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Intra-African Trade

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Abstract

This paper examines why the intra-continental trade share in Africa is only 12%, compared to 47% in North America, 53% in Asia, and 69% in Europe. Results show that exports to other African countries decrease more quickly with distance and increase less quickly with economic size, than exports to non-African countries. The analysis investigates possible explanations and identifies factors that promote trade between African countries. Intra-African exports are found to disproportionately increase with infrastructure (especially roads), trade agreements, and a more efficient customs clearing process. Diversifying the domestic economy away from agriculture and towards services is also associated with more intra-African trade. These results can guide efforts to promote African economic integration.

Keywords: intra-continental trade, exports, infrastructure, corruption, trade agreements, Africa

JEL Codes: F14, F15, O55

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1 Introduction

Africa accounts for 21.2% of the world's land and 13.7% of the world's people, but only 2.6% of the world's economic activity.[1] Understanding the causes of this disparity is one of the most important questions in economics (Collier and Gunning 1999, Acemoglu and Robinson 2010). One explanation is that Africa's lack of international trade slows economic development (Sachs and Warner 1997, Bosker and Garretsen 2012), for instance by limiting specialization, economies of scale, competition, and technology and knowledge diffusion.

As former UN Secretary General Kofi Anan said "the main losers in today's very unequal world are not those who are too much exposed to globalization. They are those who have been left out."[2] This is a concern for Africa, which accounts for only 2.7% of world trade. A closer look at the data reveals that the share of trade between African countries is especially small. The intra-continental trade share in Africa is only 12%, compared to 47% in North America, 53% in Asia, and 69% in Europe over the 1984-2016 period. This paper investigates why intra-African trade is relatively low.

According to the World Economic Forum and the African Development Bank, increasing intra-continental trade is the best way of promoting economic development and growth in Africa.[3] With this goal in mind, resources are devoted to fighting corruption, signing trade agreements like the African Continental Free Trade Agreement (AfCFTA), and investing in roads ($4.6 billion per year).[4] Despite the important policy implications and the significant time, money, and political capital that is dedicated to promoting economic integration within Africa, there is relatively little empirical evidence guiding these endeavors. This paper examines the determinants of intra-African trade and the results can inform efforts to identify and alleviate the binding constraints to trade and growth (Hallaert and Munro 2009, Hausmann, Rodrik, and Velasco 2008).

The empirical analysis explores how changing conditions within African countries affects not only total exports but also bilateral exports to African and non-African countries. Intra-African trade has increased from about 2% in 1984 to 15% in 2016. In addition, there are differences across countries, with 35% of Kenyan exports but only 9% of Nigerian exports going to other African countries. This paper examines

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[1] Calculations using the World Development Indicators database over the 1984-2016 sample period.

[2] Kofi Anan Speech at the UN Trade and Development Conference, February 11, 2000.

[3] See "Intra-African Trade is Key to Sustainable Development - African Economic Outlook," African Development Bank, May 23, 2017; "Africa's Greatest Economic Opportunity: Trading with Itself," Kingsley Makhubela, World Economic Forum, January 16, 2018; and also Bosker and Garretsen (2012) who find a positive correlation between African economic development and market access, particularly intra-African market access.

[4] Cervigni, Raffaello, Andrew Michael Losos, James L. Neumann, Paul Chinowsky. 2016. "Enhancing the Climate Resilience of Africa's Infrastructure: The Roads and Bridges Sector." The World Bank working paper 110137.

factors that contribute to this variation in the intra-African trade share, including trade agreements, infrastructure, the composition of the economy, corruption, conflict, and former colonial relationships. This is not meant to be an exhaustive list but it does incorporate common hypotheses for the lack of African trade (Brookings 2012).[5] The empirical analysis utilizes a panel-data set, a gravity empirical specification, and a rich set of fixed effects, which improves upon the cross-sectional studies common in this literature. However, the main contribution of the paper lies not in the methodological approach or the identification strategy but rather in the policy relevant findings themselves.[6]

The first set of results show that the lack of intra-African trade is not simply due to the fact that Africa is a large continent with many developing countries. In other words, the common gravity terms of distance and gross domestic product (GDP) cannot alone explain the lack of trade between African countries. Distance is a larger impediment to trade between two African countries than between an African and a non-African country. Furthermore, exports to other African countries increase less quickly with gross domestic product. The remainder of the paper examines possible explanations for these findings and identifies ways to increase intra-African trade.

Trade agreements can increase bilateral trade flows by reducing tariff barriers (Baier and Bergstrand 2007), which may be important in Africa (Rodrik 1998, Carrere 2004). The results confirm that African trade agreements increase exports but the effect depends on the type of agreement and the trading partner. Exports to non-African countries increase with non-reciprocal trade agreements, where African countries are granted preferential access to markets in developed countries (i.e. the African Growth and Opportunity Act - AGOA). However, trade between African countries disproportionately increases with preferential and free trade agreements (i.e. the Common Market for Eastern and Southern African - COMESA), as well as customs unions (i.e. the Southern African Customs Union - SACU).

Poor infrastructure can impede trade (Donaldson 2018) especially in African (Limao and Venables 2001). Underdeveloped communication and transportation infrastructure linking African countries may explain why distance is a larger impediment to African trade.[7] The findings confirm that overall exports, and especially exports to other African countries, increase with trade related infrastructure. Additional results show that the type of infrastructure matters. Trade between African countries disproportionately

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[5]Another potential explanation is that informal trade leads to an underestimate of intra-African trade flows. While it is challenging to obtain measures of informal trade, its prevalence likely depends on corruption, red tape, and a lack of trade agreements, which are examined in this analysis.

[6]This is a good example of an important topic that has been understudied due to empirical challenges (i.e. a 'sin of omission' according to Akerlof 2020).

[7]Infrastructure (Storeygard 2016), trade costs (Atkin and Donaldson 2015), and search and contracting frictions (Startz 2018) all influence *intra-national* African trade. This paper differs from these studies by focusing on *international* trade and especially the destination of these export flows.

increases with roads, and to a lesser extent the internet, while phones have a more similar impact on exports to African and non-African countries.[8]

The composition of the domestic economy is important and may influence African trade flows (Imbs and Wacziarg 2003, Brookings 2012). The results show that a large natural resource sector is positively related to exports to both African and non-African countries. However, growth in the agricultural sector is associated with a relative decline in exports to other African countries. Production of a similar set of homogeneous agricultural products may provide little incentive to export to a neighboring African country. On the other hand, African countries that specialize in services tend to trade relatively more with other African countries. These findings indicate that diversifying the economy out of agriculture and into services is one way to promote intra-African trade.[9]

Corruption and conflict generates an uncertain business environment which can adversely affect international trade flows (Dutt and Traca 2010). The results show that both factors decrease total African exports, but their impact on bilateral exports differs. Exports to African countries disproportionately decline with corruption and with inefficiencies in the customs clearing process. However, exports to African countries do not disproportionately decrease with conflict or violence. Thus, corruption and customs red tape, but not conflict, are associated with low intra-African trade shares.

European colonialism has lasting economic implications (Acemoglu, Johnson, and Robinson 2001), which can influence trade flows (Head, Mayer, and Ries 2010). The findings in this paper show that African exports to a former European colonizer begin to decline fifteen years after independence and continue to decrease for the next thirty years. As the impact of extractive institutions and infrastructure fade and trade networks with the former colonial power dissipate, African trade slowly diversifies away from the European colonizer.

Together these findings provide new insights into effective ways to promote intra-African trade. Exports to other African countries disproportionately increase with trade agreements and infrastructure, particularly the network of roads. A simpler and faster customs clearing process also encourages trade with other African countries. Furthermore, as African economies diversify out of agriculture and into services, intra-African trade increases. Finally, over time the destination of African exports evolve away from former European colonizers. These results can guide efforts to promote African economic integration.

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[8] Air infrastructure is found to be an insignificant predictor of bilateral trade and data on rail and port infrastructure is sparse.

[9] Furthermore, diversification of the domestic economy and exports away from agricultural products promotes economic growth (Hausmann, Hwang, and Rodrik 2007). Collier and Venables (2007) also argue that African countries should diversify, but into manufacturing rather than services.

This paper makes a number of contributions to the existing literature. First, studies have identified a lack of market access and trade as an important impediment to African growth (Sachs and Warner 1997, Collier and Gunning 1999, Bosker and Garretsen 2012). This paper contributes to this broader literature by examining why African countries do not trade more.[10] The analysis pinpoints the component of trade that is lacking (i.e. intra-African trade) and identifies the factors that are most successful at promoting trade between African countries.

Second, the lack of African trade according to some papers is explained by economic size and distance (Foroutan and Pritchett 1993, Coe and Hoffmaister 1998, Rodrik 1998), while others find that intra-African trade is less than these gravity terms predict (Limao and Venables 2001, Redding and Venables 2004). One feature of this literature, which may contribute to the conflicting results, is that these studies rely on cross-sectional gravity specifications where confounding factors are more problematic.[11] Instead, I utilize a panel data set to examine the relationship between changing conditions in African countries and changes in bilateral exports after controlling for both country-pair and year fixed effects, and in some specifications exporter*year and importer*year fixed effects as well. The results contribute to this literature by showing that intra-African exports fall more rapidly with distance and increases more slowly with gross domestic product, compared to exports to non-African countries.[12]

Third, to the best of my knowledge this is the first rigorous analysis that incorporates a variety of explanations for the lack of intra-African trade into a unified empirical analysis. This is important, especially if the factors determining trade are correlated. Recent improvements in the availability and quality of African data make this type of comprehensive analysis feasible and it means more sophisticated estimation strategies can be used. An appealing aspect of this unified empirical approach is that it is possible to identify the most effective ways of promoting intra-African trade, which has useful policy implications.

