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Green, Clean, and Mean? China's Foreign Direct Investment in Sub-Saharan Africa Economy

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Approval of the Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the committee listed below, which hereby approves the manuscript of Makuochukwu Ijeabalum Okoma as fulfilling the scope and quality requirements for meriting the degree of Doctor of Philosophy in Political Science and Economics.

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Abstract

Green, Clean, and Mean? China's Foreign Direct Investment in Sub-Saharan Africa's economy.

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This dissertation is an investigative study that utilized the Panel Vector Autoregressive (PVAR) model that examines the impact of China's Foreign Direct Investment on the environment and economy of Sub-Saharan Africa (SSA). In evaluating this impact, 43 SSA countries were analyzed and subdivided into various income levels; three arguments were proposed and tested.

First is China's FDI in SSA, "green." Does China's FDI lead to sustainable growth and development for the environment in SSA.? Second, does China's FDI clean up pollution through the reduction of Carbon dioxide (CO2) emissions? Lastly, does it lead to economic growth and development in SSA? The results of this analysis confirm and are consistent with other research findings that China is neither green nor clean but may lead to economic growth in the SSA, however statistically insignificant. Conversely, this research also proves that variables like education, government expenditure, and population growth lead to statistically significant economic growth. Furthermore, using the Granger Causality, it would be proved that GDP growth and CO2 emissions cause China's FDI into SSA.

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Chapter 1

The Research Problem

Introduction

This dissertation research examines the impact of China's Foreign Direct Investment (FDI) on Sub-Saharan Africa's economy and environment. Foreign Direct Investment (FDI) plays four significant roles in Sub-Saharan Africa (SSA): making the low domestic savings, filling the foreign exchange gap, filling the targeted governmental tax revenue, and filling the void of low managerial, entrepreneurship, technology, and skills.

China is the world's leading emerging economy, and Africa is the continent with the largest number of developing countries. Establishing the Forum on China-Africa Corporation (FOCAC) in 2018 was geared to foster cooperation and solidarity. This forum developed 8 major cooperation plans, which include:

1. Increasing development assistance: foreign aid in grants, interest-free loans, and a concessional loan of about RMB121.5 billion was given to Africa from 2013 to 2018. China has assisted African countries in building more than 13,000 roads and railways, 80 large-scale power facilities, 130 medical facilities, 45 sports venues, and more than 200 schools.
2. Booming trade relations: China has been the SSA's largest trade partner since 2009
3. Promoting cooperation in investment and financing
4. Facilitating agricultural development in Africa
5. Contributing to industrialization in Africa
6. Expanding cooperation in infrastructure
7. Strengthening financial cooperation
8. Expanding cooperation in the digital economy

Since 201, China has been the highest investor in SSA, which is approximately 332 billion by 2020. Therefore, this research seeks to understand the impact of China's FDI on the SSA economy and environment. Accordingly, this paper is divided into two parts. The first part briefly examines the theoretical aspect of economic growth, FDI, and environmental issues and the impact of various investments on economic growth and development. The second part examines the impact of China's FDI on the economy and environment before concluding the result.

Using the environmental economics theory under the Porter hypothesis, the primary assumption is that economic growth and sustainable use of resources can exist simultaneously. I built a Panel Vector Autoregressive model to effectively handle the exogenous nature of the variables (FDI_China, GDP, CO2 emission), as well as a Pooled OLS model for comparison.

The result of the research found that there exists an insignificant positive relationship between China's FDI and economic growth, and a negative relationship between China's FDI, and carbon emissions in Africa from 2004 to 2019

Background of the Study

According to UNCTAD (2006), foreign investment was $10,672 billion in 2005 and Gross.

Domestic Product was USD 47.43 trillion when compared with 1990 was $1,723 billion, and

GDP was USD 32.51 trillion. A positive relationship exists between the flows of FDI and

World GDP (Dunning & Sarianna, The extent and pattern of foreign direct investment, 1993) Since 2003, Chinese FDI to Africa has increased from USD 75 million in 2003 to USD 2.7 billion in 2019, peaking in 2008 at US$ 5.5 billion.

This investment ranges from construction, mining, agriculture, manufacturing, financial intermediates, scientific research, and technical service. However, there is a lack of research concerning the effect of China's investment on the economy of Sub-Saharan Africa (SSA).

The gap this study seeks to find is the impact of FDI on economic growth in SSA and the relationship between FDI and economic development in SSA. The scope of the study is limited to the impact of China's FDI on economic and environmental growth in SSA. The empirical analysis of this study is also restricted from 2004 to 2019. This research study investigates the link between China's FDI and economic growth in SSA. In pursuance of this, therefore, this study hopes to achieve the following aims and objectives:

1. To examine the effect of China's FDI on economic and environmental growth in SSA
2. To examine the extent of China's FDI's contribution to economic and environmental growth in SSA.

The general significance of the study lies in that it would be used for further studies in the area of FDI and economic, social, and environmental growth in SSA. This study shall provide greater and deeper insight into the area of China's FDI and economic, social, and environmental growth in SSA. It also gives a deeper understanding of the extent to which China's FDI can affect SSA's economic, and environmental growth.

The objective of the Study

This study would help the government and foreign and domestic investors understand the role of FDI in SSA. This study would help me obtain my doctorate.

This study employed mainly a quantitative method of data analysis. Panel secondary data was used for this study. Panel Vector Autoregressive Model (PVAR) Model will be used to analyze the data in this study. This study adapts secondary data to explain the relationship between China's FDI, CO2 emission, and economic growth in SSA. The data on Chinese outward FDI was obtained from the Statistical Bulletin of China's Outward Foreign Direct Investment (Chinese title:中国对外直接投资统计公报). Data on Relative Political Reach, Relative Political Extraction, and Total Population of known religionists was obtained from Trans Research Consortium. And the remaining macro variables were obtained from the World Development Indicators (2019)

Chapter 2

Literature Review

Introduction

Green economy (GE), according to (United Nations Environment Programme, 2022), defines a green economy as one that results in "improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities." An efficient economy that uses resources produces a low-carbon and socially inclusive environment. In a green economy, economic growth is driven by investment in economic activities that foster low carbon and pollution emissions while enhancing the effective use of resources and energy (United Nations Environment Programme, 2022). The main idea behind the green economy is to create a more sustainable economy. Sustainable in the fact that the growth and development of this time and generation would not lead to a decrease in the growth and development of the next generation (Liu, 2017). A sustainable economy can be traced back to the Limit of Growth by the Club of Rome in 1972. The book (Meadows, Meadows, Randers, & William, 1972) examined the complexity of humanity; poverty amid plenty; degradation of the environment; loss of faith in institutions; uncontrolled urban spread; insecurity of employment; alienation of youth; rejection of traditional values; and inflation and other monetary and economic disruptions, and found that there are commonalities among all societies in the areas of technical, social, economic, and political elements; and, most important of all, they interact. And to preserve the habitability of this planet for ourselves and our children, a corrective model of economic growth needs to be developed to reflect a sustainable growth model. United Nations also defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Loiseau & et al, 2016).

(Loiseau & et al, 2016) Conducted a bibliometric analysis to determine the keywords associated with the green economy since 1990 and found that over half of the phrase was used in environmental and economic dimensions, which focused on environmental issues such as climate change and renewable energy. A clean economy, in line with the green economy, refers to reducing carbon emissions, which provides better opportunities and leads to economic growth and development. The "mean," on the other hand, represents the inability of China's FDI to foster growth and development in SSA.

In March 2011, China embarked on strategies to focus more on energy and climate change by creating a new set of targets and policies for 2011-2015. (Heggelund, 2021). The China-Africa Environmental Cooperation Center was established in 2020, and In September 2021, seven African countries joined the International Coalition for Green Development on the Belt and Road (The State Council Information Office of the People's Republic of China, 2021).

Review Of Conceptual Issue

What Is FDI?

FDI is investments made by companies, governments, or/and individuals into a foreign country. According to the IMF and OECD definitions, foreign direct investment reflects the aim of obtaining a lasting interest by a resident entity of one economy (direct investor) in an enterprise that is resident in another economy (the direct investment enterprise). Which implies a long-term relationship between the host country and the direct investor. The fifth edition of the IMF's Balance of Payment Manual defines FDI as the owner of 10% or more of a company's capital as a direct investor across borders. Although this guideline is not a rule of

thumb, the 10% is used to differentiate between natural and portfolio investments.

Therefore, when a foreigner holds less than 10% shares of an enterprise, it would be classified as a portfolio investment in this paper. Still, more than 10% would be regarded aa s direct investment. OECD defines FDI as a category of cross-border investment made by a resident in one economy (the direct investor or parent) to establish a lasting interest in an enterprise (the direct investment enterprise or affiliate) that is resident in an economy other than that of the direct investor. According to OECD, FDI is based on building a lasting relationship between the host country and the investor.

The OECD divided FDI into three categories, which are:

1) direct investment positions (stocks): a. equity: which includes common and preferred shares, reserves, capital contributions, and reinvestment of earnings. Dividends, distributed branch earnings, reinvested earnings, and

undistributed branch earnings.

b. debt (intercompany loans): includes marketable securities such as bonds, debentures,

commercial paper, promissory notes, non-participating preference shares, and other tradable

non-equity securities loans, deposits, trade credit, and other accounts

payable/receivable. Income received here is regarded as FDI.

2) direct investment income flows

a. dividends and distributed branch profits

b. reinvested earnings

c. income on debt (interest)

3) direct financial investment flows

a. equity

b. reinvestment of earnings

c. debt

(Duce & Banco, 2003) classified FDI based on the direction of the investment and the investment instrument used. For the direction, it was broken down into two perspectives: the

home and the host perspective. The home perspective is based on financing from the resident

parent company to its non-resident affiliated company. From the host perspective, it is defined

as the financing done by non-resident parent companies to their resident subsidiaries,

associates, or branches.

The instrument direct investment capital instrument is divided into three:

I. Equity capital includes all shares in subsidiaries and associates (except nonparticipating, preferred shares that are treated as debt securities and included under other direct investment capital) and other capital contributions such as machinery provisions.
II. Reinvested earnings: earnings not distributed from the direct investor's shares.
III. Others include debt securities and trade credits, direct investors and direct investment enterprises, and two direct investment enterprises that share. The role of FDI in host countries shows it to be a source of capital, complements domestic private investment, and enhances technology transfer (Chowdhury & Mavrotas, 2003).

Review Of Methodological and Empirical Literature

According to (Simison, 2019), the green economy is characterized by growth in employment and income-driven by investments in economic activities, infrastructure, and assets that emits low carbon and pollution as well as enhanced energy and prevent the loss of biodiversity and ecosystem services. The green economy aims to create sustainable consumption and production to improve consumption practices, reduce resource consumption, waste generation, and emissions across the entire life cycle of processes and products and improve production and resource efficiency. Resource efficiency refers to how the factors of production and resources are harnessed to deliver value to the economy while reducing the carbon footprint and increasing energy efficiency (UN Environment Programme, 2022).

FDI Impact on Economic Growth

In discussing the effect of FDI on economic growth, scholars have studied the impact of FDI from different perspectives. The (Blomstrom, Lipsey, & Zegan, 1994), established that FDI had a positive effect on economic growth within a given income threshold. Below the threshold, FDI does not have a positive impact. Given that most of the countries in SSA fall below this threshold, the FDI would hurt economic growth in SSA. Research (Caves, 1996) explained that FDI has several positive effects because it leads to productivity gains, technology transfers, new processes, managerial skills and know-how in the domestic market, employee training, international production networks, and market access (Borensztein, De Gregoria, & Lee, 1998). Emphasized that FDI positively affects economic growth because it acts as a vehicle for technology transfer. (Balasubramanyan, Mohammed, & Sapsford, 1996) also found a positive FDI and human capital. They also found that FDI is significant for economic growth because it is more export-promoting than import-substituting countries. Also, (Bengos & Sanchez-Robles, 2003) found a positive

correlation between FDI and economic growth provided the country receiving the FDI meets the required minimum human capital, is economically stable, and its market will benefit from long-term FDI inflows. This research would use open market and tertiary school enrollment to capture these characteristics in SSA

Although (Bende-Nabende, Ford, & Slater, 2002) found a positive and significant relationship between FDI and economic growth in developing countries like the Philippines and Thailand and a negative association with developed countries like Japan and Taiwan. (Durham, 2004) argued that FDI has a significant positive relationship with economic growth in the short run and not in the long run. This research would use a generalized impulse response function to distinguish the long-run and short-run effects. (Olofsdotter, 1998) argued that FDI has a positive relationship with economic growth in countries with suitable institutional capacity. (De Gregorio, 2003) found an increase in economic growth in Latin American countries between 1950-1985 with increasing FDI. For institutional capacity, relative political extraction and reach were used to capture it. (De Mello, 1997) found a positive correlation between economic growth and FDI for Latin American countries, stating that FDI boosts investments, leading to economic growth. On the other hand, some studies showed ambiguity between FDI and economic growth. (Zhang, 2001) found that the impact of FDI and Economic growth in East Asia and Latin American countries depends on social and economic conditions. In other words, the country's environment receiving the FDI determines the impact on economic growth. To measure the environment, governmental expenditure was used.

(Obwona, 2001) also asserts that FDI spillover depends on the capacity of Uganda to absorb

the foreign technology and the type of environment in Uganda in 2001. From (World Bank, 1997) argued that FDI depends on the motives of such investment and primarily when it is geared towards leading to economic growth through export promotion. (Asiedu E. , 2005) found that natural resources and a large market encourage FDI in Africa example, Nigeria also lowers inflation, has less corruption, and political stability, and good infrastructure promotes FDI. (Basu & Krishna, 2002) reviewed the experience of a few countries in Sub-Saharan Africa that have attracted a large amount of Foreign direct investment and found that sustained efforts to promote political and macroeconomic stability were the essential ingredient for the FDI.

FDI Impact on Carbon Emissions

Recent studies on the impact of FDI on the environment have been uncertain to the host country due to the presence of the pollution haven, the nonlinear relationship, and the pollution halo effect. The Pollution haven hypothesis argues that due to the stringent environmental laws and regulation in developed countries, developing countries becomes a haven for industrialization. This hypothesis increases economic growth as well as carbon emission. At the same time, the Pollution halo hypothesis argues that firms have greener technology than developed countries. Some of the greener technologies include but are not limited to pollution abatement technologies, advanced energy-efficient technologies, and renewable energy-using technologies. This hypothesis shows that FDI increases economic growth while decreasing carbon emissions. (Yue, Yang, & Hu, 2016) Also found the existence of a pollution halo effect in 104 Chinese cities using the slacks-based measure directional distance function (SBMDDF) model.

Many scholars have argued the presence of the effect of FDI's pollution halo effect, some of which (Abdouli & Hammami, 2017) investigated the Middle Eastern and North African (MENA) countries for a causal relationship between the environmental quality and FDI using a

simultaneous-equation panel data vector autoregressive (VAR) model, and found the existence of the halo effect and FDI reduce industrial pollution and carbon emission. (Wei, Han, Pan, Shahbaza, & Zafarc, 2020) Investigated the impact of China's FDI on the total factor energy efficiency (TFEE) of China's manufacturing using modified Stochastic Impacts by Regression on Population, Affluence, and Technology (STRIPAT) AND MULTI-Stochastic frontier model and found the halo effect. (Lee, 2013) The contribution of FDI to clean energy use, carbon emission, and economic growth was examined and found the halo effect's exit. The result researchers found evidence of the halo effect, which indicated that FDI leads to greener growth and development with reduced carbon emissions.

On the other hand, (Omri & Kahouli, 2014) examines the causal relationship between energy consumption, FDI, and economic growth using a dynamic simultaneous-equation model and found a negative relationship between FDI and energy consumption in low-income countries.

Sub-Divisions of SSA

According to UNDP, SSA countries are geographically located south of the Saharan region. They comprise 46 of the 54 African countries, excluding Algeria, Djibouti, Egypt, Libya, Morocco, Somalia, Sudan, and Tunisia. Still, The World Bank includes Sudan and Somalia, making it 48 countries listed as SSA. For this research, we will be using The World Bank list. (Melton, 2018) Further, the SSA is divided into four subregions and countries, which are:

1. Central Africa: has the following countries in the subregion Angola, Burundi, Central African Republic, Chad, Congo, the Democratic Republic of Congo, Republic of Rwanda

2. Eastern Africa: which has the following countries in the subregion Comoros, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Seychelles, Somalia, South Sudan, Sudan, Tanzania, Uganda

3. Southern Africa: has the following countries in the subregion Botswana, Eswatini (Formerly Known as Swaziland), Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe

4. Western Africa: which has the following countries: Benin, Burkina Faso, Cabo Verde, Cameroon, Cote d'Ivoire, Equatorial Guinea, Gabon, Gambia, The, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome, and Principe, Senegal, Sierra Leone, Togo.

The World Bank uses Gross National Income (GNI) per capita to classify Sub-Saharan African countries into low, lower-middle, upper-middle, and high. Although GNI per capita does not paint a complete picture of a country's level of growth and development, it is a clear indicator of a country's performance. It is closely correlated with other nonmonetary measures of quality of life, such as life expectancy at birth, mortality rates of children, and enrollment rates in school. Using the World Bank Atlas method of 2021, countries with a GNI per capita of $1,085 or less are regarded as low-income economies; lower-middle-income economies earn a GNI per capita of $1,086 to $ 4,255; upper-middle-income economies earn GNI per capita of $4,256 to $13,205, and high-income economies earn a GNI per capita of $13, 205 or more.

Low-Income economies in Sub-Saharan Africa ($1,085 or less)

Burkina Faso, Burundi, Central African Republic, Chad, Congo, Dem. Rep, Eritrea, Ethiopia Gambia, The, Guinea, Guinea-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Rwanda, Sierra Leone, Somalia, South Sudan, Sudan, Togo, Uganda, and Zambia

Lower-middle-Income economies in Sub-Saharan Africa ($1,086 to $4,255)

Angola, Benin, Cabo Verde, Cambodia, Cameroon, Comoros, Congo, Rep, Cote d'Ivoire, Djibouti, Egypt, Arab Rep., Eswatini, Ghana, Kenya, Lesotho, Mauritania, Nigeria, Sao Tome and Principe, Senegal, Tanzania, Zimbabwe.

Upper-middle-income economies in Sub-Saharan Africa ($4,256 to $13,205)

Botswana, Gabon, Equatorial Guinea, Mauritius, Namibia, South Africa

High-Income economies in Sub-Saharan Africa ($13,205 or more)

Seychelle

Chapter 3

Theoretical Approach

Introduction

This chapter comprises the theoretical framework of the models, model specification, estimation techniques, a priori expectation, definition of some of the variables, criteria for decision-making as well as the presentation of data. Methodology in research works specifies the various ways and techniques of carrying out the research to produce meaningful and unbiased results.

Environmental economics: based on neoclassical economists' environmental issue was due to the undervaluation of natural capital and its inefficient use (Borel-Saladin & Turok, 2013). One of the main assumptions of this theory is that economic growth and sustainable use of resources can exist simultaneously. This is referred to as the Porter hypothesis (Porter & Van der Linde, 1995) which states that a win-win solution can exist for both the environment and the economy. (Ambec, Cohen, Elgie, & Lanoie, 2013) Argued that environmental regulation can lead to entrepreneurial innovation, which would increase economic growth and business performance. In (Pigou, 1920)environmental economics started using the concept of external cost. Thus, when the marginal social cost of production is creating than the marginal private cost of production, it creates a negative externality and estimating the external cost, which is the difference between the marginal social cost and the marginal private cost, leads to strategies of setting price right ("internalizing").

After World War II in 1945, rapid foreign investment emerged, and various theories through the late 1960s were based on the motives and purpose of foreign direct investment (Debongo, et al., 2022). Some of these theories are

The OLI Model and Eclectic Theory

In the literature on international political economy, the OLI is the most applied theoretical approach in the study of FDI (Tuman & Emmert, The Political Economy of U.S. Foreign Direct Investment in Latin America: A Reappraisal, 2004). The eclectic theory is known as the Ownership, Location, Internalization (OLI) model. It is a three-tiered model that evaluates the benefit of any FDI. This theory argues that FDI would only be chosen if its cost was lower than the national cost or if other advantages outweighed the cost. Therefore, to achieve a unified framework, I have chosen to use and extend the analysis of John Dunning. He argued that FDI is selected over other business activities, such as export, because of the presence of Ownership (O), Location (L), and Internalization (L) advantages (Dunning J. H., 1988). The central hypothesis of this theory is based on fulfilling these three conditions:

Key Component of the eclectic theory

1. Ownership advantage (O) The net competitive advantage that firms or governments of one nationality possess over another through supplying a particular market. The function of any firm is to transform inputs into a more valuable output. Inputs can be of two kinds, and the first is available to all firms. This includes the Ricardian type of endowments, such as labor and proximity to the market, and legal and commercial environment endowments, such as market structures, government legislation, and policies. From this first kind of endowment, since all firms, regardless of nationality, have access to it, this input has no added advantage. The second type of this input is those not available to all firms but are created by the individual firm, such as copyrights, technological advantages, and patents. In order words, firms and governments must own an asset that earns enough to cover the cost of international investment. This asset might be copyright, blueprint, or even patent. This advantage motivates foreign direct investment.

It should be noted that this advantage is not exclusive to international investment but also domestic investment, but it dramatically motivates foreign direct investment. The ownership advantage makes a substantial difference in foreign direct Investment. (Dunning J. H.,1979) argued that this advantage is responsible for Japanese firms having a comparative advantage in the foreign production of textiles and clothing and consumer electronics, US firms in transport equipment, and UK firms in food and tobacco products. The ownership advantage help mitigates the cost of the liabilities of foreignness, which is the inherent cost that the foreign government or a firm incurs in the host country solely because of their non-native status. The literature of 1960 specified three O competitive advantages, which are:

- O competitive advantage concerning possession and exploitation of monopoly power such as trademarks and patents (Hymer, 1960) and Industrial Organization (IO) (Porter M. E., 1980).
- O competitive advantage concerning possession of scarce capabilities and unique resources, which is gotten from the creation of barriers to entry (Dunning J. H.,2000).
- The o competitive advantage concerns the managers and leaders of the firms or country. They create an advantage because of their ability to harness human capital.

The O competitive advantage has changed over the years as markets become more liberalized, and the invention of the internet has attempted to unify the market. In the 1990s, the "O" competitive advantage for firms and governments was seen in their ability to identify products and organize resources to meet the current market need, with no respect to sustainable growth and its environmental impact. With the turn of an

era or millennium, more emphasis has been placed on capacity-building, a sustainable environment, and data-driven assets. (Dunning J. H., 2000) argued that efficiency-seeking (ES) FDI is only viable if: (a) "the investing firms are already producing in at least one foreign country." (b) trading the product is free of natural or artificial cross-border barriers. While Strategic Assets Seeking (SAS) FDI relies on intellectual capacity located in two or more countries that are preferred economically feasible, that is, the acquisition of assets outside home countries.

2. Location advantage (L): Dunning argued that location advantage is the second necessary condition before embarking on FDI. The extent to which firms choose to locate these value-adding activities outside their national boundaries. (Dunning J. H.,2003). There must be a location advantage, ranging from cheap inputs such as wages, skilled forces, and special taxes or lack of tariffs or the presence of a market. The location advantage can also be seen in the differential rates of returns between nations which builds a financial portfolio model. Therefore, the advantage of this location aids in diversifying portfolios using differential rates of return. Location advantage is also referred to as "Market Potential," which means that government and multinational firms look for markets with strong growth potential (Frey, 1984) and (Eaton & Tamura, 1994). Therefore, Governments and firms with a high real gross domestic product per capita and growth in real GDP should generate higher sales and profit making it attractive for FDI (Tuman & Emmert, 2004). In a quest for a large market, firms seek countries with various trade agreements and customs unions, such as the Economic Community of West African States (ECOWAS), The Southern African Customs Union (SACU), The East African Community (EAU), The West African Economic and Monetary Union (WAEMU), The Economic and Monetary Community of

Central Africa (CEMAC) and the Common Market for Eastern and Southern Africa (COMESA). These custom unions and agreements promote large markets, which attracts more FDI. But this advantage usually comes with a clause that the firm must produce in one of the member countries of the trade area to harness the larger market. Therefore, trade agreements should lead to more significant FDI (Tuman & Emmert, 2004). This advantage also emphasizes the domestic political environment's importance in attracting (Haggard, 1988). Firms avoid investing in countries involved in unrest or revolutionary movements (Asiedu E. , 2002).

3. (I) The extent to which the firm/government believes it is in its best interest to internalize the market, which adds value to them. This principle states that there must be a gain from the investment. This gain comes from lower costs and better skills associated with the FDI. The greater the skill force, the more attractive the country would be for FDI because it would produce competitive products and services internationally (Shaiken, 1990). Dunning argued that the transaction cost positively correlates with an imperfect market, which accounts for the internalization advantage.

This theory can be summarized as follows any firm or government has various ventures for growth which include exploiting the foreign market, diversifying horizontally or laterally into new product lines, or vertically into new activities, which could consist of the production of knowledge or acquiring existing enterprise. Therefore, if it chooses to exploit the foreign market alongside the domicile firm in the market, it must possess additional ownership advantages sufficient to outweigh the cost of servicing an unfamiliar country (Dunning J. H., 1980).

Criticisms Of The Eclectic Paradigm

1. Are Competitive or Ownership Advantages Necessary to Explain International Investment:

   The Eclectic paradigm is based on the three advantages necessary for foreign investment or production. The ownership advantage state that for any firm or government to compete internationally outside its home country, it must possess some advantages which would mitigate the cost associated with being a foreigner. The term "advantage" is a relative term, going from the standpoint of Dunning; the advantage is viewed as economic competitiveness and profitability. This means that ownership advantage refers to an economic asset, whether tangible or not. And all economic assets are measured by the expected rate of returns. This makes the ownership advantage redundant since it should already be measured as an economic asset and its expected returns. Also, the ownership advantage is independent of the location advantage. But ownership advantage cannot be an independent variable because it is conditioned on the location advantage (Itaki, 1991). Some foreign investment has taken place with no ownership advantage but has enough location advantage to offset the investment cost.

   Therefore, the ownership advantage is sufficient but not necessary for efficiency-seeking (ES) FDI.

2. Location Advantages: Structural and Transactional Market Failure:

   The second strand of the theory is based on Location advantage, which states that location advantage is necessary to embark on FDI without considering structural and transactional market failure. Structural market failures arise from government intervention in the market, affecting the cost and revenue for the firm located differently. For example, the tax imposed on the manufacturing FDI may discourage foreign investment in manufacturing but not

transportation FDI in that country. Transactional market failure is country-specific and can range from low arbitrage and leverage opportunities, exchange rate fluctuations, and the risk of poor coordinated financial decisions among regional customs unions. Therefore, as argued by Dunning that the purpose of the OLI theory is to provide sets of variables and methodology for the explanation of value-adding FDI rather than giving a full description of all kinds of FDI.

Analysis of some using the OLI model

Congo DR (DRC): In 2019, the largest China FDI flow to Africa was 930.96 (millions in USD) to Congo DR. Most of China's FDI in DRC is channeled to the mining sector; currently, China owns 15 of the 17 Cobalt operation in DRC, with five biggest mining able to draw a line of credit of 124 (billion in USD).

Location Advantage: Congo is in the Central-western part of SSA, and it is very rich in natural resources, which include gold, diamonds, copper, cobalt, coltan, timber, coffee, crude oil, natural gas, and tin ore. Congo accounts for approximately 17 percent of the global production of rough diamonds, 34 percent of global cobalt, and 10 percent of global copper. 60-80 percent of the world's coltan reserves, used in manufacturing phones, computers, and electronic equipment, are in Congo, precisely between the North and South of Kivu (United Nations Human Rights, 2004). Since the Congolese wars in 1996 and 1998, Congo has been in political upheaval and instability and is among the five poorest nations in the world. Approximately 60 million people, 64% of its population in 2021, live below the poverty level. That is living on less than $2.15 a day. MCI score of Congo is 97.6, and it ranked second with metallic minerals, metals, and coal export contributed in 2018 was 91.1%. Its change in mineral export contribution between 2013 -2018 (percentage

points) was 17.5, and the metallic mineral and coal production value in 2018 (as % of GDP) was 32.97. the Mineral rent in 2018 (as % of GDP) was 16.17.

Ownership Advantage: Given that China owes and controls 15 out of 17 of the mines in Congo, DR., It shows that China has an ownership advantage.

Internalization Advantage: Given that five of the biggest mines owed by China can draw a line of credit from China Bank of 124 (billion in USD), and their investment was 930.96 (millions in USD) in 2019.

Angola: Angola is the second more prominent exporter of petroleum to China, which accounts for about 12% of China's petroleum imports (Begu, Vasilescu, Stanila, & Clodnitchi, 2018). The largest importer of petroleum in 2017 is China supposing the USA by importing 8.4 million barrels per day. "The strategic partnership between China and Angola relies heavily on oil cooperation" (Begu, Vasilescu, Stanila, & Clodnitchi, 2018). While Angola wants to rebuild its country after its civil war. (Wolf, 2016) found that the China-Angola partnership helps the manufacturing development of China, helps Angola develop its market, and achieves economic growth and development.

However, (Murgui, 2018) states that China's investment in Angola does not lead to significant economic growth and development because it is not adaptable to the locals. An example "ghost-towns" built by China in Angola,hasch have a home with all the necessary amenities such as water and power, hospital, schools, and parks. The cost ranges from $70,000 to $190,000, and most of Angola cannot afford it since they live below the poverty line.

Location advantage: Angola is located on the west coast of Southern Africa. Angola is one of the wealthiest countries in the world, with diamonds, iron ore, phosphates, copper, coal, and gold.

Angola is the second largest producer of Crude oil. MCI score of Angola is 31.2, and it ranked second with metallic minerals, metals, and coal export contributed in 2018 was 2.9%. Its change in mineral export contribution between 2013 -2018 (percentage points) was 1.2, and the metallic mineral and coal production value in 2018 (as % of GDP) was 0. the Mineral rent in 2018 (as % of GDP) was 0.

Ownership Advantage: Given that the demand for China's energy far exceeds its local supply. Since the 21st Century, China has prioritized acquiring energy and has become the biggest investor in renewable energy, including wind and solar energy (Bejarano, 2020). This gives China an advantage identifying, acquiring, and producing of mineral resources and energy.

Internalization Advantage: In the same vein, China has an internalization advantage because 56% of China's annual energy consumption comes from coal, and 18% comes from crude oil (Bejarano, 2020).

Exogenous-growth theory

This model is also known as the Solow-Swan model or the neo-classical growth model. This theory shows that economic growth is achieved through the accumulation of exogenous factors of production (Mahembe & Odhiambo, 2014). This theory states that in the long run, the growth rate of output per worker depends on the rate of labor and technology advancement, which is dependent on exogenous factors (Solow R. M., 1956). The outside economy influences economic growth; an exogenous increase in FDI would lead to a rise in GDP per capita but does not affect the long-run economic growth rate. This theory model that economies with similar technology could improve over time and would have a converging economic growth rate due to their productivity (De Jager, 2004). This model accredited lower productivity in a financial to faster/slower population growth

and lower saving rate as well as climate deficiencies, although not accounted for in the model (Solow R. , 1956)

The vital framework of any growth theory is to sustain a positive growth rate of output per capita in the long run, and there should be advances in technological knowledge in the form of new goods, new markets, or new processes.

This framework can be shown using the neoclassical growth model developed by Solow (1956) and Swan (1956), which shows that if there is no technological progress, diminishing returns would eventually cause economic growth to cease or slow.

