T.C.

ISTANBUL COMMERCE UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

ECONOMICS PROGRAMME

THE EFFECT OF THE INTERNATIONAL TRADE ON PRODUCTIVITY IN SUB-SAHARAN AFRICAN COUNTRIES

Master Thesis

Amal Ali Ahmed

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Istanbul, 2021

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Abstract

The effects of the international trade on the economic productivity has been a hot topic in the literature that consists of conflicting theories from different schools of economics. Despite the significant amount of the studies, the literature lacks the sufficient examination of the topic for the case of African countries. This study examines the effect of international trade on the productivity of eight sub-Saharan African countries for the period between 1990 and 2017 by using annual data from Penn World Table and Word Bank Databases. The methodology employed in the study is panel data analysis with the fixed effect model. The effect of the international trade on total factor productivity is examined by using trade openness along with the control variables which are export intensity, capital intensity, exchange rate, and population. The findings indicate a significant negative effect of trade openness, capital intensity and exchange rate and significant positive effects of export intensity and population on total factor productivity.

Keywords: productivity, international trade, Africa

Öz

Uluslarası ticaretin iktisadi verimlilik üzerindeki etkileri literatürde farklı iktisat okullarının çelişen teorileriyle yoğun biçimde tartışılagelmektedir. Konuya dair önemli sayıdaki çalışmaya ragmen bu konu Afrika ülkeleri için yeterince tartışılmamıştır. Bu çalışma uluslararası ticaretin verimilik üzerindeki etkisini sekiz Sahra Altı Afrika ülkesi için Penn World Table ve Dünya Bankası veritabanlarında elde edilen 1990 ve 2017 yılları arası yıllık veri ile incelemektedir. Çalışmada kullanılan metodoloji sabit etkiler modeli ile panel veri analizidir.Uluslararası ticaretin toplam faktör verimliliği üzerindeki etkisini anlamak için açıklayıcı değişken olarak ticaret açıklığı kullanılmış ve ihracat yoğunluğu, sermaye yoğunluğu, döviz kuru ve popülasyon ise diğer açıklayıcı kontrol değişkenleri olarak modele dahil edilmiştir. Çalışma sonuçlarına göre ticaret açıklığı, sermaye yoğunluğu ve döviz kuru toplam faktör verimliliği üzerinde istatistiksel olarak anlamlı negatif etkiye sahipken ihracat yoğunluğu ve popülasyon toplam faktör verimliliğini istatistiksel olarak anlamlı bir şekilde pozitif yönde etkilemektedir.

Anahtar Kelimeler:Verimlilik, uluslararası ticaret, Afrika

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List of Abbreviations

CI:	Capital Intensity
ECOWAS:	Economic Community of Western African States
EXI:	Export Intensity
EXR:	Exchange Rate
FE:	Fixed effects
GDP:	Gross Domestic Product
GMM:	Generalized Method of Moments
IMF:	International Monetary Fund
LCU:	local currency
OECD:	Organization for Economic Co-Operation and Development
OLS:	Ordinary Least Squares
POP:	Population
PPP	Purchasing Power Parity
RE:	Random effects
SSA:	Sub-Saharan African
TFP:	Total Factor Productivity
TO:	Trade Openness
VIF:	variance inflation factor
WTO:	World Trade Organization

1. INTRODUCTION

Orthodox trade theories claim that the value of output in economics was increased through openness to international trade. Trade leads to a static increase in output and improves economic productivity(López, 2005). Trade can theoretically effect growth in developing countries in several ways. Greater trade integration promotes resource efficiency through comparative advantage and allows countries to obtain scale and scope of the economies. It also helps spread technology and managerial knowledge, decreases anti-competitive activities among local firms, and promotes competitiveness in both international and domestic marketplaces(Calderon et al., 2020). Trade liberalization contributes to gains in productivity, by eliminating limitations on domestic competition, both from external competitors and inputs. (Topalova, 2007). Melitz and Trefl (2012) argued that international trade benefits from broader markets, which fosters innovation. New productivity-boosting goods and methods, innovative goods and procedures improve productivity. Trade integration reduces development costs by increasing market size via expanding the market, which motivates firms to contribute to improving productivity. Rauch and Weinhold (1997) highlighted the trade-related productivity improvements with production specialization. Increasing openness may boost prosperity in less developed nations. Quah and Rauch (1990) illustrated that increasing trade openness may contribute to higher specialization in endogenous growth model. By maximizing economies of scale, specialization enhances productivity gain.

Biesebroeck (2005) claimed that most Sub-Saharan African industries' production technology lags well behind global best practice, which allow for significant productivity gains by copying and adopting foreign technology.(Velde, 2015) claimed that, in Sub-Saharan Africa, regional exporters have stronger productivity and business growth than other firms that should be considered with respect to growing importance and effect of technological advancements. Given its long-term impact on productivity, it is critical to make regional trade more efficient for Sub-Saharan African economies. The effects of the international trade on the economic productivity have been a hot topic in the literature that consists of conflicting theories from different schools of economics. Despite the significant amount of the studies, the literature lacks the examination of the topic for the case of Sub-Saharan African countries in terms of the relationship between international trade and productivity. This thesis aims to contribute in the creation and execution of economic policies

by policymakers that may enhance the productivity in Sub Saharan African countries. According to the catch-up effect theory which shows that underdeveloped countries can grow faster than developed ones with smaller amount of capital, there is a significant potential for Sub Saharan African countries to grow faster and increase their productivity. The effect of international trade can play a crucial role in this sense. This thesis examines the effect of international trade on the productivity in eight sub-Saharan African countries namely Kenya, Senegal, Nigeria, Cameroon, Botswana, South Africa, Togo, and Niger for the period between 1990 and 2017 by using annual data from Penn World Table and Word Bank Databases.

The remainder of the thesis is structured in the following manner. Theoretical connection between international trade and productivity is presented in chapter 2. Empirical literature on international trade and productivity, capital intensity and productivity, as well as population and productivity will be reviewed in chapter 3. The methodological approach, data sources and formulation of the variables are described in Chapter 4. Chapter 5 presents the findings of the study and chapter 6 includes the conclusion and discussion.

2. Theoretical Link Between International Trade and Productivity

This chapter includes a review of the theoretical link between trade and productivity. In the literature, four main channels are highlighted through which international trade and productivity may be linked: economies of scale, competition, reallocation and spillover (Rijesh, 2017).

The first channel, economies of scale, result in lower costs, allowing firms to compete more effectively in international markets. The most efficient firms may increase their production by taking on more capital and labor as they improve which results in an increase in productivity.Hung et al (2003) claimed that international trade can impact a firm's productivity in two ways through economies of scale channel. First, increasing production lowers average unit costs by reducing the percentage of average fixed costs in output unit costs. Labor productivity improves in exporting firms when exports raise output, but labor productivity declines in import-competing firms when imports reduce market share and output. The second form of scale effect lowers the average cost curve. The prospect of higher output from exporting encourages exporting enterprises to make fixed-cost investments, particularly R&D, so increasing their productivity level. Paus et al (2003) claimed that export expansion can boost productivity through scale effects and improved awareness of better technologies and production processes internationally.

For the case of competition channel, Baily and Gersbach (1995) explained that import-competing enterprises' productivity growth may be aided by lower-cost imported goods. As competition increases both domestically and internationally, manufacturers will need to increase productivity to maintain profit margins. Increasing competition raises productivity, and the most significant increase occurs when international competition is present. Extending the geographic range of competition raises the chances of adopting a new and more productive manufacturing process, particularly if the geographic range of competition contains firms that employ best-practice manufacturing methods. Ozler (2007) showed that exposure to foreign trade, particularly import competition, has a significant impact on the ability of domestic sectors to deviate from price-cost margins. Also, Nishimizu and Robinson (1984) claimed that improvements in domestic efficiency will be prompted by foreign competition. There is an implicit ‘challenge-response' mechanism caused by competition, which causes domestic firms to employ state-of-the-art technologies, lower ‘X-inefficiency,' and generally cut costs wherever they are able.

