, and landlocked countries.

The study further reveals that, GDP and FDI boost China-Africa IIT whereas real exchange rate, trade intensity, distance, and landlocked depress IIT.

Keywords: intra-industry trade; gravity model; China; Africa.

JEL Classification: F10; F13; F14.

Introduction

In this 21st century, international trade has seen a great deal of technological advancement, dynamic consumer preferences and complex trade policies in developing, emerging and developed economies. Several theories, especially classical trade theories initially viewed international trade to consist of each country exporting the products best suited to its endowment, technology, and environmental condition while importing the goods least suited to its regional characteristics (Ruffin 1999). Modern international trade characteristics is becoming more multifaceted and goes beyond factors of relative costs of production or factor endowments that conventional theories of trade fail to explain (Nguyen *et al.* 2020).

The term intra-industry trade (IIT) has gained momentum in the modern trade spectrum and defined as the "simultaneous import and export of goods within one and the same industry in both trade partners" (Balassa 1966). It highlights economies of scale, product differentiation and uneven competition between and within industries and countries, that international trade takes place. IIT has developed into one of the significant macro-economic practices which are beneficial in terms of preserving macro-economic stability, fostering innovation and increasing the number of differentiated variants of the same type of products in trading partner countries markets (Dudovskiy 2012).

The high growth rate of China's economy has been attributed to its involvement in international trade. Although, China maintains some level of protectionist through a plethora of tariffs and nontariff steps, the high rate of liberalization has significantly elevated trade volumes and improve economic development (Zhang *et al.* 2005).

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With the ongoing US-China trade war and intensifying retaliatory tariffs, it is predicted that both countries' trade growth would sour (UNCTAD 2019). It is vital for China to focus more on other economies including countries in Africa to maintain economic dominance. Africa's many emerging economies present exciting prospects of changing demographics, rising income levels among all socioeconomic groups, increasing demand for goods and services, rising household consumption, and improving business environments (Signé 2018). The traditional view of Africa has been as a source of valuable natural resources, it is quietly but rapidly becoming a significant market for technology-based consumer products" (African Business Magazine 2012). Despite China's total trade with Africa increase significantly by the year, no study has focus on IIT between China and African countries. Hence, the present study analyzes the extent of IIT between China and 18 major African trading partners across 10 Standard International Trade Classification (SITC) category using a non-weighted Grubel Lloyd index, and to identify the influencing factors of IIT between China and these trading partners. To test for the influencing factors of China-Africa IIT, an improved gravity model of international trade was employed which includes country specific variable such as the adoption of innovative payment systems at harbors and effect of landlocked countries which have received no attention in IIT; both theoretical and empirical studies.

This study is necessary and expected to contribute to literature and existing empirical evidence on developing country IIT. This further fills the research gap of IIT patterns between China and African countries and improves the augmented traditional gravity model. The organization of this study is as follows: The next section presents the trends in China trade with Africa. Section 2 reviews pervious literature and theoretical background. Section 3 discusses methodology, measurement of IIT, the estimated IIT indices, model specification and the hypotheses to be tested. Section 4 discusses the estimated results from the specified model used for this study. Finally, the main findings are summarized and concluded.

1. Literature Review

IIT plays crucial role in industrial, trade and growth, and has been widely discussed among developed countries. Developing countries including many African countries have made many efforts to ignite and exploit their trade potential for growth and development. Yet, trading among themselves and developed economies in the world has not yielded the expected impact. Over reliance in exportation of primary goods and natural resources partly contribute to the problem (Ofa *et al.* 2012). Therefore, strategic collaboration with China must diversify Africa's supply base into high-value added production to maintain economic growth. Economies in Africa serving has an alternative markets for Chinese goods is crucial for China's economic dominance as US trade war blurs the future. No study on IIT has been done between China and African countries, since trade flows related to North- South and South – South are dominantly recognized as inter-industry trade and can be explained by classical trade theories.

A vast literature attempted to explain the phenomenon of IIT mainly focus on: 1) the measurement of IIT (Grubel and Lloyd 1975, Brülhart 1994), 2) theoretical framework (Linder 1961, Helpman and Krugman 1985), 3) determinants of IIT for country-specific (Greenaway *et al.* 1994, Zhang and Li 2006), industry-specific (Greenaway *et al.* 1995, Fontagné *et al.* 1998), and 4) the combination of both (Balassa and Bauwens 1987). Many previous studies empirically examine the determinants of IIT among advanced countries (*i.e*. North-North) (Zhang and Clark 2009, Fontagné and Freudenberg 2002) and between advanced countries and developing countries (Clark and Stanley 1999). Studies related to China bilateral IIT have focused mainly on the United State (Shen and Gu 2007), United Kingdom (Hu and Ma 1999), Japan (Xing 2007), Korea (Lee and Han 2008) and Organisation for Economic Co-operation and Development (OECD) (Hellvin 1996). Studies on IIT predicts inter-industry trade or low IIT between developed and developing countries (*i.e.* North-South Trade) due to different levels of per capita incomes, market size and technology advancement (Clark and Stanley 1999). But increasingly affluent consumers in the urban-developing areas express preferences for product variety similar to their counterparts in high-income countries which promotes IIT in horizontally differentiated products (Sawyer *et al.* 2010). IIT has gradually been pivotal in understanding developing country trade (Ofa *et al.* 2012) however studies on the determinants of IIT in developing African countries remain low (Abebe 2019, Mulenga 2012).

1.1. Theoretical Review

Many classical trade theories and models have attempted to explain IIT. Even though, IIT is characterized by some classical theories such as Adam Smith's absolute advantage theory (1774), David Ricardo's Comparative Advantage (1817) and Hecksher-Ohlin theory (1933), they fail to completely explain it. New trade theories were developing to explain the new phenomenon of IIT, which consider monopolistic competition with increasing returns to scale, as compared to the perfect competition and constant returns to scale. For instance, Linder (1961)hypothesized that pattern of demand is determined by level of income. Since income distribution is unequal,

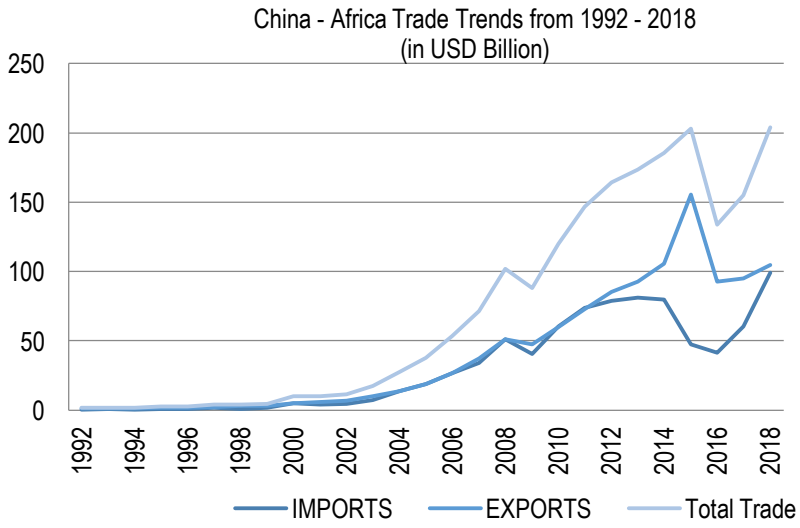
low-income earners in the North demand lower quality varieties produced in the South, while high-income earners in the South demand higher quality varieties produced in the North.