The paper proceeds as follows. The next section discusses the data used in this analysis, including the bilateral trade data and measures of economic conditions within African countries. Section 3 presents a variety of descriptive statistics that show how Africa compares to other continents, how intra-African trade differs across countries, and how intra-African trade has evolved over time. The empirical strategy

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[10]See Easterly and Reshef (2016) for examples of African export success stories.

[11]Redding and Venables (2004) have a panel dataset but use a repeated cross-sectional specification that does not account for bilateral-pair fixed effects. In addition to using a more rigorous estimation strategy, this paper picks up where Redding and Venables (2004) left off by identifying the "domestic factors (some of them subject to policy control)" that "determine export performance" in Africa.

[12]This is consistent with results showing that the factors influencing foreign direct investment differentially affect African countries (Asiedu 2002).

and estimating equation is outlined in section 4. The factors that are found to be important determinants of intra-African trade are reported in section 5. Finally, section 6 provides some concluding thoughts.

2 Data

The data used in the empirical analysis, including both the bilateral trade flows and African country characteristics, is presented in this section.

2.1 Bilateral Trade Data

Bilateral trade data for the years 1984-2016 is obtained from the World Trade Flow (WTF) data set.[13] The analysis focuses on African export flows in U.S. dollars.[14] The sample includes 49 African countries and their export flows to the other African countries, as well as 49 non-African countries. The non-African countries with the largest value of imports from Africa over the sample period are included in the analysis.[15] The empirical analysis will examine how changes in total exports, as well as exports to African and non-African countries, respond to changing domestic conditions.

2.2 African Country Characteristics

African country characteristics are gathered from a variety of data sources. The basic gravity terms of Gross Domestic Product (GDP) and population come from the World Development Indicators (WDI) database provided by the World Bank. Distance data comes from the French Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) and measures the population weighted distance (in kilometers) between all countries.

Trade agreement data for African countries is obtained from the Economic Integration Agreements (EIA) database (2017).[16] An appealing feature of this data is that it includes information on various different types of trade agreements including non-reciprocal agreements, preferential trade agreements (PTA), free trade agreements (FTA), and customs unions. This provides an opportunity to examine how

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[13]The WTF data set comes from Robert Feenstra's website at the University of California - Davis (https://www.robertcfeenstra.com/data.html) and is constructed using the United Nations COMTRADE data.

[14]Unlike the WTF data, the underlying COMTRADE data is also available at the product-level, but this is not needed for this analysis on intra-African trade. The WTF data overcomes data quality issues associated with the COMTRADE data, such as discrepancies in the importer and exporter reports (Feenstra et al. 2005), and it avoids the numerous zeros in the African bilateral product-level export data.

[15]This ensures that erratic trade flows to small non-African countries do not unduly influence the results. See Table A1 in the appendix for the sample of African and non-African countries included in the analysis.

[16]This data is provided by the Kellogg Institute at the University of Notre Dame.

the type of agreement differentially effects export flows to African and non-African partners.[17] Using the EIA's index, four binary trade agreement variables are constructed which are nested from least to most trade integration.[18]

A general measure of trade and transport related infrastructure is identified using a component of the Logistics Performance Index (LPI) from the WDI.[19] The analysis also explores how specific components of transportation and communication infrastructure affects African trade. Transportation infrastructure includes a measure of the total network of roads in kilometers from the World Bank's Africa Development Indicators (ADI), and a measure of air transportation defined as the number of registered air departures (from the WDI).[20] Communication measures include internet users, mobile cellular subscriptions, and fixed telephone subscriptions (from the WDI). While there are other infrastructure variables in the WDI database, these are the measures that have the best coverage and prove to be the most important predictors of exports.

To investigate whether the composition of the domestic economy influences export flows, data on the value added in the agriculture, natural resource, manufacturing, and service sectors (as a share of GDP) is gathered from the WDI. Using these shares and the GDP of the country, the size of each domestic sector is calculated.

Corruption is measured using the Logistic Performance Index (LPI) data from the WDI. While this captures overall corruption within an African country, it is also possible to focus more specifically on corruption associated with trade. A 'customs red tape' variable is constructed using a subindex from the LPI on the efficiency of the customs clearance process (i.e. the speed, simplicity, and predictability).[21]

The analysis utilizes two measures of conflict, which may influence trade. The number of armed conflict deaths within the country is measured using data from the Uppsala Conflict Data Program. A composite index on the severity of violence within the country is obtained from the Center for Systemic Peace, and is measured as the sum of international war, international violence, civil war, civil violence, ethnic war, and ethnic violence.

Finally, the paper explores the extent to which European colonialism influences current trade patterns.

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[17]Note that some types of agreements are only relevant for trade between an African and non-African country (i.e. non-reciprocal agreements) while others are only relevant for trade between African trading partners (i.e. customs unions). There is also information in the EIA database on common markets and economic unions but these are rare in Africa.

[18]See the data appendix A.4 for additional data details.

[19]This subindex incorporates information on ports, railroads, roads, and information technology.

[20]The network of paved roads does not increase exports above and beyond the impact of the overall network of roads. The WDI also has some information on rail lines and shipping container traffic but due to severe data limitations (many African countries have no railroads or ports) these variables are less useful for this analysis.

[21]See the appendix section A.4 for additional data details. Similar results are obtained using corruption measures constructed from the Doing Business data from the World Bank.

Using CEPII data, the number of years since independence from a European colonizer is calculated for each African country, with a maximum of 60 (Head et al. 2010).[22] Independence dummies ($Indep1_{ijt}$ to $Indep60_{ijt}$) are constructed to capture the effect of years since independence on bilateral trade to a former European colonizer.

Combining these variables generates a data set spanning 49 African countries, 98 trading partner countries (including 49 African and 49 non-African countries), and 33 years (1984-2016). The list of African and non-African countries included in the analysis are reported in Table A1.[23] Summary statistics of the gravity terms, the trade agreement variables, the infrastructure measures, the sector variables, the corruption measures, and the conflict variables are reported in Table A3. Finally, additional details about the data sources, the variables, and their coverage are in appendix section A.4.

3 Descriptive Evidence

3.1 Comparing Africa to Other Continents

It is well documented that Africa's share of the world economy is relatively small. As seen in Figure 1, Africa represents 21.2% of the world's land, 13.7% of the world's people, but only 2.6% of the world's GDP. The size of the African continent is comparable to Asia and larger than both North America and Europe. In terms of population, Africa is larger than both North American and Europe, although smaller than Asia. One of the most striking features of Figure 1 is that North America, Europe, and Asia each comprise about 30% of global economic activity, while Africa represents less than 3%.

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[22]See Table A2 for the list of European colonizers, African colonies, and the dates of independence since 1900.

[23]The African countries of South Sudan, Cabo Verde, Somalia, Seychelles, and Eswatini are not included in the analysis due to limited or non-existent data.

FIGURE 1

Continental Shares of the World's Area, Population, and GDP
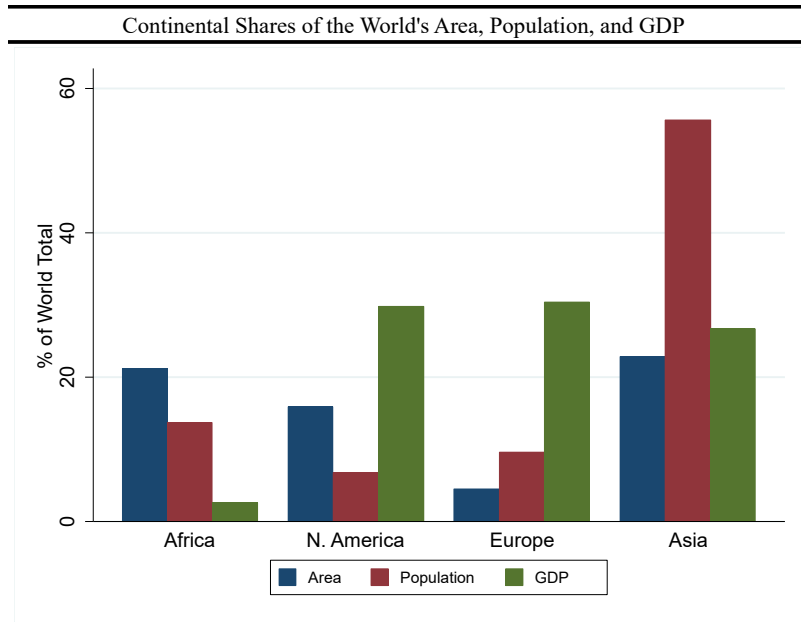
Notes: Land Area (sq. km), Population, and GDP (current US$) from the World
Bank's World Development Indicators (1984-2016).