Reallocation channel is examined by Hung et al (2003) who stated that, increases in international trade may have a positive influence on raising aggregate productivity due to the reallocation effects. It is expected that mean productivity growth at the firm level will increase when the more productive import-competing sectors stay in the market and the less productive are driven to exit. Greater confidence in recovering initial entrance expenses encourages higher-productivity plants to enter international markets. Growth of international trade could therefore boost sector productivity by increasing the share of high-productivity exporting enterprises. Melitz (2003) argued that trade exposure causes only the most productive firms to reach the export industry, although some lower-efficient firms prefer to produce only for the domestic market. Moreover, it forces the lowest-productive companies to exit the market. Haidar (2012) highlighted that more productive industries develop exporters because they can afford the high fixed cost associated with entering and supplying international markets, such as networking and adjusting to new quality requirements (self-selection hypothesis) and then the learning-by-exporting hypothesis is tested in order to increase the quality of identification in post-entry comparative of exporters compared to non-exporters.

For the spillover channel, Romer and Rivera-Batiz (1967) and Ben-David and Loewy (1998) argued that international R&D has positive effects on domestic productivity, and that these effects increase with trade openness. Exporting firms' incentive to take advantage of the economies-of-scale effect via exports, as well as the rise in R&D by domestic industries stemming from international exposure as a result of reactions of import-competing industries to global competition, will boost the total stock of knowledge, while also increasing total productivity. According to Coe and Helpman (1995), when domestic firms face international competition, they may invest more in research and development (R&D). Domestic firms including both importers and exporters, may be able to update their technology by observing from state-of-the-art technologies from foreign competitors. As a result, as domestic sectors' exposure to foreign enterprises and foreign stocks of knowledge grows, the overall stock of knowledge accessible to them may expand, resulting in higher in total productivity.

3. LITERATURE REVIEW

This section contains an overview of the review of the literature on the link between international trade and productivity. Based on the model employed, existing literature regarding the relationship between international trade and productivity, capital intensity and productivity and population and productivity are examined separately. Content, findings, and methodology regarding the studies are examined in detail, and these discussions serve as a foundation for the results of the empirical investigation.

3.1. International Trade and Productivity

Lumengo and Kinfack (2019)investigated the link between trade openness and economic growth in Africa by employing the instrumental variable panel smooth transition regression to analyze a balanced panel data set of 38 African nations with yearly data from 1970 to 2016 based on the Penn World Table and the Word Bank databases. The findings show that African nations are not homogeneous, particularly in trade openness and economic growth. The study reveals no substantial link between trade openness and economic growth in low-income nations. On the other hand, trade openness and other trade indicators have a positive and significant impact on growth in middle- and upper-income countries.

Akuffo (2012) examined the impact of trade liberalization on economic growth for thirty-eight African countries. One way and two ways fixed/random effect models are estimated by panel data between 1980 and 2008 using data from the Penn World Table and Word Bank databases. Study results show that increasing trade openness boosts GDP growth and the exchange rate is the only trade component that substantially influence s GDP growth.

Timuno (2017) investigated the factors that influenced the TFP increase in Botswana—using an Autoregressive Distributive Lag (ARDL) panel data from Statistics Botswana, National Accounts and the International Monetary Fund (IMF) database between 1977 to 2014. The results demonstrate that economic diversity and human capital lead to improved productivity growth. While trade openness is significant, particularly in the long run, its short-term effect on TFP growth is negative. Additionally, the findings imply a particular amount of inflation in the Botswana economy that encourages growth. Inflation over that level is detrimental to short-term productivity and growth.

Sunge and Ngepah (2019) explored agricultural trade liberalization's effects on agricultural TFP growth in 13 African countries. The study employed dynamic-fixed-effect's method to estimate Panel-Auto-Regressive-Distributed-Lag models during 2005 to 2016, both in FAOSTAT and World Integrated Trade Solutions (WITS) database. The findings indicate that domestic agriculture increases production but decrease productivity. Results indicate that South-North trade generates a disproportionately large revenue and statistically meaningful productivity improvements than trade between the South-south. Trade openness coefficients reflect the discriminatory benefits of trade. Trade openness reduces (by 0.004) and has a substantial (5 percent) influence on maize productivity increase. According to estimates, boosting trade with African nations by 1% decreased TFP by 0.004%.

Mbabazi et al (2006) aimed to find characteristics that potentially explain Sub-Saharan African (SSA) nations' low development performance in the context of the link between trade openness and growth. The empirical study investigates the relationships between economic growth, income inequality, and trade openness for 44 developing nations from Sub-Saharan Africa with data from 1970 to 1995 using cross-section and panel econometric methodologies. The findings showed that trade openness is positively correlated with growth and trade liberalization appears to balance or lessen the negative impact of income inequality on economic growth.

Pavcnik (2002) investigated the impact of trade liberalization on plant productivity in Chile. The fixed-effects model is predicted by using panel data from Chile's National Institute of Statistics database between the late 1970s and early 1980s. Findings showed the increased productivity in the firms that might be stemmed from the trade liberalization in the import-competing industry environment.

Muendler (2004) studied how decreased trade barriers affect productivity in Brazil by employing a fixed-effect model with a modified Olley-Pakes algorithm between 1986 and 1998 from the IBGE and PIA databases. The findings indicate that international competition forces firms to increase productivity significantly, and external inputs have a marginal impact on productivity transition the risk of inefficient companies closing increases as they become more inefficient due to the increased competition from abroad, aggregate production has increased.

Burinskiene (2012) undertook the research on the theoretical link between trade and productivity by exploring the relationship between trade and productivity utilizing historical and contemporary

trade theories and the theory of economic growth. Free trade involves lowering marginal trade costs and eliminating the rest trade obstacles associated with legislation and standards. Trade liberalization benefits global companies in the short term. The main impact of liberalization occurs as the domestic market expansion to foreign markets results in increased exports, improved resource distribution, and increased investment in export-oriented industries that previously traded primarily in domestic markets. Improvements in international trade also impact export prices, returns on new product production via Stolper Samuelson linkages, and the level of productivity expansion.

Bernard et al (2006) investigated how U.S. manufacturing sectors and factories react to tariff rate changes by employing a dataset on industry-level tariff and transportation prices. Fixed effect model is used to analyze the data from the Census of Manufactures for the years between 1977 and 2001. The study found that firms experiencing significant reductions in trade barriers experience reasonably rapid productivity increases. Results show that low-productivity plants in sectors with reducing trade costs are more probable to exit the market whereas comparatively high- productive non-exporters are more motivated to export in result of a decrease trade costs. It is shown that export rises as the tariff rates decline.

Mputu (2016) examined the link between trade terms, economic growth, and trade openness in 13 sub-Saharan African countries by employing fixed and random effect models with data from World Development Indicators (WDI), World Bank's Database, and the Penn World Table for the years between 1980 and 2011. The study revealed that terms of trade have a positive relationship with GDP in SSA, implying that any improvement leads to improved economic performance. Trade openness has a negative impact on GDP, suggesting trade openness is not beneficial to SSA.

Guei and le Roux (2019) examined the relationship between trade openness and GDP per capita in Economic Community of Western African States (ECOWAS) countries, by employing autoregressive distributed lag (ARDL) and pool mean group (PMG) models. The data covers 15 ECOWAS countries from 1990 to 2016 and collected from International Monetary Fund, the World Bank, and the World Integrated Trade Solution. The study showed that trade openness has a negative impact on GDP per capita in the long run. This suggests that the economies of ECOWAS should exercise caution in significantly relying on free trade as the main driver of economic growth.

Topalova and Khandelwal (2011) examined whether India's fast, comprehensive, and internationally enforced trade change resulted in a causal relationship between shifts in tariffs and firm productivity by using panel data between 1987 and 2001 data are collected from Prowess database. India's productivity increased as a result of the trade liberalization, according to the study. While research suggests that the tariffs' procompetitive benefits cause firms to get more productive, increasing exposure to foreign inputs seems to have had a larger influence.

