Effect of Trade on Income Inequality in sub-Saharan Africa: A note

Ogundari, Kolawole

14 October 2021

Effect of Trade on Income Inequality in sub-Saharan Africa: A note

Kolawole Ogundari
Education Research and Data Center
Olympia, Washington State USA
Email: ogundarikolawole@daad-alumni.de

Abstract

The paper examines the effect of trade on income inequality in sub-Saharan Africa (SSA) countries. We employ a balanced panel of 11 countries covering 1980-2008 and use a fractional regression model for panel data as a method of estimation. The empirical results show that trade decreases income inequality, which might be an indication that our findings support the Stolper-Samuelson (SS) theorem in the Heckscher-Ohlin (HO) model in SSA. We also found evidence that lack of democracy (i.e., the existence of autocracy) increases income inequality, while higher educational attainment decreases income inequality in the study.

Keywords: fractional regression, income inequality, education, political right, trade, SSA

JEL classification: C5, F1, I3

1. Introduction

Inequality in income and wealth distribution are endemic in sub-Saharan African (SSA) countries-considered regions with the least progress in improving living standards (World Bank, 2015). Available statistics show that 6 out of 10 countries with the highest level of inequality in the world are in SSA. At the same time, Africa ranks second after Latin America in terms of inequality in the world (AfDB, 2012). Kayizz-Mugerwa (2001) noted that Africa accounts for a large share of the world's people living in absolute poverty. These observations make improvements in wellbeing in developing countries an important priority to international organizations such as World, African Development Bank, Nations Development Agencies, non-governmental organizations (NGOs), and political activists worldwide.

The role of trade in reducing income inequality in developing countries has long been

reiterated in the literature. Stolper-Samuelson theorem in the Heckscher-Ohlin model is a typical framework that shows how trade could help reduce income inequality (Feenstra, 2004). One of this theorem's assumptions is that trade can provide scope for economic growth and poverty reduction in developing countries where labor is an abundant cheap resource. However, one of the significant implications of the theorem is the argument that trade liberalization decreases income inequality in developing countries because trade can increase the real return to the relatively abundant factor (Li and Fu, 2016). However, this assumption depends on the types of goods being traded (Feenstra, 2004). For instance, if developing countries trade more of primary goods such as cocoa, coffee, tea, cotton, and timber, among others, which employ relatively low skilled labor, the theorem will be most likely to hold. The opposing argument to this theorem has been that even if globalization via international trade is expected to lower absolute poverty, it is conditional on the fact that trade does not affect income inequality but fosters economic growth (Ravillion, 2004). But we believe that globalization is a double-edged sword because the effect of trade on income inequality can still be put into perspective.

According to Harrison et al. (2010) and Lee and Wei (2015), there has been a rise in income inequality despite trade expansion in developing countries in recent time. And, this has led economists to think beyond the simple Stolper-Samuelson prediction, especially when it comes to the impact of trade on income inequality (Lin and Fu, 2016). Other important factors are associated with variation in income inequality. For instance, the role of human capital and institution quality as drivers of income inequality in developing countries has been reported in the literature (Kosack and Tobin, 2015; Islam 2016; Mahmood and Noor, 2014). Also, whether or not trade influences income inequality depends on the pattern of growth followed by the global economic policy (Ravilion, 2004). These arguments are well supported, given the political instability and corruption reaffirm inherent volatility that has prevented governments from enacting policies that promote economic development in SSA countries. For example, lack of political freedom/democracy induces politicians to select a range of “bad policies” to enhance personal consumption and political survival at the expense of economic policies that benefit the national economy (Bueno de Mesquita et al., 2003; Knutsen, 2013).