The underlying causes of Africa's low share of world GDP is open to debate (see for instance Collier
and Gunning 1999, Acemoglu and Robinson 2010). One prominent explanation is that Africa is not
well integrated into global markets via international trade (Sachs and Warner 1997). The subsequent
subsections take a closer look at African trade.

3.2   Share of World Trade

Figure 2 shows that the share of global exports going to African countries was 2.7% over the 1984-2016
period.[24] In contrast, the share of exports bound for North America was 19%, the share headed to Europe
was 39%, and the share going to Asia was 29%. These findings are consistent with concerns that a lack
of Africa trade could in turn be slowing economic growth, by limiting specialization, economies of scale,
competition, and technology and knowledge diffusion. While this descriptive evidence does not imply a
causal relationship, it does suggest that the lack of African trade warrants attention.

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[24]This happens to be remarkably similar to Africa's share of GDP over the sample period.

FIGURE 2

Continental Share of World Trade
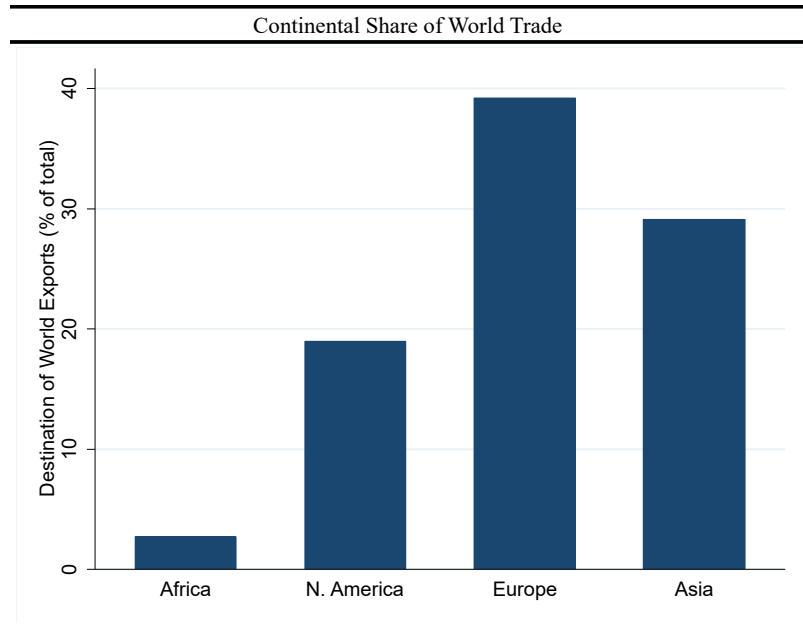
Notes: Authors calculation using World Trade Flow data from 1984-2016.

3.3   Intra-African Trade

A closer examination of the data reveals that Africa's low global trade share is due to a lack of trade between African countries. Specifically, Figure 3 shows that the share of intra-continental trade in Africa is 12%, compared to 47% in North America, 53% in Asia, and 69% in Europe over the 1984-2016 period.[25] This paper examines why the intra-continental trade share in Africa is four to six times lower.

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[25]The intra-continental trade share in South America (21%) is also much higher than in Africa.

FIGURE 3

Intra-Continental Trade Share
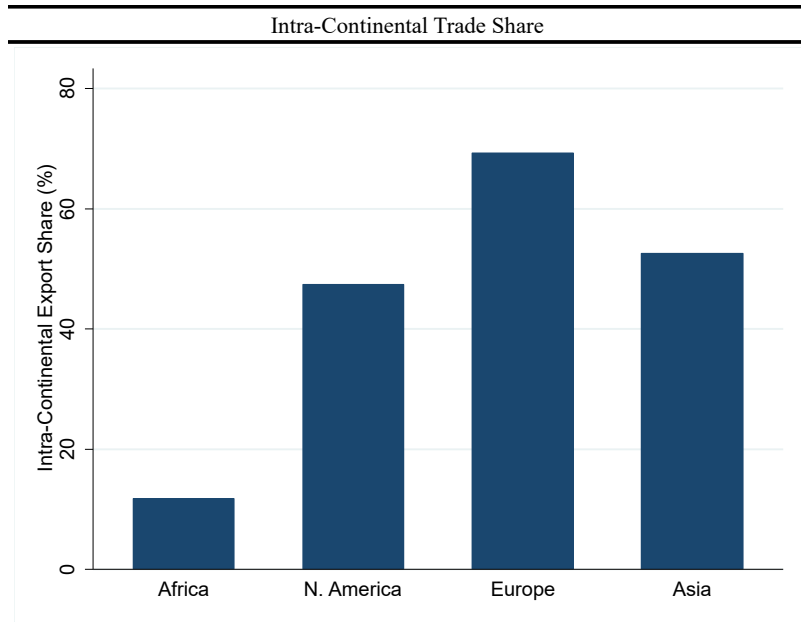
Notes: Authors calculation using World Trade Flow data from 1984-2016.

Figure 4 plots the change in intra-continental trade over time. Intra-European trade has remained at a high level and stable over the sample period. North American and Asian intra-continental trade has increased from 42% to 47% and from 41% to 53%, respectively.[26] Intra-African trade is low by comparison but it did increase from 2% in 1984 to 15% in 2016. The subsequent analysis will explore what factors have contributed to this increase in trade between African countries.

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[26]The growth of North American and Asian supply chains likely contributes to the rise in these intra-continental trade shares.

FIGURE 4
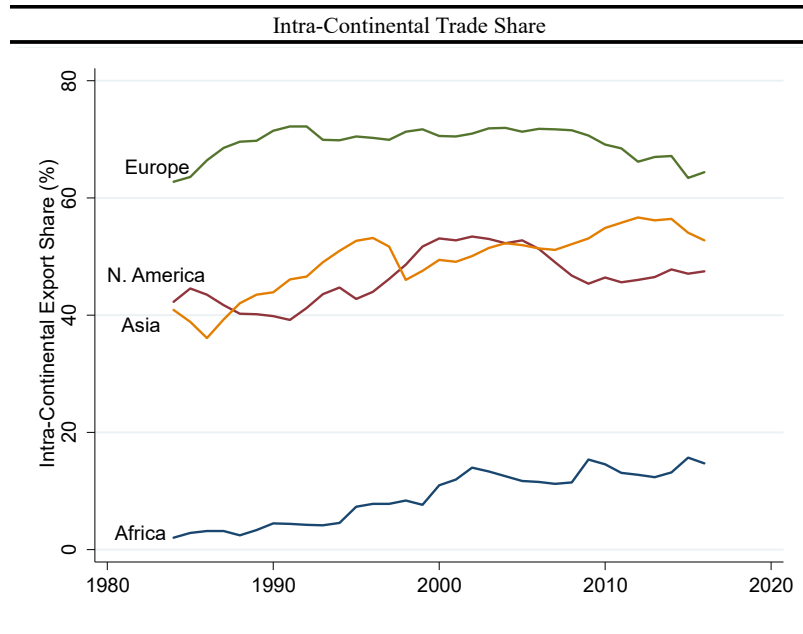
Notes: Authors calculation using World Trade Flow data from 1984-2016.

There is also geographic variation in the intra-continental trade share across African countries, as shown in Figure 5. At the high end, 43% of Zimbabwean exports go to other African countries over the sample period.[27] This may be related to improved transportation infrastructure (i.e. the Alfred Beit Road Bridge in 1995) linking Zimbabwe with South Africa, one of its largest trading partners.[28] Kenya and Uganda send about a third of their exports to other African countries, perhaps because they are both part of the East African Community customs union. On the other hand, Nigeria was not part of a customs union during this period and its share of intra-African trade is 9%. At the low end, Algeria's share of intra-African trade is only 3%, which may be because its economy is heavily focused on natural resources like oil and gas.[29] These and other possible explanations will be explored more systematically in the analysis that follows.

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[27]Eswatini (57%) and Togo (45%) are the only African countries with a higher intra-African export share.

[28]South Africa's intra-African export share is 21%.

[29]Egypt's intra-African export share is also low at 10%.

FIGURE 5
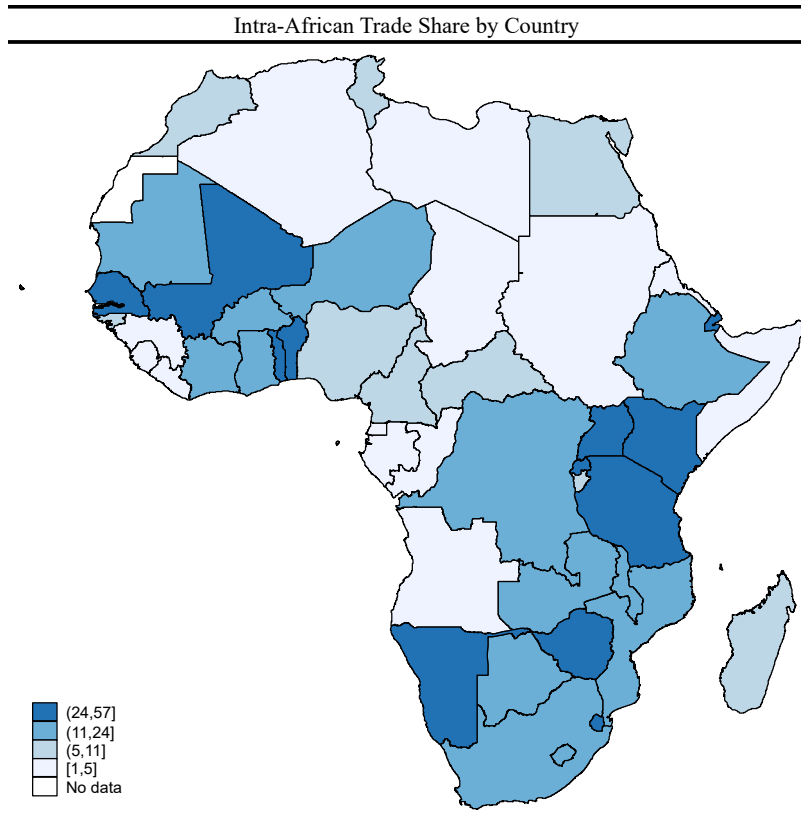
Notes: Authors calculation using World Trade Flow data from 1984-2016. Percent of total exports going to other African countries.