The basic foundation of the neoclassical model is an aggregate production function demonstrating constant returns in labor and reproducible capital. They abstracted all issues concerning population growth and labor supply by assuming a continuous labor supply normalized to equal unity. Therefore, the aggregate production function is written as a function of capital alone

$Y = f(K)$ …… (1)

This function shows the relationship between output (Y) and capital stock (K) which demonstrates how much work can be produced using a given aggregate capital stock issued a state of knowledge, with a given range of available techniques and a given range of different capital, intermediate and consumption goods. Assuming that the capital good and labor are thoroughly and efficiently put to use, f (K) is produced.

A crucial characteristic of the aggregate production function is that there are diminishing returns to the accumulation of capital because if you progressively equip people with more and more of the same capital goods without progressive new use of the capital, then a point would eventually reach where the more or marginal capital goods becomes unyielding expect as spare parts in the

event of multiple equipment failures, and where the marginal product of capital is insignificant. This can be represented by assuming that the marginal product of capital is strictly decreasing in the stock of capital:

$F^{1}(K) > 0$ and; ....…….(2)

$F^{11}(K) < 0$ for all K, …….....(3)

Since the assumption took away population growth and technological change, capital accumulation is the only remaining force that could drive economic growth. Therefore output can only increase when capital accumulation rises. Solow and Swan also assumed that people save (s) a constant fraction of their gross income (Y) and that the constant fraction δ of the capital stock disappears each year because of depreciation. Because the rate at which new capital accumulation is sY and the rate at which the old capital depreciates is δK, therefore the net rate of increase of the capital stock, in order words, the net investment, is

$K = sf(K) – \delta$…….(4)

Equation (1) is the fundamental equation of the neoclassical growth theory, it shows how the rate of change of the capital stock at any date is determined by the amount of capital already in existence at that date together with the historically given stock of capital, and equation (4) determines the entire time path of capital. The time path of output is then determined by substituting this capital path into the aggregate production function.

The Cobb-Douglas (1928) production function, also known as the neoclassical function, is modeled as follows:

$Y=L^{a}K^{b}T$ (1)

Where:

a+b=1

Y= output

L=labor

K=capital

T=time or the rate of technological progress with changes over time

The weight of a and b shows the proportion of Y allocated to labor (L) and capital (K), respectively. The Cobb-Douglas production function shows that to increase output which represents economy growth, its labor force, capital, and technological progress need to increase or improve. This model creates a framework that capital accumulation leads directly to economic growth in relation to the weight allocated to it. From this neoclassical function, we can see that economic growth depends on both the labor force, capital, and technological progress. Therefore, according to this theory, FDI leads to an increase in capital stock, technological progress, and labor force which stimulates economic growth (Mahembe & Odhiambo, 2014).

(Belloumi, 2014) argued that for FDI to have a positive impact on the economic growth rate, in the long run, the FDI must be geared towards human or technological investment (Tanaya & Suyanto, 2022) Also supporting this claim in their research on the causal nexus between FDI and economic growth in Indonesia using the autoregressive distributed lag-bounds testing approach. (Wang & Swain, 1995) in their study on the determinant of FDI in transforming economies using empirical evidence from Hungary and China found during the 1980s, China's economic growth is associated with its principal FDI in the labor force. Using the Solow model (Findlay, 1978) argued

that the technological diffusion growth rate is an increasing function of FDI. (Balasubramanyam, Salisu, & Sapsford, 1996) Also found that FDI leads to an increase of economic growth through the transfer of technologies from developed economies to developing economies. (Borensztein, De Gregorio, & Lee, 1998) also, argues that FDI effects economic growth by passing through technology transfer and marginal capital productivity.

The exogenous growth theory shows that FDI can lead to economic growth directly through capital accumulation and the introduction of foreign technologies in the production function of the host countries (Mahembe & Odhiambo, 2014).

Criticism of the neoclassical model of exogenous growth

The main challenge with basing a theory of economic growth on the neoclassical model of exogenous growth is that technological change and labor changes can affect economic growth as much as capital accumulation. But that, technological change and labor changes are ignored in this theory.

Endogenous Growth Theory

Unlike the exogenous model, this model assumes technological progress is an endogenous factor, and in order to achieve economic growth, the stock of human capital and technological progress must be changed within the economy (Romer, 1994). (Romer, 1994) argued that technological progress that leads to economic growth only happens because of "things that people do." Both the exogenous and endogenous growth theories argue that capital accumulation is an important factor in economic growth. Their major difference is that the exogenous growth theory assumes technological progress as exogenous and endogenous growth theory as endogenous (Al Nasser, 2010) and (Elboiashi, 2011).

This theory argues that FDI inflow will help local firms by decreasing costs and increasing productivity which would boost economic growth (Aitken, Gordon, & Harrison, 1997). Therefore, the endogenous growth theory to generate economic growth FDI spillover will have a positive impact on local firms' productivity (Rismawana, Haryantob, & Handoyoc, 2021). (Hayat, 2019) in the research on FDI, Institutional Quality and Economic growth argued that the absorption capacity of the economy, characterized by the local firm, and the institutional quality determines the technology transfer and the productivity spillover. (Javorcik, 2004) research on the productivity of domestic firms as a result of FDI, using the Lithuanian industry data of 1996-2000, found FDI increases the productivity of local firms through vertical (inter-industry) rather than horizontal (intra-industry) relationships. Using the same study (Liu & Zou, 2008) but with industry data from 1995-1996 in China found a negative correlation between FDI spillover through vertical relationship and productivity growth of local firms in the short run but a positive correlation in the long run.

(Li & Tanna, 2019) in studying the impact of FDI on productivity found that FDI spillover has a positive effect on institutional quality rather than human capital. (Borensztein, De Gregoria, & Lee, 1998) Their research argued only when a host country had reached the minimum level of human capital can FDI contribute to economic growth. While (Slesman, Baharumshah, & Wohar, 2015) argued that FDI spillover has a positive impact on countries with high institutional quality.

The endogenous growth model, likewise, regarded as the new growth theory, is focused on the fact that economic growth is obtained from the increasing returns of new knowledge. Knowledge can also be considered as other economic goods but has a different characteristic from a normal economic interest in that non-rival, and partly excludable goods characterize it. The endogenous

growth model emphasizes the ability to have sustained economic growth by increasing knowledge or innovation rather than capital or labor.

The endogenous model emphasizes integrating two vital issues that enhance growth. These issues are.

1) Technological progress is the production of economic activity. Initial theories view technology as a given or production of non-market forces, but in endogenous growth theory, technology is internalized into the model of market functions.

2) The endogenous growth theory also integrates that knowledge and technology have the properties of increasing returns, unlike other tangible goods, and this increasing return is regarded as the primary catalyst to economic growth.

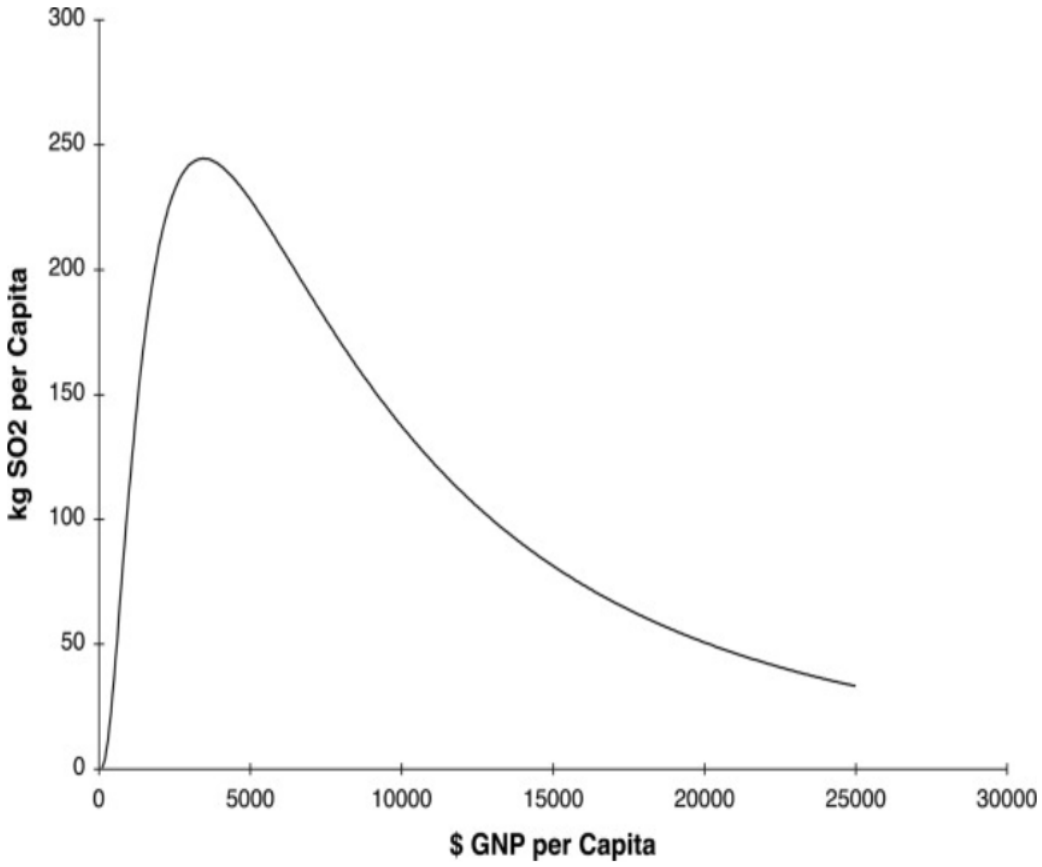
The endogenous growth model addresses the issue of what makes economies grow: why is the world richer than it was years, decades, or even centuries ago? Why are some countries richer than others, given the same economic environment? And the answer, according to the endogenous growth model, is that knowledge or innovation is the key force to growth in any economy. The reason is based on the fact that knowledge or innovation is a function of ideas, and ideas can be shared, reused, and accumulated without limits. Ideas have been proven to be superior to the law of diminishing returns, but it is characterized by increasing return that enhances economic growth. The endogenous growth model has enabled us to understand the rapid shift from the resource-based economy or industrial era to the knowledge-based economy or innovative era by emphasizing the use, creation, reuse, share, and diffusion, of ideas that are needed to create and enforce growth in the household, firms, government, and the world at large.

The fulcrum of the endogenous growth theory is the vital role played by knowledge and innovation in sustainable economic growth. As already discussed, that knowledge possesses two key ingredients that differentiate it from normal economic goods. These ingredients include being non-rival and partly excludable. Unlike normal economic goods that are rival in order words, only one person can make use of them at a particular time or excludable in order words. One has the right to eliminate others from using goods or services at a particular time.

Environmental Kuznets Curve (EKC)

The environmental Kuznets curve shows an inverted-U relationship between economic development and pollution. Krueger and Grossman identify three stages of this curve. In the first stage, pollution is high because the economy is poor and developing and is more interested in jobs, food, and survival than in a clean environment. The second stage is the middle-income stage, where income has risen to certain levels, and at this stage, pollution tends to be constant. The final stage is revealed as income increases for the developed economy; pollution decreases because they become more concerned with a greener and cleaner environment (Dasgupta, Laplante, Wang, & Wheeler, 2022). Researchers and applied econometricians generally agree with this model and have proved that air and water pollution increase with development until the country's per capita income is between $5000 to $8000 (Dasgupta, Laplante, Wang, & Wheeler, 2022). And when income per capital rises above $8000, pollution starts to decline

Figure 1: Environmental Kuznets curve



The EKC establishes a relationship between carbon emission in Kg per capita and GNP in dollar per capita, which Grossman and Krueger proposed in 1991. This curve shows that when GNP per capita is between $0-$8000, carbon emission will rise, and when GNP per capita is above $10000, the carbon emission decreases. Between GNPs per capita of $8000-$10000, there is a plateau in carbon emissions.

Pollution haven hypothesis

The pollution haven hypothesis, also known as the pollution haven effect, refers to relocating industries from more stringent countries, usually developed countries, to less severe countries, generally developing countries, to reduce cost. This hypothesis has three sub-sections. The first is

relocating heavy-polluting industries from developing countries with stringent countries (mining, industrial, and nuclear energy production). The second sub-section is the disposal of hazardous waste in developing countries by developed countries. Lastly, the unlimited access to the extraction and use of non-renewable natural resources in developing countries (Aliyu, 2005).

The Heckscher-Ohin theorem provides the theoretical framework for this hypothesis. The Heckscher-Ohlin theorem states that in the production of goods and services between two countries, the abundance of any factors of production plays a significant role in determining what a country export which goods (Edward, 1995). This theorem shows that countries export goods whose inputs are locally abundant. This means that the nations would produce and export goods in which they have a comparative advantage, and the stringent environmental laws come with higher costs making the production of this. This theorem also highlights various variations among countries from the perspective of its factors of production (O'Rourke & Williamson, 1999). Eli Heckscher and Bertil Ohlin, who founded this theorem, highlighted two key features of this theorem which are:

- That the pattern of trade shows the relative endowment of the factors of production that relatively capital-abundant countries would export capital-intensive products and services
- An open market would benefit countries with relatively abundant factors of production while hurting the countries with relatively scare factors of production.

The Heckscher-Ohin theorem has the following assumptions (Giri, 2022)

- There is no factor-intensity reversal within each country
- The production functions for the goods and services are constant return to scale

- Countries with the same production function would differ in factor-intensities. Therefore, country A will be capital-intensive, and country B will be a labor-intensive economy.
- Factors of production are mobile and fixed within countries but immobile across countries.
- Preference and utility are identical and homogenous
- There is a perfect market system. That is, there is no government intervention and imperfect competition
- Factors of production differ from countries.

Therefore, the pollution haven effect has the following empirical consequences: the outflow of FDI in developed countries is correlated positively with stringency environmental policy, and its inflow in developing countries is associated with a positive correlation with pollution. (Xing & Kolstad, 2002) Found evidence of pollution haven effect in their research of the impact of lax environmental regulation in attracting foreign investment. (Low & Yeats, 1992) found evidence to support the pollution haven effect by showing that the export of 'dirty products' from developed countries fell from 20% to 16% from 1965-1988, while that of the developing countries rose depending on the location. In Eastern Europe, it rose from 21% to 28%; in West Asia, it rose from 9% to 13%; in Latin America, it rose from 17% to 21% in the same period. Using cross-country analysis for periods 1960-1995 (Mani & Wheeler, 1997) found strong evidence in support of the pollution heaven hypothesis.

On the other hand, (Temurshoev, 2006) found strong evidence to reject the pollution haven in his research of the pollution heaven hypothesis using input-output techniques for the USA and China. (Raspiller & Riedinger, 2004) Investigated whether environmental regulations influence the location behavior of French firms and found pollution-intensive products were imported from the stringency environmental country.

Measures of Environmental Stringency

Environmental stringency or regulation refers to enforcing standards, rules, and regulations on various environmental issues. (Aliyu, 2005) divided the environmental stringency into four measures, which are ambient quality standards, product standards, production process standards, and emission or discharge standards.

Ambient quality standards refer to the maximum amount of a pollutant average in a given period present in outdoor air without negatively affecting public health. Product standard relates to the criteria and specifications of any products and services. The production process standard is the benchmark given to produce any goods related to environmental pollution. At the same time, emission standards are governmentally benchmarked on the emission of a pollutant from a process.

Environmental Policy Stringency (EPS) index is an international measure of environmental policy stringency. In this index, rigor refers to the degree to which environmental policy has an explicit and implicit price on all and every environmentally harmful activity.

Pollution Halo Hypothesis

This hypothesis argues that developed countries move greener investments to their country. This hypothesis, therefore, argues that FDI would have a positive relationship with economic growth and a negative association with carbon emissions. (Nguyen, Duc Huynh, & Nasir, 2021) Investigated the impact of economic growth, financial development, trade openness, and FDI on carbon emissions in G-6 countries from 1978 to 2014 and found weak evidence supporting the Pollution Halo hypothesis. (Wang & Wang, 2021) examined the effect of trade openness on carbon intensity in 104 countries from 2000 to 2014 and found a heterogenous impact. The high-income and lower-middle-income groups have a negative relationship between trade openness and carbon

intensity, and the upper-middle-income group has a positive relationship. (Mert & Caglar, 2020) In their study of pollution haven and pollution halo hypothesis in turkey from the period of 1974-2018 and found evidence of the asymmetric pollution halo hypothesis. (Zhang & Zhou, 2016) FDI reduces carbon emissions in China, which supports the pollution halo hypothesis. (Zhang & Zhou, 2016) argued that FDI leads to the export of greener technology to developed countries. (Pao & Tsai, 2011) using a panel cointegration framework, found a positive impact between FDI and carbon emissions for Brazil, Russia, India, and China. (Al-mulali, 2012) found a negative relationship between FDI and carbon emission in 12 middle eastern countries using panel analysis.

Assumptions and Hypothesis

From Literature, the impact of FDI on economic growth is not conclusive. This impact was based on the modernization and dependency hypothesis(Ayanwale, 2007). The modernization hypothesis, derived from the neoclassical and endogenous growth theories, states that FDI leads to economic growth through capital provision. (Calvo & Sanchez-Robles, 2002)found that the transfer of technology through FDI was important to provide the necessary infrastructure in terms of an educated population, liberalized markets, economic and social stability, and the candied for economic growth in developing economies. (Hodrab, Maitah, & Kuzmenko, 2015) Stated that FDI plays a dual function of growing capital and factor yield. (Holtbrügge & Kreppel, 2012) Also stated is that it leads to the flow of resources such as knowledge, and skills in management, organization, and marketing, aiding in a competitive market worldwide. On the other hand, the dependency hypothesis speaks of the long-term negative impact of FDI on economic growth stemming from dependency. In order words, the foreigners would control the locals. This hypothesis states that in the short-run increase in FDI would lead to a rise in consumption and investment, which would increase the economy's growth. Still, in the long run, as FDI increases,

it would lead to dependency on foreign investors, leading to a decrease in economic growth (O'Hearn, 1990). Following the augmented growth model of (Mankiw, Romer, & Weil, 1992):

This study made several assumptions about the impact of FDI on the economy and the environment. The first assumption is that FDI directly impacts the economy and the environment, supported by the exogenous growth theory and the pollution haven theory. The second assumption is that this impact can be measured supported by the exogenous growth theory and the pollution haven theory. The third assumption is premised on the notion that the selected variables have a multi-dimensional impact investing the endogenous theory, eclectic theory, and environmental Kuznets curve. Accordingly, the study tested the multi-dimensional result of the economy growth effect on the following variables the openness of the economy, the level of human capital, relative political reach, inflation, infrastructure development, population growth rate, domestic investment, and comparative political extraction. The exploratory considerations of these variables were intended for a comprehensive examination of the impact FDI has on the economy and the environment in SSA. Therefore, to the extent of the above assumptions, the study developed a causal research question and proposed the following hypothesis:

> Hypothesis 1: Is there a significant relationship between China's FDI inflow in SSA and SSA economic growth for 2004-2019?

> Hypothesis 2: Is a significant relationship between China's FDI inflow in SSA and SSA carbon emissions for 2004-2019?

The assumption above is that as China's FDI inflow in SSA increases, the expected result supports an increase in the economic growth of SSA. Similarly, an increase in China's FDI inflow should be positively related to the Carbon emission for the developing countries in SSA and negatively associated with the developed countries in SSA.

Significance of the Study and Literature Gap

To understand the impact of China's FDI on the SSA economy and environment, it is important to build upon data reporting of the Statistical Bulletin of China's Outward Foreign Direct Investment and World Bank Databank that most researchers currently follow. Expanding the economic literature to include a Panel Vector autoregressive analysis on the impact of China's FDI on the SSA economy and environment would close the literature gap in this area. In doing so, the study's significance will help guide policymakers on the importance of FDI and how to allocate it efficiently to stimulate economic growth and reduce carbon emissions

Chapter 4

Review Of China's Investment in Africa

Introduction

As discussed, three significant advantages are sought before FDI is embarked on. (Dong, Zhang, & Cai, 2011) China's FDI is mainly based on location advantages, specifically the economy, market, and energy reserves. (Yan, Ma, & Zhong, 2012) found that China's FDI is based on location advantages and the set of institutions in the African Country. (Zhao, 2015) found that access to resources is a significant attraction of China's Investment in Africa.

China has been the most significant FDI outflows among the emerging economies since the 1990s and has become a major player in Africa, not just in trade but also in Foreign Direct Investment (FDI) and aid. China's involvement in Africa dates to the 1950s and 1960s, the pre-independent an era where Chinese leaders supported African countries to gain their independence. Post independent era, Chairman Mao Zedong supported socialist regimes in Africa, which was seen in the construction of the TAZARA (Tanzania Zambia Railway Authority) railway line, which ran from the Zambian copper mines to the Tanzanian capital and main port Dar-es-Salaam took place in the 1960s. After the cold war in 1989, China's attention and investment shifted towards the oil sector in Angola, Nigeria, and Sudan and the mining activities in Congo and Zimbabwe (Copper, cobalt, platinum, etc.). It is also an essential point that the combined population of China and Africa account for one-third of the world's population.

Understanding the Environmental, Social, and Governance (ESG) of China's investment in SSA would aid answer the question of green, clean, or mean investment. According to the

China-Africa Economic and Trade Relationship Annual Report (2021), China has created 25 economic and trade cooperation zones in 16 SSA. Trade, the earliest form of this cooperation and was about US$12.14 million in 1950, US$100 million in 1960, US$1 billion in 1980, and US$10 billion mark in 2000, with an average annual growth rate of 35.5 % between 2000 and 2008. To eradicate poverty, The World Bank Group's Environment Strategy 2012-2022 also aims at achieving a green, clean, and resilient path toward development. According to (The World Bank, 2021), green refers to "a world in which natural resources, including oceans, land, and forests, are sustainably managed and conserved to improve livelihoods and ensure food security." In order words, healthily use the ecosystem to improve economic activities. Building a growth strategy based on overall wealth and not just GDP. The decline of biodiversity over the last 40 years is seen in habitat degradation and destruction. The annual loss of about 5.2 million hectares of forest between 2000 and 2010. The same can also be said about the freshwater supplies, which house over 1.4 billion people in its basin. This decline also threatens the livelihood of 100 million men and women. (The World Bank, 2021) defined "clean" as low-pollution, cleaner air, water, and land, which enables people to lead healthy and well-productive lives. In this case, the government and companies are held accountable for having low pollution through low-emission, climate-smart agriculture, transport, energy, and urban development.

There is a link between the environment and the economy, the environment provides factors of

production for the economy, and in turn, the economy releases pollution as well as various pressure to the environment. According to (Organisation for Economic Co-operation and Development, 2016) Poor, environmental quality affects economic growth and wellbeing by lowering the quantity and quality of resources or due to health impacts, etc. Recently, China has become Africa's biggest bilateral trading partner, Africa's biggest bilateral lender, and one of the most

prominent foreign investors. China invested USD 44 billion in Africa in 2019, which is 2 percent of China's global investment, although that of the USA was USD 78 billion but 0.7 percent of its global investment. The top recipient country of this China's FDI in Africa is South Africa, which makes up 13.8 percent of the FDI in Africa. In 2019 followed by DRC with 12.5 percent, then Angola with 6.5 percent. Although China's investment in Africa varies, one of the top investments is in construction and infrastructural development, accounting for 30% of the investment. For every investment, there is always a motive both for the investor and the institution or person being invested in. According to (Dunning & Sarianna 1993), every FDI has four reasons: market seeking, resource seeking, efficiency seeking, and strategic asset seeking. Marketing-seeking investors are geared towards motives that serve the domestic or regional market. In this case, the marketing-seeking reason could be seen in China's investment in Nigeria in the Ogun-Guangdong Free Trade Zone and Lekki Free Zone have attracted many FDI to serve the market in Nigeria. Resource-seeking motive: China has dramatically invested in South Africa, Benin for its gold, Nigeria for its petroleum, and Burundi for its Nickel and Uranium. Just like the name, the strategic asset investment motive is geared towards the benefit of the investing country. That is, the reason for the investment is for the comparative advantage gotten from the investment. This motive is primarily seen in private individuals and firms. Among many alternatives for firms to access and source strategic assets, foreign direct investment (FDI) is arguably the most effective way (Chung & Alcacer, 2002). Several Asian firms acquire strategic help that gives them a competitive edge over other developed countries. As a latecomer, Chinese multinational corporations (MNCs) are urgent to be engaged in strategic-asset-seeking FDI to catch up with the global giants (Deng, 2007)

In 2019 China's Investment in Africa was $2.71 billion, accounting for 2% of Chinese FDI flows. Which mainly went to Congo (DRC), Angola, Ethiopia, South Africa, Mauritius, Niger, Zambia, Uganda, and Nigeria.

Table 1: Top 5 Industries of China's Outward FDI stock in 2019

	Industry	Stock (Billions of US Dollars	Share (%)
Asia	Leasing and Business Services	605.94	41.5
	Wholesale and Retail Trade	219.75	15
	Finance	186.46	12.8
	Manufacturing	120.02	12.8
	Mining	80.67	5.5
	Subtotal	***1212.84***	***83.0***
Africa	Construction	13.59	30.6
	Mining	11.02	24.8
	Manufacturing	5.59	12.6
	Finance	5.24	11.8
	Leasing and Business Services	2.49	5.6
	Subtotal	***37.94***	***85.4***
Europe	Manufacturing	37.80	33.1
	Mining	21.18	18.5
	Finance	17.27	15.1

	Leasing and Business Services	11.66	10.2
	Wholesale and Retail Trade	5.83	5.1
	Subtotal	***93.76***	***82.0***
Latin America	Information Transmission/Software and Information Technology Service	156.10	35.8
	Leasing and Business Services	99.15	22.7
	Wholesale and Retail Trade	60.63	13.9
	Finance	26.65	6.1
	Mining	25.7	5.9
	Subtotal	***368.24***	***84.4***
North America	Manufacturing	21.45	21.4
	Mining	18.58	18.5
	Finance	14.23	14.2
	Leasing and Business Services	10.63	10.6
	Information Transmission/ Software and Information Technology	7.79	7.8
	Subtotal	***72.68***	***72.5***
Oceania	Mining	20.93	48.0
	Finance	4.68	10.7
	Leasing and Business Service	4.21	9.6
	Real-estate	3.74	8.6
	Manufacturing	2.50	5.7

Subtotal	***36.04***	***82.6***

From the table above, in Africa, the top 55.4 % of the FDI Stock went to Construction and Mining. Compared to 56.5 in Asia that went to Leasing and Business Services, Europe 51.6% went to Manufacturing, and Latin America's top 58.5% went to Information Transmission/Software and Information Technology Services and Leasing Business Services. In North America, the top 54.1 % went to Manufacturing, Mining, and Finance, while in Oceania its top 58.,7% went to Mining and Finance.

Case Studies

Given that more than 50% of China's top investment in Africa is geared towards Construction and mining, understanding this impact on the economy and the environment would go a long way to fulfilling the purpose of this research.

The National Geographic Society defines mining as the process of extracting natural resources from the earth. The extraction, processing, and use of this natural resource can be harmful to the environment, but at the same time, it can serve as a source of income for the economy, during the 1972 Stockholm Conference that a milestone in creating sustainable economic growth. Sustainable development is defined as maximizing the net benefits of economic development when subjected to the cost of maintaining the services and quality of natural resources over time. Economic effects include but are not limited to an increase in real per capita income and an increase in social and political welfare. Economic growth leads to both structural and institutional changes in an economy. While maintaining the services and quality of the natural resources implies.

- Utilizing the renewable resources at a rate less than or equal to their regenerating natural rate
- And optimizing the efficiency of non-renewable resources, subject to technological progress.

Challenges associated with Sustainable Development

To achieve sustainable development, some challenges need to be overcome, some of which are:

1. Making the Earth "transparent."
    a. Because of the solid nature of the earth, it isn't easy to know what is happening above and underground. "Improved tools are needed to discover, delineate, and identify subsurface resources, to identify the flow of fluids and contaminants in the subsurface, and to detect and monitor fractures in rock structures." (Jain, Cui, & Domen, 2016). Various technology, such as geophysical examinations that investigate both large-scale and small-scale techniques, such as airborne, electromagnetic, seismic waves, and pumping and tracer tests, are presently contributing to improving the transparency of the earth.
    b. A more accurate technology must be used to estimate the Earth's resources. The knowledge would help increase the safety, fracture locations, and stability of structures while decreasing various risk, pollution, and contamination pathways.
2. Understanding, engineering, and controlling the subsurface process (Jain, Cui, & Domen, 2016).
    a. Understanding the earth's biological, chemical, thermal, mechanical, and hydrological processes is very difficult and complex. And to achieve sustainable development, this process needs to be understood individually and collectively. The use of models

depends on the accuracy of the equations used to stimulate these interactions. Therefore, a better understanding of these interactions would lead to sustainable development through better exploration of minerals and mining.

3. Minimize the environmental footprint
    a. Mining generates toxic, corrosive, and flammable material that, if left in the environment, would cause significant contamination and pollution to the environment (Zoback & Arent, 2014). To minimize the environmental footprint, technology needs to be developed to
        - Develop chemical reagents that are environmentally friendly
        - Develop better models for effective prediction of economic effectiveness, separation efficiency, and the environmental implication of all natural resources.
        - Reduce the consumption of high energy for grinding and slurry transport
        - Develop a better technique for the disposal of waste containing toxic reagents that are environmentally friendly.
        - Develop separation techniques with fewer or no chemical reagents.
    b. Also, better management practices should be developed in line with good environmental legislation. Developing risk management plans and procedures, as well as ecology, human health, and safety, should be developed to minimize environmental footprint and led to sustainable development.
4. Protect workers and the public
    a. In the mining industry, better procedures are to be developed to protect its workers and the public from pollution (Noise), particulate emissions, and waste products. Mining

employers are prone to facing various high-risk environments, so training and education should be frequently and appropriately given to them.

In 2012, (Joint Research Centre, 2022) found that China, the USA, the EU27, India, Russia, and Japan are the largest CO2 emitters. Together they make up 49.2% of the global population, 62.4% of global DGP, 67.8% of global fossil CO2 emissions, and 66.4% of global fossil fuels consumption.

Mining trends

To address these challenges, we need to understand the current mining trends. The mining volume of mineral products has significantly increased in recent years (Jain, Cui, & Domen, 2016) which has negatively impacted the environment. Mining trends serve as a predictor of technologies' cost-effectiveness and mining growth.

(International Council on Mining & Metals, 2012) urbanization and population were vital variables for the demand for natural resources. Their analysis also included the current and future trends of mining. Which are:

- Mining locations have changed from developed to developing countries since the mid-20th century.
- More mines are in Africa, Latin America, and Asia.
- Mineral refinement remains in developed countries.
- Small-scale and artisanal mines produce most global minerals such as tantalum, tin, cobalt, gold, and copper.
- There is a gap between the training of the young and the work available. For example, the young are trained in a different language than the language where the work is available.

- There is a need for talent skilled in technical and social know-how

Future demand

- According to (World Bank Group report, 2020) production of graphite, lithium and cobalt will increase by approximately 500% by 2050 to meet the demand for clean energy technologies.
- The growth in demand would come from emerging and developed economies.
- COVID-19 or any other global economic slowdown is the only reason for a decline in mineral demand.

The price of metals will remain high.

- With the demand increase, the demand and supply lag would also increase. This would place upward pressure on the prices of the metals.
- The depletion of the reserves would also place upward pressure on prices
- An increased environmental standard would also place pressure on the prices upwards.
- The invention of new equipment, procedures, process, training, and technology would also pressure the prices since it would increase the cost of capital.

Change in technology

- Open-pit mining has been used over underground mining for some minerals.
- Productivity has increased due to changes in technology and standard.
- Technology change would lead to easy expansion and detection of new minerals, which can ease the expansion of mines.

