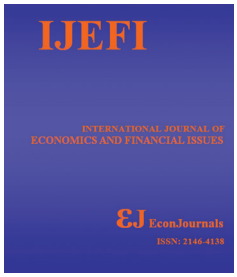


International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2023, 13(1), 13-28.

Viewpoints in Global Value Chains: Evidence from Sub-Saharan Africa

Eric Mokwaro Bosire*

College of Human Resource and Development (School of Business), Jomo Kenyatta University of Agriculture and Technology, NAIROBI, Kenya. Email: rcbosire1000@gmail.com

Received: 02 October 2022 **Accepted:** 17 December 2022 **DOI:** https://doi.org/10.32479/ijefi.13797

ABSTRACT

The aim of this paper is interrogate various perspective such as Investments, Infrastructure, Governance and Macroeconomic factors and how they influence global value chains in sub Saharan Africa. Data was derived from 37 sub Saharan Africa countries for the period 2003-2018. Panel corrected Standard Errors estimation model was adopted in analysis. Both the direct relationships and controlled relationships were tested. Macro-economic factors such as GDP growth rate, exchange rate, inflation rate and Interest rates were used as controlling factors. The paper established a significant influence of Investments on Global value chains and that it can explain up to 45% of the variation. Similarly, infrastructure has a significant influence on global value chains in sub Saharan Africa and that it can explain up to 67% of the variations. Governance also has a significant influence on global value chains and it can explain up to 10% of the variations. The overall model was significant with a 76% explanation of the variation in global value chains in sub Saharan Africa. Therefore, the paper recommends for a promotion of value added manufacturing, and an integration in global value chains. Further, the paper recommends for enhanced resource allocation to infrastructure development to aid in the reduction of the production cost and to stream line governance.

Keywords: Global Value Chains, Investments, Infrastructure Development, Governance, Macro-economic Variables, Sub-Saharan Africa
JEL Classifications: F13, E22, O12, O18

1. INTRODUCTION

Over the past four decades, the world economy has observed a substantial revolution in the organization of international trade (Antras and Chor, 2021; Pansera and Owen, 2018; Heeks et al. 2020). Production of goods and services has increasingly been globalized and firms structured their production in a rather complex and interlinked systems of cross-border and national movements of goods, services and factors of production. These networks are referred to as Global Value Chains (Shepherd, 2016; Adarov and Stehrer, 2019). Global value chains have been hailed as one of the surest means to industrialization and poverty eradication (World Bank, 2020).

When GVCs are effective, products are designed in one country, parts and components of the said products are produced by several other countries and then assembly done in yet another county. They are built upon speed of movement, cost effectiveness and reliability (World Bank, 2020). As a consequence, GVCs boost international trade and investment flows significantly. They help in creating better employment opportunities, boosting economic growth and ultimately helping in reducing poverty levels (OECD, 2013).

GVCs comprise of two elements that reflect the upstream and the downstream linkages in the entire international production and trade chains. Some economies import inputs from foreign partners to enable the produce goods and service that they will export. This is commonly referred to as backward GVC participation (Asian Development Bank, 2021). Others export domestically produced inputs to other economies for further processing and export. This is also referred to as Forward GVC participation (World Bank, 2020).

A couple of factors have been cited as reasons behind the revolution in the global economy, comprising the transformations in the information and communication technology (Adalov, 2021; Rodrik, 2018), enactments of preferential trade agreements (World Bank, 2017) which have reduced man-made trade barriers remarkably and developments in the political arena enhancing the portion of world populace taking part in the capitalist system (Antras, 2016). This revolution made it possible for firms to enhance their usage of parts and components produced abroad in their production processes and also producers of intermediate inputs selling their outputs globally (Johnson and Noguera, 2012).

However, the international fragmentation of the production process and the scattering of tasks and activities has led to a significant level of double counting in international trade. For instance, raw materials mined in one country may be exported to a second country for processing before they are exported to a manufacturing plant in yet another country. After manufacturing, the final product may again be exported to a forth country for consumption or as an input to another process. The raw material is counted once as a GDP contributor in the originating country but is counted a number of times in the subsequent exports (United Nations, 2013). But advancements in trade statistics has been geared towards identification of double counting in gross trade figures and establishment of value creation in the entire international production process. The value creation statistics will then lead to the formulation of imperative policy intuitions (Aslam et al., 2017).

Globally, GVCs continued on a promising upward trajectory from the year 1990 up and until the 2008 global financial crisis in a state referred to as hyper globalization (Friedman, 2005; Baldwin, 2016). Due to its succeeding recession and a slowed pace of policy reforms the expansion had a sharp decrease and its growth has since stagnated. The stagnation was referred to as slowbalization (World Bank, 2020) Further, fragmentations in some of the sectors and regions has matured hence impeding new developments in GVCs. Similarly, trade conflicts reported in some countries such as The United States of America and The Peoples Republic of China catalyzed a rise in protectionism policies which hinders GVCs (Bellora and Fontagne, 2020). It is estimated that if these trade conflicts continue, investor confidence will go down, hence reducing the global income by a whopping $ 1.4 trillion and pushing about 30.7 million people into poverty (World Bank, 2020). In addition, the Covid-19 Pandemic led to closure of borders which as a consequence exposed vulnerabilities in some supply chains (Asian Development Bank, 2021). However, it cannot be ignored that the pandemic opened new doors to multinational partnerships in the production of crucial vaccines (Irwin, 2021). Notably, over the past few years, globalization has faced outright opposition across the globe and protectionism finding favor (Krugman, 2019; de Bolle and Zettelmeyer, 2019; Bown et al., 2020). Protectionism policies can easily prompt reshoring of existing global value chains or shifting them to different locations. This suggests that globalization and indeed Global Value Chains has a dim future if corrective steps are not taken on time.

Today, GVC accounts for about 50% of international trade. Its expansion has led to unprecedented growth of poor countries and a sharp decrease in poverty levels. (United Nations, 2013). It is estimated that a 1% increase in GVC participation, leads to a more than 1% increase in per capita income. This increase is twice as much as that of conventional trade.

Similarly, though GVCs in Sub-Saharan Africa appear to be minimal (Figure 1), they have followed the behavior of the Global GVCs. The expansion was steady and promising from 1990 up to the global financial meltdown of 2008 when it recorded a sharp decrease. Since then the growth has been slow. Notably, Africa remains to be a minor actor in the world economy, accounting for just about 3% of the international trade. It has joined the ranks of GVCs in automotive, food, apparel and service industries. African exports are dominated by agricultural produce and natural resources and they join GVCs at its beginning point, as inputs to other countries exports. Largely, some Sub-Saharan Africa countries such as Kenya, Ethiopia, Tanzania and South Africa recorded a growth of 10% or more over the past few years. Africa accounts for 14% of foreign value added in exports globally. To a large extent it is integrated to the supply chains in Europe and central Asia which accounts for about 42% of its foreign value added. Followed by East Asia and Pacific which accounts for about 23% and other regions follow as illustrated in Figure 2.

Indeed, there is rich literature on GVCs but only a few tend to interrogate what really drives the growth of GVCs or otherwise. For instance, infrastructure and institutional development, investment policies, liberal trade policies and human capital development have been identified as some of the factors that foster the development of GVCs (Timmer et al., 2014, 2015; UNCTAD, 2013; Dollar and Kidder, 2017; Taglioni et al. 2014; OECD, 2013; Adarov and Stehrer 2021).

In this regard, this study is proposing to have a deeper look at global value chains from different perspectives that influence its behavior in Sub-Saharan Africa. But, this interrogation will be limited to such perspectives like Investments, Infrastructure Development, Governance and Macro-Economic Variables.

Figure 1: Global GVC Verses SSA GVC. UNCTAD-EORA GVC Database, 2018

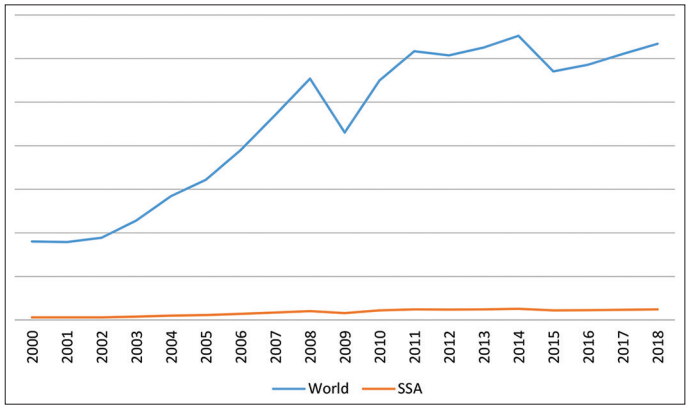
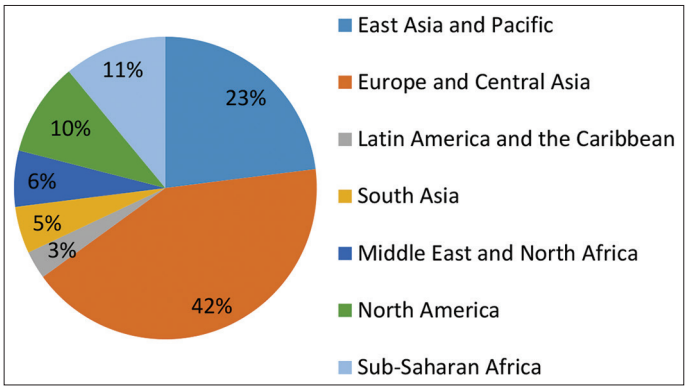


Figure 2: SSA share of FVA in exports. World development report, 2020



2. LITERATURE REVIEW

2.1. Theoretical Orientation

This section briefly looks into abstract ideas that have been generated around the area of global value chains and international trade and try to relate them to the current study. In a nut shell the theory of absolute advantage as postulated by Smith (1776) is explained.

