Economics
The Open-Access, Open-Assessment E-Journal

Discussion Paper
No. 2018-75 | October 11, 2018 | http://www.economics-ejournal.org/economics/discussionpapers/2018-75

Please cite the corresponding Journal Article at
http://www.economics-ejournal.org/economics/journalarticles/2019-10

The impacts of institutional quality and infrastructure on overall and intra-Africa trade

Jiang Yushi and Dinkneh Gebre Borojo

Abstract
The authors examine the impacts of quality of institutions, border and transport efficiency, physical and communication infrastructure on overall and intra-Africa trade covering 44 African countries and their 173 trade partners for the periods 2000–2014. Aggregate indicators are derived for quality of economic institutions, border and transport efficiency, physical and communication infrastructure using principal component analysis. The findings disclose that intra-Africa and overall Africa's trade robustly determined by quality of institutions, border and transport efficiency, physical and communication infrastructure. The estimates also indicate that the marginal effect of the quality of institutions, physical and communication infrastructure on trade flow appears to be increasing in GDP per capita. In contrast, the marginal effect of border and transport efficiency on trade decreases in GDP per capita. The authors compute simulation of improving each indicator to the best performer in the sample. The findings are robust to estimation method conducted to account for potential endogeneity.

JEL F1 F14
Keywords Trade flow; transport efficiency; quality of institutions; physical and communication infrastructure; gravity model; African countries

Authors
Jiang Yushi, School of Economics and Management, Southwest Jiaotong University, Chengdu, China, jiang.yushi@yahoo.com@qq.com
Dinkneh Gebre Borojo, School of Economics and Management, Southwest Jiaotong University, Chengdu, China

Citation Jiang Yushi and Dinkneh Gebre Borojo (2018). The impacts of institutional quality and infrastructure on overall and intra-Africa trade. Economics Discussion Papers, No 2018-75, Kiel Institute for the World Economy. http://www.economics-ejournal.org/economics/discussionpapers/2018-75

Received September 9, 2018 **Accepted as Economics Discussion Paper** September 27, 2018
Published October 11, 2018

1. INTRODUCTION

In contemporary economics literatures international trade is considered as one of the major factors positively contributing for economic growth and development (Andersen and Babula, 2008; Busse and Koniger, 2012 and Mercan, Gocer, Bulut and Dam, 2013). In this path, however, African countries have traditionally lagged the rest of the world (Portugal-Perez and Wilson, 2008 and Assane and Chiang, 2014). As world development data shows African countries are among those having the least trade share compared to other regions in the world market. Similarly, its intra-trade is relatively the lowest compared to other regions. According to the World Bank statistics intra-African trade was 11% of the continent's total trade between 2007 and 2011.

Some literatures indicate that tariff and non-tariff barriers are responsible for high cost of trade and the lower performance of developing countries in the world trade. However, recently non-tariff barriers have relatively higher impacts on trade performance of countries because tariffs on international trade are generally becoming lower as countries have been progressively liberalized joining World Trade Organization (WTO) and regional and bilateral trade agreements (UNCTAD, 2013). In most of African countries transport cost incidence for exports is five times higher than tariff cost incidence (World Bank, 2001). That is the effect of tariff cost is relatively becoming less important, while non-tariff factors, such as regulatory barriers, business environment, infrastructure, institutional quality and economic freedom are becoming major determining factors of trade. Recent empirical literatures suggest that improvement in these indicators can have robust effect on trade performance of countries. For example, employing gravity model Francois and Manchin (2013) argue the infrastructure and institutional quality more specifically economic institutional indicators affect the patterns of trade. However, they did not consider border and transport efficiency indicators in their specification and their study was also limited to time periods 1990-2003. Similarly, using gravity estimation Portugal-Perez and Wilson (2012) find that the aggregate indicators of hard and soft infrastructure have effect on export performance of developing countries over the period 2004-2007. Assane and Chiang (2014) study trade reform policies and institutional quality for the Economic Community of West African States. However, their study is limited to trade policies and institutional quality for data spanning 1984–2006. Furthermore, use gravity equation Djankov, Freund and Pham (2006) analyze the effect of time delays on international trade for 146 countries in 2005. Their findings show that, on average, each additional day a product is delayed prior to being shipped reduces trade by at least 1%. Likewise, Nordas and Pinali and Geloso Grosso (2006)

analyze the effect of time for exports and imports on international trade based on cross-sectional data for 140 countries in 2004. They find that time delays result in lower trade volumes and reduce the probability that firms will enter export markets for time-sensitive products. Also employing a gravity model, Sonora (2008) estimate the effects of economic freedom on US consumer exports and imports for the years 2000 and 2005 and finds that better economic freedom of the partner country has a positive effect on the amount of exports from the United States to that country. Hence empirical assessment of the impacts of non-tariff barriers of trade flow should take into account the business environment and infrastructure and institutional quality on the top of traditional determinants of trade flow.

In this paper our aim is to empirically examine the impact of economic institutional quality, border and transport efficiency, physical and communication infrastructure on trade flow of African countries and their participation in international and regional trade. We match bilateral trade flow of African countries with their trade partners to traditional gravity variables, physical and communication infrastructure, border and transport efficiency and quality of economic institutions indicators. Our results reveal that trade flow and probability of African countries to take part in the intra-Africa and international trade depends on quality of physical (road, railway, port and airport) and communication infrastructure, border and transport efficiency, quality of economic and governance institutions of African countries.

This study is significant for a few reasons. First, it adds to the existing literatures by conducting comprehensive empirical study on the impact of physical and communication infrastructure, border and transport efficiency and quality of institutions of African countries relatively for longer time period (2000-2014) and covering bilateral trade flow data of 44 African countries (exporter) with 173 trade partners (importers). We also test the hypothesis for trade flow within African countries (intra-Africa trade). Second, On the top of physical and communication infrastructure in which more attention has traditionally given, we thoroughly examine the impact of border and transport efficiency indicators and quality of institutions using wide range of economic and governance indicators. We control economic institutions which have greater coverage than previous indicators and a more recent one that can show business regulation, property rights and legal enforcements and sound money and governance institutions. Third, we employ twostep Heckman (1979) sample selection model to deal with a potential bias due to unobserved heterogeneity and a sample selection problem as there is 30 percent zero valued observations in the sample. Applying this method, we

examine the impact of these indicators on the probability to trade (extensive margin) and bilateral trade flow (intensive margin), avoiding any bias involved because of omission of the extensive margin. Fourth, we take into account omitted multilateral resistance effects adjusting for bilateral trade cost variables. Fifth, our model incorporates interaction terms between these indicators and per capita GDP and we also conduct counterfactual analysis to the best performing economy for each of our target variables. Finally, we run robustness check for endogeneity concern running IV method using legal origin, civil liberty, government fractionalization, check and balance and lagged values of time varying explanatory variables. As this test discloses our results are proven to be robust and similar to and reinforce the baseline results.

The rest part of this paper is organized as follows: Part two discusses literature review, Part three explains methodology of the study and data, part four presents results and findings of the study and part five contains robustness check and counterfactual analysis and part six presents conclusion and policy implications based on the findings.