Other new trade theories argue that trade is driven by economies of scale, which are internal to firms. Because of the scale economies, markets are imperfectly competitive. However, one can show that trade, and gains from trade, will occur, even between countries with identical tastes, technology, and factor endowments. Two key assumptions are presented: Under the assumption of increasing returns to scale, large firms have a cost advantage over smaller firms and monopolistic competition ensue. Increased competition can also push down prices, and thus drive smaller firms of the market. For consumers love for variety, opening up to trade means firms can serve a larger market and hence reduce costs and consumers can benefit from an increased range of varieties (Helpman and Krugman 1985). Hu and Ma (1999) reveal that the research and development ratio (as a proxy for product differentiation) and the minimum efficient scale (as a proxy for economies of scale) have shown significance as factors explaining IIT. Zhang *et al*. (2005) report that opening up markets, economic size and trade composition increase the likelihood of IIT between countries. Research on IIT has evolved to include FDI (Xing 2007), increasing economies of scale (Clark 2010), income distribution and per capita income as demand-side determinant (Gullstrand 2002) and technological advancement (Nguyen *et al.* 2020).

2. Trends in China Trade with Africa

Africa now is the fourth export destination of China in terms of value with 4.21% of China's total exported goods; behind Asia (47.8%), North America (22.4%) and Europe (19.1%). China's total trade with African countries have increased substantially during the period of 1992 to 2018 (see Figure 1). It is observed that both China's exports and imports to and fro Africa showed only a minor difference from 1992 until 2012 where China's exports increased significantly as compared to imports. Total trade volume increased from USD 1.75 billion in 1992 to USD 204.03 billion in 2018, a 98.3% increase during the period. China's trade surplus dropped from USD 108.17 billion in 2015 to USD 5.47 billion in 2018, and this was from the backdrop that African demands of Chinese goods reduced due to weak commodity prices since 2014, which greatly impacted the African economies.

Figure 1. China – Africa trade trends from 1992 – 2018 (in USD billion)



Source: UN Comtrade, 1992-2017, Chinese Custom, 2018

Table 1 shows China's top imports and exports to African countries during the period 2000 to 2018. The total export surpasses total import, making China a net exporter to Africa. China's imports from Africa increased from US$53,679 million during 2000 – 2005 to US$285,954 million during 2006 – 2011 and further increased to US$509,788 million during 2012 – 2018. Angola and South Africa were China's largest trade partner on the continent in terms of imports during the period, making up 40% of total imports. The share of China's imports from Africa to total imports from the rest of the world (ROW) double up and constant from 2% during 2000-2005 to 4% during 2006-2011 and 2012-2018.

On the side of China's export, the total value of exports to Africa substantially increased from US$60,342.91 million during 2000-2005 to US$295,408.22 million and then increased further to US$731,571.08 million during 2012-2018. Most of the Chinese goods are exported to South Africa, Egypt and Nigeria making up to about 40% of

total exports during the 2000-2018. The share of China's export to Africa as a proportion to total export to ROW double up from 2% during 2000-2005 to 4% during 2006-2011 and increased to 5% during 2012-2018.

Table 1. China's top 10 import and export destinations in Africa 2000 - 2018

China's Imports	2000-2005	2006-2011	2012-2018	China's Export	2000 - 2005	2006 - 2011	2012 - 2018
Angola	31.96	37.98	33.96	South Africa	20.18	18.06	14.86
South Africa	8.50	12.89	15.95	Egypt	11.25	10.75	14.60
Sudan*	16.00	11.66	4.24	Nigeria	13.79	11.78	11.72
Congo	10.09	6.61	6.17	Algeria	6.26	7.14	6.67
Libya	2.76	5.45	3.25	Ghana	3.21	3.51	4.44
Rep. Dem. of Congo	0.60	3.22	4.46	Kenya	2.49	2.79	4.47
Zambia	1.16	2.73	3.92	Morocco	6.42	4.66	3.03
Equatorial Guinea	7.56	3.44	2.54	Angola	1.41	4.15	3.27
Gabon	3.50	2.09	2.15	Ethiopia	1.43	1.96	3.90
Nigeria	3.20	1.70	2.18	Benin	5.49	4.35	2.46
Total Trade Africa (US$ million)	53,679	285,954	509,788	Total Trade in Africa (US$ million)	60,342.91	295,408.22	731,571.08
ROW (US$ million)	2,397,758.02	6,739,136.03	12,463,898.88	ROW (US$ million)	2,574,060.58	8,002,079.06	14,997,217.22
TT: ROW(%)	2%	4%	4%	TT: ROW (%)	2%	4%	5%

Source: UN Comtrade and own computation

3. Methodology

3.1. Data

The study uses secondary data from 2007 to 2018 and covers all 10 SITC category (see Table 2). The data consists of bilateral import and export trade transaction of China and 18 major trading partners in Africa using SITC Revision 4 obtained from UN's Comtrade Database. The 18 African countries consist of 14 countries with seaports; Angola, South Africa, Egypt, Nigeria, Algeria, Republic of Congo, Ghana, Libya, Morocco, Dem. Rep. of Congo, Cameroon, Mauritania, Mozambique, United Rep. of Tanzania, and 4 landlocked countries; Ethiopia, Sudan*, Zimbabwe and Zambia. Other additional data on GDP, GDP per capita, nominal exchange rate, and GDP deflator were extracted from World Development Indicators of World Bank (http://databank.worldbank.org). FDI was extracted from the Johns Hopkins University SAIS China-Africa Research Initiative (Johns Hopkins University SAIS China-Africa Research Initiative, 2020). The data for distance were obtained from sea-distance.org. Its measurement uses sea distance between two ports, and calculates the direct distance with vessel speed of 10 knots. For the purpose of this study, Guangzhou port represented port of departure for China.