2.1.1. Theory of absolute advantage

This theory was postulated by Smith (1776) in his inquiry into the wealth of nations in which he argued against mercantilism. Smith was dissatisfied with the idea and felt that nations do not get rich simultaneously by applying mercantilism due to the fact that one nation's export is another nation's import. Smith further stated that nations would benefit if they embraced free trade and specialization in production according to their absolute advantage. That specialization and division of labor leads to improvements labor productivity hence increased output, growth and development (Bloomfield and Arthur, 1975; Staley and Charles 1989; Myith, 1977). He also said, wealth of nations is influenced by the goods and services accessible to the citizens rather than their gold reserves. The gains brought about by trade with absolute advantage such as knowledge and technology transfer are Beneficial to all individuals and nations but not in equal measure (Schumacher, 2012) hence the idea of comparative advantage by David Ricardo.

This theory is based on the following assumptions; that there is trade between two nations, on a two country, two commodities framework. That one country must have an advantage in the production of one commodity at the lowest cost possible. That labor is mobile within a country but not mobile between countries. That there are no costs in transportation. And that the cost of commodities is calculated by the cost of labor required in the production process. Nevertheless, this theory has been criticized on different horizons. For example, the idea that one country must have an absolute cost advantage in the production one commodity does not hold water when a certain country lacks a commodity in which it possesses production superiority over other countries at a given amount of capital and labor. Apparently, most of the developing nations lack superior machinery they can install in the production hence not possible to have an absolute cost advantage. It has also been argued that most of the developed nations embraced protectionism policies which enabled them to protect and grow their infant industries (Chang, 2007). Empirical literature has proved that trade liberalization was responsible for the worsening of both the economic and social problems of most countries (Stiglitz, 2002; Shaikh, 2007).

2.2. Conceptual Framework

2.2.1. Global value chains

UNCTAD defines Global Value Chains as a location of different phases of the production process across various countries. It's a production fragmentation the enables intermediate goods to cross borders many times along the value chain. Global Value Chains is measured by Weighting the share of each country's gross exports in total regional gross exports (Aslam et al., 2017). This makes the dependent variable.

2.2.2. Investments

Investment is defined as a commitment of financial resources with an expectation of higher gains in the future period. For the purposes of this paper, investment is an independent variable and the following factors explain investments;

- Foreign direct investments; Foreign direct investment, net inflows (BoP, current US$) as measured by the World Bank World Development Indicators
- Gross Capital Formation; Gross capital formation (% of GDP) as measured by the world bank World Development Indicators
- Portfolio Investments; Portfolio investment, net (BoP, current US$) as measured by the world bank World Development Indicators.

2.2.3. Governance

The World Bank, (2017) defines Governance as the process through which the government and other non-government players join hands to make and implement requisite policies that regulate power both formally and informally. Good governance means stability in the public service, credibility and transparency in policy making process, effectiveness within the justice system and stability in the political arena (Hossain and Rahman, 2017).

For the purposes of this study, Governance will be measured by the World Wide Governance Indicators generated by the World Bank. They have identified 6 aggregate indicators which include;

- Government effectiveness: Basically the perceptions about the quality and effectiveness of the public service, its ability to act independently from the influence of politics, the authenticity of the policy making process and the ability of the government to efficiently implement such policies (Kaufmann et al., 2010)
- Regulatory Quality: Perceptions on the ability of government players to formulate and implement good policies which encourage the growth of the private sector (Kaufmann et al., 2010)
- Political Stability and Absence of Violence/terrorism: Perceptions on the stability of a country from politically instigated violence which include ethnic tension and terrorism (Kaufmann et al., 2010)
- Control of Corruption: Perceptions on the ability of the government to control people from gaining personal interests

from state resources through corruption and state capture (Kaufmann et al., 2010)
- Rule of Law: Perceptions on the ability of citizens to live harmoniously following the common instructions and rules of the society. This includes enforcement of contracts, the workings of the police service and the judicial system (Kaufmann et al., 2010)
- Voice and Accountability: Perceptions on the ability of the people to voice their dissatisfaction and how the government protects basic fundamental rights and freedoms. It also entails the ability of people to choose their government democratically (Kaufmann et al., 2010).

2.2.4. Infrastructure development

A well-developed infrastructure is essential for economic development. It aids businesses in ease to markets and reduction of transactional costs and also facilitates efficiency of other factors of production. Infrastructure is also very necessary for aiding a country's participation in the Global Value Chains (Luo and Xu, 2018).

The Africa Development Bank (AFDB) has developed an Africa Infrastructure Development Index (AIDI) which will be the basis for analyzing this variable. The Index is standardized to fall in between 0 and 100 with a higher value indicating the readiness of a country to meet its infrastructural needs (AFDB, 2018). The index has 4 indicators and a composite AIDI indicator through which infrastructure is measured and monitored. They include;

- The Transport Composite Index (TCI): which is basically measured by the road networks in kilometers (per KM^2 of exploitable land area) and the total paved roads (KMs per 10, 000) inhabitants) (AFDB, 2013)
- The Electricity Composite Index (ECI): This indicator is measured by the generation in kWh per inhabitants (AFDB, 2013)
- ICT Composite Index (ICI): it is measured by a conglomeration of sub indicators such as Fixed Line telephone subscriptions per 100 inhabitants, fixed line telephone subscriptions as a percentage of the population, mobile cellular subscriptions as a percentage of the population, number of internet users per 100 inhabitants, fixed (wired broadband internet subscribers per 100 inhabitants and international internet bandwidth (Mbps) (AFDB, 2013)
- Water Supply and Sanitation Composite Index: this one is measured by improved water sources as a percentage of population with access and improved sanitation facilities as a percentage of population with access (AFDB, 2013).

2.2.5. Macro-economic factors

Macroeconomic factors can be defined as fiscal or monetary factors that influence the national or regional economy. For purposes of this paper this paper macro-economic factors have been selected as controlling variables because they have an ability of influencing the behavior of any other factors within the economy. They include;

- GDP Growth rate: Measured by Gross Domestic Product annual growth rate as measured by the World Bank world development indicators
- Exchange Rate: Measured by Official exchange rate (LCU per US$, period average) as measured by the World Bank world development indicators
- Interest Rate: Measured by Real interest rate (%) as measured by the world bank world development indicators
- Inflation Rate: Measured by Inflation, consumer prices (annual %) as measured by the world bank world development indicators

The study will assume both a direct and a controlled relationship between Global value chains as a dependent variable and Investments, Governance, Infrastructure and Macro-economic factors as independent variables. Further a controlling effect will be added by macro-economic factors.

2.3. Empirical Literature Review

De Marchi and Alford (2021) conducted a study on state policies and upgrading in global value chains and made a conclusion that state policies are a very important component in developing global value chains. That means that for nations to increase their participation in GVCs, and at the same time be able to retain a substantial share of the value created, most often they adopt strategies such as infrastructure development in its broader sense and setting up of incentives which facilitate GVCs. On the other hand, nations that are sensitive to environmental and social outcomes tend to embrace regulatory measures which foster service delivery and economic growth. The study used a systematic review of both academic and policy literature. To achieve this, the study used a step wise approach to gather 418 relevant literature following the PRISMA method as describe by Liberati et al., (2009). Then screening of the said literature was done which excluded a total of 232 literatures, remaining with 186 elements. These then were taken through eligibility tests which excluded a total of 122 elements, remaining with 64 elements which were taken through analysis.

Kolesa (2018) investigated government policies that enhance the role of SMEs in GVCs in Slovenia and established that a wholesome approach which brings on board all stakeholders in formulation and implementation of policies related to GVCs. To this extent, firms have been encouraged to differentiate their products, embrace creativity and innovation and acquire more knowledge based assets. Further, the study recommends for a possibility of enhancing institutional frameworks which spearhead the development of GVCs and a focus on adopting a clear monitoring and evaluation frameworks. The study used a case study of Slovenia and relied on time series data from the period 1995 to 2011.

Mouanda-Mouanda (2019) studied global value chains participation for African countries with a focus on UIBE GVC index system. The study found out that African countries tend to absorb more of foreign inputs in complex GVCs as compared to their domestic value added to products exported in simple GVCs. South Africa and North Africa countries were identified to be more responsive in exports and imports in simple GVCs whereas west Africa tend to consume more of foreign intermediate products imported through complex GVCs. The study relied

upon descriptive statistics in analyzing data obtained from the University of International Business and Economics Global Value Chain Indexes.

Luo and Xu, (2018) investigated infrastructure, value chains and economic upgrades and established that infrastructure development is a catalyst to economic upgrade. Good infrastructure can aid a country to effectively participate in global value chains hence boosting international trade and hence economic growth. The study surveyed already available literature in GVCs, Infrastructure and economic growth. However, the paper does not explain fully the procedure followed in literature review and thus is scanty on the methodology.

Pahl et al., (2022), looked at jobs and productivity growth in GVCs and found GVC jobs to be more productive than non GVC jobs. Further, the study established that GVC jobs have a smaller share in the total Labour force, especially for low income countries and that expansions in GVCs is correlate with labor proactivity in a positively. The study used data from 25 low and middle income countries for the period 2000 through 2014.

Adalov and Stehrer (2019), studied foreign direct investments capital formation and Global value chains and established that foreign direct investments and capital formations influence global value chains in a significant way. They further found out that inward FDI enhances the formation of backward linkages whereas forward GVC participation is facilitated by outward FDI. Capital accumulation was found to facilitate both downstream and upstream integration. The study used WIOD country level and sector level panel dataset for 43 countries spanning the period 2000 through 2014. The paper used fractional Probit with standard errors which was clustered by country. To estimate robustness, the paper used fractional logit, panel fixed and random effects and pooled OLS with a logistic transformation.

