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FOREIGN DIRECT INVESTMENT AND ECONOMIC GROWTH IN SUB-SAHARAN AFRICA: THE ROLE OF TECHNOLOGY

BY

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF DEGREE OF MASTER OF PHILOSOPHY IN FINANCE DEGREE

JUNE 2017

DECLARATION

I declare that the content of this thesis, with the exception of all cited works, is the result of my own research and has not been presented by anyone for any academic award in this or any other university. All cited works used have been fully acknowledged. I bear sole responsibility for any shortcomings.

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ACKNOWLEDGEMENT

I express my gratitude to Prof. Joshua Y. Abor and Dr. Elikplimi Komla Abloyor, my lead and second supervisors, for their support, time and effort in overseeing my work.

I would also like to acknowledge the following for their much needed support in the completion of my thesis;

The horse is prepared against the day of battle: but victory is of the LORD (Proverbs 21:31). Am ever grateful to the Lord for his work on my soul, that it has pleased him to call me out of the world. That exceeds any accolade I could ever get in the eyes of men.

Am thankful for my dad for his unflinching support for me throughout my academic endeavours. My siblings have also played their part to which am most grateful. May the good Lord bless and keep you in his bosom.

Am also thankful to Prof. Gamel Wiredu of Ghana Institute of Management and Public Administration (GIMPA), MIS department, for his insightful comments and review of my thesis during the course of completing this thesis. Am truly grateful for your time and effort you committed to me.

My colleagues and friends, I owe a lot to for your comments that helped shape my work. I couldn’t have done it without you. And I say thank you to you.

DEDICATION

This work is dedicated first and foremost to the Lord God Almighty. It is in Him that this work was started and completed. His wisdom has been sufficient.

Secondly, this work is dedicated to all hands that have contributed one way or another towards the progress and completion of the work.

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ABSTRACT

This study sought to assess the economic impact of FDI on economic growth, factoring in technology as an absorptive capacity. To do that, we sampled 43 countries in Sub-Saharan Africa (SSA) over a 19-year period (from 1990 to 2008). We employed a Fixed Effects (FE) regression model. Studies have shown that the effect of FDI on economic growth is not always positive in developing regions; certain characteristics must exit to absorb the effects of FDI. We employ technology as an abortive capacity and interact it with FDI to find its effect on economic growth. We found that FDI had a negative and significant effect on GDP, which is our proxy for economic growth. However when we interact FDI and technology, the relationship is positive and significant. Meaning countries with technology are able to absorb more from FDI. We found also that countries with high technology are able to absorb more from FDI than countries with low technology.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Since the emergence of globalization in the last three decades or so, Foreign Direct Investment (FDI) has been an important mechanism for universal growth and development through trade and economic interaction. This is usually so especially for developing countries because of their difficulty in assessing the international capital market, weak domestic markets and their low levels of income and savings. This has made it necessary for developing nations to look beyond their borders for investment that will generate growth for them. FDI and official loans from multinational institutions (like the IMF and World Bank) have been the viable means of accessing such capital investments (Aseidu, 2002). In the case of FDI's, the main drivers at the national level -that is, the policy makers- have implemented reforms to promote trade among countries which foster economic advancement. This has led to the progressive breakdown of international barriers (Twarowska & Kakol, 2013) and improved shared prosperity among countries with competitive advantage and efficiency as they interact with other countries who have a different set of benefits in an open market for the "shared good" of the countries involved. Not only has this made available investment opportunities for the private and public sector (Sinani & Meyer, 2004), but a means through which technology innovations are shared (IMF, 1991;Meyer, 2001).

Technology is an important tool for firms to remain competitive both on the micro and macro levels. Technology improves the quality of outputs, reduces the production and processing time, reduces the cost of production (UNCTAD, 2010). It's key for a country to have relevant and contemporary technology. However technology quickly becomes obsolete making its important for countries to engage in continuous research into new forms of technology, in order the stay competitive in the global market. This is possible in a utopian economy but in the real world, not all countries have the skills, knowledge, and capital investment to engage in technology enhancing research. So, Rich countries tend to have better growth enhancing technology whilst poor countries have lower technology, widening the technological divide between the two. However through economic globalization, local corporations are able to move beyond their geographical borders. This growth is mainly through market leadership, high profitability, and scalability of business. Also, breakthroughs in efficient transportation and communication technology have aided in this globalization (Twarowska & Kakol, 2013). These multi-national companies (MNC's), so called, value technology as a means for growth so they invest substantially in research and development. They are able to transfer some of these technologies voluntarily or involuntarily as they engage in investments abroad.

Through interaction with the foreign firms, MNC's knowledge and technology can be absorbed by the local firms. This technology leads to increase in productively in the local firms. The aggregate effect of increased productivity is growth in the economy. Some studies have been done on technology transfer effect from FDI. For example, in the study by Sandra Lancheros in 2016, she found out that improved foreign markets access is important for (local) firms to adopt technology and innovation.

Although much studies have been done on technology from FDI, to the authors' knowledge, not much studies have been done on the effect of FDI on economic growth when technology is factored in as an absorptive capacity. Also some studies (see Asiedu, 2002) have shown that Africa is "Different" in terms of what attracts FDI into the continent, compared with other developing countries outside the continent. If the nature of FDI that comes into Africa is different, then it pushes for more studies must be conducted to see how technology from FDI affects growth of the economy.

1.2 Problem Statement

The economic impact of FDI on growth has been a well researched area in academia (See Figure 1.1). Studies have looked at the various effects. In chapter two, we identify three strands of research. For studies done on the FDI on developing economies, absorptive capacities are included in the models to examine the FDI-GDP relationship.

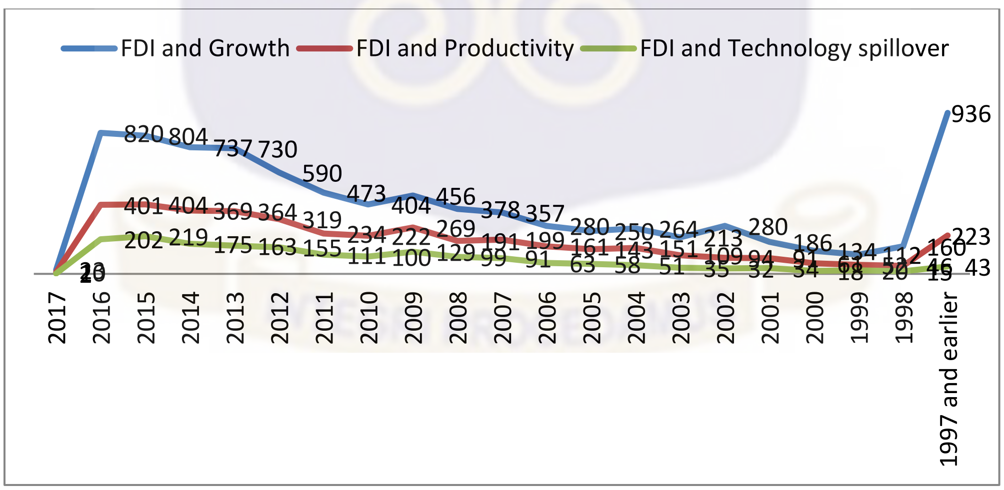
Some studies have emerged that vary FDI with absorptive capacities to see its effect on economic growth. For example Agbloyor, Gyeke-Dako, Kuipo, & Abor (2016) have looked at the relationship between FDI and growth when institutions are factored. They found that countries with strong institutions have higher economic growth through FDI than countries with weak institutions. Studies on technology have also showed how it affects productivity (Dutse, 2012; Liu, 2008). And although studies on technology has shown that FDI is a major way technology reaches developing economies, not much studies have looked at its effect as an absorptive capacity on economic growth. This thesis weeks to fill this gap.

Also technology has mostly been studied on a firm level. These studies have showed that technology spills over to host firms (Sinani and Meyer, 2004; Dutse, 2012; UNCTAD, 2010; Bwalya, 2006; Glass & Saggi, 2002) and that they are beneficial to the host country (see

Blomstrom & Kokko, 1996, Glass and Saggi, 1999[1], Wang, 1990[2]). However technology has not been studied using aggregate or country level data. This study address this gap also.

The African continent has been woefully understudied. It is no surprise Asiedu (2002) says africa is different, to borrow her term. Again, how respect to abosrptive capacity, the quantum to research done is woefully inadequate a skewed (as research done is only on one ro two countries). It is also important to note that such stuideis have moslty used firm level primary data. This studie seeks to do something diffienrent. First we incorporate macro level secondary data. Macro level data allows for multi-country study to be done, which is lacking in leterature. This we seek to address. And also we incorporate most countries in Sub-Saharan Africa, where not much studies have been done. Our masure of technlogy is also novel and we justify it significantly in the methodlogy (chapter 4). This study also seeks to contribute to existiing content by providing relevant research data and information on SSA countries with respect to FDI, growth and technlogy.

Figure 1.1 Published Articles over Selected Time Frame



Author's own computation.

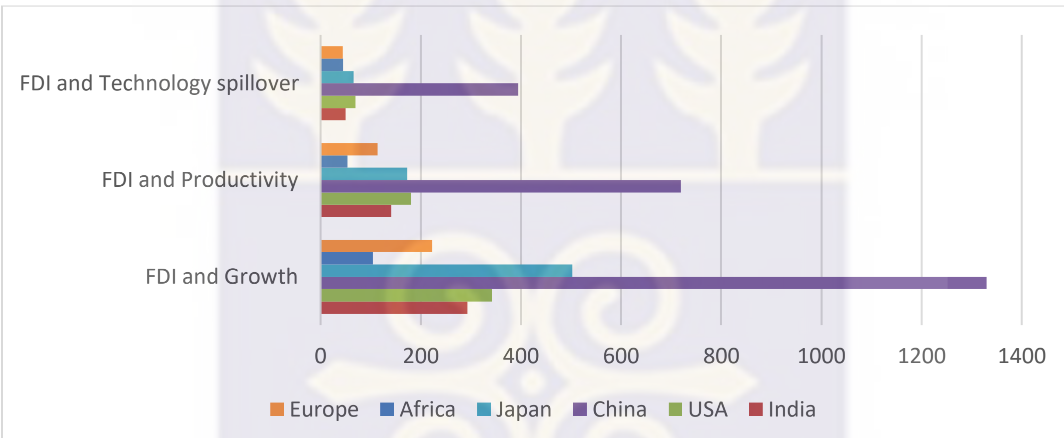
[1] Glass and Saggi (1999) found out that encouraging MNCs to setup local production subsidiaries had a general contagion effect on the local market participants, in terms of knowledge and technology transfer. Thus the presence of multinational firms may facilitate technology transfers to local firms that come into contact with them, through imitation for example.

[2] Wang (1990) finds a positive correlation between growth of domestic human capital and FDI. This means increase in FDI results in human capital investments, which contribute to growth in recipient country.

Data is sourced from Science Direct (www.sciencedirect.com). The author sampled all articles on direct effect of FDI (on growth and productivity) and indirect effect (on technology spillover) from the science direct database. The spikes in 1997 and earlier are due to aggregation of data from earlier years. This increases the number of data points.
See Appendix 2 for further explanations and table.

Figure 1.1 shows that there's more room for research into the relationship between FDI, economic growth and technology. Some research have already showed that FDI has a negative effect on economic growth. Yet very few studies have looked at the effect when technology is incorporated at an absorptive capacity.

Figure 1.2 FDI Studies Done in Selected Economic Regions around the World



Author's own computation. Data from Science direct. See Appendix 3

1.3 Research Objectives

The objective of this study is to examine the effect of FDI on growth contingent on the level of technology in sub-Saharan Africa.

The specific research objectives of the study are:

I. To find the relationship between FDI and economic growth in SSA

II. To find the effect of the above relationship when we vary technology with FDI

1.4 Research Questions

The questions this research seeks to find answers to are:

I. What is the relationship between FDI and economic growth in countries with SSA?

II. What is the relationship between technology and economic growth?

III. Does the relationship between FDI and growth change when we employ technology as an absorptive capacity?

1.5 Significance of study

This research seeks to find the conceptual and statistical link within FDI, technology and growth. The main areas of contribution are detailed below.

This study seeks to add to the existing knowledge or literature and to serve as a means for future research into issues circling Foreign Direct Investment (FDI), technology and economic growth. It will draw a relationship between FDI and technology and how they can impact economic growth. This would be beneficial to policy makers in making decisions on FDI that will affect growth positively.

1.6 Research Limitations

Some challenges and limitations are anticipated in the research. The first is access to data. Data on technology for countries in SSA is scanty. This might limit the extensiveness of the research.

The measure of technology is also a limitation. Coming up with a good variable to measure technology transfer is a challenge. Proxies for technology varies widely in research (see Appendix). The author is faced with this challenge in choosing a viable proxy for technology.

1.7 Organisation of Study

The study is organized into six chapters. Chapter one introduces the subject, provides a background to the study, identifies the gap this study seeks to fill, provides how this study seeks to fill the gap in literature, states why this study is of importance and finally how the rest of the thesis is to be organized.

Chapter two provides insight into our main variables; economic growth, FDI and technology. We present stylized facts on FDI into SSA, explore studies on technology and look into the relationship between technology, FDI and GDP (which is a measure of economic growth). We also present a trend analysis on FDI coming into Africa and compare it with other parts of the world.

Chapter three proceeds to fish out existing literature on the subject, identify theoretical underpinnings, and submit empirical findings on studies done on FDI and technology transfer, and economic growth. The theoretical framework underpinning this research is adequately explained. We look at how technology could serve as an absorptive capacity in effecting economic growth.

Chapter four presents the methodology for the study, type of regression analysis, the model for the quantitative analysis and other relevant information on how the study was carried out.

Chapter five presents analysis and findings from the research conducted. Regression results are presented in this chapter as well as the interpretation of the results. We will also include pictorial representations like scatterplots.