According to Bénassy-Quéré et al., (2007), a robust political institution can better prevent conflict, increase the flow of foreign direct investment (FDI), and enhance stability necessary to ensure growth and development in developing countries. For instance, US firms are more likely to source intermediate imports or engage in trade with countries that have democratically elected governments, as noted by Pinto and Weymouth (2014). The causal relationship between economic growth and democracy/political right has been a motivation for "exporting" democracy to some countries because a lack of political right/democracy is viewed as a symptom of weak governance and could have adverse effects on economic growth (Ugur, 2013). The author reiterated further how the epidemic of corruption has also been linked to the disappearance of a significantly large number of resources in developing countries. Unfortunately, the existence of a democratic setting or political right is not a sufficient condition to ensure a corruption-free society.

The present study aims to examine the effect of trade on income inequality in SSA. The study also incorporates variables representing the political right, corruption, educational levels, and economic performance (measure per capita gross domestic product) to avoid omitted variable bias problem. A review of the literature shows that a large number of studies have been used to raise policy discussion in this direction across the globe and in SSA (Odedokun and Round 2004; Szekely and Samano, 2012; Lee et al., 2013; Chaudhry and Imran, 2013; Mahmood and Noor, 2014; Kosack and Tobin, 2015; Islam, 2016; Lin and Fu, 2016; Anyanwu et al., 2016). Despite this, we believe the present study makes a significant methodological contribution to the literature by using a recently proposed fractional regression model for panel data by Papke and Wooldridge (2008). We observed that previous studies highlighted above either employed traditional Ordinary Least Square-OLS, fixed effect regression, or dynamic generalized method of moment-GMM model. None of the studies take into account the fractional/proportion nature of Gini-coefficient often used to capture income inequality in the literature. Unfortunately, the use of these models is likely to bias estimated parameters, which thus yield inconsistent estimates, as noted by McDonald (2008).[1] Besides, we notice that only a few studies on income inequality-trade nexus recognized

[1] Many of the existence literature on the determinants of income inequality often transformed the Gini-coefficient by multiply it by 100 before taking the logarithm. This type of transformation biased the estimated parameters, as noted by McDonald (2008).

and subsequently control for endogeneity of trade. To this end, we further make a significant contribution to the literature by controlling for the endogeneity of trade when estimating inequality-trade nexus in the present study.

The remainder of the paper is structured as follows. Section 2 focuses on data, while the analytical model is presented in section 3. Section 4 reports the results and discussion, and concluding remarks are presented in section 5.

2. Data and sources

The study employs a balanced panel data from 11 countries in Sub Saharan Africa (SSA) covering the period 1980-2008.[2] Lack of data on the Gini coefficient taken as a measure of income inequality limits the coverage of the study beyond 2008. The data on Gini-coefficient obtained from the World Development Indicator (WDI) database had lots of missing years, and not all the countries from the SSA region are available in the database. Data on corruption and political indices, as well as primary, secondary, and tertiary enrolment ratios, were sourced from the CANA database (Castellacci and Natera, 2011). The corruption perception index is measured on a scale of 0 to 10, where a higher value of the index indicates low corruption and vice-versa. The political right index is measured on a scale -7 to -1, where a higher index value indicates lacks democracy or presence of autocracy vice-versa. Per capita, Gross Domestic Product (GDP) and trade openness, which represents the ratio of the sum of total import and total export divided by GDP, were obtained from the Penn World Table (PWT) database (PWT, 2013). The climate data on annual rainfall used as an instrument for trade openness in the study was obtained from the climatic research unit database (Climatic Research Unit data 2016). Table 1 presents summary statistics of the variables used in the study.

-----Table 1 Here---

3. Analytical model

[2] The 11 countries include 4 countries from West Africa (e.g., Burkina Faso, Ghana, Nigeria, and Mali), 4 countries from East Africa (e.g., Ethiopia, Rwanda, Uganda, and Tanzania), and 3 countries from Southern Africa (e.g., South Africa, Zambia, and Zimbabwe).