Yang, (2018) investigated infrastructure and value chain position in china and came up with a conclusion that proximity of cities to domestic markets enhances their participation in GVCs whereas proximity of cities to foreign markets minimizes their participation in GVCs. Further the paper established that enhancing a country's transport network enhances aggregate welfare by 11 percentages, spatial inequalities by 13% and participation in local value chains to aid foreign markets by about 2%. The paper used data from China for the period 2000 through 2006 and a regression model in analysis.

3. METHODOLOGY

3.1. Introduction

This section explores the strategy employed in the investigations into various perspectives of global value chains in sub Saharan Africa. In a nut shell, it's simply a road map to the findings of this study.

3.2. Target Population

This study sought to interrogate data from 48 Sub-Saharan Africa Counties as stipulated in Appendix 1. Data from the year 2003 through the year 2018 was relied upon in the study. This period was selected due the fact that data is recent and available. In total, the study intended to consider a total population of 768 observations. However, 11 countries were excluded from the sample due to inadequacy of data (Appendix 1) leaving 37 countries and a total of 592 observations.

3.3. Sampling Technique

Global Value Chains are a very important aspect in the economy and therefore deserves requisite attention. Due to the fact that 592 observations are considered few, the study adopted a census method that interrogated all the available elements from the population.

3.4. Data Sources

This study will rely upon secondary data that has already been collected and stored by various institutions on their institutional databases. The sources are tabulated in Table 1.

3.5. Data Diagnostic Tests

With a view to ascertaining that basic regression models are met, the following tests were conducted both before and after estimation. To ascertain for data normality, this study opted for a Shapiro-Wilk test (1965). For data stationarity, a Levin et al. (2002) test was conducted, and for multi collinearity, the study used a variance inflation factors (VIF) test (Theil 1971). To test for heteroscedasticity, the study used Whites (1980) general test and Woodridge (2002) test to check for auto correlation. And to determine the direction and the extent of association amongst variables, this study employed a Pearson's pair wise (1896) correlation analysis.

3.6. Model Specification

The study made use of panel corrected Standard Errors model to establish the relationship between Investments, Infrastructure, Governance, Macro-economic factors and global value chains as shown by the following equations.

a. Investments

$$GVC = \alpha + \beta_1 FDI_{it} + \beta_2 GCF_{it} + \beta_3 PI_{it} + \varepsilon_0 \quad (1)$$

b. Infrastructure

$$GVC = \alpha + \beta_1 TCI_{it} + \beta_2 ECI_{it} + \beta_3 ICTI_{it} + \beta_4 WSSI_{it} + \varepsilon_0 \quad (2)$$

c. Governance

$$GVC = \alpha + \beta_1 COC_{it} + \beta_2 GE_{it} + \beta_3 PS_{it} + \beta_4 RQ_{it} + \beta_5 RL_{it} + \beta_6 VA_{it} + \varepsilon_0 \quad (3)$$

d. Macroeconomic Factors

$$GVC = \alpha + \beta_1 GRR_{it} + \beta_2 EXR_{it} + \beta_3 INF_{it} + \beta_4 INR_{it} + \varepsilon_0 \quad (4)$$

e. Overall Model

$$GVC = \alpha + \beta_1 FDI_{it} + \beta_2 GCF_{it} + \beta_3 PI_{it} + \beta_4 TCI_{it} + \beta_5 ECI_{it} + \beta_6 ICTI_{it} + \beta_7 WSSI_{it} + \beta_8 COC_{it} + \beta_9 GE_{it} + \beta_{10} PS_{it} + \beta_{11} RQ_{it} + \beta_{12} RL_{it} + \beta_{13} VA_{it} + \varepsilon_0 \quad (5)$$

Table 1: Sources of data

Variables	Sub-variables	Variable description	Data source
Global value chains	GVC	Weighted by the share of each country's gross exports in total regional gross exports.	UNCTAD-Eora database
Investments	FDI	Foreign direct investment, net inflows (BoP, current US$)	World Bank, World development indicators
	Portfolio investments (Net)	Portfolio investment, net (BoP, current US$)	
	Gross capital formations	Gross capital formation (% of GDP)	
Infrastructure development	Transport composite index	Road networks in kilometers (per KM^2 of exploitable land area) and the total paved roads (KMs per 10, 000) inhabitants)	Africa development bank, Africa infrastructure development index database
	Electricity composite index	Generation in kWh per inhabitants	
	Information and communication technology index	Fixed Line telephone subscriptions per 100 inhabitants, fixed line telephone subscriptions as a percentage of the population, mobile cellular subscriptions as a percentage of the population, number of internet users per 100 inhabitants, fixed (wired broadband internet subscribers per 100 inhabitants and international internet bandwidth (Mbps)	
	Water supply and sewerage index	Improved water sources as a percentage of population with access and improved sanitation facilities as a percentage of population with access.	
Governance	Government effectiveness	Government effectiveness: Estimate	World Bank, World Governance index database
	Control of corruption	Control of corruption: estimate	
	Political stability	Political stability and absence of violence/terrorism: estimate	
	Regulatory quality	Regulatory quality: Estimate	
	Rule of law	Rule of law: Estimate	
	Voice and accountability	Voice and accountability: Estimate	
Macro-economic variables	GDP growth rates	GDP growth (annual %)	World Bank, World development indicators database
	Inflation rates	Inflation, consumer prices (annual %).	
	Interest rates	Real interest rate (%)	
	Exchange rates	Official exchange rate (LCU per US$, period average)	

Author compilation, 2022

f. Overall Model – Controlled by Macroeconomic Factors

$$GVC = \alpha + \beta_1 FDI_{it} + \beta_2 GCF_{it} + \beta_3 PI_{it} + \beta_4 TCI_{it} + \beta_5 ECI_{it} + \beta_6 ICTI_{it} + \beta_7 WSSI_{it} + \beta_8 COC_{it} + \beta_9 GE_{it} + \beta_{10} PS_{it} + \beta_{11} RQ_{it} + \beta_{12} RL_{it} + \beta_{13} VA_{it} + \beta_{14} GRR_{it} + \beta_{15} EXR_{it} + \beta_{16} INF_{it} + \beta_{17} INR_{it} + \varepsilon_0 \quad (6)$$

4. ANALYSIS AND FINDINGS

4.1. Descriptive Statistics

The study comprised of 37 countries from sub Saharan Africa from the year 2003-2018 making a total of 592 observations. Means indicate arithmetic averages and the standard deviation the extent of variations from the mean (Table 2).

4.2. Normality Test

H_0: Sample data was not drawn from a normally distributed population

It is assumed that the population from which the sample data for this study is found, follows a Gaussian distribution. Otherwise, if this assumption is violated, inferences therefrom may not be accurate and cannot be relied upon (Ghasem and Zahediasl, 2012). Using Shapiro-Wilk (1965) test the study tested whether the sample data was drawn from a normally distributed population. From the test results presented in Table 3, we fail to reject the null hypothesis and conclude that the sample data used in this study is significantly different from a normal population.

4.3. Stationarity Test

H_0: Panels contain unit root
H_a: Panels are Stationary

Panel data is prone to many errors due to its ability to combine both time series and cross sectional properties. One of the errors is stationarity, i.e. mean and variance remaining constant for some time. Non stationarity may produce spurious regression results, hence need to deal with it before estimation. This study made use of Levin et al. (2002) test to establish whether sample data was stationary. Test results presented in Table 5 indicate that all variables were stationary at level with a trend apart from the variable explaining Infrastructure (ICTI) which was found to contain a unit root. This necessitated differencing of the variables. They then turned out to be stationary. Therefore, we reject the null hypothesis and conclude that panels were stationary at 1^{st} differencing with a trend.

4.4. Test for Multi-Collinearity

The study made use of Variance Inflation Factors (VIF) as proposed by Farrar and Glauber (1967). VIFs above 10 and those less than 1 indicate the possibility of collinearity. Hence VIFs should range between 1 and 10, (Myles, 1990). Test results presented in Table 3 indicate that the variables GE, RQ and RL were found to be collinear with VIFs of (17.27, 10.07 and 18.76 respectively). This necessitated differencing of the variables (GE, RQ and RL) which brought back the VIFs to the acceptable limit. Hence conclude that the sample data was void of collinearity problems.

Table 2: Descriptive statistics

Variable	Obs	Mean	SD	Min	Max
Country	592	19	10.68611	1	37
Year	592	2010.5	4.613671	2003	2018
GVC	592	2511331	8791129	14305.37	6.75E+07
FDI	592	6.89E+08	1.54E+09	−7400000000	1.00E+10
GCF	592	23.50761	8.689429	4.703723	53.98797
PI	592	−4.38E+08	3.19E+09	−19600000000	1.43E+10
TCI	592	9.080836	10.45616	0.0029003	53.30856
ECI	592	7.830051	15.67298	0	82.37559
ICTI	592	4.92325	9.148061	0.0000097	63.4445
WSSI	592	53.5098	20.61087	2.906174	99.78813
COC	592	−0.5667068	0.6588314	−1.868714	1.216737
GE	592	−0.7091467	0.6765023	−2.475142	1.056674
PS	592	−0.5096633	0.9679339	−3.314937	1.200234
RQ	592	−0.5953336	0.6074625	−2.645041	1.12727
RL	592	−0.6208049	0.6824088	−2.606445	1.07713
VA	592	−0.46712	0.7156903	−2.196764	0.9791626
GRR	592	4.430425	4.483707	−36.39198	33.62937
EXR	592	1010.802	3362.644	0.8667643	31558.91
INF	592	8.477103	18.94697	−8.97474	379.9996
INR	592	7.817907	11.47169	−34.46203	61.8826