4 Empirical Specification

The gravity equation is one of the oldest and most successful empirical relationships in economics (Tinbergen 1962). In its basic form bilateral trade is regressed on the size of the respective countries and the distance between them. This "naive" gravity approach (Anderson 2011, Head and Mayer 2014) was typically used in cross-sectional studies of African trade (Foroutan and Pritchett 1993, Coe and Hoffmaister 1998, Rodrik 1998, and Limao and Venables 2001). However, Anderson and van Wincoop (2003) showed that a theoretically grounded gravity equation needs to also account for multilateral resistance, and the failure to do so leads to the "gold medal mistake" in early gravity papers (Baldwin and Taglioni 2007). Multilateral resistance can be accounted for by including proxies for "remoteness" or by including importer and exporter fixed effects (Head and Mayer 2014).

More sophisticated gravity specifications have moved away from cross-sectional analyses and towards

more dynamic approaches that utilize panel data.[30] This allows bilateral-pair fixed effects to be included, which control for all unobserved time-invariant factors that affect trade between any two trading partners (i.e. geography, language, and culture). This approach identifies factors that change bilateral trade over time *within* a pair of countries.

The following gravity equation forms the basis of the empirical approach used in this paper:

$$(1) \quad \ln Exports_{ijt} = \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln X_{it} + \beta_4 \ln X_{it} * African Importer_j + \gamma_t + \gamma_{ij} + \varepsilon_{ijt}$$

where $Exports_{ijt}$ are exports from African country i to foreign country j in year t.[31] Exports are regressed on GDP and population in both the exporting (Y_{it}) and importing (Y_{jt}) countries. In a basic gravity specifications, that does not include the bilateral-pair fixed effects, the population weighted distance between country i and j is also included in equation 1.

The vector X_{it} includes domestic conditions in the African country that may influence bilateral trade, such as infrastructure, the composition of the domestic economy, corruption, and conflict.[32] These domestic conditions (X_{it}) are also interacted with $African Importer_j$, which is a binary variable indicating whether the trading partner is in Africa. The coefficient β_4 provides insight into whether a particular domestic characteristic disproportionately affects bilateral exports to other African countries.

Also included in equation (1) are year fixed effects (γ_t) and bilateral-pair fixed effects (γ_{ij}). In some specifications, exporter*year (γ_{it}) and importer*year (γ_{it}) fixed effects are included as well, which is the most rigorous approach for controlling for multilateral resistance (Baldwin and Taglioni 2007). The downside is that the exporter*year fixed effects subsume the African country characteristics (X_{it}), making it impossible to examine how factors like infrastructure and corruption effect overall trade.[33] In light of these tradeoffs, the subsequent tables will report results both with and without the exporter*year and importer*year fixed effects. Finally, robust standard errors are clustered at the exporter-year level.

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[30]Carrere (2006) demonstrates the benefits of using panel data when studying the impact of trade agreements.

[31]Focusing on uni-directional trade is more consistent with the goal of this analysis and it avoids the "silver medal mistake" identified by Baldwin and Taglioni (2007).

[32]The analysis also includes trade agreements and years since independence from a European colonizer, both of which vary at the exporter-importer-year (ijt) level. Conditions in the importing country (X_{jt}) will be accounted for using importer*year fixed effects.

[33]Note that the $X_{it} * African Importer_j$ interaction variables do survive the exporter*year fixed effects because they vary by importing country.

5   Results

This section begins by examining whether the lack of intra-African trade can be explained by the typical gravity terms of economic size and distance. The analysis then estimates how total exports respond to various country characteristics, and whether these factors disproportionately affect exports to other African countries.

5.1   Gravity

The gravity specification in equation 1 is used to estimate whether trade between African countries is more or less responsive to distance and the size of the domestic economy. Column 1 of Table 1 reports a naive gravity specification that only includes year, exporter, and importer fixed effects. The results are consistent with standard findings that bilateral trade is increasing with exporter and importer GDP but decreasing with the distance between the trading partners.

The analysis then examines whether GDP and distance differentially affect exports to other African countries. This is accomplished by interacting GDP and distance with a binary variable indicating whether the importing country is also in Africa. The results reported in column 2 show that a ten percent increase in distance is associated with a 10% decrease in exports to non-African countries but a 20% decrease in exports to African countries. This indicates that distance is a larger impediment to intra-African trade.[34]

Column 2 also shows that exports to African countries are increasing less quickly with GDP. A ten percent increase in GDP increases exports to non-African countries by 6.4% but increases exports to other African countries by only 3.7%. These results show that as the economy of an African country grows they export relatively more to non-African countries and thus the intra-African export share declines.

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[34]This finding is consistent with Atkin and Donaldson (2015), who show that intra-national trade costs are 4-5 times larger in African countries than in the U.S.

TABLE 1
Gravity Determinants of Bilateral African Trade

	ln (Exports)			
	(1)	(2)	(3)	(4)
ln GDP	0.508***	0.635***	0.609***	-
	[0.053]	[0.054]	[0.051]	-
ln Population	-0.591*	-0.597*	-0.617*	-
	[0.329]	[0.329]	[0.333]	-
ln Importer GDP	0.343***	0.320***	0.332***	-
	[0.035]	[0.034]	[0.029]	-
ln Importer Pop	1.395***	1.819***	1.611***	-
	[0.157]	[0.149]	[0.112]	-
ln Distance	-1.888***	-1.031***		
	[0.035]	[0.066]		
ln GDP * Afr Importer		-0.268***	-0.208***	-0.265***
		[0.021]	[0.032]	[0.061]
ln Dist. * Afr Importer		-0.996***		
		[0.073]		
Year FE	Yes	Yes	Yes	No
Exporter FE	Yes	Yes	No	No
Importer FE	Yes	Yes	No	No
Pair FE	No	No	Yes	Yes
Exporter*Year FE	No	No	No	Yes
Importer*Year FE	No	No	No	Yes
Observations	132,742	132,742	134,170	134,170
R-squared	0.623	0.627	0.746	0.818

Notes: The dependent variable is the log of bilateral exports. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

In lieu of exporter and importer fixed effects, column 3 includes country-pair fixed effects instead. This accounts for all time-invariant factors that determine trade between any two pairs of countries and focuses on changes over time. Since distance does not vary over time it is subsumed by these country-pair fixed effects. The interaction coefficient of interest continues to show that exports to other African countries increase more slowly with GDP than exports to non-African countries.

Finally, exporter*year and importer*year fixed effects are added in column 4, which is a much more demanding specification.[35] These fixed effects absorb GDP, population, and all other time-varying factors in the exporting and importing countries. The coefficient on the $GDP * AfricanImporter_j$ interaction term (-0.265) confirms that exports to other African countries increase less quickly with GDP and the magnitude of this effect is similar to the findings in columns 2 and 3.

Overall, the results in Table 1 show that the lack of African trade is not simply explained by the

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[35]Together with the country-pair fixed effects, there are over nine thousand dummy variables included in this regression.

standard gravity terms of GDP and distance. This findings is in contrast to the cross-sectional results in Foroutan and Pritchett (1993), Coe and Hoffmaister (1998), and Rodrik (1998) but consistent with Limao and Venables (2001). The following sections examine possible explanations for why intra-African trade decreases more quickly with distance and increases less quickly with GDP.

5.2 Trade Agreements

Trade agreements reduce tariff barriers and increase trade (Baier and Bergstrand 2007), although the magnitude of this effect is open to debate (Rose 2004, Caliendo and Parro 2015).[36] Historically the lack of trade agreements between African countries may have contributed to the low intra-continental trade share (Figure 3), as proponents of the African Continental Free Trade Agreement (AfCFTA) have argued. This section examines whether new African trade agreements have contributed to the rising share of intra-African trade (Figure 4).

To estimate the impact of trade agreements on exports, the gravity specification includes indicator variables identify whether an African country has a non-reciprocal, preferential, free trade, or customs union agreement with a partner country. Non-reciprocal trade agreements provide African countries preferential access to markets in developed countries and thus may increase exports to non-African countries. However, customs unions, which are exclusively between African countries, may increase exports to other African countries. Preferential and free trade agreements occur with both African and non-African partner countries, which provides an opportunity to examine how these trade agreements differentially affect intra-African exports.