Baldwin and Gu (2004) examined how Canadian production sector has responded to reduced protectionist tariffs between Canada and the rest of the world by using fixed effects model. The data comes from the database of Annual Surveys of Manufacturers for the years between 1980 and 1996. The study showed that export increase of the Canadian industrial sector was primarily due to trade liberalization. Growing the number of advanced technologies utilized, increasing international sourcing for higher technologies, and accessing export markets increase number of modern technology utilised.

Bayar (2002) explored the impacts of Turkey's post-1980 international trade liberalization on the productivity of manufacturing industries. Panel data for eight ISIC three-digit manufacturing industries from 1974 to 1994 is used to analyse the relationship. The study's findings showed a positive shift in inefficiency and an adverse change in industry markups after trade liberalization.

Amiti and Konings (2007)investigated the productivity gains from lowering tariffs on final products and intermediate inputs in Indonesia by employing manufacturing census data from between 1991 and 2001. The findings suggested that a 10% reduction in input tariffs results in a productivity increase of 12% for companies that import their inputs, which is more than twice as much as any benefits from lowering production tariffs.

Adofu and Okwanya (2017) investigated trade openness and total factor productivity on Nigerian manufacturing production. The Vector Autoregressive model is estimated by using yearly time series data from 1981 to 2015 collected from the Central Bank of Nigeria statistics bulletin and the World Bank Development Indicator. Results showed that trade openness positively impacts industrial production in Nigeria, but its impact on TFP is found to be insignificant. The long-term TFP effect on industrial production in Nigeria is negative.

Choudhi and Hakura (2000) examined the impact of international trade and production patterns on a set of developing countries' total productivity increase. Krugman's "technological gap" method is applied to a data collected from 44 nations, 33 of which are developing countries, using the OECD International Sectoral Database from 1970 to 1993. High import competition in medium-growth industrial sectors boosts overall productivity growth. Total productivity development is significantly determined by a production-share weighted average of technological leader's sectoral productivity advancement rates.

Alcala' and Ciccone (2004) examined the influence of international trade on the real productivity of various countries. The analysis is based on the Penn World Tables data for the year 1985 and employs two-stage least squares estimation approach. The study showed that international trade has a statistically significant and positive impact on productivity. Imports plus exports are calculated trade in terms of purchasing power parity GDP. There is an essential positive total scale impact as well. The causal impact of trade on productivity is statistically significant. Size of the country has a significant impact on production.

Economidoua and Murshid (2007) analysed the influence of trade on productivity growth during 1978–1997 using data from 9 industrial sectors in 12 OECD countries. GMM-estimate panel data From the OECD International Sectoral Database (ISDB), United Nations Industrial Development Organization (UNIDO), OECD Business Enterprise Expenditure on Research and Development (BERD), the OECD Structural Analysis Database (STAN), International Monetary Fund (IMF), and Central Intelligence Agency (CIA). Increased imports can gain manufacturers because increased exposure to higher-quality overseas products lowers the costs of copying innovative foreign tech or puts more pressure on internal production to carry out new technologies and develop production. This result is robust in panel estimators. Trade appears to have a positive impact on product development, according to the findings.

Berthou et al (2018) examined the effect of foreign trade on total productivity in 14 European countries. Fixed effects model is estimated by using data from CompNet and WIOD database between 1998 and 2011. Results showed that two-sided and one-sided export liberalization increase total welfare and productivity, one-sided import liberalization may either increase or decrease. Both trade relations raise average company efficiency, but export growth reallocates activity to more profitable firms when import penetration has the opposite effect.

Dovis and Milgram-Baleix (2009) aimed to examine how sensitive total factor productivity is to external competition in a European nation. GMM models are estimated using panel data from the Encuesta sobre Estrategias Empresariales (ESEE) database between 1991 and 2002. Results revealed that, due to enhanced international product presence in the local market and company imports, the competition increases total factor productivity. There is also proof of significant asymmetries between companies depending on their presence in international markets.

Gulzar et al (2015) examined the role of trade liberalization on industrial productivity in Pakistan. The OLS, Fixed Effects (FE), and Random Effects (RE) models are estimated using panel data from the Pakistan Bureau of Statistics database between 1980 and 2006.According to the results, trade liberalization seems to have a positive but insignificant effect on TFP both during and after liberalization. On the other hand, the effective rate of protectionism has a greater negative effect on TFP post-liberalization than it does pre-liberalization.

Hiebert and Vansteenkiste (2007) examined the impact of numerous shocks on U.S. manufacturing labour market factors, especially trade openness and technology. GVAR is generated using panel data from the OECD STAN database between 1977 and 2003. Examination of generalized impulse responses shows that trade openness on average negatively impacts real compensation and has little effect on employment. In contrast, technology tends to affect employment positively. Both real compensation and employment are significantly affected. In this case, increased import competition for industrial sectors has appeared to show itself as real wage improvement, an impact that seems to be increasing over time. In the U.S. industrial sector, rising trade openness has been related to improved domestic productivity.

Philip et al (2018) studied the relationship between trading behaviour at the firm level and productivity in the UK for the years between 2008 and 2016 from UK's Inter-Departmental Business Register (IDBR) and the ABS database by employing ONS incorporate VAT methods According to this study's findings, large companies and those owned by foreigners are more probably to engage in international trade-in products. Just around one in five businesses with more than ten workers report international trade to HMRC, but businesses that announce international trade accounted for about 40% of all workers during 2016. According to a productivity report, British companies' productivity that announces foreign trade in products was about 70% greater during 2016 than for companies that did not. After adjusting for scale, sector, and

overseas investment status, companies that announce product exports or imports have labour productivity premiums of about 21% and 20%, respectively, over non-traders. These premia are slightly reduced for trade with the E.U., which is associated with lower obstacles to E.U. products trade, giving relatively low-productivity companies entry to these sectors.

Hu and Liu (2012) examined the effect of tariff cuts after China's WTO entry on Chinese industrial companies' competitiveness. The fixed effects estimator is employed by using data from China's National Bureau of Statistics (NBS) for the year between 2000 and 2006. The findings showed that China's free trade resulted in a 2.25 percent yearly rise in TFP for Chinese industrial companies in the five years of its WTO admission. The decrease in export tariffs was found to have a substantial adverse effect on Chinese company's productivity. The export tariff reduction impacts output size, allowing foreign-produced products highly competitive in the Chinese trade. The fact that reduced production tariffs reduce profit margins in Chinese companies demonstrates the competitive strain that production tariff-freeing generates. On the other hand, free trade has greatly improved Chinese firms' competitiveness and profit margins via the intermediate inputs route. Reduced and tariff steps are practical.

Lorenzo Caliendo and Rossi-Hansberg (2011) studied the impact of trade on organization and productivity in U.S. economy. According to the findings, companies that export would expand management layers and decentralize decisions because of two-sided free trade. While productivity results are diverse through these companies, the average exporter's new company increases productivity. Non-exporters, on the other hand, decrease the number of layers, decentralization, and efficiency on average. As a result, the marginal exporter's productivity rises by around 1%, and income productivity rises by around 1.8 percent.

Akkuş (2014) examined the relationship between international trade and employee productivity in Turkey's manufacturing sector between 2003 and 2010. The fixed effect is estimated by using data from the Turkish Statistical Institute (TUIK), Annual Industry and Service Statistics, Foreign Trade Statistics, the OECD Stan Database, and the Turkish Patent Institute Statistics Databases. The direct and productivity-related indirect impacts of foreign trade on employment are estimated. The results indicate that the real impacts of export demand and import competition on employment are significant; While increasing export demand increases labour demand, increasing import entry decreases it. The productive output indirect impact, on the other hand, is purely due to import

competition. The real impacts of export markets and import entrance account for most foreign trade's overall employment effects. The positive role towards productivity in the Turkish industrial sector, on the other hand, arises directly from expenditure and R&D expenditures.