Author compilation using STATA Software, 2022

Table 3: Data normality test and multi collinearity test results

	Shapiro wilk test for normality					VIF Test for Multi collinearity			
						Level		Differenced	
Variable	Obs	W	V	z	Prob>z	VIF	1/VIF	VIF	1/VIF
GVC	592	0.27535	283.915	13.681	0.00000				
GRR	592	0.80656	75.791	10.482	0.00000	1.14	0.878514	1.13	0.882973
EXR	592	0.28128	281.589	13.661	0.00000	1.63	0.612255	1.62	0.61634
INF	592	0.26045	289.754	13.730	0.00000	1.1	0.907832	1.08	0.922502
INR	592	0.92268	30.293	8.261	0.00000	1.12	0.895029	1.11	0.902751
FDI	592	0.59155	160.029	12.292	0.00000	1.43	0.697107	1.45	0.690404
GCF	592	0.95701	16.845	6.840	0.00000	1.37	0.732206	1.36	0.734204
PI	592	0.47138	207.112	12.917	0.00000	1.59	0.630641	1.61	0.620377
TCI	592	0.71117	113.163	11.453	0.00000	3.93	0.254187	3.75	0.266865
ECI	592	0.50109	195.470	12.777	0.00000	3.01	0.331985	2.86	0.34977
ICTI	592	0.58906	161.003	12.307	0.00000	1.7	0.587218	1.78	0.562762
WSSI	592	0.98615	5.426	4.096	0.00002	2.72	0.367907	2.76	0.362461
COC	592	0.96627	13.214	6.252	0.00000	6.59	0.15177	6.23	0.160406
GE	592	0.98819	4.629	3.711	0.00010	17.27	0.057917	1.13	0.882732
PS	592	0.96551	13.511	6.306	0.00000	4.45	0.22455	4.38	0.22856
RQ	592	0.97534	9.660	5.493	0.00000	10.07	0.099261	1.14	0.878014
RL	592	0.99332	2.618	2.331	0.00989	18.76	0.053299	9.83	0.101726
VA	592	0.97951	8.029	5.045	0.00000	3.79	0.263976	3.69	0.270778
						Mean VIF	4.8	2.76	

Author Compilation using STATA Software, 2022

4.5. Test for Heteroscedasticity

H_0: Homoscedasticity

H_a: Unrestricted heteroscedasticity

According to Klein et al., (2016) regression models assume homoscedasticity, i.e. errors should be independently and identically distributed. This study employed the proposition of White (1980) to test for heteroscedasticity. According to the test results presented in Table 4, [$\chi 2\ (252) = 589.27$, $P \leq 0.01$] which is significant at 0.05 alpha level. Hence reject the null hypothesis and conclude that data contains unrestricted heteroscedasticity. Statistically, heteroscedasticity is an error that should be dealt with before estimation. Otherwise, estimations may be inefficient and biased standard errors. Therefore, to deal with this problem, the study adopted to use a Panel Corrected Standard Errors estimation method which has the ability to correct for cross sectional dependence, heteroscedasticity and serial correlation.

Table 4: Heteroscedasticity test results

Heteroscedasticity test				Auto-correlation test	
Source	χ^2	df	P	F (1 ,36)	662.400
Heteroscedasticity	589.27	252	0.0000	Prob>F	0.0000

Author compilation using STATA software, 2022

4.6. Correlation Analysis

Correlation analysis is an important tool in measurement of the association between two variables. It shows the direction of the association and at the same time shows the strength of such a relationship (Gogtay and Thatte, 2017). The study employed a

Table 5: Data stationarity test

Variable	At Level						1st Differencing					
	No Trend			With Trend			No Trend			With Trend		
	Unadj t	Adj t	P-value	Unadj t	Adj t	P-value	Unadj t	Adj t	P-value	Unadj t	Adj t	P-value
GVC	−11.8753	−8.2351	0.0000	−11.2518	−4.1286	0.0000	−22.0427	13.4448	0.0000	−27.8874	−14.162	0.0000
GRR	−14.4389	−6.3758	0.0000	−19.6598	−7.9246	0.0000	−26.6868	−15.4749	0.0000	−29.5423	−15.5028	0.0000
EXR	−2.3412	3.6831	0.9999	−11.5189	−4.1185	0.0000	−15.9119	−7.7361	0.0000	−20.9972	−8.8136	0.0000
INF	−17.3309	−8.9587	0.0000	−23.989	−13.4375	0.0000	−29.6727	−21.0729	0.0000	−32.3326	−20.0212	0.0000
INR	−28.1657	−24.8211	0.0000	−33.1027	−25.3875	0.0000	−27.891	−18.2146	0.0000	−27.808	−13.1622	0.0000
FDI	−9.9641	−4.0059	0.0000	−13.327	−4.7603	0.0000	−19.2391	−9.7492	0.0000	−21.5261	−8.467	0.0000
GCF	−11.4358	−4.8446	0.0000	−13.1047	−3.6949	0.0001	−20.2119	−11.118	0.0000	−23.4412	−11.0465	0.0000
PI	−11.2084	−2.6076	0.0046	−16.9229	−4.8401	0.0000	−25.2712	−13.3803	0.0000	−26.6844	−10.9349	0.0000
TCI	−5.3157	−2.9606	0.0015	−20.1146	−10.0848	0.0000	−21.7238	−13.3639	0.0000	−21.7557	−9.32	0.0000
ECI	−4.3203	−0.9883	0.1615	−12.7039	−4.2279	0.0000	−19.9736	−10.4856	0.0000	−23.6627	−10.0302	0.0000
ICTI	7.7185	16.9912	1.0000	−4.7281	−0.4974	0.3095	−6.5451	−0.2634	0.3961	−16.4698	−3.6396	0.0000
WSSI	2.0122	2.5716	0.9949	−8.2988	−3.2097	0.0007	−9.2348	−3.0475	0.0012	−14.4385	−2.844	0.0022
COC	−9.7597	−3.7077	0.0001	−14.7006	−5.5467	0.0000	−19.6853	−9.6547	0.0000	−23.2813	−10.4548	0.0000
GE	−9.5759	−4.007	0.0000	−16.393	−6.8803	0.0000	−22.1246	−12.3317	0.0000	−24.73	−11.3401	0.0000
PS	−9.827	−3.6548	0.0001	−14.0276	−5.2896	0.0000	−20.8577	−10.5652	0.0000	−24.7926	−11.1487	0.0000
RQ	−10.1044	−4.8235	0.0000	−14.7658	−5.7336	0.0000	−21.487	−11.6653	0.0000	−24.8257	−11.3609	0.0000
RL	−8.0499	−2.7067	0.0034	−14.6851	−5.4137	0.0000	−20.5537	−10.9463	0.0000	−23.2304	−10.5977	0.0000
VA	−12.3037	−6.6864	0.0000	−18.3509	−10.5693	0.0000	−18.5352	−10.0759	0.0000	−20.2718	−8.1441	0.0000

Author Compilation using STATA Software, 2022

Table 6: PCSE estimation results

Variables	Investments		Infrastructure		Governance		Macroeconomic	Overall	
Model	1	2	3	4	5	6	7	8	9
FDI	0.00250045	0.0023433						0.000945	0.0008723
	(0.000)	(0.000)						(0.000)	(0.000)
GCF	−87996	−92967.15						−86099.52	−76993.74
	(0.000)	(0.000)						(0.000)	(0.002)
PI	−0.0010249	−0.0013368						−0.0004197	−0.0005504
	(0.000)	(0.000)						(0.000)	(0.001)
TCI			−536815.8	−551270.9				−483506.7	−468043.5
			(0.000)	(0.000)				(0.000)	(0.000)
ECI			538467.6	543264.8				458704.8	451920.8
			(0.000)	(0.000)				(0.000)	(0.000)
ICTI			27498.39	25348.9				7746.215	6293.563
			(0.481)	(0.515)				(0.823)	(0.861)
WSSI			65436.59	72528.29				54200.99	58336.1
			(0.000)	(0.000)				(0.000)	(0.000)
COC					−873202.5	−750680.8		909536.8	1004992
					(0.406)	(0.504)		(0.245)	(0.209)
GE					−1698.451	−66834.04		527002.2	941521.7
					(0.999)	(0.978)		(0.718)	(0.506)
PS					−3261965	−3262152		−1537135	−1590307
					(0.000)	(0.000)		(0.000)	(0.000)
RQ					−3258912	−2508970		−336040.6	−94717.33
					(0.124)	(0.221)		(0.889)	(0.967)
RL					2270403	1892239		914930.3	267955.8
					(0.009)	(0.037)		(0.158)	(0.649)
VA					4748809	4925166		1777885	1714098
					(0.000)	(0.000)		(0.000)	(0.000)
GRR		−114664.1		49820.63		−162565.5	−128813.6		27525.02
		(0.020)		(0.215)		(0.003)	(0.002)		(0.568)
EXR		−684.6255		−60.58618		−76.64624	−187.6412		−279.8256
		(0.000)		(0.000)		(0.023)	(0.000)		(0.001)
INF		−10086.78		4893.404		333.7315	−6473.775		3747.874
		(0.232)		(0.378)		(0.952)	(0.348)		(0.413)
INR		−49062.51		45156.13		−59444.87	−43349.74		22655.94
		(0.001)		(0.010)		(0.000)	(0.000)		(0.145)
_cons	2404577	4165158	−467042.1	−1296228	4064249	5244652	3665482	2710225	1741882
	(0.000)	(0.000)	(0.073)	(0.019)	(0.000)	(0.000)	(0.000)	(0.002)	(0.093)
R^2	0.3937	0.4592	0.6666	0.6711	0.0948	0.1071	0.0132	0.7535	0.7613
Wald χ^2	95.39	115.03	325.44	385.90	417.24	580.56	115.12	1433.25	1540.95
prob>χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
obs	592	592	592	592	555	555	592	555	555

Pearson's (1896) pairwise correlation at a 0.05 significance level. According to the results presented in Table 7, the study established a positive and significant relationship between GVC and FDI, ECI, ICTI, WSSI, COC, RL, and VA (0.4957, $P \leq 0.01$; 0.6809, $P \leq 0.01$; 0.3743, $P \leq 0.01$; 0.2626, $P \leq 0.01$; 0.0996, $P = 0.0154$; 0.1281, $P = 0.0018$; and 0.2178, $P \leq 0.01$). On the other hand, PI was found to have a negative but significant association with GVC. The strongest significant association was that of ECI at 68% whereas the lowest significant association was that of COC at 9%.