Chapter six summarizes and conclude on the thesis bringing out the concrete findings and conclusion and remarks of these findings. Based on these, the author makes solid recommendations to the relevant stakeholders. The areas of further research are also given.

CHAPTER TWO

OVERVIEW OF FOREIGN DIRECT INVESTMENT, ECONOMIC GROWTH AND TECHNLOGY IN AFRICA

2.1 Introduction

This chapter brings to bear existing knowledge on FDI in Africa, economic growth, and technology. We present some statistics on FDI coming to Africa, explain further technology and its link with MNC's and lastly examine economic growth its link to FDI. Under the FDI section, we list some stylized facts on FDI. Stylized facts are essentially nontrivial observations consistent in research that have become or generally accepted as rule of thumbs. They express empirical truths and would justify some of the findings we present in this study

2.2 Foreign Direct Investment in Africa

FDI has been a viable source of foreign investment or capital inflows into Africa to finance long term developments, aside financial assistance from international bodies like the IMF. Capital inflows from the later have come saddled with austerity measures, most of which are generalized conditions that do not agree well with the local context, which tend to stifle the full economic impact of these loans. So, African countries are left to seek recourse in FDI inflows which do not come with such austerity measures.

Foreign Investment has therefore assumed a prominent role in mitigating the challenges of low economic growth and high poverty levels faced by the continent. Economic strategies preached by policy makers at the macro front (thus the national, regional and international levels) seek to attract FDI as the tool through which the former can be achieved. Also, developing economies that have gyrated to the forefronts of economic developments, like China, have re-emphasized the notion that receiving FDI is important in bridging the resource gap of low-income countries and also reducing debt accumulation while trying to reduce poverty (UNCTAD, 2005). Again, this recourse has been promoted in developing economies that FDI inflows is a viable channel, or perhaps the only viable channel, for not only consistent and stable capital inflows but also a means for technological knowledge, new skills and other benefits like export opportunities (Prasad et al., 2003 as cited by UNCTAD, 2005).

However, the efforts of African countries or governments to attract and foster FDI relations has been un-achieving. Statistical records over the past two decades or so with respect to reducing poverty and attracting FDI has not been encouraging. It is true Africa has been commended these few years for gradually increasing its growth rate from 3% to about 6% but such a feet when compared with other developing regions in its proper context is abysmal. Take 2014 for example, the amount of net FDI inflows around the world was about $1.678 trillion. Of this amount only $44 billion representing a mere 2.6% of the whole chunk came into Sub-Saharan Africa with the rest going to Asia (about 38.8%), Europe (about 27.6%), Latin America (about 28%) and North Africa and the Middle East (about 3%). But, surprisingly, Africa has consistently offered higher returns on investments. This contrast between higher interest rates on foreign investments and lower foreign investment flows into Africa is not limited only to that period alone, but has become the narrative of the nature and size of FDI inflows into Africa.

2.3 Technology and FDI

Technology, as used in this study refers to new knowledge, methods and innovative procedures, acquired mostly through research and development engagements, which has the capability on increasing output or productivity. It includes but not limited to knowledge creation, management knowhow, efficiency in production process, product innovations, and others. This technology when applied to production increases output. It is not surprising that studies on technology have been linked to productivity (Bwalya , 2006; Dutse, 2012; Liu, 2008; Sinani & Meyer, 2004).

New technology and innovations require huge capital investments, specialized skills (or human capital) and other characteristics to be present in the host country. The cost of such an endeavor alone is a challenge for developing economies to bear. So most developing economies depend on FDI as a means to again access to some of these technologies (Liu, 2008; UNCTAD, 2010). It is because large MNC's have the financial and technical wherewithal to engage in technology-producing research. MNC's own, control and produce over 80% of the world's technology (Dunning, 1992). Eminent scholars have found out the when a country interacts with MNC's through foreign investments (FDI), some of the technology and knowledge rub-off on the local firms (Liu, 2008; Sinani & Meyer, 2004; Blomstrom & Kokko,1996). Technlogy can be transferred across countries through international trade; through transfer of specialsed goods and services, leasing and franchasing aggrements and FDI, technlogy and intellectual property may be transferred. However, FDI is the most effective method of transfer because through FDI, technologies that are hard to to measure or obtain can be transferred to local economies (Sinani & Meyer, 2004). Therefore by encouraging MNC investments through FDI, technlogy from FDI can diffuce to local firms.

2.4 Economic Growth and FDI

It's been well documented the effect of FDI on economic growth. More studies continue to be conducted across the globe. The relationship between FDI and economic growth has been positive in more studies with vary degrees of significance. However in the African context the relationship can be negative.

Studies on FDI and economic growth can be categorized into three strands; the first strand entails studies on FDI and growth in developing countries, where The intuition for such studies is that FDI can also be of benefit to developing economies when there are certain characteristics (or absorptive capacities) in place to help absorb them.

The second strand of literature looks into the causal relationship between FDI and economic growth. These kinds of research seeks to unravel whether FDI causes economic growth or economic growth attracts FDI. The later holds in situations MNC's want to invest in economies that have high growth rates. Such studies include Basu, Chakraborty, and Reagle, 2003; Choe, 2003; Mencinger, 2003; Li and Liu, 2005. For example Choe 2003 found a bi-causal relationship between FDI and economic growth. He sampled 80 countries over a period of 25 years (1971-1995). Using a panel VAR model, that FDI inflows granger causes economic growth and economic growth also granger causes FDI. However the granger causality is stronger for economic growth causing FDI.

The third strand of research looks at issues other than those found in the two strands. Examples include studies on how the volatility of FDI affects economic growth. Such studies include Nair-Reichert and Weinhold, 2001; Zhang, 2001; Nath, 2009 and others). Nair-Reichert and Weinhold, 2001 looked that the relationship between FDI and economic growth from country to country. They sampled 24 developing countries for 25 years (1971 to 1995) using fixed effects and random effects. Their results was that there is a causal relationship between FDI and economic growth and FDI is higher in countries with open economies than those that don't have open economies.

This study looks into the first strand of literature. We employ technology as an absorptive capacity in exploring the relationship between FDI and economic growth. Not much studies have used technology as an absorptive capacity using data from SSA.

2.5 Stylized Facts on FDI

This sub-section proceeds to list a number of stylized facts that that have become accepted as empirical truths to which theories must be made to fit. A lot of studies done on Africa adopt these stylized facts. These facts have a bearing on the theory adopted for this study and how the interpretations of the results are done. The following stylized facts are enshrined into the study;

2.5.1 FDI is an important source of finance for SSA

Compared to official loans that SSA receives, FDI inflows have increased substantially over the years exceeding the former when partially substituted for. Asiedu (2002) cites that from 1990 to 1999, net official loans have decline by about 24% whilst within the same period, FDI inflows have increased by about 180%. Sufficed to say that Africa has more appetite for FDI rather than foreign loans that come with complex regulations and requirements. However, Africa it seems has received a much lower percentage of the FDI inflow in proportion to the whole world. The amount of FDI that comes to SSA is among the least FDI inflows received by any developing region. To infer from Asiedu (2002) again, within a decade (1990-1999), the amount of FDI going into developing countries increased by an over 1600%. In the case of Africa, the increase in FDI inflows was only about a 490% fold. That’s about only 37% of what other developing countries are getting.

2.5.2 Return of FDI from Africa is much higher than other continents

Studies like Asiedu (2002) and others have shown that return on investment (ROI) is much higher for African countries compared to other developing countries. Some authors have attributed this phenomenon to weak institutions and polices, international trade agreements (like AGOA), production inputs and the nature of the political climate in the economy (Abloyor et al, 2016; UNCTAD, 2005, Bartels, Kratzsch, & Eicher, 2009). Take the study done by the Research and Statistics Branch of UNIDO, Bartels, Kratzsch, & Eicher (2009) using principal component factor analysis concluded in their study that the primary concern of foreigners investing into SSA is the stability of the politcal economy to spur growth through sound investment and the proper funtioning of rule of law (thus the transparency of legal framework). Their findings remain unchanged even after they put in controls for two clusters of the host countries.

A similar report, by UNCTAD titled Economic Development in Africa also stipulated that, although weak institutions are the cause of this outcome, it also could also be a potential advantage to countries who will make the efforts to improve their governance institutions to look favourable in the eyes of the business world.

2.5.3 Technology from FDI is of immense importance to SSA

Most developing economies do not have the required human capital and capital investment to create new innovations and technology (UNCTAD, 2010). For there to be any chance of narrowing the technology gap, it behooves on them to absorb these innovations from MNCs through foreign investment. There is limited data on Africa's expenditure on R&D. This is because not much R&D is done in the continent partly because of the capital requirements for such endeavours. Not surprisingly, the Africa inverstment report, 2015, also stated that FDI on R&D has decreased year on year decrease for 4 years with only one project recorded in 2014 resulting in a capital investment decline of 82% in 2014. Therefore, Africa (and other developing economies) tend to benefit from contagion of technology from trading with MNCs. Policy maker's factor this in the regional and national policies they implement.

However, empiricists have shown that for there to be spillover of contagion of these technology, there must be certain macro and micro factors present; there must be human capital that can absorb this knowledge, local firms should have had some form of training from MNCs, local firms should have some closeness or interaction with MNCs through the value chain. A well cited paper by (Sinani & Meyer, 2004) indicate empirically that for spillover to occur, local firms must have the necessary characteristics to absorb them. So not only is technology spill from FDI's important, but local firms must be equipped to absorb them.

2.5.4 SSA do not receive much FDI despite the fact that they have higher return on investment

The amount of FDI that come into Africa is not commensurate with the returns (expected and actual) that the investment is able to churn out. For example the average return on investments from US FDI alone coming to Africa in the 1990's was about 30%, the highest return from developing regions even though just about 2% of total FDI was received by Africa. Returns have continued to increase significantly over the next decade. The average return on investment from Asia pacific was 21%; 14% for Latin America; 16% for all developing economies (Aseidu, 2002). In 2014, United States invested a total of 97 projects, a 48% increment from the number of projects in 2013, in Africa costing US$ 7.9 billion. To put things in perspective, the total amount of FDI that came into Africa in 2014 was US$ 87 billion (includes estimates, as reported by the Africa

Investment Report, 2014). This figure, although huge is dwarfed by FDI that go into other developing economies; 470 billion worth of FDI was invested in Asia and Oceana; 170billion into Latin America and the Caribbean. This indicates that there exist a paradox of high returns and low foreign investments in Africa.

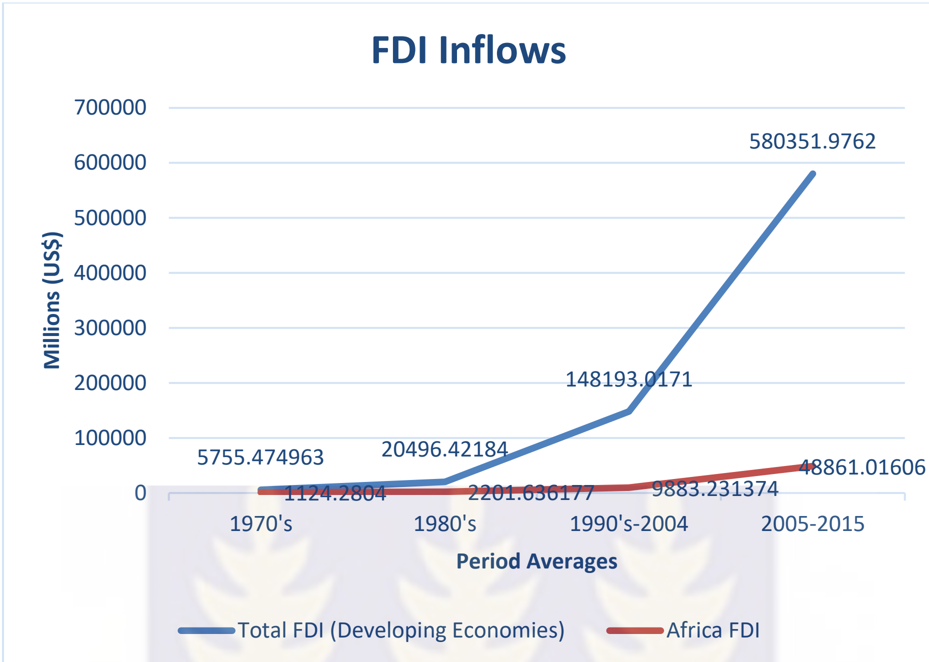
Table 2.1 Africa's FDI in Percentages

Africa's FDI	1970's	1980's	1990's-2004	2005-2015
As a % of FDI in Developing Economies	19.53	10.74	6.67	8.42
As a % of FDI in the World	4.72	2.37	1.89	3.39

Authors own computation. Source UNCTAD database. See Appendix 4

The average FDI inflows to Africa has significantly increased from about US$ 1.124 billion in 1970s, representing about 20% of total FDI received by developing economies. It doubled to about US$ 2.201 billion in the 1980's, then quadrupled to an average of US$ 9.883 billion from 1990s to 2004. However average FDI received by developing economies in the 1980's stood at about 20.5 billion, an increase of about 4 times the amount of FDI inflows it received in the 1970's. The amount Africa received dropped from 20% to about 11% from the 1970's to 1980's. In the 1990's to 2004, average FDI in developing countries increased to about US$ 148.193 billion. Africa received only about 7% of this amount, with Asia receiving most of it (over 60%). From 2005 to 2015, FDI to developing countries have increased to about 4 times to 580 billion. But the average FDI received into Africa remains at about 8%, receiving only US$ 49 billion. This is an indication of Africa's marginalization as the world continues to increase international trade and development. Africa's FDI, in terms of percentage to the world has steadily declined from about 4% in the 1970's down to about 1% on the 1990s and marginally increased to about 3% in the 2000's.