The study estimate China's IIT index with 18 major African trading partners of all 10 SITC commodities (Table 2) during the period 2007 – 2018. To reduce the bias from inflated estimates of IIT calculations done at higher levels of aggregation yield (Gullstrand 2002), this study performed calculation at the 3-digit SITC level of disaggregation and then averaged up to the 1-digit level for reporting purposes. The overall IIT index is the simple non-weighted average of the IIT indices across the ten SITC categories for both country-specific and industry-specific.

Table 2. Standard international trade classification system revision 4

SITC code	Product description
0	Food and live animals
1	Beverages and tobacco
2	Crude materials, inedible, except fuels
3	Mineral fuels, lubricants and related materials
4	Animal and vegetable oils, fats and waxes
5	Chemicals and related products, n.e.s.
6	Manufactured goods classified chiefly by material
7	Machinery and transport equipment
8	Miscellaneous manufactured articles
9	Commodities and transactions not classified elsewhere in the SITC

3.2. Measurement of Intra-industry trade

In this study, the most commonly used standard Grubel-Lloyd index (Grubel and Lloyd 1975) was adopted to measure country-specific and industry-specific level of IIT in a non-weighted average form:

$$IIT_{kij}=1-\frac{|X_{kij}-M_{kij}|}{(X_{kij}+M_{kij})} \quad (1)$$

where: X_{kij} and M_{kij} stand for exports and imports in industry k of country i trade with country j respectively. If a country simultaneously exports and imports similar types of goods and services in industry k, then X= M, and GL index equals 1 (pure intra-industry trade). If a country only exports or imports goods and services in industry k, the GL index equals 0 (pure inter-industry trade). Higher index values are associated with greater IIT as a proportion of total trade. IIT can be classified as follow: Class 1: GL > 0.33 Intra-industry trade; Class 2: 0.10 ≤ GL ≤ 0.33 Potential for intra-industry trade and Class 3: GL < 0.10 Inter-industry trade (Durán Lima and Alvarez 2020).

3.3. Model Specification

To examine the factors that influence IIT between China and its 18 key trading countries in African, the augmented gravity model by Nguyen et al. (2020) was improved to include landlocked countries and innovative payment systems in IIT transactions by some China's key trading African countries. Several studies have used augmented traditional gravity models to identify country-level determinants of IIT in bilateral trade between countries and regions (Mulenga 2012, Abebe 2019). The model takes a log-linear function to allow interpretation of the coefficient variables as elasticity and make the estimates less sensitive to outliers. To examine the possible influencing factors of China-Africa IIT, we employed the following estimate model:

$$IIT_{kxyt} = \beta_0 + \beta_1 lnGDP_y + \beta_2 lnDGDPpc_{xy} + \beta_4 lnDIS_{xy} + \beta_3 lnFDI_{xy} + \beta_4 lnRER_{xy} + \beta_5 lnTO_{xy} + \beta_6 lnnoPS_y + \beta_7 Landlocked_y + \epsilon_{xy} \quad (2)$$

where: x= China y= major African trading partners k= industry and t= 2007 to 2018; $\beta_1 \ldots \beta_7$ = coefficients to be estimated; IIT_{kxyt} = intra industry trade between China and African trading partners, and the dependent variable in this study; $lnGDP_y$= the gross domestic product of major African trading partner; $lnDGDPpc_{xy}$= difference in GDP per capita between China and its trading partner; $lnDis_{xy}$ = distance between ports of China and the capital city of the trading partners; $lnFDI_{xy}$ = outflows of FDI from china to trade partners in Africa; $lnRER_{xy}$ = the real exchange rate between China and major African trading partners; $lnTO_{xy}$= Trade openness is the degree of trade between China and major African trading partners; $InnoPS_y$ is a dummy variable that indicate the adaption of innovative payment system by a major African trading partner; 1 if country have adapted innovative payment system and 0, otherwise; $Landlocked_y$ is a dummy variable that indicate whether an African trading partner is landlocked. 1 if country is landlocked and 0, otherwise; ϵ_{xy} *is the error term*

3.4. Hypotheses

The hypotheses regarding country characteristics are based both on theoretical models of IIT and on previous empirical studies.

Gdp_Y is gross domestic product of China's key African trading partner Y. It is a proxy for market size. Large economies tend to have the potential to produce diversified products due to the economies of scale and higher demand of diversified foreign goods (Ekanayake 2001). In the empirical analysis, evidence finds GDP to be statistically positive to IIT (Filippini and Molini 2003, Mulenga 2012, Nguyen *et al.* 2019).

Hypothesis 1: GDP of China's key African trading partners has a positive relationship with IIT

$DGDPpc_{xy}$ represents the dissimilarity in GDP per capita income between China and each major African partner countries. Vidya and Prabheesh (2019) indicated that dissimilar demand structures between countries can create barriers to extensively exchanging goods in the same categories and vice versa. Empirical studies confirm a negative relationship between dissimilarity between per capita income IIT in both Mexico and Vietnam (Ekanayake 2001, Nguyen *et al.* 2020). However, per capita income is sometimes used as an indicator of relative factor

endowments. This study measured difference in GDP per capita income between China and its African trading country as:

$$DGDPpc_{xy} = |GDPpc_X - GDPpc_Y| \quad (3)$$

where: $DGDPpc_{XY}$ is dissimilarity in per capita income between China and its African partner country. $GDPpc_X$ and$GDPpc_Y$ is the Gross Domestic Product Per capita (DGDPC) for China and its African partner country respectively.

Hypothesis 2: The higher the dissimilarity in per capita income, the lower the IIT.

Foreign Direct Investment (FDI) encourages IIT, especially if foreign affiliates are set up to take advantage of the factor endowments of the host country and their production is subsequently exported back to the home country. Since most countries in Africa are endowed with natural resources and labor force, it is expected to have net inflow of FDI. We measure the variable FDI as outflows of FDI from China to trade partners in Africa.

Hypothesis 3: There is a positive correlation between FDI and IIT

RER_{XY} represents the real exchange rate between China and major African trading partners. Studies by Simwaka (2006) and Sunde *et al.* (2009) on developing countries found real exchange rate to be a significant determinate of IIT. An appreciation of Chinese Yuan would make export goods more expensive and import goods cheaper for domestic citizens. The study formulates real exchange rate between trading partners as follow:

$$RER_{XY} = NR_{XY} * \frac{D_Y}{D_X} \quad (4)$$

RER_{XY}, the real exchange rate between China and major African trading partners. NR_{XY}, the nominal exchange rate between China and major African trading partners.D_Y GDP deflator of major African trading partners and D_X GDP deflator of China.