4.7. Test for Auto Correlation

H_0: No first order auto correlation

In the presence of errors of auto correlation, the regression models become inefficient and also makes the estimation of standard errors problematic. This study made use of Woodridge (2002) test for auto correction to check for its presence. According to test results presented in Table 4, [F (1, 36) = 662.400, $P \leq 0.01$] we reject the null hypothesis and conclude that variables are serially correlated. To correct this error, the study chose to use a Panel Corrected Standard Errors estimation model which has the ability to correct for serial correlation, cross sectional dependence and heteroscedasticity.

4.8. Regression Analysis

Panel data is vulnerable to complex error structures which may affect the efficiency of coefficient estimations and biased estimation of the standard errors. Some of these errors include serial correlation, heteroscedasticity and cross sectional dependence (Reed and Ye, 2011). Two of the best estimation methods to reduce some of the errors include Feasible Generalized Least Squares (FGLS) and Panel Corrected Standard Errors (PCSE). However, FGLS is most effective when the number of time periods (T) is greater than or equal to the number of cross sections (N) (Parks, 1967). Therefore, due to the presence of serial correlation in the sample data, and the fact that (N) is greater than (T), this study opted to use PCSE, which has the ability to correct for heteroscedasticity, cross sectional dependence and serial correlation.

4.8.1. Relationships between investments and global value chains in Sub-Saharan Africa

This relationship is explained by both model 1 and model 2 in Table 6. Model 1 which is a composite model indicates a significant relationship between investments and Global Value Chain at a 0.05 alpha significance level (Wald $\chi^2(3) = 95.39$, $P \leq 0.01$). The coefficient of determination ($R^2 = 0.3937$) indicating that investments can explain up to 39% of the variations in global value chains in sub Saharan Africa. The coefficient of FDI (0.003, $P \leq 0.01$) is positive and significant at 0.05 alpha level, where s that of GCF (−87996, $P \leq 0.01$) and PI (−0.001, $P \leq 0.01$) are negative but significant at 0.05 level. Thus, conclude that Investments have a significant influence of Global Value Chains in Sub Saharan Africa. And fit equation 7.

$$\begin{aligned} GVC &= 2404577 + 0.003FDI - 87996GCF - 0.001PI \\ Sig &= \qquad\quad (\leq 0.01) \quad (\leq 0.01) \quad (\leq 0.01) \end{aligned} \tag{7}$$

$R^2 = 0.3937$

Wald $\chi^2(3) = 95.39$, $P \leq 0.01$

Where:

GVC = Global Value Chains

FDI = Foreign Direct Investments

GCF = Gross Capital Formation

PI = Portfolio Investment

Model 2, which is controlled by macro-economic factors also indicates a significant relationship between Investments and GVC (Wald $\chi^2(7) = 115.03$, $P \leq 0.01$). The coefficient of determination ($R^2 = 0.4592$) shows that investments can explain up to 45% of the variations in global value chains in sub Saharan Africa. The coefficients of FDI (0.002, $P \leq 0.01$) show a positive and a significant relationship where as that of GCF, PI, GRR, EXR and INR (−92967.15, $P \leq 0.01$; −0.001, $P \leq 0.01$; −114664.1, $P = 0.002$; −684.63, $P \leq 0.01$ and −49062.51, $P = 0.001$ respectively) show a negative but significant relationship at 0.05 alpha level. On the other hand, that of INF (−10086.78, $P = 0.232$) indicate a negative and non-significant relationship. Thus, the study concludes that investments have a significant influence on global value chains even after controlling the relationship with macro-economic factors and fit equation 8.

$$\begin{aligned} GVC &= 4165158 + 0.002FDI - 92967.15GCF - 0.001PI \\ Sig &= \qquad\quad (\leq 0.01) \quad (\leq 0.01) \quad (\leq 0.01) \\ &-114664.1GRR - 684.63EXR - 10086.78INF - 49062.51INR \\ &\quad (\leq 0.01) \quad (\leq 0.01) \quad (0.23) \quad (0.001) \end{aligned} \tag{8}$$

$R^2 = 0.4592$

Wald $\chi^2(7) = 115.03$, $P \leq 0.01$

Where:

GVC = Global Value Chains

FDI = Foreign Direct Investments

GCF = Gross Capital Formation

PI = Portfolio Investment

GRR = GDP Growth Rate

EXR = Exchange Rate

INF = Inflation Rate

INR = Interest Rate

The direct relationship model with 3 variables has a (Wald $\chi^2(3) = 95.39$, $P \leq 0.01$) where as that of a controlled relationship with 7 variables has a (Wald $\chi^2(7) = 115.03$, $P \leq 0.01$). Since model 2 with 7 variables has a higher Chi square value than model 1 with 3 variables, we conclude that Model 2 presents a better fit.

4.8.2. Relationships between infrastructure development and global value chains in Sub Saharan Africa

The relationship between Infrastructure and Global value chains (GVC) is presented by both model 3 and 4 in Table 6. Results from model 3, which represents a direct relationship indicate a significant relationship (Wald $\chi^2(4) = 325.44$, $P \leq 0.01$) between infrastructure development and GVC. And the coefficient for determination ($R^2 = 0.6666$) indicating a 66% possibility of infrastructure development explaining the variations in GVC in sub Saharan Africa. The coefficients of TCI (−536815.8, $P \leq 0.01$) show a negative but significant relationship. Whereas

Table 7: Pearson's pairwise correlation results

	GVC	FDI	GCF	PI	TCI	ECI	ICTI	WSSI	COC	GE	PS	RQ	RL	VA	GRR	EXR	INF	INR
GVC	1.0000																	
FDI	0.4957*	1.0000																
	(0.0000)																	
GCF	−0.0737	0.1056*	1.0000															
	(0.731)	(0.0101)																
PI	−0.4587*	−0.1818*	0.0886*	1.0000														
	(0.0000)	(0.0000)	(0.0311)															
TCI	0.0597	−0.0288	0.2821*	0.0379	1.0000													
	(0.1471)	(0.4836)	(0.0000)	(0.3575)														
ECI	0.6809*	0.3001*	0.1351*	−0.2777*	0.6002*	1.0000												
	(0.0000)	(0.0000)	(0.0010)	(0.0000)	(0.0000)													
ICTI	0.3743*	0.1212*	0.1482*	−0.1516*	0.4387*	0.5681	1.0000											
	(0.0000)	(0.0031)	(0.0003)	(0.0002)	(0.0000)	(0.0000)												
WSSI	0.2626*	0.0689	0.1190*	−0.0692	0.7133*	0.5726*	0.5241*	1.0000										
	(0.0000)	(0.0938)	(0.0037)	(0.0927)	(0.0000)	(0.0000)	(0.0000)											
COC	0.0996*	0.0192	0.3723*	0.0676	0.7099*	0.4480*	0.3276*	0.5730*	1.0000									
	(0.0154)	(0.6416)	(0.0000)	(0.1004)	(0.0000)	(0.0000)	(0.0000)	(0.0000)										
GE	−0.0062	0.0324	0.0412	0.0187	0.0735	0.0157	0.0571	0.0822	0.0689									
	(0.8837)	(0.4467)	(0.3325)	(0.6599)	(0.0838)	(0.7118)	(0.1789)	(0.0528)	(0.1047)									
PS	0.0139	−0.0737	0.3942*	0.1720*	0.5677*	0.3716*	0.2357*	0.4613*	0.7983*	0.0437	1.0000							
	(0.7360)	(0.0730)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.3038)								
RQ	−0.0356	0.0071	−0.0315	0.0362	0.0178	−0.0364	−0.0134	0.0170	0.0374	0.3113*	0.0040	1.0000						
	(0.4028)	(0.8673)	(0.4592)	(0.3947)	(0.6758)	(0.3920)	(0.7525)	(0.6903)	(0.3789)	(0.0000)	(0.9242)							
RL	0.1281*	0.0531	0.3466*	0.1215*	0.6563*	0.4456*	0.3333*	0.5736*	0.8946*	0.0566	0.8527*	0.0163	1.0000					
	(0.0018)	(0.1969)	(0.0000)	(0.0031)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.1833)	(0.0000)	(0.7008)						
VA	0.2178*	0.1548*	0.3440*	0.0382	0.5747*	0.4482*	0.3409*	0.4593*	0.7699*	0.0450	0.7195*	0.0204	0.8395*	1.0000				
	(0.0000)	(0.0002)	(0.0000)	(0.3529)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.2896)	(0.0000)	(0.6319)	(0.0000)					
GRR	−0.0624	0.0707	0.1803*	0.0556	−0.0039	−0.0705	−0.1067*	−0.1150*	0.0582	0.0830	0.1108*	0.1383*	0.0880*	0.1037*	1.0000			
	(0.1297)	(0.0856)	(0.0000)	(0.1770)	(0.9252)	(0.0866)	(0.0094)	(0.0051)	(0.1574)	(0.0507)	(0.0070)	(0.0011)	(0.0324)	(0.0116)				
EXR	−0.0735	−0.0641	−0.0957*	−0.4304*	−0.1512*	−0.1282*	−0.0797	−0.1545*	−0.3081*	0.0265	−0.3731*	0.0339	−0.4097	−0.3333*	−0.0339	1.0000		
	(0.0740)	(0.1195)	(0.0198)	(0.0000)	(0.0002)	(0.0018)	(0.0525)	(0.0002)	(0.0000)	(0.5335)	(0.0000)	(0.4256)	(0.0000)	(0.0000)	(0.4110)			
INF	−0.0155	−0.0063	−0.1267*	−0.0198	−0.0806	−0.0680	−0.0768	−0.0798	−0.1688*	0.0699	−0.1621*	−0.0423	−0.1844	−0.1518*	−0.1294*	0.0477	1.0000	
	(0.7062)	(0.8791)	(0.0020)	(0.6312)	(0.0501)	(0.0985)	(0.0618)	(0.0522)	(0.0000)	(0.0998)	(0.0001)	(0.3203)	(0.0000)	(0.0002)	(0.0016)	(0.2466)		
INR	−0.0634	0.0727	−0.0098	0.0235	−0.0233	−0.1179*	−0.0360	−0.1341*	0.0041	−0.0711	−0.0225	0.0274	−0.0053	0.0224	0.0157	0.0579	0.1175*	1.0000
	(0.1234)	(0.0770)	(0.8112)	(0.5675)	(0.5710)	(0.0041)	(0.3821)	(0.0011)	(0.9198)	(0.0941)	(0.5854)	(0.5201)	(0.8979)	(0.5866)	(0.7027)	(0.1593)	(0.0042)	