Figure 2.1 FDI inflows: Africa and the World



Authors own computation. Source UNCTAD database. See Appendix 4.

2.5.5 Political Stability affects FDI inflow into SSA

As has been alluded to earlier in this chapter, there's empirical evidence that suggests that foreign investors, particularly those that invest in the African continent, see political factors as a risk pertinent to investment. To safeguard their investments, they want to ensure that the legal framework in the country is not weak. Researchers have observed this phenomenon and have well documented it in literature. In researching for this study, the author found that most studies on FDI and economic growth conducted using data from Africa did control for political stability (see Agbloyor et al 2016; Adams, 2009;Bwalya , 2006). This study also includes a variable to measure or controls for strength or weakness of the political environment and how it affects our results.

2.5.6 Bulk of FDI's coming into Africa are centered on Manufacturing and extractive sectors of the economy

FDI investments coming into Africa largely go into the raw material industry than the service and finished goods industry. As identified by Bartels, Kratzsch, & Eicher (2009), there exist some form of asymmetries in the African region as the bulk of its FDI inflows go into the primary sector. Again Asiedu (2002), distingueshes FDI into two forms; market seeking FDI and non-market seeking FDI. With market seeking FDI, FDI is invested in sectors that serve the demand of the local market. Such economies are charactrized by high demand, high income levels and large markets. Non-market seeking FDI does not neek to meet the needs of the immedaite local market, but rather the external market. As such FDI is not affected by market size, income or demand. It therefore presuposses that FDI coming into small and developing economies as most likely not market seeking. FDI coming into developing econmoes , like SSA, will focus mostly on the extractive and manufacturing sector – for the external market.

Table 2.2 **FDI inflow into Africa (by Sectors)**

FDI Inflows by Sectors	US$ (Billion)	Market Share (%)
Manufacturing	28.7	33
Extraction	22.2	26
Construction	12.5	14
Electricity	10	12
ICT and Internet Infrastructure	6.2	7
Logistics, Distribution and Transportation	2.6	3
Business Services	1.7	2
Sales, Marketing and Support	1.6	2
Headquarters	0.3	0.4
Recycling	0.2	0.3
Other sectors	0.5	0.3
Total	86.5	100

Author's own computation. Data Source: Africa investment report, 2015. See Appendix 4

The africa investment report, 2015, reports that in Africa, the manufacturing sector received the highest FDI of US$ 28.7 billion in 2014 representing 33% of the market share. It said the number of projects in the manufacturing sector and its market share grew slightly by 3% in the year. The next three sectors in the economy that received higher FDI were; the mining and oil drilling (Extraction) industry received 22.2 billion accounting for 26% of the market share; the real estate (construction) industry also received 12.5 billion representing 14% of the market share; the electricity industry received 10 billion representing 7% of the market share. The Construction sector experienced 60 percent growth in project numbers in 2014. These accounts show the importance of the raw materials sector in attracting FDI into the continent.

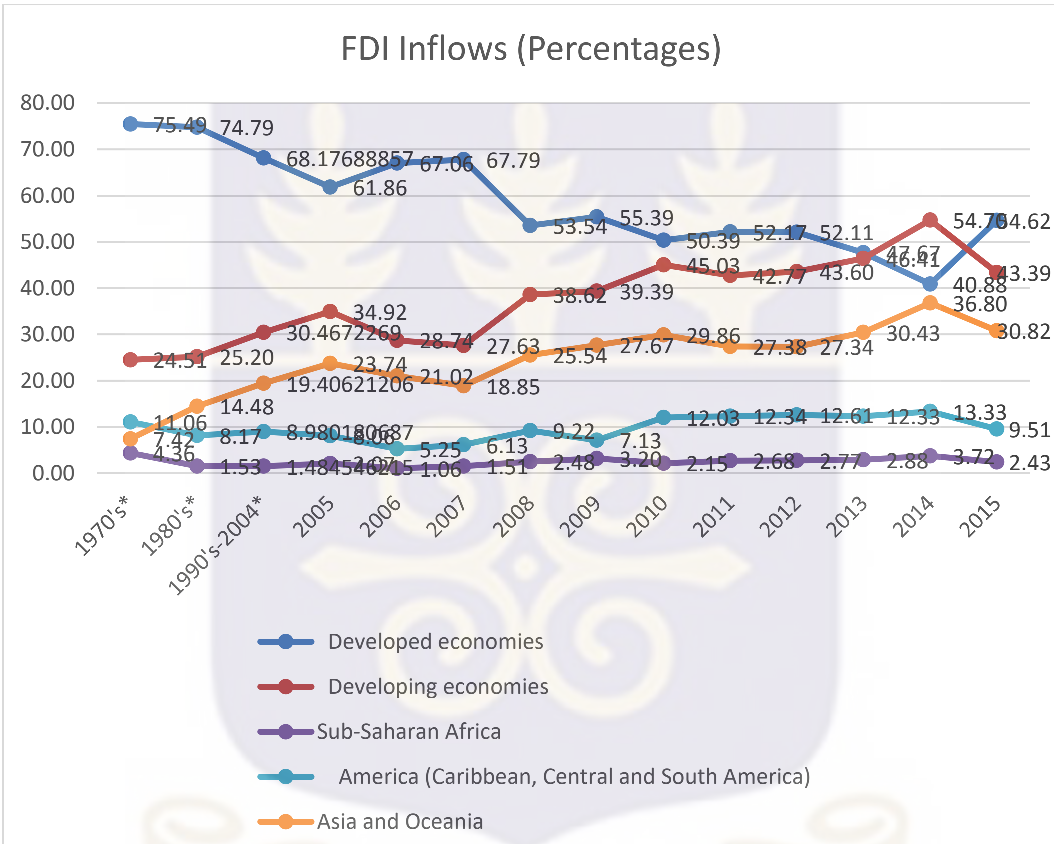
2.6 FDI Inflows into Africa: A Trend Analysis

As has been shown, FDI inflows that come to the African continent have been minimal over the years. For example, from 2005 to 2010, the average FDI inflows was into developing economies was 35.72% of the total FDI inflows in the world. Of this amount, only 3.30% of it came into Africa. The figure reduces to 2.97% when North Africa is taken out.

The figure below gives a pictorial representation of FDI inflows over an 11-year period from 2005 to 2015. FDI inflows going into developing economies plummets from 2005 to 2008 from 35% down to 28%, then picks up from 2008 going up as high as 55% in 2014 where it exceeds FDI inflows into developed economies. In 2015 FDI then plunges down to 43%. Within a period of over a decade, FDI inflow into SSA have been between 1.5% to 3.5% of the total FDI inflow around the world. Put differently, FDI entering developing economies have increased by about 445% during this period. Of this increase, 67% went into Asia and Oceana, 24% went into Latin America and the Caribbean. Only 6% was received by SSA.

So whiles FDI received by developing economies, gradually increases over time gaining an upward progression, the percentage of growth of FDI coming to SSA, when observed in continuum smoothens out. In 2013 to 2014, when the amount of FDI into developing economies superseded the amount going into developed economies, the percentage change (in this case, increment) was about 14.75%, observed as a spike in in the figure below. FDI to Asia and Oceana, within that period, increased by 20.9% and Latin America increased by a 8.11% change. SSA increased by a percentage change 29.2%, representing only an increment of 0.84% in the amount of FDI into SSA (from 2.88% to 3.72%). SSA received the increment in FDI of about US$ 6.417 billion whilst Asia's FDI increased by 35.660billion. This shows an unfavourable marginal increase in FDI to SSA countries compared to other developing economies.

Figure 2.2 FDI inflows to Developing Economies from 1970's-2015



Authors own computation. Data source: UNCTAD database. See Appendix 4

2.7 Chapter Summary

The aim of this chapter was to present an overview of the link between FDI, economic growth and technology. We identified strands in literature that have above used absorptive capacities to vary FDI on economic growth. We presented also some stylized facts of FDI and trends. This chapter is a precursor to the next chapter which delves deeper into literature on the subject.

CHAPTER THREE

LITERATURE REVIEW

3.1 Introduction

This chapter delves into existing literature to find out the theoretical and empirical underpinning on technology as an absorptive capacity. We delve also into studies on FDI and economic growth. The author immerses the reader into a pool studies done over time on the topic so that a broader perspective is acquired. Empirical evidences on the subject matter are also presented.

3.2 MNCs as a Driver of Technology

MNCs play a major role in global innovation. According to a UNCTAD report in 2005, one half of the world's total expenditure in R&D comes from MNCs. This figure increases to more than two thirds, when considering R&D for the business sector only (UNCTAD, 2005). It is therefore no surprise that about 80 percent of the world's technologies is owned by MNCs as sited earlier (Dunning, 1992). The MNCs who spend the most in R&D are usually concentrated in Information Technology and software development industries, the automotive industries, Mobile phone Industries and the Pharmaceuticals industries. Table 1 shows the Research and Development expenditure for some MNCs for the year of 2009 alone.

Table 3.1 **R&D Expenditure of Selected MNCs and Other Countries**

MNC	R&D Expenditure (in million $)	Countries	R&D Expenditure in 2009 (in million $)
Toyota	9403	United States *(2013)	473400
Microsoft	8437	China *(2015)	409000
VW	8043	Germany	11799.795
Pfizer	7507	United Kingdom	8731.631
Novartis	7163	Japan	4185.27
Nokia	6942	Canada	3639.433
Johnson & Johnson	6764	Sweden	3251.971
Samsung Electronics	6265	Brazil	343.547
General Motors	5875	Ethiopia	5.474
Honda Motors	5857	South Africa *(2012)	4.800
Daimler	5785	Botswana	1.946
Intel	5473	Rwanda	0.238
Sony	5172	Côte d'Ivoire *(2010)	0.141
IBM	4787	Benin	0.038
Takeda Pharmaceutical	4712	Togo	0.022

Author's own computation. R&D expenditure of selected MNCs and countries in 2009. Source UNCTAD 2010

Much of the researches MNCs undertake is usually done in developed economies. Little or no research is done in developing economies. This accounts for the technology gap between the developing and developed economies. However through interaction between MNCs and local firms in developing economies, particularly through direct investments, knowledge and technology trickle down or diffuses to local firms, particularly through mechanisms like imitation, competition, backwards and forwards linkages (see Figure 3).

3.3 FDI, Economic Growth and Technology

A lot of studies have been conducted in FDI and economic growth. These studies fall into two broad categories; studies that have found a direct relationship between FDI and economic growth and studies that have found that the relationship between FDI and growth is not so direct, absorptive capacities form part of the relationship. We find that studies that generally found a direct link between FDI and economic growth were conducted in developed economies whilst studies that did not find such direct links were those done in developing economies. For developing economies, it was harder for researchers to find relationship between FDI and economic growth, so they suggested the relationship depended on certain absorptive capacities (Clark, Highfill, Campino, & Rehman, 2011).

Absorptive capacity as defined by (Rehman, 2016) is the capability of a host economies to absorb or internalize external traits from FDI spillovers. That said, if a host form has high absorptive capacity, it will able to benefit or absorb more from FDI and vice versa.

Studies that found FDI's effect strengthened with the presence of an absorptive capacity include; (Agbloyor, Gyeke-Dako, Kuipo, & Abor, 2016; Sinani & Meyer, 2004; Borensztein, De Gregorio, & Lee, 1998; Li & Liu, 2005; Ramirez, 2006; Rehman, 2016). Li and Liu (2005) researched on 84 countries (from both developed and developing economies) form 1970 to 1999 examining the causal relationship between FDI and economic growth. They found that the relationship between economic growth and FDI is strong and positive when interacted with human capital. Borensztein et al. (1998) also found a similar result; human capital positively affects FDI. Other studies have shown the link between FDI and technology. Ramirez (2006) conducted a study in Mexico using a 1960 to 2001 time series data. He found out that FDI increased labour productivity. Also Sinani and Mayor (2004) studied the spillover effect from technology from FDI, sampling domestic firms in Estonia from the period 1994 to 1999. Their study revealed that magnitude of technology spillover depended on the characteristics of both the FDI inflow and the local firm; the magnitude of foreign presence and the firm size affected the spillover effect. Chakraborty and Nunnenkamp (2008) also did a similar study in India. They found that trade liberalization magnified FDI's effect on domestic companies.

Although more studies have been done on technology as a spillover effect on FDI (Blomstrom & Kokko, Multinational corporations and spillovers, 1996; Bwalya , 2006; Dutse, 2012; Marin & Bell, 2006; Sinani & Meyer, 2004; Ghali & Rezgui, 2008), few studies however have adopted technology as an absorptive capacity in an FDI-economic growth relationship. Some of them include studies like Jordaan (2008) who measured technology gap as an absorptive capacity. Jordaan (2008) found that trade liberalization and low technology gap could improve productivity in host firms. An older study by de Mello (1999) also found out that technological growth and capital accumulation magnified the effect of FDI on economic growth. He used both panel and time series techniques, sampling data from 15 OECD and 17 non-OECD countries from the period 1970 to1990. More studies needs to be done using technology as an absorptive capacity.

3.4 Foreign Direct Investment Entries

FDI occurs through MNCs engaging in international trade. Through global trade, investments are made across countries. Two primary ways that MNCs are able to invest in a country is through Equity and non-equity means (Twarowska & Kakol, 2013). In equity mode of entry, MNCs take ownership of local of existing firms. They could also build their business from the button up in the new market, which is known as a Greenfield investment. In the non-equity mode, foreign firms do not take ownership in local firms. This could be through import and export, contractual agreements and so on. Here, they do not take equity interest in the domestic market. As alluded to, FDI through the equity mode could be also through acquisitions, joint venture, and wholly owned subsidiaries.