Hypothesis 4: The real exchange rate has a negative relationship with IIT.

DIS_{XY} represents the geographical distance between China and the capital city of each African trading partners. IIT is generally regarded as being positively influenced by market proximity. Kandogan (2003) shows that distance is a more important trade-dampening factor for IIT, especially for vertical IIT of which is mostly associated with developing countries. Distance is a proxy to transportation cost and is measured in nautical miles.

Hypothesis 5: The distance between China and trading partners in Africa has a negative relationship with IIT.

TO_{xy} is trade openness which measures the degree of trade between China and major African trading partners. Krugman (1991) assumes that the higher trade volume, the higher the level opportunities for product differentiation. In other words, trade liberalization between two countries promotes IIT levels. The degree of trade between China and major African trading partners is measured as:

$$TO_{xy} = \frac{Export_{xy} + Import_{xy}}{GDP_{xy}} \quad (5)$$

Hypothesis 6: The higher the trade openness between China and major African trading partners, the greater the IIT.

$InnoPS_y$ is a dummy variable which indicate the adaption of innovative payment system such as cashless payment at the harbor by an African country? The existence of innovative payment system decreases transaction costs, long waiting times, dead time and increase purchasing power parity and harbor efficiency. Henceforward, countries who have adapted innovative payment system is likely to have higher IIT than countries who have not.

$$InnoPS_Y = \begin{cases} 1, & \text{if country have adapted innovative payment system} \\ 0, & \text{\& otherwise} \end{cases} \quad (6)$$

Hypothesis 7: The adaption of innovative payment system has a positive relationship with IIT

$Landlocked_y$ is a dummy variable which indicate whether or not an African trading partner is landlocked? Since most LLCs depends on their transit neighbors' markets, infrastructure and institutions due to their geographical constrains. Extra cost incursion and issue of purchasing power parity may arise due to fluctuation in exchange rate. The role of landlocked is expected to impede IIT.

$$Landlocked_y = \begin{cases} 1, & \text{if country is landlocked} \\ 0, & \text{\& otherwise} \end{cases} \quad (7)$$

Hypothesis 8: Landlocked has a negative relationship with IIT

3.5. Method of Estimation

The model is estimated using a panel data from 2007 to 2018 in STATA. Hausman test is perform to select the appropriate model between fixed effect and random effect model. A review of the data obtained from the sources listed were estimated using the analytical technique, Feasible Generalized Least Squares (FGLS).

4. Empirical Results

4.1. Estimation of China-Africa Intra-Industry Trade Indices

Table 3 shows the overall estimated IIT index between China and 18 major African trading partners along with total trade across ten SITC categories from 2007 to 2018 (for details refer Appendix A). The overall extent of China-Africa IIT exhibit a potential for intra-industry trade with non-weighted average indices of 0.11 or 11% and a total trade volume of $1.57 trillion USD. The average indices between China and major African trading partners over the period ranges from as low as 0.03 (Zambia) to as high as 0.36 (South Africa). Although the overall China-African IIT have increased over time, it still remains low as compared China's trade partners in OCED, ASEAN and North America, but shows some potentials IIT.

Table 3. Overall China-Africa intra-industry trade index by country, 2007 – 2018

ID	China trading partners in Africa	Non-weighted average	Total Trade (USD, $)	Trade balance
1	Algeria	0.08*	$82,533,569,842.00	
2	Angola	0.11**	$305,862,411,701.00	
3	Cameroon	0.06*	$20,345,391,293.00	
4	Congo, Rep.	0.06*	$54,733,459,805.00	
5	Congo, Dem. Rep.	0.05*	$41,859,921,932.00	
6	Egypt	0.15**	$112,559,268,002.00	
7	Ethiopia	0.13**	$27,101,986,487.00	
8	Ghana	0.10**	$52,943,723,031.00	
9	Libya	0.07*	$50,643,133,885.00	
10	Mauritania	0.06*	$19,048,913,510.00	
11	Morocco	0.19**	$40,629,051,145.00	
12	Mozambique	0.10**	$18,032,985,049.00	
13	Nigeria	0.05*	$133,449,702,999.00	
14	South Africa	0.36***	$468,453,966,604.00	
15	Sudan	0.05*	$63,281,026,105.00	
16	Tanzania	0.11**	$33,222,438,459.00	
17	Zambia	0.03*	$33,971,683,834.00	
18	Zimbabwe	0.16**	$10,788,249,645.00	
China-Africa average IIT		0.11**	$1,569,460,883,328.00	M

Note: ***Class 1: GL > 0.33 Intra-industry trade **Class 2: 0.10 ≤ GL ≤ 0.33 Potential for intra-industry trade *Class 3: GL < 0.10 Inter-industry trade.

Source: Authors Computation using UN Comtrade data from 2007 – 2018

Developed economy blocs typically have higher levels of IIT than developing economy blocs due to many developed and industrialized countries within the bloc, higher levels of per capita income triggering the demand for greater product variety allowing consumers to purchase goods that more closely approximate their preferences (Sawyer *et al*. 2010). The results also highlight the imperfect reciprocity of trade with China, having a total trade deficit with the 18 major African trading partners. Half of the China's major African trading partners exhibit potential IIT; Angola (0.11), Egypt (0.15), Ethiopia (0.13), Ghana (0.10), Morocco (0.19), Mozambique (0.10), Tanzania (0.11) and Zimbabwe (0.16) during 2007 to 2018, except South Africa that exhibits IIT at GL > 0.33. South Africa is one of the developed and high-income countries in the world and this supports previous studies that high IIT prevail among developed countries. The growing number of affluent consumers in the developing countries express preference for product variety similar to their counterparts in high-income countries that promote IIT.

Unlike the above countries, the intensity of average IIT from 2007 to 2018 between China and Algeria, Cameroon, Republic of Congo, Libya, Mauritania Dem. Rep. of Congo, Nigeria, Sudan and Zambia is weak and classified as inter-industry trade (thus, GL < 0.10). Interestingly, Nigeria, being the third biggest partner of China has low IIT, opposing Balassa and Bauwens (1987) and Helpman (1981) economies of scale and demand for differentiated goods respectively. The low levels of intra-industry between China and African countries explains the over reliance on exportation of primary goods and natural resources by African oil economies such as Republic of Congo, Libya, Dem. Rep. of Congo, Nigeria and Sudan, lacking advanced technology to engage in high-value added production. Low IIT levels also indicates that there is lack of deeper integration between China and major African trading partners such as Mauritania and Cameroon. A study by Kien and Thao (2016) argues that, economic integration has a positive impact on enhancing IIT among countries.