Vu (2012) examined the relationship between free trade and company efficiency in Vietnam. Based on data from the General Statistics Office from 2001-2004, fixed effect model is estimated. according to the findings, lowering production and input tariffs raises company productivity in Vietnam, suggesting that free trade positively impacts company efficiency and economic increase in Vietnam. Findings indicate that capital intensity harms a company's export decision, which is steady with Vietnam's condition due to the country's competitive advantage in labour-intensive industries.

Kostyantyn (2012) examined the influence of free trade on productivity dispersion using a comprehensive list of 57,734 Ukrainian industrial enterprises' financial data from 2001 to 2009. OLS regression is employed by using data collected by State Statistics Committee of Ukraine. According to the analysis, lowering the tariff decreases the productivity dispersion and the exit of the less productive firms resulting free trade. Also, tariff reductions lead inefficient companies to leave market over the following two years. As an indicator of trade liberalization and trade costs, the import duty factor can be substituted with the import penetration and export-to-output ratios.

Rijesh (2017) investigated the effect of international trade on India's productivity growth between 1980 and 2013, using OLS, fixed effect, and Random effect methods estimated by panel data from (National Industrial Classification, Central Statistical Organisation (CSO), and Annual Survey of Industries (ASI), The Indian industrial sector experienced substantial liberalization and openness throughout that period and rising manufacturing growth and productivity. There has been a rise in productivity, including labour and total factor productivity, particularly throughout the 2000s. Economies of scale, redistribution and spill-over boost efficiency which is most noticeable after a 1–2-year lag. While there is a positive association between exports and productivity overall periods analysed, only the present time is statistically significant.

Ifwarsson (2010) examined the endogenous relationship between productivity, import, export, and economic growth from 1960 to 2007 in five OECD countries with the data from World Development Indicators (WDI) and Penn Worlds Tables by using OLS and error correction models. According to the results, the evidence for a real long-run relationship between export, import, and

TFP is poor, and evidence for a positive impact of trade on productivity is not found. The findings strongly differ across nations, providing no evidence for a long-run positive impact of export to TFP or import to TFP.

Cirera et al (2021) aimed to separate the effect of input and production trade barriers on the efficiency of companies in Brazil between 2000 and 2008 by using fixed effects model with data collected from Annual Survey of Industry, Brazilian Institute of Geography and Statistics, and Secretariat of Foreign Trade. The findings show that free trade via tariff reductions on inputs or outputs raises total factor productivity, with the impact linked with a tariff cut on inputs being significantly higher. The effect of trade policy on total factor productivity is distributed over all sectors due to spill-over effects from trading to nontrading industries or suggesting that free trade exerts competitive pressure.

Hamit-Haggar (2009) aimed to investigate the determinants of total factor productivity (TFP) increase in Canadian manufacturing industries using a stochastic Frontier production model between 1990 and 2005 with the data collected from Canadian Socio-Economic Information Management System.The results demonstrate that (R&D) spending, ICT investment, and trade openness all have a beneficial influence on increased productivity via the efficiency benefits pathway.

Dua and Garg (2020) investigated the patterns and drivers of labour productivity in the manufacturing and service sectors, as well as their components, across the Asia-Pacific region's main emerging, developing, and developed economies between 1980 and 2014. Panel cointegration and group mean FMOLS models are estimated with the data collected from Asian Productivity Organization (APO)and Penn World Tables. The result implied that capital deepening, human capital, government size, institutional quality, related industry productivity, government size, and trade openness all seem to be significant determinants of productivity over all industries of the developed countries.

Madanizadeh and Pilvar (2019) examined the effect of trade openness on labour productivity in Indonesia. Ordinary Least Squares method are estimated by data between 1978 and 2017 using data from the World Development Indicator and Penn World Tables.The findings indicate that trade openness and the proportion of exports to GDP have a considerable positive effect on labour productivity.

Asada (2020) investigated the impacts of foreign direct investment and trade on labour productivity development in Vietnam. Autoregressive distributed lag (ARDL) model is estimated by panel data between 1990 and 2017 using data from the Asia Productivity Organization (APO), Research Institute of Economy. The findings indicate the existence of a positive relationship between FDI, trade, and labor productivity growth.

Ing Yan and Urata (2012) investigated the effects of international trade on productivity in the ASEAN services Sector. Fixed effect and generalised method of moments (GMM) models are estimated by using data from the Asian Development Bank Statistics Database, Association of Southeast Asian Nations and Groningen Growth Developing Centre (GGDC) for the years between 1990 and 2005. The results show that both the proportion of exports in aggregate trade and the amount of human capital are statistically significant and have positive effects on the labor productivity in the services industry.

3.2. Capital Intensity and Productivity

Novotná et al (2020) investigated the relationship between capital intensity and labour productivity in waste-related firms in the Visegrad Group (V4) countries in 2018, in comparison to 2013 by using ANOVA test and regression analysis with data from the AMADEUS database. This research showed that businesses primarily pursue moderate investment growth, driven by increased capital performance, declining labour productivity, and reduced labour endowment, yet rising profitability.

Ma et al (2014) examined the impact of a company's concentration in its core goods later exporting on element intensity and productivity from Chinese industrial companies between 1998 and 2007. fixed effects model is estimated with the panel data from China's National Bureau of Statistics (NBS). Findings indicated that, a more significant reduction in capital intensity following export is correlated with a significant rise in total factor productivity.

Boermans (2013) examined the reasons behind the fact that exporters outperform non-exporters in terms of productivity. Pooled FGLS/Fixed effects models are estimated by a micro-panel dataset from five African countries between 1991 and 2003 using data from the World Bank Regional Program on Enterprise Development (RPED). Study results showed that firms that export to countries outside of Africa grow more with capital intensity and increase productivity as employing

more labor. Firms that export to African nations, on the other hand, reduce their capital intensity and productivity by employing lower skilled labor at higher salaries.

Heshmati and Rashidghalam (2018) examined labor productivity in Kenya's manufacturing and service sectors, as well as its drivers. Data from the World Bank's Enterprise Survey database for 2013 is used to estimate ordinary least squares (OLS) model. The study found that the intensity of capital and waging influence labor productivity significantly and positively. Increased female labor force participation lowers work productivity.

Filip (2016) studied the factors that influence the growth of total factor productivity (TFP) in a set of industrialized European nations between 2000 and 2013. Pearson correlations and Panel Least Square methods are employed with data from OECD database and World Bank. According to the findings of the study, infrastructure development has the greatest positive impact on total factor productivity growth. The low intensity of capital and financial crisis influence TFP growth significantly and negatively, but the standard of education and health have only a negligible impact on determining productivity.

Hosamane et al (2008) examined the Indian manufacturing sector's productivity change for a sample of capital- and labor-intensive industries between 1993-1994 and 2003-04 with the panel data gathered from several publications of the Central Statistical Organization (CSO) and Annual Survey of Industries (ASI). The study revealed that capital-intensive industries experienced positive total factor productivity of 1.7 % per year, with technological advancement being the key contribution to this growth. In contrast, labor-intensive industries experienced a productivity shift back of –0.9 %per year in the observed period, with technological change.

Che and Zhang, (2017) assessed the influence of human capital on Chinese companies' productivity between 1998 and 2007. OLS, OP, and system-GMM methods are estimated by panel dataset from Annual Survey of Industrial Firms (ASIF) maintained by the National Bureau of Statistics of China (NBS). After 2003, sectors that used higher human-capital intensive technology had a higher increase in total factor productivity than in previous years. Findings showed that these sectors also increased technology acceptance, as shown in the imports of modern capital goods, R&D investment, and capital intensity, and the hiring of more qualified staff. Local private companies' productivity improvements are lower than those of foreign based industries.

Ahmed (2009) evaluated the effect of information and communication technology and human capital intensity on ASEAN5 productivity between 1965 and 2004. Cobb-Douglas production function and the Solow's residual model are estimated by dataset from Asian Development Bank, International Monetary Fund, and International Labour Organization. The findings showed that capital intensity plays a key role in these economies attaining a respectable boost to labor productivity by utilizing massive inputs to create output.