Estimated production trend

- Africa and North America will increase the production of natural resources
- China would also increase but not as much.
- More emphasis would be placed on increasing deep-sea mining.

Mining Contribution Index (MCI)

Mining affects the economy both directly and indirectly. MCI is an index designed by the International Council on Mining and Metals and Oxford Policy Management to account for the effect of mining on the economy both directly and indirectly. MCI captures four indicators, with measure the impact on the economy of that country.

- Mineral and metal export contribution 2018: this measures the amount of mining for other productive activities. Countries are ranked in descending order.
- Increase/decrease in mineral and metal export contribution between 2013-3018: This adds a dynamic component by indicating whether the importance of mining as an economic activity is growing or falling over five years (International Council on Mining & Metals (ICMM), 2020):
- Mineral production value as a percentage of GDP in 2018 measures the value of production from the mines with the economy. This is not the contribution of mining to GDP.
- Mineral rents as a percentage of GDP in 2018. This is the production value minus average costs, an indicator of tax and profit.

Equation 1: Mining Contribution Index (MCI)

$$MCI = \left(\frac{Absolute\ Rank_{Exp}}{Max\ Rank_{Exp}} + \frac{Absolute\ Rank_{\Delta Exp}}{Max\ Rank_{\Delta Exp}} + \frac{Absolute\ Rank_{\%GDP}}{Max\ Rank_{\%GDP}} \right) \left(\frac{1}{3} \right) (100)$$

Where:

Absolute $Rank_{Exp}$ = absolute rank for mineral export contribution in 2018

Max $Rank_{Exp}$ = max rank for mineral export contribution in 2018

Absolute $Rank_{\Delta Exp}$ = absolute rank for the change in the mineral export contribution from 2013-2018

Max $Rank_{\Delta Exp}$ = max rank for the change in the mineral export contribution from 2013-2018

Absolute $Rank_{\%GDP}$ = absolute rank for the 2018 production value as a percent of 2013 GDP

Max $Rank_{\%GDP}$ = max rank for the 2018 production value as a percentage of the 2018 GDP

The MCI helps to show that several economies depend on mining. Mining contributes a significant share to several economies, with more than 50% of exports and approximately 20 % of GDP, which are low- and middle-income countries (Ericsson & Löf, 2017). MCI ranks countries in descending order for the four indicators. Countries without data are omitted; therefore, indicator one is ranked out of 216 countries, indicator two was ranked out of 127 countries, indicator three was ranked out of 125, and the 4-indicator ranked out of 122 countries. (International Council on Mining & Metals (ICMM), 2020).

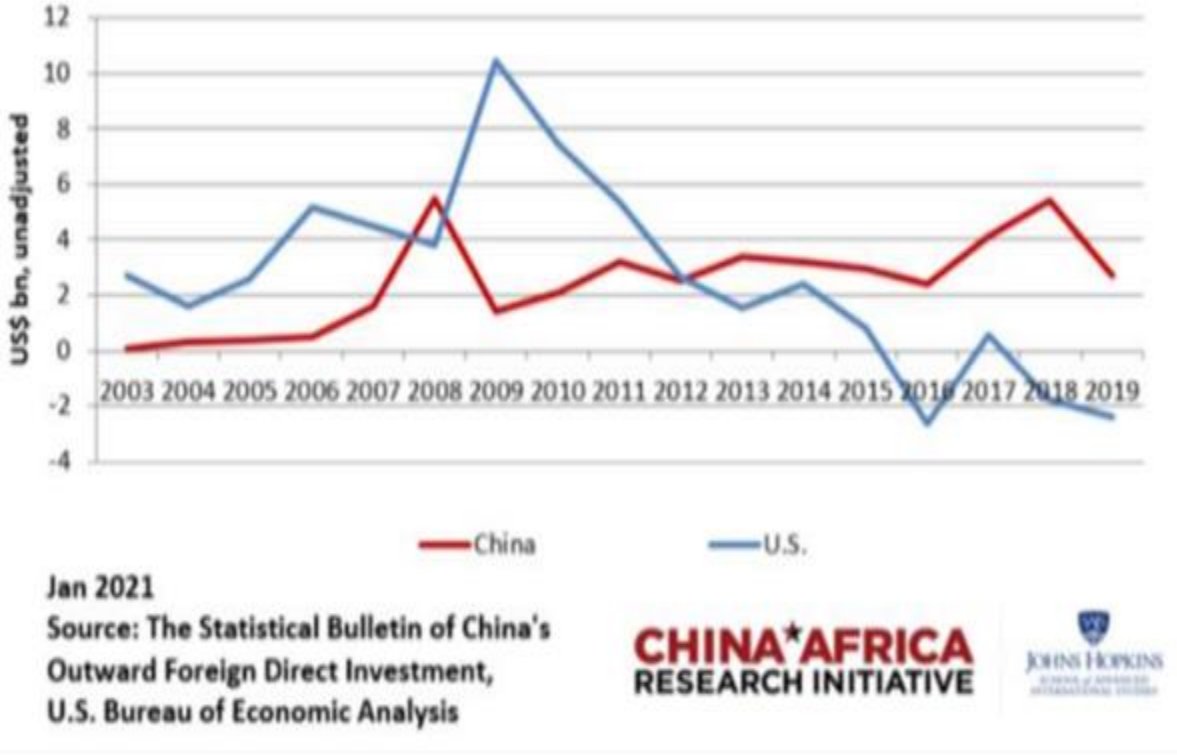
A systematic Procedure for evaluating China's FDI

Before any mining project begins in Africa, an environmental impact assessment (EIA) is conducted. An EIA is conducted to define and analyze environmental risks associated with any project, in this case, mining. EIA varies from country to country, but it is not a guarantee that the least harmful alternatives are chosen; it serves as a guide to inform the decision-makers on the environmental consequences of their project, in this case, mining. The procedures for the EIA as given by (Jain, Cui, & Domen, 2016)

China's trade with Africa

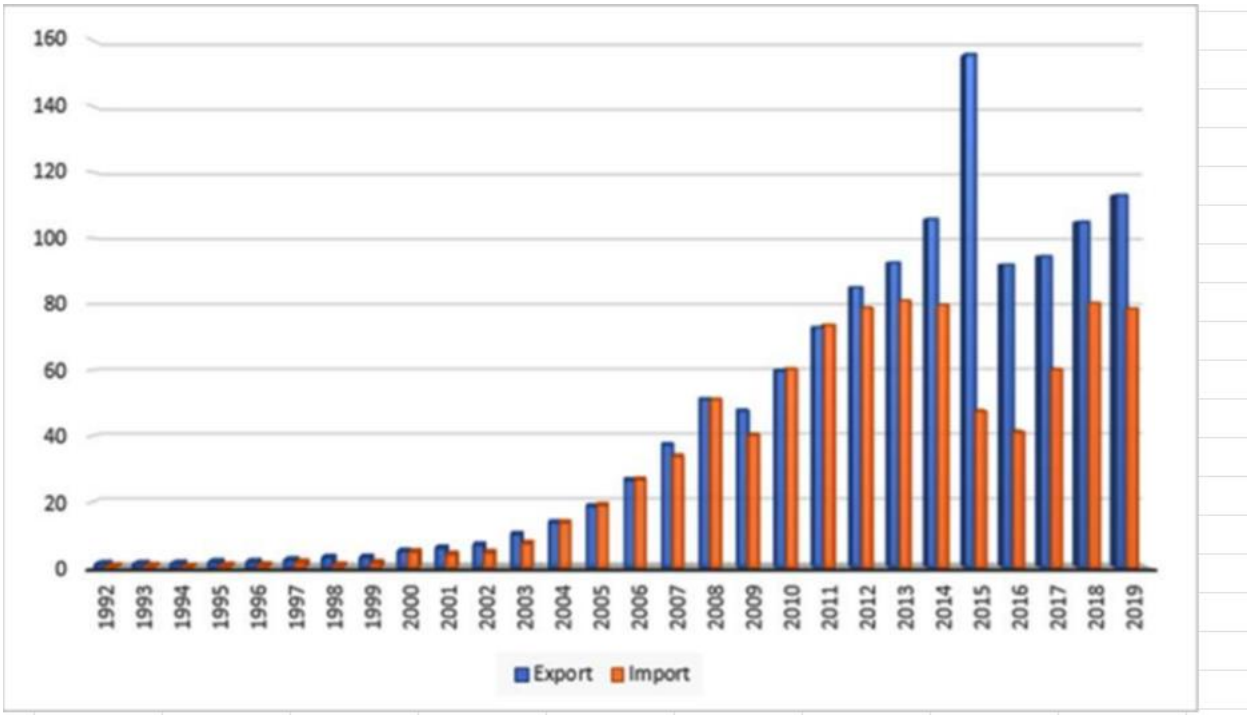
From figure 1 below, we see that China's FDI inflow gradually grew from 2003 and peaked in 2007, overtaking that of the USA for the first time but fell in 2008 and 2009, which could be attributed to the great recession of 2007 to 2009. An essential factor to consider in this graph is that as the USA FDI inflow into Africa gradually declined, the Chinese increased and overtook the USA in 2012, making China the highest investor in Africa.

Figure 2: Chinese FDI vs. US FDI to Africa, Flow



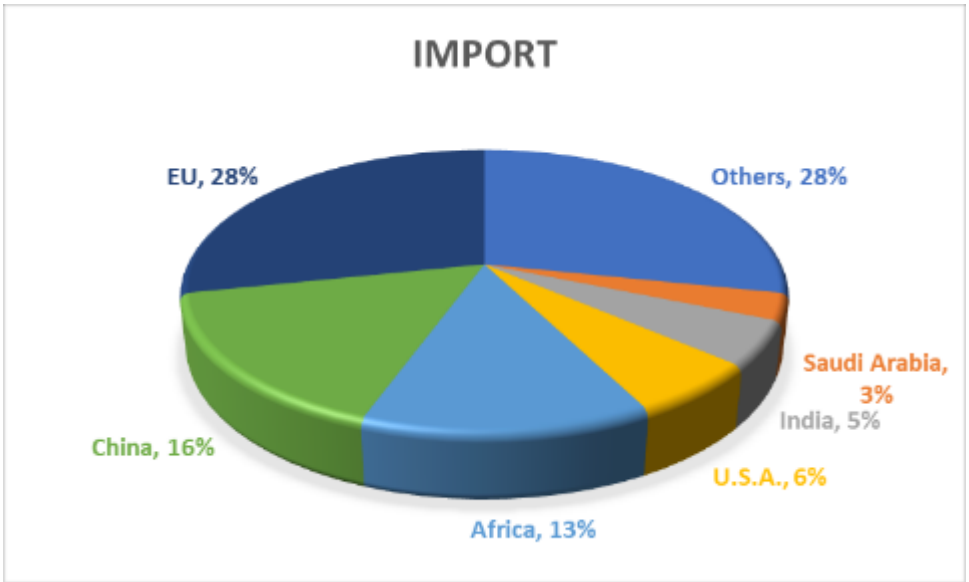
China trades with almost all African countries and does not discriminate between regions. China's trade with Africa dates to the 15th Century but was limited in the 1990s because China was not part of the World Trade Organization (WTO). After joining WTO in 2001, China's trade, mainly the export, grew substantially in 2005. In 2019 Chinese exports to Africa were USD 113 billion, and imports were 78 billion. Outside European Union, China is the major trading partner in Africa. The export and import between China and Africa were roughly the same until 2012 when export started outgrowing import, and this peaked in 2015 when the export was three times that of importance in African countries.

Figure 3: China's Trade with Africa



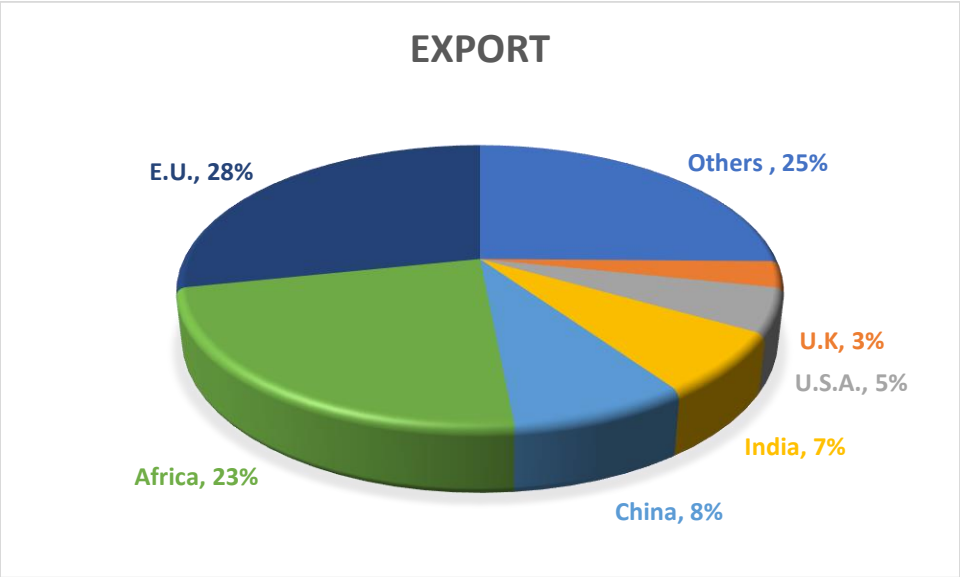
To Figure 2.2, from 1992 to 2000, China had little or no trade with Africa. From 2000 to 2006, China increased its trade with Africa, with imports and export almost the same. In 2007, export was greater than import, in 2018 both import and export were nearly the same, this cycle repeated itself in 2009 and 2010. In 2011, the import was slightly higher than the export. Export exceeded imports from 2012 to 2019, and trade increased annually. The most significant difference between export and import was seen in 2015, when the export was almost three times that of import. China's partnership with Africa has been increasing over-time

Figure 4: Africans, import share with leading partners, 2020



For the year 2020, Africa imported 16% of its total import from China, 28% for the E.U., 13% from fellow African countries,6% from the U.S.A., 5% from India, 3 % from Saudi Arabia, and 28% from the rest of the world. From the following, we can see that China was the most significant country in terms of imports in 2020

Figure 5: Africans, export share with leading partners, 2020



For the year 2020, Africa exported 8% of its total export from China, 28% for the E.U., 23% from fellow African countries, 5% from the U.S.A., 7% from India, 3% from the U.K., and 25% from the rest of the world. The following shows that China was the most significant country in terms of export in 2020. China is Africa's most important partner in terms of trade and FDI.

Table 2: Total Stock in USD, percentage of Chinese Largest FDI in Africa

COUNTRY	TOTAL STOCKS, IN USD BILLION	% OF CHINESE FDI IN AFRICA
SOUTH AFRICA	6.1	13.8
DRC	5.5	12.5
ANGOLA	2.9	6.5
ZAMBIA	2.8	6.5
ETHIOPIA	2.5	5.6
GHANA	1.8	4.1
TOTAL	21.6	49.1

Table 2.2 clearly shows that 49.1 % of the FDI in Africa are geared toward the top six host country, which goes a long way to reveal the motives behind the investment, which are:

1. Access to the continent's natural resources, like in South Africa and Ethiopia, is potentially rich in geothermal energy.
2. export markets for Chinese manufactured goods in the case of DRC and Angola
3. sufficient economic and political stability for its citizen in the case of Ghana

Table 2:Exports in USD, percentage of Chinese Largest exports in Africa

COUNTRY	EXPORTS, IN USD BILLION	% OF CHINESE'S EXPORTS TO AFRICA
SOUTH AFRICA	16.6	14.6%
NIGERIA	16.6	14.6
EGYPT	12.2	10.7
ALGERIA	6.9	6.1
KENYA	4.9	4.3
GHANA	4.9	4.3
TOTAL	62.1	54.6

(UNCTAD & Initiative, 2020)

In 2020, The top product China exported to South Africa were broadcasting equipment for $1.12B, computers worth $784M, and cloth articles worth $456M (OEC, 2020). In total, $16.6 billion worth of goods and services were exported by China to South Africa, which accounts for 14.6 % of its export to Africa.

In 2020, The top product China exported to Nigeria were synthetic filament yarn is woven fabric for $596M, non-knit women's suits worth $594M, and telephones worth $560M (OEC, 2020). In total, $16.6 billion worth of goods and services were exported by China to Nigeria, which accounts for 14.6 % of its export to Africa.

In 2020, The top product China exported to Egypt were broadcasting equipment for $571M, non-retail synthetic filament yarn worth $379M, and LCDs worth $371M (OEC, 2020). In total, $12.2 billion worth of goods and services were exported by China to Egypt, which accounts for 10.7 % of its export to Africa.

In 2020, The top product China exported to Algeria were Rubber Tires for $184M, broadcasting equipment worth $139M, and Rubber footwear worth $137M (OEC, 2020). In total, $6.9 billion worth of goods and services were exported by China to Algeria, which accounts for 6.1% of its export to Africa.

In 2020, The top products China exported to Kenya were flat-rolled steel for $136M, broadcasting equipment worth $116M, and synthetic filament yarn is woven fabric worth107M (OEC, 2020). In total, $4.9 billion worth of goods and services were exported by China to Kenya, which accounts for 4.3% of its export to Africa.

In 2020, The top product China exported to Ghana were crude petroleum for $1.24B, manganese ore worth $164M, and Sawn Wood worth $24.3M (OEC, 2020). In total, $4.9 billion worth of goods and services were exported by China to Kenya, which accounts for 4.3% of its export to Africa.

Figure 6: Chinese FDI Stock in and flows to Africa (in billion USD)

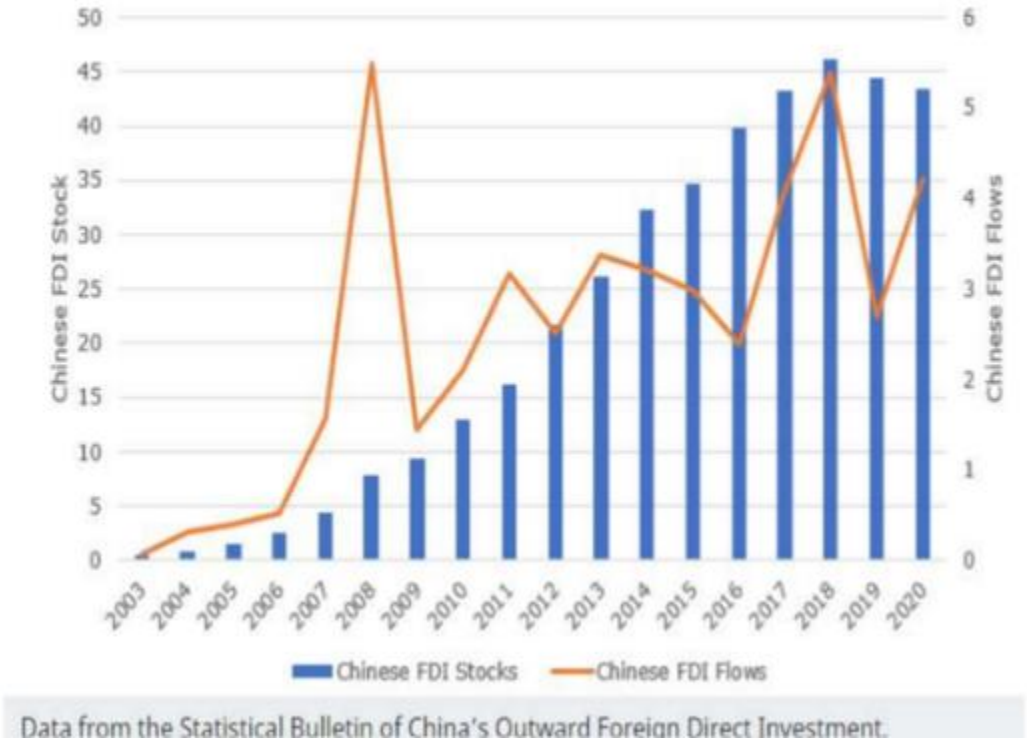


Figure 2.5 above shows the FDI Stock and flows in Africa. The Chinese FDI stocks have been gradually increasing and reached its peak in 2018, while the flow peaked in 2008 and drastically fell the following year, 2009, due to the great recession.

In terms of infrastructural development using electricity use per capita in Africa, we can5see a gradual rise.

Table 4 China’s foreign direct investment flow and stock classification and composition in 2020 (billion US dollars)

Index	FLOWS			STOCKS	
Classification	Amount	YoY(%)	Total Percentage (%)	Amount	Total Percentage (%)
Total	1537.1	12.3	100.0	25806.6	100.0
Financial	196.6	-1.5	12.8	2700.6	10.5
Non-financial	1340.5	14.6	87.2	23106.0	89.5

(2020 Statistical Bulletin of China's Outward Foreign Direct Investment, 2021)

The financial category refers to the OFDI in overseas financial enterprises, while the non-financial type refers to OFDI in overseas non-financial enterprises. Chinese OFDI did not exist at the beginning of 1978 (Rosen & Hanemann, 2009), China’s FDI into Africa was also insignificant between the period 1991 to 2004 and got a dramatic growth from 2005 to 2020.

Figure 7: Flows of OFDI by years

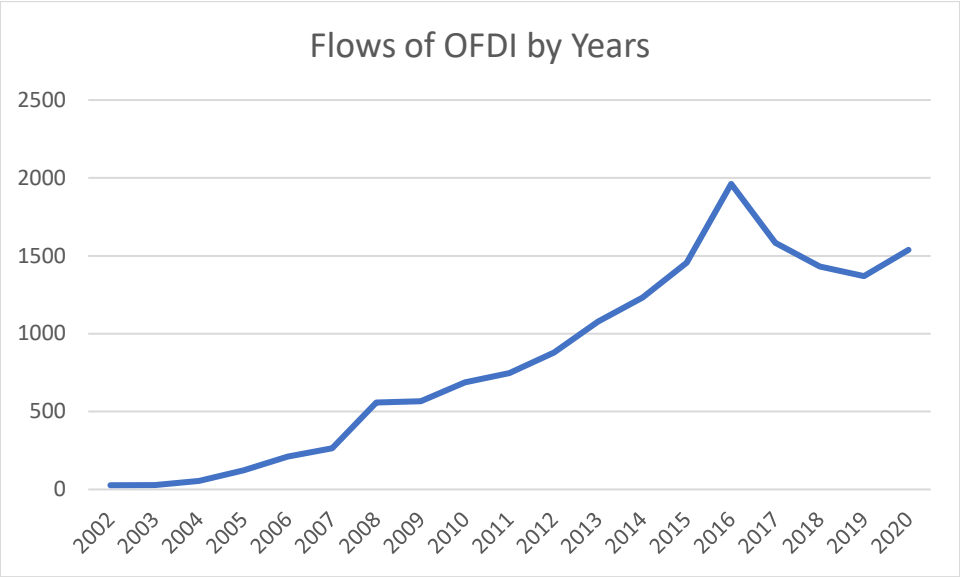
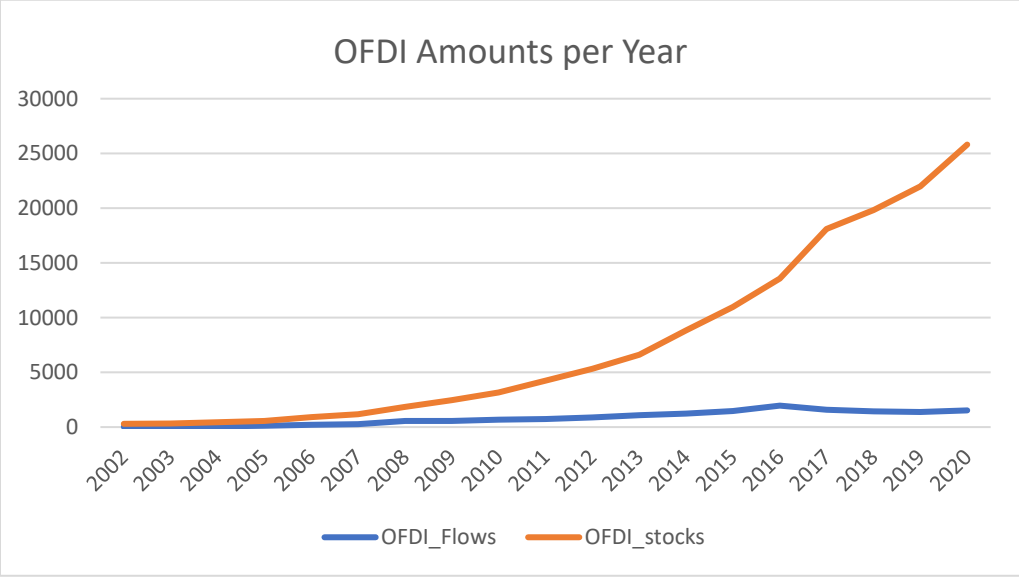


Figure 4.1, Statistical results of the past years since China established the 'Statistical System of Foreign Direct Investment.'

Figure 8: Flows of OFDI amount by years



Since the establishment of China's Statistical system of foreign direct investment, China's investment in Africa has increased annually. Ranking from the 26th to the currently largest foreign direct investor in Africa.

(2020 Statistical Bulletin of China's Outward Foreign Direct Investment, 2021).

The data from 2002 to 2005 are the data of China's outward non-financial direct investment, while the data from 2006 to 2020 are the sum of both the financial and non-financial direct investment.

Where does most of the Chinese OFDI go? Table 4.3 shows the industry distribution of the OF.DI

Table 5 Composition of China's outbound investment in 2020 (billion US dollars)

Industry	Quantity	Amount	(%)
Electricity/heat/gas and water production and supply industry	27	97.5	34.6
Manufacturing	152	69.7	24.7
Transportation / Warehousing and Postal Industry	17	33.1	11.7
Mining industry	12	27.5	9.8
Information Transmission / Software and Information Technology Services	87	20.0	7.1
Scientific research and technical service industry	81	14.3	5.1
Leasing and business services	34	7.4	2.6
Agriculture, forestry, animal husbandry, and fishery	19	4.1	1.5
Wholesale and retail trade	62	3.8	1.4
Construction industry	5	2.8	1.0
Education	3	0.6	0.2

Residential Services / Repair and Other Services	6	0.4	0.1
Culture / Sports and Entertainment Industry	3	0.4	0.1
Others	5	0.4	0.1
Total	513	282.0	100.0

(2020 Statistical Bulletin of China's Outward Foreign Direct Investment, 2021)

Chapter 5

Research Design and Methodology

Research Design

Panel Vector Autoregressive Model (PVAR)

This study uses the PVAR model to establish a causal inference among the variables. This model would use only predetermined variables to avoid endogeneity dependence. I would also use unit root and the co-integration test approach to prevent the loss of long-run information, which may arise due to differences in time series. PVAR model would because it provides a better forecast while capturing the intertwined dynamics between FDI and economic growth as well as between FDI and carbon emission. (Gujarati, 2004) argued that in the PVAR model, the variable is treated symmetrically in a form structural model, which may be seen as a reduced form equation that eliminates the endogeneity of each variable by lagging them. Using fixed effect in the PVAR model would account for unobserved individual heterogeneity. Other benefits of this model include:

- It is theory-neutral; it can be used in any growth theory. The statistical model of PVAR is based on contemporary movements of a series
- Secondly PVAR model does not distinguish between an exogenous and endogenous variable. All variables are treated as endogenous variables.
- Lastly, each variable relies not only on its historical values but also on that of other variables.

The basic assumptions of PVAR include the following:

1) Stationarity exists in the model to eliminate endogeneity

2) The expected error term is zero

3) intercept terms allowing for the possibility of a non-zero mean,

Using the reduced form of the VAR model, we would model the three following systems of equations. The subscript, which is defined as i and t, refers to country and time, respectively.

Equation 1: $GDPPCAP_t = d\{\beta_{10} + \beta_{11}GDPPCAP_{t-1} + \beta_{12}GDPPCAP_{t-2} + \delta_{11}FDI\_China_{t-1} + \delta_{12}FDI\_China_{t-2} + \alpha_{11}ENVIR_{t-1} + \alpha_{12}ENVIR_{t-2} + \theta_{1t}OPEN + \theta_{2t}HUMCAP + \theta_{3t}RPR + \theta_{4t}GOVSIZE + \theta_{5t}INSTITU + \theta_{6t}INFL + \theta_{7t}INFRAC + \theta_{8t}POP\_Growth + \theta_{9t}DOMINV + \theta_{10t}RPE + \theta_{11t}RELPP + \mu_{1t}\}$

Equation 2: $FDI\_China_t = d\{\beta_{20} + \beta_{21}GDPPCAP_{t-1} + \beta_{22}GDPPCAP_{t-2} + \delta_{21}FDI\_China_{t-1} + \delta_{22}FDI\_China_{t-2} + \alpha_{21}ENVIR_{t-1} + \alpha_{22}ENVIR_{t-2} + \theta_{12t}OPEN + \theta_{13t}HUMCAP + \theta_{14t}RPR + \theta_{15t}GOVSIZE + \theta_{16t}INSTITU + \theta_{17t}INFL + \theta_{18t}INFRAC + \theta_{19t}POP\_Growth + \theta_{20t}DOMINV + \theta_{21t}RPE + \theta_{22t}RELPP + \mu_{2t}\}$

Equation 3: $ENVIR_t = d\{\beta_{30} + \beta_{31}GDPPCAP_{t-1} + \beta_{32}GDPPCAP_{t-2} + \delta_{31}FDI\_China_{t-1} + \delta_{32}FDI\_China_{t-2} + \alpha_{31}ENVIR_{t-1} + \alpha_{32}ENVIR_{t-2} + \theta_{23t}OPEN + \theta_{24t}HUMCAP + \theta_{25t}RPR + \theta_{26t}GOVSIZE + \theta_{27t}INSTITU + \theta_{28t}INFL + \theta_{29t}INFRAC + \theta_{30t}POP\_Growth + \theta_{31t}DOMINV + \theta_{32t}RPE + \theta_{33t}RELPP\ \mu_{3t}\}$

Solow Growth Approach

The effect of China's FDI on the SSA economically and environmentally is analyzed using the standard growth accounting framework. To incorporate the environment into the social and economic model, we assume:

- Environmental pollution is a by-product of production or consumption in the economy.

- Environmental pollution has a detrimental effect on the economy
- And environmental pollution could harm production in the long run

Using these assumptions, we can model the following:

$Y_t = F(K_t, AL_t)$ *(1)*

Where Y is the economic growth at time t

AL_t is the effective labor at time t

K_t is the present capital stock

The present capital stock consists of foreign and domestic-owned capital stock, and the previous capital stock, which is;

$$K_t = 1\text{-}n\,(K_{t-1} + K_{dt} + K_{ft}) \qquad (2)$$

The augmented Solow growth function (Solow, 1956) makes the output a function of stocks of capital, labor, human capital, and productivity (Mankiw, Romer, & Weil, 1992).

Where n represents the pollution coefficient, from the assumption, we know that pollution is detrimental to the economy and, as such, would reduce the capital stock at time t.

$$Y_{it} = A_{it} K^{\alpha}_{it-1} K^{\beta}_{dit} K^{\lambda}_{fit} L^{\tau}_{it} E_{it} \qquad (3)$$

Where Y is the flow of output, K_{t-1} represents the initial capital stocks, K_{dt} and K_{ft} represent the domestic and foreign-owned capital stocks, respectively, L is the labor, and A is the total factor productivity, which accounts for growth output outside the growth in the aspects of production

and E_{it} is the adequate flow of pollution (environmental element).

Taking logs and differentiating Equation 3 concerning time, we obtain:

$$Y_{it} = a_{it} + \alpha k_{di(t-1)} + \beta k_{dit} + \lambda k_{fit} + \tau l_{it} + \theta e_{it} \qquad (4)$$

Where:

Y_{it} represents the growth rates of the output of country i at time t.

$K_{di(t-1)}$ represents previous years' domestic capital stock for country i.