2. LITERATURE REVIEW

A number of empirical literatures analyze the impact of different factors on trade flow and integration of countries. They tried to look at the impact of trade reform policies, transaction costs, quality and efficiency of infrastructure, logistics performance, economic status, cultural and geographical distance and political and institutional quality of countries and they find that these factors have significant effect on bilateral trade flow of different countries. Wilson, Mann & Otsuki (2005) evaluate four measures of trade facilitation: port facilities, customs handling, the regulatory environment and the availability of service sector infrastructure. Improvements in all four measures would have material impacts on both exports and imports. In addition to custom handling and regulatory environment, it needs comprehensive study by including all aspects of infrastructure indicators from physical infrastructure to soft infrastructure. Furthermore, Djankov et al. (2006) use gravity equation to analyze the effect of time delays on international trade. Their findings show that, on average, each additional day a product is delayed prior to being shipped reduces trade by at least 1%. Similarly, Nordas and Pinali and Geloso Grosso (2006) analyze the effect of time for exports and imports on international trade, and find that time delays result in lower trade volumes and reduce the probability that firms will enter export markets for time-sensitive products. Aforementioned literatures examined the impact of infrastructure and institutional quality on trade flow of different countries. However, a few studies have been conducted comprehensive analysis on the impact of

physical, soft and communication infrastructure and domestic institutional quality indicators on trade flow of African countries and probability to participate in world trade. In addition, studies conducted so far, however, are not sufficient, not without limitations in terms of their coverage and econometrics specification. Therefore, our study fills the gap by examining the impact of different components of infrastructure and domestic institutional quality on trade performance of African countries using robust econometric model.

3. DATA AND METHODOLOGY

3.1. Data

Our study covers trade flow from 44 African countries to 173 trade partners for the periods 2000-2014. The time span and the sample of African countries are bounded by the availability of data for important control variables. The list and definition of variables and the sources of data are given in Table 6 in Appendix A. The summary statistics of major variables is spelt in Table 8 in Appendix B. The countries included in the sample are also listed in Appendix D. Trade flow is taken from Direction of Trade Statistics (DOTS) of IMF. We use trade inflow from African countries to their trade partners as it is more suitable for gravity model approach. Facts of the explanatory variables of our interest are spelt out in the following part.

Quality of Institutional Indicator

The empirical analysis for this paper utilizes economic and governance institutions dataset of six governance indicators of Worldwide Governance Indicators (WGI) and six economic freedom indicators of Fraser Institute. Accordingly, the rule of law, absence of violence and instability, regulatory quality, government effectiveness, voice and accountability and control of corruption are used to capture quality of governance institutions of African countries. Rule of law shows contract and property right protection and abilities of police and court to enhance private rights. Political stability and absence of violence represents capacity of government in avoiding internal and external conflicts and ethnic tensions and control of corruption indicates position of countries in fighting against corruption. Regulatory quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Government effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such

policies. Voice and accountability catches view of the degree to which citizens can take an interest in selecting their government, opportunity of free expression and association, as well as a free media. Their values range approximately from –2.5 to 2.5 with higher values corresponding to better institutions.

Furthermore, economic freedom indicators are used as a proxy for economic institutions of African countries. It has six components namely: property right and legal protection, regulation, sound money, freedom to trade internationally, government size and investment freedom. The interesting thing here is that all variables used to develop the index come from the International Country Risk Guide, the Global Competitiveness Report, and the World Bank's Doing Business project, so that the subjective judgments of the authors do not influence the index. Government size represents the extent of government consumption, tax rate, transfer and subsidy and government investment. Legal protection and property right shows the key ingredients of a legal system such as rule of law, security of property rights, an independent and unbiased judiciary, and impartial and effective enforcement of the law. Regulation represents labor and credit market and business regulation. In all cases the values of these indicators vary from 0 to 10 with higher values corresponding to better status.

Using six indicators of institutional quality and six indicators of economic freedom of African countries we derive a single composite indicator using principal component analysis. From Table 7 in Appendix B the eigenvalues of the first principal component of quality of economic and governance institution is greater than 1 (4.61>1). However, none of other components have eigenvalues more than 1. Since the first component explains 66 percent of the variation in the original variables, the study uses the eigenvectors of the first principal component as weights in constructing an institutional and governance index. Detailed explanation about principal component analysis is given in Appendix B.

Border and Transport Efficiency Indicator

We add border and transport efficiency indicators in to our analysis using four sets of transport and border efficiency indicators. These are time to export, time to import, documents to export and documents to import. Time to export and to import is measured by time recorded in calendar days. The time calculation for an export or import process starts from the moment it is started and runs until it is completed. All documents required per shipment to export or import goods are captured.

This is based on the assumption that all contracts has already been agreed upon and signed by both parties. Documents needed for clearance by port and container terminal authorities, customs authorities, health and technical control agencies, banks and government ministries are taken into account. Similarly using principal component analysis we find one aggregate indicators of border and transport efficiency index. As we observe from Table 7 in Appendix B the eigenvalues of first two components of border and transport efficiency are greater than 1 (2.62 and 1.03>1). The first principal component of border and transport efficiency has variance 2.62, explaining 66 percent of the total variance. Hence we include the first principal component of border and transport efficiency indicators. We hypothesis that there should be negative relationship between border and transport efficiency indicators and trade flow as ease of cross boarder trading activities promotes flow inflow.

Physical and Communication Infrastructure Indicator

Physical and communication infrastructure shows the quality of airports, roads, rail infrastructure and level of communication infrastructure. We derive aggregate indicator for physical and communication infrastructure using road quality, railway quality, airports quality, internet subscription and telecommunication infrastructure. The eigenvalues of first two components are greater than 1 (2.562 and 1.339>1). The first principal component has variance of 2.562, explaining 51 percent of the total variance and the second one has variance of 1.339, explaining 26.8 percent. We use the interaction of these two as it can account more than 77 percent.

Entry Cost Index

We control for entry cost index using three ease of doing business indicators such as cost to start business, procedure and time to start business in exporter countries using similar procedure (Appendix B Table 7).

3.2.Methods of Analysis

This part is concerned with description of the estimation method used in the study. Our sample comprises trade flow of 44 African countries to 173 African trade partner countries for over the periods 1990-2014. Log-linear gravity model using Ordinary Least Square (OLS) estimator results in loss of information because of dropping zero value observations in trade data as it has 30 percent zero valued observations. This procedure reduces efficiency of data and may lead to biased estimates since dropping zero value observations in the estimation results with selection bias (Gómez-Herrera, 2013). Another method used by Baldwin and Di Nino (2006) to solve zero values observations in the

data is Tobit model to estimate the common currency effect on trade in new goods applying the gravity model. However, this method is inefficient since it results with loss of information and leads to biased results because of censuring zero trade values from left.

