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Growth of African countries and trade structure

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Abstract

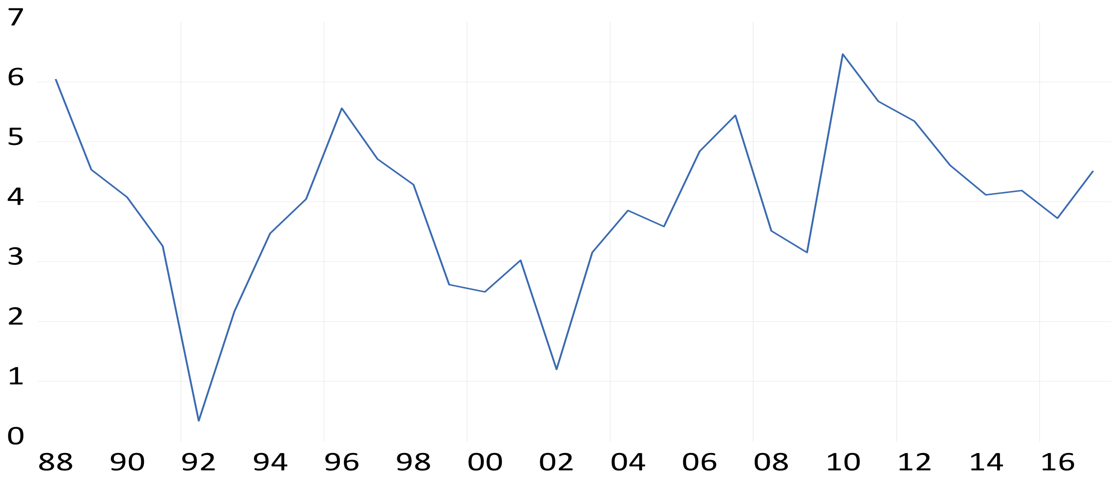
The aim of this paper is to present the impact of trade structure on economic growth in Africa. Using a panel data regression with fixed effects, we regress GDP growth against trade structure and other standard explanatory variables for eighteen African countries. Trade structure consists of concentration of trade, intra-industry trade and number of exported goods. To measure concentration of trade, the Hirschman Herfindahl (HHI) index is used while the Grubel-Lloyd (1975) index of intra-industry trade (IIT) is computed to measure IIT. Other standard explanatory variables included are gross capital formation, inflation and population growth. The results of this study suggest that trade structure has a positive impact on the growth of economies in Africa as intra-industry trade and number of exported products positively determine GDP growth. The other standard variables namely gross fixed capital formation, inflation and population growth also positively determine economic growth in Africa. This paper recommends that African countries should focus on increasing the number of exported products, increase intra-industry trade, improve infrastructure to facilitate trade and implement suitable population policies. The paper makes a contribution towards empirical literature on the impact of trade structure on economic growth in African countries; an area which has been largely ignored in the past.

Keywords: *Concentration of trade, Intra-industry trade, Exports, Growth*

Introduction

The relationship between trade and economic growth remains ambiguous, despite various multi country empirical studies (Rodriguez and Rodrik (2001). Trade openness and trade volume have been used interchangeably to refer to trade and the confusion arising from the inconsistent definition of trade has resulted in many methodological problems (Rodriguez and Rodrik (2001). The empirical estimation attempts have failed to isolate the pure impact of trade on economic growth as trade openness or trade volume are affected by other influences arising from nontrade growth factors such as exchange rate. Using trade structure as one of the exogeneous variables eliminates any confusion on definition of trade. The notion of trade can be identified as a structure, conduct or performance variable. Trade openness is more of a conduct variable as it deals with trade policy, while trade volume is a performance variable as it is an outcome of trading behaviour (Sohn and Lee, 2010). This paper therefore considers trade structure as the main variable of interest in finding the determinants of economic growth for eighteen African countries namely Egypt, Gabon, Gambia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mauritius, Morocco, Namibia, Niger, Seychelles, South Africa, Togo, Zimbabwe and Uganda. The growth rate for African economies has been fluctuating over the past years as shown on figure 1.

Figure 1: GDP Growth of African Economies 1988-2017



Source: Authors' own computation (2019)

Figure 1 shows the mean of GDP for the African economies from 1988 to 2017.The figure shows that African countries were trapped in fluctuating growth rates over the past three decades. Every upward trend in GDP growth was followed by nosediving of the rates, for example in 1992, 2002 and 2009 and 2011. Therefore new policies for sustained turnaround of African economies are necessary.

The trade structure variables of interest in this study are concentration of trade, intra-industry trade and number of exported goods. Previous work has overlooked these characteristics of trade, although they could lead to new ways of understanding the trade-growth relationship. Firstly, we analyse concentration of trade, which is the degree to which a country engages in international trade with a limited number of partner countries. In this study, we use the Hirschman Herfindahl (HHI) Index to measure trade partner concentration. The HHI index is a measure of the dispersion of trade value across an exporter's partners and a country with trade that is concentrated in a very few markets will have an index value close to 1 while a country with a perfectly diversified trade portfolio will have an index close to zero (World Bank, 2019). If the country trades with only a few other countries its trade concentration ratio is high and if it trades with many countries the trade concentration ratio is low. Trade costs can be minimised by concentrating trade, especially costs associated with congestion of insufficient infrastructure, like ports and airports. Hence, concentrating trade might lower transportation costs where the trade-related infrastructure is not well developed (Frankel et al. (1995). Further, trade-related public policies that promote local investments become easier and cheaper to implement when trade is concentrated among few partners.

Pickering and Sheldon (1984), suggest that concentration at the industry level might lead to economies of scale in production and marketing, as well as stronger competitive positions. However, because rich countries hold and create more knowledge and have a more diversified economy, better infrastructure and more efficient governments, they are likely to benefit less from trade concentration than do poor countries (Kali et al (2007). The advantage of low trade concentration however is that the greater the number of trading partners, the greater the innovations that become necessary leading to growth of countries. Further, an increase in the number and diversity of partner countries causes an increase in potential competitors for the local market, leading to higher productivity and greater economic growth. Table 1 shows the average HHI index per country for the 18 countries over the period 1988 to 2017.