K_{dit} represents domestic capital stock for country i at time t.

K_{fit} represents foreign capital stock for country i at time t.

L_{it} represents labor and human capital for country i at time t.

E_{it} represents the adequate flow of pollution (environmentally factor)

α, β, λ, τ and θ represent the elasticity of output, initial domestic capital stock, current domestic capital stock, foreign capital stock, labor and human skill capital, and environmentally factor, respectively. Assuming perfect competition and constant returns to sca,le the elasticity would be the respective factor share in total output. Therefore, equation 4 represents the fundamental growth accounting equation, which shows the growth rate of output as a function of the growth rate of the total factor productivity and the weighted sum of capital and labor growth rate.

Research has shown that positive signs are expected for α, β, λ, and θ but τ depends on the

relative strength of competition and linkage effect and other externalities that FDI generates in the development process (Ayanwale, 2007). Combining with the vector autoregression model, the final form of the equation:

$$Y_{it} = a_{it} + \alpha k_{di(t-1)} + \beta k_{dit} + \lambda k_{fit} + \tau l_{it} + \theta e_{it} + \varepsilon_{it} \quad (5)$$

$$e_{it} = a_{it} + \alpha k_{di(t-1)} + \beta k_{dit} + \lambda k_{fit} + \tau l_{it} + \theta e_{it-1} + \varepsilon_{it} \quad (6)$$

$$l_{it} = a_{it} + \alpha k_{di(t-1)} + \beta k_{dit} + \lambda k_{fit} + \tau l_{it-1} + \theta e_{it} + \varepsilon_{it} \quad (7)$$

Where εit represents the error term for the country I at time t, assuming a steady or

linearization around a steady state. Equation 5 would be used to determine the effect of China's investment on the SSA economy. Equation 6 would be used to determine the impact of China's investment on the SSA environment, while equation 7 would be used to determine the determinant of China's investment in SSA.

Pooled OLS Model

Model 1: GDPPCAP = F((GDP), FDI_China, OPEN, HUMCAP, RPR, GOVSIZE, INFL, INFRAC, POP_Growth, DOMINV, ENVIR, RPE, RELPP (8)

Where;

GDPPCAP = real gross domestic product per capita

GDP = previous gross domestic product

FDI_China = foreign direct investment inflows from China into SSA

OPEN = openness of the economy

HUMCAP = the level of human capital

RPR = Relative Political Reach

GOVSIZE = government consumption as a ratio to GDP

INFL = the rate of inflation

INFRAC = infrastructure development (per capita electricity consumption)

POP_Growth = population growth rate

DOMINV = gross domestic investment.

ENVIR = CO2 emissions (metric tons per capita)

RPE=Relative Political Extraction

RELPP=Total population of known religionists

Dataset Collection and Measurement

In this thesis, I use a strongly unbalanced panel dataset, and I define *i* as the host country, *i=1,2,3…51* for 51 51 countries(the list is shown in Table 4.4); I define *t* as the period, *t=1,2,3…17* for the period from 2004 to 2020; *β1,β2, β3…β11*are the coefficients of the explanatory variables, a is constant, *εit* is the error term. The total number of observations is 901. The data is collected from the following sources, including the "Statistical Bulletin of China's outward foreign direct investment" and the World Bank Institute (WBI).

The choice of the period 2004-2020 is mainly because of the availability of data. "Statistical Bulletin of China's outward foreign direct investment" is jointly issued by the Ministry of Commerce, National Bureau of Statistics, and the Administration of Foreign Exchange of the

People's Republic of China, they published the data in 2003, and the available data continues until 2020. And the data for 2003 was insufficient as it was their first year.

The dependent variable is the GDP growth rate, which compares the year-over-year change in a country's economic output. We would also use environmental and carbon emissions as

dependent variables to measure the environmental and social effects of the investment.

The independent variables included in the model are:

1. FDI: Measured by Chinese FDI to SSA. We expect a direct relationship between Chinese investment and economic growth in SSA. Because the higher the FDI, the higher the productivity and the higher the economic growth. FDI also creates competitiveness which leads to efficiency and increases economic growth.

2. Infrastructural development: measured by electric power transmission and loss (electric power consumption). Good infrastructural development, facilities investments, and aids in the transfer of technology, thus leading to economic growth. Other research has used the number of telephones per 1000 population. With the rise of the mobile phone, this measure would not be a good indicator of infrastructural development. Another measure used in literature and research is electric power transmission, distribution losses, and gross fixed capital formation. For this literature, electric power consumption would be used as a proxy for this variable because of the importance of electrical power. The data availability increase in infrastructural development is expected to lead to increased research in reading growth.

3. The openness of the host economy to trade is measured as the ratio of trade (import and export) to GDP, which is the standard measure from most literature to measure a country's

openness. A country's openness leads to an increase in competitiveness in the host country, which leads to an increase in economic growth. Also, an increase in export and investment would lead to the generation of foreign exchange, which can be used to import capital goods, which leads to a multiplier effect on GDP (Ayanwale, 2007)

4. Relative Political Extraction: measured the ability of the government use their output to meet the national goal.by

$$\frac{\text{Tax}}{\text{GDP}} = \alpha + \beta_1(\text{time}) + \beta_2\left(\frac{\text{Mining}}{\text{GDP}}\right) + \beta_3\left(\frac{\text{Agriculture}}{\text{GDP}}\right) + \beta_4\left(\frac{\text{Exports}}{\text{GDP}}\right) + \beta_5(\text{OECD}) + \beta_6(\text{Inclusion Dummy}) + \varepsilon$$

As a rule of thumb, an economy with low relative political extraction would hinder economic growth. Therefore, we expect an indirect relationship between political extraction and economic growth. Literature like (TransResearch Consortium, 2013)

5. Government size: measures the ratio of government consumption to GDP. We expect a direct relationship between the government size and economic growth, bearing in mind that a higher government consumption would lead to a higher provision of social capital and increase production as well as growth.

6. Human Capital: measured by the tertiary enrollment rate as a percentage of the gross enrollment. We also expect a direct relationship between human capital and economic growth. The higher the human capital, the higher the production as well as investment, and the higher the economic growth. Literature like (Barro & Lee, 1994), (Borensztein, Gregoria, & Lee, 1998) all used the ratio of secondary and tertiary institution enrolment in the population as proxies for human capital.

7. Institutional variable: according to (Acemoglu & Robinson, 2008) the set of institutions that matter for economic growth is an inclusive political and economic institution. To measure inclusive political institutions, I would use Relative Political Reach (RPR). Where RPR represents,

$$\frac{\text{Activity Rate}}{\text{Population}} = \alpha + \beta_1(\text{time}) + \beta_2(\text{Education}) + \beta_3(\text{Young Population}) + \beta_4(\text{Social Security}) + \beta_5(\text{Urbanization}) + \beta_6(\text{Populaton}) + \beta_7(\text{GDP per Capita}) + \beta_8(\text{Bureaucracy}) + \beta_9(\text{Inclusion Dummy}) + \varepsilon$$

Where: Activity Rate / Population = (Economically Active Population - Unemployment) / Population

EAP / Population = Economically Active Population / Population

Education = Secondary Education Attainment

Young Population = Population ages 0-14 / Total Population

Social Security = Social Security Taxes / GDP

Urbanization = % Urban

Population = Total Population

Unemployment = Unemployment rate

GDP per Capita = GDP per capita in 2005 constant US dollars

Bureaucracy = Expenditures in Government Wages / Total Expenditures

Inclusion Dummy = Dummy variable, which takes one if the country is to be included in the

regression, 0 otherwise. We expect a direct relationship between RPR and economic growth because an effective government would lead to higher investments and production. a certain regulatory control can lead to stability, especially in the financial market, which would foster investment and economic growth. But on the other hand, too much political reach may lead to a closed market and decreases FDI and economic growth. These institutions are used to measure the formal frameworks, policies, and structures that affect FDI in an economy and the environment.

8. Environmental Variable: measured by CO2 emissions (metric tons per capita) and energy intensity level of primary energy. We expect an indirect relationship between the environmental variable and economic growth.

9. Control Variable: measured by the inflation rate, population growth rate, gross private domestic investment, and initial GDP per capita. The inflation rate is used to measure the overall stability of the SSA countries. We expect an ambiguous relationship between the inflation rate and economic growth, inflation to a certain level can increase the interest rate and increase productivity which would lead to economic growth, but hyperinflation could lead to stagflation, a case of stagnating growth with high inflation, due to instability caused by inflation which decreases investments and productivity. The population growth rate is also used as a control variable to understand the impact the population growth rate has on the growth of the economy. We expect a direct relationship between the population growth rate and economic development in SSA because the higher the population growth, the higher the consumption, production, and investment, which would lead to economic growth. We would also use the gross private domestic investment to measure the domestic investments related to economic growth. We expect a direct relationship between domestic investment and economic growth because the higher the investment, the higher the

productivity and the higher the economic growth. The initial GDP per capita would be used as a control variable to aid in understanding each starting point before the FDI and, therefore, its effect on economic growth and also as a measure for the initial levels of growth. We expect a direct relationship between the initial growth and the economic growth because the higher the initial growth, the higher the current economic growth.

Chapter 6

Descriptive and Visual Analysis

FDI from China into Africa has dramatically increased since 2003 and has surpassed that of the USA in 2012 (Johns Hopkins University, 2021). Due to the lack of data on FDI inflow into Africa, before 2003. This study will examine the years of FDI inflow after 2003 to 2019. First when the data is intuitively examined, several observations are apparent, in that the impact of China is not statistically significant. From the observed results in Table 2.4, the mean of China's OFDI in SSA is 64.323 million USD compared to Carbon emission kiloton 32128.91. The mean annual percentage growth rate for 2019 is 3.396 and the mean trade percentage of GDP is 68.149 and the mean general government final consumption expenditure also percentage of GDP is 14.54026. The mean electric power consumption in 2019 for SSA is 57.65795. The mean annual percentage of inflation 15.18378 while its population growth rate is 2.21562. The mean gross domestic savings as a percentage of GDP is 19.15765 and the mean of GDP per capita 2774.356

The descriptive statistics are divided into four tables for efficiency, and they are as follows:

Table 6a: Overall Descriptive Summary of all the variables in 2019

Descriptive Statistics	*OFDIf*	Electricity	GDP_g	Trade	Government
Mean	64.32395	57.65795	3.396008	68.14936	14.54026
Standard Error	27.00474	3.897908	0.518676	5.21134	1.118242
Median	10.37	52.4411	4.384529	63.28192	13.76417
Mode	#N/A	100	#N/A	#N/A	#N/A
Standard Deviation	177.0819	25.56029	3.401185	34.17304	7.332802
Sample Variance	31358	653.3285	11.56806	1167.797	53.76998

Kurtosis	13.38704	-0.78032	1.154368	1.827215	1.848761
Skewness	3.179033	0.290583	-0.93546	0.861172	1.134338
Range	1060.3	91.6	15.60492	177.4394	35.19731
Minimum	-129.34	8.4	-6.14424	1.218845	3.587513
Maximum	930.96	100	9.460682	178.6583	38.78482
Sum	2765.93	2479.292	146.0284	2930.422	625.2311
Count	43	43	43	43	43
Confidence Level(95.0%)	54.49777	7.866296	1.04673	10.51691	2.256703

Table 6b: Descriptive Statistics

Descriptive Statistics	School	CO2	Inflation	Population	Savings
Mean	13.98564	32128.91	15.18378	2.21562	19.15765
Standard Error	1.852535	11920.9	10.2292	0.166025	2.944868
Median	10.0384	6348.056	2.501055	2.549387	17.45415
Mode	0	#N/A	#N/A	#N/A	#N/A
Standard Deviation	12.14788	78170.6	67.07734	1.088696	19.31079
Sample Variance	147.5711	6.11E+09	4499.37	1.185259	372.9066
Kurtosis	1.854679	16.7833	41.3142	7.293885	7.313957
Skewness	1.434161	3.917417	6.377542	-2.13934	1.662025
Range	52.61994	427205.7	444.2477	6.274991	123.3724
Minimum	0	320.2778	-3.41786	-2.48078	-21.9818
Maximum	52.61994	427526	440.8298	3.794207	101.3906

Sum	601.3825	1381543	652.9024	95.27166	823.7791
Count	43	43	43	43	43
Confidence Level(95.0%)	3.738567	24057.36	20.64336	0.335051	5.942984

Table 6c: Descriptive Statistics

Descriptive Statistics	Energy	GDPPC	Coal	Forest	Mineral	Gas
Mean	751.1578	2774.356	0.007725	0.64563	0.695563	0.285033
Standard Error	172.7257	477.5705	0.007725	0.220885	0.623547	0.166473
Median	457.7885	1414.829	0	0	0	0
Mode	0	#N/A	0	0	0	0
Standard Deviation	1132.638	3131.639	0.050657	1.448442	4.08887	1.091637
Sample Variance	1282869	9807163	0.002566	2.097985	16.71886	1.191672
Kurtosis	14.70615	6.872673	43	9.105202	41.83566	32.90649
Skewness	3.443612	2.377402	6.557439	2.873676	6.436131	5.522483
Range	6413.541	15425.01	0.33218	7.039332	26.71757	6.852321
Minimum	-14.8318	488.9396	0	0	0	0
Maximum	6398.71	15913.95	0.33218	7.039332	26.71757	6.852321
Sum	32299.79	119297.3	0.33218	27.7621	29.9092	12.2564
Count	43	43	43	43	43	43

Confidence Level(95.0%)	348.5746	963.7763	0.01559	0.445765	1.258368	0.335956

Table 6d: Descriptive Statistics

Descriptive Statistics	Oil	rpe_agric
Mean	3.063235	1.005473
Standard Error	1.322536	0.093979
Median	0	0.98956
Mode	0	3.14464
Standard Deviation	8.672447	0.616264
Sample Variance	75.21134	0.379782
Kurtosis	11.81747	5.445504
Skewness	3.341849	1.724292
Range	43.44958	3.14464
Minimum	0	0
Maximum	43.44958	3.14464
Sum	131.7191	43.23533
Count	43	43

Confidence Level(95.0%)	2.668985	0.189658

Where:

OFDIf= China's Foreign direct investment flow to Africa

Electricity= Access to electricity (% of the population)

GDP_g= GDP growth (annual %)

Trade= Trade (% of GDP)

Government= General government final consumption expenditure (% of GDP)

School= School enrollment, tertiary (% gross)

CO2= CO2 emissions (metric tons per capita)

Inflation= Inflation, GDP deflator (annual %)

Population= Population growth (annual %)

Savings= Gross domestic savings (% of GDP)

Energy= Energy use (kg of oil equivalent per capita)

GDPPC= GDP per capita (constant 2015 US$)

Coal= Coal rents (% of GDP)

Forest = Forest rents (% of GDP)

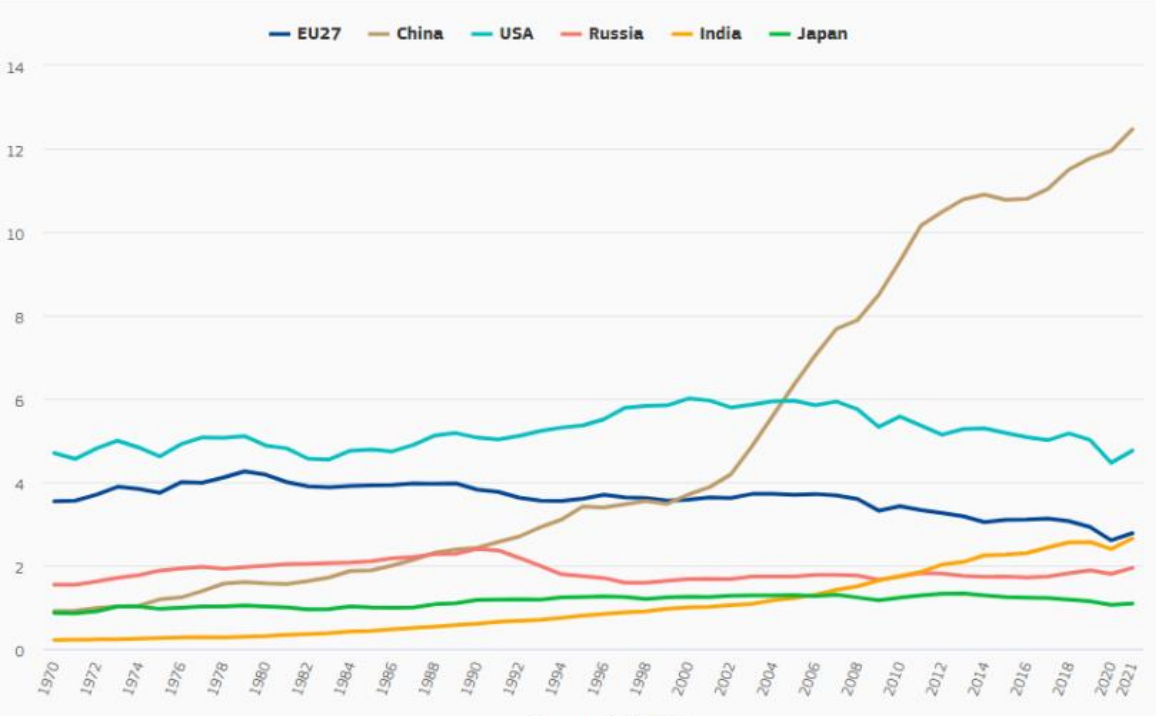
Mineral= Mineral rents (% of GDP)

Gas= Natural gas rents (% of GDP)

Oil= Oil rents (% of GDP)

Rpe_agric= Relative Political Extraction

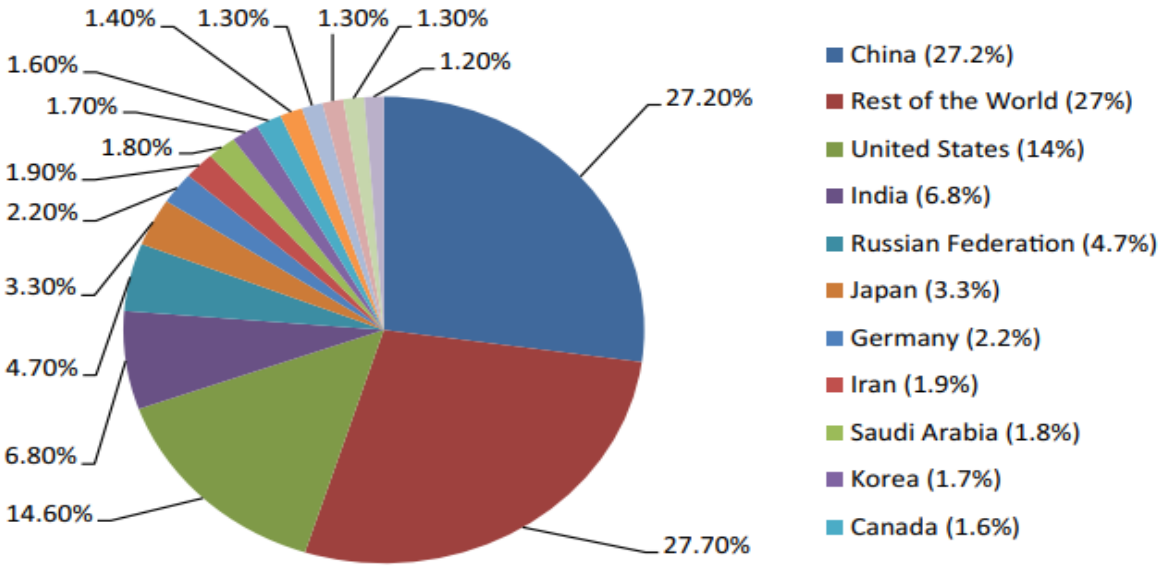
Graph 1: Fossil CO2 emissions of the major emitting economies, 1970-2021 (in Gt)



Source: JRC, 2022

Figure 2.6 paints a picture of China's emissions from 1970 to date. In 1970 it was emitting approximately at the same level as Japan, around 1980, its emission level rose while that of Japan remained the same by 1990 its emission rouse to be roughly the same with Russia. Still, it soon surpassed Russia, and in the year 2000 was approximately the same as that of the EU27. By 2005 it was almost the same as that of the USA. By 2006, China became the largest emitter of CO2 globally and has been continuously rising ever since.

Figure 9: Percentage of CO2 emissions of the major emitting economies

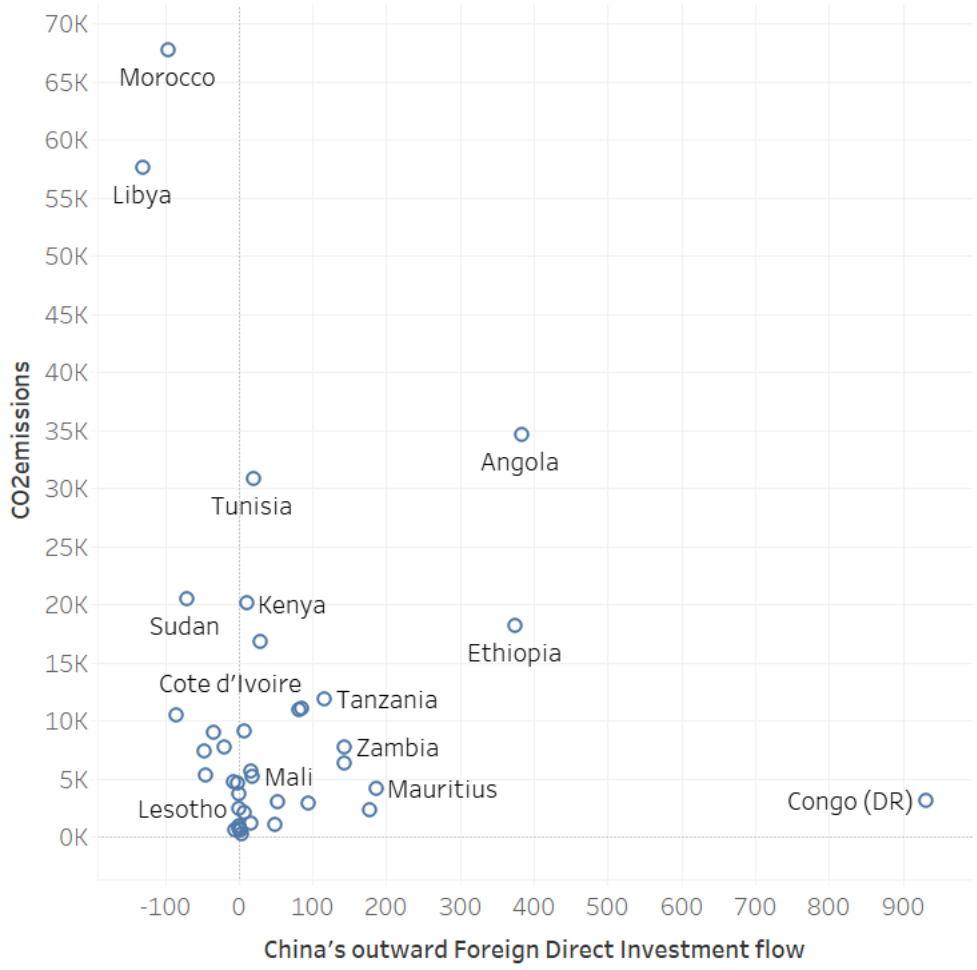


From Figure 2.7 above, we can see that compared to other top CO2 emitters, China is larger by 27.2%, and its Carbon emission is increasing. In comparison, the Rest of the World, including Africa, is 27%. Carbon emission from Canada is 1.6%, Korea is 1.7%, Saudi Arabia is 1.8%, Iran 1.9%, Germany 2.2% Japan is 3.3%, Russia Federation 4.7% India is 6.8%, the USA is 14%, the rest of the world is 27%. China is 27.2% China is the largest emitter of CO2 globally.

From figure 2.8 below, we see a slightly positive trend between China's investment in Africa and CO2 emissions. There is an association between China's investment in Africa and CO2 emissions. When the graph below is intuitively examined, several observations are apparent in that South Africa is the highest emitter of carbon in Africa, next to Egypt, Algeria, and Nigeria. While the Congo, the highest receipt of China's FDI, has almost zero carbon emissions. Angola is the second largest receipt of China's FDI, and it has close to zero carbon emissions, which is the same as that

of Ethiopia. More than half of the African countries are clustered around carbon emission level between (0 to 50) kt carbon emission, with FDI between -100 to 100 million USD. Egypt did not receive any FDI from China, yet its carbon emissions is approximately 250k, which is relatively high compared with other African countries. Figure 2.8 also, shows that South Africa and Ethiopia, receives almost the same amount of FDI from China, but South Africa's carbon emission in 2019, is between (400-450) kt while that of Ethiopia is between (0 to 50) kt

Graph 2: 2019 CO2 emission (kt) and China's outward foreign direct investment (millions of USD)



From figure 2.9 below, we see a slight positive trend between China's investment in Africa and GDP growth. the following countries were removed because they had a high amount of carbon emissions and as such served as outliners: South Africa, Egypt, Nigeria and Algeria. This means China's FDI is associated with GDP growth. When the graph below is intuitively examined, several observations are apparent, in that Rwanda has the highest GDP growth rate with an almost zero FDI from China in 2019. The next country with the highest GDP growth rate in 2019 in SSA is Eritrea and received zero FDI from China. On the contrary, Equatorial Guinea with GDP growth rate of close to -6 also has a negative FDI inflow in the 2019. As established prior Congo is the highest receipt of China's FDI in SSA for 2019 has as a GDP growth rate of approximately 4. The second highest recipient of China's FDI is Angola, and its GDP growth rate is between 0 to -2. The third highest recipient of China's FDI is South Africa, and its GDP growth rate is approximately zero. More than half of the African country are clustered around the GDP growth rate of 4 to 8, which is also around zero FDI from China. Mauritius and Uganda receive almost the same FDI from China, but the GDP growth rate of Uganda is almost 6 and that of Mauritius is approximately 3. We can also, see that both Congo (DR) and Senegal are on the same level of GDP growth but the China's FDI in Congo (DR) is approximately 900 while that of Senegal is almost -100. We also see that Eritrea and Namibia both have received nothing from China's FDI, but the GDP growth rate Eritrea is 8 and that of Namibia is almost -1.

Graph 3: 2019 GDP growth and China's outward foreign direct Investment

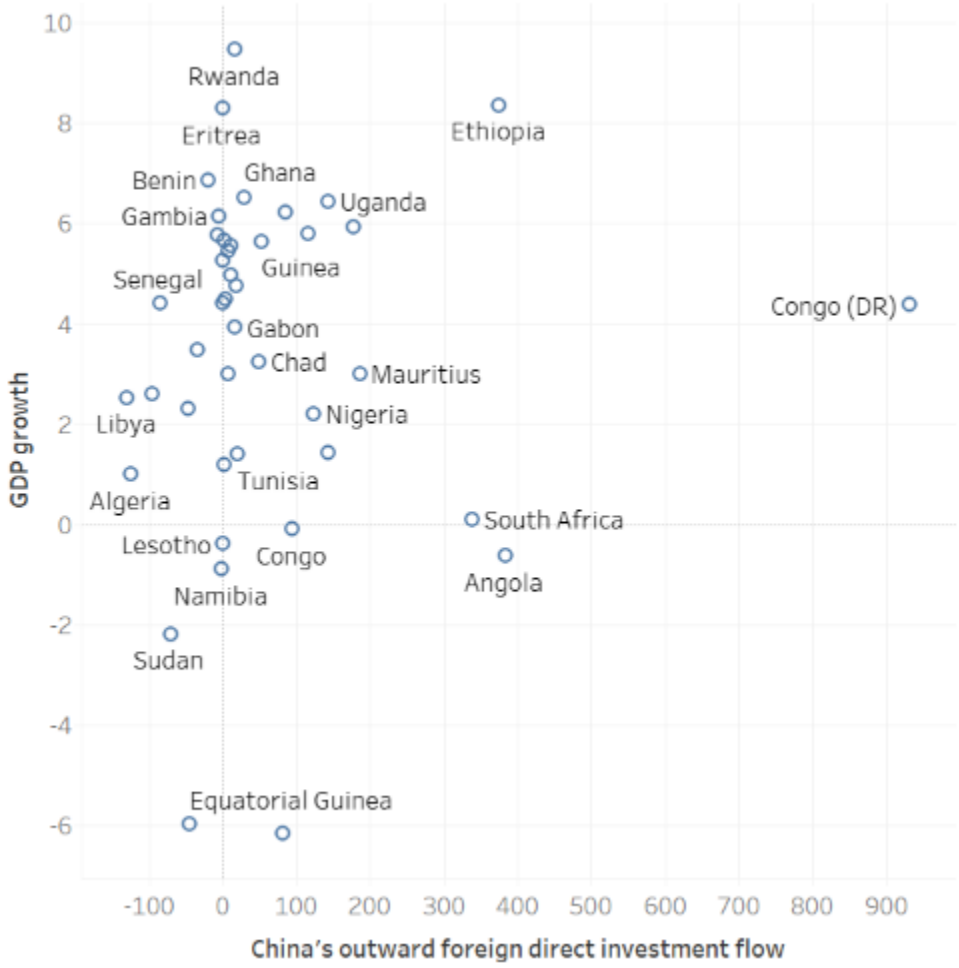


Figure 2.10 below shows a negative trend between CO2 emissions in Africa and GDP growth. This means Africa's GDP growth is negatively associated with CO2 emission. When the graph below is intuitively examined, several observations are apparent, in that South Africa is the highest emitter of carbon in Africa, next to Egypt, Algeria and Nigeria, and as such was removed because they serve as outliers. While the Zimbabwe and Equatorial Guinea has an almost 0 carbon emission, with a -6 GDP growth. More than half of the African country are clustered around carbon emission level between (0 to 50) kt carbon emission, with GDP growth. Kenya and Ghana have

the same almost carbon emissions but Kenya's GDP growth rate is approximately 5 and that of Ghana is approximately 7. Egypt and Kenya has almost the same level of GDP growth but Egypt's carbon emissions is approximately 250 kt and that of Kenya is 25 kt, which is almost ten times, the other and at the same GDP growth rate.