The relationship between trade agreements and exports is reported in Column 1 of Table 2, after accounting for GDP and population in both countries as well as year and country-pair fixed effects. The results show that a non-reciprocal trade agreement and a customs union both increase bilateral exports by about 100%, but the former increases trade to non-African countries while the latter increases trade to other African countries. The prevalence of customs unions have increased more quickly over the sample period, which together with these estimates indicates that trade agreements are contributing to a net increase in the intra-African trade share.[37] Furthermore, Column 1 also shows that exports are increasing with free trade agreements, but not with preferential trade agreements.

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[36]Furthermore, lower tariffs can reduce incentives for informal trade and thus increase measured trade flows.

[37]The number of non-reciprocal agreements in the sample increased from 850 in 1984 to 1246 in 2016, while the number of customs unions increased from 6 to 114 over the same period.

TABLE 2
Impact of Trade Agreements on Bilateral African Trade

	ln (Exports)		
	(1)	(2)	(3)
Non-Reciprocal	0.979***	1.046***	0.111
	[0.071]	[0.070]	[0.114]
PTA	-0.032	-0.427***	-0.196**
	[0.060]	[0.074]	[0.091]
FTA	0.196**	-0.417***	-0.249**
	[0.081]	[0.113]	[0.114]
Customs Union	0.973***	0.705***	0.765***
	[0.201]	[0.208]	[0.159]
PTA * Afr Importer		0.758***	0.687***
		[0.119]	[0.119]
FTA * Afr Importer		0.845***	0.752***
		[0.155]	[0.138]
Gravity Variables	Yes	Yes	Yes
Gravity Interactions	No	Yes	Yes
Year FE	Yes	Yes	No
Pair FE	Yes	Yes	Yes
Exporter*Year FE	No	No	Yes
Importer*Year FE	No	No	Yes
Observations	133,186	133,186	133,186
R-squared	0.747	0.747	0.819

Notes: The dependent variable is the log of bilateral exports. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction terms GDP*African-importer and Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Column 2 examines whether preferential and free trade agreements disproportionately increase exports to other African countries. Specifically, the PTA and FTA variables are interacted with the binary variable indicating whether the importing country is also in Africa.[38] The negative coefficients on the uninteracted PTA and FTA variables are due to the fact that many African countries transition from non-reciprocal agreements to preferential and free trade agreements with non-African countries.[39] On the other hand, the coefficients on the interaction terms show that exports to African countries increase with preferential and free trade agreements, relative to exports to non-African countries. This beneficial effect stems from the fact that PTAs and FTAs are often adopted by African countries that previously had no trade agreements and the fact that in the absence of trade agreements African tariffs are often quite high.[40]

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[38]Since non-reciprocal agreements and customs unions are with either non-African or African countries but not both, it is impossible to interact these types of agreements with the binary African importer variable.

[39]For instance, South Africa moved from a non-reciprocal agreement with the U.K. to a free trade agreement in 2000.

[40]For instance, South Africa transitioned from having no trade agreement with Tanzania to a preferential trade agreement in 2001.

The benefits of these trade agreements on intra-African trade are confirmed in column 3 after accounting for both exporter*year and importer*year fixed effects. The coefficients on the $PTA * AfrImporter_j$ and $FTA * AfrImporter_j$ remain positive, statistically significant, and similar in magnitude.[41] Overall, these results show that preferential trade agreements, free trade agreements, and customs unions all increase intra-African trade. This confirms an intuitive but important point that trade agreements are an effective way of promoting economic cooperation and integration among African countries.

5.3 Infrastructure

Poor infrastructure impedes trade (Donaldson 2018) and is especially problematic in Africa (Jedwab and Storeygard 2019 and Storeygard 2016). This can have adverse implications for both African international trade (Amjadi and Yeats 1995, Limao and Venables 2001, and Longo and Sekkat 2004) and African international trade (Atkin and Donaldson 2015). Inadequate transportation and communication infrastructure may explain why intra-African exports decrease relatively quickly with distance (Table 1).

This possibility is tested using the LPI's index on trade and transport related infrastructure. Column 1 of Table 3 shows that this broad infrastructure measure is associated with an increase in African exports. This indicates that communication and transportation infrastructure, not surprisingly, play an important role in facilitating trade.

Column 2 then examines whether infrastructure has a larger impact on intra-continental trade by interacting the LPI index with the binary variable indicating whether the trade partner is also in Africa. The coefficient on this interaction term is insignificant in column 2. However, in column 3 exports to African countries increase more quickly with trade infrastructure, after including importer*year and exporter*year fixed effects. This finding indicates that investments in trade infrastructure improvements may be an effective way of promoting intra-African trade.

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[41]The customs union coefficient is also positive and significant, but the non-reciprocal coefficient is insignificant in column 3. Since non-reciprocal agreements are typically simultaneously granted to many African countries (i.e. the U.S. African Growth and Opportunity Act of 2000), they are subsumed by the importer*year fixed effect.

TABLE 3
Impact of Infrastructure on Bilateral African Trade

	ln (Exports)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln Trade Infrastructure	1.127***	1.334***				
	[0.258]	[0.239]				
ln Roads				0.607***	0.202*	-
				[0.134]	[0.111]	-
ln Internet				0.092***	0.050***	-
				[0.016]	[0.015]	-
ln Cell Phones				0.037***	0.023***	-
				[0.009]	[0.008]	-
ln Phones				0.085***	0.057***	-
				[0.014]	[0.013]	-
ln Flights				0.014	0.019	-
				[0.018]	[0.013]	-
ln Trade Infra. * Afr Importer		-0.414	0.589**			
		[0.318]	[0.286]			
ln Roads * Afr Importer					0.845***	0.867***
					[0.165]	[0.161]
ln Internet * Afr Importer					0.089***	0.116***
					[0.014]	[0.019]
ln Cell Phones * Afr Importer					0.029**	0.025**
					[0.011]	[0.011]
ln Phones * Afr Importer					0.059***	0.018
					[0.015]	[0.015]
ln Flights * Afr Importer					-0.011	0.013
					[0.021]	[0.020]
Gravity Variables	Yes	Yes	Yes	Yes	Yes	Yes
Gravity Interactions	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Exporter*Year FE	No	No	Yes	No	No	Yes
Importer*Year FE	No	No	Yes	No	No	Yes
Observations	134,170	134,170	134,170	134,170	134,170	134,170
R-squared	0.746	0.746	0.818	0.747	0.749	0.818

Notes: The dependent variable is the log of bilateral exports. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction terms GDP*African-importer and Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Which infrastructure projects are best at promoting trade? Using entirely different data sources, column 4 explores how specific transportation and communication infrastructure components affect exports. The results show that a ten percent increase in roads, internet users, cell phones, and land phones is associated with a 6.1%, 0.9%, 0.4%, and a 0.9% increase in exports, respectively.[42] The magnitudes of these estimates indicate that African exports are especially sensitive to the network of roads.

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[42]The number of flight departures is found to have an insignificant impact on exports. The inclusion of other infrastructure measures (i.e. rail, ports, and paved roads) leads to almost a 50% decline in the number of observations, but the main road, internet, and phone estimates remain similar.

Column 5 explores whether this relationship between exports and infrastructure depends on the trading partner country. The uninteracted coefficients show that exports to non-African countries increase with all four of the infrastructure components, but the magnitude of this effect is more modest compared to column 4. The interaction results show that African exports disproportionately increase with roads, the internet, and phones, relative to exports to non-African countries. Roads are found to be especially important in fostering intra-African trade. A ten percent increase in the network of roads, is associated with a 2% increase in exports to non-African countries but a 10.5% increase in exports to African countries. The importance of roads are confirmed when importer*year and exporter*year fixed effects are included in column 6.

A few important conclusions emerge from Table 3. First, trade increases with communication and transportation infrastructure. Second, this relationship differs with the type of infrastructure. Total African exports increase with roads and communication infrastructure (i.e the internet and phones). Third, infrastructure disproportionately affects intra-African export flows. For instance, growth in the road network is associated with an increase in exports to African countries that is five times larger than the increase in exports to non-African countries. The fact that intra-African exports are especially sensitive to poor infrastructure can explain why trade between African countries decreases more quickly with distance (Table 1). Overall, these findings indicate that investments in infrastructure, and in particular roads, may be an effective way of promoting trade between African countries.

5.4 Composition of Economy

The sectoral composition of the domestic economy is important for the development process (Imbs and Wacziarg 2003). If African countries specialize in a similar set of products, there will be less incentive for intra-African trade (Brookings 2012). This could explain why exports to African countries increase more slowly with GDP (Table 1) than exports to non-African countries. For instance, growth in the agricultural sector will increase GDP but it may have little impact on intra-African trade if neighboring countries produce the same agricultural goods. This section examines whether the composition of the domestic economy influences trade between African countries.

To test for this possibility, GDP in the exporting country in equation 1 is replaced with the size of four domestic sectors: agriculture, natural resources, manufacturing, and services. The findings in column 1 of Table 4 show that total exports decrease with the size of the agricultural sector. On the other hand, exports are positively related to the size of the natural resource and service sectors. A ten

percent increase in the natural resource or service sector is associated with a 3.1% and 3.7% increase in exports, respectively.