4.2. Estimation of China-Africa Intra-Industry Trade Indices by Industries

Table 4 further examines the overall average of China-Africa IIT indices for each of the ten SITC category along with the shares of each category in total trade during the period 2007 to 2018. On the average, SITC 3, 6 and 7 made up more than half (67%) of total trade. None of the categories exhibited IIT. SITC 0, 2, 5 and 6 exhibited potentials for IIT surpassing the overall China-Africa average IIT of 0.11 except SITC 5 (0.10). The remaining six categories recorded low levels of IIT and classified as inter-industry trade. SITC 0 recorded the highest average IIT level of 0.25, this is not surprising since Food and live animals are classified as primary product industry and both China and African countries are endowed, but it had little share of total trade. SITC 2 recorded average IIT level of 0.18, which is also a resource intensive product industry. SITC 5 and 6 recorded average IIT level of 0.10 and 0.16 respectively, both Chemical and related products and manufactured goods classified chiefly by material are classified as manufactured product industry. China-South Africa showed consistent high levels of IIT across all four categories with exception of SITC 2 as compared to the other major trading partners.

In SITC 0, high levels of IIT above 0.5 existed between China and Ethiopia, South Africa and Zimbabwe while countries like Algeria, Republic of Congo and Dem. Rep. of Congo recorded pure inter-industry trade (0.00) with China. Only China-Angola and China-Egypt recorded high level of IIT above 0.5 in SITC 2. SITC 5 showed only China-Morocco IIT level above 0.5. In addition, SITC 6 showed that China-South Africa and China-Zimbabwe recorded IIT levels of 0.67 and 0.78 respectively, followed by China-Rep. of Congo with 0.45. This is expected with SITC 5 and 6 (Chemical and related products and manufactured goods classified chiefly by material are classified as manufactured product industry) since these countries are developing and have no well-established industrial sectors, and lacking technological advancement to dominate the manufactured product industries.

Table 4 also reveals that the individual average IIT index for each of the remaining six categories; SITC 1, 3, 4, 7 8 and 9 were all below the overall China-African average IIT, and classified as inter-industry trade. SITC 9 which covers commodities and transactions not classified elsewhere in the SITC showed relatively high IIT level of 0.09 as compared to the others. China-Cameroon recorded the highest level of IIT with 0.21 in this industry; China-South Africa, second largest (31.41%) share of total trade fell within this industry but recorded 0.00, which is pure inter-industry trade. This could result from the difficulty in classifying and interpreting products. SITC 1 and 4 both recorded average IIT of 0.08 with China-South Africa recording the highest level of IIT 0.67 and 0.49 respectively. All other major African trading partner of China showed average IIT levels less than 0.5. SITC 3 recorded average IIT of 0.05; mineral fuels, lubricants and related materials are natural-resource intensive products of which China is expected to have a lot of pure inter-industry trade and mostly net importers with major partners in Africa.

Table 4. Overall China-Africa intra-industry trade indices across industries, 2007 –2018

China trading partners in Africa	SITC 0	% of TT	SITC 1	% of TT	SITC 2	% of TT	SITC 3	% of TT	SITC 4	% of TT	SITC 5	% of TT	SITC 6	% of TT	SITC 7	% of TT	SITC 8	% of TT	SITC 9	% of TT
Algeria	0.00	2.09	0.20	0.02	0.38	0.19	0.04	17.79	0.00	0.02	0.02	2.94	0.00	25.01	0.00	36.42	0.00	15.48	0.13	0.02
Angola	0.03	0.19	0.20	0.00	0.67	0.15	0.00	88.28	0.00	0.00	0.00	0.54	0.08	3.89	0.00	4.40	0.00	2.54	0.05	0.00
Cameroon	0.09	2.92	0.00	0.00	0.12	16.24	0.11	17.74	0.06	0.00	0.06	5.18	0.02	21.80	0.00	21.15	0.00	14.97	0.21	0.00
Congo, Rep.	0.00	0.37	0.00	0.00	0.01	5.70	0.00	79.25	0.00	0.00	0.02	0.59	0.45	6.83	0.00	4.93	0.00	2.31	0.07	0.02
Congo, Dem. Rep.	0.00	1.12	0.00	0.00	0.01	17.40	0.00	7.94	0.13	0.00	0.08	2.14	0.24	56.42	0.00	9.88	0.00	4.88	0.00	0.22
Egypt	0.25	1.32	0.02	0.31	0.63	3.36	0.07	7.72	0.26	0.01	0.17	8.28	0.03	28.32	0.00	30.21	0.02	20.38	0.06	0.08
Ethiopia	0.72	0.70	0.23	0.01	0.02	11.07	0.00	1.41	0.03	0.00	0.01	4.35	0.14	23.36	0.00	44.93	0.02	13.96	0.15	0.21
Ghana	0.46	5.25	0.00	0.03	0.11	5.53	0.06	12.71	0.16	0.00	0.00	6.80	0.01	26.32	0.00	21.52	0.00	20.26	0.12	1.57
Libya	0.01	0.60	0.00	0.01	0.38	0.28	0.00	59.77	0.00	0.00	0.15	1.08	0.01	11.32	0.00	13.50	0.00	13.44	0.11	0.01
Mauritania	0.39	5.05	0.00	0.00	0.00	56.02	0.00	7.67	0.01	0.01	0.01	1.02	0.00	14.13	0.00	6.83	0.00	9.28	0.13	0.00
Morocco	0.14	7.23	0.10	0.05	0.27	4.75	0.00	0.05	0.11	0.13	0.52	4.51	0.02	24.65	0.40	34.76	0.19	23.86	0.16	0.03
Mozambique	0.45	1.35	0.00	0.05	0.03	23.03	0.12	2.96	0.00	0.00	0.01	6.92	0.16	26.66	0.00	22.94	0.00	16.07	0.06	0.03
Nigeria	0.06	2.22	0.00	0.02	0.34	2.33	0.01	9.34	0.00	0.01	0.04	6.97	0.02	28.37	0.00	32.58	0.00	18.03	0.04	0.12
South Africa	0.66	1.00	0.67	0.09	0.03	17.63	0.49	1.89	0.49	0.01	0.47	3.27	0.67	21.76	0.05	12.57	0.02	10.38	0.00	31.41
Sudan	0.28	0.77	0.00	0.03	0.07	2.56	0.00	58.86	0.00	0.11	0.05	2.43	0.01	12.58	0.00	13.07	0.00	9.50	0.10	0.09
Tanzania	0.37	0.76	0.07	0.16	0.09	10.18	0.00	0.25	0.25	0.01	0.08	6.65	0.14	31.36	0.00	29.97	0.00	20.64	0.05	0.02
Zambia	0.02	0.59	0.01	1.99	0.01	4.74	0.01	0.01	0.00	0.00	0.02	0.73	0.14	78.37	0.00	11.69	0.00	1.88	0.05	0.01
Zimbabwe	0.53	0.82	0.00	40.83	0.04	11.15	0.02	0.07	0.00	0.00	0.01	3.72	0.78	17.28	0.00	21.12	0.01	4.86	0.05	0.15
China-Africa average (industries)	0.25		0.08		0.18		0.05		0.08		0.10		0.16		0.03		0.01		0.09	