Graph 4: 2019 GDP growth and CO2 emission

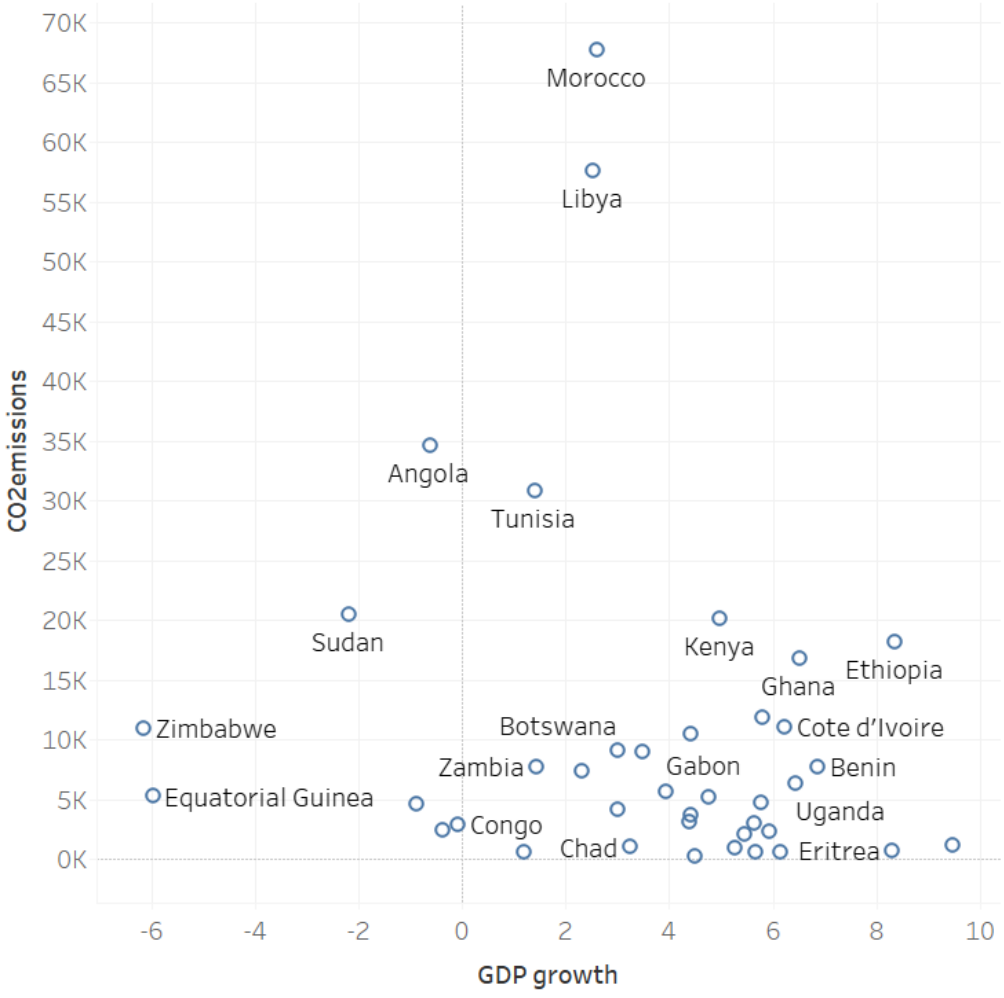
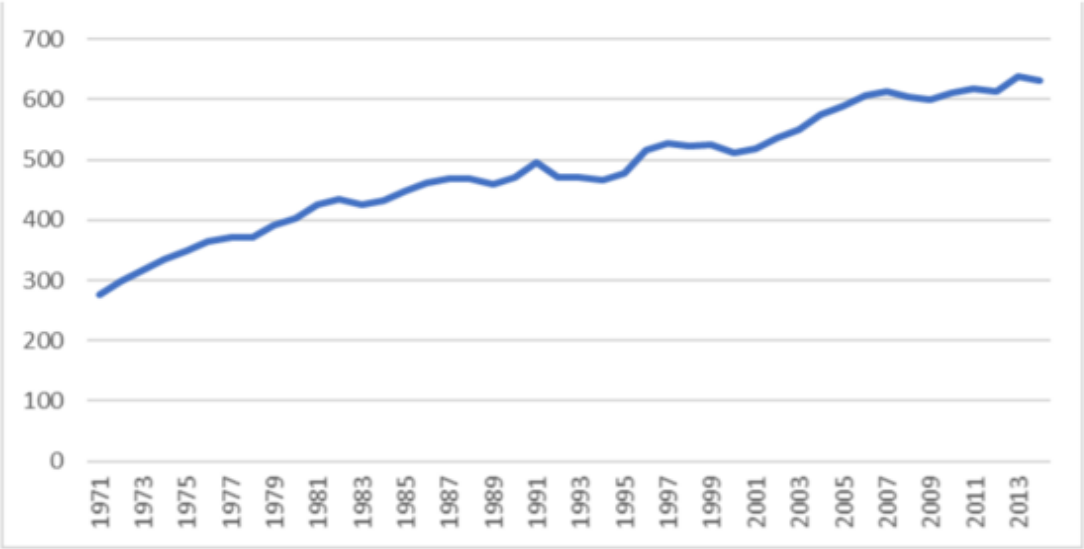


Figure 10: heat map of CO2 emissions for 2019

The heat map above shows he intensity of carbon emissions for each country in Africa, in 2019. With South Africa, Egypt, Algeria and Nigeria taking the lead in intensity on carbon emissions.

This also, shows that carbon emission in Africa, is not geographically located, outside of South Africa and Egypt almost all countries emit carbon at the at approximately the same level.

Graph 5: Mean of electricity use per capita in Africa



In terms of infrastructural development using electricity use per capita in Africa, we can see a gradual rise.

Chapter 7:

Results and Analysis

Introduction

This chapter focuses on the data presentation, estimation, and analysis to address the issues of green, clean, and mean? China's foreign direct investment in Sub-Saharan Africa's economy. The study covers descriptive analysis and econometric analysis. The model specified in the previous chapter is used in this chapter to determine the relationships between China's Foreign direct investments in Sub-Saharan Africa and if it has been clean, green, or mean.

It commences with descriptive analysis to provide insight into the relationship between relationships China's Foreign direct investments in Sub-Saharan Africa. This is used to achieve the first and second objectives of this study.

Data Issue

An overview of Chinese OFDI in SSA

In 2020, Chinese net foreign direct investment (FDI) flows were US$153.71 billion, which amounts to 12.3% from the previous year, despite the COVID-19, which shrunk the world economy by 3.3% and world trade by 5.3%, and foreign direct investment by 40%. The global outward foreign direct investment (OFDI) stock into 189 countries was 7.9 trillion US dollars, of which US$1477.73 billion were on equity investment, US$786.04 billion were reinvestment of earnings and US$3168.9 billion as debt instrument investments

Determining the Optimum Lag Order Estimation

Estimating the appropriate lag order to use in the PVAR is a delicate econometric issue. Using Akaike Information Criterion, Hannan-Quinn (HQ) criterion and Final Prediction Error (FPE) criterion, an optimum lag of 2 was chosen.

Table 7: Optimum Lag

Criteria/n	1	2	3	4	5
AIC(n)	2.565250	2.558261	2.561997	2.565662	2.568382
HQ(n)	2.571522	2.567670	2.574543	2.581345	2.587200
SC(n)	2.581281	2.582308	2.594060	2.605741	2.616476
FPE(n)	13.003903	12.913340	12.961681	13.009281	13.044710

Panel unit root test

The first step in estimating the PVAR framework is to check for stationarity in all the data properties. Two generations of unit root tests exist, the first is to identify the presence of cross-sectional dependency, and the second generation is to verify the existence of the cross-sectional dependency. To test the presence of cross-sectional dependence, we would use the diagnostic test given by Pesaran for cross-sectional dependence

cross-sectional dependence

Because Breusch and Pagan do not have high power for the Lagrange multiplier, and it is not appropriately centered for a fixed Time. Pesaran uses a modified Lagrange multiplier to resolve the challenges of Breusch and Pagan. Therefore, its

H_0: There is no cross-sectional dependence

H_1: There is cross-sectional dependence

Table 8: Dependence Test

Test	**p-value**	**Hypothesis Testing**	**Interpretation**
Breusch-Pagan LM	9.28e-09	Reject the Null hypothesis	There is cross-sectional dependence
Pesaran CD	2.685e-07	Reject the Null hypothesis	There is cross-sectional dependence
Augmented Dickey-Fuller	0.1	Reject the Null hypothesis	

Wooldridge Test for Autocorrelation in Panel Data

H_0: There is no autocorrelation or serial correlation in the error term

H_1: There is autocorrelation or serial correlation in the error term

Augmented Dickey-Fuller for a unit root in Panel Data

H_0: There is a unit root present in a time series

H_1: There is no unit root present in a time series

To obtain efficient Ordinary Least Square estimators, certain assumption needs to be made, the first being no perfect multicollinearity. This means that no two or more regressors be strongly correlated. Using the correlation matrix shows the statistical relationship between variables. Therefore, to test for multicollinearity, I would use the variance inflation factor (VIF) quantifies, and when VIF is greater than 10, then the severity of the multicollinearity is high. After running

VIF, we notice a high correlation in the following variables Access to clean fuels and technologies, CO2 emissions, Electric power consumption, and Energy use. To correct the multicollinearity, I dropped the following variables Access to clean fuels and technologies, CO2 emissions, Electric power consumption, and left Energy use, and the multicollinearity was corrected.

The second assumption to consider homoskedasticity, the error term has the same variance given any value of the explanatory variable. Using the Bruesch-Pagan test to determine the presence of homoskedasticity. For a 95% coefficient limit, I found that its p-value was less than 0.1, which is statistically significant.

Table 9: Analysis of Pooled Panel OLS

	Sub-Saharan African economies	*Low and lower-middle-income economies*
Lag of GDP growth	*3.5144e-01 (3.422e-16)****	*0.26066 (0.0051)****
OFDI	*5.4559e-04 (0.431283)*	*-0.00084 (0.4477)*
Openness to Trade	*6.9772e-03 (0.403204)*	*0.01520 (0.7810)*
Population	*-1.7975e-01 (0.577252)*	*2.08997 (0.0578)***
Carbon emission (CO2)	*2.1226e-01 (0.404636)*	*36.36795 (0.3456)*

	-1.6984e-02	*-0.01928*
Inflation	*(0.017018)***	*(0.7636)*
	9.2684e-03	*-0.01487*
Domestic Savings	*(0.559293)*	*(0.8176)*
	-7.2982e-02	*0.16084*
Human Capital (School)	*(0.036612)***	*(0.7021)*
	-7.9113e-02	*-0.29348*
Government	*(0.031029)***	*(0.1035)**
	4.4655e+00	*-0.15894*
Constant	*(0.001313)****	*(0.9765)*
R-Squared	*0.24292*	*0.5583*
Adjusted R-Squared	*0.21339*	*0.4699*
No of countries	*34*	*20*

Note: the values in parenthesis are the probability values, and those in *, **, and *** represent those values that are 1%,5%, and 10% significant.

As a rule of thumb: the coefficient shows the magnitude and direction of the variables while the p-values show the significance of the relationship where 1% significance shows a 99% level of confidence, 5% significance shows a 95% level of confidence, 10% significances show 90% level of confidence. Any percentage above ten is considered insignificant because of the low confidence level.

From table 7.7, when Pooled Panel OLS for Sub-Saharan African economies

The GDP growth (annual %): the coefficient of GDP growth rate when lagged by one period is 0.35144, which is 35.144% in percentage, which shows that there is a positive relationship between the dependent variables and the independent variable, and it is 1% significant given 3.422e-16 p-value.

China's outward FDI flows (OFDI): the coefficient of OFDI is 0.0005455, which is 0.05455% in percentage, which shows a positive relationship between OFDI and GDP growth. It can be explained that a 0.0005455 increase in OFDI brings about a unit increase in GDP growth. Its p-value is 0.431283, which has a low significance level and only about 60% confidence level.

Openness to Trade (% of GDP): the coefficient of Openness to Trade (% of GDP) is 0.0069772, which is 0.69772% in percentage, which shows a positive relationship between Openness to Trade and GDP growth. It can be explained that a unit increase in GDP growth is brought about by a 0.0069772 increase in Openness to Trade. Its p-value is 0.4032, which has a low level of significance and only a 60% confidence level.

Population growth (annual %): the coefficient of Population growth is -0.17975, which is -17.975% in percentage, which shows a negative relationship between population growth and GDP growth. It can be explained that a 0.17975 decrease in population growth brings about a unit increase in GDP growth. Its p-value is 0.577252, which has a 50% level of significance and only a 50% confidence level.

CO2 emissions (metric tons per capita): the coefficient of CO2 emissions is 0.21226, which is 21.226% in percentage, which shows a positive relationship between CO2 emissions and GDP growth. It can be explained that a unit increase in GDP growth is brought about by a 0.21226 increase in CO2 emissions. Its p-value is 0.404636, which has a low level of significance and only a 60% confidence level.

Inflation, GDP deflator (annual %): The inflation coefficient is -0.016984, which is -1.6984% in percentage, which shows a negative relationship between inflation and GDP growth. It can be explained that a 0.016984 decrease in Inflation brings about a unit increase in GDP growth. Its p-value is 0.017018, which has a 1% level of significance and a very high level of confidence.

Gross domestic savings (% of GDP): the coefficient of Gross domestic savings is 0.009268, which is 0.9268% in percentage, which shows a negative relationship between Gross domestic savings and GDP growth. It can be explained that a 0.009268 increase in domestic savings brings about a unit increase in GDP growth. Its p-value is 0.559293, which has a 50% level of significance and only a 50% confidence level.

School enrolment, tertiary (% gross): the coefficient of school enrolment is -0.072982, which is -7.2982% in percentage, which shows a negative relationship between school enrolment and GDP growth. It can be explained that a 0.072982 decrease in school enrolment brings about a unit increase in GDP growth. Its p-value is 0.036612, which has a 5% level of significance and a 95% confidence level.

General government final consumption expenditure (% of GDP): the coefficient of government expenditure is -0.079113, which is -7.9113% in percentage, which shows a negative relationship between government expenditure and GDP growth. It can be explained that a 0.079113 decrease in population growth brings about a unit increase in GDP growth. Its p-value is 0.031029, which has a 5% level of significance and a 95% confidence level.

Intercept: the coefficient of Intercept is 4.4655, which is 3446.55% in percentage, which shows that there exists a positive relationship between intercept and GDP growth. It can be explained that

assumed the independent variables are equated to zero. The GDP growth would be 4.4655. Its p-value is 0.001313, which has a 1% level of significance and a 99% confidence level.

From table 4.1, when Pooled Panel OLS for low-income economies and lower-middle-income economies with GNI per capita of $4,255 or less

The GDP growth (annual %): the coefficient of GDP growth rate when lagged by one period is 0.26066, which is 26.066% in percentage, which shows a positive relationship between the dependent variables and the independent variable is 1% significant given 0.0051 p-values.

China's outward FDI flows (OFDI): the coefficient of OFDI is -0.00084, which is -0.084% in percentage, showing a negative relationship between OFDI and GDP growth. It can be explained that a 0.00084 decrease in OFDI brings about a unit increase in GDP growth. Its p-value is 0.4477, which has a low significance level and only about 60% confidence level.

Openness to Trade (% of GDP): the coefficient of Openness to Trade (% of GDP) is 0.01520, which is 1.520% in percentage, which shows a positive relationship between Openness to Trade and GDP growth. It can be explained that a unit increase in GDP growth is brought about by a 0.0152 increase in Openness to Trade. Its p-value is 0.7810, which has a low level of significance and only a 22% confidence level.

Population growth (annual %): the coefficient of Population growth is 2.08997, which is 20.8997% in percentage, which shows a positive relationship between population growth and GDP growth. It can be explained that a 2.08997 increase in population growth brings about a unit increase in GDP growth. Its p-value is 0.0578, which has a high level of significance and 95% level of confidence.

CO2 emissions (metric tons per capita): the coefficient of CO2 emissions is 36.36795, which is 3636.795% in percentage, which shows a positive relationship between CO2 emissions and GDP

growth. It can be explained that a 36.36795 increase in CO2 emissions brings about a unit increase in GDP growth. Its p-value is 0.3456, which has a low level of significance and only a 66% confidence level.

Inflation, GDP deflator (annual %): The inflation coefficient is -0.01928, which is -1.928% in percentage, which shows a negative relationship between inflation and GDP growth. It can be explained that a 0.01928 decrease in Inflation brings about a unit increase in GDP growth. Its p-value is 0.7636, which has a low level of significance and a 23% confidence level.

Gross domestic savings (% of GDP): the coefficient of Gross domestic savings is -0.01487, which is -1.487% in percentage, which shows a negative relationship between Gross domestic savings and GDP growth. It can be explained that a 0.01487 decrease in domestic savings brings about a unit increase in GDP growth. Its p-value is 0.8176, which has a low level of significance and only a 20% confidence level.\

School enrolment, tertiary (% gross): the coefficient of school enrolment is 0.16084, which is 16.084 % in percentage, which shows a positive relationship between school enrolment and GDP growth. It can be explained that a 0.16084 increase in school enrolment brings about a unit increase in GDP growth. Its p-value is 0.7021, which has a low level of significance and a 30% confidence level.

General government final consumption expenditure (% of GDP): the coefficient of government expenditure is -0.29348, which is -29.348 % in percentage, which shows a negative relationship between government expenditure and GDP growth. It can be explained that a unit increase in GDP growth is brought about by a 0.29348 decrease in population growth. Its p-value is 0.1035, which has a 10% level of significance and a 90% confidence level.

Intercept: the coefficient of Intercept is -0.15894, which is -15.894% in percentage, which shows a negative relationship between intercept and GDP growth. Assuming the independent variables are equated to zero, the GDP growth would be -0.15894. Its p-value is 0.9765, which has a low level of significance and 1% level of confidence.

Panel Granger Causality Test SSA

H_0: Independent Variable does not have Granger causality on dependent Variable

H_1: Independent Variable does have Granger causality on dependent Variable

Table: 10a: Panel Granger Causality Test SSA

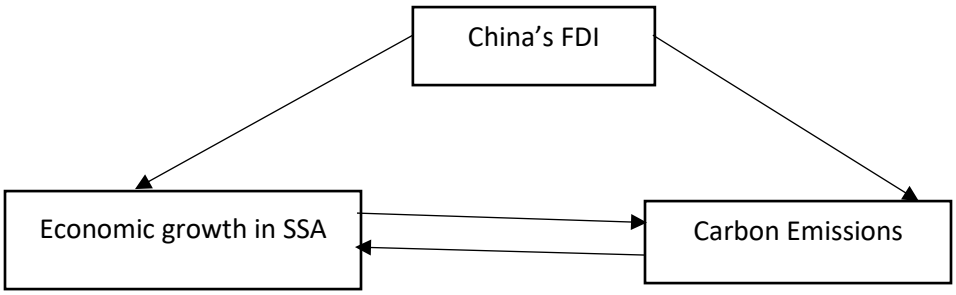
Dependent Variable	**Independent Variable**	**p-Value**	**Hypothesis testing**
GDP growth rate	**OFDI_Flows**	0.4839	Fail to reject the null hypothesis
OFDI_Flows	**GDP growth rate**	2.2e-16	Reject the null hypothesis
OFDI_Flows	**CO2 _emissions**	0.02115	Reject the null hypothesis
CO2 _emissions	**OFDI_Flows**	0.8653	Fail to reject the null hypothesis
CO2 _emissions	**GDP growth rate**	9.328e-06	Reject the null hypothesis

GDP growth rate	**CO2 _emissions**	4.993e-15	Reject the null hypothesis

Table: 10b: Panel Granger Causality Test SSA

Dependent Variables	Independent Variable	Statistically Significant
GDP growth does not granger cause	China FDI in SSA	Not Statistically significant
China FDI in SSA granger cause	GDP growth	Not Statistically significant
Carbon emissions does not granger cause	China's FDI	Not Statistically significant
China FDI granger cause	Carbon emissions in SSA	Statistically significant
Carbon emissions granger cause	GDP growth	Not Statistically significant
GDP growth granger cause	Carbon emissions in SSA	Not Statistically significant

Chart 1: Panel Granger Causality Test SSA



GDP growth rate does not granger cause China's FDI but China FDI in SSA granger cause GDP growth. Carbon emissions does not granger cause China's FDI but China FDI in SSA granger cause Carbon emissions. Carbon emissions does granger cause economic growth and GDP growth in SSA granger cause Carbon emission.

Panel Granger Causality Test for low-income economies and lower-middle-income economies with GNI per capita of $4,255 or less

H_0: Independent Variable does not have Granger causality on dependent Variable

H_1: Independent Variable does have Granger causality on dependent Variable

Table: 11: Panel Granger Causality Test for low-income economies and lower-middle-income economies

Dependent Variable	**Independent Variable**	**p-Value**	**Hypothesis testing**
GDP growth rate	**OFDI_Flows**	0.6704	Fail to reject the null hypothesis
OFDI_Flows	**GDP growth rate**	0.3983	Fail to reject the null hypothesis
OFDI_Flows	**CO2 _emissions**	0.3694	Fail to reject the null hypothesis
CO2 _emissions	**OFDI_Flows**	0.4156	Fail to reject the null hypothesis
CO2 _emissions	**GDP growth rate**	0.9729	Fail to reject the null hypothesis

GDP growth rate	**CO2 _emissions**	0.005041	Reject the null hypothesis

GDP growth rate does not granger cause China's FDI nor does China FDI in SSA granger cause GDP growth. Carbon emissions does not granger cause China's FDI nor does China FDI in SSA granger cause Carbon emissions. Carbon emissions does not granger cause economic growth nor does Carbon emission in SSA does not granger cause GDP growth.

Panel Granger Causality Test of SSA economies with GNI per capita of $4,255 or more

H_0: Independent Variable does not have Granger causality on dependent Variable

H_1: Independent Variable does have Granger causality on dependent Variable

Table: 12. Panel Granger Causality Test of SSA economies with GNI per capita of $4,255 or more

Dependent Variable	**Independent Variable**	**p-Value**	**Hypothesis testing**
GDP growth rate	**OFDI_Flows**	0.6086	Fail to reject the null hypothesis
OFDI_Flows	**GDP growth rate**	0.9883	Fail to reject the null hypothesis
OFDI_Flows	**CO2 _emissions**	0.5131	Fail to reject the null hypothesis
CO2 _emissions	**OFDI_Flows**	0.8899	Fail to reject the null hypothesis

CO2 _emissions	**GDP growth rate**	0.2361	Fail to reject the null hypothesis
GDP growth rate	**CO2 _emissions**	0.4656	Reject the null hypothesis

GDP growth rate does not granger cause China's FDI nor does China FDI in SSA granger cause GDP growth. Carbon emissions does not granger cause China's FDI nor does China FDI in SSA granger cause Carbon emissions. GDP growth does not granger cause economic growth but Carbon emissions in SSA does granger cause GDP growth.

Table 13: Results of panel VAR model for Sub-Saharan Africa

Response to	**OFDI**	**CO2**	**GDP**
D($OFDI_{t-1}$)	0.1885***	0.0013	0.0449
	(0.0228)	(0.0008)	(0.0917)
D($CO2_{t-1}$)	0.0005***	0.0000	0.0001***
	(0.0001)	(0.0000)	(0.0000)
D(GDP_{t-1})	-0.0001	-0.0000	-0.0020
	(0.0001)	(0.0001)	(0.0028)
D($OFDI_{t-2}$)	0.1151	-0.0013	0.0028
	(5.9128)	(0.0007)	(0.0821)
D($CO2_{t-2}$)	0.0005	0.0000	0.0001
	(0.0003)	(0.0000)	(0.0000) **
D(GDP_{t-2})	0.0001	-0.0000	-0.0019

	(0.0003)	(0.0001)	(0.0029)
D(Trade)	-0.0047	-0.0004	-0.0306
	(0.0067)	(0.016)	(0.0448)
D(Government)	-0.0006	-0.0001	-0.0062
	(0.0017)	(0.0003)	(0.0095)
D(School)	0.0013***	-0.0000	-0.0039
	(0.0002)	(0.0002)	(0.0063)
D(Inflation)	0.0104	-0.0001	-0.0028
	(0.0083)	(0.0001)	(0.0034)
D(Population)	0.0002	-0.0000	-0.0009
	(0.0003)	(0.0000)	(0.0012)
D(Savings)	0.0062***	-0.0000	-0.0036
	(0.0018)	(0.0002)	(0.0044)
D(RELPP)	0.0001	-0.0000	-0.0004
	(0.0001)	(0.0000)	(0.0005)
D(GDPPC)	0.0061	0.0006***	0.0010
	(0.0033)	(0.0000)	(0.0034)
D(Electricity)	0.0058*	-0.0001	-0.0143
	(0.0026)	(0.0007)	(0.0226)
D(rpr_work)	0.0001	-0.0000	0.0004
	(0.0001)	(0.0000)	(0.0006)
D(Clean fuels)	0.0023	-0.0000	-0.0081
	(0.0012)	(0.0004)	(0.0144)

Constant	0.0001	-0.0000	-0.0004
	(0.0001)	(0.0000)	(0.0006)

Notes: three-variables VAR model is estimated by GMM. Country-time and fixed effect are removed before estimation. Reported numbers show the coefficients of regressing the column variables on lags of the row variables. Heteroskedasticity adjusted t-statistics are in parentheses ***, **, and * indicate significance at 1%, 5%, and 10% with critical values of 2.576, 1.96, and 1.645, respectively. D(.) denotes the first difference

The PVAR model is reported in the Table above. First, for China's outward FDI flows (OFDI) equation, the results reported five coefficients were statistically significant at the conventional level of significance. The results show that the first lags of China's outward FDI flows (OFDI) are positively correlated with its current level. The estimated coefficients associated with the first lag of China's outward FDI flows (OFDI) are equal to 0.1885, and they are significant at the 1% level. The results show that the first lags of Carbon dioxide (CO2) emission are positively correlated with the current level of OFDI. The estimated coefficients associated with the first lag of CO2 are equal to 0.0005, and they are significant at the 1% level. The results show that School is positively correlated with the current level of OFDI. The estimated coefficients associated with School are equal to 0.0013, which are significant at the 1% level. The results show that Savings are positively correlated with the current level of OFDI. The estimated coefficients associated with School are equal to 0.0062, which is significant at the 1% level.

The results show that Electricity is positively correlated with the current level of OFDI. The estimated coefficients associated with electricity are equal to 0.0058, which is significant at the 10% level. For the Carbon emission (CO2) equation, the results show that only one variable has a substantial impact on the level of Carbon emission (CO2) level, which is a coefficient associated

with GDP per capita. The results show that GDP per capita positively correlated with the current level of Carbon emission (CO2). The estimated coefficients associated with GDP per capita are equal to 0.0006, which are significant at the 1% level. for the GDP growth equation, the results reported two coefficients were statistically significant at the conventional significance level. The results show that the first lags of Carbon emission (CO2) are positively correlated with its current level. The estimated coefficients associated with the first lag of Carbon emission (CO2) are equal to 0.0001 and are significant at the 1% level. The results show that the second lags of Carbon emission (CO2) are positively correlated with its current level. The estimated coefficients associated with the first lag of Carbon emission (CO2) are equal to 0.0001 and are significant at the 5% level. The results show that China's outward FDI flows do not significantly contribute to economic growth, but Carbon emissions contribute. Also, regarding the Carbon emission equation, GDP per capita significantly impacts carbon emissions. Finally, China's outward FDI flows are positively impacted by access to electricity, the general government's final consumption expenditure (% of GDP), schools, and the lag between China's outward FDI and Carbon emission (CO2).

Table 14: Results of panel VAR model for low-income economies and lower-middle-income economies with GNI per capita of $4,255 or less

Response to	***OFDI***	***GPD***	***CO2***
D(OFDI$_{t-1}$)	-0.2277***	-0.0745	-3.5246***
	(0.0618)	(0.3697)	(0.9699)
D(GDP $_{t-1}$)	8.7863*	0.0888	0.0280***
	(4.2579)	(0.2957)	(0.0077)

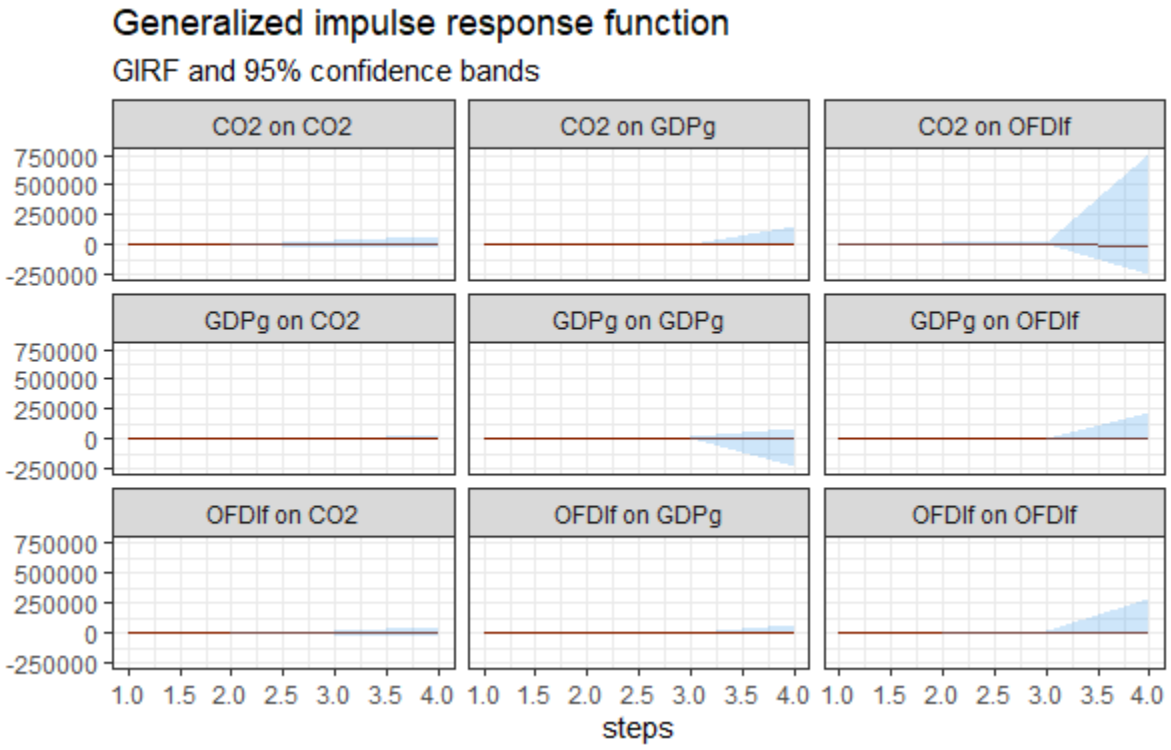
D(Trade$_{t-1}$)	2.6801	-5.5268	0.1071**
	(1.7500)	(4.2640)	(0.0374)
D(CO2$_{t-1}$)	-0.8548**	-0.0089	-0.0008***
	(0.3200)	(0.0120)	(0.0002)
D(OFDI$_{t-2}$)	0.0320	-0.0872	4.4603***
	(0.0869)	(0.4747)	(1.2099)
D(GDP $_{t-2}$)	18.0028	1.2728	0.0012
	(13.5196)	(0.9295)	(0.0022)
D(Trade$_{t-2}$)	2.7684	2.7385	-0.1015*
	(2.4523)	(2.1152)	(0.0435)
D(CO2$_{t-2}$)	-0.1688	0.0002	0.0005*
	(0.0911)	(0.0163)	(0.0002)

Notes: three-variables VAR model is estimated by GMM. Country-time and fixed effect are removed before estimation. Reported numbers show the coefficients of regressing the column variables on lags of the row variables. Heteroskedasticity adjusted t-statistics are in parentheses ***, **, and * indicate significance at 1%, 5%, and 10% with critical values of 2.576, 1.96, and 1.645, respectively. D(.) denotes the forward orthogonal deviations

PVAR model is reported in Table 4.8. First, for China's outward FDI flows (OFDI) equation, the results said that only three coefficients were statistically significant at the conventional significance level. In particular, the results show that the first lags of China's outward FDI flows (OFDI) negatively correlate with its current level. In contrast, the lag of GDP and CO2 was positively correlated with China's outward FDI flows (OFDI). The estimated coefficients associated with the first lag of China's outward FDI flows (OFDI) on the OFDI model are equal to

-0.2277 and are significant at the 1% level. The estimated coefficients associated with the first lag of GDP on the OFDI model are equal to 8.7863, and they are significant at the 10% level. The estimated coefficients associated with the first lag of CO2 on the OFDI model are equal to -0.8548, and they are significant at the 5% level. For the GDP model, the results show no variables have a substantial impact on the level of GDP. Thirdly, regarding the Carbon emission equation, the first lag of general government final consumption expenditure (% of GDP), Trade, OFDI, and Carbon emissions, significantly impact carbon emissions. The first lag of the General government's final consumption expenditure (% of GDP) and Trade has positively contributed to Carbon emissions. In contrast, the first leg of OFDI and Carbon emissions has negatively contributed to carbon emissions. The first lags of GDP, OFDI, and CO2 have a significant level of 1%, and the second lag of OFDI. The first lag of Trade has a 5% level of significance in the contribution of carbon emissions. In comparison, the second lag of CO2 has a 10% level of significance in the contribution of carbon emissions.