3.1 Empirical Specification

Guided by the relevant literature, we assume that the income inequality represented by Gini-coefficient is likely to be determined by several factors: trade, the level of human capital, and institution quality. In recognition of this, the empirical model used in the study is implicitly specified below:

$$Gini_{i,t} = \alpha_0 + \gamma_i Trade_{i,t} + \tau' X_{i,t} + \nu_i + \eta_t + \varepsilon_{i,t} \qquad 1$$

where, $Gini_{it}$ represents Gini-coefficient-a proxy for income inequality in country i at year t; $Trade$ represents trade openness; X represents vector of other determinants of income inequality which include educational level, democracy index, corruption index, per capita gross domestic product; γ and τ are parameters to be estimated; ν_i represents specific regional dummies; η_t represents time-specific dummies and ε_{it} is the error term

Because the dependent variable in Equation 1 is a fractional/proportion data by construction, we believe the use of a traditional linear fixed model, Ordinary Least Squares (OLS), or dynamic model based on a generalized method of moment (GMM) is likely to yield biased estimated parameters of the equation as noted by McDonald, (2008). Since a fractional/proportion data is bounded between 0 and 1, which means that the effect of explanatory variables tend to be non-linear and variance tends to decrease when the average value of the dependent variable get closer to one of the boundaries (Papke and Wooldridge, 1996; McDonald, 2008).[3]

Accordingly, Papke and Wooldridge (1996) argued that fractional /proportional data is better handled by a fractional regression model based on Quasi-Maximum Likelihood Estimation (QMLE) and proposed by the same authors for cross-section data. Recently, Papke and Wooldridge (2008) proposed the extension of the fractional regression model for panel data using both the Quasi-Maximum Likelihood Estimation (QMLE) and generalized estimating equation (GEE). The QMLE for panel data is employed in this study.

3.2. Endogeneity of Trade

[3] The problem in using OLS on fractional dependent variable is that it is not asymptotically efficient estimator. It is rather an unbiased and consistent estimator.

When investigating the income inequality-trade relationship, the endogeneity of trade has been long recognized in the literature (Li and Fu, 2016; Barrios et al., 2010; Frankel and Romer, 1999). However, not all-existing studies consider this (Szekely and Samano, 2012; Mahmood and Noor, 2014; Anyanwu et al., 2016, etc.). This study corrects for the endogeneity of trade by employing an instrumental variable (IV) regression technique. It made use of annual rainfall taken as an instrument for trade, following the work of Barrios et al. (2010) and Li and Fu (2016).[4] Primary commodities such as coffees, cotton, tea, cocoa, and timber, among others, dominate international trade in SSA. Based on this, we believe the choice of rainfall as an instrument is robust, given that rainfall influences the production of these primary commodities but do not have any significant contribution in determining income inequality. Li and Fu (2016) also noted that the use of rainfall is a well-accepted instrument of trade in small and poor developing economies, given that agricultural products are affected by weather conditions such as temperature and rainfall. This makes rainfall and temperature exogenous shock to income or trade in the developing regions.

4. Results and Discussion

The result of the endogeneity of trade in equation 1 was carried out by regressing trade openness on rainfall, corruption index, political index, GDP per capita, and educational enrolments using instrumental variable regression (IV regression) approach as the first stage (see: Woodridge 2009).[5] The predicted value of the trade openness from the first stage is then used as the explanatory variable in the second stage, similar to equation 1. Because the study only employs one instrument, the relevance of the instrument is based on the estimated F statistics from the first stage. However, the F-statistic obtain from the first stage is 23.81 and well beyond the rule of thumb of the critical value of 10, which shows that the instrument is sufficiently strong.

[4] Lack of detailed temperature data prevented us from also using it in this study.

[5] For the first stage: $Trade = \beta_0 + \tau Rainfall + \delta X + \mu$. For brevity, the result for the first stage is not presented in the paper but will be made available if requested from the author. The study employs rainfall data as instrument since pattern of trade in SSA is predominately agricultural goods such as timbers, cocoa, coffee etc. following the suggestion of Li and Fu (2016).

4.1. *Effect of trade on income inequality*

Table 2 present the results of the determinants of income inequality defined by Gini-Coefficient. The results show that income inequality is negatively associated with the trade. However, while the result is insignificant in model 1 when the trade is not instrumented, the estimate shows a significant result when the trade is instrumented.