Acquisitions take the form of Greenfield or brownfield investments. Brownfield investments occur when foreign firms acquire already existing firms in the domestic market whilst Greenfield investment is an investment into a newly formed business (Twarowska & Kakol, 2013). Brownfield investments are relatively low risk as compared to when the foreign firm builds its own structures and networks from the bottom up. Brownfield acquisitions are the most used method of Foreign Direct Investment. It is also quicker in terms of market penetration. However the foreign firm might not have full ownership of the domestic firms as compared to a Greenfield investment.

Joint venture occurs when foreign firms partner with local firms to undertake a project. It could be relatively short termed as the partnership ceases to exist after the project is completed. It grants the foreign firm access to the local market through the local firm at a much cheaper cost compared to an acquisition (Twarowska & Kakol, 2013). However, the foreign firm has only a part ownership of the joint venture. Also joint venture provides a means for foreign firms to circumvent strict market regulations and requirements for entry into a market. Partnering with a local firm could also provide a smooth entry into the domestic market.

Import and export is a non-equity mode of entry. With imports and exports, the foreign firm has no presence in the local market. The foreign firm's goods, materials and equipment are sold to the firms in the local markets. The foreign firm has no control of the goods after they have entered the local market. If it's a direct form of import or export, the firm could be involved in the marketing of the good. If it is an indirect form of import, sales is done by agents not linked to the foreign firm (Twarowska & Kakol, 2013).

A contractual agreement takes the form of licenses or franchise. Under these agreements, the foreign firm can give rights to the sale of its goods and services, patent rights, brand name, copyright, technical knowhow to local firms for a premium. The foreign firm does not take equity positions in the local firm but offers different forms of assistance to the local firm.

3.5 Forms of Technology Transfers from MNC's

From literature, forms of technology spillover occur in two primary ways - horizontal and vertical. Each form has peculiar characteristics. The author proceeds to identify them.

3.5.1 Horizontal Spillovers

Technology spillover is termed as horizontal when MNCs technology is absorbed by local firms within the industry in which the MNCs operate (Javorcik, 2010). This diffusion is intra-industry as it occurs between firms at the industry level, hence the name horizontal. Under horizontal spillovers, knowledge externalities are transferred through demonstration effect (DE) and competition effect (CE).

3.5.1.1 Demonstration Effect (DE)

Under the Demonstration Effect (DE), the local firms (in the industry) learn from foreign firms through observation and imitation (or copying) product innovations, management novelties or improved forms of organization processes and adapting them to suit local conditions. Ideally, this diffusion of knowledge will have positive impact on the local firms' productivity. Through interaction (both direct and indirect) with the MNCs and their affiliates, information is diffused and results in higher chance of adoption by these locals (Blomstrom and Kokko, 1996). As local firms observe the foreign firms (MNCS), they absorb knowledge like cheaper ways of production, management efficiencies, marketing strategies and others (Javorcik, 2010).

3.5.1.2 Competition Effect (CE)

The second channel in which technology diffuses into local firms is through the competitive pressure that the presence of foreign firms imposes on local firms. The competition effect (CE) forces local firms to operate more efficiently and productively so as to stay relevant or maintain their market share. The form of diffusion can either have a positive long run effect and a negative short to medium term effect on local firms (Aitken & Harrison, 1999). Aitken and Harrison (1999) first documented negative spillover in intra-industry studies using data from Venezuela. CE occurs through entry of multinationals who trade locally thereby increasing market size and competition in the local market. Countries with liberal trade policies may also experience this competition effect (Javorcik, 2010).

Figure 3.1 Technology Diffusion Chart

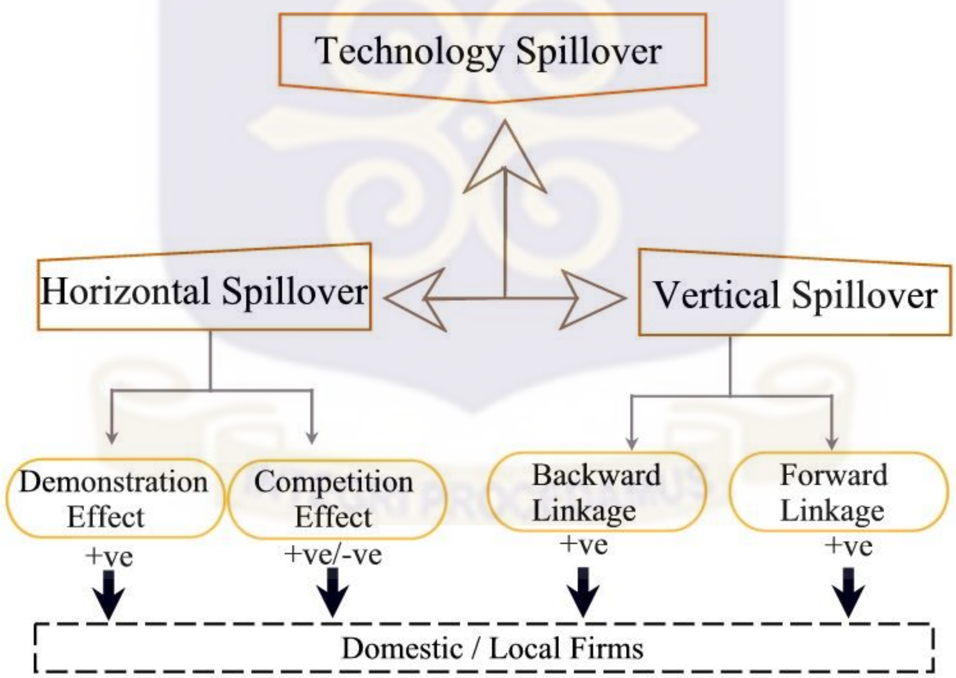


Chart showing Technology Diffusion to local or host firms (from top to bottom). Source: Author’s own computation

3.5.2 Vertical spillovers

On the other side of the technology diffusion spectrum is through Vertical spillover from MNCs to domestic correspondents and vice versa. This form of diffusion occurs inter industry across separate industries in the production line. The MNCs and the local firm are not competitors in this case. For there to exist some chance of technology transfer, the local and foreign firm must complement each other in the production cycle. The nature of their business should be such that at least one has to depend of the other for production. Vertical technology diffusion can occur through Backward linkages (BL) – transfer of technology from the foreign buyer to the local supplier- and Forward linkages (FL) –transfer of technology from the foreign supplier to the local buyer (Javorcik, 2010).

3.5.2.1 Backward Linkages (BL)

Backward linkages occur when MNEs transfer technology directly to their local suppliers through technical training so that the quality of the supplies they need from them can be improved. The form of diffusion occurs because of the foreign firm's desire for quality supplies from the local firm to be used for production. Also as identified by Smarzynska (2004), MNEs and local suppliers "closeness" may bring the foreign firms workers and local workers into contact which will create the opportunity for technology to diffuse to the local workers.

3.5.2.2 Forward Linkages (FL)

Forward linkages occur in situations where the MNCs are the suppliers and the local firms become the buyers. Local firms may receive training in best marketing and selling practices, technology and equipment from MNEs to enable them produce effectively and at the required quality. The technology diffused is aimed at increasing sales of the local firms, so they too can buy from supplies form the foreign firms. MNCs identify that their sales figure are tied to that of their buyers who are the local firms. Because their business success is tied to that of the local firms, they encourage effective production and marketing aspects of the production line of the domestic firms. So they diffuse technology to the local buyers through training them in sales and providing equipment to boost sales.

3.6 Theoretical Framework on technology as an absorptive capacity

There are theories that have been used to explain FDI like the product life cycle theory, exchange rate theory, dunning's eclectic paradigm, among others. But these theories explain FDI only. In order to find a meaningful theory to explain technology as an absorptive capacity to FDI, we delve into theories that exist in the area of industrialization. Some of the well accepted and documented theoretical models include the Dunning paradigm, dependency theory, growth theory, modernization theory and industrialization theory. These theoretical studies lie within the industrial organization framework. Modernization theory and dependency theory are opposites on the broad spectrum of models. They are cited by more authors as the most dominant theoretical frameworks underpinning FDI and economic growth. This study supports the modernization theory with supports the position that FDI leads to economic growth through various channels. It is further explained in the coming paragraphs.

The standard approach or Dunning's paradigm was formulated by John Dunning in his 1992 paper "Multinational Enterprises and Global Economy". It provides a theoretical underpinning explaining what determines the flow of FDI into a country or market. Three standard approaches or factors are identified to be central to the decision of undertaking an FDI by an MNC.

Firstly, the MNC seeking to invest must have a competitive advantage which is not present in the host country. Secondly, the MNCs must be ready to take advantage of this competitive edge by using or deploying it to its advantage rather than leasing or selling it to third parties or its competitors.

And thirdly, the host country or country of intended investment must have certain properties that will be advantageous for the MNC to want to invest in them.

3.6.1 Dependency theory

Dependency theory one of the earliest form of theory explaining technology spillover from investment. It emerged in the early 1970s.

Dependency theory thrives on the following assumptions; the world is a capitalist economy, foreign investments always move from developed economies to developing ones, Developed nations extract resources from developing nations.

The dependency theorist believes that FDI do not lead to economic growth, at least not in the long run. They believe that through foreign investment developed countries deprive developing countries of the natural resources they need to develop. Put differently, dependency theorists argue that FDI affects economic growth both in the long and short term. Arguments raised include developing country becomes dependent on the foreign firms for its economic growth. But these foreign firms are profit seeking. Therefore they become monopolists causing unfair completion in the local markets (Adams, 2009). Market inefficiencies arise and this stifles economic growth. Sylwester (2005), also cited in his work that depandency theorist believe FDI has a crowding out effect that effects domenstic investment through raising cost of investments and also, causing market distortions that are detrimental to economic gorwth and development.

3.6.2 Modernization theory

This theory first appeared in the 1950 and 1960's and has evolved over time (up to the late 1990's). It has no single proponent but has been attributed to American social scientists in the early 1950's. As it evolved, its definition broadened and new versions have come up. The most popular definition is that it's a theory that explains how a country modernizes or changes from its traditional way of life or society to a modern one. Some of the versions that have been theorized out of the main theory include Marxist, capitalist, western views and many others. This study adopts another view of modernization theory. The early versions of the theory can be broken down to three main parts; Economic modernization, literacy and cultural development and national identity. The study adopts the unpopular version of the theory- Economic Modernization. This theory looks into technological and social innovations that are able to spur growth. Sub-theories under the economic modernization include Diffusion of Innovations theory which essentially explains why innovation spreads and measures the rate at which it is able to spread.

The Economic modernization theory, on the other hand stipulates that FDI is necessary for economic progress in a country. As indicated earlier, this theory opposes the view of the dependency theory. In fact this theory was developed out of the weakness identified by the critics of the dependency theory. Dependency theorists, who have a capitalist viewpoint, base their views on these systematic economic postulations;

For an economy to grow, it will require huge capital investments. FDI brings in capital investments into the country. These capital investments are difficult to obtain from other means (in such quantities and favourable terms). An economy can have access to huge capital investments through FDI. It therefore makes sense for a nation which wants to develop its economy to encourage FDI into the country. It can therefore be said that FDI leads or could lead to economic growth because it provides the necessary capital investments.

This theory emerges from the neoclassical and endogenous growth thinking. To them, FDI is important for economic growth especially in developing countries because it provides capital investment, innovation and knowledge which the country desperately needs but cannot provide on its own. Developing countries do not possess the human capital, infrastructure, stability (political and social), technology and innovation needed to generate and promote growth. FDI not only brings in the capital needed but also provides for knowledge and expertise to be shared.

This study agrees with the modernization theory in that developing economies cannot obtain the wherewithal for economic growth without the presence of FDI. FDI is a necessary evil to achieve economic development swiftly, a quicker way to bridge the divide. The model for the study imbibes this thinking.

Technology flow is particularly important here. The investments that comes into the country is both direct (capital investment) and indirect (investments other than capital). Indirect investments that can come into the country include infrastructural development, novel human skills, managerial and marketing procedures or techniques and other nuances that add to improving capital investment. It’s not uncommon to see new roads constructed to link a mining site to a processing center or employees being trained to new knowledge or new technology being brought into the country to replace archaic ones. This new road will not only benefit the mining company. It has a ripple effect on the economy - it would promote easy access for businesses which will increase output and contribute to economic growth.

3.6.3 Industrialization theory

This theory was pioneered by Hymer in 1976. His study brought to light the unnoticed effects of MNCs in global industrialization. He came up with a model better than the standard neoclassical trade theory of Heckscher and Ohlin which was dominant at the time. The standard neoclassical trade theory held these assumptions; factors of production were immobile, production functions were identical across countries and no differences in scientific and technological knowhow among nations (Fan, 2002). That meant there was no opportunity for technology to spillover across national borders.

It was based on the neoclassical financial theory of portfolio flows, which viewed MNCs only as arbitrageurs of capital looking to benefit from interest rate differentials (Fan, 2002). Simply, MNCs moved their capital (in terms of money) from low income countries to those that have high returns to earn higher spreads. A weakness of this theory is that it did not identify the role FDI capital inflows contributed to the development of a country (Fan, 2002). What Hymer did was to shift focus away from the dominant neoclassical financial theory. He explained that FDI flows did not only include capital but also management skills and new technology. That is foreign investment resulted in the transfer of capital or assets is not the full picture. He theorized foreign investment as an offshoot of industrial organization (Fan, 2002).

3.6.4 Growth theory

New growth theories emerged during the middle parts of the 1980s. Unlike the dependency and industrialization models, these models examine the effect of FDI on growth, using a growth theory framework. The traditional new classical model or the Solow growth model holds here. Here are its assumptions; diminishing returns to physical capital, technological change is exogenous unlike the industrialization model where it's endogenous, FDI does not affect growth in the long term and capital flows from surplus(developed regions) units to deficit units(developing regions). The growth model is similar to the dependency theory in that it assumes countries with equal capital labor ratios and factor prices will have converging long run equilibrium (Fan, 2002).