that of ECI and WSSI (538467.6, P ≤ 0.01 and 65436.59, P ≤ 0.01 respectively) show a positive and significant relationship. That of ICTI (27498.39, P = 0.481) show a positive but non-significant relationship. Therefore, conclude that Infrastructure development has a Significant relationship with GVC and fit equation 9.

$$\begin{aligned} GVC &= -467042.1 - 536815.8TCI + 538467.6ECI \\ Sig &= \quad (\leq 0.01) \quad (\leq 0.01) \\ &\quad + 27498.39ICTI + 65436.59WSSI \\ &\quad (0.481) \quad (\leq 0.01) \end{aligned} \tag{9}$$

$R^2 = 0.6666$
Wald $\chi^2(4) = 325.44$, $P \leq 0.01$
Where:
GVC = Global Value Chains
TCI = Transport Composite Index
ECI = Electricity Composite Index
ICTI = Information, Communication and Technology Index
WSSI= Water, Sewerage and Sanitation Index

On the other hand, model 4 which is controlled by macro-economic factors indicate a significant relationship (Wald $\chi^2(8) = 385.90$, $P \leq 0.01$) between Infrastructure development and GVC. Its coefficient of determination ($R^2 = 0.6711$) indicating that Infrastructure development can explain up to 67% of the variations in GVC in sub Saharan Africa. The coefficients of TCI and EXR (−551270.9, P ≤ 0.01 and −60.59, P ≤ 0.01 respectively) indicate a negative but significant relationship. Whereas that of ECI, WSSI and INR (543264.8, P ≤ 0.01; 72528.29, P ≤ 0.01 and 45156.13, P = 0.01) indicate a positive and significant relationship. That of ICTI, GRR and INF (25348.9, P = 0.515; 49820.63, P = 0.215 and 4893.404, P = 0.378) indicate a positive but non-significant relationship. Hence, conclude that Infrastructure development has a significant relationship with GVC under controlled circumstances. Equation 10 fits.

$$\begin{aligned} GVC &= -1296228 - 551270.9TCI + 543264.8ECI \\ Sig &= \quad (\leq 0.01) \quad (\leq 0.01) \\ &\quad + 25348.9ICTI + 72528.29WSSI + 49820.63GRR \\ &\quad (0.515) \quad (\leq 0.01) \quad (0.215) \\ &\quad - 60.59EXR + 4893.404INF + 45156.13INR \\ &\quad (\leq 0.01) \quad (0.378) \quad (0.01) \end{aligned} \tag{10}$$

$R^2 = 0.6711$
Wald $\chi^2(8) = 385.90$, $P \leq 0.01$
Where:
GVC = Global Value Chains
TCI = Transport Composite Index
ECI = Electricity Composite Index
ICTI = Information, Communication and Technology Index
WSSI= Water, Sewerage and Sanitation Index
GRR = GDP Growth Rate
EXR = Exchange Rate
INF = Inflation Rate
INR = Interest Rate

The direct relationship model with 4 variables has a (Wald $\chi^2(4) = 325.44$, $P \leq 0.01$) where as that of a controlled relationship with 8 variables has a (Wald $\chi^2(8) = 385.90$, $P \leq 0.01$). Since model 4 with 8 variables has a higher Chi square value than model 3 with 4 variables, we conclude that Model 4 presents a better fit.

4.8.3. Relationships between governance structures and global value chains in Sub- Saharan Africa

The relationship between governance and global value chains is represented by model 5 and 6 in Table 3. According to the results from model 5 which is a direct relationship (Wald $\chi^2(6) = 417.24$, $P \leq 0.01$), governance has a significant relationship with GVC. Its coefficient of determination ($R^2 = 0.095$) indicating that governance can explain up to 9% of the variations in GVC in sub Saharan Africa. The coefficients of RL and VA (2270403, P = 0.009 and 4748809, P ≤ 0.01 respectively) have a positive and significant relationship. Whereas that of PS (−3261965, P ≤ 0.01) is negative but significant. Those of COC, GE and RQ (−873202.5, P = 0.406; −1698.451, P = 0.999 and −3258912, P = 0.124 respectively) are negative and non-significant. Therefore, conclude that governance has a significant influence on GVC in sub Saharan Africa under a direct relationship. And fit equation 11.

$$\begin{aligned} GVC &= 4064249 - 873202.5COC - 1698.45GE - 3261965PS \\ Sig &= \quad (0.406) \quad (0.999) \quad (\leq 0.01) \\ &\quad - 3258912RQ + 2270403RL + 4748809VA \\ &\quad (0.124) \quad (0.009) \quad (\leq 0.01) \end{aligned} \tag{11}$$

$R^2 = 0.0948$
Wald $\chi^2(6) = 417.24$, $P \leq 0.01$
Where;
GVC = Global Value Chains
COC = Control of Corruption
GE = Government Effectiveness
PS = Political Stability
RQ = Regulatory Quality
RL = Rule of Law
VA = Voice and Accountability

On the other hand, model 6 is controlled by macro-economic factors and presents a significant relationship (Wald $\chi^2(10) = 580.56$, $P \leq 0.01$) between governance and GVC. Its coefficient of determination ($R^2 = 0.1071$) indicate that under a controlled environment, governance can explain up to 10 percent of the variations in GVC in sub Saharan Africa. The coefficients of RL and VA (1892239, P = 0.037 and 4925166, P ≤ 0.01) are positive and significant. Whereas those of PS, GRR, EXR and INR (−3262152, P ≤ 0.01; −162565.5, P = 0.003; −76.65, P = 0.023 and −59444.87, P ≤ 0.01 respectively) are negative but significant. Those of COC, GE and RQ (−750680.8, P = 0.504; −66834.04, P = 0.978 and −2508970, P = 0.221 respectively) are negative and non-significant. The coefficients of INF (333.73, P = 0.952) is positive but non-significant. Thus conclude that under a controlled environment, governance still has a significant influence on GVC in sub-Saharan Africa. And fit equation 12.

$$GVC = 5244652 - 750680.8COC - 66834.04GE - 3262152PS$$
$$Sig = \quad (0.504) \quad (0.978) \quad (\leq 0.01)$$
$$- 2508970RQ + 1892239RL + 4925166VA - 162565.5GRR$$
$$(0.221) \quad (0.037) \quad (\leq 0.01) \quad (0.003)$$
$$- 76.65EXR + 333.75INF - 59444.87INR$$
$$(0.023) \quad (0.952) \quad (\leq 0.01) \qquad (12)$$

$R^2 = 0.1071$
Wald $\chi^2(10) = 580.56$, $P \leq 0.01$
Where;
COC = Control of Corruption
GE = Government Effectiveness
PS = Political Stability
RQ = Regulatory Quality
RL = Rule of Law
VA = Voice and Accountability
GRR = GDP Growth Rate
EXR = Exchange Rate
INF = Inflation Rate
INR = Interest Rate

Model 6 with 10 predictors has a higher chi square (Wald $\chi^2(10) = 580.56$, $P \leq 0.01$) than model 5 (Wald $\chi^2(6) = 417.24$, $P \leq 0.01$) with 6 predictors. Hence conclude that model 6 with 10 variables are a better fit.