The negative effect of trade on income inequality found in this study is an indication that trade expansion decreases income inequality in sub-Saharan Africa (SSA). The result aligns the Stolper-Samuelson (SS) theorem strongly in the Heckscher-Ohlin (HO) model, which proposes that income inequality decreases with the expansion of international trade in developing countries. The pattern of trade in SSA is predominantly agricultural goods such as cocoa, tea, cotton, and coffee, among others that employ relatively low-skilled labor. On this basis, we argue that our findings conform with the Stolper-Samuelson (SS) theorem in the Heckscher-Ohlin (HO) model.

4.2. *Effects of other control variables on income inequality*

Although not the study's primary focus, we also take a look at the effect of other control variables on income inequality in model 2 of Table 2. A positive coefficient of the political right shows that lack of political freedom/democracy increases income inequality in the study. The earlier result in the present study that trade is negatively associated with income inequality, coupled with the fact that lack of democracy promotes income inequality strongly aligns with the work of Lin and Fu (2016). The authors found evidence that trade expansion would likely reduce income inequality under autocracy.

The negative coefficient of corruption perception index shows that increased perception of the low level of corruption reduces income inequality in the study. These findings are similar to that of Aradhyula *et al.,*'s (2007), who found that the effectiveness of trade policy is contingent upon whether a country has a functioning democracy, conducive law and order, and free of corruption and civil thrives.

We also found that an increase in per capita GDP and educational attainment reduces

income inequality in the study area. This is because education is capable of shaping the mindset of the people. The role of education in decreasing income inequality has been stressed over the years in the literature (Mahmood and Noor, 2014).

Other results show that there is strong evidence of heterogeneity in income inequality among the countries in the regions with eastern and western African regions reporting significantly lower income inequality, compared to countries in the southern African region (the reference region). This is not surprising given that the Southern Africa region is viewed as the most inequitable sub-region in SSA (AfDB, 2012).

-----Table 2 Here---

5. Concluding remarks

The Stolper-Samuelson theorem in the Heckscher-Ohlin model provides a framework for understanding the relationship between trade and income inequality in developing countries. This theorem shows that trade decreases income inequality in developing countries since trade in primary goods can increase the real returns to the relatively abundant factor, such as the case of low-skilled workers in these countries. Accordingly, we examined the effect of trade on income inequality by controlling for other potential income inequality drivers, such as institution quality, educational level, and economic growth to avoid omitted variable bias problem.

The study employed a cross-country level data from 11 countries, which covers the period of 1980-2008. The Fractional regression for panel data with the instrument was the apparent choice of estimation because of its advantages over previous methodologies used in similar studies. We control for endogeneity of trade using rainfall as the instrument. The empirical results show that trade expansion decreases income inequality in the study area. The results of other potential drivers reveal that lack of political democracy (i.e., the existence of autocracy) increases income inequality, as a low level of corruption decreases income inequality in the study area. Higher educational attainment and per capita GDP significantly and consistently reduce income inequality in the study area.

The empirical results have shown that trade reduces income inequality in the region. Therefore, we argue that our findings support the argument of the Stolper-Samuelson theorem in the Heckscher-Ohlin model despite the contrary argument in some literature. The theorem holds that expansion of trade in primary goods would most likely reduce income inequality. Trade increases the real return to factor that is relatively abundant, such as low-skilled workforce in the region.

References

AfDB (2012). Income inequality in Africa: Brief Notes for Africa Development Bank's long- term strategy. Brief Notes No.5, March 7, 2012.

Anyanwu. J.C., A. E.O. Erhijakpor, and E. Obi (2016). Empirical Analysis of the key drivers of income inequality in West Africa. *African Development Review*, vol. 28(1): 18-38.

Aradhuula. S., T. Rahman, and K. Seenivasan (2007). Impact of International trade on income and income inequality. Selected paper prepared for presentation at the American Agricultural Economics Association Annual meeting Portland Oregon, July 29-August 1, 2007.