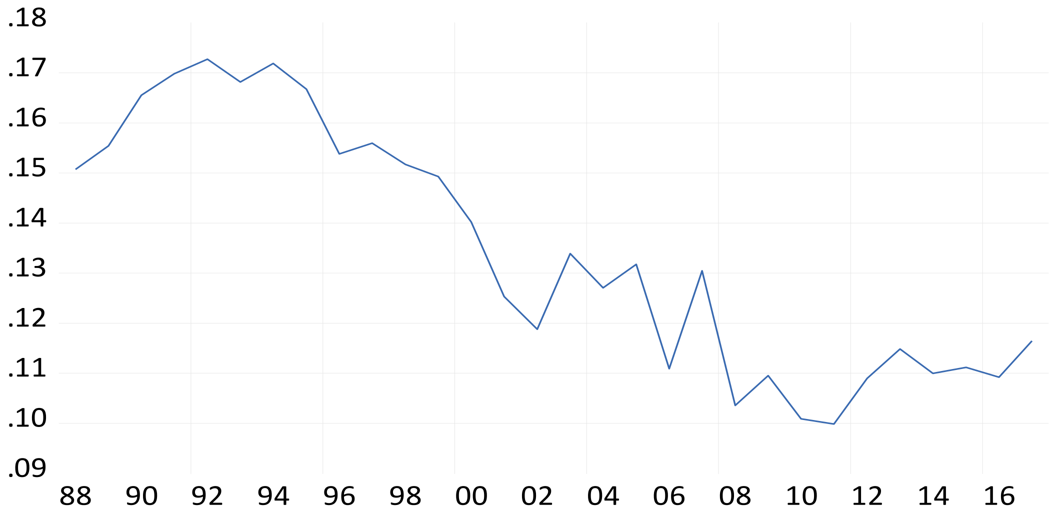
Table 1: Average HHI Index 1988-2017

Country	**Average HHI 1988-2017**
Egypt	0,06
Gabon	0,27
Gambia, The	0,32
Ghana	0,07
Guinea	0,09
Kenya	0,07
Madagascar	0,15
Malawi	0,08
Mauritius	0,15
Morocco	0,11
Namibia	0,13
Niger	0,39
Seychelles	0,15
South Africa	0,07
Tanzania	0,07
Togo	0,07
Zimbabwe	0,09
Uganda	0,06

Source: Authors' own computation (2019)

Table 1 shows that generally, most African countries have low HHI with Egypt, South Africa, Kenya, Tanzania being amongst the countries with lowest HHI, meaning they trade with many countries. Niger, followed by Gabon have the highest HHI meaning that they have lesser trade (Kali et al. 2007) suggests that low concentration of trade has a positive impact on output growth in that it facilitates technology adoption since the implementation and dissemination of foreign innovations is made easier when more people become familiar with the language and the conventions of these innovations. In order to understand HHI trends over the years, figure 2 shows the mean of HHI for the African countries.

Figure 2: HHI of African Economies 1988-2017



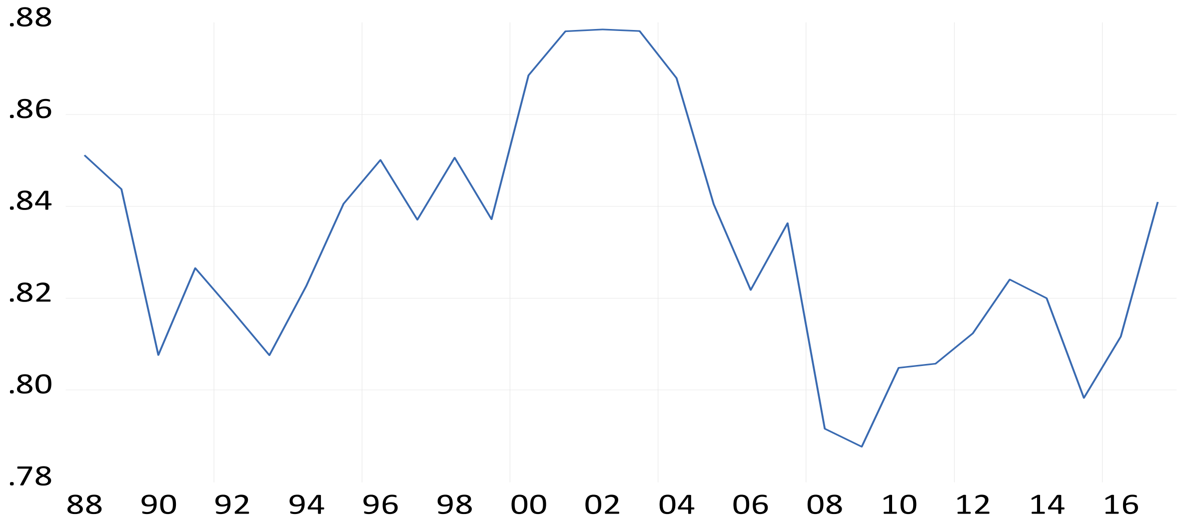
Source: Authors' own computation (2019)

As shown on figure 2, the HHI for the African countries has been falling over the period of study implying an increase in trade partners, This is a result of economic integration efforts by the countries and a decrease in trade concentration is empirically associated with economic growth.

The second trade structure variable in our study is the intra-industry trade index, which is measured using the Grubel–Lloyd intra-industry trade (IIT) index. The proportion of intra industry trade in world trade has steadily grown over the last half century (Krugman et.al, 2015) In the case of intra-industry trade in homogeneous products, the welfare gains for a country are similar to welfare gains under inter-industry trade since the gains are based on lower opportunity costs, in the form of lower transportation, insurance or financing costs or the provision of low cost seasonal goods (Sawyer et al, 2004). Intra-industry trade in homogeneous goods or services between countries can occur under four possible circumstances; identical bulky material with high cost of transportation relative to value, homogeneous services can also be the basis for intra-industry trade due to joint production of the service, entreport and re-export trade and seasonal or other periodic fluctuations in output or demand. For intra-industry trade in differentiated products, these welfare gains also occur but there are additional factors to consider. Product differentiation enhances consumers' choices and welfare such that domestic consumers have more types of the product to choose from. However the products are produced under imperfect competition where Price >Marginal cost and there is excess capacity and underused plants. Despite this, intra-industry trade reduces monopoly power of domestic firms, thus reduces problems associated with monopolies. It also enables production at higher levels of output, thus firms enjoy lower costs due to economies of scale, resulting in price decline. A higher level of intra-industry trade means firms enjoy greater economies of scale, thus intra-industry trade of differentiated products therefore enhances scale effects, thereby engendering growth (Sawyer et al, 2004).