Timmer and Los (2002) analyzed labor productivity growth in the agricultural and manufacturing sectors of 40 countries in between 1975 and 1992. Data envelopment analysis (DEA) is employed by using dataset from Penn World Tables, IMF, OECD, and Groningen Growth and Development Centre (GGDC). The findings showed that change in international production function is highly concentrated at high capital intensity levels. There is a more pronounced effect on agriculture than in industry. Additionally, the rise of labor productivity is split into the impacts of capital intensification, knowledge, and innovation. The findings imply that there is a distinct route of development along which increasing capital intensity seems to become a necessary condition for gaining from foreign technological transfer.

3.3. Population and Productivity

Liu and Westelius (2016) examined the demographic effects on productivity and inflation in Japan between 1990 to 2007 by using fixed effects model with panel data from WDI, OECD, World Economic Outlook, and IMF Staff Calculates. The study showed that the aging of the workforce has a substantial negative effect on TFP. Additionally, counties with greater population growth caused higher inflation. The findings provide compelling evidence that population headwinds can significantly affect total factor productivity and bring deflationary influences.

Ursavaş (2020) aimed to investigate the relationship between population factors and the probability of TFP growth in Turkey between 1986 and 2017. Probit regression is estimated using data from World Development Indicators (WDI) and Penn World Table (PWT). The findings suggest the per capital rise, number of dependents, young dependence ratio, and birth rate lower the chance of growth in the overall productivity of factor.

Morikawa (2011) aimed to explore the factors that influence service industry productivity, such as economies of scale and density in Japan between 2002 and 2005 by using establishment-level data

from the Survey of Selected Service Industries. The results showed that, once the population size of a city increases, productivity rises by 7% to 15%.

Maestas et al (2016) studied the impact of population aging on economic growth, the labor force, and productivity in U.S. states beween1980 and 2010. Fixed effect and ordinary least squares (OLS) Models are estimated by using data from Census Integrated Public Use Microdata Series, American Community Surveys, and the Bureau of Economic Analysis (BEA). Findings showed that a 10% increase in the aging population slows the growth rate of GDP per capita by 5%. Two-thirds of the decrease is related to slower increase in labor productivity, while one-third is related to lower labor force growth.

Garces-Voisenat (2012) studied the relationship between population densities, human capital, and productivity. Fixed effects model is estimated by using panel data for sample of 209 nations worldwide from the World Development Indicators of the World Bank. The findings showed that increasing population density has a positive impact on productivity, and the degree of education among the population has an even greater impact.

Pritchett (1996) examined the relationship between factor accumulation, population growth, and productivity in OECD countries between 1960 and 198. Fixed effects model is estimated by using panel data from Penn World Tables and World Bank data. The findings showed that total factor productivity increase is uncorrelated with population growth.

Ahrend et al (2014) studied the differences in productivity between functioning urban regions in five OECD nations between 2003 and 2010. Fixed effects model and pooled regressions are estimated by using panel data from the OECD Metropolitan Database. The research shows that cities with fragmented government tend to be less productive. A metropolitan region with twice the number of municipalities has a 6% poorer productivity for a given population size.

4.Data, Methodology and Results

This chapter discusses and explains the data and methods used in this study and presents the analysis results. In this context, the subsequent sub-chapters will expand on data and variable construction techniques, the model is used to illustrate the effect of international trade on productivity.

4.1. Data

This research employs annual data derived from the World Bank's Development indicators and the Penn World Table for the years between 1990 and 2017 for the following eight countries in sub-Sahara Africa: Kenya, Senegal, Nigeria, Cameroon, Botswana, South Africa, Togo, and Niger. The period and the countries are selected due to the data availability of the variables employed in the model. Table 1. exhibits the variables, their calculations, and resources in detail. Additional details will be given in the following sub-chapters.

Table.1. Variables, Calculations and Resources

Variables	Calculations	Resources
TFP (Total Factor Productivity)	TFP level at current PPPs (USA=1)	Penn World Table
TO (Trade Openness)	Trade (% of GDP)	World Bank's Development indicators
CI (Capital Intensity)	Capital stock at current PPPs (in mil. 2011US$)/ Labor force, total	Penn World Table, World Bank's Development indicators
EXI (Export Intensity)	Exports of goods and services (current LCU)/ GDP (current LCU)	World Bank's Development indicators
EXR (Exchange Rate)	National currency/US$ (market+estimated)	Penn World Table
POP (Population)	Population, total	World Bank's Development indicators

4.2. Construction of Variables

4.2.1 Total Factor Productivity

Total factor productivity is the dependent variable in this study as a measure of a country's productivity in terms of labor and capital usage performance in producing goods and services. Penn Word Table, the data source for TFP level in this study, reports the TFP level at current PPPs (USA=1) for each country.

4.2.2. Trade Openness

Trade openness can be defined as total trade as a percentage of GDP, with a higher ratio indicating greater trade openness. Total trade to GDP is considered a well-defined and consistent trade indicator. It has a crucial importance for this study based on its main aim to measure the foreign trade intensity's effect on the total factor productivity. This indicator is reported by World Bank as the sum of exports and imports of goods and services measured as a share of gross domestic product.

4.2.3. Capital Intensity Ratio

Capital intensity can be defined as the interaction between the capital and the labor used in an economy, capturing the degree of capital intensity in the economy's production factors. This variable is employed with the aim of measuring the effect of capital intensity on the total factor productivity. Capital intensity is calculated as the capital stock ratio to the labor force. The capital stock is reported by Penn World Table at current PPPs (in mil. 2017US$). The labor force is defined by the World Bank as the number of people ages 15 and older who supply labor for the production of goods and services.

4.2.4. Export Intensity

Export intensity is the percentage number of exports to total output in current local currency. Export intensity is recognized as one of the most widely used indicators of a country's export intensity. The aim of using this variable is to discover the relationship between export intensity and

productivity. Export intensity is calculated as exports of goods and services current local currency to GDP current local currency.

4.2.5. Exchange Rate

The exchange rate is the ratio of one unit of home currency to another country's currency unit. In this study, exchange rates are expressed as the ratio of the national currencies to USD and used in the model to understand the effect of the countries relative currency values on their productivity since it is an essential factor in the volume of the international trade. Penn World Table defines the exchange rate as national currency/USD (market+estimated).

4.2.6. Population

The World Bank defines the total population as the de facto term, which includes all people in a country regardless of their legal status or citizenship. The variable is transformed by dividing each observation by a factor (10.000.000) to solve the problems deriving from the unit of measurement incompatibilities with the other variables used in the model. It is employed in the model with the aim of determining the effect of population on total factor productivity.

4.3. Model

This study employs the panel data method to examine the effect of international trade on productivity in Sub-Saharan African Countries. The fixed-effect model of panel data analysis method is employed based on the results of the related tests. The total factor productivity is modeled to a series of explanatory variables, namely, trade openness (TO), export intensity (EXI), capital intensity (CI), the exchange rate (EXR), and population (POP). The model is:

$$TFP = f(TO, CI, EXI, EXR, POP) \quad (1)$$

where total factor productivity is a feature of trade openness, capital intensity, export intensity, exchange rate, population, countries' effects, and time effects. In terms of the linear specification described in the following section, the model can be represented in the following way:

$$TFPit = \beta 1TOit + \beta 2CI\,it + \beta 3EXI\,it + \beta 4EXR\,it + \beta 5POP\,it + \alpha i + uit \quad (2)$$

where αi is each entity's intercept term, TFPit is the dependent variable, total factor productivity (TFP), i = entity, and t = time. β is the independent variable's coefficient, and uit is the error term. The independent variables are TOit=trade openness, CI it = capital intensity, XI it= export intensity), EXR it =exchange rate, and POP it =population.

4.4. Panel Data Analysis

A panel data is a cross-sectional time-series dataset that, in theory, gives longitudinal data of a collection of variables on observed units such as entities, households, firms, regions, and countries over a long period. A cross-sectional data collection is made up of measurements on a limited number of variables over a specified period. On the other hand, a time-series data collection comprises one or more variables of measurements over time. An unbalanced panel dataset arises from the absence of observations for such variables for a specified number of periods during data collection.