Barrios, S., L. Bertinelli, and E. Strobl (2010). Trends in rainfall economic growth in Africa: a neglected cause of Africa's growth tragedy. *Review of Economics and Statistics*, Vol. 92(2): 350-366.

Bénassy-Quéré, A., M. Coupet. & T. Mayer (2007) Institutional Determinants of Foreign Direct Investment. *The World Economy*, Vol. 30(5): 764-782.

Bueno de Mesquita, B., A. Smith, R. M. Siverson, and J. D. Morrow (2003). *The logic of political survival*. Cambridge, MA: MIT Press.

Castellacci, F. and J. M. Natera (2011). A new panel dataset for cross-country analyses of national systems, growth, and development (CANA), Working paper version. Available at: http://English.nupi.no/Activities/Project/CANA.

Chaudhry, I. S and F. Imran (2013). Does trade liberation reduce poverty and inequality? Empirical evidence from Pakistan. *Pakistan Journal of Commerce and Social Sciences*, Vol. 793): 569-587.

Climatic Research Unit data (2016). Annual climate data on rainfall. Available @ https://crudata.uea.ac.uk/cru/data/hrg/).(Accessed, June 14, 2016).

Feenstra, R. C. (2004). *Advanced International Trade: Theory and Evidence.* Princeton, NJ: Princeton University Press.

Feenstra, R.C, and G.H. Hanson (1996). Foreign investment, outsourcing, and relative Wages. In R. C. Feenstra, G. M. Grossman and D.A. Irwin (Eds.). *The political economy of trade*: papers in Honor of Jagdish Bhagwati (pp.89-127). Cambridge, M. A: MIT Press.

Findlay, R and H. Kierzkowski (1983). International trade and human capital: a simple general equilibrium model. *Journal of Political economy*. Vol. 91(6): 957-978.

Harrison, A., J. McLaren, and M. McMillian (2010). Recent findings on trade and inequality. NBER Working paper series No. 16425. Cambridge, M. A: National Bureau of Economic Research.

Kosack. S and J. L. Tobin (2015). Which countries' Citizen are better off with trade? *World Development*, Vol. 76: 95-113.

Kayizzi-Mugerwa, S (2001). Globalization, Growth, and income inequality: the African experience, Working paper, No. 186. OECD Development Center.

Knutsen, C. H (2013). Democracy, State Capacity, and Economic Growth. *World Development*, Vol. 43: 1-18.

Lee, H-Y., J. Kim, and B. C. Cin (2013). Empirical Analysis on the determinants of income inequality in Korean. *International Journal of Advanced Science and Technology*, Vol. 53: 95-110.

Lee, J, and D. Wei (2015). Technological change, Skill demand, and wage inequality: Evidence from Indonesia. *World Development*, Vol. 67: 238-250.

Lin, F, and D. Fu (2016). Trade, institution Quality, and income inequality. *World Development*, Vol. 77: 129-142.

Mahmood, S ad Z. M. Noor (2014). Human capital and income inequality in developing countries: New Evidence using the Gini coefficient. *Journal of Entrepreneurship and Business*, Vol. 2(1): 40-48.

McDonald, J (2008). Using Least Squares and Tobit in Second Stage DEA Efficiency Analyses. Flinders Business School Research Paper Series 2008-3 ISSN 1441-3906, Flinders University Adelaide USA.

Odedokun, M.O, and J. I. Round (2004). Determinants of income inequality and its effects on economic growth: evidence from African countries. *African Development Review*, Vol. 16(2): 287-327.

Papke. L. E and J. M. Wooldridge (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, Vol. 145: 121-133.

Papke, L. S & J. M. Wooldridge (1996). Econometric methods for fractional response variables with an application to 401(K) plan participation rates. *Journal of Applied Econometrics*, 11: 619-632.