Source: Authors Computations using UN Comtrade data from 2007 – 2018

Natural resource endowed countries like Angola, Rep. of Congo, Libya and Sudan are expected to have majority share of total trade fall under this industry category with low IIT levels. China-South Africa recorded the highest average IIT level of 0.49, and this could be the results of China importing raw crude such as petroleum oils and oils obtained from bituminous minerals from South Africa, and refining them for re-export. Unlike SITC 3, China is a net exporter under SITC 7, major trading partners in Africa depended on China for Machinery, and transport equipment since the industry is human-capital intensive and technology intensive. SITC 7 recorded average IIT level of 0.03 with majority of trade pure inter-industry trade. China-Morocco recorded the highest average level of IIT with 0.40. SITC 8, which encompasses miscellaneous manufactured articles such as apparel and clothing accessories, and footwear recorded the lowest average IIT levels of 0.01, since most products are unskilled labor intensive. China would like to exploit the vast unskilled labor within for such products, likewise some African countries. China-Morocco recorded the highest average IIT level within the industry with 0.19, the least high among all the ten SITC categories.

4.3. Regression Analysis

Prior to the analysis of the step-by-step regression model of the augmented gravity model to examine the influencing factors of China-Africa IIT, this study executed diagnostic test such as Multicollinarity Test, Hausman Test, and Heteroscedasticity Test, before the FGLS regression analysis was performed.

4.3.1 Descriptive statistics

In table 5, the descriptive statistics in logarithm form, reveal that the total observation of the study was 216. The independent variable RER had the highest level of variability with a standard deviation of 2.7, and the variable with the lowest variability was Distance, having a standard deviation of 0.191. The GDP mean of 24.618 was the highest, while the lowest mean was 0.222 for landlocked, implying fewer landlocked countries in the study.

Table 5. Descriptive statistics

Variable	Observation	Mean	Std.Dev.	Min	Max
lnIIT	216	-2.624	.933	-4.915	-.903
lnGDP	216	24.618	1.23	21.934	27.066
lnDGDPPC	216	8.129	.882	3.935	9.298
lnFDI	216	4.114	1.71	-2.124	8.478
lnDistance	216	8.932	.191	8.627	9.189
lnTI	216	-7.635	1.038	-9.751	-4.958
lnRER	216	3.225	2.721	-2.94	8.02
Landlocked	216	.222	.417	0	1
InnoPS	216	.278	.449	0	1

4.3.2. Diagnostic Test

4.3.2.1. Multicollinarity Test

Firstly, this test was meant to check if the independent variables such as GDP, DGDPPC, FDI, TI, RER, Distance, Landlocked and InnoPS are not correlated. This study performed VIF (Variable Inflation Factors) to check whether multicollinearity exists between the independent variables. Any variable with *vif* coefficients more than 5, implies that multicollinearity exist and might be a problem in the model. Accordingly, the result shown in Table 6 indicates that all the *vif* coefficients of the independent variables were less than 5 with mean *vif* of 1.948, which implies that the collinearity could not be a problem in the model. TI and GDP recorded the highest *vif* coefficients of 2.984 and 2.803 respectively.

Table 6. Variable inflation factors

Variables	VIF	1/VIF
lnTI	2.984	.335
lnGDP	2.803	.357
Landlocked	1.979	.505
InnoPS	1.711	.584
lnDistance	1.619	.618
lnFDI	1.605	.623
lnRER	1.514	.66
lnDGDPPC	1.371	.729
Mean VIF	1.948	.

Source: Author's computation

4.3.2.2. Hausman Test

After running both fixed effect model and random effect model, the Hausman test was carried out and results presented in Table 7, having a p-value of 0.111. This implies that the null hypothesis, which states that there is no systematic difference in the coefficients cannot be rejected, and thus the random effect model is preferred over fixed effect model. Using the fixed effect model in this study could be problematic since it does not take into account time invariant variables like distance, landlocked, innovative payment systems, and other dummy variables. This study, therefore, used the random effects model estimation method.

Table 7. Hausman (1978) specification test

Test summary	Coefficient			
Chi-square test value	8.948			
P-value	.111			
Variable	Fixed	Random	Difference	Prob.
lnGDP	.2325705	.44853	-.2159595	.1695846
lnDGPPC	-.0671502	-.0547294	-.0124208	.0193618
lnFDI	.0918902	.0889978	.0028924	.0041497
lnTI	-.4700782	-.5166588	.0465806	.0712395
lnRER	.2119655	.0484065	.163559	.0741001

Source: Author's computation

4.3.2.3. Heteroscedasticity Test

Panel Group Wise Heteroscedasticity test for the random effect model was performed to check whether there is a problem of heteroscedasticity in the model. The test results which account for Lagrange Multiplier LM test, Likelihood Ratio LR test, as well as Wald test all reported a 1% significance level with p-value of 0.000, t indicating a very high presence of heteroscedasticity across panels in Table 8. This study used a step-by-step FGLS in random effect to run the model to control for the heteroscedasticity problem.

Table 8. Panel group wise heteroscedasticity tests

Panel Groupwise Heteroscedasticity Tests	P-Value
Lagrange Multiplier LM Test	0.0000
Likelihood Ratio LR Test	0.0001
Wald Test	0.0000

Source: Author's computation

4.3.3. Regression Results

Table 9 reports the feasible GLS regression in random effect model results of the influencing factors of IIT between China and major African trading partners. A step-by-step regression analysis model was adopted to examine whether the introduction of the two new dummy variables (landlocked countries and innovative payment system) to the Gravity model has significant changes. First regression model in column (1) examined the effects on GDP, DGDPPC, FDI, TI, RER and distance with 19% of the variations in IIT, and explained by the independent variables. Subsequently, the introduction of InnoPS in column (2) increased the explanatory power to 20%, then the inclusion of variable landlocked to the model to regress the final and main model specification of the study in column (3) with explanatory power of 22%. The overall findings are supportive of the theoretical and empirical IIT hypotheses and levels of significance in this study.