A panel data regression is distinguished from a time series or cross-section analysis (Baltagi, 2005):

$$yit = \alpha + Xit\beta + uit \quad i = 1,\dots,N;\ t = 1,\dots,T \tag{3}$$

where *i* represents households, individuals, firms, and nations, and t represents time. Thus, the *i* represents the cross-section, while the t subscript denotes the dimension of the time series. α is the intercept term, β is $K \times 1$, and *Xit* seems to observe the K independent variable.

Fixed effects and random effects models are the two kinds of effects models used in panel data estimations. Different approaches for panel data regressions are suitable based on the data (Xu et al., 2007).

4.4.1. Fixed effects models

Fixed effect model examines the relationship between independent variables and a dependent variable belong to entities such as countries, individuals, and firms by examining the influence of factors that change over time. When utilizing fixed effect, the fact that any factor about the entity might influence or bias the independent or dependent should be taken into consideration. This gives the justification for assuming an association among the error term of the entity and the explanatory

factors. Fixed effect eliminates the influence of such time-invariant features, allowing for an examination of the predictors total impact on the dependent variables. Fixed-effects model is not suitable if there is a relationship between the error components. (Torres-Reyna, 2007)

The fixed-effects model's equation is as follows:

$$Yit = \beta 1Xit + \alpha i + uit \quad (4)$$

where αi = *(i=1....n)* represents an unobserved intercept, *Yit* = is the dependent variable, with *i* equalling country and *t* equalling time, *Xit* =denotes a single explanatory variable, $\beta 1$= is the coefficient of the independent variable and *uit* is the disturbance term.

4.4.2. Random-effects models

In random-effects models, variability between entities is random and unrelated to the explanatory variables throughout all periods. Additionally, the model must incorporate any available variables, particularly invariant time constant features if not then the model would be biased as a result of missing variables. In other words, if variations between entities are likely to possess a substantial impact on model outcome results for the dependent variable, the random-effects model must be considered(Torres-Reyna, 2007).

The random-effects model is:

$$Yit = \beta Xit + \alpha + uit + \varepsilon it. \quad (5)$$

where Yit denotes the dependent variable, where *i* is the entities and t denotes the time, uit is the error that occurs between entities, ε*it* is the error within entities, Xit denotes the set of explanatory variables while β denotes its coefficient and α (i=1..., n) denotes the entities ' unknown intercept.

4.4.3. Hausman Test

Hausman is a widely used test in choosing the best-suited panel data form for the model and data, namely choosing between fixed and random effect models. The hypothesis of Hausman test is as follows: H0: Choose RE (p> 0.05) and H1: Choose FE (p <0.05). When the Ho hypothesis is accepted with a p value greater than 0.05, random effect model is chosen. When the Ho hypothesis

is rejected with a p value less than 0.05, fixed effect model is chosen for the model estimation(Greene, 2012).

4.4.4. Multicollinearity

Multicollinearity refers to the association between independent variables in the regression model, which refers to a high correlation between them. The variance inflation factor (VIF) is an analytical instrument used for testing the multicollinearity. When the VIF is greater than 10, it is accepted that multicollinearity exists(Kim, 2019).

5.1 Results

The result of the model that used to estimate the impact of the international trade on the productivity for the selected countries is explained in this section. Summary statistics for the variables in the model can be seen in Table 2.

Table 2: Summary Statistics

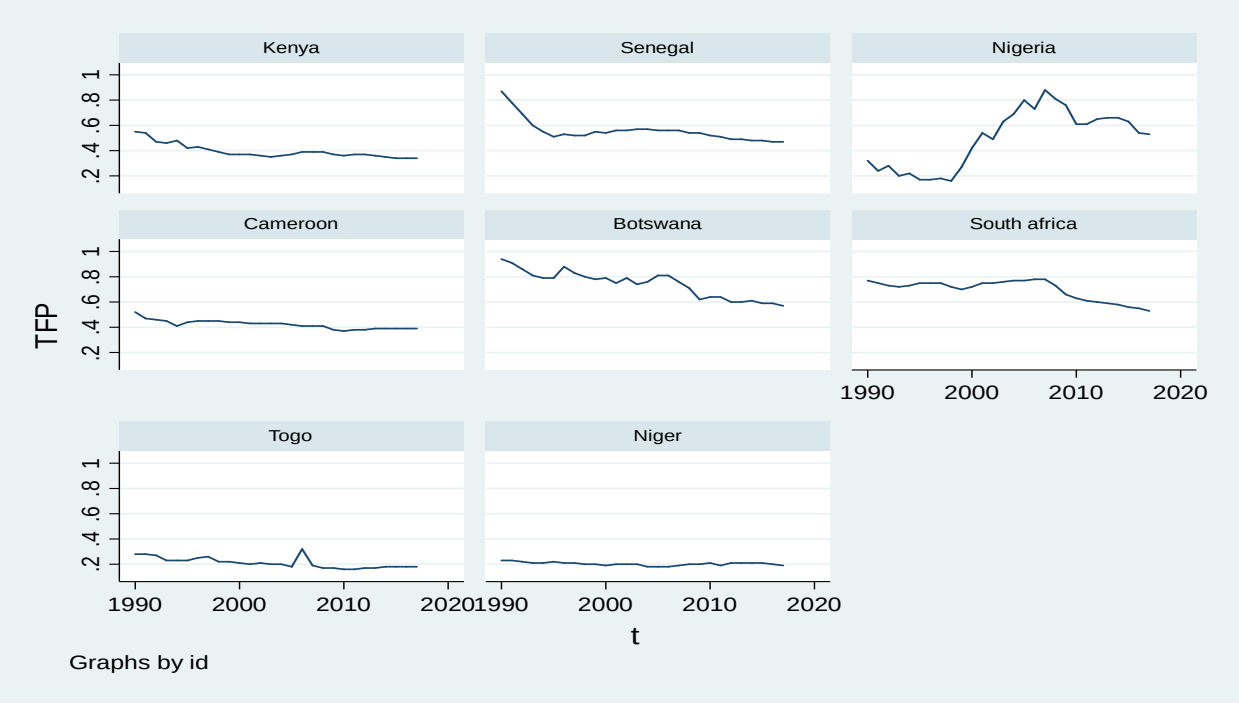
Variable		Mean	Std. Dev.	Min	Max	Observations
TFP	overall	0.47	0.21	0.16	0.94	N = 224
	between		0.20	0.20	0.74	n = 8
	within		0.10	0.13	0.85	T = 28
TO	overall	59.79	20.41	20.72	122.55	N = 224
	between		19.18	37.55	95.91	n = 8
	within		9.65	30.93	97.63	T = 28
CI	overall	0.03	0.04	0.00	0.20	N = 224
	between		0.03	0.01	0.09	n = 8
	within		0.02	-0.03	0.15	T = 28
EXI	overall	0.28	0.11	0.09	0.62	N = 224
	between		0.10	0.18	0.51	n = 8
	within		0.05	0.12	0.44	T = 28
EXR	overall	282.07	250.94	1.86	733.04	N = 224
	between		250.44	5.63	513.98	n = 8
	within		88.58	32.77	501.12	T = 28

POP	overall	3.38	4.33	0.13	19.00	N =	224
	between		4.47	0.18	13.76	n =	8
	within		1.10	-0.89	8.61	T =	28

Source: Calculated by the researcher using data from Penn World Table and World Bank Database

The number of overall observations is 224 due to 8 countries and 28 time periods between 1990 and 2017. The overall mean in total factor productivity is (0.47), the standard deviation is (0.21), which shows a significant variation in the variable. Average total factor productivity for each country varies between minimum (0.20) and maximum (0.74) levels. Total factor productivity within countries varies between minimum (0.13) maximum (0.85). The overall mean of trade openness is (59.79), the standard deviation is (20.41) and the highest trade openness value observed in data is (122.55). Trade openness value for each country varies between minimum (37.55) and maximum (95.91), while within value varies between minimum (30.93) maximum (97.63). The overall mean of the capital intensity ratio is (0.03), the standard deviation is (0.04), and (0.20) is the maximum value. The average capital intensity ratio for each country varies between minimum (0.01) and maximum (0.09), while within countries value varies between minimum (-0.03) maximum (0.15). The overall mean in export intensity ratio is (0.28), standard deviation (0.11), and the maximum value is (0.62). The average export intensity ratio for each country varies between minimum (0.18) and maximum (0.51), while within countries value varies between minimum (0.12) maximum (0.44). The overall mean of the exchange rate is (282.07), and the standard deviation is (250.94), which indicates a significant variation in the variable, and the maximum exchange rate value is (733.04). The average exchange rate for each country varies between minimum (5.63) and maximum (523.98), and exchange rate value within countries varies between minimum (32.77) maximum (501.12). Overall mean in population is (3.38), the standard deviation is (4.33), and the maximum population observed is (19.00). The average population for each country varies between minimum (0.18) and maximum (12.76), population within countries varies between minimum (-0.89) maximum (8.61). As indicated in the data section, the population is transformed by being divided by 10.000.000.