Alternative methods commonly used in gravity model specification are PPML and Heckman selection models. PPML model by Santos Silva and Tenreyro (2006) is preferred estimation method in the presence of heteroscedasticity. However, this method is not appropriate if probability of trade among countries is correlated with unobserved characteristics of that pair of countries and severely biased when zeros are not random outcomes (Westerlund and Wilhelmsson, 2011). In addition, it does not behave so well for an aggregated dataset in the presence of unobserved heterogeneity. Gómez-Herrera (2013) Comparing different methods to estimate gravity models of bilateral trade for a dataset covering 80% of world trade showed that the best method to estimate gravity model of bilateral trade is Heckman sample selection procedure. This study revealed that Heckman (1979) sample selection model is the estimator with the most desirable properties, confirming the existence of sample selection bias and the need to take into account the first step (probability of exporting) to avoid the inconsistent estimation of gravity parameters. Therefore, in this study we employ two-step Heckman (1979) sample selection procedure to estimate the gravity model of trade flow of African countries since there are many zero value observations in our trade flow data. In addition, it allows for a two-stage decision process via estimating determinants of the probability to trade (extensive margin) simultaneously with estimating determinants of bilateral trade flow (intensive margin), avoiding any bias involved because of sample selection and omission of the extensive margin (Helpman, Melitz and Rubinstein, 2008). Therefore, it needs estimating outcome equation to determine the effect of control variables on the volume of trade and selection equation to examine the effect of these variables on the probability of trade. Hence, the extensive and intensive margins of our estimation are defined in equations (1) and (2) below. We start with the basic estimating equation, as specified in equation (1).

$$\ln(Trade_{ijt}) = \beta_0 + \beta_n(OV_{ijt}) + \beta_m(IV_{it}) + \beta_k(MR_{ijt}) + \gamma_t + \varepsilon_{ijt} \quad \text{---------- (1)}$$

Where, $Trade_{ijt}$ denotes bilateral trade flow between i and j countries, OV_{ijt} represents other control variables such as GDP of reporter, GDP of partner, Distance between capital of i and j countries, population density of of i and j countries, colonial relationship, common colony, common language, WTO membership, RTA, population of both i and j countries and area of i and j countries and access

to sea; IV_{it} represents border and transport efficiency, quality of economic institutions, physical and communication infrastructure of African countries and MR_{ijt} is inverse Mills ratio. Multilateral resistance term (MRT), which is a function of exogenous variables, is taken in to account by employing the Baier and Bergstrand (2009) method[1] , γ_t and ε_{ijt} show time fixed effect and stochastic term.

Extensive margin (selection equation) shows that $Trade_{ijt}$ defined in equation (1) is observed when the following condition is satisfied:

$$\varphi_0 + \varphi_n(OV_{ijt}) + \varphi_m(IV_{it}) + \varphi_k ECOST_{ijt} + \eta_t + U_{ijt} > 0 \quad \text{---------- (2)}$$

Where, $Trade_{ijt}$ denotes bilateral trade flow between i-reporter and j-partner countries, OV_{ijt} represents other control variables such as GDP of i countries, GDP of j countries, distance between capital of i and j countries, RTA_{ijt}, WTO membership, colonial relationship, common colony, common language, landlocked, population of both i and j countries and area of i and j countries; IV_{ijt} represents border and transport efficiency, physical and communication infrastructure and quality of institutions of African countries. $ECOST_{ijt}$ denotes business entry cost used as exclusion restriction and η_t and U_{ijt} are time fixed effect and stochastic term, respectively.

Business entry cost is represented by index derived using cost to start business, procedure and time to start business and used as an exclusion restriction. It is excluded from outcome equation and included in selection equation as it can affect probability of trade between partners and reporting countries (Helpman et al., 2008 and Araujo, Ornelas and Mion, 2012). The selection equation is used to calculate inverse Millis ratio which captures the probability of selection variables omitted from intensive margin (outcome equation) defined in equation (1). The selection equation is used to calculate inverse Millis ratio which captures the probability of selection variables omitted from intensive margin (outcome equation) defined in equation (1).

[1] Using MRT captures the role of country size because trade barriers have a large impact for small countries which typically trade a large proportion of their output internationally (Portugal-Perez and Wilson, 2012). So, we replace bilateral variables that account for bilateral trade costs by MRT in the model using the following Baier and Bergstrand (2009) methods BY indexing (i,b,c) for reporter and (j,e,f) for partner countries.

$$MRTlnX_{ijt} = lnX_{ijt} - \{ \sum_{e \neq i} \theta_i \ln X_{iet} + \sum_{b \neq j} \theta_j \ln X_{bjt} - \sum_c \sum_f \theta_j \theta_i \ln X_{cft} \}$$

Where, X is bilateral variables accounting for bilateral trade costs, $\theta_i = Y_i/Y_T$ and $\theta_j = Y_j/Y_T$, $Y_i = GDP_{it}$, $Y_T = GDP_{world}$

4. Results and Findings

4.1. The impacts of border and transport efficiency, quality of institutions, physical and communication infrastructure on overall trade flow of African countries

Table 1 presents twostep Heckman (1979) estimation results for border and transport efficiency, quality of economic institutions, physical and communication infrastructure. Market entry cost is considered as exclusion restriction variable and included in extensive margin defining probability of trade among countries. It has negative effect on probability of countries to participate in trade. Countries with high market entry cost have less probability to trade. Its coefficient is significant at 1% level of significance. The results are vigorous because to find stable and robust results, exclusion restriction variables should have the coefficients that accord with intuition and statistically significant at conventional levels. The Mills ratio is statistically significant at 1% level of significance implying that there is existence of sample selection bias and strongly supports using twostep Heckman (1979) sample selection procedure.

Table 1: The impacts of border and transport efficiency, quality of economic institutions, physical and communication infrastructure on trade flow of African countries (twostep Heckman)

Variable	I (a) Outcome	I (b) Selection	II(a) Outcome	II(b) Selection	III(a) Outcome	III(b) Selection
$lngdpc_{it}$	1.161**	0.198**	1.086**	0.166**	1.193**	0.204**
	(0.024)	(0.006)	(0.029)	(0.007)	(0.035)	(0.007)
$lngdpc_{jt}$	0.922**	0.241**	1.037**	0.229**	0.904**	0.214**
	(0.020)	(0.004)	(0.026)	(0.005)	(0.029)	(0.005)
$lnpop_{it}$	1.787**	0.337**	1.827**	0.332**	1.879**	0.352**
	(0.032)	(0.007)	(0.039)	(0.006)	(0.049)	(0.008)
$lnpop_{jt}$	1.407**	0.264**	1.495**	0.243**	1.379**	0.237**
	(0.024)	(0.005)	(0.031)	(0.005)	(0.035)	(0.006)
$lndis_{ij}$	-0.565**	-0.023**	-0.533**	-0.007	-0.570**	-0.018+
	(0.028)	(0.008)	(0.035)	(0.009)	(0.040)	(0.011)
$Comrelig_{ij}$	1.334*	0.517**	0.001	0.192	1.011	0.268
	(0.584)	(0.196)	(0.733)	(0.199)	(0.852)	(0.250)
$comcol_{ij}$	0.831**	0.117**	0.807**	0.053**	0.451**	-0.002
	(0.060)	(0.018)	(0.071)	(0.018)	(0.084)	(0.023)
$colrel_{ij}$	0.657**	-0.603**	0.535*	-0.563**	0.186	-0.662**
	(0.198)	(0.078)	(0.238)	(0.076)	(0.282)	(0.096)
WTO_i	1.285**	0.448**	1.341**	0.400**	1.538**	0.456**
	(0.063)	(0.014)	(0.079)	(0.015)	(0.095)	(0.018)
WTO_i	0.449**	0.028	0.560**	0.067**	0.081	-0.006
	(0.062)	(0.019)	(0.059)	(0.015)	(0.081)	(0.022)