The impact of sectoral growth on exports to different trading partners is examined in column 2. Exports to non-African countries increase with all four sectors of the domestic economy. These export flows are especially sensitive to the size of the natural resource sector, which is consistent with oil, gold, diamonds, and minerals being in high demand. The relationship between sectoral growth and exports to African countries is more heterogeneous. The point estimates on the interaction terms show, for instance, that intra-African exports decline with the agricultural sector (coefficient of -0.651), relative to exports to non-African countries. This is consistent with specialization in a similar set of homogeneous agricultural products leaving little incentive for intra-African trade. Exports to African countries also decrease with the size of the manufacturing sector. These agricultural and manufacturing findings are consistent with the results in Table 1 showing that exports to African countries increase less quickly with GDP. However, growth in the service sector promotes intra-African trade. A ten percent increase in the service sector is associated with a 3.7% increase in exports to other African countries, relative to non-African exports. A differentiated industry like services may be more conducive to intra-industry trade with neighboring countries.

TABLE 4
Impact of Domestic Industry Composition on Bilateral African Trade

	ln (Exports)		
	(1)	(2)	(3)
ln Agriculture	-0.175**	0.135*	-
	[0.077]	[0.075]	-
ln Natural Resources	0.307***	0.319***	-
	[0.051]	[0.047]	-
ln Manufacturing	-0.034	0.084*	-
	[0.047]	[0.046]	-
ln Services	0.374***	0.193***	-
	[0.074]	[0.067]	-
ln Agr * Afr Importer		-0.651***	-0.563***
		[0.085]	[0.083]
ln NR * Afr Importer		-0.024	0.051
		[0.051]	[0.050]
ln Manuf * Afr Importer		-0.247***	-0.243***
		[0.057]	[0.052]
ln Serv * Afr Importer		0.372***	0.490***
		[0.089]	[0.090]
Gravity Variables	Yes	Yes	Yes
Gravity Interactions	No	Yes	Yes
Year FE	Yes	Yes	No
Pair FE	Yes	Yes	Yes
Exporter*Year FE	No	No	Yes
Importer*Year FE	No	No	Yes
Observations	134,170	134,170	134,170
R-squared	0.746	0.747	0.818

Notes: The dependent variable is the log of bilateral exports. The independent variables measure the log size of the domestic Agricultural, Natural Resource and Construction, Manufacturing, and Service industries. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction term Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Exporter*year and importer*year fixed effects are included in column 3. Intra-African trade still decreases with the agriculture and manufacturing sectors and increases with the service sector. The point estimate on the agriculture interaction term is smaller than in column 2, while the point estimate on the service interaction term is larger. Overall, the findings show that both total exports as well as the destination of these exports are influenced by the composition of the domestic African economy. According to these results, one strategy to increase intra-African trade would be to promote diversification of the domestic economy, in particular by encouraging movement away from the agricultural sector and towards the service sector.

5.5 Corruption

Institutional quality and contract enforcement are both important determinants of trade flows (Nunn 2007 and Levchenko 2007). Conversely corruption may discourage trade and is especially problematic in many African countries (Acemoglu and Robinson 2010 and Sequeira and Djankov 2014).[43] Similarly time delays and inefficiencies in the customs clearing process can also impede international trade (Djankov, Freund, and Pham 2010). This section explores whether corruption and customs inefficiencies adversely affect African exports.

Table 5 examines the relationship between exports and overall corruption, measured using the Logistic Performance Index (LPI). Total exports decrease with the level of corruption in the African country in column 1.[44] Columns 2 and 3 then explores whether corruption disproportionately affects exports to other African countries. The African interaction coefficient is negative in both columns and significant in column 3, which includes the exporter*year and importer*year fixed effects. These results show that intra-African trade disproportionately decreases with corruption.

TABLE 5
Impact of Corruption on Bilateral African Trade

	ln (Exports)					
	(1)	(2)	(3)	(4)	(5)	(6)
ln Corruption	-1.660***	-1.442***	-			-
	[0.405]	[0.353]	-			-
ln Customs Red Tape			-	-1.546***	-1.310***	-
			-	[0.388]	[0.327]	-
ln Corruption * Afr Importer		-0.465	-1.415***			
		[0.442]	[0.422]			
ln Customs Red Tape * Afr Importer					-0.500	-1.375***
					[0.425]	[0.393]
Gravity Variables	Yes	Yes	Yes	Yes	Yes	Yes
Gravity Interactions	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes	No
Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Exporter*Year FE	No	No	Yes	No	No	Yes
Importer*Year FE	No	No	Yes	No	No	Yes
Observations	134,170	134,170	134,170	134,170	134,170	134,170
R-squared	0.746	0.747	0.818	0.746	0.747	0.818

Notes: The dependent variable is the log of bilateral exports. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction terms GDP*African-importer and Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

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[43] In some situations, corruption may actually help facilitate trade, especially if it allows firms to evade high tariff barriers (Dutt and Traca 2010, Sequeira and Djankov 2014, Olney 2016, Sequeira 2016).

[44] The point estimate of -1.66 shows that a standard deviation increase in corruption (0.12%) is associated with a 0.20% decline in exports.

Rather than using a broad measure of corruption, the remainder of Table 5 focuses on corruption related to international trade. Specifically, inefficiencies in the customs clearing process makes trade more expensive and time consuming. The findings in column 4 confirm that exports decline with customs red tape.[45] Furthermore, exports to African countries disproportionately decrease with customs corruption (columns 5 and 6). The interaction coefficient is negative and significant after exporter*year and importer*year fixed effects are included in column 6.

Overall, Table 5 shows that total exports are decreasing with both corruption and customs inefficiencies (columns 1 and 4). Furthermore, both factors disproportionately decreases trade with other African countries (columns 3 and 6). Thus, corruption in general and customs inefficiencies in particular appear to play a role in the lack of intra-African trade.

5.6 Conflict

Conflict also breeds instability and uncertainty and thus may adversely affect international trade (Heilmann 2016 and Amodio and Di Maio 2018).[46] Furthermore, conflict is especially prevalent in Africa (McGuirk and Burke 2017), which may contribute to the relatively low intra-continental trade share. To test for this possibility, this section examines the relationship between African exports and two different measures of conflict.

The findings show that total exports decline with conflict deaths within the African country, and the relationship with violence is negative too but insignificant (see column 1 of Table 6).[47] In column 2, exports to non-African countries decrease both with conflict deaths and violence. Developed countries may be apprehensive about entering into business relationships with African countries dealing with conflict. However, exports to African countries do not disproportionately decrease with conflict and violence. Neither interaction coefficient is statistically different from zero, and in fact the estimated relationship between violence and exports to African countries is close to zero (-0.089 + 0.070). Column 3 includes exporter*year and importer*year fixed effects and the results confirm that intra-African trade is not especially sensitive to conflict.

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[45]A standard deviation increase in customs inefficiencies (0.12%) is associated with a 0.19% decrease in exports.

[46]Heilmann (2016) uses consumer boycotts as a measure of conflict, while this paper relies on more conventional measures of conflict deaths and violence. Unlike Amodio and Di Maio (2018), this analysis focuses on the relationship between conflict and exporting rather than importing. Martin, Mayer and Thoenig (2008) find that bilateral trade decreases the likelihood of military conflict, while multilateral trade increases the likelihood of conflict.

[47]Both conflict deaths and violence have a negative and significant impact on exports when included individually.

TABLE 6
Impact of Conflict on Bilateral African Trade

	ln (Exports)		
	(1)	(2)	(3)
ln Conflict Deaths	-0.029**	-0.028**	-
	[0.013]	[0.012]	-
ln Violence	-0.055	-0.089**	-
	[0.045]	[0.045]	-
ln Conflict Deaths * Afr Importer		-0.003	-0.003
		[0.016]	[0.015]
ln Violence * Afr Importer		0.070	0.066
		[0.056]	[0.053]
Gravity Variables	Yes	Yes	Yes
Gravity Interactions	No	No	Yes
Year FE	Yes	Yes	No
Pair FE	Yes	Yes	Yes
Exporter*Year FE	No	No	Yes
Importer*Year FE	No	No	Yes
Observations	132,847	132,847	132,847
R-squared	0.745	0.746	0.818

Notes: The dependent variable is the log of bilateral exports. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction terms GDP*African-importer and Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Overall, the results in Table 6 indicate that conflict adversely affects exports. However, unlike other explanations explored in this paper, these findings show that conflict does not disproportionately decrease exports to other African countries. Thus, while conflict has numerous adverse societal and economic ramifications, it does not appear to be the most important obstacle to intra-African trade.

5.7 Colonial Relationships

This section examines whether vestiges of European colonialism influences African trade flows. European colonization can have lasting economic implications (Acemoglu, Johnson, and Robinson 2001), which may be especially relevant for African countries (Acemoglu and Robinson 2010). After independence the destination of export flows may slowly diversify away from the former European colonizer (Head et al. 2010), as the impact of extractive institutions and infrastructure fade and trade networks with the former colonial power dissipate.