4.8.4. Relationships between Macroeconomic factors and global value chains in Sub- Saharan Africa

Macro-economic factors were selected as controlling variables in this study. However, the researcher opted to test their direct relationship with GVC in sub-Saharan Africa, hence this section. According to the results from model 7 in Table 6, macro-economic factors have a significant relationship with GVC (Wald $\chi^2(4) = 115.12$, $P \leq 0.01$). However, its low ($R^2 = 0.0132$) indicate that they can only explain about 1% of the variations in GVC in sub Saharan Africa. The coefficients of GRR, EXR and INR (−128813.6, P = 0.002; −187.65, $P \leq 0.01$ and −43349.74, $P \leq 0.01$) indicate a negative but significant relationship. And those of INF (−6473.78, P = 0.348) indicate a negative but non-significant relationship. Hence conclude that macro-economic factors have a significant influence on GVC in sub Saharan Africa. And fit equation 13.

$$GVC = 3665482 - 128813.6GRR - 187.65EXR$$
$$Sig = \quad (0.002) \quad (\leq 0.01)$$
$$- 6473.78INF - 43349.74INR$$
$$(0.348) \quad (\leq 0.01) \qquad (13)$$

$R^2 = 0.0132$
Wald $\chi^2(4) = 115.12$, $P \leq 0.01$
Where:
GVC = Global Value Chains
GRR = GDP Growth Rate
EXR = Exchange Rate
INF = Inflation Rate
INR = Interest Rate

4.8.5. Overall relationship between all variables and GVC in sub Saharan Africa

The overall relationship is represented by model 8 and 9 in Table 6. Model 8 is a direct relationship whereas model 9 is a controlled relationship. The controlling effect is added by macro-economic factors. According to the results from model 8, there is a significant relationship (Wald $\chi^2(13) = 1433.25$, $P \leq 0.01$) between the predictors and GVC in sub Saharan Africa. The coefficient of determination ($R^2 = 0.7535$) indicating that the overall model can explain up to 75 percent of the variations in GVC in sub Saharan Africa. The coefficients of FDI, ECI, WSSI and VA (0.00095, $P \leq 0.01$; 458704.8, $P \leq 0.01$, 54200.99, $P \leq 0.01$ and 1777885, $P \leq 0.01$ respectively). Those of ICTI, COC, GE and RL (7746.2, P = 0.823; 909536.8, P = 0.245; 527002.2, P = 0.718 and 914930.3, P = 0.158) are positive but non-significant. The coefficients of GCF, PI, TCI and PS (−86099.52, $P \leq 0.01$; −0.0004, $P \leq 0.01$; −483506.7, $P \leq 0.01$and −1537135, $P \leq 0.01$) are negative and significant. Those of RQ (−336040.6, P = 0.889) is negative and non-significant. Therefore, conclude that the overall model of Investments, Infrastructure and Governance has a significant influence on global value chains in sub Saharan Africa. And fit model 14.

$$GVC = 2710225 + 0.000945FDI - 86099.52GCF - 0.0004PI$$
$$Sig = \quad (\leq 0.01) \quad (\leq 0.01) \quad (\leq 0.01)$$
$$- 483506.7TCI + 458704.8ECI + 7746.21ICTI$$
$$(\leq 0.01) \quad (\leq 0.01) \quad (0.823)$$
$$+ 54200.9WSSI + 909536.8COC + 527002.2GE$$
$$(\leq 0.01) \quad (0.245) \quad (0.718)$$
$$- 1537135PS - 336040.6RQ + 914930.3RL + 1777885VA$$
$$(\leq 0.01) \quad (0.889) \quad (0.158) \quad (\leq 0.01) \qquad (14)$$

$R^2 = 0.7535$
Wald $\chi^2(13) = 1433.25$, $P \leq 0.01$
Where:
GVC = Global Value Chains
FDI = Foreign Direct Investments
GCF = Gross Capital Formation
PI = Portfolio Investment
TCI = Transport Composite Index
ECI = Electricity Composite Index
ICTI = Information, Communication and Technology Index
WSSI= Water, Sewerage and Sanitation Index
COC = Control of Corruption
GE = Government Effectiveness
PS = Political Stability
RQ = Regulatory Quality
RL = Rule of Law
VA = Voice and Accountability

On the other hand, when a controlling effect of macro-economic factors is added to the overall relationship, the model is still significant (Wald $\chi^2(17) = 1540.95$, $P \leq 0.01$). the coefficient of determination ($R^2 = 0.7613$) indicates that the overall model can explain up to 76% of the variations in GVC in sub Saharan Africa. The coefficients of FDI, ECI, WSSI and VA (0.0009, $P \leq 0.01$;

451920.8, P ≤ 0.01; 58336.1, P ≤ 0.01 and 1714098, P ≤ 0.01 respectively). Those of ICTI, COC, GE, RL, GRR, INF and INR (6293.56, P = 0.861; 1004992, P = 0.209; 941521.7, P = 0.506; 267955.8, P = 0.649; 27525.02, P = 0.568; 3747.87, P = 0.413 and 22655.94, P = 0.145). The coefficients of GCF, PI, TCI, PS and EXR (−76993.74, P = 0.002; −0.00055, P = 0.001; −468043.5, P ≤ 0.01; −1590307, P ≤ 0.01; and −279.83, P = 0.001 respectively). And those of RQ (−94717.33, P = 0.967) is negative and insignificant. Thus conclude that the overall model with a controlling effect of macroeconomic factors has a significant influence on global value chains in sub Saharan Africa. And fit equation 15.

$$GVC = 1741882 + 0.00087FDI - 76993.74GCF - 0.00055PI$$
$$Sig = \quad (\leq 0.01) \quad (0.002) \quad (0.001)$$
$$- 468043.5TCI + 451920.8ECI + 6293.56ICTI$$
$$(\leq 0.01) \quad (\leq 0.01) \quad (0.861)$$
$$+ 58336.1WSSI + 1004992COC + 941521.7GE$$
$$(\leq 0.01) \quad (0.209) \quad (0.506)$$
$$- 1590307PS - 94717.33RQ + 267955.8RL + 1714098VA$$
$$(\leq 0.01) \quad (0.967) \quad (0.649) \quad (\leq 0.01)$$
$$+ 27525.02GRR - 279.83EXR + 3747.87INF + 22655.94INR$$
$$(0.568) \quad (0.001) \quad (0.413) \quad (0.145) \qquad (15)$$

$R^2 = 0.7613$
Wald $\chi^2(17) = 1540.95$, P ≤ 0.01
Where:
GVC = Global Value Chains
FDI = Foreign Direct Investments
GCF = Gross Capital Formation
PI = Portfolio Investment
TCI = Transport Composite Index
ECI = Electricity Composite Index
ICTI = Information, Communication and Technology Index
WSSI= Water, Sewerage and Sanitation Index
COC = Control of Corruption
GE = Government Effectiveness
PS = Political Stability
RQ = Regulatory Quality
RL = Rule of Law
VA = Voice and Accountability
GRR = GDP Growth Rate
EXR = Exchange Rate
INF = Inflation Rate
INR = Interest Rate

Model 9 with 17 predictors has a higher chi2 (Wald $\chi^2(17) = 1540.95$, P ≤ 0.01) than model 8 with 13 predictors (Wald $\chi^2(13) = 1433.25$, P ≤ 0.01). Therefore, conclude that model 9 presents a better fit.

5. CONCLUSIONS AND POLICY IMPLICATIONS

5.1. Introduction

Based on the findings from chapter 4, this study makes the following conclusion and possible policy implications.

5.2. Conclusions

The main aim of this study was to look into global value chains from different perspectives such as Investments, Infrastructure development, Governance and Macro-economic factors and establish their relationships. Panel data was used from 37 sub Saharan Africa countries from the year 2003-2018. The paper tested for both direct and controlled relationships using Panel corrected standard errors estimation model.

From both the direct models and controlled models, it was established that all the variables under study (Investments, Infrastructure, Governance and Macro-economic factors are significant in explaining the behavior of global value chains in sub Saharan Africa. However, controlled models were found to be a better fit than direct relationship models. The controlling effect was added using macro-economic factors.

Therefore, supports the proposition by Smith (1776) on the theory of absolute advantage. Liberalizing trade, embracing specialization and division of labor in production according to a countries core productive competencies leads to increased output and reduction of fixed overheads hence absolute advantage.

5.3. Policy Implications

The world is experiencing a substantial change due to increased innovations in technology, international trade and investments. To remain competitive and harness the potential of industrialization, Sub Saharan Africa should promote value added manufacturing, and integrate more into global value chains. Sub Saharan Africa countries should also consider minimizing on protectionism policies to enable expansion of international trade and thus global value chains.

Infrastructure development is a significant factor in the variations of global value chains in sub Saharan Africa. Effective and efficient infrastructure network enables a reduction in production cost hence possibilities in exploiting the benefits of absolute advantage. Therefore, there is need for countries to deliberately channel resources to infrastructure development.

Governance can explain up to 10% of the variation in global value chains in sub Saharan Africa. It is indeed a significant factor in influencing global value chains. Therefore, there is need to streamline governance especially as relates to manufacturing, international trade and business regulation.

REFERENCES

Adalov, A. (2021), The Information and Communication Technology Cluster in the Global Value Chain Network. Policy Notes and Reports 50. Vienna, Austria: The Vienna Institute for International Economic Studies.

Adalov, A., Stehrer, R. (2019), Implications of Foreign Direct Investment, Capital Formations and its Structure for Global Value Chains. The Vienna Institute for International Economic Studies, Working Paper 170.

Africa Development Bank, (2013). Africa Infrastructure Development Index. Côte d'Ivoire: Africa Development Bank.

Africa Development Bank, (2018). African Economic Outlook 2018. Côte d'Ivoire: Africa Development Bank.

