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Determinants of Foreign Direct Investment into Africa's Knowledge-based Industries

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Abbreviations

IHS	Institute for Housing and Urban Development
KBE	Knowledge-based Economy
KBI	Knowledge-based Industry
FDI	Foreign Direct Investment
MNE	Multinational Enterprise
KFDI	Foreign Direct Investment into Knowledge-based Economies
SSA	Sub-Saharan Africa
GDP	Gross Domestic Product
GVA	Gross Value Added

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Chapter 1: Introduction
1.1 Background

It is clear that a digitalized global transformation has occurred and permeated into numerous aspects of daily life around the world. The way humans work, consume, and spend their leisure time is drastically different than a century ago. Digitalization has also sped up the trend of globalization. Metaphorically, the world is a now much smaller place where products and ideas are transferred and adopted at a staggering, and in some cases crippling, pace (Dickens, 2011). Although agriculture and Fordist industries are still the driving forces, in varying degrees, in many developing economies, the digital revolution and globalization are influencing every economy. Technological advances have increased human productivity and even replaced work that previously required human labor (World Economic Forum, 2016). Information is increasingly available allowing for interweaving global networks. New industries driven by innovation and knowledge have become well established and are initiatives that many countries are focusing on. These modern industries are considered to be more sustainable and are more competitive in the global market.

Yet, there has not been a universally agreed upon definition for these new "knowledge-based industries" or the "knowledge-based economy." The Organization for Economic Co-Operation and Development (OECD) defines knowledge-based economy as

> *"…an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors."* (OECD, 2005, pg. 15)

The definition OECD offers illustrates the fact that this new focus on knowledge-based industries and economy is a transition that includes many different sectors. These industries do not rely heavily on natural resources, but on human knowledge and ingenuity. The OECD (1996) considers a worker in a knowledge-based industry as being not engaged in the output of physical products, but rather the primary agent concerned with innovative design and ideas. Innovation goes beyond the physical, including process management that increases efficiency and can grow an economy without producing a tangible product. This is a paradigm shift from the industrialization period where economic growth was mainly concerned with the tangible inputs an economy needed to produce a physical product.

Even though the knowledge economy resides mainly in the West it is not exclusively in developed countries. Developing countries are striving to compete in sophisticated and innovative knowledge-based economies as well. In recent decades, there have been countries in Asia, such as Malaysia, China, Singapore, and Korea (Chandra & Yokoyama, 2011; Juraev, 2014; Nawrot, 2014), and South America, like Costa Rica (OECD, 2012a), that have transitioned from agrarian and primary industries to knowledge-based economies. These economies leapfrog an industrialization period, providing inspiration that development and growth is not linear and path-dependency exists (Redding, 2001). Their success in sophisticated sectors have also brought success to more traditional manufacturing and agriculture sectors through innovation and a spillover effect (Rischard, 2009). According to Rischard, any country desiring for a successful

knowledge economy needs to focus on human capital, good governance, infrastructure, and an open business environment. Not surprising, these aspects are included in both the World Economic Forum's Pillars to Competitiveness (Schwab & Sala-i-Martin, 2014) and the United Nations' 2030 Goals for Sustainable Development (United Nations, 2015). Both the World Economic Forum and United Nations are concerned with economic growth that is socially sustainable. One aim of this paper is to provide a literature review that shows how through knowledge-based industries, an African country can economically develop with direct and indirect social benefits.

A knowledge-based economy does not just benefit those that are gifted and fortunate to be able to work in an advanced occupation. From Moretti (2013), when a new skilled job is created several other jobs are indirectly created as well. These complimentary jobs could be other skilled jobs like a doctor or an unskilled job like a waiter. In Moretti's (2013) *The New Geography of Jobs,* he argues that in a city with a strong knowledge-based economy there will be higher wages for knowledge workers and the wages for all other workers will be higher as well. An industry's job multiplier effect will be imperative for Africa's growing youth population. Currently, only half of the population between 18-25 have a wage-earning job and its estimated that the majority of Africa's population will be younger than 25 by 2020 (Schwab & Sala-i-Martin, 2014). The rising unemployment of the youth has been labeled as a possible "ticking time bomb" (Ighobor, 2013). A growing, unskilled youth have some predicting the possibility of an Arab Spring for SSA. However, others see this a huge opportunity for the continent. In the next 15 years, Africa will have the most favorable demographic for growth and if the population can be educated an "economic renaissance" may propel the continent's development (ADB et al., 2016). Through knowledge-based industries, Africa's large youth population can fully develop their creativity, innovativeness, and entrepreneurial spirit and create a competitive edge over the aging West.

However, the current development structure in many African countries look very different than an "economic renaissance." The abundance of cheap labor and natural resources with the lack of government funding and regulations have exposed developing countries to exploitation, especially in the extraction and mining sectors (UNCTAD, 1997). Exploitation of resources without fair distribution of the wealth can be observed in Collier & Goderis' (2008) "resource curse" theory. Their research concluded that institutions, such as a federal government, if weak will cause negative long term effects following a short term commodity boom. This will lead to economic hardship for countries that are dependent on mining and exporting natural resources. Collier and Goderis (2008) reason that this is caused by several factors including "a race to the bottom," lack of regulations, poor management from leadership, and corruption. The resource curse theory goes further and shows that in the opposite case, when there are strong institutions, the wealth generated by the commodity boom is more evenly distributed and positive long term effects are observed.

There is a dire need for a better path for development in Africa. Inline with the resource curse theory, there is little evidence that the present extraction economy has promoted inclusive wealth distribution or social equality even though national GDPs have been growing substantially faster than the global average since 2000. Against the common notion of advantages with natural endowments, the resource-rich countries in Africa have not done any better than resource-poor countries in elevating their population out of poverty. Sadly, several of these endowed countries such as Angola, Republic of Congo, and Gabon have seen extreme poverty rise (Chuhan-Pole et

al., 2012). The current structure of many African mining industries has created an economy of two worlds. Natural resource reservoirs have been compared to enclaves that act almost independently from their surroundings. The economic prosperity from these mines "hop" over the local economy on its way to the multinationals overseas with very little prosperity being shared. Even at the lowest level of social inclusion, the foreign firms employ labor from abroad, not locally. Ferguson (2005) terms this situations as the Angolan Model. In Angola, a global exporter of crude oil, the government has received billions of dollars from oil firms for mining rights, however, little direct or indirect positive impacts can be observed. Angola consistently scores near last in the UN Human Development Index. Unfortunately, attempts to restructure the distribution of economic growth is easily suppressed. There are too many influential stakeholders and policy makers that benefit from the current structure of the extraction industry for any real impactful policy changes to occur (Artadi & Sala-i-Martin, 2003; Collier, 2002). Although in the recent decade there has been some improvements in human development, this may be in part because some African countries are taking the preliminary steps to decouple their economic dependency on natural resource extraction (Ernst & Young, 2014). It is becoming apparent that Africa needs to put a higher priority on transitioning to a diversified economy.

A positive consequence of globalization is the growing market for foreign direct investment (FDI). Investments from developed to developing countries can play a very important role when governments do not have the resources for long term infrastructure projects (Collier, 2014). FDI will be critical for the development of a knowledge-based economy in Africa as well. The "East Asian Miracle" of rapid growth with consistent distribution of wealth was in part because of the large increase of FDI into the developing countries. Starting in the mid-1980s, the East Asian region's economy had an incredible rate of expansion, which Urata (2001) argues was in part because of the twelve-fold increase in FDI during that period. FDI brings capital, technological and knowledge transfers, and competition to the host country (Hill, 2009; Kurtishi-Kastrati, 2013). It was because of these unique benefits from FDI that East Asia was able to close the technology gap between them and the developed world (Stiglitz, 2001).

Although, in some areas of the world developing countries are becoming more technologically sophisticated, Africa is still struggling to keep pace and it is becoming more imperative that progress is made. The lack of technological readiness will add to the growing income inequality gap between Africa and the West (Liefner, 2009). Knowledge-based industries exist in Africa but they are relatively weak and need support from policy makers through several forms including promoting and facilitating the necessary elements to attract FDI. Through the capital, technological and knowledge transfers, and competition from FDI an African knowledge-based industry can be successful on the continent and globally. However, there is a lack of knowledge about the determinants that attract FDI for knowledge-based industries in Africa. In contrast to the mining industries of the past, social sustainability is the utmost importance for the future of Africa, so a synergy must be created between the knowledge-based economy and social inclusiveness. Based upon Africa's backwards economic and social progress, this report argues that a transition to a knowledge-based economy will be a positive driver to resolve these issues and only through FDI can this transition become a reality for Africa.

1.2 Problem Statement

The past strategy of FDI concentrating in primary industries such as extraction of natural resources has not lifted the African population from poverty or addressed the growing gap between innovative countries and technologically lagging countries (Liefner, 2009). Economies that rely only on a single or a few industries are vulnerable to price shocks that may reverse any progress that has been made in the past. In response to the unsustainable approach and vulnerability that has been seen in the past and present economies in Africa, which has failed to address social inclusion, it can be through developing a knowledge-based economy with FDI that Africa will be able to economically diversify, produce needed innovations, and distribute future prosperity more equally.

1.3 Research Objectives

The objective of this report is to identify the location factors of FDI into the knowledge economies (KFDI) globally and within Africa. The resulting determinants will lead to social benefits as well as economic growth, creating synergy between the knowledge-based economy and social sustainability. Thus, a knowledge-based economy and social inclusiveness can grow in unison. A global analysis of the determinants for KFDI will be conducted, benchmarking African countries and cities against successful knowledge-based economies. In the process of identifying and analyzing the variables that attract KFDI, the locations of current knowledge-based industries in Africa will be identified and regional differences will be researched. The results of this investigation could potentially be the beginnings of forming policy recommendations for the future growth of a knowledge-based economy in African countries. This report does not attempt to explain all factors that determine foreign direct investment and is not arguing that the agriculture and manufacturing industries should take a backseat in Africa's development, rather the report is aiming to add empirical analysis to academia that can be employed by fellow researchers and policy leaders who want to focus on knowledge-based industries to complement and enhance their already existing economies.

1.4 Provisional Research Question(s)

This paper will address the question:

To what extend, do location factors influence FDI into the knowledge-based industries in Africa?

Sub-questions:

1) To what extent, do African countries attract KFDI differently than non-African countries?
2) Do regional differences exist when attracting KFDI in Africa?
3) Are there determinant differences between subsectors in the knowledge-based economy?

1.5 Significance of the Study

Scientific Significance:

Currently, there is a lack of quantitative research conducted surrounding the knowledge-based economies in Africa and a lack of information on how to attract FDI into such industries. There has been research about the determinants of FDI but into other industries in Africa (Asiedu, 2002; Ndikumana & Verick, 2008; J. C. Anyanwu, 2012). Also, there has been research concerning the determinants of KFDI for other locations (Aubert, 2005; Chen & Puttitanun, 2005; Chandra & Yokoyama, 2011; Nawrot, 2014; Juraev, 2014), but to date there are very few published reports focused on African countries or cities. This report hopes to bring to light possible unique determinants of KFDI into Africa. In many ways the African context is different than others around the world, so specific research needs to be conducted. This report will also add to the building literature that globalization has influenced the determinants of FDI and urban level aspects are becoming more competitive. Lastly, this report will contribute to the theory that developing a knowledge-based economy can be economically and socially inclusive.

Policy Significance:

The report will use statistical analysis to identify location factor determinants that attract KFDI, thus this report should add to the foundation of any level of policy designed to attract such investment in Africa. This thesis is concerned with economic growth that is also socially inclusive, thus the results will be inline with the UN Sustainable Development Goals and Millennium Goals for Africa creating synergy between the knowledge-based economy and social benefits. Furthermore, the results of this investigation could be generalized to other countries that have similar circumstances to that of Africa.

1.6 Scope and Limitations

This examination has several levels of scope: global, continental, country, and city. At first, global definitions and importance of a knowledge-based economy and foreign direct investment will be illustrated in the literature review. Following will be the initial statistical analysis done at a global level. Investigating the determinants of KFDI in a global scope will help strengthen policy arguments and benchmarking. This will be achieved by using African and non-African country level data. A similar approach will be used to identify determinants for the continent, also using African country level data. At this level, regional differences will be examined. FDI and location factor data has been collected for a grouping of several major African cities and 50 other non-African cities allowing analysis at the city level to be conducted as well.

There are several limitations that have been identified in this investigation. First, due to a limited amount of research surrounding KFDI in Africa there is little precedent to form a model for the African context. Also, this study is focusing on urban level determinants and is under the assumption that Africa has begun to stabilize, so macroeconomic factors are playing a lesser role in determining FDI. If this assumption is not accurate then the results will have less impact on future policy making. Furthermore, as with any research, the depth and breadth of available data will ultimately be the framing agent of this thesis. Lastly, after examining the available datasets it has become clear that two different models will have to be constructed for the country and city level. The indicators for country level model are different than those available for cities. However,

a country level analysis is still vital information for local policy makers, therefore a country level analysis will still be conducted.

Chapter 2: Literature Review

2.1 Introduction

The author agrees with the statement “the shift to a digital, knowledge-based economy, prompted by new goods and services, will be a powerful engine for growth, competitiveness, and jobs. In addition, it will be capable of improving citizens' quality of life” (European Commission, 2000). A section of this chapter will illustrate how a growing knowledge-based economy can be socially inclusive. Growth of a knowledge-based industry depend a number of aspects including raising society’s education level, strong infrastructure, and good governance (World Bank Institute, 2008). A rise in education levels will increase overall incomes and distribute wealth (Gregorio & Lee, 2002). Strong digital infrastructure, such as internet access, increases human development (Sabbagh, Friedrich, El-Darwiche, Singh, & Ganediwalla, 2012). And a corrupt free government that protects property rights is the foundation for long-term social growth (Rodrik, 2003).

This report categorizes the jobs and industries that are included in the knowledge economy. Furthermore, even though a country’s development is not able to be identically replicated, several success stories will be illustrated to give examples that knowledge economies do exist in developing countries and that it can bring prosperity to those not directly involved in knowledge-based industries. For decades, foreign direct investment has been an influential factor for development in Africa. FDI creates channels for capital, technological and knowledge transfers, and competition from the West to developing economies. This flow of information and innovation is critical because of the degree of sophistication needed to be successful in the competitive knowledge economy. Chapter 2 finishes by bringing these two concepts together with a literature review of the determinants of overall FDI and specifically KFDI into Africa.

2.2 Knowledge-Based Economy

2.2.1 Definition

The digitalization of our world has rapidly shifted how a person, a firm, and an industry can contribute to society. The shift to a digitized world has been led by the ubiquitous internet and has resulted in information becoming increasingly valued. The Kondratiev cycle theory states that there have been five fifty-year cycles in the global economy, starting in 1770, that have changed the techno-economic paradigm. We are now at the beginning of the fifth k-wave, being propelled by information and communication technologies (Dickens, 2011). Rather than needing to physically produce an object, the economy can grow through less tangible forms of production. The first step in this analysis is to define these new knowledge-based industries and economies. As expected with a broad concept, many authors have supplied various definitions and synonyms, such as creative, high tech, or advanced industries. In a groundbreaking piece, Machlup (1962) analyzed the production and distribution of knowledge in the United States. Machlup’s writing is considered to be the beginning of the study of knowledge economics. However, similar to the dynamics of the knowledge economy, over time Machlup’s definition has become somewhat outdated and too narrow (Hogan, 2011). As a prominent contemporary expert in the field of

economics of science and technology and knowledge distribution, Dominque Foray's definition for a knowledge-based economy is used as the lens for this study,

> *"…economies in which the proportion of knowledge-intensive jobs is high, the economic weight of information sector is a determining factor, and the share of intangible capital is greater than that of tangible capital in the overall stock of real capital."* (Foray, 2006, pg. 9)

Foray brings out several key elements. The first being intangible capital, also known as knowledge capital. Unlike traditional inputs, it was not until the 21st century that knowledge capital began to be systematically valued and standardized. New accounting standards elevated the monetary value of knowledge capital and allowed for historical comparisons, highlighting the growing trend of firms investing more in intangible than tangible capital (OECD, 2013). In 2006, intangible business capital in the United States was valued at $3 trillion (Corrado, Hulten, & Sichel 2006). The authors categorized intangible capital into three groupings: computerized information (the value of the computer software a firm uses), innovative property (the value of investments towards scientific and non-scientific research and development), and economic competencies (the value for strategic planning and brand equity, like advertising). Lundvall (2000) contributes to this theory of monetizing knowledge by arguing that knowledge is an asset that can be sold. In a historical sense, knowledge has replaced labor as the input for growth which replaced agriculture during the industrial revolution (Aubert, 2005).

In Foray's definition, the relationship between knowledge and information becomes visible. Nicholas Henry (1974) has been credited as one of the first to theorize the relationship between the two. However, with time Russell Ackoff's (1989) interpretation has become more commonly used. Ackoff's hierarchy of interrelationship puts Data at the base of the DIKIW pyramid, followed by Information, Knowledge, Intelligence, and Wisdom. Ackoff saw data merely as representative objects, information as processed data that is put into context to be more useful in decision making, and knowledge as the cognitive process of humans to analyze the information. To further the practicality of knowledge economics Lundvall & Johnson (1994) defined four types of knowledge:

- *Know-what* is knowledge about "facts" and can be broken down into smaller information, such as the population of a city.
- *Know-why* is knowledge of the principles and laws of nature, humans, and society. Advanced engineering or technological industries need this type of knowledge to increase procedural efficiency.
- *Know-how* are specific skills and training that are kept within the borders of a firm. For industry know-how to be shared and collaborated industry networks are critical.
- *Know-who* involves the ability to communicate with experts and firms and develop a knowledge of who knows what and who knows how to do what.

While all four types are important to the knowledge economy, there is a difference in how these categories are learned and the effects they have on the economy. Specifically, *know-what* and *know-why* are learned through more traditional methods. With advances in technology, these types of information and knowledge can be codified and transferred easily. As a result, this

information has become increasingly available through online databases and communication networks. *Know-how* and *know-who* is tacit knowledge that is mainly learned through social engagement, making it more difficult to transfer. Thus, policies and firms in the knowledge-based economy should focus efforts towards *know-how* and *know-who* (Lundvall & Johnson, 1994; Dickens, 2011).