$lnarea_j$	-0.146**	0.002	-0.179**	0.017**	-0.173**	0.006
	(0.012)	(0.004)	(0.016)	(0.004)	(0.017)	(0.004)
$lnarea_i$	-0.318**	-0.059**	-0.177**	-0.029**	-0.416**	-0.092**
	(0.016)	(0.005)	(0.020)	(0.005)	(0.025)	(0.006)
$lnentrycost_{it}$		-0.287**		-0.222**		-0.298**
		(0.022)		(0.032)		(0.024)
lan_{ij}	1.679**	0.405**	1.874**	0.411**	1.960**	0.457**
	(0.055)	(0.016)	(0.069)	(0.016)	(0.085)	(0.021)
Sea_i	1.620**	0.335**	1.040**	0.117**	0.991**	0.098**
	(0.050)	(0.013)	(0.060)	(0.015)	(0.064)	(0.017)
RTA_{ij}	3.351**	0.750**	3.377**	0.699**	3.207**	0.687**
	(0.070)	(0.025)	(0.088)	(0.025)	(0.101)	(0.030)
$ln(eco\_institutionst_i)$	0.368**	0.093**				
	(0.029)	(0.093)				
$ln(border\_transport_{it})$			-1.244**	-0.405**		
			(0.079)	(0.018)		
ln(physical_ communication$_{it}$)					0.329**	0.053**
					(0.045)	(0.012)
_cons	-10.023**	-3.740**	-11.885**	-3.735**	-8.695**	-3.067**
	(0.490)	(0.091)	(1.394)	(0.316)	(0.675)	(0.109)
Mills ratio	3.890**		4.754**		4.171**	
	(0.152)		(0.196)		(0.229)	
No. ob	69,319		66,156		41,491	
Cencered	27,067		26,762		17,446	

Source: Regression results, ** significant at 1%, * significant at 5%, + significant at 10%, standard error in parenthesis, i=1,…, 44 and j=1,…,173 indicate the reporter and partner country, respectively. All specifications include time fixed effects and MRT corrections for bilateral trade cost variables.

The estimated coefficients of all standard trade flow variables are significant and their signs are consistent with the predictions of the gravity model for both outcome and selection equations except for colonial relationship between trader and partner countries as its effect on extensive margin is significant and negative. The economic size represented by GDP per capita of the African countries and their trade partner countries significantly determine trade flow of African countries and their probability to trade. Their effect is positive and significant at 1% level of significance. Geographical distance between African countries and their trade partners has significant negative effect on both intensive and extensive margins indicating that physical distance discourages volume of trade and probability to trade. This result is consistent with the theory that the shorter the distance, the lower the transaction costs and the more the trade among countries. Population density of African countries and their trade partner countries have significantly positive effect on trade flow of African countries. They have robust effect on both intensive and extensive margins. Furthermore, WTO membership for African countries and their trade partners have a significant positive effect on trade flow and

likelihood of trade in all specifications. This result is congruent with the view that WTO accurately promotes trade flow and enhances trade integration among member countries. The coefficient of common language is statistically significant and positive indicating that countries with common language have more trade flow compared to countries with different languages. The coefficients of common colony are robust positive indicating that countries which have common colony trade more and participate in trade integration compared to countries which have no common colony. Similarly, the coefficient of colonial relationship has positive effect on intensive margin implying that colonial relationship significantly affects volume of trade. However, it has negative effect on extensive margin. The coefficients of common religion between African countries and their trade partners are positive but not significant at conventional level. The other important traditional gravity variables significantly affecting trade flow of African countries are access to sea and regional trade agreement. The coefficients of both access to sea and regional trade agreement are positive showing that countries which have access to sea and countries member to regional trading blocs trade more and will have higher probability to trade compared to countries which have no access to sea and are not member of regional trading blocs.

Turning to our explanatory variables of main interest, border and transport efficiency indicator has highly significant negative effect on trade flow of African countries. It has also strong effect on probability to trade. Its effect is significant at 1% level of significance indicating that improving border and transport efficiency will have significantly positive influence on trade volume and probability of trade for African countries. This result is reasonable because according to world development indicator of World Bank database, most countries that require the highest number of documents to import and export and relatively longer time to trade are located in Africa.

The impact of physical and communication infrastructure of African countries on trade flow is robust positive. This result is steady with the view that the better the communication infrastructure the more accessible information about the foreign market. Acquiring important information in turn benefits traders by decreasing the costs of trade. Therefore, increasing telephone subscriptions and internet user penetration reduces transport and transit costs of trade and boosts trade performance of African countries. Likewise, quality of physical infrastructure of African countries has also significant positive effect on trade flow of African countries. Hence, improvement in a country's quality of physical and communication infrastructure can make a significant difference to the trade

performance of African counties. Similarly, the effect of quality of institutions on trade flow is robust positive. This implies that improving quality economic and governance institutions enhances trade flow and positively contributes to the probability of countries to trade.

In addition, we estimate an interaction term for quality of institutions, border and transport efficiency and physical and communication infrastructure with respect to GDP per-capita of African countries. All interaction terms are statistically significant. The marginal effect of the quality of economic institutions, physical and communication infrastructure on trade flow seems to be increasing in GDP per capita. In contrast, the marginal effect of border and transport efficiency on trade decreases in GDP per capita (Table 9 in appendix C). Hence improvement in quality of institutions and physical and communication infrastructure highly important for relatively richer African countries and border whereas improvement border and transport efficiency is increasingly important to African countries with relatively lower GDP per capita income.

4.2.The impacts of border and transport efficiency, quality of institutions, physical and communication infrastructure on Intra-Africa Trade

African trade is more dominated by extra-Africa trade. However, intra-Africa trade shares less than 12% of Africa's total trade which is extremely low compared to intra-regional trade in other parts of the world. We run separate estimation constraining trade flow to intra-Africa. As the coefficient of entry cost is robust negative, countries with high market entry cost have less probability to trade. This result is important because to find stable and robust results, exclusion restriction variables should have the coefficients that are statistically significant at conventional levels. The Mills ratio is also statistically significant implying that there is existence of sample selection bias and strongly supports our exercise.

Table 2: The impacts of border and transport efficiency, quality of economic institutions, physical and communication infrastructure on intra-Africa trade

Variable	I (a) Outcome	I(b) Selection	II (a) Outcome	II (b) Selection	III(a) Outcome	III(b) Selection
$lngdpc_{it}$	1.007**	0.240**	0.979**	0.155**	1.050**	0.214**
	(0.045)	(0.014)	(0.047)	(0.014)	(0.068)	(0.016)
$lngdpc_{jt}$	0.832**	0.305**	0.969**	0.294**	0.948**	0.261**
	(0.050)	(0.014)	(0.060)	(0.013)	(0.073)	(0.015)