The proposition that intra-industry trade entails lower costs of factor-market adjustment than inter-industry trade, originally made by Balassa (1965), has become widely accepted in international economics. There are no adjustment costs when shifting factors of production from one industry to another because intra-industry trade is more intense among countries with similar incomes and factor endowments, thus, it is easier for resources to be reallocated among industries. Thus intra-industry trade is likely to be larger among industrial economies of similar size and factor proportions (Salvatore, 2014). The gains from intra-industry trade may be larger and adjustment costs lower than inter-industry trade only implying that countries with a higher level of intra-industry trade would tend to have higher productivity growth. The weakness of the index is that one can get very different values depending on how one defines the industry or product group. The more broadly one defines the industry or product group, the more likely a country will engage in intra-industry trade. All the countries under study have high average intra-industry trade index over the period with the highest being Mauritius at 0.94 and the lowest being Seychelles and Gabon at 0.74. The high intra industry trade indices signify that the economies are likely to be experiencing economies of scale lower adjustment costs, which are necessary for economic growth. Figure 3 shows the mean of IIT index for the economies over the study period.

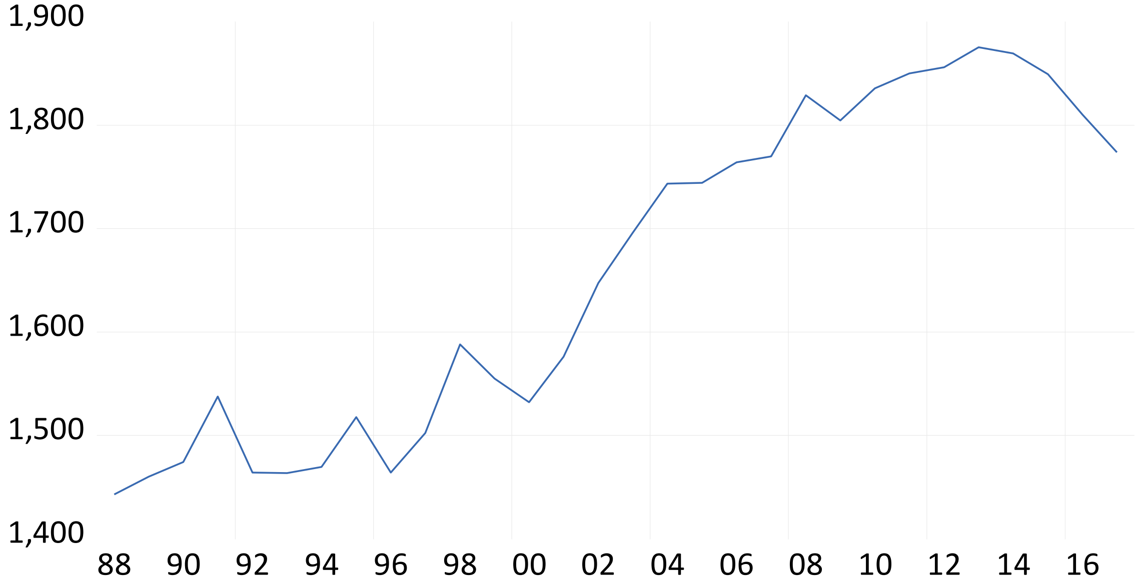
Figure 3: IIT Index of African Economies 1988-2017



Source: Authors' own computation (2019)

With reference to Figure 3, there have been fluctuations in IIT index over the years with the lowest experienced in 2008 – 2009, possibly due to the global economic crisis. The highest IIT was experienced between 2000 and 2004. The index was also low in 2015, but has been increasing steeply since then. Thus the countries are expected to have experienced growth when IIT index was on an upward trajectory. The third trade structure variable of interest is the number of exported goods. As the number of exported goods increases, economic growth is also expected to increase for the African countries. Data shows that South Africa leads on number of exported goods followed by Kenya and Egypt while Gabon and Niger and the least exporters amongst the African countries. Figure 4 shows the mean of exported goods over the period of study.

Figure 4: Exported goods by African Economies 1988-2017



Source: Authors' own computation (2019)

The number of exported goods for the African countries has been rapidly increasing over the years as shown on Figure 4, with the highest number of goods exported in 2014 and the lowest in 1988 and 1991. Empirically it was proven that an increase in number of exported goods lead to an increase in GDP growth.

Theoretical Literature

The relationship between trade structure and growth has not obtained as much attention from researchers as the relationship between growth, trade policy and trade volume. It is important to examine the relationship between trade structure and growth since it gives the pure impact of trade on growth. Such an investigation involves understanding the theoretical and empirical association between trade structure and economic growth. Studies on economic growth derive from the two main competing theories, namely Solow's (1956) neo classical growth theory and Romer's (1986) endogenous growth theory. Even though these theories ignore trade structure as a driver of economic growth, they explain another variable in our study, gross capital formation or capital as a determinant of economic growth.