2.2.2 Industries in the Knowledge-Based Economy

Several multinational organizations have classifications for firms and industries based on their activities, such as the North American Industry Classification System (NAICS) and the Statistical Classification of Economic Activities in the European Community (NACE). This study will use the NACE classification system for three reasons: it is the standard system for the European Union, it was recently revised to better suit modern economic activity, and the statistical department of the European Union (Eurostat) has compiled a list of industries they consider to be

Table 1. Aggregation of Knowledge Intensive Activities based on NACE Rev. 2

NACE Code	Description	NACE Code	Description
09	Mining Support Service Activities	70	Activities of Head Offices; Management Consultancy Activities
19	Manufacture of Coke and Refined Petroleum Products	71	Architectural and Engineering Activities; Technical Testing and Analysis
21	Manufacture of Basic Pharmaceutical Products and Preparations	72	Scientific Research and Development
26	Manufacture of Computer, Electronic, and Optical Products	73	Advertising and Market Research
51	Air Transport	74	Other Professional, Scientific, and Technical Activities
58	Publishing Activities	75	Veterinary Activities
59	Motion Picture, Video, and Television Program Production, Sound Recording and Music Publishing Activities	78	Employment Activities
60	Programming and Broadcasting Activities	79	Travel Agency, Tour Operator, Reservation Service, and Related Activities
61	Telecommunications	84	Public Administration and Defense; Compulsory Social Security
62	Computer Programming, Consultancy, and Related Activities	85	Education
63	Information Service Activities	86	Human Health Activities
64	Financial Service Activities, Except Insurance and Pension Funding	90	Creative, Arts, and Entertainment Activities
65	Insurance, Reinsurance, and Pension Funding, Except Compulsory Social Security	91	Libraries, Archives, Museums, and Other Cultural Activities
66	Activities Auxiliary to Financial Services and Insurance Activities	94	Activities of Membership Organizations
69	Legal and Accounting Activities	99	Activities of Extraterritorial Organizations and Bodies

Created by Author. Source: Eurostat, 2016

"knowledge intensive" using the NACE system. Eurostat created the knowledge intensive classification by using 2008 and 2009 EU Labor Force Survey data and selected industries where at least 33 percent of the total employment were college educated (Table 1). The Information and Communications Technology (ICT) industries are sometimes used as a synonym for knowledge-based industries, but as Table 1 shows there are numerous other occupations that fall under that classification. For example, the entertainment and advertising industries are considered knowledge-based. More advanced education and training may be needed for highly scientific occupations compared to advertising industries, but in advertising sectors there is a great deal of creativity and ingenuity that is required. By mastering those qualities, these industries contribute to the economy's growth and create jobs without a heavy reliance on natural resources. The aspect of needing less natural resources in knowledge-based industries is a divergence from the traditional industrialization method of growth.

2.2.3 Global Hot Spots of Knowledge-Based Economies

Although knowledge and innovation have been considered an economic driver since the 18th century (Jacob, 2014) and was in the academic sphere starting in the 1940s with Joseph Schumpeter's *Capitalism, Socialism and Democracy* (1942), it has only been until more recently that have we understood the prominent role of knowledge. As Machlup was writing his revolutionary work in 1962, knowledge-based industries had already reached one-third of the United States' gross national product and by the 1980s the knowledge economy was accounting for half of the nation's GNP (OECD, 1996) and has constituted for 70 percent of recent growth in advanced countries (Hogan, 2011).

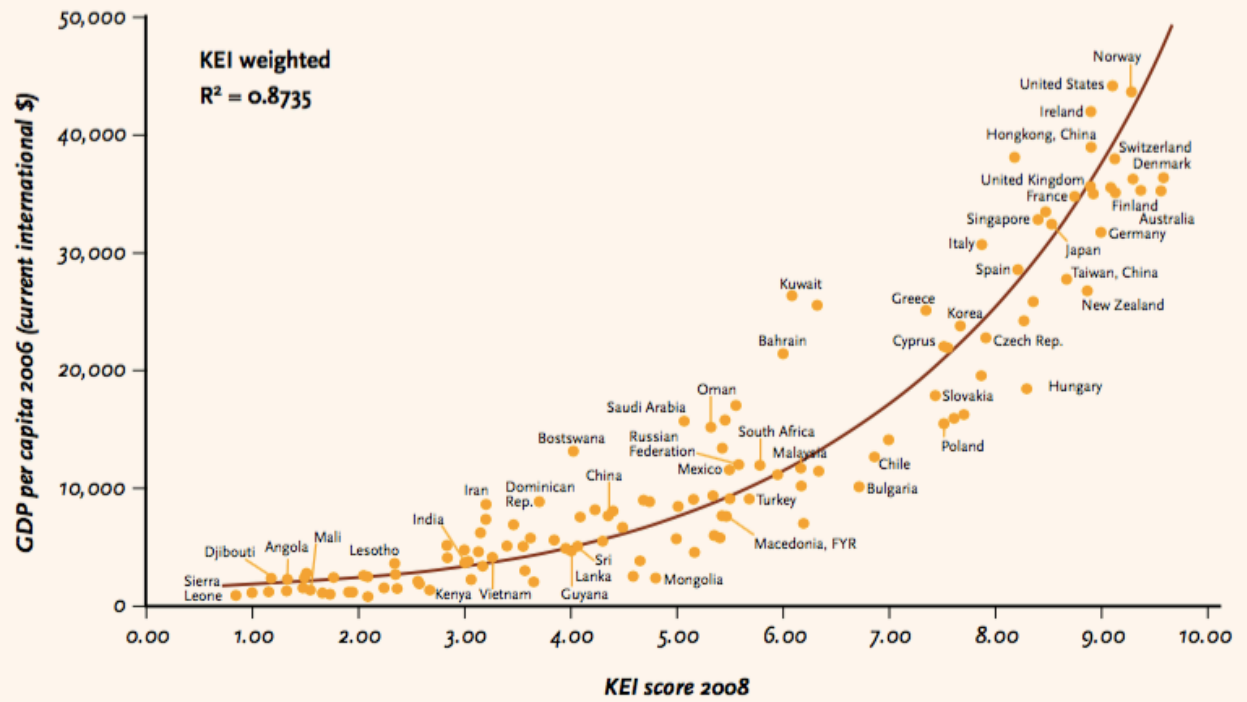
Several studies have been conducted to identify and compare national knowledge-based economies. Starting in 1995, the World Bank created the Knowledge Economy Index (KEI) and through their growing Knowledge Assessment Methodology (KAM) a database of 146 countries was constructed. Used to determine the capacity and strength of a country's knowledge economy, the KAM has four pillars: Economic Incentive and Institutional Regime, Effective Innovation System, Education and Training, and Information and Communication Technologies Infrastructure (The World Bank, 2012). The Economic Incentive and Institutional Regime pillar refers to a "knowledge-conducive" environment that encourages innovation and entrepreneurism and has transparent regulations, a corrupt-free government, and adequate intellectual property rights. An Effective Innovation System has an R&D ecosystem that includes universities, public and private research centers, and policy think tanks. This network is the source of a country's technical progress. A strong education system at all three levels is required for a knowledge-based economy. Primary, secondary, and higher education is necessary for a country's ability to adopted, adapted, and create innovation. Lastly, digital infrastructure that is accessible, reliable, and efficient is a distinct element of a knowledge-based economy. Strong infrastructure increases the productivity and access to the global marketplace for firms in the knowledge economy and for firms in other sectors (D. Chen & Dahlman, 2005).

The most recent revision of the KAM, 2012 found that the top 10 countries were: Sweden, Finland, Denmark, the Netherlands, Norway, New Zealand, Canada, Germany, Australia, and Switzerland (The World Bank, 2012). In a separate study, Saisana & Munda (2008) concluded that the top 10 knowledge economies were: Sweden, Denmark, Luxembourg, Finland, USA, Japan,

United Kingdom, the Netherlands, Ireland, and Austria (Saisana & Munda, 2008). Hence, it is clear that highly developed countries also have the strongest knowledge economies.

An analysis of the World Bank's 2008 KEI scores, compared the scores to GDP per capita and confirmed the common belief that there is a very strong relationship between the two variables, an R-squared value of 0.8735 (Table 2). Furthermore, in both studies a large portion of the indicators mirrored social not economical aspects (i.e. quality of life indicators). This is an important point that agrees with the premise that started Chapter 2, that a knowledge-based economy has the capability of improving citizens' quality of life, such as a focus on education and training programs. In the Saisana & Munda study, they found an "extremely high" correlation between their knowledge economy rankings and human development. This relationship will be discussed further later in the chapter.

Table 2. 2008 KEI Score vs. GDP Per Capita



Source: (World Bank Institute, 2008)

2.2.4 African Hot Spots of Knowledge-based Economies

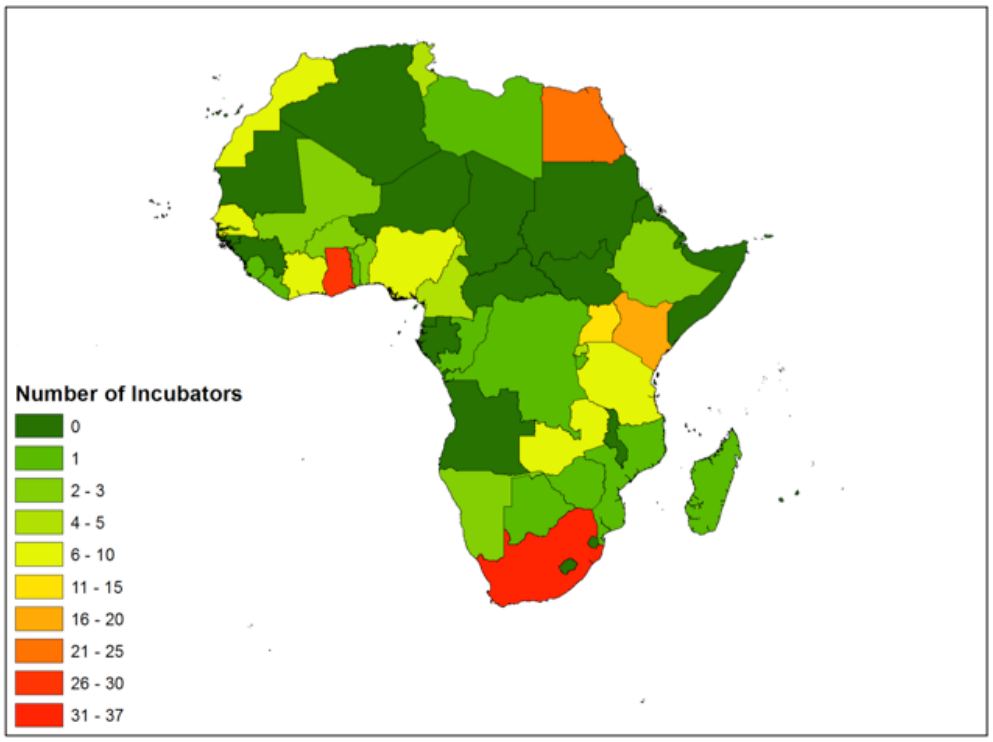
2.2.4.1 Innovation and Entrepreneur Incubators in Africa

Even though not listed in either top 10, some African countries do compare well against larger economies. Mauritius and South Africa rank higher than Mexico and Tunisia and Botswana have nearly the same score as China (The World Bank, 2012). Through the literature review, successful locations of knowledge-based economies have been identified. To start, Africa has a growing community of technology and entrepreneurial incubators which has been the building blocks for many tech start-ups and could be the foundation for a future knowledge economy.

Michael Porter (1990) argues that knowledge economies that have a strong central technology or innovation hub offer unique advantages. The competition and cooperation exhibited between related firms in close proximity creates an environment that is conducive for innovation and higher productivity. This concentration creates an environment of positive externalities such as economies of scale, a skilled workforce, and technology spillovers that is critical for growth in the knowledge economy (Temouri, 2012). Formal clusters of similar firms, such as a science park, are commonly imagined for Porter's theory, however, technological and entrepreneurial incubators can offer a similar environment. Both are spaces that facilitate physical agglomeration of knowledge-based industries which provides better allocation of resources, but also promotes networking between the firms. This face-to-face interactions between knowledge workers is necessary for the spillover effects to occur and strengthens the business and innovative network allowing for a collaboration of industry *know-how* (Turok, 2004).

Produced by the author, but from a database put together by the Fab Foundation (a US based non-profit) and BongoHive (a Zambian innovation incubator), below is a map illustrating the concentration of over 200 innovation incubators (Table 3). These concentrations can change relatively quickly because of the nature of tech start-ups and incubators, but it presents a good snap shot of the activity happening in Africa. Also, these incubators are not dispersed randomly throughout their home country, rather they are concentrated in local hot spots. Even in the top countries with a number of innovation spaces (South Africa, Ghana, Egypt, Kenya, and Uganda) the majority of the incubators are located in one or two cities of each country (Cape Town, Johannesburg, Accra, Cairo, Nairobi, and Kampala).

Table 3. Technology and Innovation Incubators



Created by Author, Source: (Fab Foundation & BongoHive, 2016)

Box 1. Example of a successful knowledge-based incubator

The Meltwater Entrepreneurial School of Technology (MEST) in Accra, Ghana was started in 2008 by the San Francisco-based technology multinational Meltwater. The incubator works in two stages. The first stage is a twelve-month software development and entrepreneur course for exceptional collage graduates from Ghana, Nigeria, Kenya, and South Africa. As a final project, students present business plans to the incubator's board members. If a strategy gathers enough confidence and meaningful interest from the board a $50,000 round of seed funding is granted, along with high-end facilities with 24-hour electricity and internet and a global network of advisors. Through this process Meltwater gains equity in the new start-up. In only a short period of time since formation, MEST has generated several award winning start-ups in the fields of SaaS, Digital Media, and Healthcare IT. Also, the organization has an initiative to support women and their current enrollment has the highest level of participation from women yet (meltwater.org, 2016). In this example, we see foreign investment investing for profit and social benefit. The first stage increases local human capital by offering access to educational and mentoring services that were not previously available. In the second stage, Meltwater is able to secure equity in a tech start-up in Ghana's growing knowledge-based economy.

2.2.4.2 Mobile Technologies in Africa

An unprecedented transformation from the knowledge-based economy that is lost in global comparison indices is the explosion of cellphone users and the subsequent rise of mobile banking in Africa. At the turn of the century mobile phones were considered "an object of luxury and privilege" in Africa, but they are now "a potent force for economic development" (Aker & Mbiti, 2010). As of 2013, there were 253 million unique mobile phone subscribers in Sub-Saharan Africa (SSA) and that number is expected to increase by 43 percent in just four years, totally 346 million subscribers in 2017 (GSMA, 2013). In comparison, the penetration of landline telephones is 2 percent in seven SSA countries (Bell et al., 2015). Africa's leapfrog of traditional telephone communication to mobile phones has brought numerous benefits including: reducing the cost of information, more efficient markets, better communication in supply chains, job opportunities in rural and urban areas, risk reduction, and facilitating the delivery of financial, agricultural, health and educational services (Aker & Mbiti, 2010). Also, GSMA (2013) estimates that the mobile phone ecosystem has directly created 3.3 million jobs in SSA and accounts for 6.3 percent of the region's GDP. The term leapfrogging references to the process of a country advancing in development by skipping a step or stage that was previously thought necessary. According to theory, leapfrogging occurs when there is a society with advanced capabilities, but technological backwards (Abramovitz, 1986; Nawrot, 2014). Applying the example of the rapid adoption of the mobile phone in Africa to the leapfrog theory, the social capabilities in African is rising and there maybe more technological advancements through leapfrogging in the near future.

The widespread acceptance and accessibility of modern communication infrastructure paved the way for a second successful transition, this time in the financial services sector. In 2007, M-PESA was created by Safaricom, the leading mobile phone provider in Kenya, as a service for people to transfer money to others with a simple mobile phone. Within three years, M-PESA had 9 million active subscribers, equaling 40 percent of Kenyan adults, transferring US$3.8 billion every year. Furthermore, this service unintentionally resolved a domestic remittance system that was very costly. Over the years of urbanization, many rural workers had migrated to cities for

work with the intention of sending money back to their families. However, prior to M-PESA money could only be physically sent. The innovation of mobile banking has made sending money cheaper, safer, and instantaneous (Mas & Radcliffe, 2010). One study found that by using M-PESA a rural household's income could increase from 5-30 percent (Economist, 2013). M-PESA has grown to include other services such as payments to business, loan payments, and salary distribution. Safaricom's technological innovation transformed the financial service sector, giving the poor and rural populations access to inexpensive banking services. The company has also expanded to other African countries, India, Afghanistan, and parts of Eastern Europe. The transformation of the telecommunication and banking sectors through innovation is a sign of an active knowledge-based industry that is growing economically and providing widespread social benefits. The Kenyan success was made possible because of the capability of the population, the infrastructure from the boom in mobile phones, and the positive role of the government allowing for M-PESA to act as an alternative to traditional financials (Mas & Radcliffe, 2010).