$lnpop_{it}$	1.685**	0.476**	1.751**	0.401**	1.829**	0.444**
	(0.068)	(0.014)	(0.075)	(0.013)	(0.115)	(0.018)
$lnpop_{jt}$	0.868**	0.332**	1.040**	0.316**	1.001**	0.327**
	(0.056)	(0.016)	(0.067)	(0.015)	(0.090)	(0.018)
$lndis_{ij}$	-0.438**	0.072**	-0.415**	0.056**	-0.364**	0.084**
	(0.053)	(0.021)	(0.059)	(0.019)	(0.077)	(0.025)
$Comrelig_{ij}$	5.043**	0.899*	3.529**	-0.452	4.748**	-0.603
	(0.975)	(0.460)	(1.139)	(0.398)	(1.461)	(0.507)
$comcol_{ij}$	1.116**	0.587**	0.942**	0.353**	0.815**	0.353**
	(0.116)	(0.036)	(0.115)	(0.032)	(0.158)	(0.045)
WTO_i	1.382**	0.270**	1.354**	0.241**	1.502**	0.329**
	(0.093)	(0.030)	(0.104)	(0.029)	(0.147)	(0.036)
WTO_i	1.365**	0.129**	1.422**	0.255**	0.920**	0.081+
	(0.109)	(0.042)	(0.108)	(0.030)	(0.151)	(0.046)
$lnarea_j$	-0.105**	-0.077**	-0.134**	-0.059**	-0.145**	-0.076**
	(0.030)	(0.011)	(0.034)	(0.011)	(0.043)	(0.013)
$lnarea_i$	-0.348**	-0.153**	-0.233**	-0.060**	-0.426**	-0.152**
	(0.033)	(0.010)	(0.034)	(0.010)	(0.054)	(0.013)
$lnentrycost_{it}$		-0.371**		-0.265**		-0.292**
		(0.078)		(0.074)		(0.056)
lan_{ij}	0.757**	0.049	1.059**	0.191**	1.116**	0.213**
	(0.086)	(0.033)	(0.100)	(0.030)	(0.136)	(0.042)
Sea_i	1.562**	0.379**	1.186**	0.159**	1.286**	0.185**
	(0.091)	(0.028)	(0.099)	(0.030)	(0.123)	(0.036)
RTA_{ij}	2.920**	0.486**	3.146**	0.531**	2.945**	0.484**
	(0.090)	(0.031)	(0.115)	(0.030)	(0.144)	(0.038)
$ln(eco\_institutions_{it})$	0.483**	0.155**				
	(0.053)	(0.018)				
$ln(border\_transport_{it})$			-1.314**	-0.511**		
			(0.141)	(0.038)		
$ln(physical\_communicati_{it})$					0.203*	-0.026
					(0.080)	(0.025)
_cons	-6.322**	-2.355**	-9.728**	-2.399*	-6.747**	-2.624**
	(0.834)	(0.248)	(3.452)	(0.981)	(1.188)	(0.245)
Mills ratio	2.657**		3.772**		3.349**	
No. ob	(0.299)		(0.356)		(0.499)	
Cencered	15,611		16,351		9,624	
	4,903		5,891		3, 388	

Source: Regression results, ** significant at 1%, * significant at 5%, + significant at 10%, # variables included in exclusion restriction model, standard error in parenthesis, i=1,…, 44 and j=1,…,44 indicate the reporter and partner country, respectively. All specifications include time fixed effects and MRT corrections for bilateral trade costs variables

Our results in Table 2 disclose that the coefficients of all standard trade flow variables are significant and their signs are consistent with the predictions of the gravity model for both outcome and selection equations. In addition, the coefficient of common religion is changed to positive and significant.

Coefficients of border and transport efficiency variable is negative and significant at 1% level of significance. Quality of institutions has also robust positive effect on volume of trade and probability to trade. Furthermore, improvement in physical and communication infrastructure enhances intra-Africa. However, its effect on extensive margin is insignificant.

5. Robustness Check and Counterfactual Estimation

5.1.Robustness Check

According to some literatures there will be reverse causality between infrastructure and trade. The same problem will happen between institutional quality and trade. That is efficiency of infrastructure and institutional quality will be driven by trade integration and trade integration can also be driven by good institutions and quality of infrastructure. However, the infrastructure and quality of institutions will have more direct and immediate effect on the likelihood of trade and volume of trade. On the other hand, the effect of trade on improvement of institutional quality and infrastructure is less direct and sluggish to be recognized (Portugal-Perez and Wilson, 2012). Though the existence of reverse causality is less, examining the possibility that our results are driven by reverse causality is worthwhile. To address this problem we did four things. First, we aggregate infrastructure indicators by principal component analysis that partly reduces the endogeneity problem. Second, we run a model constraining to only intra-Africa trade that we spell out in Table 2. Excluding these countries will limit trade flow of African countries to only 12% of our sample. When extra-Africa trade partners are excluded, the correlation between infrastructure and trade should become weaker if there is reverse causality (Donaubauer, Glas and Nunnenkamp, 2015). The underlying assumption is that Africa's trade with its major trade partners is relatively important to drive the demand for better infrastructure and, thus, provide relevant incentives to improve the countries' endowment with infrastructure and institutional quality. Our results in Table 2 prove to be robust to the exclusion of extra-Africa major trade partners or controlling only to intra-Africa trade. Almost all control variables are hardly affected when we exclude these countries suggesting our findings are unlikely to suffer from serious reverse causality problems.

Finally, we conduct IV estimator to control for endogeneity. Physical and communication infrastructure, border and transport efficiency indicators are instrumented by civil liberty, government fractionalization and checks and balance, respectively following works of Donaubauer, Glas and Nunnenkamp (2015) and Lin (2015) who used these variables as an instrument for

infrastructure and internet. Furthermore lagged values of time varying explanatory variables are used as instruments. We add legal origin as an instrument for indicator of institutional quality (Borrmann, Busse and Neuhaus, 2006). In our analysis we consider countries with French legal origin have lower institutional quality and highly regulated business environment because the French legal origin is highly correlated with an excessive regulatory environment and may lead to lower quality institutions, particularly when the French legal system was implemented in developing countries (Djankov, La Porta, López-de-Silanes, and Shleifer, 2002). However, common law (English origin) provides the next highest quality of law enforcement and also the highest protection (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1998). Table 3 and Table 4 provide IV results for overall and intra-Africa trade. These results provide that evidence with that of our baseline results.

Table 3: The effects of quality of economic institutions, border and transport efficiency, and physical and communication infrastructure on overall trade flow (IV regression results)

Variable	I	II	III
$lngdpc_{it}$	0.595**	0.471**	0.784**
	(0.018)	(0.035)	(0.026)
$lngdpc_{jt}$	0.535**	0.620**	0.641**
	(0.010)	(0.012)	(0.016)
$lnpop_{it}$	1.266**	1.206**	1.337**
	(0.022)	(0.021)	(0.027)
$lnpop_{jt}$	0.973**	1.199**	1.235**
	(0.013)	(0.015)	(0.019)
$lndis_{ij}$	-0.488**	-0.588**	-0.604**
	(0.023)	(0.028)	(0.036)
$Comrelig_{ij}$	-0.475	-0.250	-1.139
	(0.442)	(0.542)	(0.766)
$comcol_{ij}$	0.530**	0.535**	0.554**
	(0.049)	(0.056)	(0.078)
$colrel_{ij}$	0.305**	0.058	0.063
	(0.045)	(0.056)	(0.073)
WTO_i	0.418**	0.599**	0.303**
	(0.054)	(0.050)	(0.074)
WTO_i	-0.163**	-0.239**	-0.271**
	(0.009)	(0.011)	(0.041)
$lnarea_j$	-0.214**	0.069**	-0.255**
	(0.014)	(0.024)	(0.020)
$lnarea_i$	1.833**	1.468**	1.419**
	(0.117)	(0.104)	(0.140)
lan_{ij}	0.972**	1.184**	1.215**
	(0.041)	(0.045)	(0.059)
Sea_i	1.127**	0.683**	0.983**
	(0.039)	(0.063)	(0.069)