New growth theories have improved on the supposed weaknesses in the neoclassical growth model. The weaknesses in the neoclassical model include; technological progress measured as an exogenous variable, growth measured by capital accumulation. The new growth theory focuses on technology and its transfer as drivers of economic growth. Studies done following this line of thought have focused on the impact of research and development (R&D), human capital, and its transfer through trade to effect growth.

3.7 Empirical Framework

Studies circling technology suggest that technology diffuses to local firms through foreign firm presence or through worker mobility (or labour turnover). The former implies that as long as the foreign firm has presence in the domestic market, there will be opportunities for technology to transfer to local forms. The later suggest that rather when employees from multinationals leave to join local firms or start their own firms in the local market, they are able to transfer foreign knowledge and technology acquired to the local firms. These studies feed into the justification for using technology as an absorptive capacity. This section of the study will look into some of the studies done in each case.

2.6.1 FDI and Technology transfer through Labour Mobility

Some studies have looked at technology spillover occurring as a result of labour mobility or worker turnover. Thus the idea that when workers leave organizations to another (in this case from an MNC to a local firm), there is a high probability that they will spillover technology they have absorbed from the previous employers (Görg and Strobl, 2005; Balsvik, 2010). Other studies have gone around this same idea but used a different approach. For example Poole (2009) used wage differentials to measure mobility from MNCs to local firms. She samples employer employee data from Brazil and found a positive relationship between wages of workers and their prior experience with multinationals. Again Bloom (1992) found a significant relationship between worker mobility and technology transfer. He sampled data from manufacturing firms based in South Korea. He found a significant transfer of technology into local firms when production managers who previously worked with multinationals left them to work in domestic plants. Pack (1997), also find the same results using data from the Taiwanese chemical industry. He found that in the data period he used (in the mid-1980s), the number of engineers and specially trained workers who left MNCs to work in domestic firms were huge- 50 percent and 63 percent respectively. These skills will be absorbed by the domestic firms that hire them. Glass and Saggi (2002), Fosfuri et al. (2002) also support technology spillover through worker mobility. However an older study by Gershenberg (1987) found insignificant labour mobility of workers from MNCs to domestic firms using data from Kenyan firms.

2.6.2 Foreign Firm Presence and Technology Spillover

Some studies have sort to link foreign firm presence with the rate of spillover. Significantly more studies have been done here compared to the other studies on technology spillover. These studies have shown that so far as the foreign firm exist in the local environment interacting with local participants, fighting for the same local resources, there are a significantly high chance of technology spillover (Griffith, 1999; Liu et al., 2000; Liu, 2008; Haskel et al. 2002).

Pioneering work by Findly (1978) has shown that the presence of foreign investment (and foreign firms) give domestic firms more chance to observe the technology used by the foreign firms which affects their ability to improve their technology also. A more recent study by Neven and soitis (1996) find significant relationship between FDI inflow between USA and Japan. But when they analyze FDI inflows between selected countries within the European Union, they find a weak relationship. They estimated three regression models each tackling one aspect of the study. One regression model analyzed FDI inflows entering Europe (European Community) from the United States (USA), another analyzed FDI inflows entering Europe from Japan, and the third analyzed FDI inflows coming from countries within the European Community. A 6 year period from 1984 to 1989 was used for the study, and the data collected was at the sectoral level and the countries involved were USA, Japan and the European Community (EC) consisting of United Kingdom (UK), Italy, France and Germany. They used R&D expending as a proxy from measuring technology. Neven and soitis (1996) also stated in his article after reviewing empirical literature that the social benefits of R&D could be twice as beneficial to the private firms that undertake them. Lui (2008) conducted a similar research using data from 20000 manufacturing firms in China. Using the panel data she finds that FDI lowers short term productivity and increases in the long run. The short run growth reduces because, resources is committed to learning the new technology, out of the resources used for production. Thus technology is expensive to learn or acquire and require some commitment of scare resource. She uses an endogenous growth model to explain how FDI spillover technology. Mansfield (1992) also provides proof that by the end of year, the amount technology from foreign firms that diffuses to local firms within the industry is about 70 percent. Only in some instances have technology diffusion been curtailed like in the case of the Exxon –Florio amendment and ICL acquisition of ICL by Fujitsu.

3.7.2 Technology as an absorptive capacity

The above studies show the technology trickles down to local firms when MNC's engage with them. However few studies have actually looked as technology as an absorptive capacity. We believe that if technology is able to trickle down to host firms, then it could have an impact on economic growth. Study seeks to delve deeper into that.

3.8 Chapter Summary

This chapter thoroughly dealt with the empirical and theoretical aspects of the study. The chapter showed the importance of multinationals in the transfer of technology across the globe. The empirical links between MNC's, FDI's, Technology and economic growth are here presented. Foreign investments and how (or in which form) they occur was defined based on studies done to date on the area. Theories that have been used to explain the transfer of technology were enumerated. A strand of the Mordernization theory was adopted for the study.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This Chapter discusses the research methodology used in the collection, analysis and presentation of the data and results of the study. It also shows how the research is to be conducted. Included in this chapter is the research approach, research design, and sampling technique, sources and description of data, justification and measurement of variables.

4.2 Research Design

To achieve the proposed research of assessing the technology spillover effect from FDI on growth, the quantitative research method is adopted. Quantitative research approach is the systematic, logical and organized analysis of numerical data so as to draw factual conclusions that are supported by findings from the data.

The population for the study is countries located within the Sub-Saharan region. We use the definition accepted by the UN for Sub-Saharan Africa; it is made up of all African countries located below the Sahara desert. It includes countries in the eastern parts of Africa like Eritrea, Somalia, North and South Sudan; countries in the western parts like Ghana, Liberia, Sierra Leone, Cote D'Ivoire , Mauritania , Mali; countries in the central parts like Congo, Gabon, Central Africa Republic, Rwanda , Burundi; and the southern parts like south Africa, Namibia, Botswana and Mozambique. Also islands (or archipelagoes) on the borders of the continent and below the desert are also classified as part of Sub-Saharan Africa. Madagascar is one of them. We do not adopt the alternative view of SSA where the continent is divided into northern Africa; made of the league of Arab States and Southern Africa; made up of Non-Arab States. This definition precludes Mauritania, Somalia Djibouti and Comoros, located below the Sahara, as SSA countries because they are Arab states and predominantly Muslim Countries.

The sample of the study is 43 SSA countries. Macro data is collected from the forty-three (43) SSA countries sampled for the study. The list of countries are presented in Table 4.1. Unbalanced panel data spanning nineteen years (19) is retrieved from the world development indicators of the World Bank database. We employ the fixed effects (FE) model estimation. Stata software is used to run the regressions and present results.

The study used a large number of countries and multiple years to give a higher degree for freedom as the number of data points are high. A high degree of freedom increases the credibility of the findings from the study. Also collinearity among independent variable is reduced. As cited by Brooks (2008), Baltagi (2001) and Jensen (2012), panel datasets allows for complex computations to be done seamlessly, observe much variations over time, control individual heterogeneity and minimizes biases. Thus, panel data allows us to control for unobservable variables such as cultural and environmental factors, differences in acceptable practice peculiar to certain locations, or other variables that only change over time but not over country or location (example national laws and regulations, international agreements, etc.). This makes it a better option compared to cross-sectional data and time series.

4.3 Data Sources

This study uses macro level data derived from secondary data sources (online databases). Panel data is employed, pooling data from 43 counties in Sub-Saharan Africa from the period 1990 to 2008. Most of the data for the study was derived from the databases of the World Bank and other credible and acceptable sources of data for scholarly studies.

Data on FDI and GDP per capita is derived from the world development indicators. The FDI data is measured as the total net foreign investment coming into the country. This does not include domestic investments. GDP variable in the model is simply GDP values per country measured in US$. As stated earlier, forty-three (43) SSA countries are used for the study of which a panel data set is drawn for a period spanning nineteen (19) years 1990-2008. This period is chosen because it captures both the privatization and post privatization era. The 1990s saw a lot of government institutions privatizing in SSA countries (Nellis, 2006 as cited by Adams, 2009). This meant more foreign investments came into the country through acquisitions and mergers of government or public institutions. In the table below shows an alphabetical representation of the countries selected for the study.

Table 4.1 **Countries sampled for the Study**

Selected Sub-Saharan countries for the Study			
Angola	Côte d'Ivoire	Malawi	South Africa
Benin	Equatorial Guinea	Mali	Swaziland
Botswana	Eritrea	Mauritania	Tanzania
Burkina Faso	Ethiopia	Mauritius	Togo
Burundi	Gabon	Mozambique	Uganda
Cabo Verde	The Gambia	Namibia	Zambia
Cameroon	Ghana	Niger	Zimbabwe
Central African Republic	Guinea	Nigeria	
Chad	Guinea – Bissau	Rwanda	
Comoros	Kenya	Senegal	
Congo (Brazzaville)	Lesotho	Seychelles	
Congo (Democratic Republic)	Madagascar	Sierra Leone	

4.4 Regression Model

4.4.1 Fixed Effects (FE) Model

The fixed effects model takes the form of an Ordinary Least Square;

$$y_{it} = \alpha_{it} + \beta X_{it} + \mu_i + \varepsilon_{it} \qquad \text{(a)}$$

Where y is the dependent variable for country i at time t and X is a set of explanatory variables for country i at time t. μ_i is the fixed effect which is time invariant. $\alpha$is the constant term. β is the coefficient to be estimated for the independent variable and ε_{it} is the error term or idiosyncratic noise.

4.5 Estimation Technique

Fixed effects (FE) model treats for unobserved individual heterogeneity (thus μ_i). It is used to analyze the relationship between explanatory variables and the explained variable particularly in situations where there is the possibility that the independent variable could be affected by the error term. In certain situations, there can be some similar characteristics that are peculiar to independent variables in the equation (thus they are the same for each). It could be country specific characteristics or time specific characteristics. If we don't account for this effect, it will be present in our estimates and our estimates will not be efficient (i.e. with minimum variance possible).

This characteristic will cause the independent variable to be correlated the error term. The correlation will make our estimate biased so we need to control for it. The FE model removes the time-invariant characteristics so our estimates as not biased. In our case, we employ a country specific fixed effects (μ_i) into our model. We also test if Random effects (RE) model fits our model better than the fixed effects model. We employ the Hausman test to test whether the FE model or the RE model is the best fit for our data.

4.6 Model Specification

The proposed model for the study is:

$$GDP_{it} = \beta_1 + \beta_2 FDI_{it} + \beta_3 TECH_{it} + \beta_4 (FDI * TECH)_{it} + \sum_{j=n}^{N} \beta_j X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

Here are the interpretations:

β_1 denotes the constant. It's the point at which all the independent variables are zero. Thus, it is equal to the dependent variable when all the independent variables are zero.

FDI_{it} denotes the Foreign Direct investment (FDI) net inflows into country i at time t. It refers to direct investment equity flows entering into a country. It can also be said to be the net inflows from foreign investment enough to acquire at least 10 percent voting rights in a domestic firm. It is the sum total of equity capital, reinvestment of earnings, and other capital.

$\beta_2$is the coefficient of FDI to be estimated in the regression model. We expect a relationship other than positive because of our sample set. Studies done in developing economies usually have a negative.

$TECH_{it}$ denotes the Technology variable for each country and each year. We proxy technology by scientific and technical journal articles which is an indication of the presence of innovation or technology in the local country. Scientific and technical journal articles refers to the sum of scientific and engineering articles or publications in physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences fields published within the year. We impose an assumption that technology presented in these applied science journals have an effect on the technology within the country.

$\beta_4$denotes the coefficient for TECH variable. We expect a positive relationship indicating the positive relationship between economic growth and technology.

$(FDI * TECH)$ denotes the interaction between FDI and Technology. We refer subsequently to this variable as our interaction term.

β_4 represents the coefficient of the interaction term. We expect the interaction to be positive. Thus, the relationship between the interaction (FDI and Technology) should be positive so the coefficient β_4 should be positive. A positive coefficient suggests that countries with a higher level of innovation or technology are better able to absorb FDI. Thus, these countries are able to benefit from FDI in terms of achieving higher levels of economic growth.

X_{it} denotes control variables that have been used in studies like this one. We include a set of information conditions to be sure that we are capturing the effect of the technology and FDI indicators on economic growth. These control variables have been used in other studies (see Adams, 2009; Agbloyor et al, 2016). The variables include; government expenditure, political stability, labour force, and trade openness.

$\mu_i$denotes the country specific effect which is the same across time for the data. Thus, it is time invariant hence the subscript i.

ε_{it} denotes the error term or white noise in the regression.

Table 4.2 Model Variables, Interpretation and Sources

Symbol	Meaning and interpretation	Source
FDI	FDI inflows coming into the country	International Monetary Fund(IMF), Balance of Payments database
TECH	Technology present in host country.	National Science Foundation, Science and Engineering Indicators.
INTERACTION TERM	Absorptive capacity: derived by FDI*TECH	World Bank data
GDPCU	GDP in constant US$	World Bank national accounts, OECD national accounts
EXPCU	Government expenditure	World Bank national accounts
PSTAB	Legal and Political risk	World Governance Indicators
OPEN	Country openness to the external world. Measured by the sum of imports and exports multiplied by GDP	World Bank national accounts data, OECD national accounts data
LABPER	Labour force. Labour is defined as people 15 years and older who meet the International Labour Organization definition of the economically active population.	International Labour Organization database

4.7 Pre-estimation Test

With respect to our FE regression, we check the robustness of our standard errors. If our standard errors are robust, we need not add robust to our regression equation when using Stata. To test for that, we test whether our data is hetero- or homoskedatic. If our sample is homoskedastic, meaning there's constant variance in the error term, then we need not use robust standard errors in our regression else our regression will be biased. The opposite is true if our data is heteroscedastic; if our data is heteroskedastic, we have to use robust standard errors else our results will be biased. To test this, we use the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity.