2.2.5 Inclusive Growth through the Knowledge-based Economy

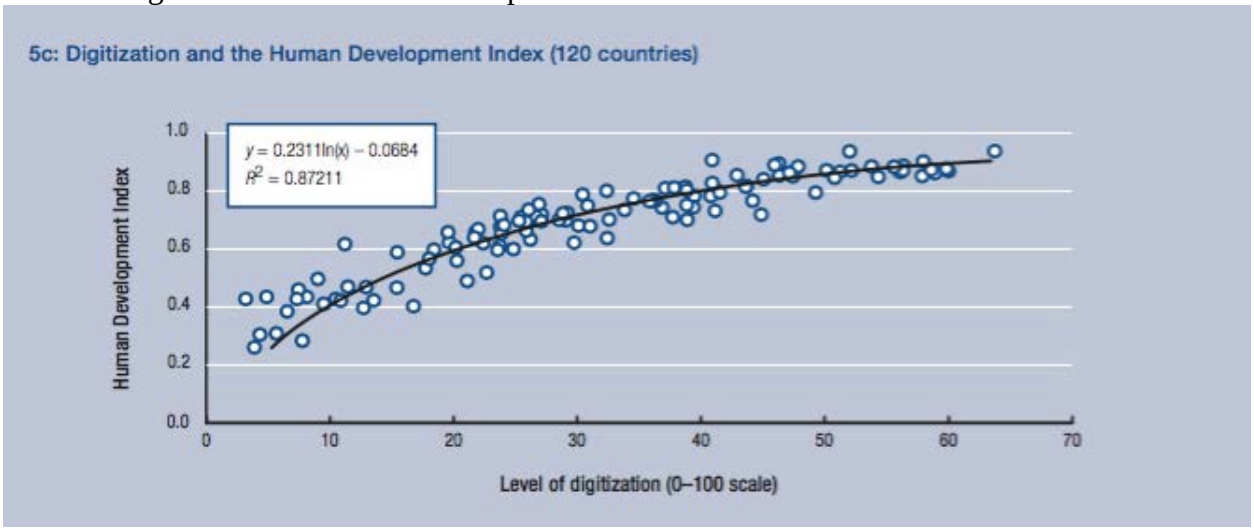
Transitioning an economy to be more knowledge intensive through FDI can coincide with sustainable and inclusive progress. The knowledge economy stands on pillars of education, infrastructure, good governance, and entrepreneurialism (World Bank Institute, 2008). In the United Nation's Sustainable Development Goals for 2030 similar tenements are observed in the *Quality Education*, *Decent Work and Economic Growth*, and *Industry, Innovation and Infrastructure Goals*:

- *By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education*
- *Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries*
- *Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries*
- *Achieve higher levels of economic productivity through diversification, technological upgrading and innovation through a focus on high-value added and labor-intensive sectors.*
- *Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity, innovation, affordability, equitable access for all and encourage the formalization and growth of micro-, small-, and medium-sized enterprises* (United Nations, 2015)

Holding true to these values, policy makers can evenly distribute sustained growth and create an environment that would lend itself positively to a successful knowledge-based economy. There are mixed views surrounding modern innovation and inequality though. By nature, advances in technologies favor the higher skilled, monopolies, and the elite. However, with strong institutions and regulations that empower the citizens through accessible technologies, like the internet, a country can evolve with the digital world and capture the benefits it offers (The World Bank, 2016). Table 4 gives evidence in support of this theory. In a regression model, the adoption of digitalization has been shown to improve education, health, and living standards, the variables included in the Human Development Index. For less developed countries, the beginning stages of

digitalization has an even greater impact, so a focus to encourage the knowledge-based economy and digitalization in Sub-Saharan Africa is likely to have a noticeable influence. (Sabbagh et al., 2012). In the same study, employment was improved with digitalization as well, a ten percent increase in digitalization was observed to decrease unemployment by one percent.

Table 4. Digitization vs Human Development Index



Source: (Sabbagh et al., 2012)

2.2.5.1 Job Multiplier Effect

Illustrated earlier in the M-PESA case, innovation and knowledge-based industries in Africa can have an influence on income levels and job growth. As a result of Safaricom's M-PESA innovations, 80,000 Kenyans have additional income (The World Bank, 2016). Knowledge-based industries directly create jobs, but there is a multiplier effect that creates complementary jobs as well. The job multiplier effect theory states that the creation of a new job can result in further job creation because of the increased demand for local goods and services. When that new job is in a knowledge-based industry it leads to an even greater effect on the local economy because of the higher disposable income that knowledge workers earn. These jobs can range from retail clerks and waiters to high earning occupations like lawyers and doctors. Much of the effect is caused by the increased income in the local economy, but the effect could also cause entirely new complementary firms to be founded to support a cluster of knowledge-based firms (Moretti, 2010).

In a nation-wide study of the multiplier effect of high-tech industries in the United States, when one new job was created in a high-tech industry 4.3 other local jobs were created (Hathaway & Kallerman, 2012). In comparison, the report found that manufacturing industries had only one-third the effect of high-tech industries. A similar study was done in Sweden also finding a positive multiplier effect, however, smaller than in the United States. The report states that the lower effect could be caused by the larger social welfare programs in Sweden and a smaller income gap compared to the United States (Moretti & Thulin, 2013). Another country level study was conducted in Northern Ireland which showed that the knowledge-based industries have nearly a two to one effect, producing two indirect jobs for every one new knowledge worker (Johnston, 2015). Furthermore, a study for the Europe Union, Goos, Konings, & Vandeweyer (2015) found

that there was a job multiplier effect of five and that less established economies could expect an even higher multiplier effect. Lastly, in one of the few studies surrounding African knowledge-based industries and its job multiplier effect, the Nigerian telecom industry was found to produce 400,000 indirect jobs. At that time, the telecom industry directly employs 120,000 people, so the multiplier effect would be 3.33 (Ogbu, 2006).

It needs to be mentioned that these multiplier effects are observed in the long-run. When there is growth in knowledge-based industries the increase for local products and services outweigh the present supply. The local economy will begin to grow to match the demand, resulting in a new equilibrium that is more productive and inclusive. However, those effects do not happen immediately and a long-run approach is necessary since the multiplier effect could increase with time if agglomeration occurs and a technology cluster is formed. Allowing an economy to generate growth organically will in turn result in a much more stable process. Although the initial focus is to generate good quality jobs for more fortunate individuals the positive effects, which may be greater by some magnitude, can be felt throughout the entire community. The job multiplier effect from knowledge-based industries and the process in which complimentary jobs are created is much more inclusive and sustainable than the "enclaves" of the mining industries in Africa.

Box 2. Mitigating the Middle Income Trap in South Africa

The job multiplier theory could have a very impactful effect on a country like South Africa who is struggling with high unemployment and a "middle income trap." South Africa is not able to compete against low-income countries because of their relatively higher wages nor has South Africa reached a point of advancement where they can produce high-value goods and services that compete with more advanced countries (CDE, 2013; Rogerson & Rogerson, 2014). A lack of competition, innovation, and a skilled labor force have been listed as constraints on South African's development as well (CDE, 2013). By promoting a knowledge-based economy, the South African government can tackle these obstacles. A successful knowledge-based industry will directly impact the lack of innovation and human capital issues and indirectly contribute to the 2020 goal of 5 million new jobs through the job multiplier effect. Further analysis of the job multiplier effect of the knowledge-based economy throughout Africa is necessary, but with overwhelming evidence of a positive effect in other regions of the world and the examples of the Kenyan and Nigerian telecom industries similar trends could be expected for other African countries.

A middle income trap may presently be a larger concern in South Africa than the rest of African countries, but as lower income countries begin to develop it may become a continental concern. A country is considered to be middle income when its GDP per capita reaches US$10,000. It is possible to reach that point through primary industries. However, once a country has reached that level the current economic structure stagnates and may even fall. This is caused because the country has reached the threshold where if wages continued to grow in the primary industries, firms would begin to exit for cheaper labor elsewhere. There needs to be a transition to higher productive industries or the country will be trapped in a situation with low economic growth. These industries, including knowledge-based industries, are involved in more advanced production for both domestic and foreign markets (Kharas & Kohli, 2011). However, a country does not merely advance from low to medium to higher levels without educating the workforce. A concerted effort

at all levels including university and R&D institutions is necessary for a country to continue their path of grow. A focus on developing a country's human capital increases the supply of labor to higher productivity industries, but that demand for such labor is another aspect that must be addressed. A lack of good quality jobs will force those that are skilled into less productive occupations and deter others from obtaining a higher education (Atalay, 2015). Although, reaching middle-income level for many African countries will take time, a middle-income trap is an important issue that policy makers should be aware of so a smooth development path can be achieved.

2.3 Negatives from the Extraction Industry

Although it is not an objective of this thesis to analyze the negative effects from foreign investments in Africa, the history and current path of development in Africa is an important element that should be addressed when discussing FDI into Africa. A critique of the past and present extraction industry is an essential discussion for Africa to be successful in the coming generations. Economically, African countries could be separated based upon natural endowments, specifically resource-rich and resource-poor countries. It is easily reasoned that those that are heavily endowed with profitable minerals would have a head start in the path towards development that its inclusive. Historically, there have been resource-rich country that distributed wealth fairly between its citizens. As an example, the Norwegian government set up a pension fund available to every citizen, solely funded from oil revenues. Governmental foresight and prudency will allow future generations of Norwegians to prosper from the inclusive decisions made by previous policy makers. In Africa, Botswana has been hailed as a success story for a resource-rich African country because of the tremendous increases in the quality of healthcare and education that has been funded from the diamond industry (Cook & Sarkin, 2010). Nevertheless, Botswana is the exception and not the rule when analyzing growth patterns for resource-rich countries in developing regions, including Africa.

There are a multitude of obstacles resource-rich African countries have to deal with. Historically, it may be considered bad luck to have a large natural resource endowment in Africa. A study investigating rebellions in Africa between 1960-1999 found that a resource-rich country had a 20 percent chance of a rebellion every five years. A resource-poor country only had a 1 percent chance of such an event. Among the many reasons for such a high possibility of a revolution in a resource-rich country, the author reasoned that the potential for high profits in a successful revolt and the low cost to hire and arm an army was among the top (Collier, 2002). In the same study, Collier found that when government revenue from natural resources exceeded 15 percent of GDP African governments became dysfunctional. Furthermore, the economic enclaves are nearly completely detached from the rest of the country. They are so well protected and disconnected that civil wars may not even disrupt operation. During horrific civil wars, the resource-rich countries of Angola and Sudan had some of the highest GDP growth (Ferguson, 2005).Through dysfunction, political elites are able to personally profit from the government revenue and a weak rule of law is perpetuated.

The nature of business in the extraction industry is an obstacle African governments have not resolved either. The disconnected enclaves lack an economic ripple effect into the population and other industries. Very little employment has been created from the extraction industries

because the supply chain of materials only starts in Africa, there are little processing or complimentary industries. Much of the raw materials that are collected in Africa, such as oil and gold, are shipped to foreign lands to be refined and have other value added operations conducted causing there to be a very low job multiplier effect in Africa. In the case of Ghana, there has been lost opportunities to create more direct or indirect jobs. The Ghanaian gold mining industry accounts for about around 5.5 percent of the GDP while only employs 20,000 people, .008 of the population. However, there are 500,000 Ghanaians, mostly youth, that participant in very dangerous informal mining, galamsey. The practice of informal mining is not licensed and involves untrained workers that do not have the necessary safety equipment exposing them to life threatening conditions. There are also cases where the mining firms choose to employ foreign workers instead of qualified, highly skilled local labor, limiting the amount of quality jobs available. Although the Ghanaian government receives large amounts of revenues from the mining, US$5 billion in 2013, there has not been many successful attempts to train and educate the informal working population (Ackah-Baidoo, 2016). Unfortunately, when weak institutions exist and there is opportunity for both public and private stakeholders to personally benefit from the current situation, efforts for reform are futile (Ayee, Soreide, Shukla, & Le, 2011).

There are many parties at blame in this systemic abuse of natural resources and public revenue. The mining firms cannot be blamed for the high capital-intensive nature of the industry and not all government officials are perpetuating corrupt activities. However, the extraction industries have not provided the necessary economic and social benefits the majority of the populations need. While poverty worldwide has been falling, in Africa, including resource-rich countries such as Nigeria, poverty has become more widespread. According to Artadi and Sala-i-Martin (2003), since the 1960s most Africans are worse off today than ever before. Aside from the impending dangers of finite resources, governments must focus on educating and skilling their populations and simultaneously attracting new industries to provide employment. Future industries must be able to provide good quality jobs, provide a job multiplier effect for indirect job growth, and promote social inclusion. It will be through the knowledge-based industries that Africa can decouple itself from the mining industries and sustainably grow.

2.4 Foreign Direct Investment

Academic literature has been provided details of knowledge-based economies and the benefits that it brings. Certainly not an exhaustive list, but the theories and examples given should help the reader realize the advantages a knowledge-based economy would provide to an African country and city. In the author's opinion, this path will be much more successful and can only reach its full potential with the involvement of foreign direct investment. The relationship created between developed and developing countries through FDI establishes a link where tangible and intangible capital can flow. The following sections will highlight the trends of foreign direct investment into Africa and the benefits that FDI brings to the host country.

2.4.1 General Characteristics of FDI

Generally speaking, there are two types of FDI: greenfield and mergers and acquisitions. Even though mergers and acquisitions entail economic activity, the primary action is change of ownership. Greenfield investment is considered to have a more positive effect in development

because entirely new firms and business are established (AfDB et al., 2016). This report is concerned with greenfield investments. There are several opportunities that firms seek when investing into foreign countries. First, a firm may enter a new economy in hopes to supply the local demand or produce a product to sell outside of the host country's borders, these are market seeking and non-market seeking strategies respectively (E. Asiedu, 2002). According to Drogendijk and Blomkvist 2013, there are three other categories for investing firms. A firm may be resource-seeking, which involves securing a position in a country based up specific advantages that country holds. These advantages include natural resources, political framework, infrastructure, and advantageous trade location. When a multinational enterprise expands its global network to better facilitate foreign subsidies and knowledge exchange, it is efficiency-seeking. Lastly, the strategic asset-seeking strategy involves acquisitions and partnerships to strengthen a firm's R&D and create new knowledge. Although all these forms of FDI are observed in Africa, the non-market, resource-seeking strategy would be the overwhelming majority due to the strong history of extraction-based FDI. The knowledge-based industries could see FDI inflows in the three categories Drogendijk and Blomkvist detail, but it could be imagined that the strategic-asset strategy would be a differentiating characteristic of KFDI compared to primary sectors. There will be a further discussion of specific elements FDI brings to knowledge-based economies.

2.4.2 Trends of Foreign Direct Investment

Historically, Africa has lagged far behind in global comparisons of foreign direct investment. Prior to 2000, Africa accounted for around 1-2 percent of global FDI inflows and only .8 percent in 2000 (Anyanwu & Erhijakpor, 2004b). At the turn of the century, Africa saw a large increase in FDI from $20 billion in 2003 to $50 billion by 2007 (ECA, 2014), but the rise stagnated and in 2014 FDI flows into Africa only totaled $54 billion. Although, developing countries are now receiving more FDI than developed countries, the African continent is accounting for less than 5 percent of total global FDI, a third of the amount that Latin America receives and an eighth that flows into Asia (UNCTAD, 2015b). Yet, even though the continent is receiving relatively little FDI in recent years it has the highest return on investment in the world (Rini, 2010).

The breakdown of African FDI has changed over the years. The service sector is now the lion's share of overall FDI in Africa, accounting for nearly half, passing the historical leader the primary industries. Service sector FDI has quadrupled since 2001 and the finance industry is the largest sub-sector with 56 percent (UNCTAD, 2015b). The service sector is responsible for almost half of the economic activity in Africa and in some countries two-thirds of the work force is in the service sector (UNCTAD, 2015a). The direct impact of the sector has become a vital source for growth in Africa and is also a sign for future growth. A strong finance industry is critical for an economy to transition from primary to knowledge-based industries. Even at the turn of the 20th century, Schumpeter understood the importance of a financial system being able to lend to entrepreneurs. Capital is an integral part for innovation and in Schumpeter's theories the banker "authorizes" entrepreneurs to innovate by making capital accessible (Croitoru, 2012; King & Levine, 1993). Thus, the growing financial service sector adds to the potential of a knowledge-economy in Africa.

The need for FDI in the knowledge-based industries is an obstacle for all industries in Africa. In 1999, the Millennium Development Goals were developed to facilitate sustainable

solutions to global social problems. For Africa to meet these goals, investments had to equate to 33 percent of total GDP (UNECA, 1999). Unfortunately, that has not been the case and currently investments are only 19 percent of GDP (UNCTAD, 2014). According to Dupasquier & Osakwe (2006), historically there have been nine obstacles hindering FDI growth: uncertainty (political and macroeconomic stability), inhospitable regulatory environment, GDP and market size, poor infrastructure, high protectionism, high dependence on commodities, increase competition, corruption and weak governance, and poor and ineffective marketing strategy. Among these obstacles are national and international aspects, but regional fluctuations have an effect on the attractiveness for FDI as well. Political unrest in a country has a negative effect on neighboring countries because foreign investors see the increased level of risk contagious damaging the attractiveness of the surrounding region (Dupasquier & Osakwe 2006).

2.4.3 Benefits that FDI brings to Knowledge-Based Industries

Effects of investments can differ greatly based on a number of factors including the type of investment and industry (Dunning, 1994). For the knowledge-based industries, foreign direct investment brings four necessary aspects: capital, technology and knowledge transfers, and competition (Hill, 2009; Kurtishi-Kastrati, 2013). These four spillover effects will be essential for African knowledge-based economies.

2.4.3.1 Capital

For any new business or start-up, initial funding is one of the biggest worries. This is especially true for knowledge-based industries because the heighten risk of new innovations and technologies not being successful (OECD, 2012b). Even established African domestic banks cannot fulfill the entire local demand because lending regulations and financial limitations (InfoDev, 2013). The firms that do qualify for financing from domestic banks are offered very high interest rates that hinder any profitable enterprise. Local lending has become so limited that it is projected to have a negative effect on capital accumulation in Africa. In the comings years, domestic commercial banks will lend less than they receive in loan payments, effectively lessening the available capital in the market (AfDB et al., 2016). The relatively slow growth of Africa has been partially attributed to the lack of capital accumulation which hinders the growth of savings and potential investment funds (Aryeetey, 2004). Investments from large multinational enterprises (MNE) with diverse, global portfolios are able to absorb the increased risk because of their profit structures compared to a traditional bank.

There are mixed views on the effect of FDI capital and the local investing market. Kurtishi-Kastrati (2013) argues that FDI does not “crowd-out” other investments rather it attracts public and domestic investing, creating a larger source of funds. The “crowding in” is caused by the assurance that the investment is not risky and that there is a higher return on investment. In a 17 year study with 58 developing countries, Collins & Bosworth (1999) found that foreign direct investment resulted in an increase of the same amount in domestic investing, doubling the available funding. Ndikumana & Verick (2008) found that there was a positive relationship between FDI and domestic private investing in Sub-Saharan Africa (SSA). Ndikumana & Verick also found that the crowding in effect worked both ways, FDI attracts and domestic investing and vice versa. In contrast, Adams (2009) found a negative effect on domestic investment from FDI in SSA.

However, in Adams' study the effect was in the present year and when a lagged variable was modeled there was a positive relationship. In reality, the lagged year analysis may better represent investment decisions since investment decisions are generally not knee-jerk decisions and evaluate circumstances from year to year. In either case, foreign direct investment does adds to the drying well of domestic accumulation of capital which can resolve a key hindrance of Africa's growth.