Solow (1956) and Swan (1956) based their growth model on the neoclassical growth theory, where an economy grows as a result of increasing input of capital and labour The Solow model of growth highlights the impact on growth of saving, population growth and technological progress in a closed economy setting without a government sector. The conventional Solow neoclassical growth model postulates that the growth of output per worker over prolonged periods depends on technological progress which is assumed to take place smoothly over time. Any country that increases its capital–labour ratio will have a higher output per worker, however, because of diminishing returns, the impact on output per worker resulting from capital accumulation per worker will continuously decline. In the long run an economy will gradually approach a steady state equilibrium and ceases to grow and the only way to dampen the effects of diminishing returns and grow such an economy is through an infusion of technological progress. Hence the theory takes the long-run growth rate as exogenously given from the economic system The Solow theory therefore ignores trade structure as a determinant of economic growth. Romer (1986), challenged the view that the only way to grow an economy was through an infusion of technological progress and stressed that the long-run rate of economic growth is determined by factors endogenous to the economic system. Romer extended the concept of capital to include human capital in the endogenous growth models as healthy and educated workers would be able to use existing capital and technology more efficiently. Human capital is considered as the main source of increasing returns in growth rates between developed and developing countries. (Gundlach et al., 2001) specify that the theoretical foundation for the impact of human capital on economic growth takes its roots within the endogenous theory. Hence, like the Solow growth model, Romer's endogenous growth model also ignores the role of trade structure as a determinant of economic growth.

There are however theories that explain trade structure, and these are the theories of intra-industry trade in differentiated products. The theories are not mutually exclusive hence more than one of these theories may be applied to a particular industry at any given time. These are the product cycle theory, overlapping demands theory and economies of scale theory. Overlapping demands/spillover theory by Staffan Linder (1961) suggests that trade in manufactured goods is likely to be greatest among countries with similar tastes and income levels thus low-income countries will likely trade with other low-income countries while high income countries trade amongst themselves. There is a high probability of overlapping demands since the tastes of consumers are conditioned strongly by their income levels. Firms therefore tend to produce goods with a large domestic market and hence export manufactured products whereby a large domestic market exists, resulting in intra-industry trade. In the process of satisfying the domestic market the nations acquire necessary experience and efficiency that enable them to subsequently to export these commodities to other nations with similar tastes and income levels (Salvatore 2014). However, contrary to the overlapping demands theory, developed and developing nations enjoy a growing amount of intra-industry trade since in developing countries, there are high income earners while in developed countries there are also low income earners (Sawyer et al, 2004).

The product cycle theory developed by Venon (1966) which also explains intra-industry trade accounts for the reasons for and duration of the technological gap between countries that trade. The theory suggests that industrialised countries are innovative, hence they specialise in producing newly invented goods based on technological innovations, while developing countries are imitators that produce and export goods which are familiar to the international economy (Salvatore 2014). The life of a product has four major stages namely introduction, where research and development for the product takes place, followed by product growth driven by research and development, highly skilled labour plus refinement in production. At that stage, the goods are consumed only in that country with no international trade (Appleyard et al, 2014). This is followed by product stabilisation in design and production and the standards and characteristics of the product begin to emerge while mass production techniques and economies of scale are realised. Innovating countries consider investing in other developed countries (Appleyard et al, 2014). Production is then completely standardised and the product loses its distinctiveness for the innovating country as the production process is familiar and it now requires unskilled, low-cost labour while capital and raw materials and becomes a common good. The comparative advantage shifts from the innovating country to a country with cheap labour hence production and export of the product shifts from the developed country to the developing country in the form of foreign direct investment or the sale of the patent. The developed country may then import the product from the developing country, hence intra industry trade (Appleyard et al, 2014).

Economies of scale theory also explain trade structure in that it explains intra industry trade. Economies of scale are a reduction in average costs that result from increase in size of a firm's plant and equipment. Increasing returns to scale refer to the production situation where output grows at a rate that is proportionately more than the increase in factors of production and this can lead to greater division of labour and specialisation hence beneficial trade between nations that are identical (Salvatore (2014). According to Antweiler and Trefler (2002, a third of all goods-producing industries are characterized by increasing returns to scale and mutually beneficial trade can be based on increasing returns to scale.

Empirical Literature

Empirical literature suggests various determinants of economic growth in different countries. However most of the literature tests the significance of trade openness and trade volume to growth and largely ignore trade structure as a determinant of growth. Even though the impact of trade structure is important, considering that it gives the pure impact of trade on economic growth without other influences arising from nontrade growth factors, few studies examined the empirical relationships between trade structure and economic growth. These include Lederman and Maloney (2003) who considered the influence of natural resource abundance, export concentration, and intra-industry on economic growth. Results from the study showed that trade variables are important determinants of growth, especially natural resource abundance and export concentration. The study proved that trade structure is an important determinant of growth and export concentration reduces growth by hampering productivity. Intra-industry trade was found to be generally associated with good growth performance.

Kali et al (2007) empirically tested the significance of trade structure, namely number of trade partners and the concentration of trade among partners, on the economic growth of a country. Standard OLS regressions and fixed effects regressions were used in the study. Findings from the study revealed that the structure of trade, independently from trade openness, contribute to economic growth. The study found a positive correlation between the number of trading partners and growth especially for rich countries. There was also positive correlation between trade concentration and growth especially for poor countries.

Antweiler and Trefler (2002) found out that a third of all goods-producing industries are characterized by increasing returns to scale, hence scale economies are a quantifiable and important source of comparative advantage. (Basu and Das 2011) used the generalized kernel estimation methodology to examine the role played by skill and technology content of the exports so as to understand the differences in economic performance for 88 developing countries over 1995 to 2007. Findings from the study suggested that as the skill and technology content of exports increased, the impact on GDP per capita increased positivity. Using data for 205 Australian manufacturing industries for the period 1986 to 1991, Menon and Dixon (1996) established that IIT contributed almost half the sharp growth in total trade.

Grossman and Helpmann (1991) suggest that trade promotes growth through the transmission and creation of knowledge. With trade, the number of potential buyers is increased and also the potential for economic profits associated with innovation, brand recognition, patent registrations are increased. Firms also realise improvements over competing firm's products. Ceteris paribus, countries with more trading partners face a greater number of foreign technologies and the adoption of those technologies leads to greater productivity hence economic growth. Further, trade ensures expansion of the potential market in which domestic producers can sell their products leading to growth (Grossman and Helpmann, 1991).