Chart 2: Generalized impulse response function



The chart above shows the impulse functions for the VAR model of OFDI, GDP, and CO2.

The Impulse Response Function (IRF) traces the impact of the shock to CO2 on CO2 itself. In the graph, we would see:

- No initial shock to CO2 in the first period
- Then a slight increase in CO2 from period 2.5 to 4.

The Impulse Response Function (IRF) traces the impact of the shock to CO2 on GDP. In the graph, we would see:

- No initial shock on GDP in the from period 1 to 3
- An increase in the shock on GDP from period 3 to 4
- A continuous increase in the shock on GDP from period 3 to 4

- The impact does not converge but keeps expanding positively in period 4.

The Impulse Response Function (IRF) traces the impact of the shock to CO2 on OFDI. In the graph, we would see:

- No initials on OFDI from periods 1 to 3
- A significant increase in OFDI from period 3 to 4
- A slight and continuous decrease in OFDI from period 3 to 4

The Impulse Response Function (IRF) traces the impact of the shock on GDP on CO2. In the graph, we would see:

- No initial shock to CO2 in periods 1 to 2
- No shock to CO2 in periods 2 to 3
- No shock to CO2 in periods 3 to 4

The Impulse Response Function (IRF) traces the impact of the shock to GDP on GDP itself. In the graph, we would see:

- No initial shock to GDP in periods 1 to 2
- Then a slight increase in GDP from periods 3 to 4.
- A tremendous and continuous decrease in GDP from period 3 to 4

The Impulse Response Function (IRF) traces the impact of the shock to GDP on OFDI. In the graph, we would see:

- No initial shock to OFDI in periods 1 to 3
- Then an increase in OFDI from period 3 to 4.

The Impulse Response Function (IRF) traces the impact of the shock to OFDI on CO2. In the graph, we would see:

- No initial shock to CO2 from periods 1 to 3
- Then a slight increase in CO2 from periods 3 to 4.

The Impulse Response Function (IRF) traces the impact of the shock to OFDI on GDP. In the graph, we would see:

- No initial shock to GDP from period 1 to 2
- Then a slight increase in GDP from periods 3.25 to 4.
- A step increase in GDP from periods 3.25 through periods 4

The Impulse Response Function (IRF) traces the impact of the shock to OFDI on OFDI itself. In the graph, we would see:

- No initial shock to OFDI from periods 1 to 2
- Then an increase in GDP from periods 3 to 4.
- A continuous increase in GDP from periods 3 to 4

From chart 2: we can conclude that:

The impact of CO2 on GDP and OFDI would be seen in the long run, not in the short run. We also see that the shock or impact of GDP on OFDI increases in the long run, as well as the impact of GDP on GDP. OFDI would have a positive effect on GDP in the long run but a negative impact on itself in the long run. From period 3, CO2 slightly impacts GDP growth and greatly impacts

OFDI positively and negatively. While GDP growth has no impact on CO2 in the short-run and long-run, GDP growth impacts itself negatively from the third period and OFDI positively. OFDI positively impacts CO2 slightly in the long run and GDP growth. And largely positively impacts itself in the long run.

Chapter 8

Summary, Limitation and Future Research

Introduction

During the study, I examined the impact of China's foreign direct investment in SSA related to its environment and economy. This chapter summarizes the entire research work, generates a conclusion, and finally makes a good policy recommendation.

Summary Of the Study

At the initial stage of this research, the importance and relevance of China's foreign direct investment were stated to create sustainable economic growth and environment in Africa. From 2001 through 2018, the total investment by China into Africa totalled $126 billion.

The literature review reviewed the various issues about the impact of China's FDI on economic growth in Africa. The issues reviewed were definitional/conceptual issues, theoretical issues, methodological issues, and empirical issues. Under the conceptual issue, depth insight was drawn into various forms of China's FDI in Africa and its relationship with the trade. Under the theoretical issue, the neoclassical model of exogenous growth and the endogenous growth theory was reviewed. It was observed that the endogenous growth theory is the vital role played by knowledge as well as China's FDI in sustainable economic growth and the environment in Africa. The methodological issue talks about the various studies that have taken place between China's FDI, and economic growth and the methodologies used.

Pooled Ordinary Least Square (OLS) AND The Panel Vector Autoregressive Model (PVAR) were adopted to investigate the impact of China's investment on economic growth and the

environment in SSA. The result of this study shows a positive relationship between China's FDI and economic growth, as well as the environment.

Using the pooled OLS model for the SSA, this study shows a positive relationship between China's foreign direct investment and economic growth in Africa, as well as carbon emissions in Africa and economic growth in Africa, but they are not statistically significant. However, there exist a negative statistically significant relationship between inflation and economic growth, and between human capital and economic growth. For the Low and lower middle-income economies there exist a negative statistically insignificant relationship between China's foreign direct Investment and economic growth, as well as carbon emissions. However there exist a positive statistically significant relationship between population growth rate, the lag of GDP growth and economic growth and negative statistically significant relationship between government expenditure and economic growth in the low and lower middle-income economies.

For the panel granger causality test for SSA, China's FDI granger causality GDP growth and carbon emission and GDP growth granger causes carbon emission, but GDP growth does not granger cause China FDI and carbon emission does not granger cause China's FDI.

Under the VAR model, a positive insignificant statistically correlation exists between China's foreign direct investment and economic growth in Africa, for the first model. For the second model which evaluates other variable in response to Carbon emissions, it shows a positive insignificant relationship between the first lag China's FDI and carbon emission. The result also shows a negative insignificant relationship between the second lag China's FDI and carbon emission. The only variable that statistically significantly is GDPPC, which is positively correlated with carbon emission, which is in line with the Environmental Kuznets

Curve. Given that most of SSA countries is in the first stage, pollution is high because the economy is poor and developing, with GDPPC below $5000. The last model which evaluates the response to GDP, the result shows a positive significant relationship between carbon emission and economic growth. And positive insignificant relationship between FDI and economic growth.

For the Low and lower-middle-income economies under the Panel VAR model, the first model which evaluates the response to China's FDI there exist a negative highly statistically significant relationship between the first lag of China's FDI on its current level. There is also a positive significant relationship between the first lag of GDP on economic growth and a negative statistically significant relationship between the first lag of carbon emission on economic FDI. For the second model, which evaluates the response to GDP, a negative statistically insignificant relationship exists between China's FDI and economic growth. The result also shows a negative insignificant relationship between the first lag of carbon emissions and GDP and a positive insignificant relationship between the second lag of carbon emission and GDP. The last model evaluates the response to carbon emissions; the result shows a negative statistically significant relationship between the first lag of China's FDI and carbon emission. The result also shows a positive statistically significant relationship between GDP and the second lag of China's FDI on carbon emissions. The result also shows a positive statistical relationship between the first lag of Trade and a negative relationship between its second lag on carbon emissions.

For the generalized impulse response function, the results show that from period 3 and period 4, carbon emissions have a positive significant and continuous impact on China's FDI, GDP growth has a negative shock on GDP growth, and positive continuous shock of GDP growth

on China’s Foreign direct Investment. For the same period their positive continuous shock of China’s FDI on itself.

The gap this study seeks to fill is in the contribution of China’s F.D.I. to economic growth and environment in Africa and to determine the relationship between China’s F.D.I. and economic growth and environment in Africa. Therefore, from the result of this study, China’s F.D.I. contributes a very insignificant amount to economic growth in Africa as well as to its environment. The reason could be due to the negative relationship between human capital and economic growth.

This study's result supports this study's objectives, which shows a positive relationship between economic growth and China’s FDI, although statistically insignificant in SSA. This implies that the more of China’s FDI, the more economic growth and that China’s FDI contributes to the economic growth of SSA is not statistically significant. Therefore, whether China’s FDI is “mean” in SSA is “no.” Instead, this calls for encouragement toward an increased focus on other variables that are statistically significant such as school, government expenditure, and inflation.

On the other hand, this study's result supports this study's objectives, which show a positive insignificant relationship between the first lag of China’s FDI and carbon emission and a negative insignificant relationship between the second lag of China’s FDI and the current level of carbon emissions. Given that the generalized impulse response functions show a slight positive effect of China’s FDI on carbon emissions from period 3. This implies that China’s FDI, on carbon emission in SSA is concluded to be positive. Therefore, whether China’s FDI is clean and green in Africa is “no”.

Summary of Findings

Empirical Findings

The result from the test of the hypothesis shows that first lag of FDI contributes to the current lag, the first lag of carbon emission and school enrolment rate also contributes to China's FDI. The result also shows that GDPPC contributes to carbon emission. While carbon emission contributes to GDP in SSA within the period under investigation. It was discovered that there is a positively statistically relationship first lag of FDI and the first lag of carbon emission on the current lag China's FDI. The result also shows a positively significant relationship between school and the current level of China's FDI. This study also shows a positive statistically relationship between GDPPC and carbon emission, as well as between the carbon emission and GDP. From the generalized impulse response function, we see that the impact of carbon emission on CO2 drastically increased from period 3, while the impact of carbon emission of GDP slightly increased from the same period. We also see that the impact of GDP growth on China's FDI slightly increased in period 3. While there is little effect of China's FDI on both carbon emission and GDP from period 3. This relationship confirms the a priori expectation.

Recommendation

It has empirically investigated China's FDI's impact on SSA's economic growth. It was acknowledged that the challenges facing economic growth in SSA are multi-dimensional. From the result, it is necessary to offer the following policy recommendation based on the empirical findings.

Increase China's Clean Green Foreign Direct Investment: Given that there exists a positive insignificant relationship between China's FDI and economic growth, therefore, to increase China's clean green FDI the following recommendations are suggested:

1. Creating an accountability agency: Given that In line with the established Forum on China-Africa Corporation (FOCAC) in 2018, which was geared to foster cooperation and solidarity. More forums and accountability agencies need to be created in Africa to ensure that China's FDI will be used to foster growth and development.
2. A better clean-up structure: Since most SSA fall below $5000 GDP per capita, clean-up policies and structures need to be enacted and enforced to create sustainable development.
3. Rewriting the investment agreement to include a clause that ensures the reinvestment of a certain percentage of earnings generated into the public system preferable school. And the agreement should limit the ownership of strategic assets by foreigners
4. A political stability. Given that political stability increase investment. African countries should create and encourage political stability in all their countries.

Specific Recommendations

For the specific recommendation, I would use the four subregions and randomly select countries from them to examine the impact of China's FDI on the environment and the economy in 2019.

In Angola for 2019, all other things being equal, China's FDI led to a decrease of 10115.1 in economic growth, and carbon dioxide emission increased by 1.56373, which would lead to a 2708.9001 increase in China's FDI. Therefore, Angola should accept less of China's FDI

In Rwanda for 2019, all other things being equal, China's FDI led to a decrease of 4969.53 in economic growth, and carbon dioxide emission increased by 0.49019 and would lead to a 1258.263771 increase in China's FDI. Therefore, Rwanda should accept less of China's FDI

In Seychelles for 2019, all other things being equal, China's FDI led to a 2.04656218 increase in economic growth, and carbon dioxide emission increased by 0.118436 and would lead to a 153.2599 rise in China's FDI. Therefore, Seychelles should accept more of China's FDI

In Tanzania for 2019, all other things being equal, China's FDI led to a decrease of 22666.4

in economic growth and carbon, di oxide emission increased by 0.683346054 and would lead to a 5736.115852 increase in China's FDI. Therefore, Tanzania should accept less of China's FDI

In South Africa for 2019, all other things being equal, China's FDI led to a decrease of 18798.1117 in economic growth, and carbon dioxide emissions increased by 4.105520127

and would lead to a 5359.464554 increase in China's FDI. Therefore, South Africa should accept less of China's FDI

In Zambia for 2019, all other things being equal, China's FDI led to a decrease of 6168.5

in economic growth and carbon, di oxide emission increased by 1.060907339 and would lead to a 1697.99787 increase in China's FDI. Therefore, Zambia should accept less of China's FDI

In Nigeria for 2019, all other things being equal, China's FDI led to a decrease of 80232.43307 in economic growth, and carbon dioxide emission increased by 1.913291139 and would lead

to a 20256.66699 increase in China's FDI. Therefore, Nigeria should accept less of China's FDI

In Mail for 2019, all other things being equal, China's FDI led to a decrease of 7118.62332

in economic growth and carbon, dioxide emission increased by -17773836.11 and would lead to a 1774.717021 increase in China's FDI. Therefore, Mail should accept less of China's FDI

Limitation

The limitation of this study was primarily data related. As such, the period was limited to 2004-2019. Data for total enrolment (primary, secondary, and tertiary) was not readily available in most databases. There was a lack of data, and some variables were not used to conduct the research. Another limitation was an estimation error, a characteristic of secondary data

Chapter 9

Conclusion

Researching and writing this thesis challenged me beyond my expectation, having to start over multiply times, was truly eye opening. But what a beautiful result this labor produced. Initially, I went in with the idea that I found was a gap in literature discussing the history of development and growth in SSA and connecting it to the importance of FDI to economic growth in SSA. After, reviews and constructive criticism I ended up laying a theoretical framework for FDI and economic growth and building my thesis from there.

Another challenge I encountered was getting data, some data where missing and some were unavailable for some SSA countries. Data on electric power consumption was missing for some countries and sparely available for other countries. Countries like Burkina Faso, Djibouti, Malawi, South Sudan, and Sao Tome and Principle had very little data for the following variables, access to clean fuels and technologies for cooking, access to electricity, GDP growth, trade, general government final consumption expenditure, tertiary school enrollment, CO2 emissions, inflation, population growth, gross domestic savings, Electric power consumption, energy use, and GDP per capita.

Another challenge encountered during this research was getting China's OFDI flows and stock to specific countries in SSA. Unlike every other data and variable which was available on public English databank such as the World Bank Databank and Transrearch Consortium. China's FDI data was in Mandarin especially for the earlier years of 2004 through 2009. I had to spend months understanding the data and interpreting it to English.

This thesis, I believe, reflects the larger part of what really leads to economic growth in SSA. It shows that China's FDI has little or no statistically significant impact on economic growth, but

variables like education represented by tertiary school enrollment, domestic saving representing private-public partnership, inflation which represents the monetary instrument and general government final consumption expenditure representing monitoring agency.

Therefore, more emphasized should be placed on education, and various investments including but not limited to China's FDI should be channelled to building and developing tertiary school enrolment. For there to be a sustainable growth and development in SSA countries, especially in Low and lower-middle-income economies, more should be done to their educational system. Because its impact on economic growth is statistically significant. And the contribution from education would help reduce carbon emissions

Also, more emphasizes should be placed on the monitoring agency as well as the monetary instrument represented as the general government final consumption expenditure and inflation respectively. They have a statistically significant impact on the environment and the economy.

This research extended previous inquiries related to sustainable development and growth by examining the impact of China's FDI on the economy and the environment. The study is one of the early types of research on the environment in SSA. The results have provided insightful support for existing scholarly study and identified several recommendations for future research.

This study began by creating and building a foundation based on available statics to create an objective for the study. It moved on to reviewing various works of literature about the environment, economic growth, and FDI. This chapter was segmented into a review of the conceptual issue, the methodological and empirical literature, the effects of FDI on the economy, and carbon emissions. The visual analysis supported these theories, showing a negative trend between CO2 emissions and GDP growth and a positive trend between China's investment and GDP growth.

The examination was based on the OLI model, exogenous growth theory, endogenous growth theory, Environmental Kuznets curve, Pollution haven hypothesis, and Pollution Halo hypothesis. Using the Granger causality test, we found that economic growth is not caused by China's FDI, but economic growth causes China's FDI. We also found that Carbon emissions do not cause China's FDI, but China's FDI causes carbon emissions, and carbon emissions cause economic growth, which creates a cycle. Using the VAR model for this study, the following conclusion is drawn,

Firstly, there exists an insignificant positive relationship between China's FDI and economic growth, and a negative relationship between China's FDI and carbon emissions in Africa from 2004 to 2019.

One of the major reasons attributed to the negative relationship between China's FDI and carbon emission is that a large proportion of China's FDI is geared to mining, which is positively attributed to carbon emissions. Channelling this proportion of China's FDI in SSA to education, would lead to a negative relationship between China's FDI and carbon emissions and would also lead to a statistically significant positive relationship between China's FDI and economic growth. This would lead to a more sustainable economic growth and development.

Therefore, the question of whether China's FDI in Africa is mean is no, because an insignificant positive relationship exists between China's FDI and economic growth. But China's FDI is not clean or green since a positive relationship exists between China's FDI and Carbon emissions.

Suggestion For Further Study

Further studies can therefore focus on the other measures of factors that significantly impact economic growth. The studies should be compared with this to understand better the impact of

China's FDI on economic growth and the environment. The result from such studies would help inform the government on what level of education requires more funding to foster economic growth

Another recommendation for further study is to evaluate the impact of other nations FDI into SSA countries and compare it with this research to determine if their investment in SSA is mean, clean or green.

Another recommendation should be to investigate the impact of China's FDI on individual SSA, especially countries like Congo (DR), Angola, Ethiopia and South Africa, who receive more from China. To actually understand the impact to this economy individually.

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Appendix 1.1

To effectively understand the impact of China’s foreign direct investment in Africa's economy and environment, we need to look at its history and understand the importance and implications of various African assets related to the environment and the economy. According to (Wiehe, 2020), Africa’s history is also essential because the colonial powers established the modern borders, which has gone a long way to defining the identity of Africa. (Hopkins, 2009) To combat poverty in Africa which would lead to economic growth and development, we need to understand the history of economic development in Africa.

Africa both has a complex history and its sources and method of analysis (Frankema, Hillbom, Kufakurinani, & Meier zu Selhausen, 2022). Therefore, to effectively understand the effect of

China's foreign direct investment in Africa, we would have to understand the complex history of Africa, which would help us know how it is affected by China's foreign direct investment.

Angola: Pre-Colonial era, because of the poor record keeping in Angola, little is known of Angola. (Clarke, 2020) But what is known about Angola is the presence of the extensive Kingdom of Kongo, and it was first inhabited about 25 000 years BCE. Also, the northern part of Angola, which consists primarily of dense forest, was settled by a people whose language and name have since been lost. More is known about the early inhabitants of the southern part of Angola. They were called the Khwe and were part of the Khoe language group. Research suggests that the Khwe developed as a distinct language group about 2 000 years ago (South African History, 2022). The Khwe people in southern Angola are estimated to have adopted a pastoralist mode of production somewhere between 1 000 BCE and 500 BCE. According to (South African History, 2022), before 1000 CE, Bantu-speaking peoples migrated into the area from present-day Nigeria and Cameroon. The Bantu-speaking peoples brought with them technologies such as iron smelting and pottery-making. The people of northern Angola have become fully integrated into the Bantu-speaking communities, so there is no remnant of their original language in present-day Angola.

As the Bantu-speaking peoples settled down, they developed distinct linguistic communities. The Khoe-speaking and Bantu-speaking groups of people initially made alliances and intermarried, and they traded and shared technology. (Davidson B. , 1999) While they were on the move, the Bantu-speaking peoples herded mostly goats and lived on hunting and gathering, but they began to herd cattle after trading with the Khwe people. After 1000 CE, several centralized states were formed by various Bantu-speaking groups in northern and central Angola, including the Bakongo, Lunda, and Mbundu. (South African History, 2022) While larger centralized states were forming in northern Angola, the Ovimbundu (or southern Mbundu) were organized into several small

kingdoms organized around kinship and locality based on different political ideas and institutions. Some of which include Autocratic ideas of kingship and the semi-democratic tendencies creating ways in which the rulers and the ruled negotiated relations of power. (South African History, 2022) There was a certain amount of centralization of power, but it was always reliant on kings being perceptive of local issues. Through village councils, which were to some degree democratically elected, the kings ruled with much restraint imposed by ordinary people. By the 1800s, the Ovimbundu people had formed about 22 kingdoms with various degrees of autonomy and cooperation and settled in the central highlands of Angola. This was, and remains, one of Angola's most densely populated areas. As such, before the colonization era, Angola was able to create a political system and establish an economic system of trade using the then technology.

During the Colonization: The colonialization of Angola by the Portuguese took almost 400 years to unfold. The first meeting between Portuguese explorers and King Nzinga of the Kingdom of Kongo was in 1482. (Davidson B. , 1999) By 1490, the Portuguese were primarily interested in the Slave trade and as much conquered and developed the coastal areas such as Luanda in 1575 and the city of Benguela in 1617. The Portuguese could use the inland rulers to buy enslaved people captured during any local conflict and ship them off for sale. During colonization, routes were developed from the coastal areas to various trade posts and missionary stations. And as such foster growth and development of the economy. The slave trade was a source of income and employment for some local nobility. For kingdoms like the Ovimbundu, who prospered from the slave trade, the abolition of the work in 1836 would create internal turmoil and make them vulnerable to conquest.

The Ndongo joined the colony of Angola in 1671. The Ovimbundu Kingdoms were all integrated into the Colony of Angola by 1904. The last people to join the colony of Angola was Kwanyamo,

a subset of the Ovambo peoples in Southern Angola. (South African History, 2022) In September 1915, the Portuguese defeated the last king of the Kwanayamo, King Mandume. The defeat of the Kwanyamo marked the total domination by the Portuguese over Angola. At this point, the Colony reached the boundaries stipulated in the Berlin Conference of 1884 – 1885 by the European colonial powers. In 1890, the British Empire stopped every attempt by the Portuguese to expand the colony of Angola. Because the Slave trade was made illegal worldwide in 1836 but was still legal in Angola till 1875, it drastically affected the income and employment of the people of Angola.

(Davidson B. , 1999) During the Colonial era, the Portuguese made investments in infrastructure, built schools, assisted struggling farmers, and deployed Portuguese addiction Soldiers to maintain peace and prevent the liberation movement. Other acquisitions included a Beer-industry by the Portuguese, which led to the export of alcohol and increased the GDP of the Colony in 1963. In the late1960s American and European companies began great investments in the search and extraction of oil in the colony. The oil extracted by Texan oil companies created royalties to the Portuguese in Angola and generated employment and income for the Angola citizen who worked at the Texan oil companies. (Davidson B. , 1999) There was a lot of fighting and unrest in Angola for the liberalization movement, and on November 11, 1975, Portugal granted Angola its independence.

Algeria is located in the fertile coastal Northwest of Africa and the Arab world, popularly referred to as the Maghrib (or the Maghreb), and has such Algeria has been a transit nation, especially for Europe and the Middle East.

Prehistory of Central North Africa:

(Patowary, 2016)As far as history could take us, the Tassili-n-Ajjer cave paintings in southeastern Algeria between 6000 to 2000 B.C. started from the early inhabitants of the Maghrib. (Casey, 2008) This era was marked by Neolithic civilization characterized by animal domestication and subsistence agriculture and development, especially in the Saharan and Mediterranean East. This era was also known for the joining of North Africa to Africa and the creation of a distinct native population that came to be called Berbers, who were characterized by their different language and culture, which was lost due to lack of written language.

North Africa during the Classical Period

(Joshua, 2020) This era began with the creation of Carthage (present-day Tunisia) in 800 B.C. through the Phoenician traders. The Berbers grew in agriculture, manufacturing, and trade. The political organization supported several states and their trade link with Carthage. The Berbers and Carthage traded enslaved people and military recruitments and weapons. After the Punic wars in 146 BC, Carthage town was destroyed. Still, the Berber leaders grew stronger. The Berber annexed the Roman Empire in 24 A.D. this led to an increase in urbanization and agriculture. The Berber was referred to as the "granary of the empire" because it was one of the most significant grain exports during the Roman Empire. (Algeria, 2022) Christian arrived in Berber in the second century; by the fourth century, certain regions of the Berber became Christianized. At the same time, Islam spread between 642 and 669 first Arab military expeditions into the Maghrib.

During the Colonization: (Metz, 1993) stated that France entered Algiers in 1827, using three years blockaded, and by 1848 nearly all of northern Algeria was under French control, and the new government of the Second Republic declared the occupied lands an integral part of France. Three "civil territories Algiers, Oran, and Constantine, were organized as French départements (local administrative units) under a civilian government. Colons (colonists), or, more popularly, pieds

noirs (literally, black feet), dominated the government and controlled the bulk of Algeria's wealth (Library of Congress, 2021).

In June 1958, Charles De Gaulle became the Prime Minister of France and created a constitution integrating Algeria as an associate of France but did not integrate it. And for the first time in Europe, Muslim women were registered to vote, which led to 80 percent of the Muslim electorate turning out to vote in September, and 96 percent of them approved the constitution. On July 1, 1962, 6 million of the 6.5 million Algerian electorates cast their ballots in the referendum for their independence. Which led to the creation of the People's Democratic Republic of Algeria was formally announced on September 25, 1962. Oil was first discovered in Algeria in 1956, and commercial production began in 1958. Algerian economy became heavily dependent on oil, which led to the crisis and recession in Algeria during the 1980 oil glut.

Present-Day Algeria: Algeria has the following natural resources: petroleum, natural gas, iron ore, phosphates, uranium, lead, and zinc. In 2008, Algeria had 12.3 billion barrels in oil reserves and 161.7 trillion cubic feet in natural gas. Algeria joined the Organization of the Petroleum Exporting Countries (OPEC) in 1969. Oil is Algeria's principal income generator, accounting for more than 80 percent of its export and more than 20 percent of its GDP. Algeria is the World's second producer of Helium and has approximately 21 percent of the world's helium deposits.

Benin

Benin was first established as a succession of several kingdoms, one of which was Dahomey, one of the great medieval kingdoms. Another prominent kingdom was Allada, which was created in the 16th century; the kingdom of Abomey, which was founded in 1625 and the Porto-Novo, also founded in the 16th century (The History of the Kingdom of Dahomey, 2020). The English

missionary brought the gospel in 1645 and built a port at Ouidah (Whydah) in 1650, considered the first foreign direct investment in Benin. In 1704, France received permission to construct its port at Ouidah. In 1752 the Portuguese built their port in Hogbonou to add to the flourishing slave trade (Manning, 1975). In 1882 the kingdom of Porto-Novo signed an agreement with the protector of France. In 1892, France announced a protectorate over the entire kingdom. Dahomey was conquered in1894 by the French. In 1894, France established the "Colony of Dahomey and its dependencies." In 1904, Dahomey was incorporated into French West Africa, which included: Mauritania, Senegal, French Sudan (now Mali), French Guinea (present-day Guinea), Cote d'Ivoire, and Upper Volta (Present-day Burkina Faso).

During the Colonization: in 1946, Dahomey became an overseas territory of France. On the 1st day of August 1960 gained their independence from France. Between 1963-1972 was marked by a period of political instability. In 1975, Dahomey was renamed by the military government headed by Major Mathieu Kerekou as the People's Republic of Benin (Africa Contemporary Record, 1992). The name changed to the Republic of Benin in 1990. In 1989, Benin agreed to International Monetary Fund and World Bank economic adjustment measures.

Present-Day Benin: Benin benefits from various bilateral investment treaties between the following countries: Burkina Faso, Canada, Germany, Kuwait, Netherlands, Switzerland, and United Kingdom (United Nations UNCTAD, 2020).

Botswana

(Tlou & Campbell, 1984) She is located in the center of Southern Africa. Botswana is blessed with various wildlife such as birds, different species of mammals, and fishes at its border. The recorded history of Botswana is dated back to the 14th century through its inhabitant known as Tswana

origin, also known as “Batswana.” (Fearon, 2003)During the 19th century, its inhabitants comprised at least eight Kingdoms, which shared a common language, religion, and history.

(Schrank, 1974) stated that the Germany Settlers in Southwest Africa (present-day Namibia) were pushing westward during this period. Dutch settlers, referred to as Afrikaners (Boers), were moving northwards and annexing more and more Batswana lands. To maintain their territory in 1870, Batswana traditional leaders, referred to as DIKGOSI, met with the British Government. Batswana became a British Protectorate in 1885, referred to as the Bechuanaland Protectorate.

(Dale, 1979) Foreign Direct Investment was first seen in Botswana, in 1867-1869, during the discovery of gold mining at Tati near Francistown, which led to the mining of diamond mines at Kimberley, south of Botswana became Southern Africa’s first great industrial area from 1871 (Luebering, 2022). The British South Africa Company used the road through the Bechuanaland Protectorate to colonize other countries such as Rhodesia (Present-day Zimbabwe), which led to another FDI, the building of a railway from Bechuanaland Protectorate to Rhodesia.

(Mmolawa, 2000) On September 30, 1966. Bechuanaland Protectorate became the independent Republic of Botswana.

Present Day Botswana: because of its location, Botswana serves as a gateway to Southern Africa. According to the United Nations Conference on Trade and Development (UNCTAD), the total stock of foreign direct investment (FDI) in Botswana fell from USD 4.82 billion in 2018 to USD 260 million in 2019 due to the COVID-19 pandemic (Gebregziabhear, 2018).

In 2012, the Government of Botswana established the Botswana Investment and Trade Centre (BITC), aimed at promoting investment, export, and development. To achieve these goals, the government of Botswana offered lower tax rates, no foreign exchange control, and started an

electronic tax and custom process in 2016 and 2017 (Magombeyi & Odhiambo, 2017). To streamline sector-targeted investment, the government of Botswana established Special Economic Zones Authority (SEZA) in Botswana's different geographic areas (Dietsche, 2014). The government of Botswana still encourages foreign direct investment geared towards its diamond hub and has recently promoted investments in significant water, electricity, transportation, and telecommunication infrastructure projects. This is brought substantial investment in the following areas: the mining, mineral processing, beef, tourism, solar energy, and financial services sectors (Akinboade, Siebrits, & Roussot, 2004).

Burkina Faso

As recorded by history, the first people to settle in present-day Burkina Faso were the Mossi people of the 11th and 13th centuries. They established various kingdoms such as the Ouagadougou, Tenkodogo, and Yatenga (Izard & Ki-Zerbo, 1992). This kingdom became a significant center of the trans-Saharan trade. The trans-Saharan business was used to establish the trans-Saharan route, which added to the spread of commerce, religion, and development. This kingdom was characterized by iron production, furnaces, mines, and surrounding dwellings dating from the 5th century to the 8th century. Present-day Burkina Faso was known as the Iron-age Bura culture from the 13th century to the 3rd Century. These kingdoms created strong fortress to withstand the Mali and Songhay Empires, but in 1980 succumbed to the colonization of the French.

During the Colonization: Present-day Burkina Faso became a colony of the French in 1980, and in 1989 its name was changed to Upper Volta, and its bounds were established. Iron production continued during the colonial period. In 1960, Burkina Faso gained independence from the French under President Maurice Yameogo (History of Burkina Faso, 2022).

After Colonization: Burkina Faso experienced a lot of coups and unrest. 2nd of August 1984, the name Upper Volt was changed to Burkina Faso, which means land of upright/honest people, under President Sankara's initiative (Fosu, 2002). Part of the initiative was launching anti-imperialism policiesreign aid, nationalizing all land and mineral wealth, and averting the power and influence of the World Bank and International Monetary Fund (IMF).

According to the (World Investment Report, 2021), FDI declined in Burkina Faso from USD 163 million in 2019 to USD 149 million in 2020, while its stock FDI remained the same at USD 3 billion in 2020. The investment was geared toward its mining sector in the gold, zine, and manganese mine.

Burundi

Burundi is one of the few African countries whose borders were not defined by the colonial rulers. Burundi had two major clans, the Hutu and the Tutsi clan, the Hutu clan was responsible for the farms, and the Tutsi were in control of the army and most of the economy, particularly in the export of coffee. (Weinstein, 1972). Both clans spoke the same language called the Rundi (Kirundi). From the 19th Century till 1923, Burundi was colonized by German. Then in 1923, after Belgium won the League of Nations mandate, Burundi and Rwanda were transferred under their colony (Girma, 2015). In 1896, Germany built their first military post in Burundi.