Antras, P. (2016), Global Production: A Contracting Perspective. Princeton, New Jersey: Princeton University Press.
Antras, P., Chor, D. (2021), Global Value Chains, Working Paper No. 28549, NBER Working Paper Series. Massachusetts Avenue, Cambridge: National Bureau of Economic Research.
Asian Development Bank. (2021), Global Value Chains Development Report 2021, Beyond Production. Philippines: Asian Development Bank.
Aslam, A., Novta, N., Fabiano, R. (2017), Calculating Trade in Value Added. IMF Working Paper No. 17/178. United States: International Monetary Fund.
Baldwin, R. (2016), The Great Convergence: Information Technology and the New Globalization. Cambridge, Massachusetts: Belknap Press.
Bellora, C., Fontagne, L. (2020), Shooting Oneself in the Foot? Trade War and Global Value Chains. CEPII Working Paper No. 2019-18.
Bloomfield, AI. (1975), Adam Smith and the theory of international trade. In: Skinner, A.S., Wilson, T., editors. Essays on Adam Smith. Oxford: Clarendon Press. p455-481.
Bown, C.P., Erbahar, A., Zanardi, M. (2020), Global Value Chains and the Removal of Trade Protection, Working Paper. United States: Peterson Institute for International Economics.
Chang, H. (2007), Kicking away the ladder: The real history of free trade. In: Shaikh, A. Globalization and the Myths of Free Trade: History, Theory, and the Empirical Evidence. Routledge Frontiers of Political Economy. New York: Routledge.
Charles, C.E. (1989), A History of Economic Thought: From Aristotle to Arrow. Oxford: Blackwell.
Daria, T., Deborah, W. (2014), Making Global Value Chains Work for Development. Economic Premise; No. 143. World Bank: Washington, DC.
De Bolle, M., Zettelmeyer, J. (2019), Measuring the Rice of Economic Nationalism. PIIE Working Paper. No. 19-15. Washington, DC: Peterson Institute for International Economics.
De Marchi, V., Alford, M. (2021), State policies and upgrading in global value chains: A systematic literature review. Journal of International Business Policy, 5, 88-111.
Dollar, D., Kidder, M. (2017), Institutional quality and participation in global value chains. In: Measuring and Analyzing the Impact of GVCs on Economic Development, Global Value Chain Development Report, 2017.
Farrar, D.E., Glauber, R.R. (1967), Multi collinearity in regression analysis: The problem revisited. Review of Economics and Statistics, 49(1), 92-107.
Friedman, T.L. (2005), The World is Flat: A Brief History of the Twenty-first Century. New York: Farrar, Straus and Giroux.
Ghasem, A., Zahediasl, S. (2012), Normality tests for statistical analysis: A guide for non-statisticians. International Journal of Endocrinology and Metabolism, 10(2), 486-489.
Gogtay, N.J., Thatte, U.M. (2017), Principles of correlation analysis. Journal of the association of physicians of India, 65(3), 78-81.
Heeks, R., Malik, F., Morgan, S., Nicholson, B. (2020), Understanding and managing business-development hybrids: An institutional logics case analysis. Development Studies Research, 7(1), 31-49.
Hossain S., Rahman Z. (2017), Does governance facilitate foreign direct Investments in developing countries? International Journal of Economics and Financial Issues, 7(1), 164-177.
Irwin, A. (2021), What it will take to vaccinate the world against COVID-19. Nature, 592(7853), 176-178.
Johnson, R.C., Noguera, G. (2012), Accounting for intermediates: Production sharing and trade in value added. Journal of International Economics, 86(2), 224-236.
Kaufmann, D., Kraay, A., Mastruzzi, M. (2010), The world wide governance indicators; Methodology and Analytical Issues, The World Bank, Development Research Group, Macroeconomics and Growth Team, Policy Research Working Paper no. 5430.
Klein, A.G., Gerhard, C., Buchner, R.D., Diestel, S., Schermelleh-Engel, K. (2016), The detection of heteroscedasticity in regression models for psychological data. Psychological Test and Assessment Modelling, 58(4), 567-592.
Kolesa, S. (2018), Global Value Chains: Government policies for enhancing the role of small and medium enterprises in global value chains-a case of Slovenia. Management, 13(1), 49-70.
Krugman, P. (2019), What Economists (Including me) got Wrong about Globalization. Bloomberg, Massachusetts: MIT Press.
Levin, A., Lin, C.F., Chu, C.S.J. (2002), Unit root tests in panel data: Asymptotic and finite-sample properties. Journal of Econometrics, 108(1), 1-24.
Liberati, A., Altman, D.G., Tetzlaff, J., Mulrow, C., Gotzsche, P.C., Ioannidis, J.P.A., Clarke, M., Devereaux, P.J., Kleijnen, J., Moher, D. (2009), The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. Journal of Clinical Epidemiology, 62(10), e1-34.
Luo, X., Xu, X. (2018), Infrastructure, Value Chains, and Economic Upgrades (August 13, 2018). World Bank Policy Research Working Paper No. 8547.
Mouanda-Mouanda, G. (2019), Global value chains participation for African countries: an overview from UIBE GVC index system. Open Journal of Business and Management, 7(2), 941-962.
Myint, H. (1977), Adam Smith's theory of international trade in the perspective of economic development. Economica, 44(175), 231-248.
Myles, R.H. (1990), Classical and Modern Regression with Applications. Duxbury, Advanced Series in Statistics. 2nd ed. Boston, MA: PWS-Kent Publishing Co.
Organisation for Economic Co-operation and Development. (2013), Interconnected Economies: Benefiting from Global Value Chains. Paris: OECD Publishing.
Organisation for Economic Co-operation and Development. (2013), Interconnected Economies: Benefiting from Global Value Chains. Meeting of the OECD Council at Ministerial Level. OECD Paris, 2 Rue Andre-Pascal, 75775 Paris Cedex 16. Paris, France: Organisation for Economic Co-operation and Development.
Pahl, S., Timmer, M.P., Gouma, R., Wiltjer, P.J. (2022), Jobs and Productivity Growth in Global Value Chains: New Evidence for Twenty-five Low and Middle Income Countries. The World Bank Economic Review, 36(3), 670-686.
Pansera, M., Owen, R. (2018), Framing inclusive innovation within the discourse of development: Insights from case studies in India. Research Policy, 47(1): 23-34.
Parks, R. (1967), Efficient estimation of a system of regression equation when disturbances are both serially and contemporaneously correlated. Journal of the American Statistical Association, 62, 500-509.
Pearson, K. (1896), Mathematical contributions to the theory of evolution III. Regression, heredity and panmixia. Philosophical Transactions of the Royal Society A, 187, 253-318.
Reed, W.R., Ye, H. (2011), Which panel data estimator should I use? Applied Economics, 43(8), 985-1000.
Rodrik, D. (2018), New Technologies, Global Value Chains, and Developing Economies. NBER Working Paper No. 25164. National Bureau of Economic Research: Cambridge, MA, USA.
Schumacher, R. (2012), Adam smith's theory of absolute advantage and the use of doxography in the history of economics. Erasmus Journal for philosophy and Economics, 5(2), 54-80.
Shaikh, A. (2007), Globalization and the myth of free trade: History, Theory, and the Empirical Evidence. In: Routledge Frontiers of

Political Economy. New York: Routledge.
Shepherd, B. (2016), Trade Facilitation and Global Value Chains: Opportunities for Sustainable Development. International Centre for Trade Facilitation and Sustainable Development (ICTSD). Geneva, Switzerland: International Environment House, Chemin de Balaxert. p1219
Smith, A. (1976), An inquiry into the nature and causes of the wealth of nations (WN). In: Campbell, R.H., Skinner, A.S., editors. The Glasgow Edition of the Works and Correspondence of Adam Smith. Vol. 2. Oxford: Oxford University Press.
Stiglitz, J. (2002), Globalism's discontents. The American prospect, 13(1), 16-21
Theil, H. (1971), Principles of Econometrics. New York: John Wiley and Sons, Inc.
Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R., de Vries, G.J. (2015), An illustrated user guide to the world input output database: The case of global automotive production. Review of International Economics, 23(3), 575-605.
Timmer, M.P., Erumban, A.A., Los, B., Stehrer, R., de Vries, G.J. (2014), Slicing up global value chains. Journal of Economic Perspectives, 28(2), 99-118.
United Nations Conference on Trade and Development. (2013), Global Value Chains and Development: Investment and Value Added Trade in the Global Economy, 2013. Geneva, Switzerland: United Nations Conference on Trade and Development.
United Nations. (2013), World Investment Report 2013, Global Value Chains: Investment and Trade for Development, United Nations Publication. New York, United States: United Nations.
United Nations. (2015), Transforming our World: The 2030 Agenda for Sustainable Development A/RES/70/1. New York, United States: United Nations.
White, H. (1980), A heteroscedasticity-consistent covariance matrix estimator and a direct test for heteroscedasticity. Econometrica, 48, 817-838.
Wooldridge, J.M. (2002), Econometric Analysis of Cross Section and Panel Data. Cambridge: MIT Press.
World Bank. (2017), Global Value Chain Development Report 2017, Measuring and Analyzing the Impact of GVCs on Economic Development.
World Bank. (2017), World Development Report 2017, Governance and the Law, World Bank Flagship Report.
World Bank. (2020), World Development Report 2020, Trading for Development in the Age of Global Value Chains. Washington, DC: World Bank.
Yang, G. (2018), Infrastructure and Global Value Chain Position: Evidence from China. Department of Economics and Business. Barcelona: Universitat Popmeu Fabra.

APPENDIX

Appendix 1: Sub-Saharan Africa countries

Sampled Countries				Excluded Countries	
No.	**Country**	**No.**	**Country**	**No.**	**Country**
1.	Angola	25.	Liberia	1.	Benin
2.	Benin	26.	Madagascar	2.	Burkina Faso
3.	Botswana	27.	Malawi	3.	Comoros
4.	Burkina Faso	28.	Mali	4.	Congo Republic
5.	Burundi	29.	Mauritania	5.	Equatorial Guinea
6.	Cameroon	30.	Mauritius	6.	Eritrea
7.	Cape Verde	31.	Mozambique	7.	Ethiopia
8.	Central Africa Republic	32.	Namibia	8.	Guinea
9.	Chad	33.	Niger	9.	Guinea Bissau
10.	Comoros	34.	Nigeria	10.	Sudan
11.	Republic of the Congo	35.	Rwanda	11.	Zimbabwe
12.	Cote d'Ivoire	36.	Sao Tome Principe		
13.	Democratic Republic of the Congo	37.	Senegal		
14.	Equatorial Guinea	38.	Seychelles		
15.	Eritrea	39.	Sierra Leone		
16.	Eswatini (Formerly Swaziland)	40.	Somalia		
17.	Ethiopia	41.	South Africa		
18.	Gabon	42.	South Sudan		
19.	Gambia, The	43.	Sudan		
20.	Ghana	44.	Tanzania		
21.	Guinea	45.	Togo		
22.	Guinea-Bissau	46.	Uganda		
23.	Kenya	47.	Zambia		
24.	Lesotho	48.	Zimbabwe		

Author compilation, 2022

NB: These Countries were excluded due of inadequacies in data compilation