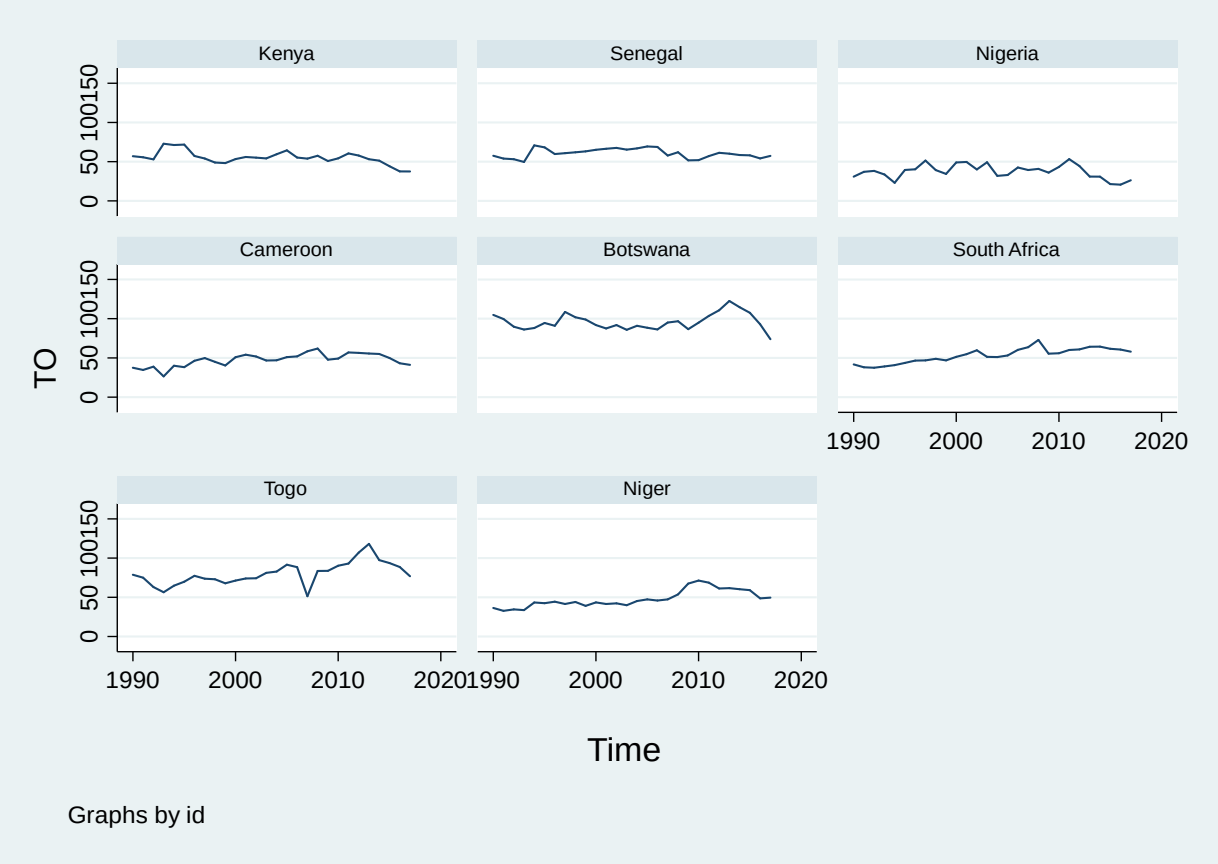
Figure 1. Total Factor Productivity



Source: Calculated by the researcher using data from Penn World Table Database

Total factor productivity graphs for different countries from 1990 to 2017 are shown in Figure 1. Botswana (.74178571) and South Africa (.69607143) have the highest mean values total factor productivity, while Togo (.21071429) and Niger (.20321429) have the lowest mean values total factor productivity. Total factor productivity in Nigeria increased by more than 30% between 2000 and 2009. On the other hand, total factor productivity in Botswana declined by more than 20% between 2005 and 2017. The total factor productivity of other countries, on the other hand, has remained relatively stable.

Figure 2: Trade Openness



Source: Calculated by the researcher using data from World Bank Database

Figure 2 shows trade openness graphs for selected countries between 1990 and 2017. The highest mean values of trade openness are found in Botswana (95.913214) and Togo (80.264643), while the lowest mean values are found for Nigeria (37.546786) and Niger (48.129643). Botswana's trade openness decreased by more than 30% while Togo's trade openness decreased by more than 40% between 2013 and 2017.

The results of the random and fixed effect models can be seen in table 3. With respect to the results of the Hausman test, the fixed-effect model is chosen to be employed in the the study.

Table 3: Fixed Effect and Random Effects Models

Variables	Fixed Effect Model	Random Effect Model
TO	-.0043505 *** (0.000)	-.0040334*** (0.000)
CI	-1.999569*** (0.000)	-1.807058*** (0.000)
EXI	1.062989 *** (0.000)	1.036626*** (0.000)
EXR	-.0001985*** (0.003)	-.0001723*** (0.004)
POP	.061827*** (0.000)	.052448*** (0.000)
_cons	.33887*** (0.000)	.3454872*** (0.000)
F-test(model) F(5,211) = 42.22	Prob > F = 0.0000	
Wald chi2(5) = 166.40		Prob > chi2 = 0.0000
R2	0.5001	0.4974
N	224	224

Source: Calculated by the researcher using data from Penn World Table and World Bank Database
*p < = .05, **p < = .01, ***p < = .001

The equation regarding the selected chosen fixed effect model is:

$$TPF = .33887 - .0043505TO - 1.999569CI + 1.062989\,EXI - .0001985EXR + .061827\,POP \quad (6)$$

The model seems to fit the data according to the F Wald test results and all independent variables are statistically significant. Based on the model, trade openness, exchange rate and capital intensity have negative impacts while the population and export intensity have positive impacts on total factor productivity. Even if trade openness, capital intensity, export intensity, exchange rate, and population are all zero, each country is expected to have 0.33887 units of total factor productivity (p<.0000). For a one-unit decrease in trade openness, countries' total factor productivity is predicted to decrease by -.0043505, assuming all other factors remain constant (p<.0000). As capital intensity decreases by one-unit, total factor productivity decreases by -1.999569 units (p<.0000) as all other factors remain constant. With all other factors kept constant, total factor productivity will increase by 1.062989 units with respect to a one-unit increase in export intensity (p<.0000). Total factor productivity is expected to decrease by -.0001985 units, assuming all other variables remain stable (p<.0000), With respect to a one-unit decrease in the exchange rate. As the population increases by one-unit, total factor productivity increases by.061827 units (p<.0000), provided that all other factors remain constant. As indicated before, the Hausman test results show that hypothesis H_0 is rejected as it can be seen in the table 4.