Pinto, P. M., and Weymouth, S. (2014). Politics, Production Costs, and Offshoring: Evidence from US Imports, [online], Available at http://www.proquest.com/

PWT (2013). Peen World Table version 6.1 data. http://pwt.econ.upenn.edu

Ravillion. M (2004). Looking beyond averages in the trade and poverty debate. Policy Research Working paper series, No. 3461. The World Bank.

Szekely, M and C. Samano (2012). Did trade openness affect income distribution in Latin America? United Nations University (UNU-WIDER) Working Paper No. 2012/03.

Ugur, M (2013). Europeanization, EU conditionality, and governance quality: Empirical evidence on Central and Eastern European countries. *International Studies Quarterly*, 57 (1). pp. 41-51.

Wooldridge, J. M. (2009). *Introductory Econometrics: A Modern Approach*, 4th Edition. Mason, OH: South-Western Cengage Learning.

World Bank (2015). *World Development Indicators*, 2015. Washington, DC, World Bank.

TABLES

Table 1: Summary statistics of variables used in the study

Variables	**Unit**	**Mean**	**Std. Deviation**
Gini-Coefficient	Ratio or proportion	0.4916	0.1006
Trade Openness	(Import + Export) /GDP in ratio	0.4230	0.2506
Corruption Index	Index in 0 to10 scale	3.2498	1.0025
Political Index	Index in -7 to -1 scale	-4.8401	1.6699
GDP per capita	PPP adjusted at 2005 price	1266.2970	1505.7530
Primary Education	Enrollment in percentage	79.4944	28.2036
Secondary Education	Enrollment in percentage	24.7249	20.7716
Tertiary Education	Enrollment in percentage	4.1333	4.9774
East-Africa Region	Dummy	0.3636	0.4818
West-Africa Region	Dummy	0.3636	0.4818
South-Africa Region	Dummy	0.2727	0.4406

Note: PPP stands purchasing power parity

Table 2: Estimated results based on fractional regression for panel data

Variables	Without instrument				With instrument+			
	Model 1		Model 2		Model 1		Model 2	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Trade Openness	**-0.0891**	**0.0586**	**-0.1079****	**0.0449**	**-0.5838*****	**0.0982**	**-0.5676****	**0.2896**
Corruption Index	-	-	-0.0248**	0.0122	-	-	-0.0480***	0.0193
Political Index	-	-	0.0118*	0.0062	-	-	0.0189***	0.0063
GDP per capita	-	-	-0.0367**	0.0165	-	-	-0.0611***	0.0214
Primary Education	-	-	-0.0135	0.0277	-	-	-0.0139	0.0277
Secondary Education	-	-	-0.0975***	0.0175	-	-	-0.0093	0.0489
Tertiary Education	-	-	-0.0216*	0.0129	-	-	-0.0219*	0.0125
East-Africa Region	-0.4914***	0.0300	-0.7096***	0.0341	-0.5672***	0.0263	-0.6878***	0.0324
West-Africa Region	-0.3434***	0.0233	-0.4947***	0.0306	-0.3765***	0.0203	-0.4853***	0.0324
Constant	2.5535***	0.0599	1.07512***	0.1696	0.4919***	0.0509	1.2666***	0.2166
# of observations	319		319		319		319	
# of periods	29		29		29		29	
# of countries	11		11		11		11	
First stage F-statistics	Not Available				23.81			
Log_PSlikelihood	-143.3334		-142.5926		-143.0239		-142.5944	
Time Dummies	YES		YES		YES		YES	
Deviance	5.6628		4.1803		5.0429		4.1841	
Pearson	5.5894		4.1266		4.9748		4.1316	
1/DF (Deviance)	0.0197		0.0149		0.0175		0.0149	
1/DF (Pearson)	0.0195		0.0147		0.0173		0.0147	
AIC	1.0993		1.1322		1.0973		1.1323	
BIC	-1648.95		-1615.84		-1649.57		-1615.84	

*Note: *** 1% significant; ** 5% significant; * 1% significant; GDP per capita and educational enrollments were transformed into logarithm; +Trade openness is instrumented using annual rainfall data.*