2.4.3.2 Technology Transfer

Technology transfers from developed countries to Africa is critical for productivity and efficiency. New technologies can rejuvenate the economic cycle (Schumpeter, 1976) and is especially important in developing countries where relatively little R&D is undertaken. According to Henry, Kneller, & Milner (2009), with a one percent rise in foreign R&D stock there will be a positive effect of .08 percent on the host country's output. Although the positive effect may seem small, an increase of .08 percent in South Africa's 2015 GDP would equal an additional US$254 Million (Central Intelligence Agency, 2016). This effect does have many factors including the size of the domestic firm, the type of industry, international trade, and, importantly, the host country's ability to absorb the technology (Henry et al., 2009; UNCTAD, 2011; Kurtishi-Kastrati, 2013; ECA, 2014). Unfortunately, Sub-Saharan Africa falls below other developing regions in effectively absorbing technology transfers because of the relatively low levels of human capital (Elmawazini & Nwamkwo, 2007; Henry et al., 2009). The low level of human capital also de-incentivizes investing firms to actively support the technology transfer, a "negative spillover effect" (Elmawazini & Nwamkwo, 2012). In a study about Nigeria's extraction sector, a very low technological spillover effect was found (Akinlo, 2004). Extraction has been a long standing source of FDI for SSA so this could be the reason for the region's poor record of technology absorption, negatively skewing the numbers for positive spillover effects happening in other industries. Akinlo's findings also support the theory that sufficient human capital is needed for technology transfers. Technology transfers relate to both a product and a process. Investing firms can introduce new machinery to the host country to increase productivity, but also business process innovations can have a strong effect on productivity. Ola-David & Oyelaran-Oyeyinka (2012) found that in Nigeria's manufacturing industry FDI transferred technological products had the largest contribution to productivity, but in Kenya it was the process innovations that contributed the most.

2.4.3.3 Knowledge Transfer

Technological transfers tend to be tangible assets, while knowledge transfers concern the intangible assets such as technological *know-how* and managerial and marketing skills. These are skills earlier described in the report as being critical to innovation because it is not easily codified and must be learned through experiencing it. These skills are transferred through a learning processes by local firms, managers, workers, and entrepreneurs. The process can be through formal trainings or informal observations of best practices (Ola-David & Oyelaran-Oyeyinka, 2012). New found knowledge is intended to increase productivity of the host firm, but sometimes workers may choose to leave the firm and start their own spin-off business resulting in a more productive and competitive economy (Kurtishi-Kastrati, 2013). However, the potential for workers to leave the firm and start a competing company is one of the reasons that multinational enterprises limit how much they transfer. Governments structuring intellectual property rights to promote and facilitate

knowledge transfers is critical to fully realize the potential of the FDI (Yang & Maskus, 2009; Pérez-Villar & Seric, 2014). Knowledge transfers play a very critical role in educating the future workers in the knowledge-based industries and will especially be important for Africa due to a migration of highly skilled workers leaving their home country for jobs in more developed countries (ECA, 2014). This brain drain has been estimated to account for up to a third of the R&D professionals from developing countries (Aubert, 2005).

2.4.3.4 Competition

Lastly, foreign direct investment creates positive competition for the host country's economy. From Hsu, Lin, & Wei (2008), "the core value of the knowledge-based economy lies in innovation. The momentum behind innovation arises from competition." The local economy becomes more domestically competitive and the country will become more competitive in global trade markets as well. Generally speaking, the introduction of FDI brings higher productivity to the local economy. Since the new firm is more productive, through technological advances and/or business processes transferred from the developed, home country, other local firms must become more productive to stay in the market (Kurtishi-Kastrati, 2013). Many multinational enterprises require local suppliers to have a high standard of quality certification, such as ISO 9000, raising the quality of economic production by the host country (Moran, 2006). Competition brings down the prices for local consumption but also for trading beyond the country's borders. The resulting competition promotes sales growth for both the foreign and local firms (Sinani & Meyer, 2004). In a case study analyzing the effects of competition from FDI in Indonesia, there were a handful of positive spillover effects observed including increases in technological development and capacity, domestic innovative capacity, inflows of foreign technologies, educational attainment, employment of scientific personnel, and R&D expenditures. The study also found that higher levels of competition resulted in higher spillover effects (Sjöholm, 1999). In Nigeria's manufacturing industries, competition from FDI lead to more improved and innovative products (Ola-David & Oyelaran-Oyeyinka, 2012). Furthermore, Kerr & Nanda (2015) argue that added competition increases the amount of high-risk innovations among smaller firms.

At first, innovation absorption is needed for development and catching-up to already existing knowledge-based economies, but FDI driven competition will lead to innovation creation as well. In this case, firms will be able to export their innovations and will not be burdened with licensing fees for using an imported innovation (ECA, 2014). However, there is not a consensus in literature that competition from foreign firms is good for developing countries. Competition may have a short-term negative effect on the local economy if firms can not imitate or absorb the new technologies or business practice of the investing firm. The local firms that are not able to become more productive may be forced out of the market. However, the long-term positives of competition from FDI listed above are considered to outweigh the short-term negatives (OECD, 2002).

2.5 Determinants of Foreign Direct Investment into Knowledge-based Industries

This chapter has given a strong review of current academic literature concerning knowledge-based industries and foreign direct investment. Working towards accomplishing the UN Sustainable Development Goals and the Millennium Development Goals, a government can bring together solutions to societal problems and create an environment that is attractive for KFDI. Overlapping aspects include ending government corruption, increasing human capital, and expanding and modernizing infrastructure. It should be evident that knowledge-based industries in Africa will be relying heavily on FDI because of the added benefits foreign investment bring from more advanced economies. This report will now turn its focus on the main objective, identifying indicators that influence FDI into Africa's knowledge-based industries.

Over the years, there has been numerous empirical studies analyzing the determinants of aggregated FDI flows into Africa's economies (Asiedu, 2002; Ndikumana & Verick, 2008; J. C. Anyanwu, 2012) and some research on specific countries and industries (Tembe & Xu, 2012; Collier, 2014). It is also worth examining examples of FDI into knowledge economies in developing countries outside of Africa to understand global trends (Aubert, 2005; Chen & Puttitanun, 2005; Chandra & Yokoyama, 2011; Nawrot, 2014; Juraev, 2014). However, there has been far less research concerning determinants of FDI into the knowledge economies of Africa. Though, we can examine some African case studies, such as Rwanda's ICT growth, to gather evidence of determinants (Ntale, Yamanaka, & Nkurikiyimfura, 2013).

After extensive literature review, the author has developed reasoning to analyze four variables: Good Governance, Human Capital, Digital Infrastructure, and Innovation & Business Environment. These variables are in line with the World Bank's Pillars of Knowledge Economy, described above. Although, the author expects there to be a significant relationship between KFDI and several general macroeconomic variables there will not be a comprehensive analysis (Anyanwu, 2012; Elizabeth Asiedu, 2006; Basu & Srinivasan, 2002; Mijiyawa, 2010; Onyeiwu, 2004; Tembe & Xu, 2012; UNESCO, 2014). This is based on the assumption that as Africa rises to similar levels of other emerging regions macroeconomic factors will become comparable, thus other determinants should be evaluated to identify other significant indicators attracting KFDI. Below, the author will defend the four variables with theories from the literature review and case studies.

2.5.1 Good Governance

The concept of good governance has been categorized in many ways in literature, for this report there will be a focus on corruption and intellectual property rights. There is a large body of literature that supports a significant relationship between these variables and foreign direct investment. In line with UNESCO's recommendation to African countries to concentrated on eliminating corruption in government institutions to attract FDI (UNESCO, 2014) many studies have found a negative relationship between a corrupt government and FDI. Goodspeed, Martinez-vazquez, & Zhang, (2007) found a slight negative relationship when developed and developing countries were analyzed together against aggregate FDI. Chandra & Yokoyama (2011) found a strong relationship between corruption and FDI in six knowledge-based economies in Asia. In the Chandra & Yokoyama report, even in the case of the most corrupt country in their study, China, a

large majority of FDI that flowed into China went into knowledge economies that were located in providences with less corruption. When analyzed against overall FDI, corruption had a strong, negative relationship in a study that was done in Sub-Saharan Africa (SSA) and in West Africa (Asiedu, 2006; Raheem & Oyinlola, 2013). However, a similar study was done in SSA and there was a positive relationship between corruption and aggregate FDI. The authors of the report reasoned that the unexpected result was actually not very surprising because resource-rich countries in that region rank high in corruption and receive much of the FDI that flows into the region (such as Angola and Nigeria), skewing the results especially for resource-poor countries (Asiedu & Gyimah-brempong, 2008). This is a very pertinent argument because the knowledge-based economy does not rely on natural resources, allowing those countries with less natural endowments to develop and advance. However, this puts even more weight on the agenda of a corrupt-free government for those African countries that are resource-poor.

Good Governance may also be presented by how the government chooses to tax and subsidies products and services. Taxes are necessary, but high taxes can hamper economic development and turn away investments. Subsidies have an effect on economic development, but are generally implemented to help with a low level of economic growth. Government subsidies are a form of intervention when the production of a certain good is not economically competitive and needs assistance to stay afloat. Subsides generally offset the deficits that firms incur during the production process. For the overall economy of a city the gross domestic product can be calculated as such: GDP = GVA + Taxes – Subsidies (Euromonitor, 2016). GVA, gross value added, is the sum of output for all the local firms minus their operating expenses. Since taxes have been deducted from the GVA it is added back into the equation for GDP. Any subsidies implemented would be an offset for operating expenses, so subtracting subsidies from the equation is necessary to understand the true value of the local economy. The difference between Taxes and Subsidies would signal certain agendas for the local government. If there is a need for higher tax returns a positive balance would be expected. However, according to Pierre Poret at the OECD lower taxes rate attract FDI (Poret, 2015). In Poret's study of 10,000 multinational enterprises, tax holidays and exemptions were significant determinants for investments. A negative balance could be caused by high subsidies as well. Although, subsidies may place a burden on government expenditures it indicates that the government is willing to facilitate local firms to become more competitive. This study hypothesizes that there will be a negative relationship between the tax balance and KFDI.

Growing global support, including from UNCTAD (2011) and UNESCO (2014), intellectual property rights (IPR) is an important issue for emerging economies. This holds especially true in the case of knowledge-based economies where innovative products and ideas are seen as both an input and output. In the early stages of developed, literature supports the idea that less IPR encourages growth because host firms and entrepreneurs can increase their capacity through the process of imitating technologies from FDI. However, there is a threshold where stricter IPR are critical to continue development (Chen & Puttitanun, 2005). In the Chen & Puttitanum analysis, they argue that there is a U-curve when comparing IPR and economic development. There is an initial dip and then an increasing, positive impact on economic development when IPR is increased. In the study given above concerning six knowledge-based economies in Asia, there was also a positive relationship between IPR and FDI (Chandra & Yokoyama, 2011). In a separate study about China, firms in providences that had stronger IPR had

more investments, R&D, and patents published (Ang, Cheng, & Wu, 2009). In an analysis of Costa Rica's knowledge-based economy, improvements in the IPR regime was a factor that attracted KFDI (OECD, 2012a). In a country without a developed IPR framework, investing firms may have less incentive to facilitate technological or knowledge transfers because of the fear that it will be copied by competing host firms. A country can stifle the potential FDI and the additional benefits it brings into knowledge-based economies without an appropriate approach to IPR.

2.5.2 Digital Infrastructure

Being one of the pillars of a knowledge-based economy, infrastructure and, specifically, digital infrastructure is a necessary element for attract FDI into knowledge-based industries. A strong ICT infrastructure system can "unleash" economic development and offers opportunities to leapfrog stages of development. It also creates a conducive environment for innovation and entrepreneurship, particularly important for knowledge-based economies (Economou, 2008). Aspects like the internet connectivity and mobile phones make it possible for knowledge-based industries to grow, it also increases the market size for modern products and ideas, in turn increasing the potential for higher returns on investment for FDI. Agreeing with Aubert (2005) and UNCTAD (2011), Suh & Khan (2003) found a positive relationship between ICT infrastructure and FDI in Latin American countries (LAIA) and European countries (CEFTA). Furthermore, Ko (2007) found a divergence of the relationship between ICT infrastructure and FDI in developed and developing countries. A positive relationship was observed in developed countries, but in developing countries there were negative externalities that were creating a negative result. The author reasoned that the negative externalities were slow and unreliable internet connectivity because the amount of internet users was exceeding the bandwidth a developing country had access to. Since Ko's study, there has been a massive increase in the amount of bandwidth. The implementation of submarine internet cables increased bandwidth by more than twenty-fold (Nyirenda-jere & Biru, 2015).

Along with Africa's supply of ICT infrastructure, the demand for such modern technologies have increased too. There is a strong argument that access to landline telephones increase the attraction of FDI in Africa (Anyanwu & Erhijakpor, 2004a; Asiedu, 2002, 2004, 2006; Ndikumana & Verick, 2008). However, mobile phone users in Africa have not been as rigorously analyzed, even though, Gani & Sharma (2003) describes that component as a "pull factor" for FDI. Gani & Sharma (2003) also see internet users as another attraction for FDI, which is in line with Choi (2002) who found that a 10 percent increase in internet users increased FDI by more than two percent in a 53 country study. In Rwanda, the government has invested heavily into its digital infrastructure, including connecting to two submarine internet cables and establishing a mobile phone network that covers over 96 percent of its population. This has led to global leaders in financial services and telecommunications locating offices there. Through Rwanda's proactive approach by using digital infrastructure to promote its knowledge-based industries over US$540 million in FDI has been invested into the knowledge economy. Rwanda's initiative did not solely have economic benefits. We can see that the population has the ability to be better informed through the enhancement of telecommunications which is critical for education and safety. Also, the government has greatly improved its service delivery in the agriculture and healthcare sectors, such as better connecting rural healthcare centers to hospitals in urban areas (Ntale et al., 2013). Development in digital infrastructure is the foundation for knowledge-based economies and at the

same time social benefits can be distributed throughout the population. Areas with high connectivity will be at the forefront of successful knowledge-based economies and therefore a positive relationship between digital infrastructure and KFDI is expected.

2.5.3 Human Capital

Similar to infrastructure, a focus on human capital will have both social benefits and spur KFDI in Africa. It has been shown in multiple studies that there is a necessary level of capability in a society for technology and knowledge transfers to be successful and addressing capability issues has become a common recommendation for emerging innovation economies (Aubert, 2005; Fu & Li, 2010; UNESCO, 2014). In addition, a lack of capability in Sub-Sahara Africa has been shown to have a negative effect on spillover from FDI. In SSA and other developing countries there is a drastic difference between the amount of technological transfers that occur compared to more developed countries (Elmawazini & Nwamkwo, 2012). However, there has been growth in capacity in some African countries, such as Uganda, who has seen an exponential growth in published scientific papers (Aubert, 2005). Governments must supply their population with adequate primary, secondary, and tertiary education or they will be at risk of losing potential FDI and stifling the positive benefits from FDI. Seen in analysis of countries successfully transitioning to advanced knowledge-based economies, such as in Korea, human capital was instrumental in attracting FDI to facilitate the process of evolving from the early stages of "start-up" to "innovation adoption and adaption" and finally to "innovation creation." In the Korean case, education constituted for more than one-fifth of government expenditures in the beginning stages of the transition, with a focus first on literacy then emphasizing science and technology (Juraev, 2014).

Similar determinants were found in a case study about Costa Rica's knowledge-based economy. In that study, foreign investors said that the ability for the workforce to speak English and the availability of good quality technicians and college graduates were contributing factors to their decision to invest (OECD, 2012a). Azémar & Desbordes (2010) also found a strong, positive relationship between the level of English in the workforce and FDI in a 44 country study that included developed and developing countries. In an extensive study of FDI into India at the district level, there was a strong, positive relationship between high school education and FDI (Mukim & Nunnenkamp, 2010). In a study looking at the determinants of American FDI into SSA, Elizabeth Asiedu (2004) found a strong, positive influence with literacy. More recently, some SSA countries have begun developing an education system that will foster an innovative environment that should be conducive for FDI in knowledge-based industries. One example is in Rwanda, where there is an initiative to supply primary schools with enough laptops for every student and a partnership with the American institute Carnegie Mellon University, becoming the first American university in Africa offering degrees and a physical research presence (Ntale et al., 2013). Lastly, in a study analyzing the determinants of Chinese investments into Africa, there was a slight positive relationship between annual patent registration and FDI (Drogendijk & Blomkvist, 2013). The study used annual patent registration to proxy human capital. This report will also use patents along with scientific publication, literacy, English proficiency, government expenditure in education, and student enrollment levels to proxy human capital. It is expected that as human capital rises so will KFDI.