Other studies test the impact of several macroeconomic variables on economic growth, including the additional variables included in this study namely gross capital formation, inflation, and population growth**.** Hossain and Mitra (2013) examined the dynamic causal relationships between economic growth and five determinants, which are trade openness, foreign aid, domestic investment, long-term external debt, government spending for a panel of 33 African countries for the period 1974-2009. A short-run bidirectional causality is found between economic growth and trade openness. Moreover, the authors found the long-run effects of trade openness, domestic investment and government spending on economic growth are significantly positive.

Barro (2003) suggests that GDP per capita growth rate is enhanced by the rule of law, the investment ratio, favourable movements in terms of trade and increased international openness and it is negatively affected by fertility rate, ratio of government consumption to GDP and inflation rate. Ali (2012) investigated the factors that stimulated and maintained economic growth in Malaysia from the year 1997 to 2010 using time series analysis and found out that consumption price index, stock market index, export and housing price index were significant determinants.

Crespo et. al (2014) investigated determinants of regional economic growth based on a new data set of 255 European Union regions for the period 1995–2005 using Bayesian model averaging (BMA) and the findings suggest that regions containing capital cities are growing faster, as do regions with a large share of workers with a higher education. Empirical findings by Moral-Benito (2012) suggest that the most robust growth determinants are the price of investment goods, distance to major world cities, and political rights. Obwona (2002) suggest that FDI has a positive impact on GDP growth in Uganda.

Choe (2003) tested the causal relationships between economic growth and FDI in 80 countries over the period 1971–95, using a panel VAR model and the results showed that FDI Granger–causes economic growth, and vice versa suggesting a strong positive association between economic growth and FDI inflows. Keun and Byung-Yeon (2009) studied the determinants of long-run economic growth by conducting cross-section estimations and fixed-effects panel and system-GMM estimations and found out that technology and tertiary education and institutions were the determinants of long-run economic growth. Higher education and international trade lead to an increase in economic growth in China. while high fertility, high inflation, and the presence of state-owned enterprises (SOE) reduce growth rates among the provinces (Baizhu and Yi, 2000).

Research Problem

African countries have failed to achieve sustained GDP growth rates over the past three decades. As shown on figure 1, the countries are trapped in fluctuating growth rates such that years of increasing GDP growth are usually followed by years of declining growth. This suggests that policies by the countries, including trade policies, need to be reviewed so as to bring sustained growth over long periods. Currently, trade policies by the countries focuses mostly on trade openness and trade volume with an analysis of policies regarding tariffs or custom barriers, and related measures, but pays little or no attention to the trade strategies or trade structure followed. This is despite the fact that trade structure has been subject to noticeable changes in many countries, for example an increase in regional trade agreements. African countries may realise sustained economic growth by focusing more on trade structure s it gives pure impact of trade on economic growth.

Research Objective
This paper investigates the impact of trade structure, particularly concentration of trade, intra-industry trade and number of exported goods on economic growth of African countries. The paper also investigates the significance of other variables on economic growth namely gross capital formation, inflation and population growth.

Research Hypothesis
Ho: Trade structure variables namely concentration of trade, intra-industry trade and number of exported goods do not have an impact on economic growth of African countries.
H_1: Trade structure variables namely concentration of trade, intra-industry trade and number of exported goods have an impact on the economic growth of African countries.

Methodology
An estimation of data from 18 African countries is done namely Egypt, Gabon, Gambia, Ghana, Guinea, Kenya, Madagascar, Malawi, Mauritius, Morocco, Namibia, Niger, Seychelles, South Africa, Togo, Zimbabwe and Uganda. Our econometric specification follows Levine and Renelt (1992) where the rate of growth of GDP growth is regressed against a set of explanatory variables that capture trade structure, a vector of standard explanatory variables and total trade. We introduce the variable of interest first, namely trade structure and other variables now standard in the literature, to examine both robustness and suggestive channels of influence. The general equation is as follows,

$$\text{GDP}_{it} = \beta_0 + \beta_1\, Trade\ Structure_{it} + \beta_2 Standard\ \ Explanatory\ Variables_{it} + + u_{it} \ldots\ldots\ldots 1$$

The specific equation is given as follows

$$GDP_{it} = \beta_0 + \beta_1\, HHI\ Index_{it} + \beta_2\, IIT\ Index_{it} + \beta_3 No.Of\ exported\ Products + \beta_4 Gross\ capital\ formation_{it} + \beta_5 Inflation_{it} + \beta_6 Population\ growth_{it} + u_{it} \ldots .2$$

Explanation of variables
The dependent variable, GDP_{it} is the GDP growth of African countries. The explanatory variables consist of trade structure variables (HHI Index + IIT Index + number of exported goods) and other variables namely gross capital formation, inflation and population growth. The Grubel-Lloyd (1975) index of intra-industry trade (IIT) was introduced by Herb Grubel and Peter Lloyd 1971. Despite concerns relating to the effects of the aggregate trade imbalance, the index provides a relatively reliable measure of the importance of lIT at any point in time. The importance of IIT has increased with the emergence of regional trading blocs since countries contemplating joining or forming a regional trading block consider adjustment costs and these costs depend on the extent of intra-industry trade (Menon and Dixon, 1996).

The Grubel-Lloyd IIT index is calculated s follows;

$$1 - \frac{\text{Xi}-\text{Mi}}{\text{Xi}+\text{Mi}} \quad \ldots\ldots\ldots 3$$

Where Xi is value of exports and Mi is value of imports of good i where X-M is an absolute value. The intra-industry trade index ranges from zero (no intra-industry trade) to 1 (where 100% of trade is intra-industry trade). The closer the index is to 1, the more intra-industry trade there is relative to inter-industry trade. The closer it is to 0, the less intra-industry trade there is relative to inter-industry trade in the same good or service. The weakness of the index is that one can get very different values depending on how one defines the industry or product group. The more broadly one defines the industry or product group, the more likely a country will engage in intra-industry trade. The scale economies arising from IIT are thought to lead to more rapid productivity gains and hence faster growth (Krugman, 2015).

To measure concentration of trade, a Hirschman Herfindahl (HHI) index is used. The index ranges from zero to one and increases with concentration. This index is widely used in studies that focus on general indicators of economic concentration (Antweiler and Trefler 2002). A low number indicates low concentration of trade.