Independence dummies ($Indep1_{ijt}$ to $Indep60_{ijt}$) are included in equation 1 and capture the effect of years since independence on bilateral trade to the former European colonizer. Figure 6 plots the point

estimates and the 95% confidence intervals on each of these binary variables.[48] The findings show that African countries continue to export to their European colonizer for approximately fifteen years after independence. However, after that bilateral exports fall continuously for the next thirty years. These findings are consistent with the existing literature on the impact of independence on trade (Head et al. 2010) and show that European colonization has had a lasting impact on African trade flows. This decline in African exports to former European colonizers likely contributes to the rise in the intra-African trade share over the sample period (Figure 4).

FIGURE 6
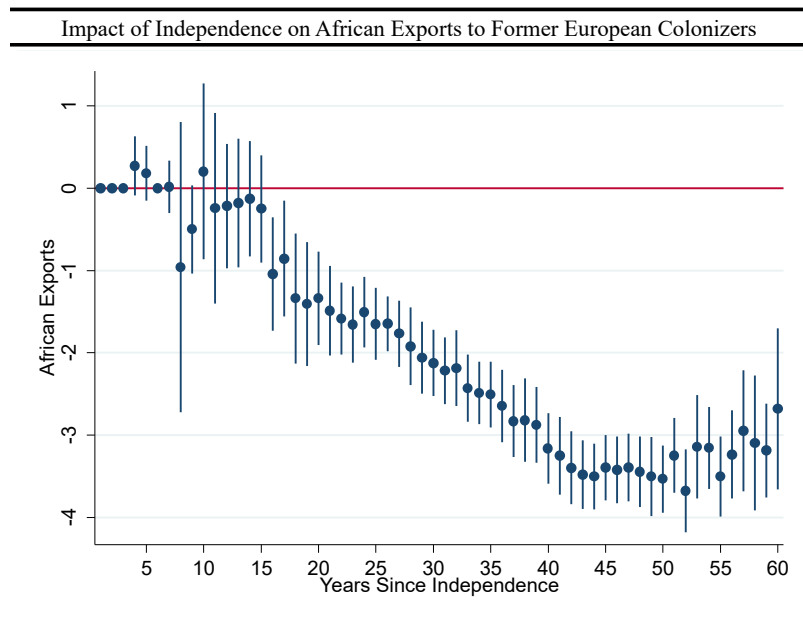
Notes: The dependent variable is the log of bilateral exports. Coefficient estimates and 95% confidence intervals are reported on independence dummies, which indicate the number of years since independence from a European colonizer post 1900. Regresssion controls for GDP, Pop, Importer GDP, Importer Pop, bilateral pair fixed effects, and year fixed effects. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Robust standard errors clustered at the exporter-year level in brackets.

5.8 Unified Empirical Analysis

An important contribution of this paper is to combine the various possible explanations for intra-African trade into a unified empirical framework. This section focuses on the most promising characteristics

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[48]The first three dummies ($Indep1 - 3$) are omitted because the sample begins in 1984 and Zimbabwe's independence from the U.K. in 1980 was the last in Africa (see Table A2).

identified in the previous sections and examines the impact of these factors on both total exports and exports to other African countries.[49]

Total exports continue to be sensitive to many of the same domestic conditions, although the magnitude of these effects change. In column 1 of Table 7 exports are increasing with trade agreements; increasing with roads, the internet, and phones; increasing with the natural resource and service sectors; and decreasing with customs red tape. It is reassuring that the estimated impact of these various factors is of the expected sign and the findings identify ways to promote export led growth in African countries.

The analysis then focuses on which factors disproportionately affect trade with other African countries. Column 2 reports the uninteracted coefficients in the left subcolumn and the African interaction coefficients in the right subcolumn.[50] Exporter*year and importer*year fixed effects are included in column 3 which generates qualitatively similar results. We see that intra-African trade disproportionately increases with preferential and free trade agreements. It also increases more quickly with communication and transportation infrastructure, such as roads and the internet. The road network is found to be an especially important determinant of intra-African trade. Exports to African countries are negatively related to the size of the domestic agriculture sector but positively related to the size of the service sector. Finally, customs inefficiencies deter intra-African exports more than exports to non-African countries.

These findings offers insights into ways to promote economic integration between African countries. Specifically, investments in roads and the internet, pursuing trade agreements, encouraging the domestic economy to diversify into the service sector, and improving the efficiency of the customs process appear to be the most effective ways of encouraging intra-African trade.

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[49]Including other explanatory variables (i.e. conflict, flights, and independence dummies) does not change the results and is cumbersome to report.

[50]This unconventional approach of reporting coefficients from the same regression in two separate columns is necessary given the large number of independent variables.

TABLE 7
Bilateral African Trade

	ln (Exports)				
	(1)	(2)		(3)	
	Uninteracted	Uninteracted	* Afr Imp	Uninteracted	* Afr Imp
Non-Reciprocal	0.992***	1.036***	-	0.100	-
	[0.071]	[0.070]	-	[0.113]	-
PTA	-0.081	-0.509***	0.793***	-0.164*	0.635***
	[0.060]	[0.072]	[0.115]	[0.087]	[0.114]
FTA	0.158**	-0.218*	0.508***	-0.217*	0.713***
	[0.079]	[0.111]	[0.154]	[0.112]	[0.135]
Customs Union	1.109***	0.959***	-	0.847***	-
	[0.196]	[0.201]	-	[0.157]	-
ln Roads	0.560***	0.094	0.948***	-	0.890***
	[0.135]	[0.111]	[0.162]	-	[0.158]
ln Internet	0.087***	0.059***	0.067***	-	0.111***
	[0.015]	[0.014]	[0.014]	-	[0.019]
ln Cell Phones	0.034***	0.022**	0.023**	-	0.021*
	[0.009]	[0.009]	[0.011]	-	[0.012]
ln Phones	0.070***	0.048***	0.055***	-	0.003
	[0.015]	[0.014]	[0.016]	-	[0.017]
ln Agriculture	-0.186**	0.014	-0.406***	-	-0.504***
	[0.074]	[0.072]	[0.086]	-	[0.081]
ln Natural Resources	0.244***	0.284***	-0.079*	-	-0.014
	[0.047]	[0.044]	[0.047]	-	[0.048]
ln Manufacturing	0.070	0.122***	-0.107**	-	-0.158***
	[0.046]	[0.047]	[0.053]	-	[0.051]
ln Services	0.317***	0.232***	0.160*	-	0.390***
	[0.073]	[0.065]	[0.084]	-	[0.089]
ln Customs Red Tape	-1.199***	-1.167***	-0.117	-	-1.055***
	[0.396]	[0.335]	[0.379]	-	[0.386]
Year FE	Yes	Yes		No	
Pair FE	Yes	Yes		Yes	
Exporter*Year FE	No	No		Yes	
Importer*Year FE	No	No		Yes	
Observations	133,186	133,186		133,186	
R-squared	0.749	0.751		0.820	

Notes: The dependent variable is the log of bilateral exports. The regressions include GDP, Pop, Importer GDP, Importer Pop, and the interaction term Pop*African-importer. The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016. Columns 2 and 3 report the uniteracted coefficients and the African interaction coefficients from the same regressions in two separate subcolumns. Robust standard errors clustered at the exporter-year level in brackets. *** p<0.01, ** p<0.05, * p<0.1.

6 Conclusion

The causes of global inequality and especially Africa's under-performance is one of the most important economic questions. One explanation for Africa's slow economic growth is a lack of international trade. This paper shows that the dearth of trade is largely due to an absence of intra-continental trade between

African countries. The goal of this paper is to identify the factors contributing to this low intra-African trade share.

The empirical analysis uses a panel-data set, a gravity specification, and a rich set of fixed effects to examine the importance of a variety of possible explanations for African exporting behavior. This is not meant to be an exhaustive list, but it does incorporate many factors that are typically mentioned as important determinants of African exports.

The first important finding is that the lack of African trade is not simply explained by the standard gravity terms of GDP and distance. This in and of itself is an important contribution to the existing cross-sectional findings in the literature. The results show that intra-African trade decreases more quickly with distance and increase less quickly with exporter GDP.

The second set of results identify domestic characteristics that contribute to growth in total exports. The findings show that exports are increasing with trade agreements, increasing with infrastructure, and decreasing with corruption in the African country. Furthermore, exports are sensitive to the composition of the domestic economy. Overall, these findings provide insights into ways African countries could promote export led growth.

The final set of results identify factors that encourage exports to other African countries. The findings show that intra-African exports disproportionately increase with trade agreements, roads, the diversification of the domestic economy away from agriculture and towards services, and improvements in the customs process. These findings can inform efforts to promote African economic integration.