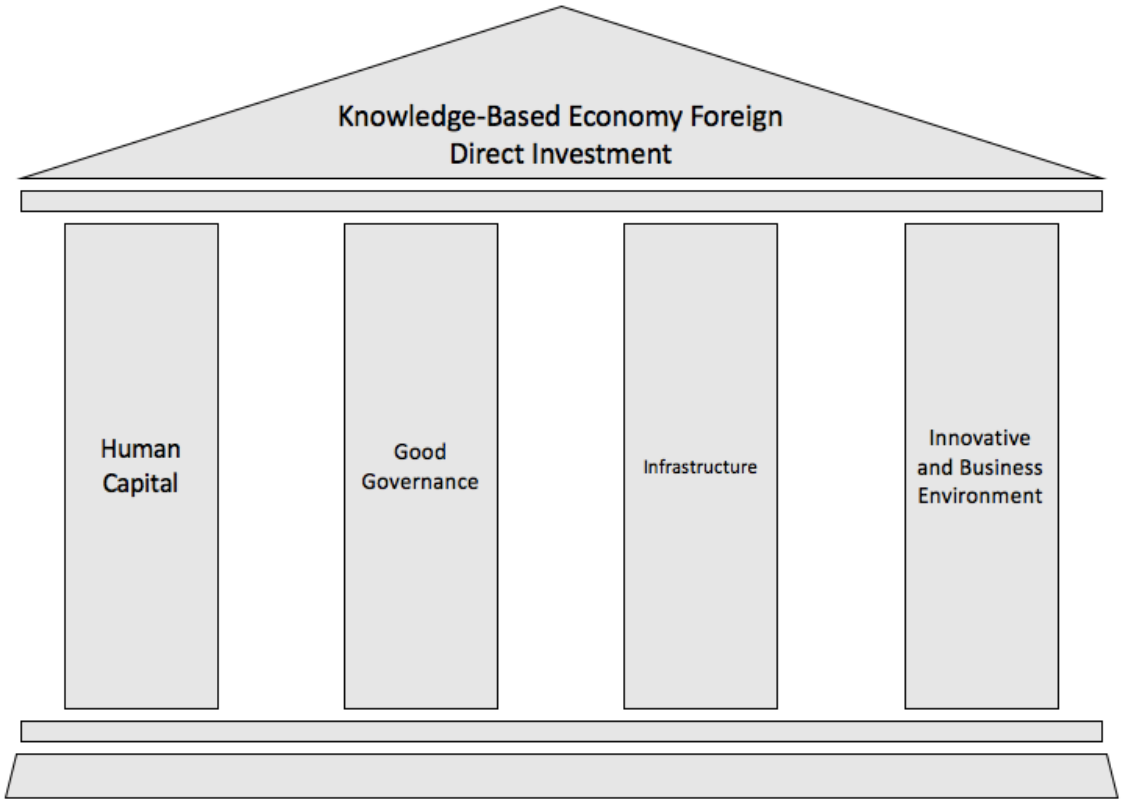
2.5.4 Innovation and Business Environment

Innovation is difficult to predict, but it can be facilitated by a conducive environment. There will be numerous indicators used to estimate the relationship between FDI into African knowledge-based industries and the innovation and business environment including: capital accessibility, agglomeration of past KFDI, size of current knowledge-based economy, technological incubators, and days to start a business. During the literature review, the author found mixed effects between domestic investment and FDI. However, according to Krugell (2001) in Sub-Saharan Africa there is a strong, positive correlation between the two variables. These results are in line with Ndikumana & Verick (2008) findings, who also studied SSA. Furthermore, Ndikiumana & Verick argues that there is a two-way linkage between FDI and domestic investment. The variables attract each other because the presence of one demonstrates confidence to the other. The presence of confidence is observed in agglomeration of FDI as well. In Africa, previous year FDI in a location has been shown to have a strong causality to attract present year FDI (Anyanwu, 2012; Krugell, 2001; Sichei & Kinyondo, 2012). In India, Mukim & Nunnenkamp (2010) found a similar causality, FDI was attracted to areas that were industrially diverse as well. A diverse location attracting FDI supports the idea that knowledge-based industries are better when agglomerating together allowing for spillover effects. As elaborated above, Africa has a growing community of technology and innovation incubators which can act as a mini-ecosystem or science park by bringing human capital, digital infrastructure and KFDI together. The report will include this development in the model to see if this has attracted FDI into knowledge-based industries. Lastly, the ease of doing business has been shown to have a very strong correlation to FDI in Africa (Mottaleb & Kalirajan, 2010). In the Mottaleb & Kalirajan study, to proxy the ease of doing business the authors used the indicator of how many days it takes to start a business. This variable is a good measure for attracting FDI and entrepreneurs in the knowledge-based economy. If there are numerous obstacles to starting a business both foreign investors and local innovators may be deterred and choose another option.

2.6 Conceptual Framework

Below is the study's conceptual framework (Table 5). Illustrating the equal importance of each Pillar, the report hypothesis that Human Capital, Good Governance, Infrastructure, and Innovative and Business Environment will have a positive effect in attracting knowledge-based economy foreign direct investment.

Table 5. Conceptual Framework



Source: Author, 2016

Lessons Learned

The process of literature review and conceptual framework has widened my understanding of both the knowledge-based economy and the effects of foreign direct investment. To fully understand the knowledge economy, it is important to review many different definitions and see how it is a divergence from the previous idea of economic growth. Information, specifically know-how, is becoming more valuable because of the increased competitiveness from globalization. The growth of the knowledge economy does give me hope that a there is a path of economic growth that is socially sustainable. I have learned that FDI plays a larger role than just supplying financial support. There are knowledge and technology transfers that occur that may be more valuable to the host country than the capital itself. However, those transfers do not automatically happen and require facilitation from different parties. In the context of Africa, the body of work for both concepts are relatively new. Thus the process of identifying the determinants of FDI for the knowledge-based industries in Africa has exposed me to a multitude of various published literature. It is interesting to see the evolution of the knowledge economy in parallel with globalization and digitalization. Globalization and digital innovations span every region and in turn so does the potential for the knowledge economy. Through reading similar studies, I have also started to develop the strategy and statistical modelling that will be fundamental in the coming chapters.

Chapter 3: Research Design and Methods

Following is a description of the variables and indicators included in the models created to examine the influence of location factors determinants on foreign direct investment into knowledge-based industries in Africa. Also, the research strategy, data collection method, and data analysis is explained.

3.1 Research Questions

The main question for this thesis is:

To what extent, do location factors influence FDI into the knowledge-based economy in African countries and cities?

Sub-questions:

1) To what extent do African countries and cities attract KFDI differently than non-African locations?
2) Do regional differences exist when attracting KFDI in Africa?
3) Are there determinant differences between subsectors in the knowledge-based economy?

3.2 Operationalization: Variables, and Indicators

After examining the available datasets on FDI and location factor indicators it is clear that two models will have to be constructed due to differing indicators between the country and city level in Africa. At the country level, the World Economic Forum's Global Competitive Index indicators are available. At the city level, the Euromonitor International's Passport: Cities database will be used along with the World Bank's database of technology incubators. Both models will be relevant to policy makers, especially for those in small countries, where the capital city is home to most of the economic activity and population.

The literature review provided information on several important elements that need to be included in the model. The indicators used fall into the four pillars of the knowledge-based economy: Good Governance, Human Capital, Digital Infrastructure, and Innovation and Business Environment. During the literature review, these four pillars were observed to attract KFDI and are the categorizes used in the World Bank's Knowledge Economy Index. However, these are complex concepts that do not have an exact metric, so quantifiable indicators will be used to proxy the variable. Proxies act as estimations of the actual object, but are necessary in the case that the object is multifaceted and not easily defined as a single value. In Table 6, the dependent variable for the country level model, KFDI, is listed with two indicators: the total annual dollar amount (KFDIDollar) and the annual frequency (KFDICount). Although similar, the dollar amount and the frequency of KFDI may result in different significant determinants, possibly having an effect on policy recommendations. To keep the report consistent, the KFDI Count models have been moved to the Annex. However, the author believes there is still important information from the analysis, but only the most pertinent information from the KFDI Count findings will be used when addressing the core and sub-questions.

Listed in Table 7 are the independent variables that will be used for the country level model. These indicators come from the World Economic Forum's Global Competitiveness Index which is comprised of a multitude of measurements. Since indicators that are similar to each other have

a correlation that will hamper statistical analysis, indices have been created combining the smaller measures into a larger variable. These indices have been constructed by Dorcas Nthoki at the Institute for Housing and Urban Development in Rotterdam, the Netherlands by using the P2 distance process. The P2 distance process of creating a composite index alleviates the concern of multicollinearity between the independent indicators. In the Annex can be found a description of the methodology of the P2 distance and further discuss of constructing the indices can be found in the *2016 African Economic Outlook* (AfDB et al., 2016). In Table 7, the indicators used to construct the indices are listed below their corresponding index. To address the second sub-question, dummy variables will be constructed to see if there are regional differences in Africa. As stated earlier, there will be two models that will be analyzed because of the varying indicators between the country and city level. The dependent variable, KFDI, is the same in the city model as in the country level (see Table 9). Table 10 lists the determinants in the model for the city level analysis.

Table 6. Dependent Variable, Country Level Model

Variable	Indicator	Unit	Source
Foreign Direct Investment into KBI	• Total Annual Dollar Amount • Annual Frequency of Investment	'000 USD Count	fDi Markets fDi Markets

Table 7. Independent Variables, Country Level Model

Variable	Indicator	Source
Good Governance (GGov)	• Institutions o Intellectual Property Protection o Public Trust in Politicians o Judicial Independence o Transparency of Government in Policymaking o Ethical Behavior of Firms o Strength of Auditing and Reporting Standards o Strength of Investor Protection	WEF
Human Capital (HumCap)	• Higher Education and Training o Tertiary Education Enrollment o Quality of Math and Science Institutions o Quality of Management Schools o Availability of Research and Training Services • Innovation o Quality of Scientific Research Institutions o University Industry Collaboration in R&D o Availability of Scientists and Engineers o Patent Applications	WEF WEF
Infrastructure (Infra)	• Infrastructure o Quality of Roads o Quality of Railroad Infrastructure o Quality of Port Infrastructure o Quality of Air Transport Infrastructure o Quality of Electricity Supply o Mobile Telephone Subscriptions o Fixed Broadband Internet Subscriptions	WEF
Innovation and Business Environment (IBEnviro)	• Goods Market Efficiency o Intensity of Local Competition o Total Tax Rate o Number of Procedures to Start a Business	WEF

	o Number of Days to Start a Business o Prevalence of Trade Barriers o Trade Tariffs o Business Impact of Rules on FDI o Burden of Customs Procedures	
	• Financial Market Development o Availability of Financial Services o Affordability of Financial Services o Ease of Access to Loans o Venture Capital Availability	WEF
	• Technology Readiness o Availability of Latest Technology o Firm-level Technology Absorption	WEF
	• Previous Year KFDI	fDi Markets

Table 9. Dependent Variable, City Level Model

Variable	Indicator	Unit	Source
Foreign Direct Investment into KBI	• Total Annual Dollar Amount	‘000 USD	fDi Markets
	• Annual Frequency	Count	fDi Markets

Table 10. Independent Variables, City Level Model

Variable	Indicator	Unit	Source
Good Governance (GGov)	• Tax Surplus	‘000 USD	EI
Human Capital (HumCap)	• Secondary Education Level	‘000	EI
	• Tertiary Education Level	‘000	EI
Digital Infrastructure (Infra)	• Mobile Telephone Users	%	EI
	• Households with Computers	%	EI
	• Households with Internet Access	%	EI
	• Household with Broadband Access	%	EI
Innovation and Business Environment (IBEnviro)	• Technology and Innovation Incubators		WB
	• GVA of Knowledge Economy	‘000 USD	EI
	• Employment Rate	%	EI
	• Previous Year KFDI	‘000 USD	fDiMarket
	• Disposable Income	‘000 USD	EI
	• GDP Growth	%	EI

3.3 Research Strategy

To address the research questions, the study has several elements that need to be considered when deciding which research strategy to use. First, the study is examining large sets of quantitative, secondary data of global activity of greenfield FDI. Second, a large scope is required to answer the proposed questions. Third, there is varying time periods for the variables being used. The KFDI and independent variables have been measured annually from 2005 to 2014. It is only through analyzing changes over time that causality can be established. Furthermore, the findings will be generalized to form policy recommendations. For those reasons, the research strategy will be a desk research method. A desk method can be used when there is a large scope for a study,

when the study has multiple references to points in time, and when the objective is to generalize a causality to propose policy recommendations. Internal validity is the first objective of the analysis, however, if there are robust results external validity as well may be very strong.

3.4 Sample Size and Selection

An objective of this study is to generalize the results so that policy recommendations for African countries and cities can be made. The country and city models will be dealt with separately because different indicators will be used. At the country level, non-African country data will be analyzed to create a benchmark for African countries. The benchmarking analysis will include 30 countries and their annual KFDI inflow from 2006 to 2014. Since the African city database of KFDI is very representative of the overall KFDI activity at the city level, African country totals will be aggregated from the city totals. This will result in 27 countries being analyzed. As represented in the Table 7, the independent variables that will be used for the country level model come from the World Economic Forum's Global Competitiveness Index.

Similar to the country analysis, the city level model will include a benchmarking analysis of non-African cities. The benchmarking model will include the top 50 cities receiving the most KFDI in the Euromonitor International database. This analysis will be conducted using data from 2005 to 2014. The benchmarking is necessary for comparison and for future policy recommendations. In the African city model seven African cities: Cairo (Egypt), Nairobi (Kenya), Casablanca (Morocco), Lagos (Nigeria), Cape Town (South Africa), Johannesburg (South Africa), and Tunis (Tunisia) will be analyzed. Although the city model is smaller than the country level analysis all the regions in Africa are represented and the seven cities selected are leading centers of growth.

3.5 Data Collection Method

The work of previous research has lent itself useful for this study. There is an extensive database of information about the independent and dependent variables that were selected for this study. For this reason, the investigation will take a panel approach. Data has been sourced from fDi Markets, World Economic Forum, Euromonitor International, and the World Bank. The country level model will be using data from fDi Markets and the World Economic Forum's Global Competitiveness Database. Data from fDi Markets, Euromonitor International, and the World Bank will be used in the city level model.

There are several benefits for using this database: the existing information is robust, the sources are reputable, and it is cost effective. The process of recollecting this information would be very time consuming and a financial burden. Analyzing the relationship and causality between the determinants and FDI will require a large spreadsheet of information that is reported with temporal references. Although, secondary data collection is considered to be less strenuous than collecting primary data there will be an extensive amount of time needed to compile the gathered data from the external sources into one database.

To determine which industries were considered to be within the knowledge-based economy the author cross referenced the 39 available industry sectors in the fDi Markets database with the

NACE's definition of a knowledge-based industry (see section 2.2.2 for more details). As a result, 15 sectors are considered to be knowledge-based and thus FDI into these sectors would be considered KFDI. The selected sectors are Aerospace, Alternative/Renewable Energy, Biotechnology, Hotels & Tourism (minus Construction purposes), Business Services, Communications, Consumer Electronics, Financial Services, Healthcare, Leisure & Entertainment, Medical Devices, Pharmaceuticals, Semiconductors, Software & IT services, and Space & Defense.

3.6 Reliability and Validity

For a study to be scientific and meaningful for policy recommendations, there must be a high level of reliability and validity. According to Neuman (2006), there are four types of reliability that must be accomplished for data to be used appropriately. The first is measurement reliability which states that the results do not vary because of the measurement process or instruments. The other three are subgroups of measurement reliability that ensures the measurement process and instruments do not skew the results according to time, social groups, and indicators (stability, representative, and equivalence, respectively). The analysis will be using data that has been collected by world-class organizations and used in peer viewed publications. Also, the statistical model will be conducted only after rigorously testing the statistical skewness of the data. For those reasons, the author is confident that the results will satisfy the four measures of reliability.

In addition, Neuman (2006) listed a number of types of validity. Validity measures how well the model "fits" with reality. The more valid a study is the better the indicators measure what is observed. The results must fit common beliefs and have a theoretical background. An independent verification strengthens a studies validity, a reason peer viewed publications are seen as good sources of academic information. A study's indicators must have acceptable relationships between the dependent variable and other indicators. In a desk research study that uses large datasets, statistical computations are conducted which allow for validity checks. However, even using statistical computer software such as Stata does not account for some bias, such as insufficient amount of observations which may influence to validity of a study. Fortunately, there are thousands of observed KFDI records, so bias introduced by an unrepresentative sample is not a concern.

3.7 Data Analysis Method

Data will be collected from reputable sources managing and maintaining large databases and once spreadsheets are completed with all the necessary variables a multivariate statistical analysis will take place. The method for computing the KFDI Dollar models will be an OLS Fixed/Random Effect Model. The Fixed/Random Effect Model is used for panel data that is clustered into groupings. In this study the clusters are either the countries or cities being analyzed. Analyzing the model in clusters limits the effect of residuals over time. Through this process unknown and unmeasured characteristics within the cluster can be accounted for resulting in a more robust analysis of the independent variables. Information surrounding the KFDI Count analysis can be located in the Annex.

However, prior to running the models appropriate procedures will have to be conducted to test for any heteroskedasicity, multicollinearity, and nonlinearity. Transforming indicators may be necessary to account for any skewness that appears during the tests. The instruments and process is necessary when conducting an analytical model and following these steps will result in a reliable study. In the process of preparing the data, it was observed that the following variables were not normally distributed: KFDI Dollar, Institutions, Infrastructure, Higher Education and Training, Goods Market Efficiency, Financial Market Development, Technological Readiness, Innovation, Tertiary Education, Secondary Education, Mobile Telephone Users, GVA of Knowledge Economy, Tax Surplus, Employment Rate, Household with a Computer, Households with Internet Access, Households with Broadband Access, Previous Year KFDI, and Disposable Income. To correct for this the variables were transformed into natural log forms. This process creates a more normal distribution of the data, an assumption that is necessary before completing the Fixed/Random Model. In the following chapter, the variables that were transformed to the log version will also be noted in the results tables. When an observation has a value of zero its log transformation creates an undefined value. In this case, that observation is given a blank value and during the regression analysis it is removed. This is especially pertinent to the KFDI Dollar variable. There are some instances that the countries and cities being analyzed do not receive any KFDI. However, the fixed/random effect models are able to compensate for the gaps within location clusters. Heteroskedasicity was observed in the analyses, so the *vce(robust)* command was used to correct the residuals.

Lastly, testing between the independent variables is required to reduce multicollinearity. If there is strong multicollinearity, or correlation, between the independent variables then the results of the analysis could be skewed. If so, then one of the variables must be removed from the model. During the modelling, the *estat vce, correlation* command was used after the regression to determine any correlation between the independent variables. In the case that two variables had a correlation value over 0.40 one of the variables were removed from the model. At the beginning of each analysis all the indicators will be included in the model. A step by step process of calculating the correlation between the indicators and removing those with high correlation will result in a model for each analysis that will have only several independent indicators. This process is similar to a stepwise analysis, however, in the study the variables are examined and removed by hand.

The study will utilize the statistical analysis computing program Stata for testing, transforming, and modeling. The models to be statistically regressed are:

$$KFDIDollar = C + \beta_1 GGov + \beta_2 HumCap + \beta_3 Infra + \beta_4 IBEnviro + \varepsilon$$
$$KFDICount = C + \beta_1 GGov + \beta_2 HumCap + \beta_3 Infra + \beta_4 IBEnviro + \varepsilon$$

As described in Table 7, *GGov* refers to the indicators used to proxy Good Governance, *HumCap* for Human Capital, *Infra* for Digital Infrastructure, and *IBEnviro* for Innovation and Environment. The corresponding β for each variable is the resulting coefficient from the Stata regression. In the analysis, for indicators to be statistically significant they must at least have a 95 percent confidence that the coefficient's value represents the relationship between the indicator and the dependent variable. The constant in the equation is labelled as *C* and the error term is ε.

Chapter 4

In the following chapter the descriptive and iterative results from the analysis will be presented. The results will be structured to answer the three sub-questions of this report, which are:

1) To what extent do African countries and cities attract KFDI differently than non-African locations?
2) Does geographical regions influence KFDI in Africa?
3) Are there determinant differences between subsectors in the knowledge-based economy?