The HHI index is calculated as follows;

$$HHI = \sum_{J}^{N}\left(\frac{\text{Tij}}{\sum_{j}^{N}\text{Tij}}\right)2 \quad \ldots\ldots 4$$

N denotes the total number of trading partners and Tij is the total value of trade (exports plus imports) between countries i and j. To rule out the problem of multicolinearity between the number of trading partners and trade concentration, we compute the correlation between the changes in the number of exported goods with the changes in trade concentration (HHI). Export concentration is expected to have a negative effect on growth, suggesting that focusing only on few trade partners retards growth. This suggests that FTAs strongly enhance economic growth. The number of exported goods per country and the Hirschman Herfindahl (HHI) index were extracted from WITS World Bank indicators (2019). GDP growth, Gross capital formation, inflation and population growth were extracted from World Bank's World development indicators (2019). Data for computing the Grubel-Lloyd (1975) index of intra-industry trade (IIT) was also extracted from World Bank's World development indicators (2019).

Estimation of the model

The use of panel data allows us to control for omitted time-specific effects and country specific effects and diminish the endogeneity biases (Temple 1999). For this study data is extracted from 18 African countries for the period 1988 – 2017. The Hausman test is used to determine whether to use the fixed or random effects model.

Fixed Effects Model

Fixed effects explore the relationship between predictor and outcome variables within an entity. Each entity has its own individual characteristics that may or may not influence the predictor variables (for example, being a male or female could influence the opinion toward certain issue). Fixed Effects removes the effect of time-invariant characteristics so that the net effect of the predictors on the outcome variable can be assessed. Another important assumption of the fixed effects model is that time-invariant characteristics are unique to the individual and should not be correlated with other individual characteristics. The fixed effects approach assumes that although the intercept may differ across individuals, each individual's intercept does not vary over time. The model assumes that slope coefficients are constant across the firms over time. Fixed effects regression enables one to control for omitted variables that differ between cases but are constant over time. It allows one to use the changes in the variables over time to estimate the effects of the independent variables on the dependent variable, and is the main technique used for analysis of panel data. The following is the fixed effects regression model;

$$\mathrm{Y_{it}} = +\beta_{1i} + \beta_2 \mathrm{X_{2it}} + \beta_3 \mathrm{X_{3it}} + u_{it} \quad \ldots\ldots 5$$

The subscript i is on the intercept term in the equation to suggest that the intercepts of the firms may be different due to special features such as managerial style or philosophy (Gujarati 2005). Using within groups fixed effects the mean values of the variables in the observations on a given individual are calculated and subtracted from the data for that individual. If α_i is correlated with any of the X_j variables, the regression estimates from a regression of Y on the X_j variables will be subject to omitted variable bias. Even if the unobserved effect is not correlated, with any of the explanatory variables, its presence will in general cause OLS to yield inefficient estimates and invalid standard errors. The mean values of the variables in the observations on a given individual are calculated and subtracted from the data for that individual.
Given the following equation

$$Y_{it} = \beta_1 + \sum_{j=2}^{k} \beta_j X_{jit} + \alpha_i + \delta t_i + \mathcal{E}_{it} \quad \ldots\ldots 6$$

Subtracting the following mean values:

$$\bar{Y}_i = \beta_1 + \sum_{j=2}^{k} \beta_j \bar{X}_{ij} + \alpha_i + \delta \bar{t}_i + \bar{\mathcal{E}}_{it} \quad \ldots\ldots 7$$

The following is obtained;

$$Y_{it} - \bar{Y}_i = \sum_{j=2}^{k} \beta_j \left(X_{jit} - \bar{X}_{ij}\right) + \alpha_i + \delta(t - \bar{t}\ \ ) + \mathcal{E}_{it} - \bar{\mathcal{E}}_i \quad \ldots\ldots 8$$

The unobserved effect disappears.

Random effects Model
The rationale behind random effects model, also. known as error components model, is that, unlike the fixed effects model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. Random effects assume that the entity's error term is not correlated with the predictors which allows for time-invariant variables to play a role as explanatory variables (Gujarati 2005). The random effects approach assumes that individual specific constant terms are randomly distributed across cross sectional units and the units are drawn from a large population. Taking equation 6.3, instead of treating β_{1i} as fixed, the assumption is that it is a random variable with a mean value of β_1. Thus the intercept value of a country can be expresses as follows:

$$\beta_{1i} = \beta_1 + \varepsilon_i \qquad i = 1,2, \ldots, N \quad \ldots\ldots 9$$

Where ε_i is a random error term with mean value zero and varianceσ_ε^2. The SMEs have a common mean value for the intercept ($i.e. \beta_1$) and the individual intercept values for each company are reflected in the error term (Gujarati 2005).

Substituting 9 into 5 the following random effects equations are obtained:

$$Y_{it} = \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \cdots + \beta_k X_{kit} + \varepsilon_i + u_{it} \quad \ldots\ldots 10$$
$$= \beta_1 + \beta_2 X_{2it} + \beta_3 X_{3it} + \cdots + \beta_k X_{kit} + w_{it} \ldots\ldots 11$$

$$\text{Where } w_{it} = \varepsilon_i + u_{it} \quad \ldots\ldots 12$$

w_{it} is an error term with two components ε_i, the individual specific error component and u_{it}, the combined time series and cross section/individual specific components.

The following assumptions must hold if the estimator is efficient:

$$\varepsilon_i \sim N(0, \sigma_\varepsilon^2\ )$$

$$u_{it} \sim N(0, \sigma_u^2)$$

$$E(\varepsilon_i u_{it}) = 0 \quad E(\varepsilon_i \varepsilon_j) = 0 \quad (i \neq j)$$

$$E(u_{it}u_{is}) = E(u_{it}u_{jt}) = \ E(u_{it}u_{js}) = \ 0 \quad (i \neq j;\ (t \neq s) \text{……………………..13}$$

The individual error components are not correlated with each other and are not autocorrelated across both cross section and time series units.