The coefficient of GDP for China's major African trading partner has the expected positive relationship with IIT and significant at 1% levels, implying that GDP which measures economic performance and proxy to market size is the most importance influencing factor that triggers China-Africa IIT. The significance level and positive sign in all models (column 1 – 3), confirms the theoretical intuition of African countries with large market size can take advantage of economies of scale due to large domestic market. China can penetrate into these economies to offer goods due to higher demand for foreign goods, which improves IIT between China and major African trading partners. The results are consistent with empirical findings of Abebe (2019), Mulenga (2012), Nguyen *et al.* (2020), Zhang and Li (2006).

The coefficient of dissimilarity in GDP per capita income between China and major African trading partners' variable showed the expected negative relationship with IIT but not statistically significant in this study from column (1) – (3), therefore fails to verify the hypothesis. However, DGDPPC, which sometimes serves as proxy for demand pattern, is not an influencing factor that triggers China-Africa IIT in this study, some wealthy or middle-income

African countries like South Africa, Morocco and Egypt that have similar income to China exhibits higher IIT level as compared to the less developed ones. Therefore, countries with wider gap in natural factor endowments such as oil, gold and less overlap in demand patterns with China like Zambia, Dem. Rep. of Congo, and Sudan are likely to focus more on taking advantages of specialization, along comparative advantage lines reducing the levels of IIT. Exceptional countries like Ethiopia and Zimbabwe combined high-income disparity with high IIT levels, which is likely due to their concentrated trade in vertically differentiated products with China. The findings of this study is consistent with both theoretical, Linder (1961) and empirical studies, Clark and Stanley (1999), Kien and Thao (2016), Sawyer *et al*. (2010).

The outflow of China's Foreign Direct Investment (FDI) to African trade partners' variable showed the expected positive relationship with IIT, and statistically significant at 5%, verifying the hypothesis stated. As China and Chinese multinational companies invest in African partner countries to take advantage of factors of production like natural resources and labor force, the final products is subsequently exported back to China. Exploring new emerging markets, developing new products for domestic African markets, supplying parts, and upgrading business partners operations motivates China's increment of outflow FDI to Africa. Lemi (2018) found that, despite a substantial Chinese aid for trade (AfT) flow to Africa, it has played little role in Africa's trade with China. The findings was consistent with Vidya and Prabheesh (2019). Zhang and Li (2006) also added that, FDI is likely to favor horizontally differentiated IIT than vertically differentiated IIT. The positive coefficient of FDI remains same but significance level varied across column (1) - (3); in column (2) FDI was statistically insignificant.

InTI that measures the trade openess between China and African trading partners had unexpected negative sign and statiscially significant at 10% level in column (1) and (2), and statistically significant at 5% levels in column (3). One reason could be that most African trading partners over depend on exporting natural resources (i.e comparative advantage) and import goods of higher cost of production goods to them. If trade openess that focus on comparative advantage continues between China and African trading partners, China-Africa IIT is expected to depress. Also, African countries trade more domestically instead of foreign trade (Djoumessi and Bala 2013). This findings was similar to Abebe (2019) and Nguyen *et al.* (2020) but was inconsistent with (Sawyer *et al.* 2010, Zhang and Li 2006, Clark and Stanley 1999).

The real exchange rate (*InRER*) coefficient is negative as expected and statistically significant at 5% level in column (3) and 1% in column (1) and (2). Fluctuation in the real exchange rate is an influential factor that triggers China-Africa IIT. Appreciation of Chinese Yuan against various African currencies would make Chinese exported products more expensive, and import products cheaper for Chinese citizens thus depressing IIT. The findings of this study was consistent with Do (2006) and Sunde *et al.* (2009) which concludes that, in developing countries the exchange rate is found to be a significant factor in explaining IIT.

Consistent with theoretical expectation is the estimated coefficient of *lnDistance* which had a negative relationship with IIT and statistically significant at 1% level. Distance, which is a proxy to transportation cost between China and major African trade partners, is a strong significant influencing factor that creates barrier to China-Africa IIT. Proximity between trading countries encourages IIT due to some level of share similar demand structure and culture (Nguyen *et al.* 2020). For instance, the closest country Tanzania exhibited potential for IIT (11%) and Mauritania, the farthest trading partner in the study from China recorded low IIT level of 0.06. The hypothesis is verified, and findings confirmed the study of Kien and Thao (2016), Abebe (2019), (Nguyen *et al.* 2020).

The coefficient estimated for *landlocked* verified the expected negative relationship associated with IIT and statistically significant at 5% level. The dummy variable landlocked is a significant influencing factor that impedes IIT, implying a landlocked country in Africa is likely to have low IIT levels with China. Balancing the interaction between distance and real exchange rate is crucial for landlocked countries, since they are deprived of seaports, they depend on their transit neighbors' markets and infrastructures. Therefore, interactions between extra cost incursion and unfavorable exchange rate could discourage landlocked countries for IIT. The calculated GL index for China-Zambia authenticated these findings that, Zambia, although not the furthest but a landlocked country, recorded the lowest average IIT (0.03). This is because of extra cost of transporting goods from its closest neighbor, South Africa. Despite Zimbabwe and Ethiopia being landlocked countries, China has a relatively high IIT level with them, probably because they are closest in distance to China as African trade partners.

The adaption of innovative payment system at harbors had a positive relationship with IIT but was statistically insignificant. The existence of innovative payment system such as cashless payment and online goods clearance at the harbor of a country decreases transaction costs, long waiting times, and dead time, while increasing purchasing power parity and harbor efficiency. The findings of the study found, *InnoPS* had no influencing effect on China-Africa IIT. This could be because countries like Ghana, and Nigeria, among others which

have adopted *InnoPS* are still at the early stages of integration, and such technological development projects could take over 4 years to reach its full optimization of service and exert significant effect on IIT.