Post Colonization: In 1962, Burundi gained independence under Mwami Mwambutsa IV, a Tutsi. This led to a conflict with the Hutu, and since then, the country has been characterized by coups d'états with seven major coups d'états, five of which led to a regime change (Poppe, 2015). Burundi is represented by its fragile nature, such as slowed development and investment processes (Nkurunziza, 2017).

In 1990, Burundi slowed its move toward to democratic regime establishing constitute change. In line with that, on February 28th, 2005, a vote was conducted in favor of the national referendum with a post-transitional constitution. In 2006, the Hutu and the Tutsi signed a peace treaty, which reduced violence in the country (Ndayishimiye, 2008).

Cameroon

The area of Cameroon was first occupied by the Bantu people in 1,500 B.C.E. the first record of the European arriving in this country was in 1472 when the Portuguese explorers and traders. In 1808, the Fulani migrated from the Sahel region of western and north-central Africa to farm and rear cattle (Balogun, 1986). Malaria prevented European colonization till late 1870. The involvement with the European before then was basically for trade and the acquisition of enslaved people. But in the late 19th century, the European Christian missionary established their presence in Cameroon (Reid, 2019). In 1884, a German official invaded Cameroon and raised its flag, calling it "German Kamerun" with investment in the infrastructure, particularly the railroad structure in Germany. However, it was built on the back of the Indigenous people of Cameroon. Also, during the early years of German colonization, rubber was discovered in the east part of Cameroon (Mbaku, 2005). With the defeat of Germany in World War 1, the League of Nations assigned Cameroon to the French and British Cameroon. French Cameroon continued to develop and invest in infrastructures while combining their capital with labor and ending the German practice of forced and harsh labor. While the British chose to pitch their tent in Nigeria, a neighboring country, this was not correctly accepted by the Cameroonian and led to little investment from the British in Cameroon compared to Nigeria (Takougang & Krieger, 2018).

After Colonization: Cameroon gained its independence from France on the first day of January 1960, and the British on the first day of October 1960 before the Union of the Peoples of Cameroon

(UPC), the largest party in Cameroon, asked for the amalgamation of the French and British Cameroon into a single Cameroon (Awasom, 2002). In February 1961, a bilingual state was formed, known as the Federal Republic of Cameroon (Ardener, 1962).

Present-Day Cameroon:

Under the Structural Adjustment Program, Cameroon liberalized its trade and privatized its parastatals, with most foreign and domestic hinging on that. The Cameroon investment code was enacted in 1990, which eliminated requirements for technology transfer, screening of investment, and the rationing of foreign exchange privileges. This code also made Cameroon an Industrial Free Zone (IFZ), which was characterized by a ten-year tax holiday and 15% corporate tax year beginning the 11th year) for enterprises that export at least 80% of their output (Corporation, 2022). Despite this attractive investment code and IFZ, Cameroon still has not been able to attract foreign investment because of its problem implementing its policy transparently (Mujih, 2012).

Cape Verde

Portuguese explorers were the first established and recorded settlers of Cape Verde. They settled there in 1462 and were used as a stop-over for the enslaved people transported to Europe through the Atlantic (Davidson S. E., 1985). Cape Verde was the first country in the tropical region to be colonized by the Portuguese and the starting point for the building of the Portugal Empire. In the first century of the Portuguese colony in Cape Verde, Cape Verde was seen as an extension of Portugal, not a settlement. As such, the Portuguese colonies established various plantations of cotton and sugar to grow the economy of Cape Verde, but because of the dry climate, it was not a success. This increased emphasis on the enslaved person and the transatlantic slave trade. Cape Verde became the route from Guinea-Bissau through Brazil. Cape Verde also became a strategic

route for Africa and America to supply the transatlantic slave trade, which led to a diverse culture in Cape Verde (Filipa, 2011).

The 1807 Abolition of slave act by the British drastically reduced the slave trade business and the economy of Cape Verde. This led to a period of decline in the economy of Cape Verde in the last 50 years of 1800. This led to a shortage of food, natural disasters in Cape Verde, and the change in power in Portugal, which was unfavorable for Cape Verde, led to a deteriorating economy (Ferreira Costa, 2019).

The journey to independence for Cape Verde was in partnership with Guinea-Bissau, which founded the African Party for the Independence of Guinea and Cape Verde (PAIGC) on the 19th of September 1956 (Lobban, 2019). In 1975, Cape Verde and Guinea gained independence from the Portuguese.

After Colonization: PAIGC remained a powerful coalition until the military coup in Guinea-Bissau in 1980, which led to a split, and the African Party for the Independence of Cape Verde (PAICV) gained power in Cape Verde (Edalina & Gerhard, 2020). In 2013, Cape Verde submitted a request to be called Cabo Verde in all languages, in line with what is called in Portugal (Neto, 2020).

Present-Day Cabo Verde: In 2007, Cabo Verde moved from a low-income country to a middle-income country and met its Millennium Development Goals (Sumner, 2010). Cabo Verde has strategies geared towards increasing and encouraging foreign direct investments. Some plans include tax benefits for foreigners who buy a second home in Cabo Verde and permanent residents to foreigners who invest more than $2 million (USD) in Cabo Verde. Cabo Verde seeks foreign

and domestic investment to drive economic growth, which is geared toward tourism, transportation services, and renewable energy (Fernando, Marta, & Helena, 2021).

The Central African Republic

The early settler of the Land comprises people from different ethnic groups: The Banda, Baya, Ngbandi, and Azande. During the 16th and 17th centuries, like many other African countries, the Central African Republic became a major route for the slave trade (Pasch, 2008). Enslaved people from this country were shipped to the Mediterranean coast, Europe, Arabia, the Western Hemisphere, and some ports in Africa. The Bobangi were the major slave trader using the Ubangi river (Ogot, 1999).

Colonization Period:

The Scramble for Africa is when Western European powers invaded and colonized most of Africa (Mostafa, 2016). The French explored the Central African Republic using the Ubangi River through Brazzaville, a city in the Republic of Congo (Pierre-Marie, Emmanuel, & Tamara, 2020). However, no record is available to establish which European explorers settled first: French, German, or Belgians. In 1887 the French established the Central African Republic as their colony, and in 1889 established a post in Ubangi River at Bangui. In 1894 Central African Republic, Ubangi-Shari, became a French territory (Samarin, 1982).

During this period in about the 1930s, coffee, tea, and cotton were the primary export of the Ubangi-Shari, as well as the mining of gold and diamond. On the 12th of July 1960, the Central African Republic gained independence from France (Beyer & al, 1970).

After Colonization:

After the colonization by the French, the Central African Republic increased its production of the diamond by eliminating the monopoly on mining by the concessionary companies and giving Central Africa the right to mine diamonds (Greenhalgh, 1985).

Present-Day Central African Republic

After the civil war in 2013, which stopped all foreign direct investment, foreign direct investment continued to flow into the Central African Republic. The FDI increased from $26 million (USD) in 2020 to $35 million (USD) in 2019, which was geared to the mining of diamonds, gold, uranium, and wood (Léonce, Karmen, & Adam, 2020).

Chad

Chad was s diverse place that was home to more than 200 different ethnic groups and 110 different languages. People in the North of Chad were prominent farmers, with Pastoralism becoming the mode of production in 5000 BCE (Isichei, 2000). The first trans-Saharan trade route was established through Chad in 3000 BCE, and the Sao People of Chad were known for their fortified walls and power. Still, the Kanembu overthrew the Sao and took their lands and cities, drastically improving the agricultural practices and works (Africa Contemporary Record, 1992). Different empires, such as the Kanem-Borno Empire, emerged as a strong power in Chad, aiding slave trading. Between 1880 and 1900, Rabah Fadlallah, who was seen as a hero in Africa, gained control of northern Chad and fought the French explorer. But the French increased its army in Chad and finally gained control of Chad (Hylke, 2010).

Colonization Period:

During this period, the French initially placed control of Chad to the governor-general in Congo. Still, in 1910, Chad joined the federation of Afrique Équatoriale Française (AEF, French Equatorial Africa) after complaining of neglect by the French (Phyllis, 1993). Chad was characterized by Forced labor by the French, which was geared towards working in their private companies, government, or emergencies with no compensation. Chad was difficult for the local citizen because of the famine and the tax system (head tax) imposed by the French. And the opposition party was raised, which fought for their independence, which was finally gained on the 11th day of August 1960 (Le Vine, 1966).

After Colonization:

After its independence, Chad knew a lot of violence and the longest standing Civil war in Africa, which lasted for more than 24 years (Straus, 2012).

Comoros:

In the early 16th century, Comoros was used as a significant route for the trade between Africa and Madagascar Island by the Arabs (Said, et al., 2011). And as such, it got its name ‘Kamar,' meaning the moon, an Arab word. From the 16th Century till the 18th Century, Comoros was known for its kingdoms, chiefdom, and its sultanates. The French came into Comoros in 1841, and it became a French colony in 1912 and was considered by the French a part of Madagascar. In 1973, an agreement was reached between the French and the Comoros sultanates to gain their independence in 1978, but on the 6th of July 1975, Comoros gained independence. Comoros experienced a lot of coups and violence after their independence (Daou, 2017).

Present-Day Comoros:

The Comoros government encourages both domestic and foreign investment in the economy by giving tax concessions and benefit. But with the unstable political environment, few assets are seen. Most of its investment goes to the fishing and agricultural sector of the economy, with China being its biggest investor (Meidan, 2006).

Republic of Congo

Also referred to as Middle Congo, Congo-Brazzaville, and Congo but different from the is also known as Zaire. From the early 14th century through the 19th century Central Africa was made of various kingdoms such as the Kongo, the Lunda, the Luba, and Kuba (Gondola, 2002). The Kingdom of Kongo had control of the present-day Congo, with its capital in Mbanza-Kongo (present-day Angola). In the late 15th century, the first Portuguese sailors arrived Congo and brought spoils from Portugal. And to get the spoils, King Afonso 1 raided its kingdom and neighboring kingdom to get enslaved people to trade for the booties, which boosted economic growth in Congo (Gondola, 2002). The enslaved people were sent to sugar plantations in Brazil, the US, and The Caribbean through the Atlantic. By 1780, 15,000 enslaved people were shipped annually from Congo to various locations. In 1870 the first Welsh-America arrived Congo and explored the land. Still, in 1876, central Africa was allocated to the International African Association, and as such, Congo became the private estate of the Belgian King, Leopold II (Gondola, 2002). And this period was known for its hard times because of the presence of corruption, bribery, and theft with unpaid and worsening working conditions for the enslaved people, used in building infrastructures such as the railway between Matadi and Stanley Pool and the Rubber Plantation. This led to the demand for its independence and the gaining of its independence in 1960 (Nest, 2002).

After Colonization:

Congo experienced a lot of unrest after the colonization in the quest for power and balance of power. The Mouvement National Congolais (MNC), the majority party of the Central government, and the Association des Bakongos (Abako), the majority party for the Local government, were in a constant fight (Lemarchand, 1964). This conflict carried on, and in 2000 a peace agreement was reached between the parties and the rebels. Still, this agreement was ineffective because, in 2001, another conflict emerged near the Presidential Palace. Congo is one of the top countries in central Africa that receive investment because of its oil sector, and it currently has no limit to foreign direct investment (Anyanwu J. C., 2012).

The Democratic Republic of Congo

The country is also called the DRC, or Congo (Kinshasa), with its capital in parathesis to differentiate it from the Congo republic (Sumaili, et al., 2009).

During the 15th through the 19th century, DRC was known for its developed and elaborate political system in its various kingdom. This kingdom was fostered using the trade of enslaved people. From the 19th century till 1960, DRC was colonized by Belgium (Vansina, 2010).

At their independence in 1960, Congo's economy was based on the extraction of diamond and copper, which was still controlled by the Belgium companies such as Belgian Union Minière du Haut-Katanga (UMHK), which was valued at $430 million. After many conflicts over ownership and control of the companies, a compromise was reached in 1967. The daily operation and management of the mines and company were given to the Congolese, and the Belgium leadership appointed them. But the conflict and strive persistently to the early 1990s led to negative economic

growth from 1990-to 1995. Congolese has relied heavily on agriculture, which accounts for two-fifth of its GDP and three-fourths of its employment in the labor force (Nand, 2012).

Cote D'Ivoire

She was also known as the Ivory Coast. The first known record of this country was in the quest of the Sudanese empire in search of gold, which led to the Sudanese empire dominating the region. But this led to the rise of the various kingdoms in those regions, including the Akan and the Kong kingdoms. The Portuguese arrived in the country first, but in 1842, the French declared it its colony. On the 7th of August 1960. Cote D'Ivoire gain its independence from the French (Fage, 1962).

Djibouti

Two major ethnic groups that make up present-day Djibouti are the Afar and the Issa ethnic groups. From 1843 and 1886 was acquired through a treaty by the French and was initially known as French Somaliland in 1892. In 1897, Ethiopia received part of Djibouti in a pact with the French. Djibouti gained independence from the French on the 27th of June 1977 (Degefu, 2003).

Egypt

(Shaw, 2000) Many inventions and innovations began in Egypt, such as writing, which was the first record in Egypt during 3200 BC. Ancient Egypt was a highly organized society divided into Northern (Lower) Egypt and Southern (Upper) Egypt. The country was divided into 42 nomes and was governed by the nomarch, who collected taxes and enforced laws and order. Egypt is

known for its pyramid. The first steps of the pyramid were built in 2665 BC. The First Intermediate Period lasted from 1281 BC to 2055 BC, characterized by a split into several Egypt and civil wars. Still, at the end of this period, it was reunited and called the Middle Kingdom. It was a great art and literature period, and Pharaohs added more pyramids. (Shaw, 2000)This period ended in 1650 BC with the beginning of the Second Intermediate Period. The Palestinian, known as the Hyksos, ruled the Northern part of Egypt while the Egyptians maintained power in the Southern Part. In 1550 BC, Egypt restored its influence in the North and was united with the South. This was called the New Kingdom. During this period, Egypt restored its power and strength and invaded various countries such as Palestine and Syria, taking the country on the Nubia. After this era was the Third Intermediate Period which lasted for 747 BC (Shaw, 2000).

Modern Egypt

In 1978, the French army invaded Egypt, but with the help of the British navy, they conquered the French military. In 1859, French engineer Ferdinand de Lesseps began building the Suez Canal using funds from the British. The Suez Canal was completed in 1869. And this investment fostered friendship between Egypt and the British. In 1942, German troops invaded Egypt, and with the help of the British army, they conquered the Germans (Burns, 2003).

Eritrea

The country Eritrea was also known as Mdree-Babree, which means Land of the Sea. During the 3rd and 4th centuries, Eritrea was part of the kingdom of Axum of Sudan. From the 16th to the 19th century, present-day Eritrea was subject to the influence and expansion of Egypt, the British, and the Italians as colonial masters. Eritrea came under the government of Italy through the gradual possession of lands and, finally, its national Rubattino Shipping Company (Pateman, 1990).

Ethiopia

Unlike Eritrea, Ethiopia defeated Italy and became one of the few countries in Africa that were not colonized. Ethiopia has been one of the leading countries to foster regional blocs. She was one of the first countries to sign the Charter of the United Nations. From 1930 to 1974, Ethiopia was built on exporting its cash crop coffee and establishing import substitution in textiles and footwear. To date, Agriculture is still the primary input to its GDP (Doxey, 1987).

Gabon

According to (Yates, 2020), Portuguese explorers and traders were the first recorded Europeans visiting Gabon in the late 15th Century.

Nigeria

The history of Nigeria can be dated to the 5th century BC. Various small communities, such as the Jos plateau, are characterized by the iron technology known as Nok Culture. Trade was based on this technology and took place north through the Saharan and east through Sudan. The Northern part of Nigeria was controlled by the Hausa people, who developed a stable community and a strong-walled city which served as a transit for various traders from Mail and Gao in the west and Borno in the east. This led to the growth of multiple empires. The Yoruba controlled the west, known as the Oyo empire, which also ruled regions from Niger to the west of Dahomey. Evidence of finding in various indigenous locations such as brass items in Bida, Ile-Ife, and Benin, bronze in Igbo-Ukwu, terra cotta animals in Borno, and terra cotta heads in Nok (Azubuike, 2009).

Colonization Period:

The Portuguese made the first significant foreign investment in Nigeria by the Europeans, who came and fortified various trading stations. However, they concentrated on missionary work. In 1812, the British government led the expedition south to Nigeria. And this led to the colonization of Nigeria by the British. The British built a trading empire known as the Royal Niger Company, where trading of enslaved people, goods, merchandise, and quasi-governmental activities took place. During the Berlin Conference in 1885, Nigeria was allotted to the British after various struggles for it by other Europeans, the French, and the Dutch (Azubuike, 2009). After which, the British formed the Oil Rivers Protectorate, which runs from the Nger Delta area to Calabar. This protectorate was later expanded to the Lagos colony. At the same time, the northern part of Nigeria became a protectorate in 1900.

In 1914, the Northern and Southern Protectorate was amalgamated to form the now present Nigeria by the British led by Lord Lugard. Lord Lugard gave two reasons for the amalgamation: Northern Nigeria needed to pool its resources with Southern Nigeria because the Northern was still dependent on the Colonial Office to balance its budget. At the same time, Southern Nigeria had a better-developed trade that generated revenue from its custom and excise duties, which would help the North. The second reason for the amalgamation was the presence of an outlet of the sea in the Southern Protector to also aid trade from the Northern Protector, given that River Niger was traffic seasonally (Azubuike, 2009). In the nineteenth century, Nigeria's primary source of revenue was Agriculture, those living in the riverine areas fished the northern practices of nomadic animal rearing, and the rest cultivated the land based on the climate and season. Its output was mainly cash crops, including cotton, rubber, palm oil, tin columbite, and coal, mainly exported to Britain. In 1945, the British developed a Ten-Year Plan of Development and Welfare for Nigeria, 1946-1955. This plan was funded by twenty-three million pounds sterling from the British and twenty-

six million from Nigeria. This plan brought about rapid structural development such as hospitals, telecommunication, roads, and railways (Azubuike, 2009).

After Colonization:

Nigeria obtained its independence in 1960. At the independence, they adopted the Westminister model of democracy, with the Prime minister from the north, the general governor from the east, and the leader of the opposition from the west. From 1962 to 1968, the First National Development plan was enacted, emphasizing an open-door policy to increase multilateral trade and foreign direct investments. But this came with a lot of strife and civil war, which lasted from 1966 to 1970, and this halted the plan, and a second National Development Plan from 1970-1974 was drawn.

The oil boom in Nigeria also led to a decrease in agricultural export from 73 percent in 1962 to 1 percent in 1981. Oil accounted for 93 percent of export between 1973 and 1981, accounting for more than 75 percent of government revenue.

Appendix 1.2 List of Sub-Saharan African countries

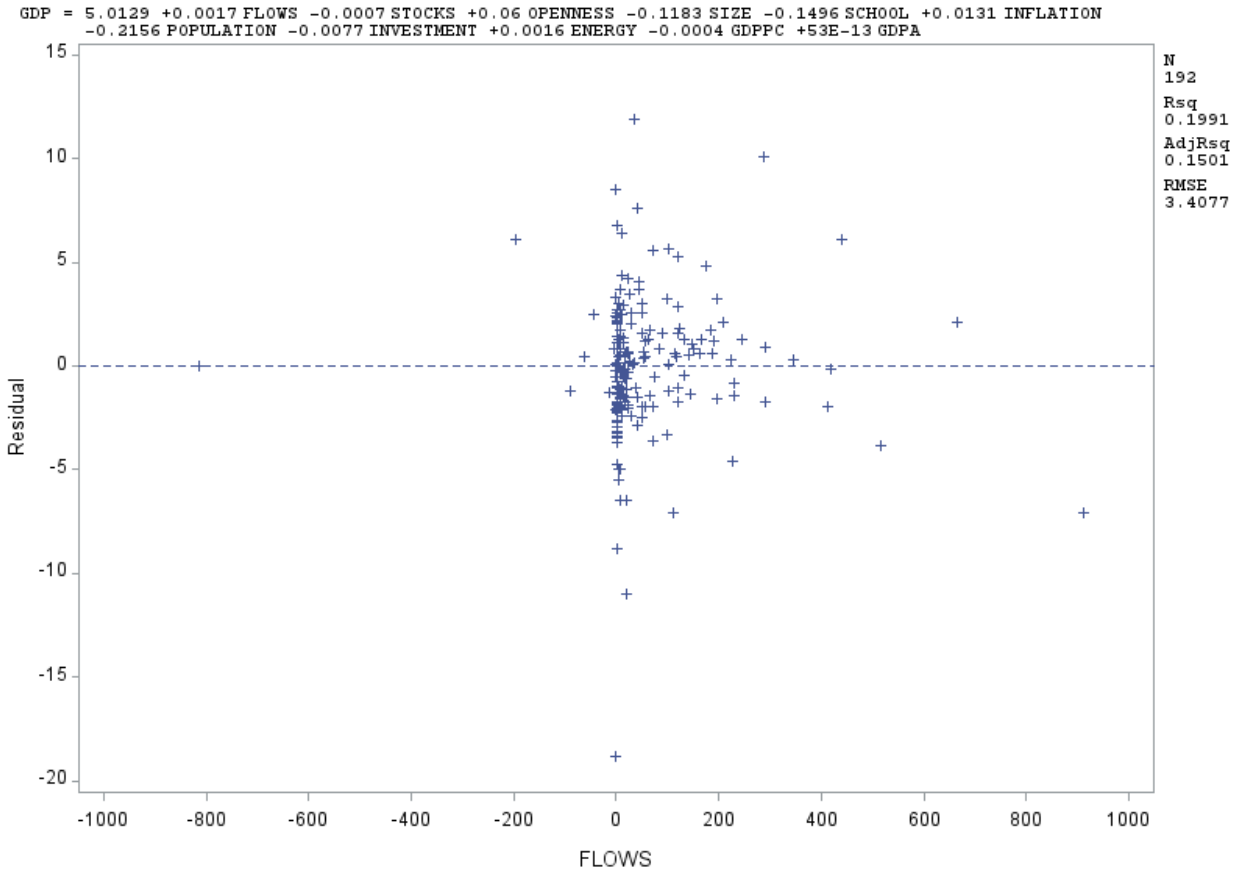
S/NO	Sub-Saharan Africa countries
1	Algeria
2	Angola
3	Benin
4	Botswana
5	Burkina Faso

6	Burundi
7	Cameroon
8	Cape Verde
9	Central Africa
10	Chad
11	Comoros
12	Congo (DR)
13	Congo
14	Cote d'Ivoire
15	Djibouti
16	Egypt
17	Equatorial Guinea
18	Eritrea
19	Ethiopia
20	Gabon
21	The Gambia
22	Ghana
23	Guinea
24	Guinea Bissau
25	Kenya
26	Lesotho
27	Liberia

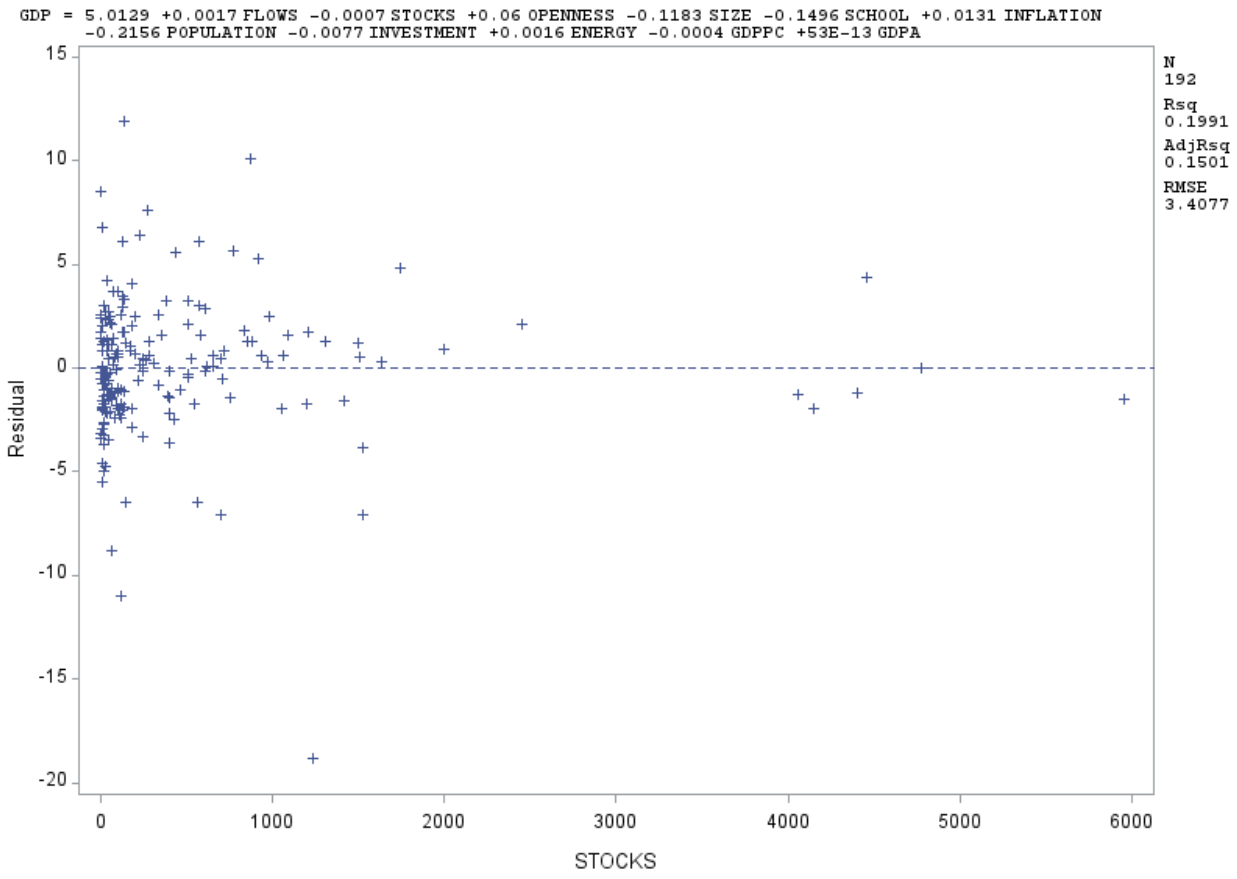
28	Libya ArabJm
29	Madagascar
30	Malawi
31	Mali
32	Mauritania
33	Mauritius
34	Morocco
35	Mozambique
36	Namibia
37	Niger
38	Nigeria
39	Rwanda
40	Sao Tome and Principle
41	Senegal
42	Seychelles
43	Sierra Leone
44	South Africa
45	South Sudan
46	Sudan
47	Tanzania

48	Togo
49	Tunisia
50	Uganda
51	Zambia
52	Zimbabwe

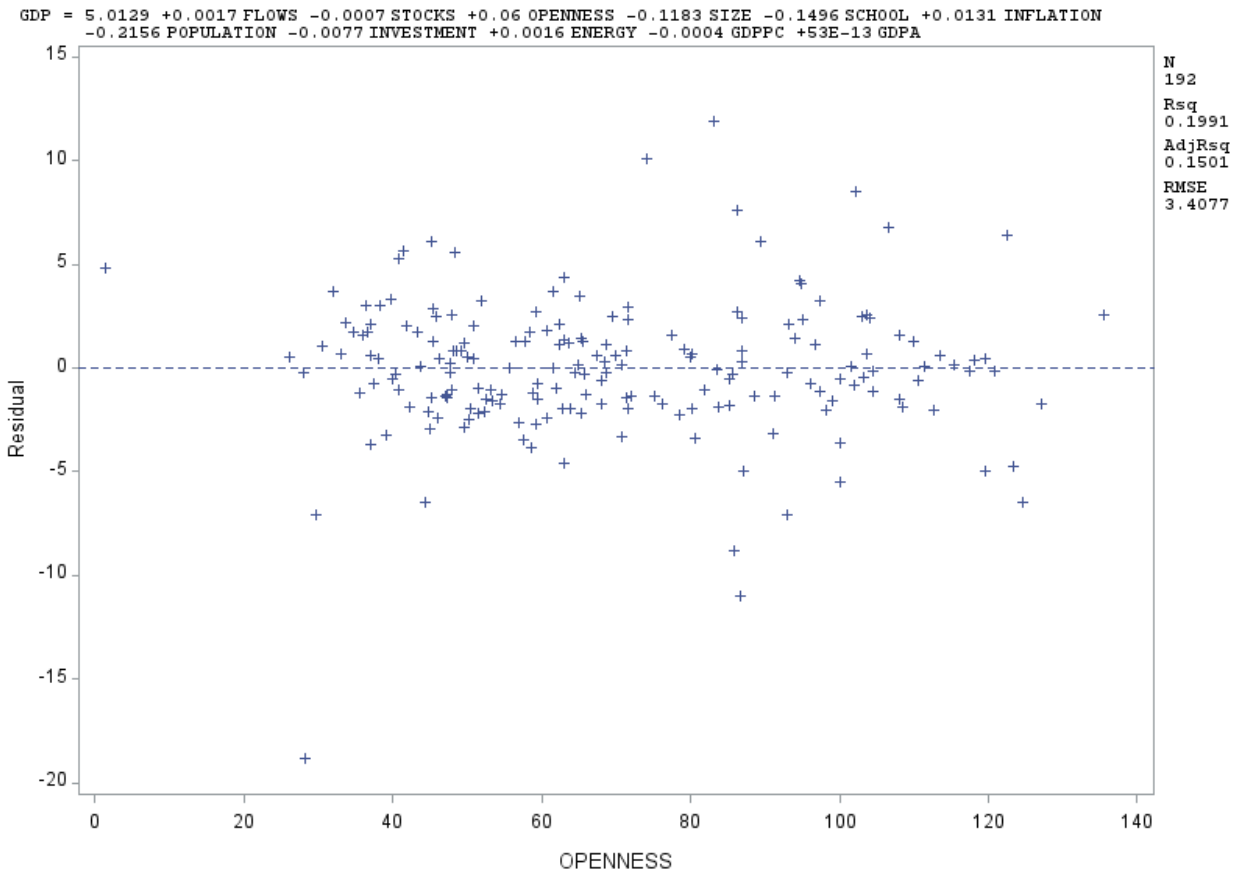
Appendix 1.3: The relationship between residual and OFDI_flows