We will also do a Hausman Test to see if the fixed effect (FE) regression model is the most appropriate compared to a random effects (RE) model. To do that we test whether or not there is covariance between the independent variables and the error term. If our test proves that there is no covariance between the error term and the independent variable, then a RE model would be appropriate. If the opposite is true, then FE would be appropriate.

4.8 Justification of variables

4.8.1 Dependent variables

To achieve the purpose of the study, the dependent variable for the regressions are economic growth.

Since Gross domestic product (GDP) is the monetary sum of the market value of all final goods and services produced by residents of the country. So, an upward trend of a country's GDP suggests that the country is producing more goods and services or better put, the country is increasing its value adding to its raw materials. An economy that produces more final goods for consumers is said to be vibrant and developed (or developing). GDP or GDP per capita is frequently used to measure economic growth in studies with data from Africa (see Aseidu, 2002; Adams, 2009; Al Khathlan, 2014; Agbloyor et al, 2016).

4.8.2 Independent Variables

4.8.2.1 FDI Net Inflow Variable

We make FDI inflow one of the independent variables in our model because we want to see its relation to economic growth and how technology (as an absorptive capacity) affects the relationship. FDI inflow is the measure for foreign investments in local equity (of at least 10%) that come into the country.

4.8.2.2 Technology Variable

The common proxy for measuring technology in literature has been intellectual property rights (patents, copyrights, industrial design and utility model etc.) and research and development factors like R&D expenditure, employees, etc. (see João , 2010; Branstetter, Fisman , & Foley, 2006;Liu, 2008; Neven & Siotis, 1996). But such data is non-existent for Sub-Saharan Africa. This study uses a new approach for measuring technology from FDI.

We use the total number of scientific and technical journal articles produced by the country as a proxy. Scientific and technical journal articles refers to scholarly works published within the country in the fields of physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences. In our estimation, journal publications represent new knowledge or technology that has been found or created. We expect a positive relationship with economic growth.

To use this variable as a proxy for technology, we make some key assumptions;

1. Technology published in applied journals, in the respective countries, represent new technology in the respective countries.
2. As more technology come into a country, it is reflected in the number of published article presented per year.
3. Published articles is the best measure of technology in the country represented.

4.8.2.3 Interaction Term

We interact FDI and technology to form an interaction term which will measure the absorptive effect of FDI when technology is present. We expect the relationship of FDI on GDP to be positive. So the interaction term (an absorptive capacity) so see if it will have an effect on the FDI-GDP relationship. We expect the interaction term to have a positive relationship with dependent variable.

4.8.3 Control Variables

The control variables are explained below.

4.8.3.1 Government Expenditure Variable

This control variable measures how much the government spends annually. Government consumption or expenditure is the sum of transfer payments to households, interest on transfer payments and government purchases. These expenditures have an effect on economic growth so we have to control for it so that it does not affect our results. We expect a positive relationship between government consumption and economic growth (measured by GDP).

4.8.3.2 Political Stability

We account for political risk by using the World Governance Indicators (WGI) data on political risk. Specifically, we use the indicator; Political Stability and Absence of Violence or Terrorism Estimate from the WGI. Political Stability and Absence of Violence or Terrorism measures the probability of occurrence of political instability and/or the incidence of politically motivated violence or acts of terrorism. Each country is given a score from -2.5 to 2.5. We expect it to be positively related with the dependent variable.

4.8.3.3 Trade Openness to the External World

This variable measures the degree of openness of the economy; thus the degree of integration of a country (or economy) in the world economy. Openness reflects how easy the country is able to import or export to the other parts of the world. It is measured by taking the value of the exports plus imports (total trade value) expressed as a percentage of GDP of the respective country. Trade openness used as a control variable in the study is supported by other studies (Adams, 2009;

Agbloyor et al, 2016). There is no expectation of the sign of the coefficient for this variable; it could be positive or negative.

4.8.3.4 Labour Force

We use data on labour force to account for human development. We get our data on labour force from the world bank databse; world development indicators. We expect it to be directly related to economic growth.

4.9 Limitations of the study

The study is limited in the following ways;

The data on which the study is conducted is limited to only 43 Sub-Saharan countries and for a fixed time period (from 1990 to 2008, spanning 19 years). This means only factors that appear within these countries and time frame will be captured and discussed upon. All other factors that may or have occurred outside this frame is not accounted for. Perhaps further studies could be done on the uncaptured parts.

Also, the study does not categorize the countries (under study) into income earning groups or regions– thus into high income earning, middle income earning and low income earning countries or groups. Therefore, this study neither performs any regional analysis nor analyses the empirical relations in stratified earning groups. Again, this calls for more studies to be done.

Last, access to data for the proxies were quite a challenge. Technology proxy proved difficult to ascertain. This has limited to some extent the quantum of the work done. It must be noted however that these challenges do not affect the quality of the work done and the results of the findings.

CHAPTER FIVE

ANALYSIS AND DISCUSSION OF RESULTS

5.1 Introduction

This chapter presents the empirical evidence resulting from the statistical analysis performed on the data. Results from the regressions of the study is here presented and interpreted for conclusions and recommendations to be drawn from. Tables and charts will be presented for a simpler understanding of the results.

5.2 Descriptive Statistics

The table below presents a summary statistics of the variables used in the regressions. The table presents the number of observations, the mean, standard deviation, and the maximum and minimum values of both the dependent variable and the independent variable. We log GDP, FDI, government expenditure and the interaction term to smoothen the variation and make it normally distributed. The values for GDP, FDI, Interaction term and government expenditure were the actual values so they were huge figures hence the need for logging. The table below presents the descriptive statistics.

Table 5.1 Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
lnGDP	808	9.521283	.5818748	8.003491	11.47627
lnFDI	803	7.608242	1.006778	2	9.994977
Tech	785	156.7213	598.5485	.2	6137.3
lninteraction	776	8.962239	1.533451	2.897627	13.78295
lnExpcu	728	8.679416	.5949417	7.176319	10.7284
Open	778	73.12675	49.07174	0	531.7374
labper	789	.1086784	.0836993	.0017907	.419002
pstab	430	-.4816278	.9058577	-2.994749	1.19232

From the table, the mean of the logged GDP (in current US$) of 808 observations is 9.52. That means averagely, the logged GDP value for our sample set is 9.52. A standard deviation of 0.58 is quite large considering we used logged values. When we run the descriptive statistics for our data using actual values (which we did not present), we found that the standard deviation was about US$ 49 billion. Because the SSA countries in the model are from both developed, under-developed and developing economies, there is a wide variation in their GDP values. Developed economies produce more hence will have a higher GDP. The maximum and minimum logged values are 11.48 and 8 respectively.

For FDI, the mean of the variable is 7.61 and a standard deviation, a measure of the squared variance, is around 1. The range of the maximum and minimum values is 7.99. A standard deviation of 1 implies the variation in FDI inflows is much higher than the average GDP of the sample. Also the average FDI inflows to the 43 countries was more than half of their average GDP. It implies FDI is a strong source of capital investment for them.

The technology variable measures the innovation present in the country or economy. The level of innovation present in the countries of the study also vary widely, hence a standard deviation close to 598.55. The mean of 156.72 indicates that averagely 156.72 publications are made annually in our data set. The high standard deviation shows how wide technology varies in the sample set. Within the 785 observations, the range of innovative technology present in the sample countries is between 0.2 and 6137.3.

The interaction term interacts the technology variable with the FDI. Our aim is see the effect of FDI on economic growth when technology is present in the country. The high standard deviation of 1.5 indicates a very high variation in the data, since the variable is logged. The mean value is 8.96. The positive mean means the relationship between the two variables are positive. The number of observations also reduces to 776 due to some missing data points.

As control variables for the regression model, we control for government expenditure, trade openness, labour force and political stability. We control for these, because most studies on economic growth in SSA have used them; there is evidence they could have an effect on the dependent variable (economic growth variable). The log of Government expenditure (in current US$) represents government consumption in our regression model. We expect that government spending directly affect the economic wellbeing of the country, which is an indication of economic growth. In our dataset of 728 observations, we observe that averagely, the logged government expenditure of SSA countries in the sample is about 8.68 of their GDP. The variation in the government expenditure is also 0.59 thus the range for the consumption expenditure is 3.55.

Trade openness accounts for how opened the SSA countries are to the external world. Averagely, the level of trade openness is 73.13 with a standard deviation of 43.1. That means that averagely import and export constituted 73% of GDP and the value varied by 43.1% within the sample. The number of observations for this variable is 772 representing about 94.40 of the total data observations.

The labour variable consist of people 15 years and older that are economically active and engaged in some work, expressed as a percentage of the population. Its mean value is 0.1087 and its standard error is 0.084. Averagely, about 0.11% of the population are over 15 years and economically active in the sampled data. The standard deviation of 0.08% shows how little variation is within the mean. The range between the minimum and maximum is 0.42%.

Political stability measures the level of political freedom in the country. We use the data from the world governance indicators. Unfortunately, the political stability data only starts from 1996. That reduces our observations to 430. Averagely the level of political stability is -0.48. It is not surprising because generally, the level of political stability is very low among SSA countries. The standard error is 0.91 and the maximum and minimum values is -3.0 and 1.19 respectively.

5.3 Correlation and Covariance

We then proceed to run correlation and covariance analysis on our data. This is to inform us of the strength of correlation among the variables. The table is presented below.

Table 5.2 Correlation Table

	lnGDP	lnFDI	Tech	lninteration	lnExp	Open	labper	pstab
lnGDP	1.0000							
lnFDI	0.6971	1.0000						
Tech	0.5976	0.3340	1.0000					
lninteraction	0.8438	0.8861	0.5162	1.0000				
lnExpcu	0.9457	0.6386	0.5983	0.8048	1.0000			
Open	-0.0468	0.2823	-0.0779	0.0731	-0.0283	1.0000		
labper	-0.4219	-0.4879	-0.2352	-0.4604	-0.4248	-0.3828	1.0000	
pstab	-0.0245	0.0750	-0.0035	0.1114	0.0652	0.1746	-0.4419	1.0000

As can be seen from Table 5.2 there is stronger correlation between FDI and GDP, Tech and GDP, GDP and government expenditure, and the interaction term and GDP as expected, with correlations coefficients above 0.50 in all cases. The rest of the variables have a weak correlation (with coefficients less than 0.50) with the dependent variable. FDI and the interaction term are strongly correlated with a correlation coefficient of 0.89 and this is expected since the interaction term is the product of FDI and technology. The interaction term is also strongly correlated with the Technology, having a coefficient of 0.512. Also, government expenditure seems to be strongly correlated with GDP and the interaction term. The rest of the correlation coefficients are less than 0.50.

5.4 Scatterplot matrix

Below is a scatterplot matrix diagram showing the relationship between the dependent variable and the two main independent variables of this research- the technology and interaction variable. We look at the pictorial representation to see whether there are any visible signs of relationship. We not only take the dependent variable and relate it to technology and the interaction term, but also we look at the relationship when the independent variables are logged.

What better way to observe this relationship than constructing scatter plot, which is simply a two dimensional graph of ordered pairs. Because we are examining 5 variables – 1 dependent variable and 4 independent variable (of which 2 are the logged variables) – we employ a scatterplot matrix, which is a group of scatterplots arranged in a matrix form. We then proceed to examine each of the tables.

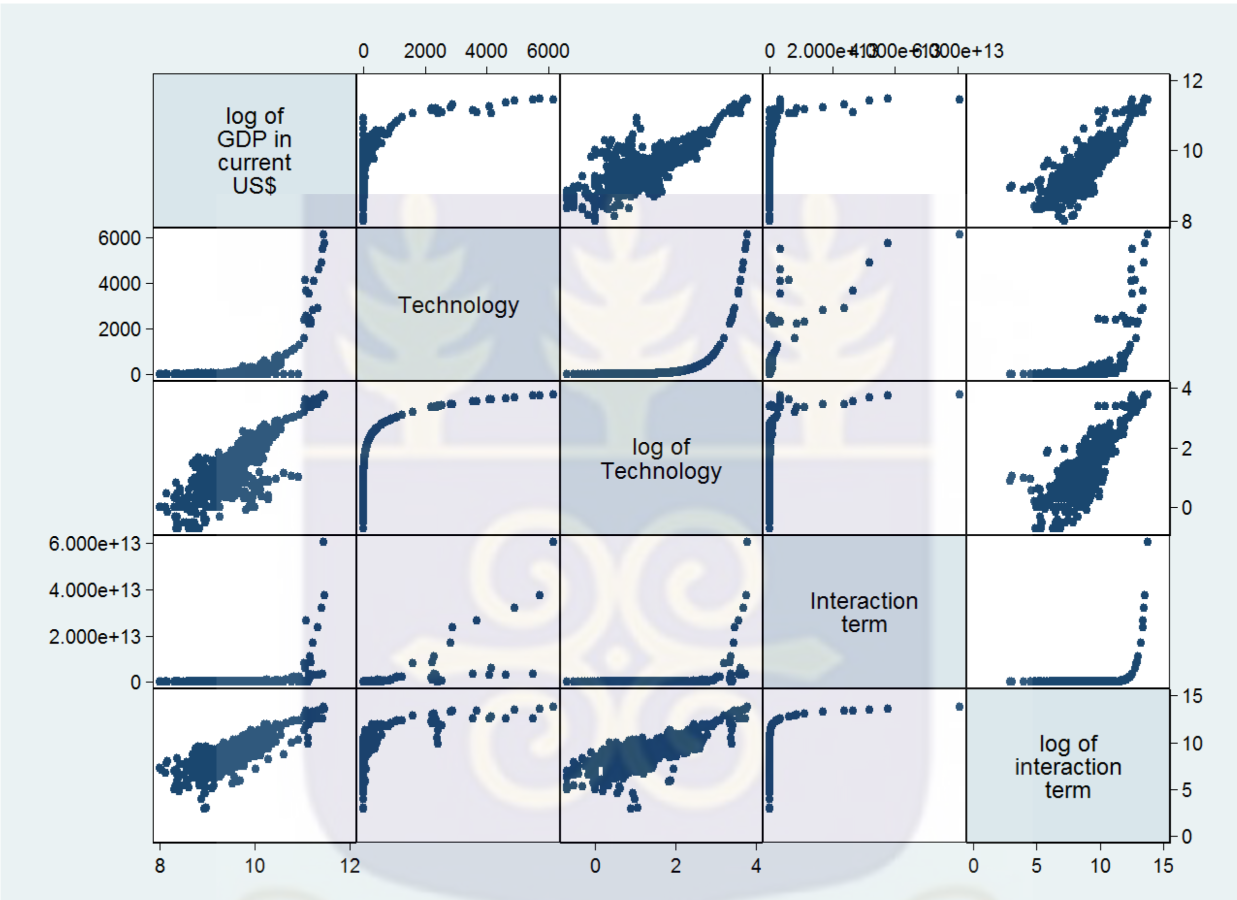
In the scatterplot of the dependent variable and the interaction term, we observe a positive relationship. Upon further examination, we observe that the interaction term is high when GDP is high enough or reaches a certain point (when log of GDP is at 11). In the region where GDP is much lower (from 0 to 10), the interaction term remains leveled and close to zero. It's as if there's no change in the level of the interaction term, when GDP is low. This means that at low GDP levels, technology is very low and its absorptive capacity tends to be low also. But when GDP is high enough technology is high enough to absorb more from FDI.