Table 5. FGLS regression results for influencing factors of IIT between China and major African Trading Partners

Variables	lnIIT	lnIIT	lnIIT
	(1)	(2)	(3)
lnGDP	0.254***	0.223***	0.235***
	(0.0751)	(0.0769)	(0.0764)
lnDGDPPC	-0.0213	-0.0360	-0.0365
	(0.0751)	(0.0751)	(0.0744)
lnFDI	0.0763*	0.0676	0.0833**
	(0.0411)	(0.0412)	(0.0416)
lnTI	-0.162*	-0.175*	-0.208**
	(0.0931)	(0.0928)	(0.0934)
lnRER	-0.0782***	-0.0670***	-0.0581**
	(0.0244)	(0.0252)	(0.0254)
lnDistance	-0.606*	-0.602*	-1.030***
	(0.314)	(0.312)	(0.373)
Landlocked			-0.387**
			(0.189)
InnoPS		0.256	0.149
		(0.156)	(0.163)
Constant	-4.576	-3.922	-0.618
	(4.028)	(4.023)	(4.301)
Observations	216	216	216
Number of Country	18	18	18
R-squared	0.194	0.204	0.219
Prob > chi2	0.0000	0.0000	0.0000

Note: Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Source: Author's computation

Conclusion

As IIT is recognized to have potential benefits to improve the economic prospects of countries, it has gradually been pivotal in understanding developing country's trade. This study measured the extent of China-Africa bilateral IIT of 18 major trading partners and across 10 SITC industries, from 2007 to 2018, examining the influencing factors of China-Africa IIT using an improved gravity model of international trade estimated by FGLS.

The overall average China-Africa IIT by country specific showed a low (0.11) but with potential for IIT. South Africa was the only trading partner that exhibited IIT at GL > 0.33. Half of the 18 China's major trading partners namely, Angola, Egypt, Ethiopia, Ghana, Morocco, Mozambique, Tanzania and Zimbabwe showed potential for IIT at a range of 0.10 ≤ GL ≤ 0.33. The average IIT between China and Algeria, Cameroon, Republic of Congo, Libya, Mauritania Dem. Rep. of Congo, Nigeria, Sudan and Zambia was weak and classified as inter-industry trade (GL < 0.10). Among the 10 SITC classified industries, SITC 0 (Food and live animals), SITC 2 (Crude materials, inedible, except fuels), SITC 5 (Chemicals and related products, n.e.s.) and SITC 6 (Manufactured goods classified chiefly by material) had potential for IIT, whereas SITC 1 (Beverages and tobacco), SITC 3 (Mineral fuels, lubricants and related materials), SITC 4 (Animal and vegetable oils, fats and waxes), SITC 7 (Machinery and transport equipment categories), SITC 8 (Miscellaneous manufactured articles) and SITC 9 (Commodities and transactions not classified elsewhere in the SITC) were dominantly inter-industry trade.

The empirical results of the improved gravity model (column 3) used to examine the influencing factors of IIT between China and its major trading partners in Africa showed that, GDP, FDI, RER, TI, distance, and landlocked countries are the influencing factors of IIT. The study further revealed that GDP and FDI had a positive relationship, enhanced IIT while RER, TI, distance and landlocked countries had a negative relationship, and depress IIT. However, DGDPPC and InnoPS were not statistically significant but showed expected relationship with IIT.

This study recommends that, governments and policy makers, especially those of landlocked countries should formulate and implement policies towards currency stabilization. Moreover, the findings provides China's

BRI policy makers information on which infrastructure development and technological know-how, can be undertaken and explored in their engagement with trade partners on the key essence to develop and strengthen industries to reap the full benefits of IIT.

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Appendix A

China trading partners in Africa	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average	Total Trade
Algeria	0.022	0.034	0.076	0.088	0.061	0.077	0.076	0.052	0.106	0.110	0.115	0.104	0.077	$82,533,569,842.00
Angola	0.034	0.011	0.093	0.050	0.110	0.061	0.076	0.107	0.106	0.205	0.203	0.223	0.107	$305,862,411,701.00
Cameroon	0.043	0.095	0.011	0.013	0.015	0.259	0.027	0.077	0.038	0.090	0.035	0.039	0.062	$20,345,391,293.00
Congo, Rep.	0.077	0.094	0.061	0.066	0.028	0.011	0.026	0.018	0.052	0.103	0.076	0.091	0.059	$54,733,459,805.00
Congo, Dem. Rep.	0.109	0.022	0.035	0.019	0.059	0.033	0.036	0.045	0.037	0.028	0.109	0.028	0.047	$41,859,921,932.00
Egypt	0.088	0.077	0.085	0.133	0.187	0.147	0.182	0.089	0.143	0.180	0.235	0.246	0.149	$112,559,268,002.00
Ethiopia	0.058	0.070	0.093	0.145	0.129	0.118	0.157	0.116	0.157	0.175	0.157	0.207	0.132	$27,101,986,487.00
Ghana	0.120	0.113	0.124	0.199	0.068	0.167	0.123	0.058	0.077	0.101	0.092	0.077	0.102	$52,943,723,031.00
Libya	0.017	0.026	0.160	0.158	0.117	0.010	0.115	0.092	0.050	0.053	0.015	0.030	0.070	$50,643,133,885.00
Mauritania	0.032	0.029	0.015	0.007	0.013	0.034	0.073	0.079	0.026	0.113	0.133	0.124	0.057	$19,048,913,510.00
Morocco	0.227	0.236	0.184	0.185	0.150	0.191	0.208	0.184	0.173	0.194	0.162	0.218	0.193	$40,629,051,145.00
Mozambique	0.022	0.022	0.077	0.015	0.054	0.114	0.158	0.233	0.103	0.140	0.102	0.091	0.099	$18,032,985,049.00
Nigeria	0.075	0.091	0.056	0.039	0.034	0.044	0.045	0.040	0.023	0.056	0.066	0.056	0.052	$133,449,702,999.00
South Africa	0.306	0.361	0.393	0.342	0.347	0.360	0.313	0.405	0.385	0.379	0.353	0.324	0.356	$468,453,966,604.00
Sudan	0.014	0.018	0.008	0.009	0.013	0.040	0.065	0.097	0.014	0.064	0.199	0.115	0.055	$63,281,026,105.00
Tanzania	0.086	0.034	0.019	0.120	0.084	0.090	0.132	0.197	0.093	0.081	0.227	0.144	0.109	$33,222,438,459.00
Zambia	0.044	0.043	0.010	0.012	0.017	0.014	0.020	0.029	0.021	0.036	0.021	0.041	0.026	$33,971,683,834.00
Zimbabwe	0.095	0.065	0.204	0.159	0.085	0.155	0.202	0.229	0.112	0.161	0.210	0.235	0.159	$10,788,249,645.00