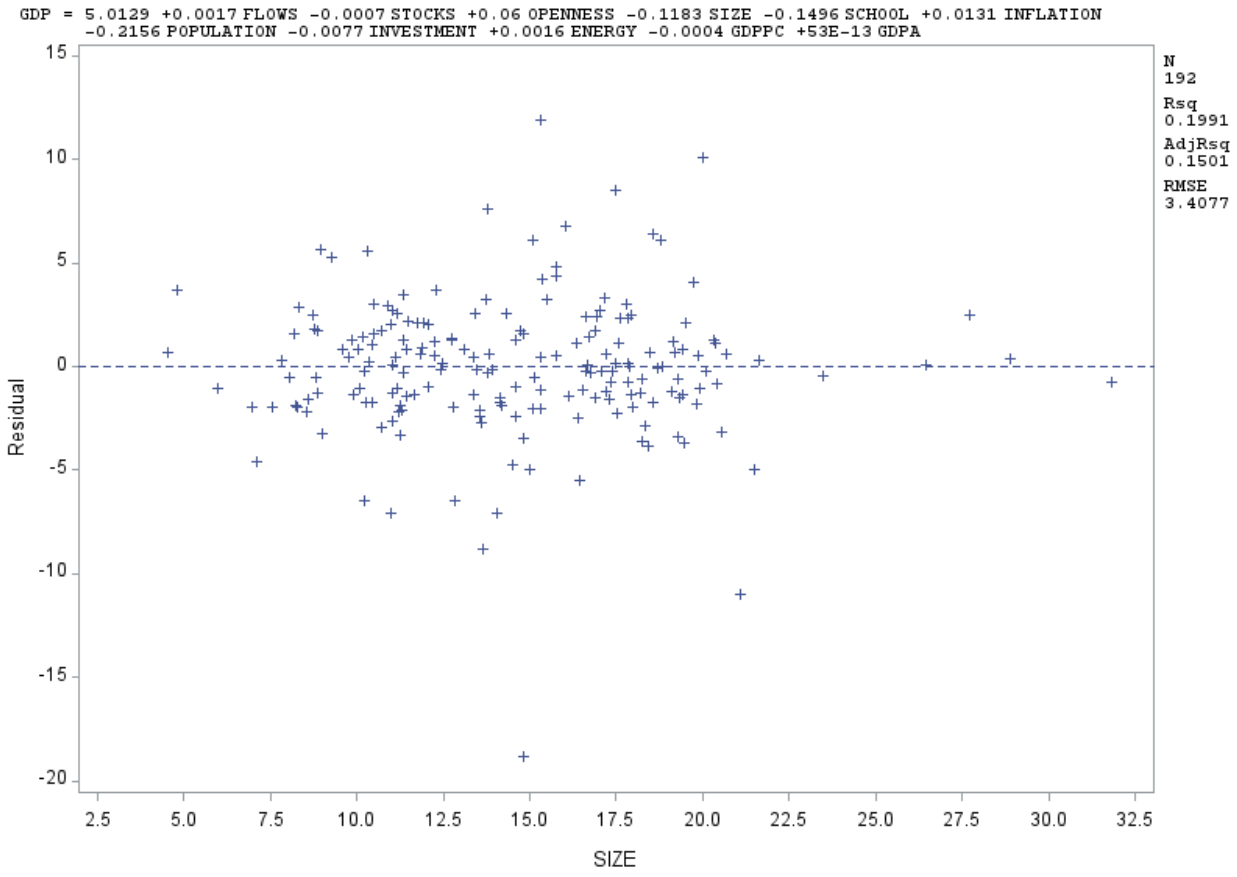
Appendix 1.4: The relationship between the residual and OFDI_Stocks



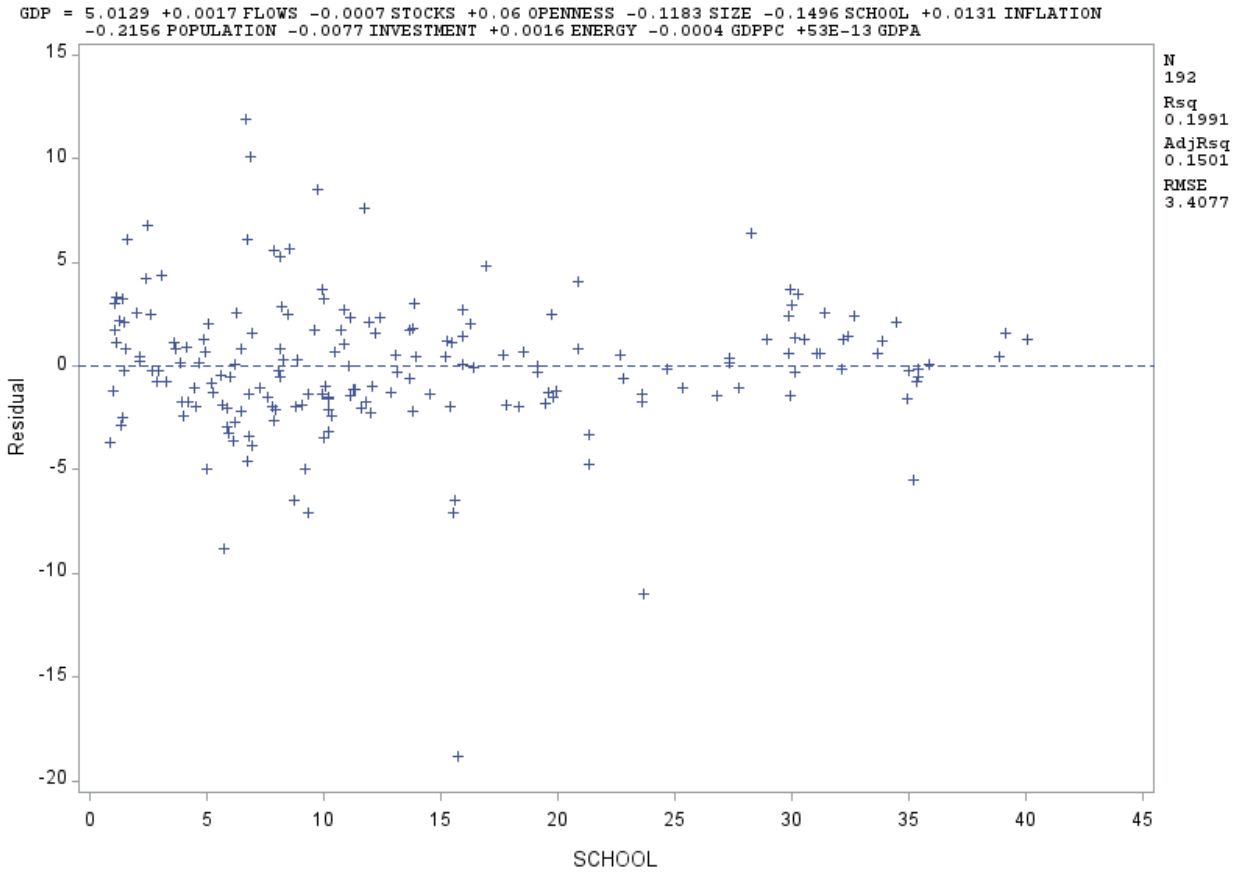
Appendix 1.5: The relationship between the residual and Openness



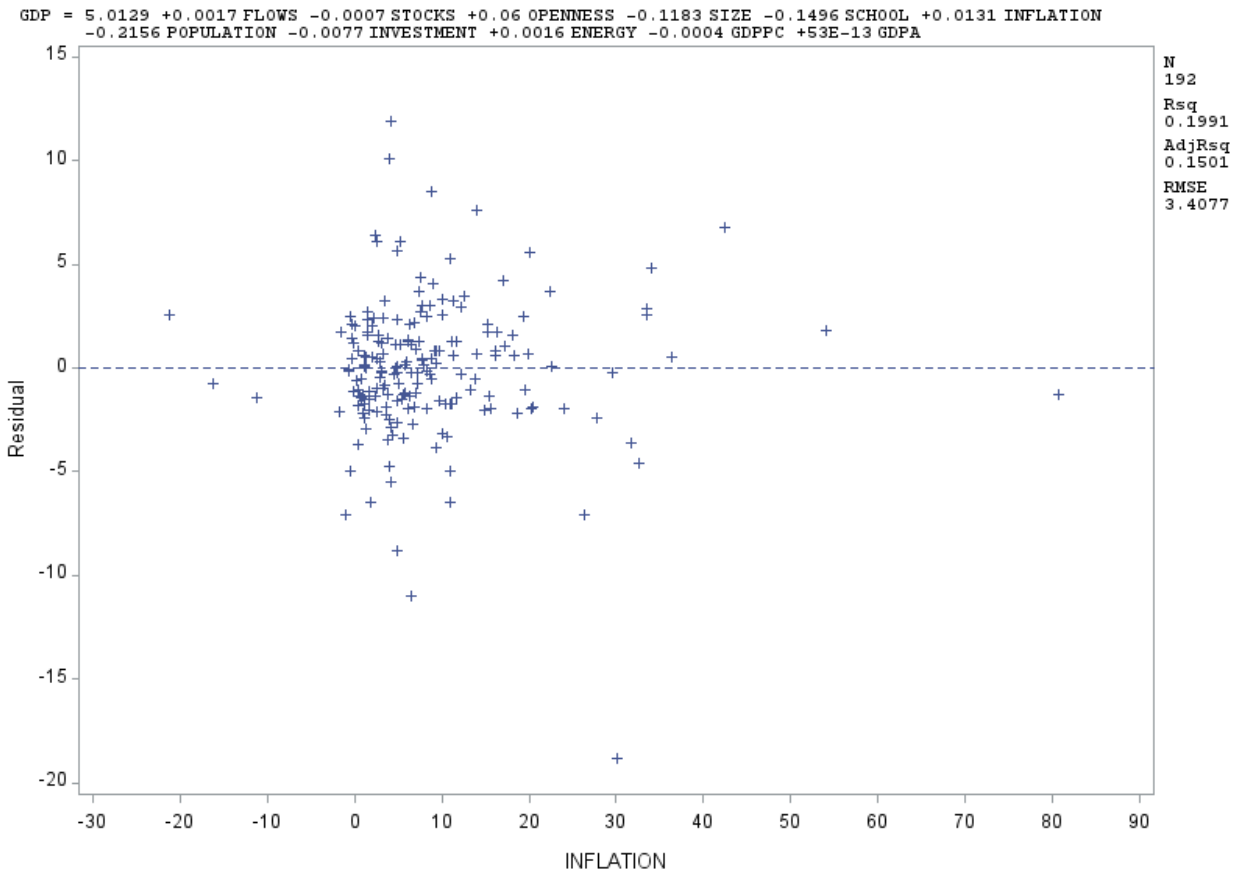
Appendix 1.6: The relationship between residual and Government Size


GDP = 5.0129 +0.0017 FLOWS -0.0007 STOCKS +0.06 OPENNESS -0.1183 SIZE -0.1496 SCHOOL +0.0131 INFLATION
-0.2156 POPULATION -0.0077 INVESTMENT +0.0016 ENERGY -0.0004 GDPPC +53E-13 GDPA
N
192
Rsq
0.1991
AdjRsq
0.1501
RMSE
3.4077
Residual
SIZE
15
10
5
0
-5
-10
-15
-20
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0
27.5
30.0
32.5

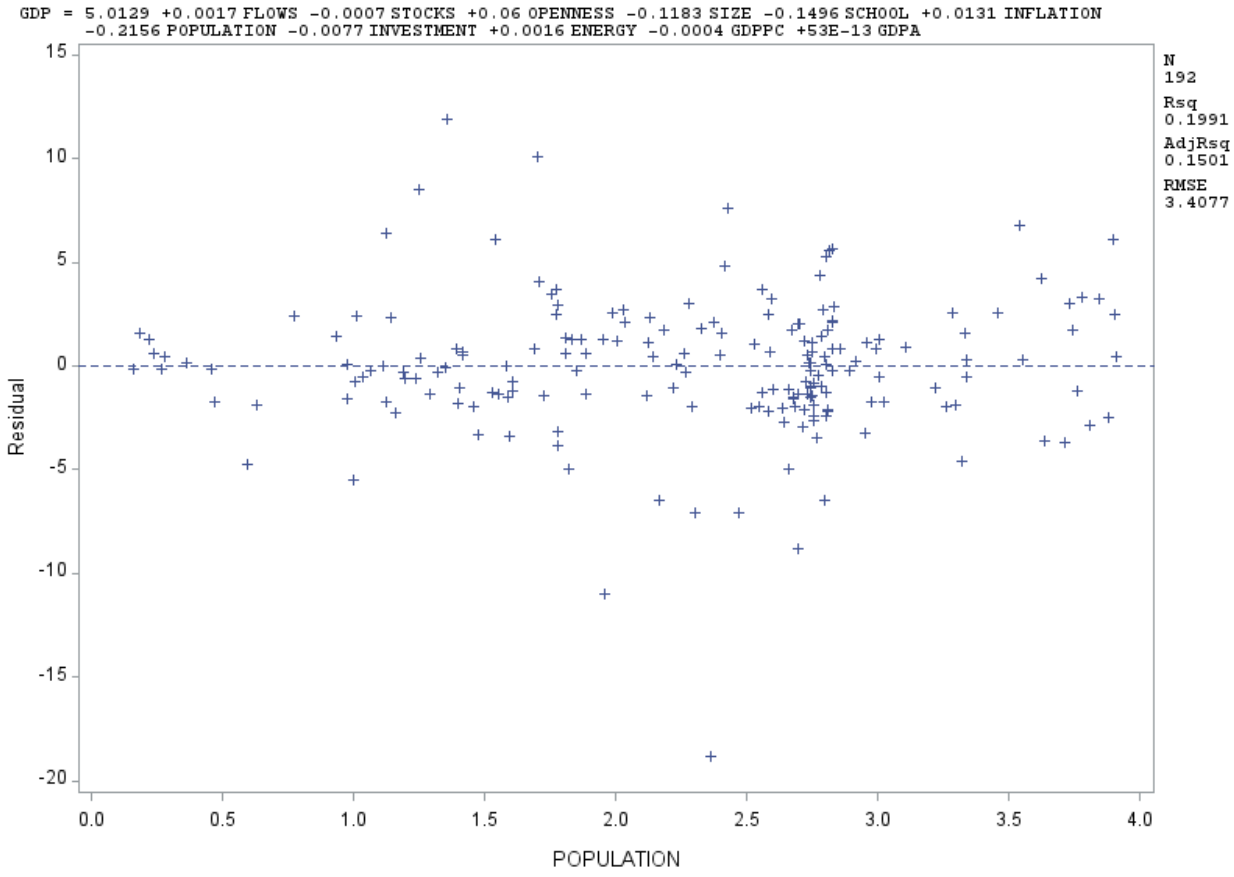
Appendix 1.7: The relationship between the residual and School



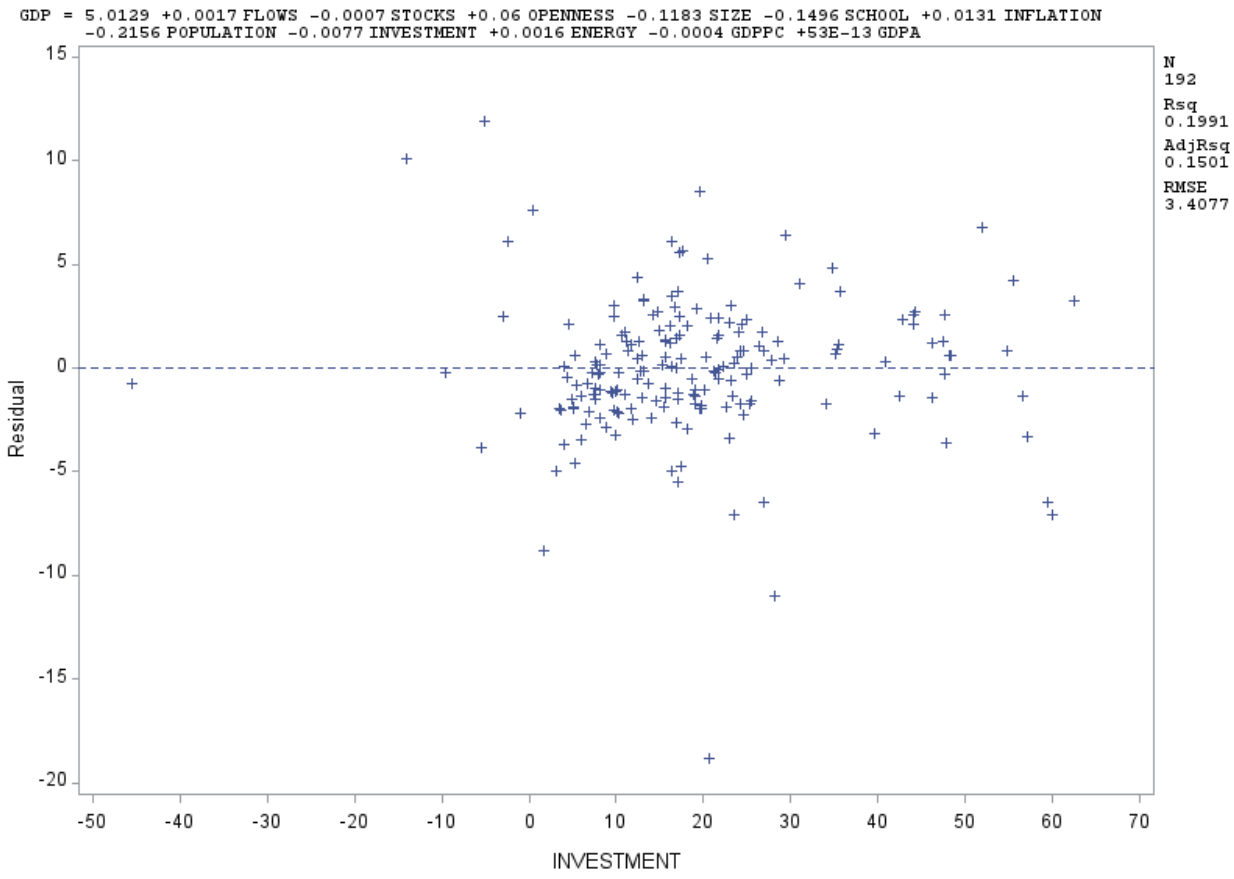
Appendix 1.8: The relationship between the residual and Inflation



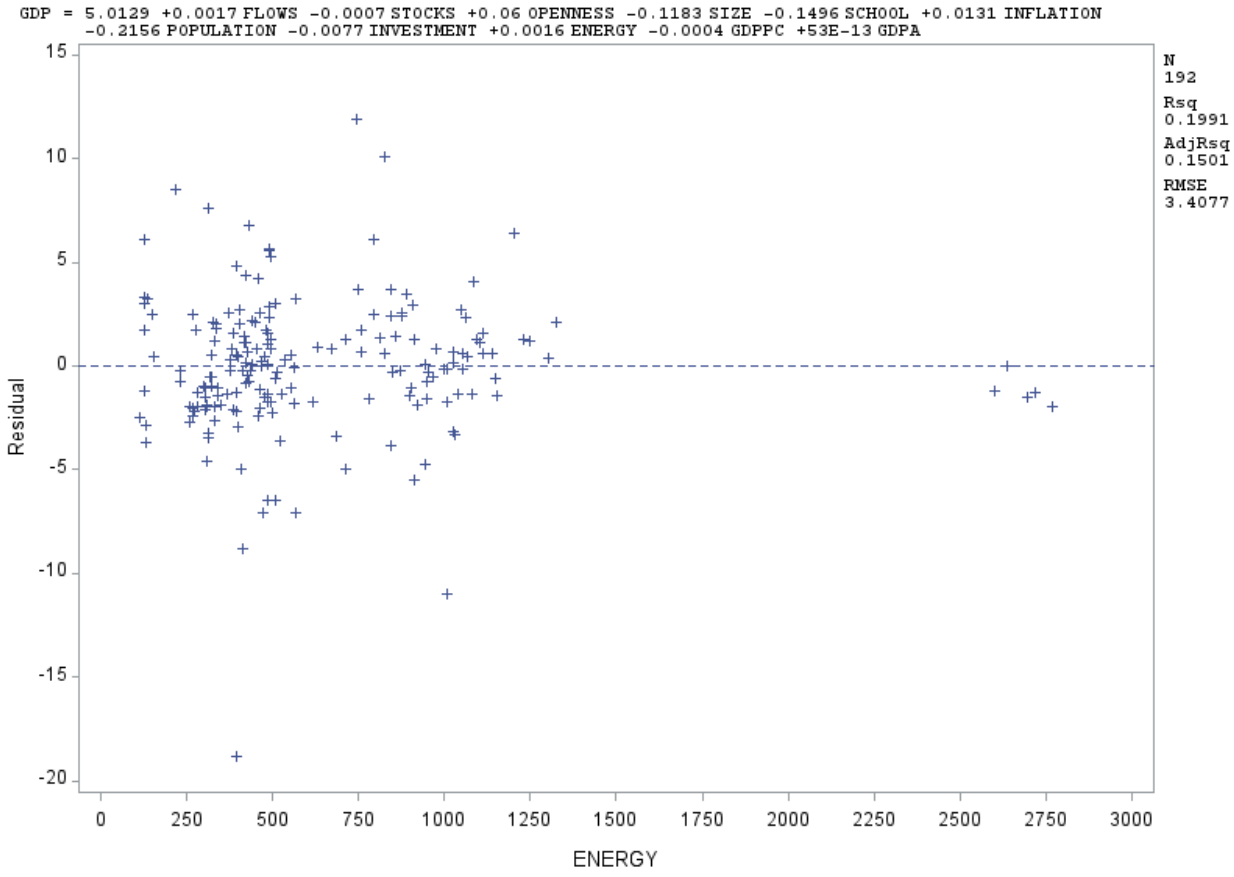
Appendix 1.9: The relationship between the residual and Population



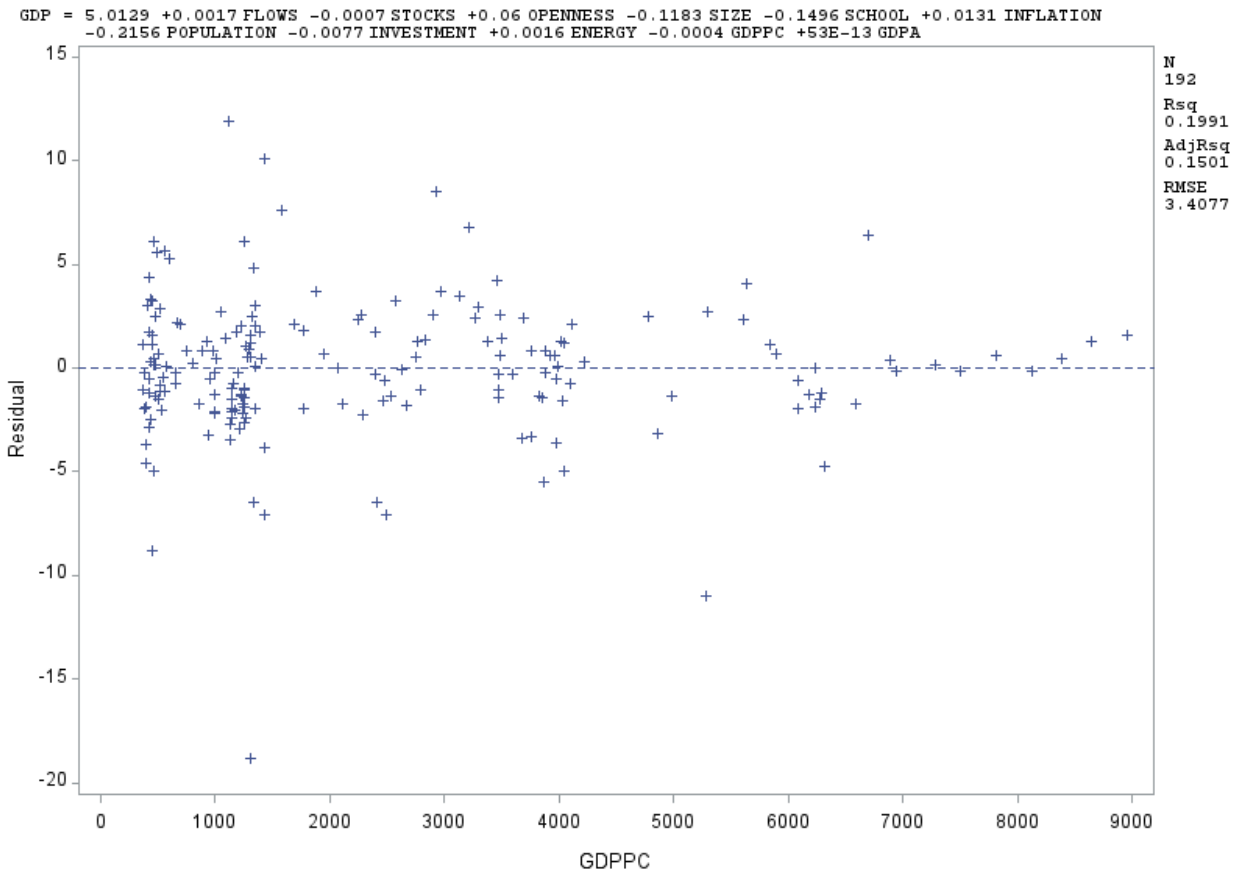
Appendix 1.10: The relationship between the residual and Investment



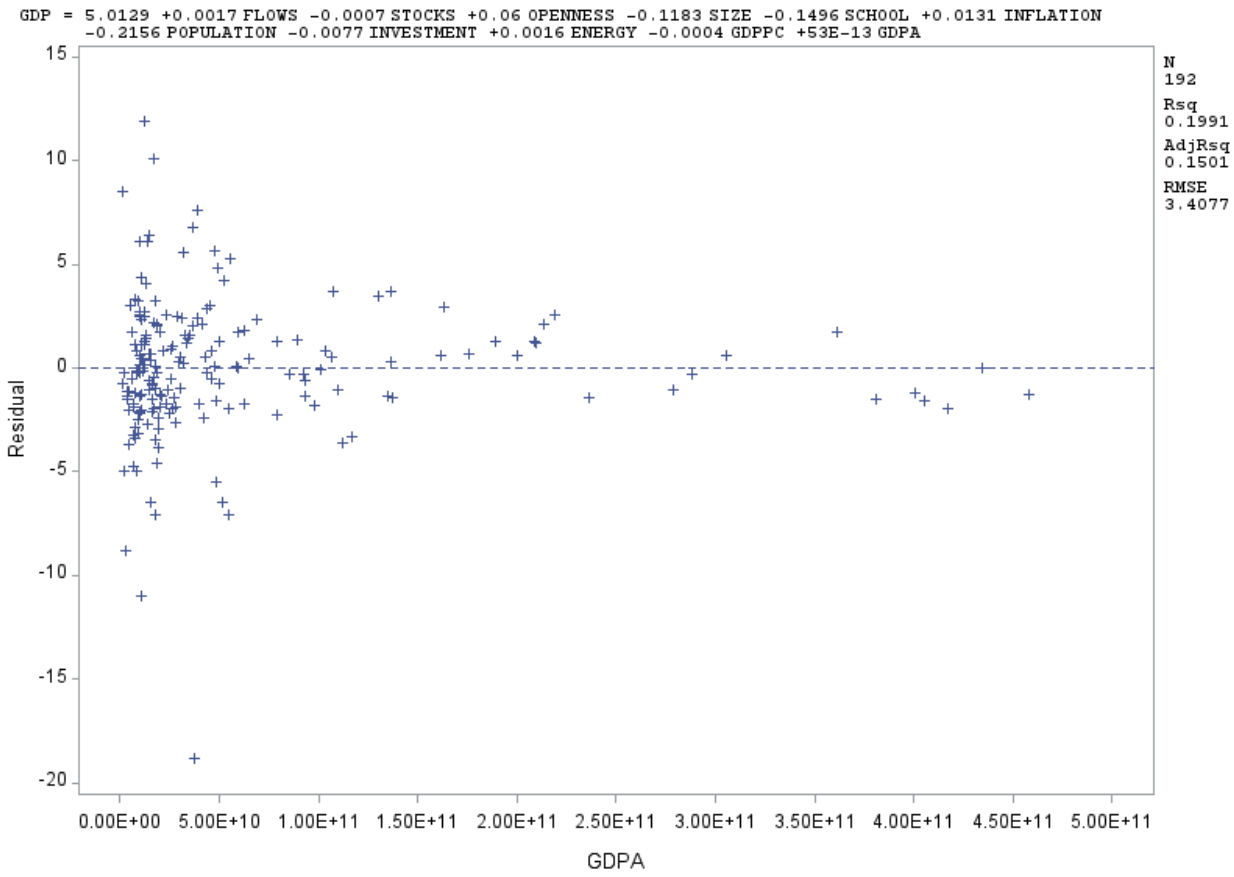
Appendix 1.11: The relationship between the residual and Investment

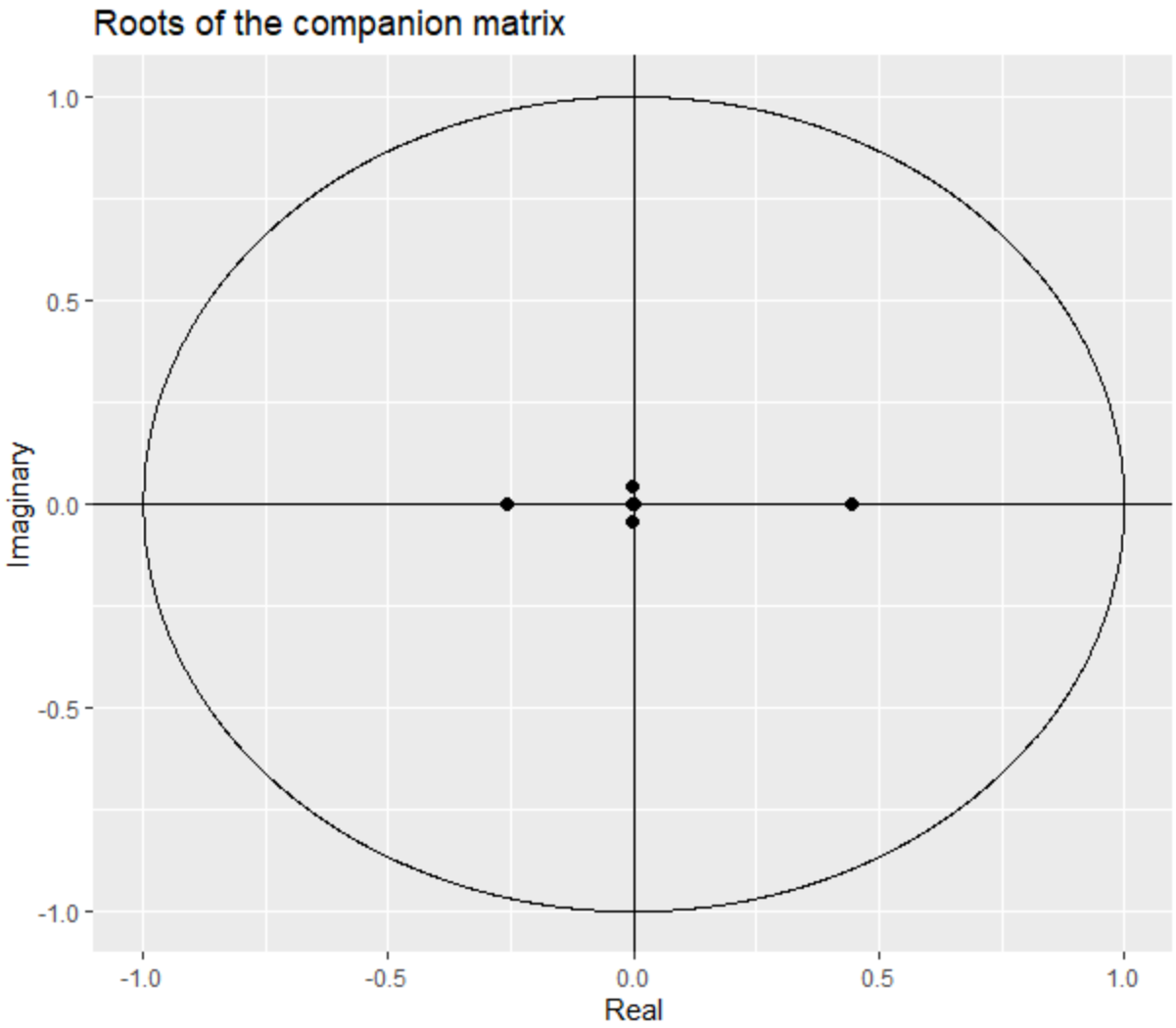


Appendix 1.12: The relationship between the residual and GDPPC



Appendix 1.13: The relationship between the residual and




Roots of the companion matrix
1.0
0.5
0.0
-0.5
-1.0
Imaginary
-1.0
-0.5
0.0
0.5
1.0
Real