RTA_{ij}	2.487**	2.827**	2.860**
	(0.045)	(0.050)	(0.064)
$ln(eco\_institutions_{it})$	1.616**		
	(0.144)		
$ln(border\_transport_{it})$		-1.626**	
		(0.147)	
$ln(physical\_communication_{it})$			0.433**
			(0.129)
Cons	-0.644**	0.896**	-0.223
	(0.238)	(0.332)	(0.344)
Obs.	48,675	31,989	18,922
R2	0.324	0.449	0.456
Wald	0.000	0.000	0.000

Source: Regression results, **significant at 1%, *significant at 5%, +significant at 10%, robust standard error in parenthesis, i=1,… ,44 and j=1,…,173 indicate the reporter and partner country, respectively. All specifications include time fixed effects.

Table 4: The effects of quality of economic institutions, border and transport efficiency, and physical and communication infrastructure on intra-Africa trade (IV regression)

Variable	I (a) Outcome	II (a) Outcome	III(a) Outcome
$lngdpc_{it}$	0.582**	0.186**	0.680**
	(0.033)	(0.061)	(0.050)
$lngdpc_{jt}$	0.453**	0.530**	0.595**
	(0.027)	(0.032)	(0.041)
$lnpop_{it}$	1.233**	1.131**	1.348**
	(0.041)	(0.039)	(0.054)
$lnpop_{jt}$	0.483**	0.528**	0.607**
	(0.031)	(0.040)	(0.050)
$lndis_{ij}$	-0.592**	-0.606**	-0.597**
	(0.043)	(0.053)	(0.066)
$Comrelig_{ij}$	4.169**	3.637**	6.935**
	(0.848)	(1.050)	(1.334)
$comcol_{ij}$	0.441**	0.213*	0.350**
	(0.081)	(0.092)	(0.132)
WTO_i	0.923**	0.757**	0.609**
	(0.075)	(0.087)	(0.120)
WTO_i	1.292**	1.374**	1.188**
	(0.105)	(0.098)	(0.136)
$lnarea_j$	0.000	0.028	-0.049
	(0.024)	(0.031)	(0.039)
$lnarea_i$	-0.191	0.240**	-0.283**
	(0.028)	(0.047)	(0.044)
lan_{ij}	0.740**	0.978**	0.999**
	(0.079)	(0.089)	(0.126)

Sea_i	1.249**	0.508**	1.135**
	(0.071)	(0.110)	(0.141)
RTA_{ij}	2.551**	2.874**	2.844**
	(0.066)	(0.075)	(0.104)
$\ln(eco\_institutions_{it})$	1.498**		
	(0.260)		
$\ln(border\_transport_{it})$		-2.933**	
		(0.253)	
$\ln(physical\_communicati_{it})$			0.728*
			(0.295)
Cons.	-1.797**	1.107+	-1.480*
	(0.491)	(0.586)	(0.715)
Ob.	12,851	8304	4924
	0.311	0.376	0.407
	0.000	0.000	0.000

Source: Regression results, ** significant at 1%, * significant at 5%, + significant at 10%, robust standard error in parenthesis, i=1,… , 44 and j=1,…,44 indicate the reporter and partner country, respectively. All specifications include time fixed effects.

5.2.Counterfactual Analysis

Based on our estimates in Table 1 we simulate the effects of border and transport efficiency, quality of economic institutions and physical and communication infrastructure on trade flow to the best performing country in the sample. This simulation indicates the percent of the average African economy would gain by improving these indicators to the best performer (Table 5). To show how these counterfactuals are estimated, for example, suppose that a reform on border and transport efficiency of African countries leads to a 1 percent increase in the in border and transport efficiency index. This in turn results in $\widehat{\beta}_{border\_transport}$ percent improvement in trade performance. The percentage change in trade flows made by improvement in border and transport efficiency of African countries to the best performing country can be converted to distance equivalent value using $\frac{\widehat{\beta}_{border\_transport}}{\widehat{\beta}_{distance}}$. For instance, if a reform is made to improve transport efficiency of average African economies to the Mauritius (the best performing country in border and transport efficiency), trade flow would be improved by 7.43 percent. This improvement in trade would be equivalent to a reduction of 13.92 percent or 984.12 km in distance. Similarly, improvement in institutional quality of average African economies to the Botswana (the best performing country in quality of institutions), trade flow would be enhanced by 9.85 percent that is equivalent to reduction of 17.43 percent and 1234.0 km in distance. The effect of physical and communication infrastructure is relatively the highest compared

to the effect of quality of institutions and border and transport efficiency. A reform that results in improvement of physical and communication infrastructure of African countries to South Africa, trade would improve by 9.61 percent. This figure translates to a distance equivalence of 18.68 percent and 1322.5 km reduction.

Table 5: Simulation results

Policy Variables	Trade flow (percent)	Distance reduction (percent)	Distance equivalence (km)
Border_transport	7.43	13.92	985.5
Physical_ communication	9.61	18.68	1322.5
Quality of eco_institutions	9.85	17.43	1234.0

Source: Computed by authors

6. Conclusion

In this paper we examine the impact of quality of institutions, border and transport efficiency, physical and communication infrastructure indicators on overall and intra-Africa trade for a dataset covering all Africa's trade partners. Our study covers 44 African countries as reporter and 173 trade partner countries. We use twostep Heckman (1979) sample selection procedure that allows for a two-stage decision process through estimating extensive and intensive margins simultaneously avoiding any bias involved because of sample selection and omission of the extensive margin. We also examine the impact of institutional quality and infrastructure controlling alternative variables from different sources and restricting sample of trade flow to intra-Africa trade (less than 12%). In addition, we conduct robustness check for endogeneity using IV estimator. IV method is applied using check and balance, government fractionalization, Civil liberty and legal origin and lagged values of time varying independent variables as instruments for physical and communication infrastructure, border and transport efficiency and institutional quality indicators. As this test discloses our results are proven to be robust.

Controlling for different traditional gravity variables, we find that infrastructure and institutional quality variables are significant determinants not only of trade flow, but also of the probability of African countries to trade. Quality of physical and communication infrastructure has robust positive effect on trade flow and probability of African countries to trade. Hence improvement in efficiency of physical and communication infrastructure boosts trade performance of African countries. The

results further indicate that both intensive and extensive margins are significantly affected by cross-border trade procedures and transport efficiency of African countries. Our results also disclose that improvement in quality of institutions of African countries is an important determinant of trade performance of African countries. In addition, the marginal effect of the quality of economic institutions, physical and communication infrastructure on trade flow seems to be increasing in GDP per capita and the marginal effect of border and transport efficiency on trade decreases in GDP per capita. Our counterfactual analysis show that improvements in quality of institutions, border and transport efficiency, physical and communication infrastructure to the best performing country in the sample can have considerable effect on trade flow of African economies.