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A ONLINE APPENDIX

A.1 Sample of Countries

TABLE A1
List of Countries

African Countries		Non-African Countries	
Algeria	Liberia	Australia	Mexico
Angola	Libya	Austria	Netherlands
Benin	Madagascar	Barbados	Norway
Botswana	Malawi	Belgium	Pakistan
Burkina Faso	Mali	Brazil	Peru
Burundi	Mauritania	Canada	Poland
Cameroon	Mauritius	Chile	Portugal
Central African Republic	Morocco	China	Romania
Chad	Mozambique	Denmark	Russian Federation
Comoros	Namibia	Finland	Saudi Arabia
Congo, Dem. Rep.	Niger	France	Singapore
Congo, Rep.	Nigeria	Germany	Spain
Cote d'Ivoire	Rwanda	Greece	Sweden
Djibouti	Sao Tome and Principe	Hong Kong SAR, China	Switzerland
Egypt, Arab Rep.	Senegal	India	Syrian Arab Republic
Equatorial Guinea	Sierra Leone	Indonesia	Taiwan
Eritrea	South Africa	Iran, Islamic Rep.	Thailand
Ethiopia	Sudan	Ireland	Trinidad and Tobago
Gabon	Tanzania	Israel	Turkey
Gambia, The	Togo	Italy	Ukraine
Ghana	Tunisia	Japan	United Arab Emirates
Guinea	Uganda	Jordan	United Kingdom
Guinea-Bissau	Zambia	Korea, Rep.	United States
Kenya	Zimbabwe	Lebanon	Vietnam
Lesotho		Malaysia	

Notes: The sample includes 49 African exporters, 49 African importers, and 49 non-African importers over the years 1984-2016.

A.2 Dates of Independence

TABLE A2
European Colonizers, African Colonies, and Independence Dates since 1900

%

France		**United Kingdom**		**Belgium**	
Algeria	1962	Botswana	1966	Burundi	1962
Benin	1960	Egypt, Arab Rep.	1922	Congo, Dem. Rep.	1960
Burkina Faso	1960	Eritrea	1952	Rwanda	1962
Cameroon	1960	Gambia, The	1965		
Central African Rep.	1960	Ghana	1957	**Italy**	
Chad	1960	Kenya	1963	Eritrea	1941
Comoros	1975	Lesotho	1966	Libya	1951
Congo, Rep.	1960	Malawi	1964		
Cote d'Ivoire	1960	Mauritius	1968	**Portugal**	
Djibouti	1977	Nigeria	1960	Angola	1975
Gabon	1960	Sierra Leone	1961	Guinea-Bissau	1974
Guinea	1958	South Africa	1910	Mozambique	1975
Madagascar	1960	Sudan	1956	Sao Tome and Principe	1975
Mali	1960	Tanzania	1964		
Mauritania	1960	Uganda	1962	**Spain**	
Morocco	1956	Zambia	1964	Equatorial Guinea	1968
Niger	1960	Zimbabwe	1980		
Senegal	1960			**Turkey**	
Togo	1960	**Netherlands**		Libya	1911
Tunisia	1956	South Africa	1902		

Notes: Dates of independence of 49 African countries (since 1900) from European colonizers.

A.3 Descriptive Statistics

TABLE A3
Summary Statistics

	Obs	Mean	Std. Dev.		Obs	Mean	Std. Dev.
Gravity Terms				Trade Agreements			
ln (Exports)	143,313	4.62	4.33	Non-Reciprocal	159,936	0.22	0.42
ln (GDP)	146,028	22.49	1.62	PTA	159,936	0.15	0.36
ln (Pop)	150,862	15.82	1.42	FTA	159,936	0.05	0.22
ln (GDP Importer)	146,006	24.38	2.44	Customs Union	159,936	0.01	0.12
ln (Pop Importer)	149,721	16.45	1.63				
ln (Distance)	149,589	8.41	0.72				
Infrastructure				Composition of Economy			
ln Trade Infrastructure	151,272	0.76	0.15	ln Agriculture	146,028	20.75	1.69
ln Roads	161,421	9.91	1.40	ln Natural Resources	146,028	20.27	1.95
ln Internet	150,862	7.87	5.48	ln Manufacturing	146,028	20.11	1.89
ln Cell Phones	151,272	8.56	6.66	ln Services	146,028	21.63	1.67
ln Phones	151,272	10.96	2.11				
ln Flights	151,272	8.17	1.98				
Corruption				Conflict			
ln Corruption	151,272	0.95	0.12	ln Conflict Deaths	161,421	3.24	2.62
ln Customs Red Tape	151,272	1.02	0.12	ln Violence	158,157	0.31	0.62

A.4 Data Appendix

Given the paper's focus on developing African countries, the data can occasionally be difficult to obtain and incomplete. This section discusses in more detail the data sources and the construction of the variables used in this analysis.

The World Trade Flow (WTF) data set provides a reasonably complete picture of African trade. Of the 49 African countries in the sample, export data is missing to all bilateral partner countries for Eritrea and Ethiopia prior to 1993, Botswana, Lesotho, Namibia, and South African prior to 2000, and for Sudan from 2008-2011. These observations are not included in the analysis.[51]

Trade agreement data comes from the Economic Integration Agreements (EIA) database and measures the degree of economic integration between every pair of countries. Using the EIA's index (which ranges from 0 to 6), four binary variables are constructed indicating a non-reciprocal agreement, a preferential

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[51]As long as a country's bilateral export flows are not missing to all trading partners, these zeros are included in the analysis.

agreement (PTA), a free trade agreement (FTA), or a customs union.[52] These binary variables are nested from least to most trade integration. For example, all common markets are a type of preferential agreement but not all preferential agreements are a common market. This avoids the preferential agreement variable switching to zero in the dataset, if for instance a country moves from a PTA to a common market (i.e. Uganda and Kenya in 2001).[53] Finally, the EIA data is available from 1984-2012, and thus trade agreements in 2012 are used for the subsequent years.

A general measure of trade and transport related infrastructure is identified using a component of the Logistics Performance Index (2007-2016), which is discussed in more detail below. This subindex ranges from 1-5 and incorporates information on ports, railroads, roads, and information technology. More detailed infrastructure measures come from the World Bank's African Development Indicators (ADI) and the World Development Indicators (WDI) datasets. Specifically, the total road network in kilometers in a given African country and year (1990-2010) comes from the ADI. Data on individual internet users, fixed telephone subscriptions, mobile cellular subscriptions, and registered flight departures comes from the WDI dataset for the 1984-2016 period.[54] Missing infrastructure, road, internet, phone, and flight data is identified using linear interpolation and nearest neighbor extrapolation.[55] There are other potentially appealing variables in the WDI, but unfortunately the coverage is incomplete for these infrastructure variables which limits their usefulness (i.e. rail network and container port traffic).

The WDI has data on the GDP share of four sectors of the domestic economy: agriculture (which also includes forestry and fishing; ISIC 1-5), natural resources (which also includes construction; ISIC 10-14 and 40-45), manufacturing (ISIC 15-37), and services (ISIC 50-99).[56] This data spans the years 1984-2016 for most countries, and the occasional missing value is identified using linear interpolation and nearest neighbor extrapolation. These sectoral shares are then multiplied by GDP to obtain the size of the agriculture, natural resource, manufacturing, and service sectors for each African country over the sample period.

Corruption is measured using the Logistics Performance Index (LPI) data from the WDI (2007-2016). The LPI is a survey conducted by the World Bank where respondents evaluate countries on six dimensions

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[52]There is also data on common markets and economic unions but these are rare in Africa.

[53]Non-reciprocal agreements are considered a type of PTA and FTA, but only for non-African countries where non-reciprocal agreements are relevant.

[54]There are no internet users and cell phones prior to the mid-1990s.

[55]Nearest neighbor extrapolation (i.e. using 1985's value for 1984 or using 2015's value for 2016) is preferable to linear extrapolation which can lead to implausibly small or large values over a sufficient time frame.

[56]The natural resources and construction sector is calculated as the difference between the WDI's Industry and Manufacturing sectors. The rare missing Manufacturing observation (i.e. <5% of the sample) is identified using the size of the Industry sector and a country's average Manufacturing share from other years.

of logistics on a scale of 1 (worst) to 5 (best).[57] A broad corruption measure is defined as five minus the overall LPI measure. A more specific measure of corruption related to trade is identified as five minus the LPI subindex on the efficiency of the customs clearing process (i.e. the speed, simplicity, and predictability).[58]

The number of armed conflict deaths in a given country and year is measure using data from the Uppsala Conflict Data Program (1989-2016). These include deaths related to armed force between two parties, at least one of which is the government of a state. A different measure of conflict is obtained from the Center for Systemic Peace. This index (0-10) measures major episodes of political violence (MEPV) within a country and year (1984-2016), which is the sum of international war, international violence, civil war, civil violence, ethnic war, and ethnic violence.[59]

Any analysis of almost fifty developing African countries over a thirty three year period (1984-2016) will face some data constraints. The interpolation and extrapolation methods are not perfect but they are a sensible and common approach for handling missing observations. If anything they will lead to less time-series variation within a country, which should attenuate the results.[60] This section outlines, hopefully in a transparent way, the approaches used to address these inherent data challenges.

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[57]The six dimensions that comprise the overall LPI score are efficiency of the customs clearing process, the quality of trade and transport related infrastructure, the ease of arranging competitively priced shipments, the competence and quality of logistics services, the frequency with which shipments reach consignee within the schedule or expected time, and the ability to track and trace consignments.

[58]Missing observations are identified using linear interpolation and nearest neighbor extrapolation.

[59]Conflict death missing observations are identified using linear interpolation and nearest neighbor extrapolation. The violence variable has near complete coverage, with the few missing observations for Eritrea, Namibia, and Sudan identified using nearest neighbor extrapolation.

[60]For example, values early in the sample that are identified using nearest neighbor extrapolation will be subsumed by the exporter (or pair) fixed effects because they do not vary over time.