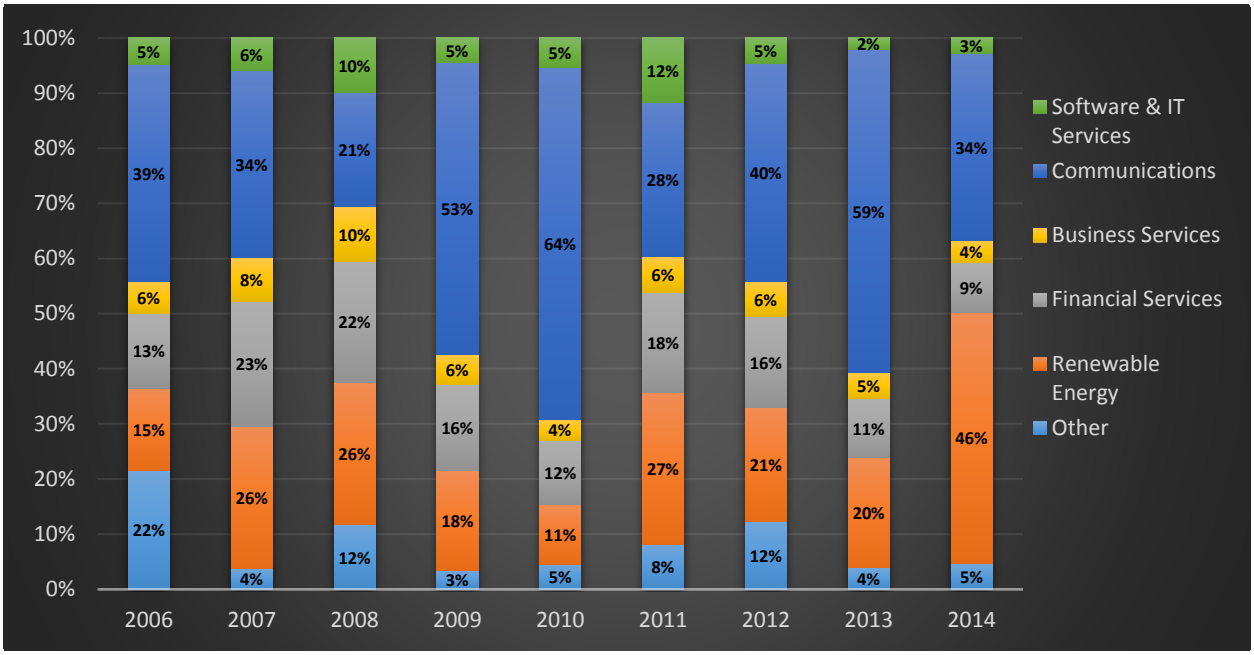
Although it is not an objective for Chapter 4, in the pursuit of answering the sub-questions, the core question of this report (To what extent, do location factors influence FDI into the knowledge-based economy in African countries and cities?) will begin to be answered as well.

4.1 To what extent do African countries and cities attract KFDI differently than non-African locations?

4.1.1 Country Level Descriptive Analysis

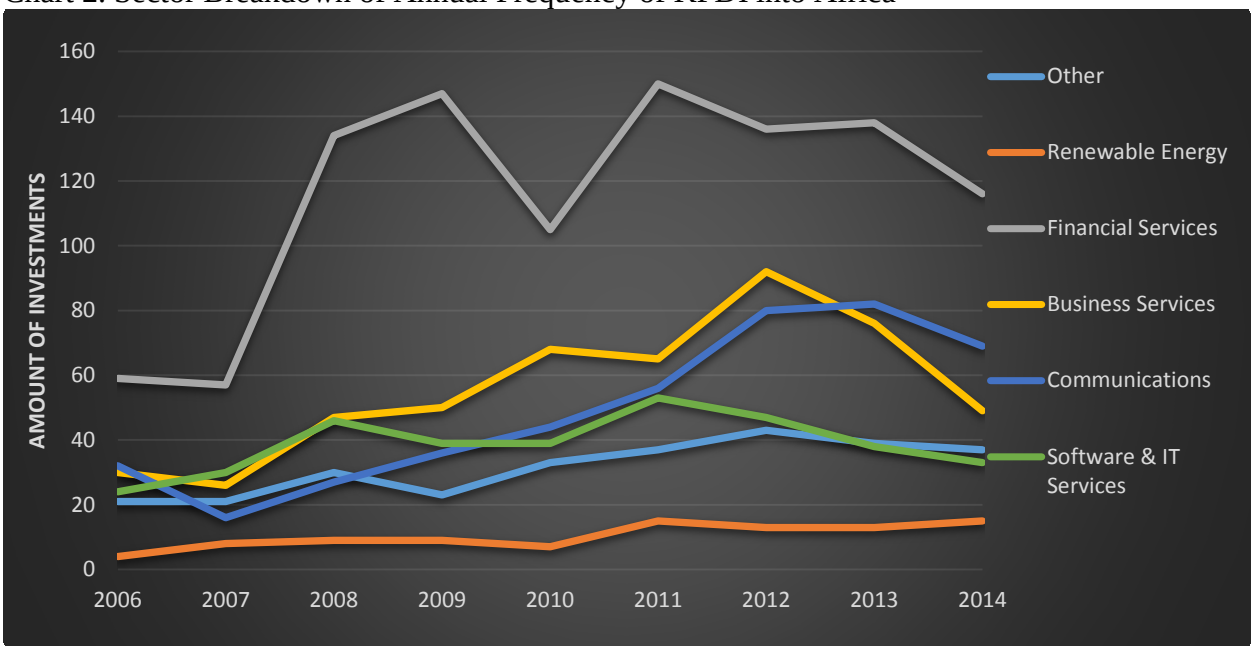
Before discussing the results from the regression models, a breakdown of the subsectors that received the most foreign direct investment will be examined. For African countries during the 2006-2014 period the Renewable Energy, Communications, Financial Services, Business Services, Software & IT Services sectors received the most KFDI. In Chart 1 is the sectorial breakdown for the dollar amounts of KFDI into Africa and Chart 2 displays the fluctuation over time of the annual amount of foreign investments into the sectors. The Other group is the sum of all the other subsectors.

Chart 1. Sector Breakdown of KFDI into Africa



Source: Author, 2016. Bases on fDi Markets

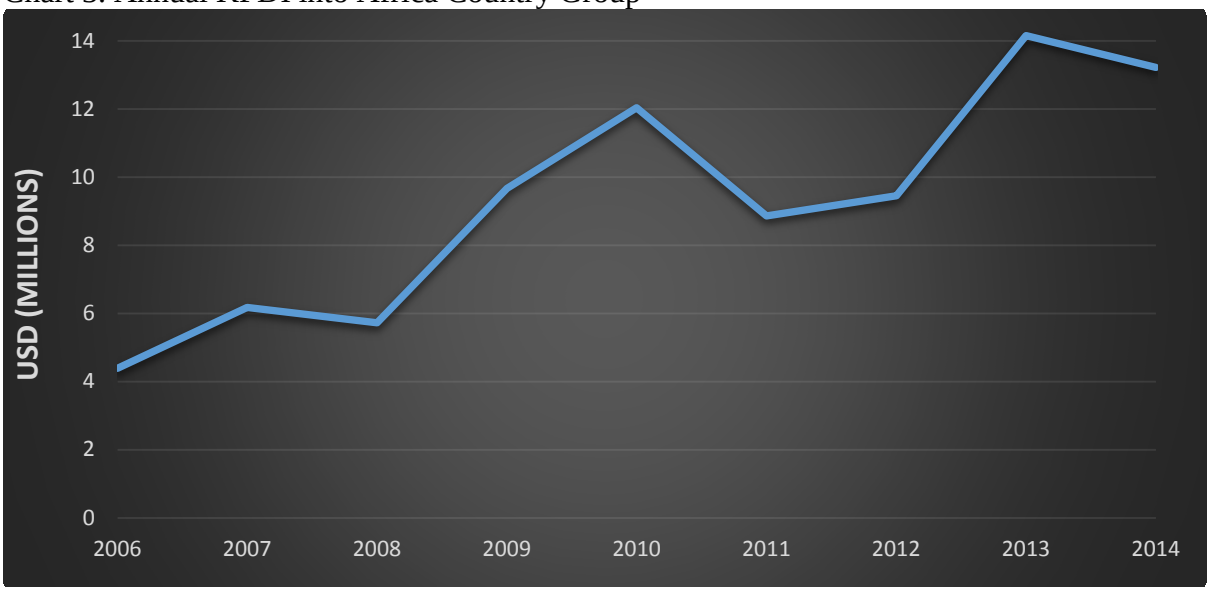
Chart 2. Sector Breakdown of Annual Frequency of KFDI into Africa



Source: Author, 2016. Bases on fDi Markets

From the charts, it is observed that Communication is the prominent sector based on dollar amounts, but Financial Services receives the most investments every year. In terms of dollars, the Communication sector was not just the largest sector, but in some years it was over 50% of the total KFDI inflow into Africa. During the 2006-2014 period, the Communication sector received only an average amount of investments, consequently the average Communication investment is over $90,000. However, the Renewable Energy Sector has the highest average investment amount of over $238,000. In Chart 2, it is only the Renewable Energy sector that stays below Other. However, the Renewable Energy sector is a significant portion of the dollar amounts, especially

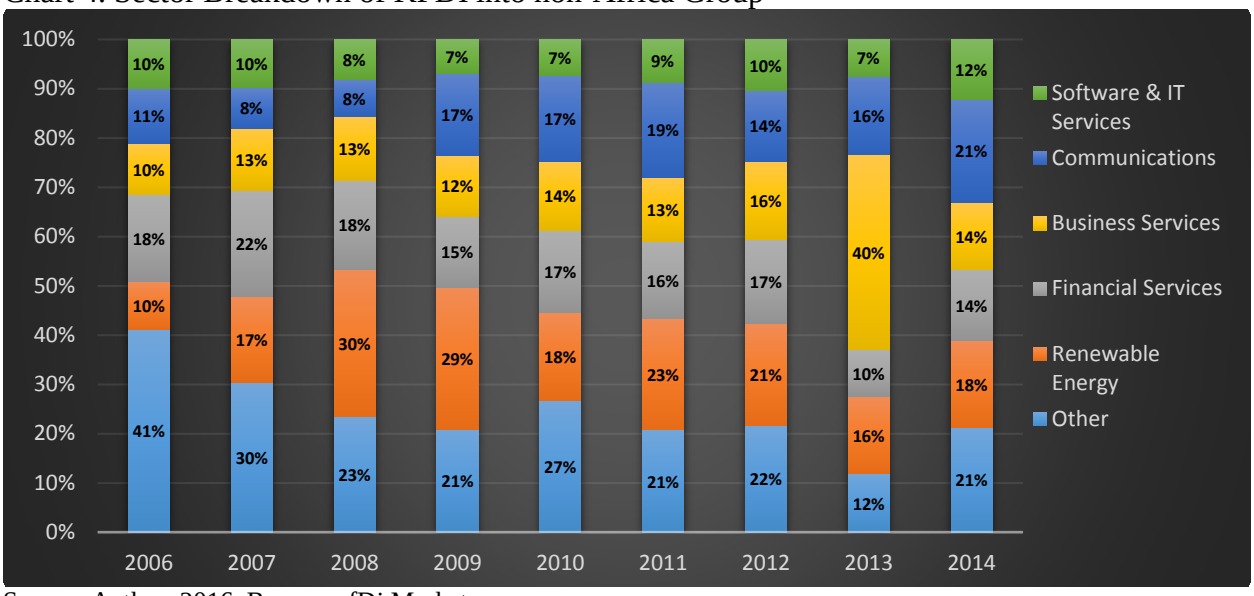
Chart 3. Annual KFDI into Africa Country Group



Source: Author, 2016. Bases on fDi Markets

in 2008 and 2014 when it received the most amount of KFDI. It is worth noting that there was a steady tread of increases of total KFDI every year throughout the whole period except for small dips in 2011 and 2014 (See Chart 3). This is especially surprising because of the 2008 economic crisis which restricted investments globally for several years afterwards.

Chart 4. Sector Breakdown of KFDI into non-Africa Group



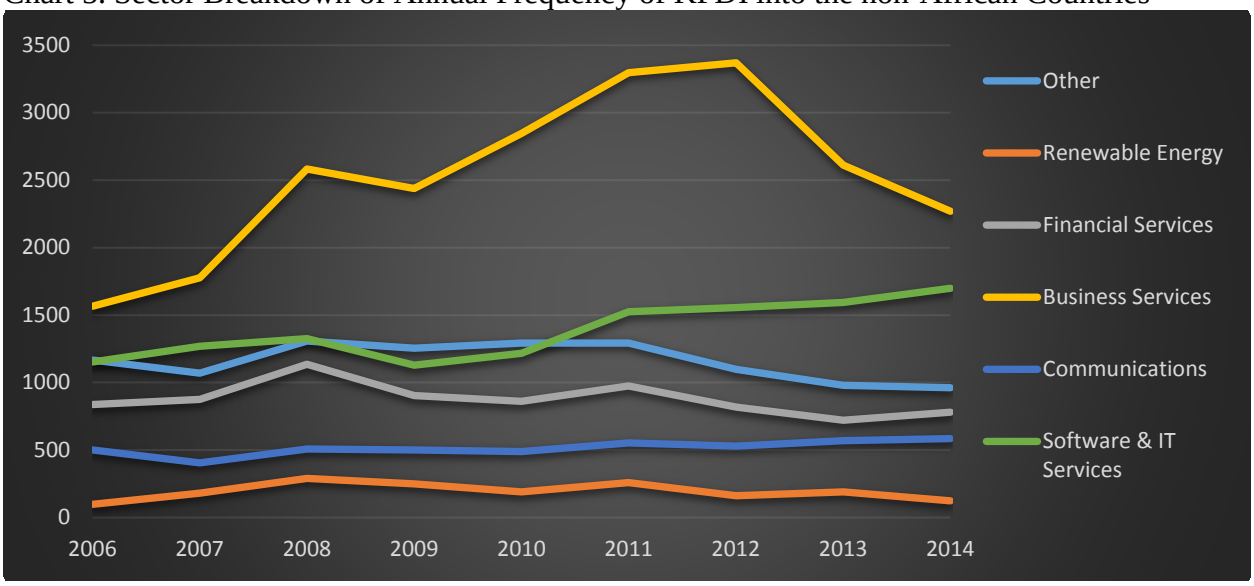
Source: Author, 2016. Bases on fDi Markets

Above in Chart 4 is a breakdown of the top five knowledge-based sectors in the non-African country group. The five sectors that attracted the most KFDI were Software & IT Services, Communications, Business Services, Financial Services, and Renewable Energy. Although the Other group was the majority of KFDI for the non-African countries in 2006, 2007, and 2010, there is an observable change in the overall proportion of KFDI activity. While the Communication sector has gradually been increasing its share from 2006 to 2014, the Renewable Energy and Business Services had several very large years. Furthermore, the Software & IT Services and Financial Service sector stayed relatively steady through the years.

In Chart 5, it can be observed that the Business Service sector has been receiving the most investments in the knowledge-based economy. At its peak in 2012, Business Services received double the amount of the second highest sector, Software & IT Services. During the 2006-2014 period it can be seen that Renewable Energy, Communication, Financial Services, and Other did not have any noticeable increases with Financial Services and Other actually ending with less investments in 2014 than in 2006. However, Business Services and Software & IT Services did have a noticeable increase in 2014 since 2006, but considerably less than the investment totals for 2012. See the Annex for Annual KFDI inflows for the non-Africa Group.

When comparing African and non-African countries, one can easily look passed the African data because of the magnitude that the top countries receive. The non-African group receives over 100 times the amount each year than the African countries. However, there are similarities and trends that can still be observed through these different scales. The most noticeable is the fact that in both groups Renewable Energy, Financial Services, Business Services,

Chart 5. Sector Breakdown of Annual Frequency of KFDI into the non-African Countries



Source: Author, 2016. Bases on fDi Markets

Communications, and Software & IT Services were the top five subsectors in the knowledge-based economy. These sectors are the underpinnings of current and future global growth. There has been a global effort to wean ourselves off fossil fuels and move towards sustainable energy sources. The growth in the technology and ICT sectors are transforming the scale and speed at which information can be shared. And financial and business service are fundamental for a growing economy. So, it should not be a surprise that these sectors are the prominent knowledge-based industries in Africa and globally. Also, there is a similar dip or stagnation in the overall trend of both groups during the 2012-2014 period.

In both groups a service sector has a very strong lead in the amount of investments annually. For Africa it is the Financial Services and for the non-African group it is Business Services. This may be because of the opportunities that service sectors have been experiencing, but also the lower initial costs service sectors have compared to the Renewable Energy and Aerospace sectors which requires a much larger investment into equipment and machinery. The constant proportions of the six sectors in the non-African group compared to pattern of extremes for African investments is another noticeable difference in this breakdown. During the nine years, the non-African group had only six instances of a sector accounting for more than 25% of the overall dollar amount. However, the African countries had twelve cases of this happening. Furthermore, there was only one year where a sector diverged from the proportional rankings in the non-African country group. In the African country analysis, the proportional rankings changed every year. This is evidence that the top knowledge-based economies and African knowledge-based economies are at different stages of development and are evolving differently.

4.1.2 Country Level Inferential Analysis

This section will compare the results of the panel data regressions of African and non-African countries. Again, for both models the Hausman test was used to determine if a fixed or random effect was observed. In the OLS KFDI Dollar model, a random effect was used for the

Summary Table 1. African Country KFDI Dollar Model

	N	Mean	SD	Min	Max
KFDI Dollars (Log)	197	4.7	1.8	0	8.8
Institutions (Log)	231	1.3	.17	.91	1.7
Market Efficiency (Log)	231	1.4	.12	.98	1.6
Financial Market (Log)	231	1.3	.21	.67	1.8

Source: Author, 2016. Calculated with Stata.

Summary Table 2. Non-African Country KFDI Dollar Model

	N	Mean	SD	Min	Max
KFDI Dollars (Log)	243	8.3	.85	6.4	10.4
Technological Readiness	243	4.7	.98	2.6	6.3
Institutes (Log)	243	1.5	.20	1.1	1.8
Financial Market Development (Log)	243	1.5	.16	1.1	1.9
Innovation (Log)	243	1.4	.21	1.0	1.8

Source: Author, 2016. Calculated with Stata.