To conclude, our results disclose that improvement in the efficiency of physical and communication infrastructure, border and transport efficiency and quality of institutions do not just influence the volume of trade for African countries, but also the probability that countries participate in trade. We can draw the following policy conclusion from our findings. To increase the volume of trade and integrate African countries with the rest of world and to facilitate intra-Africa trade, it is significantly important to improve quality of domestic institutions of African countries, physical and communication infrastructure, border and transport efficiency together because relying on investment of physical infrastructure without equally emphasizing on border and transport efficiency and institutional quality may not help reduce cost of trade in African countries and may not facilitate their trade performance.

APPENDIX

Appendix A

Table 6: Source and definition of some important variables

Variable	Source	Unit of measurement
$Flow_{ijt}$	DOTS	Trade flow (dependent variable
Traditional gravity variables		
$gdpca_i$	WDI	Per capita GDP of African countries
pop_i	CEPII	Total population of African countries in million
gdp_{ct}	WDI	Per capita GDP of trade partners
dis_{ict}	CEPII	Distance between capitals of African countries

		and trade partners
pop_{jt}	CEPII	Total population of Trade partner countries' in million
$Comcol_{it}$	CEPII	Common colony
Col_{ij}	CEPII	Colonial relationship
Lan_{ij}	CEPII	Common language
$Comrelig_{ij}$	CEPII	Common religion
RTA_i	CEPII	Regional trade agreement
$Area_i$	CEPII	Areal size of African countries
$Area_j$	CEPII	Areal size of trade partner countries
Quality of economic institutions indicators		
cc_{it}	WGI	Control of corruption
rl_{it}	WGI	Rule of law
$stab_{it}$	WGI	Absence of violence and instability
va_{it}	WGI	Voice and accountability
rq_{it}	WGI	Regulatory quality
ge_{it}	WGI	Government effectiveness
$Soundmoney_{it}$	Fraser Institute	Sound money
$Regulation_{it}$	Fraser Institute	Business, credit and labor market regulation
$Intfree_{it}$	Heritage Foundation	Trade internationally freedom index
$Propertyright_{it}$	Fraser Institute	Property right
$Legelaenfo_{it}$	Fraser Institute	Legal enforcement
$Government_{it}$	Fraser Institute	Size of government in the economy
Entry cost indicators		
$Costs_{it}$	World Bank	Cost to start business
$Proc_{it}$	World Bank	Procedure to start business
$Time_{it}$	World Bank	Time to start business
Border and transport efficiency indicators		
$Docim_{it}$	WDI	Document to import
$Docex_{it}$	WDI	Document to export
$Timport_{it}$	WDI	Time to import

$Texport_{it}$	WDI	Time to export
Physical and ICT infrastructure indicators		
$Internet\_subscription_{it}$	WDI	Internet users (per 100 people) for reporter
$Railway\_quality_{it}$	QOG	Quality of railway infrastructure
$Air\_quality_{it}$	QOG	Quality of airways
Road $\_quality_{it}$	QOG	Quality of road
$Telecommunication_{it}$	WDI	Fixed telephone subscriptions (per 100 people)

Appendix B

Principal Component Analysis

We prefer this method because it allows us to apply a purely mathematical transformation without taking into account any priors about the underlying data structure. We have derived four aggregate indicators (entry cost, quality of economic institutions, border and transport efficiency and physical and communication infrastructure) from 24 single variables using principal component analysis that aim to reduce the dimensionality in data. It changes the data into new aggregate variables. To derive these indicators we used variables mentioned in Table 6. The information available in a group of variables is summed up by a number of mutually independent principal components. Each principal component is essentially the weighted average of the variables included. The eigenvalues and the components are given in Table 7 below. The eigenvalues are the variances of the principal components. The first principal component usually has the maximum variance for any of the combination. Similarly, in all cases the Kaiser-Meyer-Olkin Measure (KMO) of sampling adequacy is used to check for the appropriateness of the PCA, this is greater than the minimum KMO criteria of 0.50 for PCA analysis.

Table 7: Principal component analysis

Political and governance index

Component	**PC 1**	**PC 2**	**PC 3**	**PC 4**	**PC 5**	**PC 6**	**PC7**	
Eigenvalue	4.610	0.872	0.664	0.505	0.172	0.091	0.087	
Proportion	0.659	0.125	0.095	0.072	0.025	0.013	0.013	
Cumulative	0.659	0.783	0.878	0.950	0.975	0.988	1.000	
	Eigenvectors							
Variable	Vector 1	Vector 2	Vector 3	Vector 4	Vector 5	Vector 6	Vector	KMO

						7		
Voice_accountability	0.274	-0.593	0.709	0.124	0.178	0.151	-0.040	0.768
Rule of law	0.444	0.020	-0.174	-0.066	-0.075	-0.002	-0.873	0.860
corruptioncontrol	0.420	-0.018	-0.295	-0.155	0.792	-0.195	0.216	0.917
Gov.effectiveness	0.424	-0.041	-0.174	-0.420	-0.294	0.659	0.305	0.837
Regu.qualirty	0.433	0.054	0.189	-0.237	-0.439	-0.683	0.242	0.807
Stability	0.350	-0.122	-0.328	0.824	-0.195	0.030	0.194	0.874
economicfreedom	0.249	0.793	0.456	0.213	0.137	0.194	0.026	0.693
Overall KMO								0.838

ICT and physical infrastructure quality

Component	PC1	PC2	PC3	PC4	PC4	
Eigenvalue	2.562	1.339	0.699	0.322	0.078	
Variance Proportion	0.512	0.268	0.140	0.064	0.016	
Cumulative Proportion	0.512	0.780	0.920	0.984	1.000	
Eigenvectors						
Variable	Vector 1	Vector 2	Vector 3	Vector4	Vector5	KMO
Internet subscription	0.106	0.702	-0.637	0.289	0.080	0.366
Railway quality	0.599	0.020	-0.108	-0.303	-0.733	0.612
Air quality	0.529	-0.121	0.315	0.776	0.062	0.838
Road quality	0.591	-0.053	-0.073	-0.436	0.673	0.647
Tel_subscription	0.013	0.699	0.692	-0.180	0.002	0.456
Overall KMO						0.642

Component	PC1	PC2	PC3	PC4	
Eigenvalue	2.619	1.034	0.283	0.064	
Proportion	0.655	0.259	0.071	0.016	
Cumulative	0.660	0.913	0.984	1.000	
Variable	Vector 1	Vector 2	Vector 3	Vector 4	KMO
Document to export	0.467	0.537	0.675	-0.196	0.517
Document to import	0.477	0.515	-0.668	0.248	0.486
Time to export	0.536	-0.445	-0.215	-0.685	0.504
Time to import	0.517	-0.498	0.230	0.657	0.493
Overall KMO					0.500