From the assumptions in 13, it follows that;

$$E\ (w_{it}) = 0 \quad and \quad var\ (w_{it}) = \sigma_\varepsilon^2\ +\ \sigma_u^2 \text{…………………………………………..14}$$

This is a crucial assumption of the random effects model. It is necessary for the consistency of the Random Effects model. It can be tested using the Hausman test.

Choosing between Fixed and random effects model

The differences between fixed effects model (FEM) and random effects model (REM) is that in FEM each cross-sectional unit has its own fixed intercept value, in all N such values for N cross sectional units. However, in REM, the intercept β_1 represents the mean value of all the cross sectional intercepts and the error component ε_i represents the random deviation of individual intercept from the mean value (Gujarati 2005). Because FE allows for arbitrary correlation between $X_{ji}$and α_i while random effects does not, FE is widely thought to be more convincing tool for estimating ceteris paribus effects (Wooldridge 2006).Observed characteristics that remain constant over time for each individual are retained in the regression model when the random effects model is used to estimate.

Thus, random effects is used when as many time constant controls as possible are included amongst the explanatory variables (Wooldridge 2006). However, the precondition for using random effects is that the observations need to be drawn randomly from a given population (Dougherty 2014). This research used the random effects model since there are observed characteristics that remain constant over time for each individual. Results from the Durbin – Wu - Hausman test show whether one should use the fixed or random effects approach in estimation of a model. To use the random effects test, the unobserved effect should be distributed independently of the X_j variables. One uses the random effects estimates unless the Hausman test rejects it (Wooldridge 2006).

Durbin – Wu -Hausman Test (1978) - Fixed vs Random Effects test

The Durbin – Wu - Hausman test is carried out to determine whether to use OLS or instrumental variable (IV) estimation in models where there is suspected measurement error or endogeneity (Dougherty 2014). The following is the hypothesis for the test:

- H_0 :α_i are distributed independently of X_j
- H_A : α_i are not distributed independently of X_j

If the null hypothesis is not rejected, then both random and fixed effects are consistent but fixed effects is inefficient as it involves estimating unnecessary dummy variable coefficients

(Dougherty, 2014). The random effects model should therefore be used if we fail to reject the null hypothesis. Rejecting the null hypothesis means random effects estimates are subject to unobserved heterogeneity bias therefore differ systematically from fixed effects estimates (Dougherty, 2014). In that case rejecting null hypothesis means the fixed effects model should be used. Under the null hypothesis, the test statistic has a chi squared distribution.

Panel unit root tests

Panel unit root testing emerged from time series unit root testing. The major difference to time series testing of unit roots is that we have to consider asymptotic behaviour of the time-series dimension T and the cross-sectional dimension N. The way in which N and T converge to infinity is critical if one wants to determine the asymptotic behaviour of estimators and tests used for nonstationary panels.

Levin-Lin-Chu Test

Individual unit root tests have limited power. The power of a test is the probability of rejecting the null when it is false and the null hypothesis is unit root. It follows that we find too many unit roots. Levin-Lin-Chu Test (LLC) suggest the following hypotheses.

H_O: each time series contains a unit root

H_A: each time series is stationary

Im, Pesaran and Shin Test

The Im-Pesaran-Shin (IPS) test is not as restrictive as the Levin-Lin-Chu test, since it allows for heterogeneous coefficients. The null hypothesis is that all individuals follow a unit root process:

$$H_0 = \rho = 0 \forall i$$

The alternative hypothesis allows some (but not all) of the individuals to have unit roots:

$$H_A: \rho i < 0 \text{ for } I = 1,2,\ldots\ldots N_1$$

$$\text{or} \quad H_A: \rho i = 0 \text{ for } I = N_1 + 1,\ldots..N$$

Empirical Results

Before we implement random or fixed effects regression, the data was first subjected to stationarity tests. The results of the stationarity tests are presented in table 2. Using Levin, Lin, and Chu tests in table 2 the results show that variables are stationary after first differencing except for GDP growth, Inflation and Population growth. However, Under the Im, Pesaran and Shin stationarity tests, all variables are stationary at levels except for number. of exported products and Herfindahl index.

Table 2: Stationarity tests results

		Levin, Lin & Chu	*Im, Pesaran, Shin*
Variable	***Models***	***t-stat***	***t-stat***
GDP growth	*Intercept*	*-4.55120****	*-8.35491****
	Intercept and trend	*-3.02977***	*-7.29948****
	None	*-7.63428****	
Herfindahl index	*Intercept*	*-1.23809*	*-1.39597**

	Intercept and trend	*-1.98200***	*-1.72191***
	None	*-2.84513***	
ΔHerfindahl index	*Intercept*	*-13.0593****	*-13.5939****
	Intercept and trend	*-12.5118****	*-12.0571****
	None	*-17.8987****	
Intra-industry trade	*Intercept*	*-1.79231***	*-1.44847**
	Intercept and trend	*-2.23824***	*-2.77130***
	None	*-0.77843*	
Δ Intra-industry trade	*Intercept*	*-11.7701****	
	Intercept and trend	*-8.77020****	
	None	*-18.7615****	
No. of exported Products	*Intercept*	*-1.18587*	*-0.64826*
	Intercept and trend	*-0.58826*	*-0.12278*
	None	*0.45063*	*-11.7224****
ΔNo. of exported products	*Intercept*	*-8.79894****	*-9.38500****
	Intercept and trend	*-6.15138****	
	None	*-16.7078****	
Gross fixed capital formation	*Intercept*	*-1.96068***	*-2.45766****
	Intercept and trend	*-1.25057*	*-2.40967****
	None	*-1.44344**	
*Δ*Gross *fixed capital* formation	*Intercept*	*-9.55316****	
	Intercept and trend	*-6.89165****	
	None	*-17.7214****	
Inflation	*Intercept*	*-8.20001****	*-8.35632****
	Intercept and trend	*-7.52596****	*-7.01654****
	None	*-7.28492****	
Population growth	*Intercept*	*-10.3371****	*-15.3667****
	Intercept and trend	*-16.0773***	*-20.5786****
	None	*-2.31320***	

Source: Author's own computation (2019)

Given these results, stationarity tests thus provided strong evidence of stationarity at level and first differences. This allowed for estimation of the model in order to analyse the impact of trade structure on growth of African economies. Before estimation, we first carried out the diagnostic tests for our data.