African analysis and a fixed effect for the non-African model. As described above, when KFDI Dollars was transformed to the log version some observations that were originally valued at zero had a log value that was undefined. These observations were removed, but the author does not believe this will under represent the significant determinants of KFDI. Above in Summary Table 1 and 2, the dependent and significant independent variables are listed with their corresponding number of observations, mean, standard deviation, minimum and maximum.

Results Table 1. African Country KFDI Model

	KFDI Dollars (Log)
Institutions (Log)	-5.377***
	(1.553)
Market Efficiency (Log)	6.906***
	(1.808)
Financial Market (Log)	4.654***
	(1.335)
Northern Africa	1.525
	(0.874)
Southern Africa	-0.489
	(0.913)
Western Africa	0.027
	(0.967)
Eastern Africa	0.086
	(0.890)
Central Africa	-
	-
Constant	-4.194*
	(1.845)
Observations	197
R^2	0.358

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Author, 2016. Calculated using Stata.

In Results Table 1 is the final model for African Country determinants of KFDI. To reiterate the process that was described in Chapter 3, each analysis started with all the hypothesized determinants of KFDI. After running the appropriate model, the correlation between the independent determinants were calculated. The determinant that had the highest correlation score among all other determinants were removed. The process was repeated until the remaining determinants were below the suitable correlation value. Through this process there is no multicollinearity between the determinants. The results of the KFDI Dollars analysis find that the Institutions, Market

Efficiency, and Financial Market variables are highly significant.

A positive relationship between KFDI Dollars and Market Efficiency and Financial Market are in line with previous literature, theories, and the study's hypothesis. As a proxy for the Innovative and Business Environment Pillar, the Market Efficiency variables expresses the incentives to invest, ease to start a business in a country, and the competition of the local market. It would be expected that as it becomes easier for investments to flow in more investments would be attracted. Also, in the knowledge-based economy competition breeds innovation and thus more investment. The Financial Market also proxies the Innovative and Business Environment Pillar and is compiled of indicators measuring the availability of financial services. The positive relationship between Financial Market and KFDI Dollar supports theories and examples expressed in Chapter 2. An unexpected result was the negative relationship between Institutions and KFDI Dollars. Since the objective of this section is to compare Africa and Non-Africa determinants, interpreting this unexpected result will be discussed further in the answer of the third sub-question and in Chapter 5.

In Results Table 2, the significant variables for the non-African country model can be found. In accordance with the Hausman Test, a fixed effect model was used and the Goods Market Efficiency and Technological Readiness variables were found to be negatively correlated with KFDI Dollar and the Institutions variable positively related. Although initially unexpected, the negative relationship between KFDI and Goods Market Efficiency and Technological Readiness maybe caused by too much competition. The investments being analyzed are greenfield investment, or investments that create a new business. So, if there are too many local competitors, investors may choose another location to start their business. The countries chosen for the Non-African sample have very competitive economies, so competition might very well be getting to the point that KFDI is becoming deterred by competition. The positive relationship between Institutions and KFDI is inline with theory about intellectual property rights (IPR), as a country develops there is a U-shape curve between KFDI and IPR. In the early stages of development, it is beneficial for countries to be more relaxed with IPR, but after surpassing a threshold stricter IPR are important to attract further investments. The non-African countries in this study are all passed this threshold thus a positive correlation was hypothesized.

Results Table 2. Non-African Country KFDI Dollars Model

	KFDI Dollar (Log)
Institutions (Log)	3.194***
	(0.823)
Market Efficiency	-0.907***
	(0.244)
Tech Readiness	-0.316***
	(0.09)
Financial Market (Log)	0.416
	(0.486)
Innovation (Log)	0.747
	(0.674)
Constant	7.628***
	(0.796)
Observations	243
R^2	0.233

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Author, 2016. Calculated with Stata.

To begin comparing the determinants of KFDI for African and non-African countries a simplified table, Comparison Table 1, was created to compare side by side the significant independent variables and their relationship to KFDI. It can be observed that the two groups share significant variables, however, some these variables have opposing relationships to KFDI. Several factors may cause the correlations to differ, including the differences in development stages and the construction of the indices. The Communication sector is an example of how development stages can effect investments. The countries in the non-African group already have a strong digital infrastructure and thus there is less room for growth compared to the African group which has received a large amount of investment towards building such infrastructure. This highlights a possible type of KFDI that is entering Africa. If a firm is looking to invest in digital infrastructure because there is a demand for such a service, they are market seeking. Unlike other types of strategies for greenfield KFDI that looks to achieve growth in the global market from an investment, a market seeking strategy sees potential growth in the local economy. An investment in African communication infrastructure has a huge potential. In the response to the third sub-question of the report there will be a breakdown of the top four subsectors in Africa and the determinants of each will be analyzed. In that analysis, the KFDI into the Communication sector also has a negative relationship with Institutions while the other three subsectors do not. As noted in Chart 1, the Communication Sector has been the largest portion of the overall dollar value of KFDI into Africa, so the negative relationship that is observed at the overall level may be more descriptive of the Communication sector and less of the knowledge-based economy as a whole.

Comparison Table 1. African Countries vs. Non-African Countries Significant Indicators

		Good Governance	Innovation and Business Environment		
		Institutions	Market Efficiency	Technology Readiness	Financial Market
KFDI Dollars	Africa	-***	+***		+***
	Non-Africa	+***	-***	-***	

Source: Author, 2016. Model analysis

The market seeking strategy may be observed in the opposing relationship for the Technological Readiness variable as well. One would expect there to be a positive relationship when technology is readily available and used. However, in the non-African group it might be the situation that there is less opportunity for improvements because technology is already ubiquitous in society. On the other hand, found in the Annex, Technology Readiness had a positive and significant relationship with KFDI Count. In Africa as technology becomes more available and absorbed into business practices the opportunities for KFDI becomes greater because the market has yet to be saturated.

The difference in variable relationships may be found within the smaller indicators used to construct the variable. This could be in case for Market Efficiency. Although the variable measures how easy it is to invest and start a business in a country, it also includes competition. It is difficult to image that government incentives to encourage investment actually deters investment, but excessive competition may be the reason for the inconsistency. Although theory says that competition is good for the economy, the absolute level of competition could be too high in the top 30 countries deterring new greenfield investment. Also, there may be long standing companies

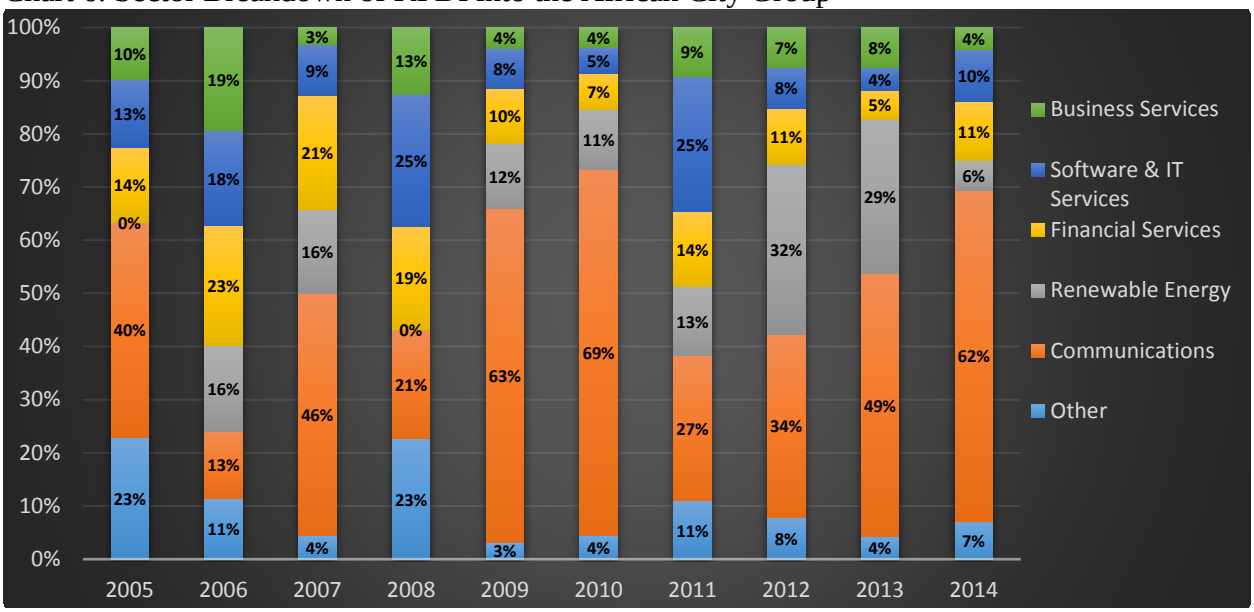
that have a strong hold of the market. However, in Africa competition is much lower. In African knowledge-based economies there are growing markets that are competitive, but possibly not to the level that deters entry into the market.

It is clear that there are differences between the determinants of KFDI into African countries and non-African countries. As the African knowledge-based economies are just developing it would be expected that the two groups have different determinants. However, a further analysis of the individual indicators that are used for the variables may help uncover some additional details behind the differences in determinants of KFDI. The differences do highlight opportunities for African countries. First, since there are determinant differences, African countries can focus on the positively correlated determinants such as the Market Efficiency and Financial Market to gain advantage over other knowledge-based economies. Secondly, now that African countries can benchmark themselves against more developed knowledge-based economies weakness can be identified. A focus on both the strengths and weaknesses will result in more attractive knowledge-based economies throughout Africa.

4.1.3 City Level Descriptive Analysis

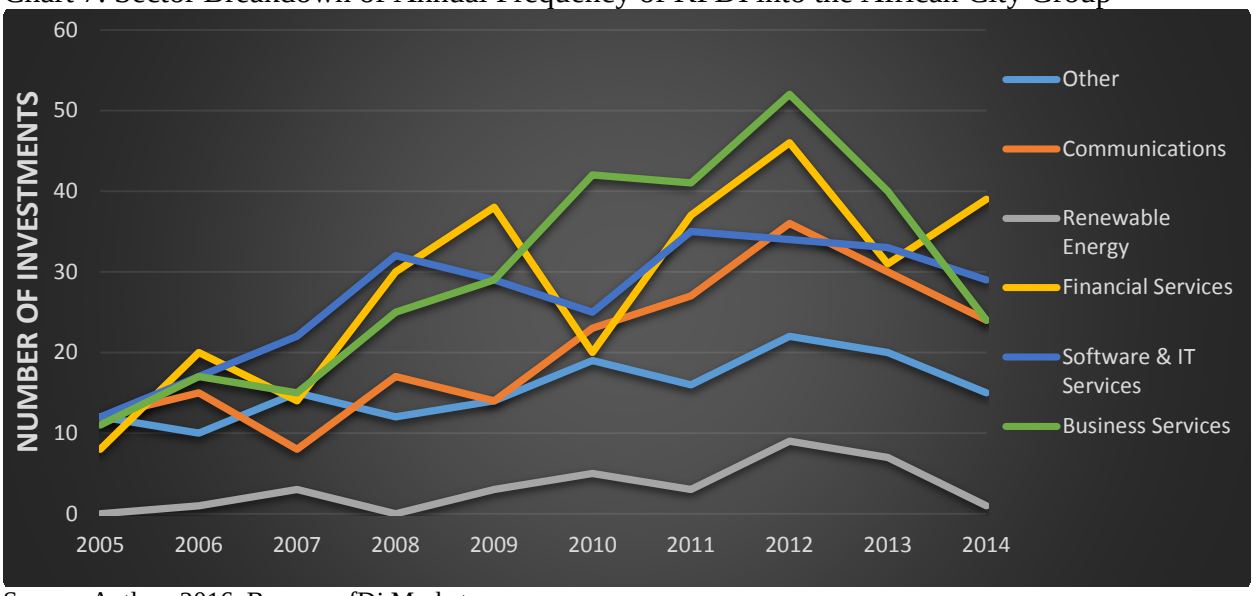
The following section is a descriptive analysis comparing the trends of KFDI into the African and non-African city groups. Below in Chart 6 is a proportional breakdown of the top five subsectors in the African city group. Standing out is the Communication sector which has received an overwhelming amount of KFDI compared to the remaining sectors. In six of the of the ten years, the Communication sector makes up for at least 40 percent of the total KFDI. However, there are

Chart 6. Sector Breakdown of KFDI into the African City Group



Source: Author, 2016. Bases on fDi Markets

Chart 7. Sector Breakdown of Annual Frequency of KFDI into the African City Group



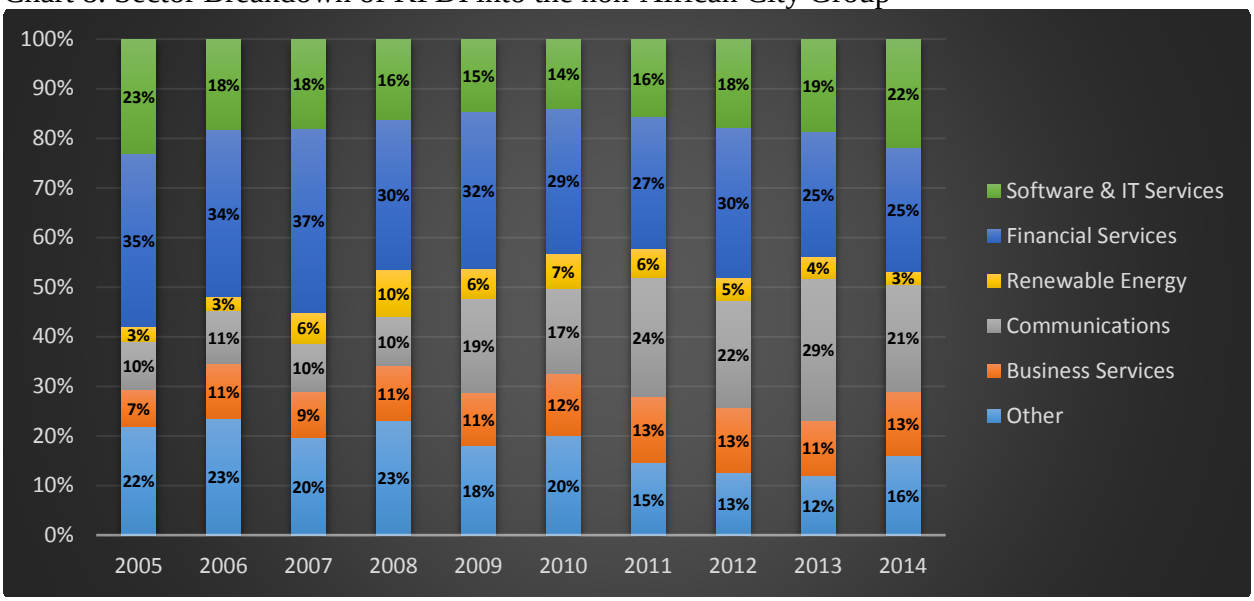
Source: Author, 2016. Bases on fDi Markets

several years where the Software & IT Services, Financial Services, or Renewable Energy sectors received a substantial amount of KFDI as well. Furthermore, in the years when there is not a tremendous amount of Communication KFDI the service sectors hold a strong percentage of the overall KFDI. This hints at the possibility that there were massive, individual investments into the Communication sector in several years skewing the representation. In Chart 7, this suspicion is confirmed. Over the years, the Communication sector ranked fourth in the frequency of KFDI and in the year it received the most investments the sector received a relatively lower amount KFDI dollars. Along with the Communication sector, Renewable Energy seems to rely on large, individual projects with some years without any investments and two that were 30 percent of the overall annual KFDI.

Furthermore, between 2005 to 2014 the Service sectors received the most investments per year with the Business Services sector peaking at over 50 investments in 2012. From 2005 to 2012 there was an overall steady increase in the frequency of investments, but in 2013 there was a downturn which continued to worsen in 2014, expect for Financial Services which recovered some of its loses. The prominence of the Service sectors is not a surprise. First, they are the leading sectors globally for the knowledge-based economy. Secondly, one would expect these sectors to locate themselves in city locations, gravitating towards other Service industries.

Below, Chart 8 depicts the top five sectors and their proportional share of foreign direct investment into the knowledge-based economy in the top 50 cities worldwide. It is visible that the Financial Service sector had a steady lead as the top sector, but its share slightly declined in the more recent years. Subsequently, the Communication and Software & IT Services sectors began to gain ground. It would be expected that changes in global trends move slowly through the years and that may be the case for KFDI. It is possible that the Financial Service sector was in a stage of growth in the mid-2000s, but coming into the mid-2010s technological innovations in software and telecommunication has lead to a shift in investments into the knowledge-based economy.

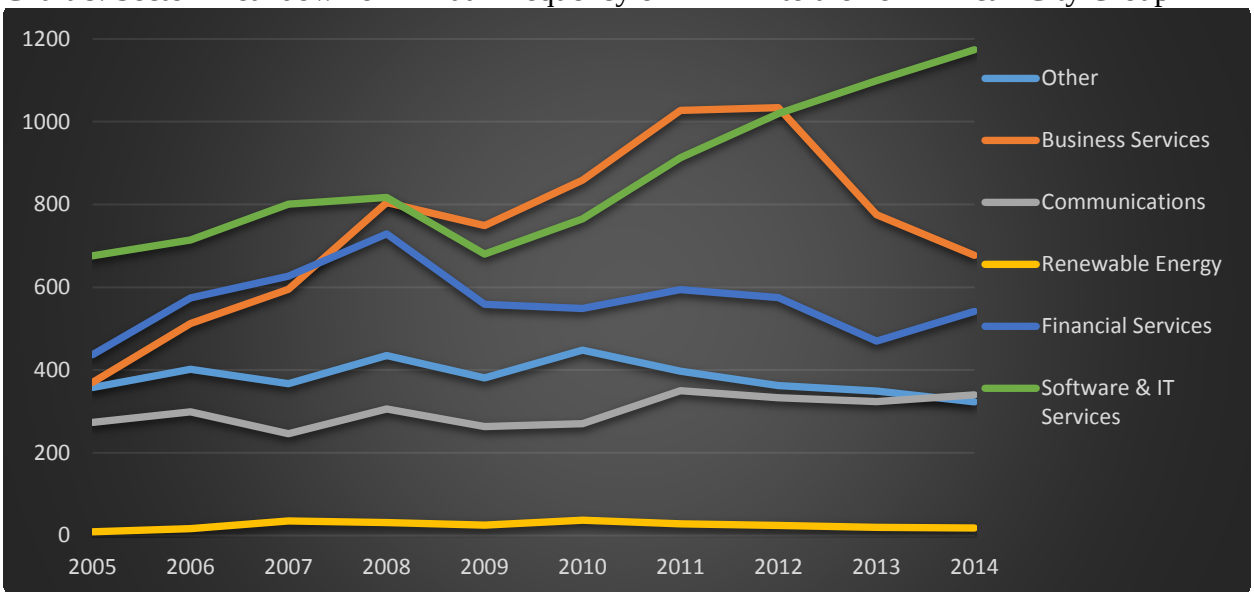
Chart 8. Sector Breakdown of KFDI into the non-African City Group



Source: Author, 2016. Bases on fDi Markets

Analyzing the annual frequency of KFDI into the non-African City group in Chart 8, several trends come to light. The first is the almost universal downturn in KFDI after the 2008 economic crisis. However, since 2008 it has only been the Software & IT Service sector that has recovered. Business Services made a slight recovery, but a decline in 2013 brought investments into the Business Service sector below its pre-2008 level. In the remaining sectors, post-economic crisis there has been a stagnation and no noteworthy growth. Although, we see the Communication Sector growing in terms of dollars since 2011, the amount of investments has stayed about the same. As expected the service sectors have a very strong hold on receiving the most investments every year.