Tabel 4: Hausman Test

Vriables	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
TO	-.0043505	-.0040334	-.0003171	.0001682
CI	-1.999569	-1.807058	-.1925111	.0390099
EXI	1.062989	1.036626	.0263629	.0430748
EXR	-.0001985	-.0001723	-.0000263	.0000189
popnew	.061827	.052448	.009379	.0021977
b = consistent under Ho and Ha; obtained from xtreg B = inconsistent under Ha, efficient under Ho; obtained from xtreg				
Test: Ho: difference in coefficients not systematic chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B) = 29.87 Prob>chi2 = 0.0000				

Source: Calculated by the researcher using data from Penn World Table and World Bank Database

The Variance Inflation Factor (VIF) test shown in table 5 is illustrated to determine multicollinearity. The results indicate that all independent variables have VIF measures with less

than ten and 1/VIF greater than 0.10, which indicates there is no multicollinearity between variables.

Table 5: Multicollinearity

Variable	VIF	1/VIF
TO	8.94	0.111802
EXI	8.48	0.117987
EXR	1.94	0.515645
POP	1.85	0.540043
CI	1.56	0.639867
Mean VIF	4.55	

Source: Calculated by the researcher using data from Penn World Table and World Bank Database

6. CONCLUSION

Orthodox trade theories claim that the value of output in economics was increased through openness to international trade. Trade leads to a static increase in output and improves economic productivity (López, 2005). Trade can theoretically effect economic growth in developing countries in several ways. Greater trade integration promotes resource efficiency through comparative advantage and allows countries to obtain scale and scope of the economies. It also helps to spread technology and managerial knowledge, decreases anti-competitive activities among local firms, and promotes competitiveness in both international and domestic marketplaces(Calderon et al., 2020). The link between trade openness and economic growth is not always positive. Although trade openness provides several benefits to many developing nations, particularly those in the East Asia and Latin America regions, which are responsible for the prior favorable openness-growth nexus but does not provide similar benefits to Sub-Saharan African countries.

Despite the significant amount of the studies on this topic, there are only a few existent studies that examine the relationship between trade openness and productivity for the case of Sub-Saharan African countries. This study employs the panel data analysis method with fixed effect models to examine the effect of international trade on productivity in Sub-Saharan African Countries namely Kenya, Senegal, Nigeria, Cameroon, Botswana, South Africa, Togo, and Niger. The effect of the international trade of total factor productivity is examined by using trade openness variable, along with the other control variables which are export intensity, capital intensity, exchange rate, and population.

The findings of the study indicate that trade openness, capital intensity and exchange rate have significant negative impacts on productivity while export intensity and population have significant positive impacts on productivity in selected Sub-Saharan African countries. Although results regarding the negative impact of trade openness are compatible with the existent literature on Sub Saharan Africa, they point out the necessity to examine the nature of the international trade and implement effective trade policies that may foster the productivity for these countries. The capital structure of the selected countries also requires an examination to reveal the underlying reasons of its productivity decreasing impact which is left to the future studies. The number of the Sub-Saharan African countries included in this study is limited do the data availability for the selected

variables. The analysis in this study should be implemented with a wider coverage of Sub-Saharan African countries to reveal the characteristic of the relationship between the international trade and productivity that can be generalizable for the whole region.

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APPENDIX : STATA Outputs of The Analysis

```
. xtreg TFP TO  CI EXI EXR POP, fe

Fixed-effects (within) regression               Number of obs      =       224
Group variable: id                              Number of groups   =         8

R-sq:                                           Obs per group:
     within  = 0.5001                                         min =        28
     between = 0.0241                                         avg =      28.0
     overall = 0.0444                                         max =        28

                                                F(5,211)           =     42.22
corr(u_i, Xb)  = -0.8055                        Prob > F           =    0.0000
```

TFP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TO	-.0043505	.001009	-4.31	0.000	-.0063396	-.0023614
CI	-1.999569	.2279231	-8.77	0.000	-2.448867	-1.550271
EXI	1.062989	.2063339	5.15	0.000	.6562488	1.469729
EXR	-.0001985	.0000593	-3.35	0.001	-.0003155	-.0000816
POP	.061827	.005068	12.20	0.000	.0518366	.0718173
_cons	.33887	.0372703	9.09	0.000	.2654001	.4123398
sigma_u	.35177271					
sigma_e	.0737684					
rho	.95787636	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(7, 211) = 103.64                     Prob > F = 0.0000
```

```
. xtreg TFP TO  CI EXI EXR POP, re

Random-effects GLS regression                   Number of obs     =       224
Group variable: id                              Number of groups  =         8

R-sq:                                           Obs per group:
     within  = 0.4974                                         min =        28
     between = 0.0276                                         avg =      28.0
     overall = 0.0493                                         max =        28

                                                Wald chi2(5)      =    166.40
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =    0.0000
```

TFP	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TO	-.0040334	.0010604	-3.80	0.000	-.0061118	-.001955
CI	-1.807058	.2393625	-7.55	0.000	-2.2762	-1.337916
EXI	1.036626	.2152816	4.82	0.000	.6146818	1.45857
EXR	-.0001723	.0000602	-2.86	0.004	-.0002903	-.0000542
POP	.052448	.0049244	10.65	0.000	.0427963	.0620997
_cons	.3454872	.0673348	5.13	0.000	.2135135	.477461
sigma_u	.14537017					
sigma_e	.0737684					
rho	.79522377	(fraction of variance due to u_i)				

```
. hausman FE RE, sigmamore
```

	Coefficients (b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
TO	-.0043505	-.0040334	-.0003171	.0001682
CI	-1.999569	-1.807058	-.1925111	.0390099
EXI	1.062989	1.036626	.0263629	.0430748
EXR	-.0001985	-.0001723	-.0000263	.0000189
POP	.061827	.052448	.009379	.0021977

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(5) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 29.87
Prob>chi2 = 0.0000

```
. vif
```

Variable	VIF	1/VIF
TO	8.94	0.111802
EXI	8.48	0.117987
EXR	1.94	0.515645
POP	1.85	0.540043
CI	1.56	0.639867
Mean VIF	4.55	

```
. tab id , sum ( TFP)
```

id	Summary of TFP		
	Mean	Std. Dev.	Freq.
1	.39535714	.0566655	28
2	.55678571	.08898829	28
3	.49464286	.23046623	28
4	.42178571	.03410806	28
5	.74178571	.1066338	28
6	.69607143	.0797375	28
7	.21071429	.04198135	28
8	.20321429	.01334821	28
Total	.46504464	.21297803	224

```
. tab id , sum ( TO )
```

id	Summary of TO		
	Mean	Std. Dev.	Freq.
1	55.221786	8.3448401	28
2	60.671071	5.932502	28
3	37.546786	8.7919382	28
4	47.369643	8.1252015	28
5	95.913214	10.444312	28
6	53.206429	9.2605216	28
7	80.264643	14.494335	28
8	48.129643	10.790114	28
Total	59.790402	20.405162	224

```
.
```

```
. xtsum TFP TO CI EXI EXR POP
```

Variable		Mean	Std. Dev.	Min	Max	Observations	
TFP	overall	.4650446	.212978	.16	.94	N =	224
	between		.1997206	.2032143	.7417857	n =	8
	within		.1014931	.1304018	.8504018	T =	28
TO	overall	59.7904	20.40516	20.72	122.55	N =	224
	between		19.17616	37.54679	95.91321	n =	8
	within		9.652373	30.92576	97.62576	T =	28
CI	overall	.0312342	.0381509	.003079	.203753	N =	224
	between		.0319455	.0084456	.089044	n =	8
	within		.0236334	-.0331788	.1459432	T =	28
EXI	overall	.2785369	.1073749	.092181	.615226	N =	224
	between		.1030588	.1775216	.5072514	n =	8
	within		.0468423	.1192945	.4391756	T =	28
EXR	overall	282.0668	250.9418	1.86	733.04	N =	224
	between		250.4375	5.631429	513.9821	n =	8
	within		88.58105	32.77469	501.1247	T =	28
POP	overall	3.375	4.330311	.13	19	N =	224
	between		4.468833	.1753571	13.76071	n =	8
	within		1.095024	-.8857143	8.614286	T =	28