When we proceed to look at the relationship between the dependent variable and the log of the interaction term. We observe a positive relationship between the two. However from 0 to 5 on logged interaction's axis, there are no data points. Above point 5, we see most data points clustered and from point 12 to 15, we see much less clustering and data points. Thus there are more countries with low technology compared to those with high technology. That also mean countries with low GDP's will have low FDI absorption compared with countries with high GDP's.

The relationship between technology and the interaction term is generally a positive one albeit some data points show that high technology occurs even at low levels of spillover. So we see a bi-directional relationship in the scatterplot; one set shows that technology or technological presence is increasing when level of the interaction term is also increasing; another shows that technology is not much affected by the interaction term (indicating they are not affected by technology). The increasing positive relationship shows a positive relationship between technology and FDI.

When we look at the relationship between the logged values of the technology and interaction term, we observe the same positive relationship between them. We observe again that the positive relationship begins at some threshold and it's clustered in the region closer to the origin.

Figure 5.1 Scatterplot Matrix



The scatter plot of GDP and the Technology variable is quite similar to the plot of the log of GDP and the interaction term. Again here, we see that technology is high only when GDP is high above a certain level. When GDP is high enough technology increases sharply. But we see more of the data points within the region with low GDP, where technology is low. Few points are about the threshold where technology is rising.

When we observe this relationship using the logged values of GDP and technology, we see a positive relationship. GDP and technology are positively correlated although more data is clustered and much closer to the origin. The clustered data points are much more than the data spread in the other part of the graph showing that most of the SSA countries have low GDP and with that, the domestic level of technology tends to be also low. The relationship between GDP and the interaction variable is also very pronounced meaning SSA countries with higher technology tend to also have higher GDP's too. But because much of SSA countries are low GDP earning countries, we see that a large number of the data points are clustered at a low GDP region of the graph. From this finding, we can infer partially that based on our sample set that not much FDI would be absorbed by technology seeing that technology is low in our selected countries.

5.5 Regression analysis

5.5.1 Model results: Fixed effects

We estimate our first regression model using fixed effects. We regress GDP on FDI, Technology, the interaction term, and the control variables. We include an OLS regression as our first model. So that the FE models would serve as some form of a robustness check. We present our fixed effects (FE) regression results in the second column labeled M2 (meaning model 2), and another FE regression result in model 3 (M3). In M1 we include all the variables in the regression and run an OLS regression. In M2, we include all our variables and run a FE regression. In M3, we remove political stability and run a FE regression. We include M3 because the number of observations reduce to about half when political stability is included in the model so we take it out to see if a change in the sample observation could affect the results. This is because our political stability values start from 1996, reducing the number of observations.

When we run on OLS, the technology variable is significant at 10% and the interaction term is significant at 1%. The R-squared of 93% also suggests a high predictive power of the model. The coefficient of technology and its standard errors are positive and close to zero. However, the interaction term is 0.07 and significant at 5%. The R-squared and adjusted R-squared are very large (above 90% in both cases). The number of observation is 350. In comparing the coefficient of FDI and interaction term, we see that the coefficient for the interaction term is higher than that of FDI. This tells us that technology presence increases the effect of FDI on economic growth. We can then proceed to our main regression result (M2 and M3) to see if the situation is the same or not.

R-squared for the M2 is 88% signaling that 88% of the variation in GDP is caused by our independent variables. Put differently, 87% of the total variability in the model estimation is accounted for by the linear model; this is an estimate of the strength of the relationship between the model and the response variable. The adjusted R square is 87% which is also high. Although this is a cross country study, it is not surprising to have such high R square; as some studies on economic growth and FDI in sub-Saharan Africa have had high R squares too (Adams, 2009;Abor, 2010). The number of observation is 350 and the number of groups is 38. The table below presents the results of the regression.

Our independent variables are significant in M2 and M3 (at 1% and 5% significance level), with the exception of political stability which is insignificant.

Table 5.3 Regression table (Fixed effects)

VARIABLES	(M1) lnGDPcu	(M2) lnGDPcu	(M3) lnGDPcu
lnFDIcu	0.0315	-0.104***	-0.0938***
	(0.0223)	(0.0203)	(0.0154)
Tech	2.43e-05*	5.28e-05***	3.41e-05**
	(1.37e-05)	(1.51e-05)	(1.37e-05)
lninteraction	0.0708***	0.138***	0.117***
	(0.0168)	(0.0184)	(0.0134)
lnExpcu	0.692***	0.384***	0.521***
	(0.0254)	(0.0303)	(0.0249)
Open	-0.000717***	-0.00212***	-0.00104***
	(0.000205)	(0.000151)	(0.000147)
labper	-0.583***	-2.081***	-1.733***
	(0.157)	(0.184)	(0.132)
pstab	-0.0778***	0.00116	
	(0.0107)	(0.0108)	
Constant	2.737***	6.162***	4.954***
	(0.197)	(0.267)	(0.220)
Observations	372	372	677
R-squared	0.928	0.884	0.842

Adjusted R-squared	0.9271	0.868	0.831
Number of countries		39	39

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

In M2, we observe that FDI is significant as 1% alpha level but has a negative effect on GDP with a co-efficient of 0.104. This implies that GDP reduces by 0.104 when FDI is increased by 1 unit. In M3, the co-efficient for FDI is much smaller with a negative co-efficient of 0.094. The interpretation is the same for the coefficient; GDP reduces by 0.094 when FDI is increased by 1 unit. This is congruent with studies done on economic growth in Africa; FDI tends to be negatively related to GDP. Most studies have explained, even as observed in the stylized facts presented in chapter 2, that FDI's that come to Africa are extractive in nature and usually do not seek to satisfy or serve the local market. Therefore, they do not contribute much to economic growth as expected, aside taxes they pay to the local government and the low-level professionals they employ locally. Their footprint on local economic growth is small in SSA countries, compared to the developed economies they export to.

The technology variable is significant at 99% and 95% confidence interval in M2 and M3 respectively. However, the coefficients are positive and close to 0. Even the co-efficient is still close to zero when we observe the OLS regression which is significant at 10%. This means technology present in the sample countries have a positive relationship with economic growth, however the effect on economic growth is very minimal. This is in congruence with what we observed in the scatter plot matrix. We could say the technology exist in the sample countries but its effect on economic growth is small.

When we interact FDI with technology, its effect is more pronounced on the dependent variable. We observe a coefficient of 0.138 and 0.117 for M2 and M3 respectively, significant at a 1% level of significance. These coefficients show that FDI is more absorbed when technology is present in the host country; the coefficient of FDI on growth is negative however the interaction term (FDI*Technology) is positive. That means countries with higher technology are able to transform the negative impact of FDI on economic growth into a positive one. This is because they can more easily absorb the advanced technologies associated with FDIs.

Government expenditure also has a positive relationship on economic growth and it is very significant at a 1% level of significance. The coefficient are 0.384 for M2 and 0.521 for M3. Meaning countries in which governments spend more tend to have higher growths; because government expenditures are generally towards infrastructural and market growth.

Trade openness is also significant at a 99% confidence interval, although the effect to GDP is negative. In our sample countries, imports exceed export levels whilst imports are usually unprocessed raw materials and exports finished value added products. This means trade openness harms rather than benefits the economy. This is supported by one of the stylized facts; FDI that comes into SSA countries is usually in the extractive industry (discussed in chapter 2). Because a higher chunk of FDI coming into SSA are into the extractive sectors (e.g. mining, manufacturing for external environment, etc.), the expected growth effect from these investments are not directly beneficial to the local markets; the benefits are hauled to external markets through larger exports than imports.

Labour force is also significant at a 1% level in all three models. However the coefficients are negative in each case. The interpretation is that although the sample countries do have a high labour force, it does not automatically translate into high economic growth. The author thinks that the reason could be that the high level of labour are mostly unskilled and unspecialized, therefore they are not able to increase output significantly.

We controlled also for political stability in M2, as it is consistent with most studies done in SSA. As expected, the political stability variable is positively correlated with GDP. However the coefficient is insignificant at 5% alpha level. Because the number of observations are fewer and the result is insignificant, we drop it in M3.

5.6 Pre-Estimation Tests

5.6.1 Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

To test whether we should use robust standard errors for our regression model, we do the Breusch-Pagan test for heteroscedasticity. Heteroscedasticity occurs when there's unequal variability (scatter) across a set of second, predictor variables. It has generally been said to exist naturally in data. If our data is heteroscedastic, then our results could be biased if we don't use robust standard errors. To do this, we run an OLS regression of our variables and test for heteroscedasticity, using Stata command "estat hettest". Our null hypothesis states that there is constant variation in the error term so if we fail to reject the null, it means our dataset is not heteroscedastic (thus it is homoscedastic) and hence there's no need for robust standard errors. Below our the results;

We rerun our OLS regression, but this time around we drop political stability and maintain the other variables. The table below presents our test results after we perform the Breusch-Pagan / Cook-Weisberg test for heteroskedasticity.

Table 5.4 Test for Heteroscedasticity

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity		
Ho: Constant variance		
Variables: fitted values of GDP		
chi2(1)	=	0.08
Prob> chi2	=	0.7743

Our P value (of 0.7743), from the Breusch- Pagan test for heteroscedasticity is insignificant (greater than 0.05), indicating that the variation from the regression line is constant among our data points (i.e. there is no heteroscedasticity in the dataset) and therefore, the normal standard errors are not biased. Also, we observe from our scatter plot that that there is no heteroscedasticity; data that exhibits heteroscedasticity are usually cone shaped.

5.6.2 Hausman Test

We proceed to do a Hausman test on our regression. This test was propounded by Hausman in 1978. He employed hypothesis testing to compare which model estimation (i.e. whether FE or RE) best fits the data. To determine the most appropriate model between the two, the difference between the coefficients is squared and divided by the difference in the variation of the coefficients to determine its chi- square. Thus mathematically;

$$chi^2 = \frac{(b - B)^2}{Var\ b - VarB}$$

Where b represents FE coefficients and B represent RE coefficients.

We do a hausman test to justify our use of FE rather that RE. We specify our null and alternate hypothesis.

$$H_o: Cov\ (X_1, \varepsilon_{it}) = 0$$

(The null hypothesis states that random effects model is appropriate; i.e. there's no correlation between the variables and the error term)

$$H_a: Cov\ (X_1, \varepsilon_{it}) \neq 0$$

(The alternate hypothesis states that the Fixed effects (FE) model is appropriate; i.e. Random effects is not appropriate)

Our null hypothesis proposes that the correlation between the independent and the error term is random (or not systematic) and they are not inter-related. Therefore, a random effects estimation would be appropriate. Hence the mathematical expression indicating the covariance between them is zero (or there's no covariance). The alternate hypothesis insinuates the opposite; there exist some correlation between the independent and the error term (covariance between them is more than zero).

The table below presents the hausman test results;

Table 5.5 Hausman test results

	---- Coefficients ----			
	(b) FE	(B) RE	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
FDI	-0.0841837	-0.0754175	-0.0087662	0.0047944
Tech	0.0000305	0.0000275	2.97E-06	3.17E-06
Interaction	0.1090934	0.1070176	0.0020758	0.004901
Gov. Exp	0.5883393	0.6519714	-0.0636321	0.0115638
Trade openness	-0.0972443	-0.1144304	0.0171861	0.007321
labour	-1.683713	-1.251441	-0.4322716	0.0618394
chi2(6)	=	(b-B)'[(V_b-V_B)^(-1)](b-B) 37.66		
		Prob>chi2	0.000	

The chi square for the test is 37.66 and the P value is 0.000. The P value is significant so we therefore reject the null hypothesis and conclude FE model is appropriate for the regression; there is some correlation between the independent variable and error term hence random effects estimation is not appropriate for the model.

5.6.3 Test for endogeneity

To test for possible endogeneity, simultaneity and reverse causality issues. To do this we suspect that, although technology can impact GDP directly, technology can impact FDI which would in turn affect GDP. This can affect the results of our findings. To do this, we run an IV (instrumental variable) regression.