Entry cost index				
Component	PC1	PC2	PC3	
Eigenvalue	1.658	0.842	0.500	
Proportion	0.553	0.281	0.167	
Cumulative	0.553	0.833	1.000	
Variable	Vector 1	Vector 2	Vector 3	KMO
entry_cost	0.442	0.894	0.067	0.730
entry_procedure	0.627	-0.362	0.690	0.557

entry_time	0.641	-0.263	-0.721	0.553
Overall KMO				0.576

Source: Computed by authors

Table 8: Summary of variables

Variable	Obs	Mean	Std.	Min	Max
$Distw_{ij}$	113565	7080.2	3831.6	188.3	19603.1
Pop_{it}	113565	19.7	26.9	0.1	177.5
Pop_{jt}	113565	37.6	137.2	0.0	1364.3
$Gdpc_{it}$	113393	1985.7	2705.5	112.2	16185.9
$Gdpc_{jt}$	111410	11890.8	17012.6	112.2	100819.0
$Area_i$	113565	601614.5	611652.8	455.0	2500000.0
$Area_j$	113565	747532.5	2012407.0	25.0	17000000.0
$Colony_{ij}$	113565	0.0	0.1	0	1
$Comrelig_{ij}$	113565	0.2	0.2	0	1
WTO_i	113565	0.8	0.4	0	1
WTO_j	113565	0.8	0.4	0	1
RTA_i	113565	0.1	0.3	0	1
$Landlocked_i$	113565	0.7	0.4	0	1
$Comcol_{ij}$	113565	0.1	0.4	0	1
$Eco\_Instituions_{it}$	83974	0.0	2.1	-5.1	5.6
$Border\_Transport_{it}$	71909	0.0	1.6	-3.1	6.4
$Physical\_communication_{it}$	43645	0.0	1.6	-3.2	3.9

Source: Computed by authors

Appendix C

Table 9: Marginal effects of quality of economic institutions, transport efficiency and infrastructure on trade flow

Variables	I(a) Outcome	I(b) Selection	II(a) Outcome	II(b) Selection
$lngdpc_{it}$	1.146**	0.166**	0.331*	-0.072+
	(0.044)	(0.008)	(0.142)	(0.038)
$lngdpc_{jt}$	0.953**	0.209**	0.907**	0.212**
	(0.036)	(0.006)	(0.032)	(0.006)
$lnpop_{it}$	2.038**	0.343**	2.037**	0.378**
	(0.064)	(0.009)	(0.059)	(0.010)
$lnpop_{jt}$	1.466**	0.232**	1.407**	0.234**
	(0.044)	(0.006)	(0.039)	(0.006)
$lndis_{ij}$	-0.635**	-0.038**	-0.596**	-0.029*
	(0.051)	(0.011)	(0.045)	(0.012)
$Comrelig_{ij}$	2.601*	0.999**	2.818**	1.015**

	(1.083)	(0.267)	(0.963)	(0.271)
$comcol_{ij}$	0.585**	0.013	0.675**	0.038
	(0.109)	(0.025)	(0.096)	(0.025)
$colrel_{ij}$	-0.141	-0.705**	0.070	-0.694**
	(0.363)	(0.102)	(0.319)	(0.103)
WTO_i	1.871**	0.484**	1.720**	0.487**
	(0.126)	(0.020)	(0.110)	(0.020)
WTO_i	0.154	-0.065*	0.203+	-0.040
	(0.127)	(0.030)	(0.113)	(0.030)
$lnarea_j$	-0.155**	0.010*	-0.157**	0.010*
	(0.021)	(0.005)	(0.019)	(0.005)
$lnarea_i$	-0.370**	-0.055**	-0.317**	-0.056**
	(0.037)	(0.008)	(0.037)	(0.009)
$lnentrycost_{it}$		-0.203**		-0.205**
		(0.028)		(0.029)
lan_{ij}	2.139**	0.460**	1.939**	0.444**
	(0.111)	(0.024)	(0.097)	(0.024)
Sea_i	0.901**	0.048*	1.709**	0.187**
	(0.086)	(0.019)	(0.103)	(0.027)
RTA_{ij}	3.193**	0.641**	3.001**	0.639**
	(0.125)	(0.032)	(0.109)	(0.032)
$ln(econ\_institutions_{it})$	0.484**	0.072**	-4.871**	-0.910**
	(0.062)	(0.014)	(0.580)	(0.153)
$Ln(border\_transport_{it})$	-0.977**	-0.330**	4.313**	0.358*
	(0.129)	(0.028)	(0.586)	(0.151)
$ln(physical\_communication_{it})$	0.284**	0.045**	-2.029**	-0.669**
	(0.061)	(0.014)	(0.328)	(0.083)
$ln(econ\_institutions_{it})$* $lngdpc_i$			0.727**	0.134**
			(0.082)	(0.021)
$Ln(border\_transport_{it})$*$lngdpc_i$			-0.625**	-0.082**
			(0.074)	(0.019)
$ln(physical\_communication_{it})$*$lngdpc_i$			0.284**	0.091**
			(0.044)	(0.011)
Cons.			-5.624**	-1.546**
			(1.378)	(0.344)
Mills ratio	5.217**		4.602**	
	(0.304)		(0.263)	
No. observations	36,245		36,245	
Censured obs.	14,561		14,561	

Source: Regression results, ** significant at 1%, * significant at 5%, + significant at 10%, # variables included in exclusion restriction model, robust standard error in parenthesis, i=1,… , 44 and j=1,…,173 indicate the reporter and partner country, respectively. All specifications include time fixed effects and MRT terms.

Appendix D

List of countries

African countries: AGO, BEN, BFA, BWA, CIV, CMR, COG, COM, CPV, DJI, DZA, EGY, ETH, GAB, GHA, GIN, GMB, GNB, KEN, LBR, LBY, MAR, MDG, MLI, MOZ, MRT, MUS, MWI, NAM, NER, NGA, RWA, SDN, SEN, SLE, SYC, TCD, TGO, TUN, TZA, UGA, ZAF, ZMB and ZWE

Trade partner countries : ABW, AFG, ALB, ARE, ARG, ARM, AUS, AUT, AZE, BEL, BEN, BFA, BGD, BGR, BHR, BHS, BIH, BLR, BLZ, BMU, BOL, BRA, BRB, BRN, CAN, CHE, CHL, CHN, CIV, CMR, COG, COL,COM, CPV, CRI, CUB, CYP, CZE, DEU, DJI, DMA, DNK, DOM, DZA, ECU, EGY, ESP, EST, ETH, FIN, FJI, FRA, FRO, GAB, GBR, GEO, GHA, GIN, GMB, GNB, GNQ, GRC, GRD, GRL, GTM, GUY, HKG, HND, HRV, HTI, HUN, IDN, IND, IRL, IRN, IRQ, ISL, ISR, ITA, JAM, JOR, JPN, KAZ, KEN, KGZ, KHM, KNA, KOR, KWT, LAO, LBN, LBR, LBY, LCA, LKA, LTU, LVA, MAC, MAR, MDA, MDG, MDV, MEX, MKD, MLI, MLT, MMR, MNG, MOZ, MRT, MUS, MWI, MYS, NCL, NER, NGA, NIC, NLD, NOR, NPL, NZL, OMN, PAK, PAN, PER, PHL, PNG, POL, PRK, PRT, PRY, QAT, ROM, RUS, RWA, SAU, SDN, SEN, SGP, SLB, SLE, SLV, STP, SUR, SVK, SVN, SWE, SYC, SYR, TCD, TGO, THA, TJK, TKM, TON, TTO, TUN, TUR, TZA, UGA, UKR, URY, USA, UZB, VCT, VEN, VNM, VUT, WSM, YEM, ZAF, ZMB and ZWE

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