Diagnostic Tests

The diagnostic tests carried out are multicollinearity, Wald test of joint significance and Panel Cross-Section Dependence Test. The results of our test showed no evidence of multicollinearity (See appendix 1 Pairwise correlation matrix). The Wald test is used to find out if explanatory variables in a model are significant. If the Wald test shows that the parameters for certain explanatory variables are zero, the variable can be removed from the model. If the test shows the parameters are not zero, it can be included in the model. The null hypothesis is that variables are not jointly significant in explaining growth thus C(1)=C(2)=C(3)=C(4)=C(5)=C(6)=0. Table 3 shows results from Wald Test of joint significance

Table 3:Wald Test of joint significance

Test Statistic	**Value**	**Df**	**Probability**
F-statistic	4.673189	(6, 498)	0.0001
Chi-square	28.03914	6	0.0001

Source: Authors' own computation (2019)

We reject the null hypothesis based on the results of the Wald test and conclude that variables are jointly significant. We also used the Panel Cross-Section Dependence Test. Disturbances in panel data models are assumed to be cross-sectionally independent, but considerable evidence show that cross-sectional dependence is often present in panel regression settings. The problem of cross-sectional dependence is that it results in estimator efficiency loss and invalid test statistics. Hence, we carry out the Panel Cross-Section Dependence Test. The null hypothesis is that no cross-section dependence may be stated in terms of the correlations between the disturbances in different African countries. Thus the hypothesis is stated as follows;

$$H_0 \rho_{i,j} = Corr\left(u_{i,t}, u_{j,t}\right) = 0 \quad for\ i \neq j$$

The results of the cross-section dependence tests presented on Table 4

Table 4: Panel Cross-Section Dependence Test Results

Test	**Statistic**	**d.f**	**Prob.**
Breusch-Pagan LM	171.2520	153	0.1486
Pesaran scaled LM	1.043396		0.2968
Bias-corrected scaled LM	0.721967		0.4703
Pesaran CD	5.269479		0.0000

Source: Authors' own computation (2019)

Results on table show that three out of four tests prove no serial correlation on residuals between the African countries. We therefore fail to reject the null hypothesis and conclude that there is no cross-section dependence on correlations between the disturbances in different African countries. We then run the Hausman test to choose the best estimation technique between fixed and random effects. The results are presented on table 5.

Table 5: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f	Prob
Cross-section random	13.846677	6	0.0314

Source: Authors' own computation (2019)

The results of the Hausman test indicate that the best estimation technique is the fixed effects. We therefore reject the null hypothesis. Even though fixed effects is the best estimator, we present results for both fixed and random effects estimators on table 6 to test the robustness of the results.

Table 6: Fixed Effects and Random Effects results

	Fixed Effects Coefficient	Random Effects Coefficient
Herfindahl index	-2.302597	-2.041327
Intra-industry trade	7.633722***	8.449605***
No. of exported Products	0.002160**	0.002401**
Gross fixed capital formation	0.122346***	0.131268***
Inflation	0.001244**	0.009544**
Population growth	0.825857**	0.466243**
Constant	2.651818	

*** $p<0.01$ – statistical significance at 1% level
** $p<0.05$ - statistical significance at 5% level
* $p<0.1$ - statistical significance at 10% level

Source: Authors' own computation (2019)

The results from both estimations are almost similar therefore they are robust. Using fixed effects results trade structure variables namely intra-industry trade and number of exported products are significant in determining GDP growth with positive coefficients. This means that a change in trade structure through an increase in IIT index and increase in number of exported products cause an increase in GDP. However one trade structure variable, HHI index is not statistically significant meaning that HHI does not determine growth of African countries. The other variables, gross fixed capital formation, inflation and population growth are also statistically significant with a positive relationship to GDP growth.

Conclusions and Policy Recommendations

Several conclusions and policy recommendations can be made from the study. We conclude that trade between African countries within similar industries can led to growth of economies. Trade between firms within similar industries lead to specialisation and economies of scale, in line with the product cycle theory (Venon, 1966; Antweiler and Trefler, 2002; Maloney 2003). We also conclude that for African countries, an increase in the number of trade partners does not lead to growth. To realise growth, the countries need to increase the number of exported products. Instead of adding more trade partners through economic integration, the countries are better off increasing the number of exported products even if it is to the same trade partners. They can also value add their exports to increase benefit from trade. While we do not recommend high inflation for any economy, inflation within acceptable ranges signifies an active, growing economy. Hence countries need to maintain healthy inflation levels to realise economic growth. High inflation signifies an overheated economy while very low inflation signifies an economy that is not growing. African countries should pay focus to their increased labour supply due to population growth and capitalise on it to grow their economies through ensuring skills development (Romer 1986; Gundlach et al., 2001). Gross fixed capital formation in the form of infrastructural investment for example investment in ports and airports can lead to economic growth of African countries.

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Appendix 1 – Pairwise Correlation Matrix

	GDP	DHHI	DIIT	DEXPORTS	DGFCF	INFLATION	POPULATION
GDP	1	-0.0350021...	0.10535035...	0.12170586...	0.12093144...	0.04225178...	0.10540003...
DHHI	-0.0350021...	1	-0.0279586...	-0.0062059...	-0.0325681...	-0.0039658...	-0.0055376...
DIIT	0.10535035...	-0.0279586...	1	0.03189949...	-0.2586710...	-0.1384432...	-0.0109700...
DEXP...	0.12170586...	-0.0062059...	0.03189949...	1	0.05741311...	-0.0163953...	0.01577146...
DGFCF	0.12093144...	-0.0325681...	-0.2586710...	0.05741311...	1	-0.0196940...	0.05452664...
INFLAT...	0.04225178...	-0.0039658...	-0.1384432...	-0.0163953...	-0.0196940...	1	0.12550238...
POPU...	0.10540003...	-0.0055376...	-0.0109700...	0.01577146...	0.05452664...	0.12550238...	1