Under IV regression, the type of regression we employed is the Two Stage Least Squares (2sls). We run two regression models; in the first regression, we treat the technology variable as an instrument (or instrumental variable) to the FDI variable. Thus we employ Technology is an instrumental variable to FDI to account for any unobserved correlation between the two variables. In the second model, we treat technology variable as an instrument (or instrumental variable) to the interaction term.

The table below is the regression output.

Table 5.6 Test for Endogeneity using 2stage least squares

VARIABLES	(1) lnGDPcu	(2) lnGDPcu
lnFDIcu	-0.136	-0.104
	(0.0975)	(0.0790)
lninteraction	0.176***	0.193***
	(0.0614)	(0.0707)
lnExpcu	0.659***	0.598***
	(0.0378)	(0.0687)
Open	-0.000104	-0.000279
	(0.000423)	(0.000336)
labper	-0.750***	-0.626***
	(0.190)	(0.167)
pstab	-0.0953***	-0.0922***
	(0.0147)	(0.0135)
Constant	3.326***	3.459***
	(0.460)	(0.531)
Observations	372	372
R-squared	0.917	0.918

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the above table we observe a very high R-squared (of about 92%) for both models. This gives a sense of the high predictive power of the regression models.

When the coefficients for the interaction term and FDI are observed, we see the results is similar to the main FE regression model the study employed. FDI is negatively related to the dependent variable albeit not significant in model 1 and 2.

The interaction term, which happens to be the main focus of the study shows and positive and significant relationship with the GDP, the dependent variable in both models. This is very similar to the findings from the main regression models. We see that that when we control of endogeneity, the regression results do not change that much. That means endogeneity may not be a problem in the main regression.

5.6 Chapter summary

This chapter presents regression results of the study. The FE regression results are provided with tables and interpreted in a meaningful way. Our results showed that FDI had a negative effect on GDP. However when FDI is interacted with Technology, it results in a positive relationship. With means countries with high technology absorb more from FDI. The next chapter summarizes the findings and provides conclusions and recommendations.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This is the final chapter of the study. This chapter presents the summary of findings, conclusion, and recommendations. The summary of findings presents the scope of the study, the specific objectives, the methodology, brief analysis and findings. The conclusion concludes the study by looking at the implication of the findings and general remarks. The conclusions would be drawn from the analysis and discussions of the findings. And the recommendation discuses some recommendations inferred from the results of the study.

6.2 Summary of Findings

The study sort to find relationship between economic growth and FDI, when technology is factored in. our sample size was 43 countries in the Sub-Saharan region spanning from 1990 to 2008. The time frame captures the privatization era (the 1990's) and post privatization era. The privatization era, according to (Adams, 2009), is the period where SSA countries privatized most of their state owned enterprises. That period also saw more inflows of FDI and multinational collaborations.

Some earlier studies have indicated that in developing regions, FDI does not always positively affect growth, unless some absorptive capacities are in place. Other studies on technology have shown that technology comes from FDI and it affects productivity. However there is a missing link of the effect of FDI on economic growth when technology is present. The study sought to find the missing link between FDI, technology and growth.

The objectives of this study was to determine the relationship between FDI and economic growth in SSA countries and secondly, to examine the effect of this relationship when technology is present. We employ a Fixed Effects (FE) regression model.

We define technology as new knowledge and innovation, emerging from research and development that has the capacity to increase output or productivity. We use data on applied research as a measure for technology, sourced from the World Development Indicators (WDI) database.

We create an interaction term and include it in our model along with FDI and other control variables. The interaction term is supposed to measure FDI's effect on growth when technology is present, as an absorptive capacity.

After running the regressions, we found out that FDI is significant and negatively affects economic growth. Our technology variable was significant and positively affects economic growth, although the coefficient was very small. The interaction term was positive, significant and had a higher coefficient. That means countries with technology are able to absorb more form FDI. We found also that countries with higher technology are able to absorb more form FDI than countries with lower technology.

6.3 Conclusion

In this section of the dissertation, we conclude the research based on the findings of the work.

We conclude by saying technology increases not only productively but has a ripple effect on the economic growth of the country. However the best way for developing economies to get technology is through FDI. Technology comes to developing economies through MNC engagements in the form of FDI.

The level of technology also affects the country's ability to absorb FDI. However SSA countries are not benefiting much from FDI because of low levels of technology. Hence it is important for SSA countries to improve their level of technology in order to absorb more from FDI.

6.4 Recommendations

Based on the findings of this study here are some recommendations;

Technology has a positive relationship with growth. However for increase in economic growth, higher levels of technology is needed to absorb more from FDI. Therefore local governments must put in place measures that create higher levels of technology. Industrialization must be encouraged, businesses must be given the necessary tools and help, investment in young students to be innovative among others are some of the things local governments can do. This will help increase the level of technology and that will have a ripple effect on growth.

Governments and policy makers must make policies that attract not any kind of FDI, but FDI that brings in technology that is valuable for growth. Not all FDI are beneficial to the host countries growth. Therefore local governments must collaborate with MNCs that can help the economy. The extractive kind of FDI must not be encouraged.

Local firms must be encouraged to collaborate with MNC. Through collaborations, MNCs transfer – directly or indirectly- knowledge and technology to local firms. Through partnerships and collaboration, local firms and MNCs could come into contact which will encourage transfer of technology. This would increase absorption of technology in the country.

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Appendix

Appendix 1

Appendix 1 presents Frequently Used Measures of technology and Innovation. The author samples scholarly journal publications and identifies various measures of technology and computes it into table 1. The author then proceeds to access each measure based on its advantage and disadvantage.

Table 5 **Frequestly Used Measures for Technology found in Literature**

PROXY	STUDY	MERIT	DEMERIT
New products / product innovations	Elenkov & Manev (2009), Sasidharan, (2006), Hale and Long (2006)	Measures actual implementation	Not all products succeed
Patents / patent applications/ Patent citations	Makri & Scandura (2010)Jung et al. (2008),	Measures technological progress and the importance of patents	In some situations, Patents are not useful. patenting is not harmonized across countries
Invention disclosures or suggestions	Axtell et al. (2000)	Measures technological progress and amount of ideas generated	Ideas might not become products
Innovations in processes	Marin and Bell (2006; 2008), West et al. (2003), Kinoshita (2000)	Measures improvements in processes and methods	Difficult to measure, challenge of innovators dilemma.
Ratio of new product sales to total sales	Bwalya (2006), Czarnitzki & Kraft (2004), Javorcik & Spatareanu (2008)	Measures customers response to innovation	Sales output is affected many variables

Ratio of new product sales to cost of R&D	Gumusluoglu & Ilsev (2009), UNCTAD (2010)	Show how R&D had impacted sales (efficiency)	Sales output is affected many variables
Cost of R&D	UNCTAD (2010),García-Morales et al. (2008), Neven & Siotis (1996), (Lancheros, 2016)	Data very available (Most used measure of technology)	Does not measure efficiency
Number of employees into R&D	UNCTAD (2010), García-Morales et al. (2008),	Data very available (Most used measure of technology)	Does not measure efficiency
Entry into New markets	Elenkov & Manev (2009)	Measures innovation and efficiency	Some Acquisitions fail
Productivity and efficiency	(Liu, 2008) , Dutse (2012), Chuang and Lin (1999),	Easy to measure / Quantifiable	Productivity is the result of many variables
Kowlegde creation and skills (labour)	(UNCTAD, 1999; Gorg and Greenaway 2001; Pradhan 2006), (Seghir, 2012), Bwalya (2006)	Relatively closer measure of technology	May be affected by more than one variable and hard to disentangle.
Payments of Royalties and License fees	UNCTAD (2010)	Quantifiable and easy to compute	May be weak form of measure in some cases.

Measurement of Technology found in literature. Source: computation by author.

Appendix 2

Appendix 2 shows sampled articles (from science direct) published within the stipulated timeframe to do a comparative study. Articles that border on the direct effects of FDI are sampled and compared with articles on indirect effects. The author looked for articles with these key words: FDI and growth, FDI and productivity for the direct effects and key work: FDI and technology spillover, FDI and innovation for articles on technology diffusion from FDI. The results are computed in Table 2.

The articled were sourced from science direct. Science direct has one of the largest database on scholarly journals and books. Their database consist of published (or yet to be published) scholarly publications and books from over five thousand publishers worldwide. These do not include predatory journals.

Table 6 **Sampled Schorlary Journals on Selected Topics over Time**

Year	FDI and Growth	FDI and Productivity	FDI and Technology spillover
2017	23	10	2
2016	820	401	202
2015	804	404	219
2014	737	369	175
2013	730	364	163
2012	590	319	155
2011	473	234	111
2010	404	222	100
2009	456	269	129
2008	378	191	99
2007	357	199	91
2006	280	161	63
2005	250	143	58
2004	264	151	51
2003	213	109	35
2002	280	94	32
2001	186	91	34
2000	134	61	18
1999	112	52	20
1998	160	46	15
1997 and earlier	936	223	43
Total Publications	8587	4113	1815

Source: Authors computation, Data from science direct database. The spikes in 1997 and earlier are due to aggregation of data from earlier years. This increases the number of data points.

Appendix 3

Appendix 3 shows sampled scholarly articles categorized into selected countries and regions; Africa, China, Europe, India, USA and Japan. The journals are grouped into journals on FDI and Growth, Journals on FDI and Productivity, and journals on FDI and Technology. This is done for comparative study purposes, to see the quantum of research done to date on the specified topics, in the selected regions or areas. Results are computed in table 3.

Table 7 **Sampled Schorlarly Articles Accounding to Topic and Region(Area of Study)**

Selected Countries and Regions	FDI and Growth	FDI and Productivity	FDI and Technology spillover
China	1330	719	395
Europe	223	114	44
Africa	104 (*SA70)	54(*SA 35)	45(*SA 19)
Japan	503	173	66
India	293	141	50
USA	342	180	70

Source: Authors own computation, Data from science direct database
*SA refers to studies done in South Africa.

Appendix 4

Appendix 4 presents a table showing FDI inflows. The inflows are measured in 3 categories; 1. Current US dollars. 2. Percentage to total FDI and 3. Percentage of GDP. The time period is from 1970 to 2015. Figures were gotten from UNCTAD database; FDI inflows.

FDI INFLOWS

YEAR		1970's*	1980's*	1990's-2004*	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
World	US Dollars (millions)	23800.03	92930.79	523237.3587	950125.01	1402125.86	1902244.48	1497788.14	1181412.19	1388821.03	1566838.97	1510918.31	1427180.95	1276999.29	1762155.04
	% of World	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	% of GDP	-	0.63	1.639630687	2.02	2.80	3.40	2.48	2.07	2.22	2.25	2.15	2.05	1.74	2.46
Developed economies	US Dollars (millions)	18044.55	72427.95	367623.6314	587709.79	940318.37	1289493.50	801909.21	654366.69	699889.23	817414.80	787358.83	680275.02	522042.92	962496.29
	% of World	75.49	74.79	68.17688857	61.86	67.06	67.79	53.54	55.39	50.39	52.17	52.11	47.67	40.88	54.62
	% of GDP	0.41	0.61	1.468391514	1.68	2.55	3.20	1.87	1.62	1.67	1.81	1.77	1.52	1.15	2.27
Developing economies	US Dollars (millions)	5755.47	20496.42	148193.0171	331752.13	402982.75	525525.04	578482.16	465306.64	625330.31	670149.29	658773.74	662405.60	698493.63	764670.44
	% of World	24.51	25.20	30.4672269	34.92	28.74	27.63	38.62	39.39	45.03	42.77	43.60	46.41	54.70	43.39
	% of GDP	0.59	0.71	2.311960492	3.02	3.33	3.77	3.59	2.95	3.19	2.97	2.77	2.80	2.61	2.77
Africa	US Dollars (millions)	942.27	1313.38	7292.182512	29631.66	34578.23	50290.80	57728.57	54194.92	43571.48	47786.34	55155.71	52154.20	58299.77	54079.48
	% of World	5.29	2.55	2.078877397	3.12	2.47	2.64	3.85	4.59	3.14	3.05	3.65	3.65	4.57	3.07
	% of GDP	0.57	0.45	1.519099876	2.66	2.69	3.38	3.28	3.31	2.25	2.26	2.38	2.19	2.36	2.32
Sub-Saharan Africa	US Dollars (millions)	1124.28	2201.64	9883.231374	19635.65	14825.83	28698.61	37176.55	37780.05	29889.30	41972.72	41868.74	41088.05	47506.89	42892.09
	% of World	4.36	1.53	1.484546215	2.07	1.06	1.51	2.48	3.20	2.15	2.68	2.77	2.88	3.72	2.43
	% of GDP	0.61	0.37	1.732132029	2.53	1.65	2.76	3.13	3.41	2.23	2.74	2.61	2.41	2.67	2.58
America (Caribbean, Central and South America)	US Dollars (millions)	2654.30	6364.66	46538.75057	76581.84	73627.45	116680.84	138148.65	84237.90	167117.68	193314.95	190508.61	176002.42	170284.90	167582.07
	% of World	11.06	8.17	8.980180687	8.06	5.25	6.13	9.22	7.13	12.03	12.34	12.61	12.33	13.33	9.51
	% of GDP	0.78	0.81	2.730315556	2.98	3.21	4.71	4.79	3.54	4.48	4.61	4.63	5.08	4.04	4.06
Asia and Oceania	US Dollars (millions)	1877.93	11930.12	91767.73796	225533.63	294777.04	358553.40	382604.94	326873.82	414641.15	429048.00	413109.42	434248.98	469908.96	543008.89
	% of World	7.42	14.48	19.40621206	23.74	21.02	18.85	25.54	27.67	29.86	27.38	27.34	30.43	36.80	30.82
	% of GDP	0.39	0.74	2.250349306	3.09	3.47	3.48	3.19	2.70	2.86	2.49	2.23	2.18	2.22	2.47

*= Average values