Chart 8. Sector Breakdown of Annual Frequency of KFDI into the non-African City Group



Source: Author, 2016. Bases on fDi Markets

When comparing the activity of KFDI into the African and non-African City groups there are similarities and differences. First, the overall activity of the non-African City group appears much more stable and does not fluctuate as much as the African City group. Globally, the Communication sector is growing, but in the African cities analyzed Communications has been the predominate sector since 2005. The African City group did not have any visible downturn in KFDI in 2008 while globally there was a very large dip and some sectors have not rebounded. In terms of the amount of annual investments the service sectors are on top in both groups. The growth in these sectors has been well documented and one would expect this trend to continue both globally and in African cities. It is interesting to note that during the 2005 to 2014 period the Other group had only a marginal share of KFDI dollars and frequency. The Other group makes up the remaining 10 knowledge-based industries and while it does hold a meaningful portion of the total KFDI dollars globally, annual frequency is declining in both groups. Further investigation into the other subsectors would be necessary to understand the stagnation.

4.1.4 City Level Inferential Analysis

In the following section, the results of the city level panel models will be discussed. Below in Summary Table 3 and 4 are the dependent and significant independent variables along with their corresponding number of observations, mean, standard deviation, minimum, and maximum.

Summary Table 3. African City KFDI Dollars Model

	N	Mean	SD	Min	Max
KFDI Dollars (Log)	64	5.2	.90	3.6	7.2
Secondary Edu (Log)	64	7.5	.69	6.6	8.9
Tax Surplus (Log)	64	7.2	.83	5.2	8.5
Incubator Dummy	64	.42	.50	0	1

Source: Author, 2016. Calculated using Stata.

Summary Table 4. Non-African City KDFI Dollars Model

	N	Mean	SD	Min	Max
KFDI Dollars (Log)	500	6.3	1.0	1.8	9.1
Lagged Year KFDI (Log)	500	6.3	1.0	1.8	9.1
Employment Rate (Log)	500	4.2	.16	3.5	4.6
GDP Growth	500	4.0	4.8	-12.5	23.3

Source: Author, 2016. Calculated with Stata.

Below in Results Table 3 are the significant indicators for KFDI Dollars at the African City level. For the KFDI Dollars model, Secondary Education, Tax Surplus, and the Technology Incubator Dummy are significant. Secondary Education and Technology Incubators having a positive relationship with KFDI while the Tax Surplus has a negative relationship. A positive relationship between Human Capital and KFDI supports the theories and report's hypothesis that higher Human Capital will attract more investments. Similarly, the Technology Incubator dummy variable was used to help proxy the Innovation and Business Environment of the city and the hypothesized positive relationship was found. The dummy variable was constructed from a World Bank database and measured if an incubator existed or not in the city. A technology incubator can act similar to a science park in the West. These locations bring talented workers and entrepreneurs

Results Table 3. African City KFDI Dollars Model

	KFDI Dollars (Log)
Secondary Edu (Log)	3.392*
	(1.072)
Tax Surplus (Log)	-0.367*
	(0.132)
Incubator Dummy	0.698*
	(0.232)
Constant	-17.68
	(7.828)
Observations	64
R^2	0.365
Adjusted R^2	0.333

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

together. The presence of entrepreneurs and investors is needed for the knowledge-based economy and tech start-ups. Also, serendipitous encounters can occur when innovators from different sectors come together.

Although the relationship is negative between Tax Surplus and KFDI the findings were hypothesized correctly. The variable was constructed to proxy Good Governance by using the understanding that a city's GDP = GVA + Tax – Subsides. Consequently, the difference between GDP (Gross Domestic Product) and GVA (Goods Value Added) would be the balance of government taxes minus government subsidies. A negative relationship was expected between Tax Surplus and KFDI based on the theories that higher taxes would drive off KFDI. Also, a low Tax Surplus might indicate that the government is attempting to promote a more competitive local economy by subsidizing local firms.

Listed in Results Table 4 are the significant indicators from the analysis of KFDI into the Non-African City group. The KFDI Dollars model had three highly significant and positive determinants: Lagged Year KFDI, Employment Rate, and GDP Growth. The power and agglomeration theories state that as something occurs the chances of it occurring again increases. At the city level, economic development and concentration of business should lead to further growth. The positive relationship between these three independent indicators and KFDI support these theories. The three significant indicators are considered to be a part of the Innovation and Business Environment Pillar and it gives strong evidence in support of the hypothesis that a strong Innovation and Business Environment will attract KFDI.

Results Table 4. Non-African City KFDI Dollars Model

	KFDI Dollars (Log)
Lagged Year KFDI (Log)	0.293***
	(0.037)
Employment Rate (Log)	1.714*
	(0.84)
GDP Growth	0.023*
	(0.01)
K-Economy Employment	0.033
	(0.02)
Constant	-4.199
	(3.643)
Observations	500
R^2	0.130
Adjusted R^2	0.123

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

To begin comparing the results of the African and non-African city models, a simplified table was created. Below, Comparison Table 2 illustrates the relationship the significant variables have with KFDI. Found in the Annex, there was a

significant and positive correlation between Tertiary Education and KFDI Count in the Non-African City analysis. The positive correlation between education and KFDI in both models supports the theory that higher Human Capital will attract more KFDI. The difference in the education level of the indicator highlights the groups' different stages of development. From the results, it seems that for African cities looking to attract KFDI it is more important to bring up the education levels of the greater population with secondary education compared to focusing on higher levels of education for a smaller segment of society. Better education and training of the whole population will create a more productive economy and create better paying jobs. Eventually, it would be expected that by upgrading secondary education there would be positive effects on tertiary education as well. For the non-African City group an acceptable level of secondary education attainment has already been achieved. Once that base education level is prevalent throughout the population, focusing on tertiary levels can be a further determinant for KFDI.

Comparison Table 2. African Cities vs. Non-African City Significant Indicators

		Good Governance	Innovation and Business Environment				Human Capital
		Tax Surplus	Incubator	Lagged KFDI	GDP Growth	Employment Rate	Secondary Education
KFDI Dollars	Africa	-*	+*				+*
	Non-Africa			+***	+*	+*	

Source: Author, 2016. Model analysis

Another similarity found between the African and non-African City groups was the very strong and positive relationship between the Innovation and Business Environment Pillar and KFDI. The positive relationship was found for both KFDI Dollars and Count (see Annex for complete KFDI Count model). For the African City Model, the Innovation Incubator dummy variable was found positive for KFDI Dollars variable. For the non-African City group, a prosperous economy is a strong determinant of KFDI Dollars. Employment rate and GDP growth levels are more of a litmus test of the overall local economy compared to the other determinants. It is very important for these non-African cities to continue to be competitive. If there is stagnation in the local economy or current year KFDI decreases, the future of knowledge-based industries would be in jeopardy. In contrast, the African cities analyzed, a strong local economy should does not seem to be a factor to attracts KFDI. These seven African cities are attracting KFDI outside of purely economic prosperity. This is an interesting difference between the two groups and may be explained by the size of the knowledge-based economy. The non-African city group is in a much higher level of development, both in overall economic activity and in the knowledge-based economy. While, in the African city group the knowledge-based economies are still in their infancy. For the non-African cities, the current knowledge-based industries may be much more intertwined in the local economy, so a downturn could have a damaging ripple effect and a boom could greatly benefit the knowledge-based industries. Conversely, the small knowledge-based industries in the African cities may not have strong connections to other local industries, thus being insulated from fluctuations in the overall economy.

4.1.5 Lesson Learned

Between the three sub-questions, the first one was by far the most intensive. The preparation compiling the databases into Excel and the assumption testing in Stata for this question was the groundwork for the following questions. It also makes good progress towards answering the main question of the thesis. The next two sub-questions look at specific angles of the main question, while this sub-question results in broad answers. Furthermore, the objective was to benchmark African locations with the top areas globally to set the stage for policy recommendations. If Africa is going to compete worldwide in the knowledge economy, it is important to understand the determinants of KFDI globally. The country and city level analysis allowed for different scopes and indicators to be analyzed which will be important for policy recommendation as well.

4.2.1 Do geographical regions influence KFDI in Africa?

After addressing the question surrounding the differences globally, this sub-question investigates differences in KFDI determinants at a regional level in Africa. Promoting cooperation between African countries, especially bordering countries, has been an initiative of the global development community because of the many benefits it offers including trade and transportation. Understanding differences within Africa's regions may help explain the results of the larger regression models as well.

Traditional regional differences exist in part because of geographic location. The position a country has in the international trade routes can give rise to a big competitive advantage especially in terms of international trade. In Africa, the coastline and port cities are very advantageous because trade flows into the continent from the oceans. Through the port cities, African countries become connected and a working link in the global network of trade. Traditional connectivity and trade has always relied on hard infrastructure and although still a cornerstone for trade, modern day connectivity has been forever changed by the internet. As certain aspects of trade begin to be digitalized, access to computers and strong internet connections are becoming more instrumental. The bandwidth at which a country and city can connect and operate at in the global digital network is a fundamental element for some industries in the knowledge-based economy. Since the role in which locations play in the global digital network is not solely influenced by its physical location, regional differences in the traditional sense may not exist for KFDI inflows into Africa.

Endowments of a location influence its position in networks. In conventional thought, this pertains to the natural resources a country has within its borders. A country with large reserves of vital materials, such as oil or iron ore, can position itself strategically in the global network. For the knowledge-based economy, human capital and innovative minds are the oil and ore. Industries that use ICT, human creativeness, and digital resources can link even the most remote locations to the modern, global network. This idea leads the author to hypothesize that there will not be a large difference in determinants for regions in Africa. The proximity to markets across the Atlantic and Pacific Ocean is not as advantageous for the knowledge-based economies along the coasts, thus not a strong determinant for KFDI. The human capital and innovative levels observed in the knowledge economies hubs span across regional lines and is not determinant based upon the physical location.

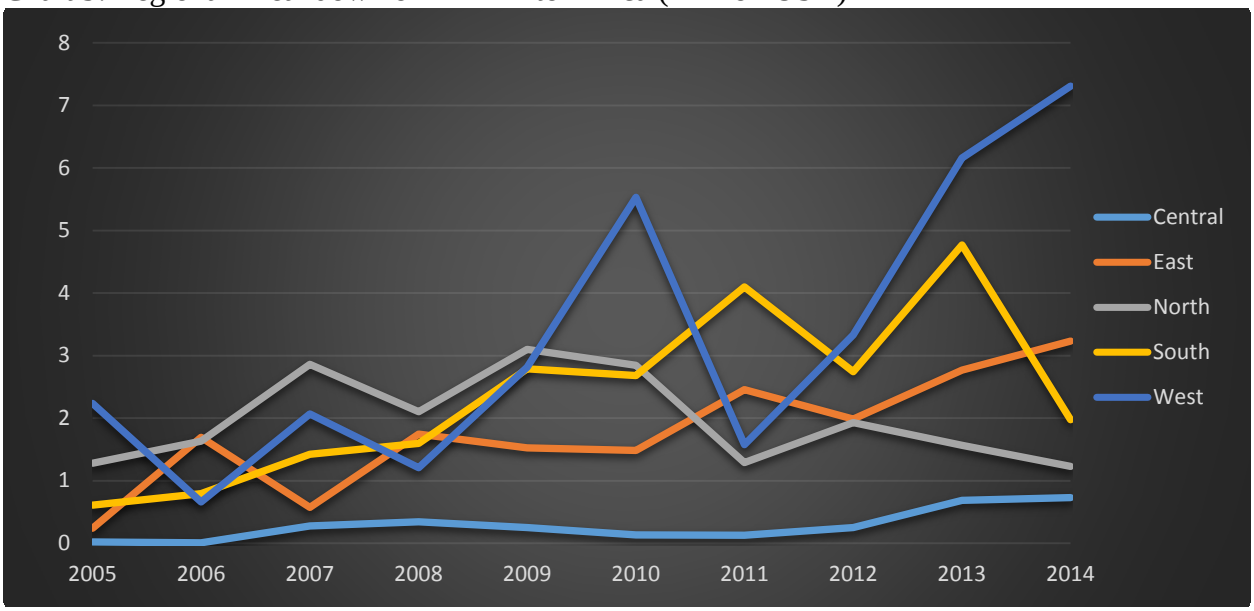
Similar to the sector breakdown that will be addressed in the third sub-question, investigating the determinants of KFDI from different angles will facilitate policy recommendations and advance this field of research. There will be a descriptive analysis of the annual trends of KFDI into North, South, East, West, and Central Africa and then a section will address the results from regression models that used dummy variables for the regions of Africa.

4.2.2 Breakdown of KFDI at the Regional Level

Below in Chart 9 is the annual KFDI dollar amounts into each region. In terms of annual dollars, South and East Africa steadily grew from 2005 to 2013, while West Africa had received

some very large investments in 2010, 2013, and 2014. North Africa led in KFDI Dollars for several years in the beginning of the period, but stagnated and began to decline in 2009. In 2014, North Africa received less KFDI than at the beginning of the analysis. However, this was an anomaly, West and South Africa increased their KFDI dollars by more than threefold from 2005 to 2014 and East Africa's 2014 KFDI was more than 13 times the 2005 amount. Although never receiving more than one million USD in a year, inflows into Central Africa also increased over the time period and was relatively close to the amount that North Africa received in 2014.

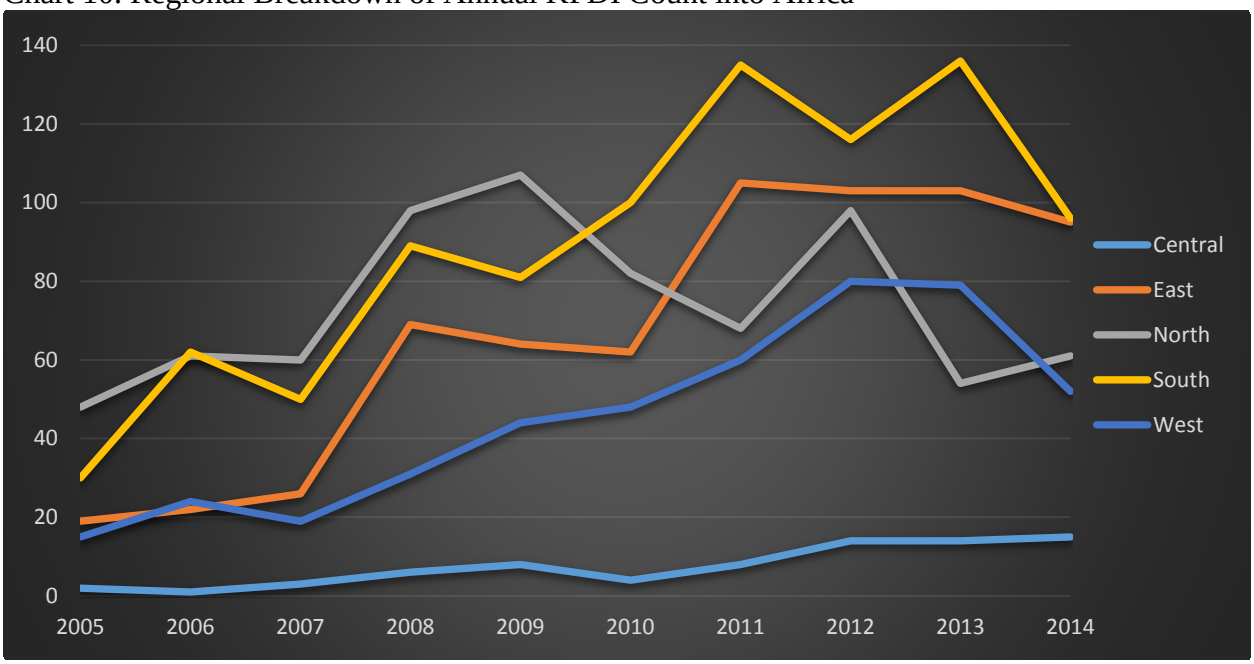
Chart 9. Regional Breakdown of KFDI into Africa (Million USD)



Source: Author, 2016. Bases on fDi Markets

Chart 10 further illustrates the trends in KFDI into different regions of Africa. The chart follows the total amount of greenfield investments per year into the knowledge-based economy of each African region. There is an overall trend of growth from 2005 until a noticeable decline in 2014. Similar trends of growth seen in Chart 9 are observed in Chart 10 for South, East, North, and Central Africa, but there is a divergent in the trend for West Africa. Although the region was receiving a much greater amount of investment dollars, it was well below other regions in the annual frequency of investments. Also, in the 2014 dip in investments West Africa had the highest amount of dollars for any region in any year. The large spikes that are seen in the annual KFDI dollar amounts that West Africa receives and the lower frequency of investments suggestions that larger projects may be more attracted to West Africa. Subsectors, like Communication, that require large investments in machinery and equipment could be the type of KFDI that is flowing into West Africa. All regions ended with an increase from 2005 to 2014 and Central, West, East, and South at least tripled their 2005 levels.

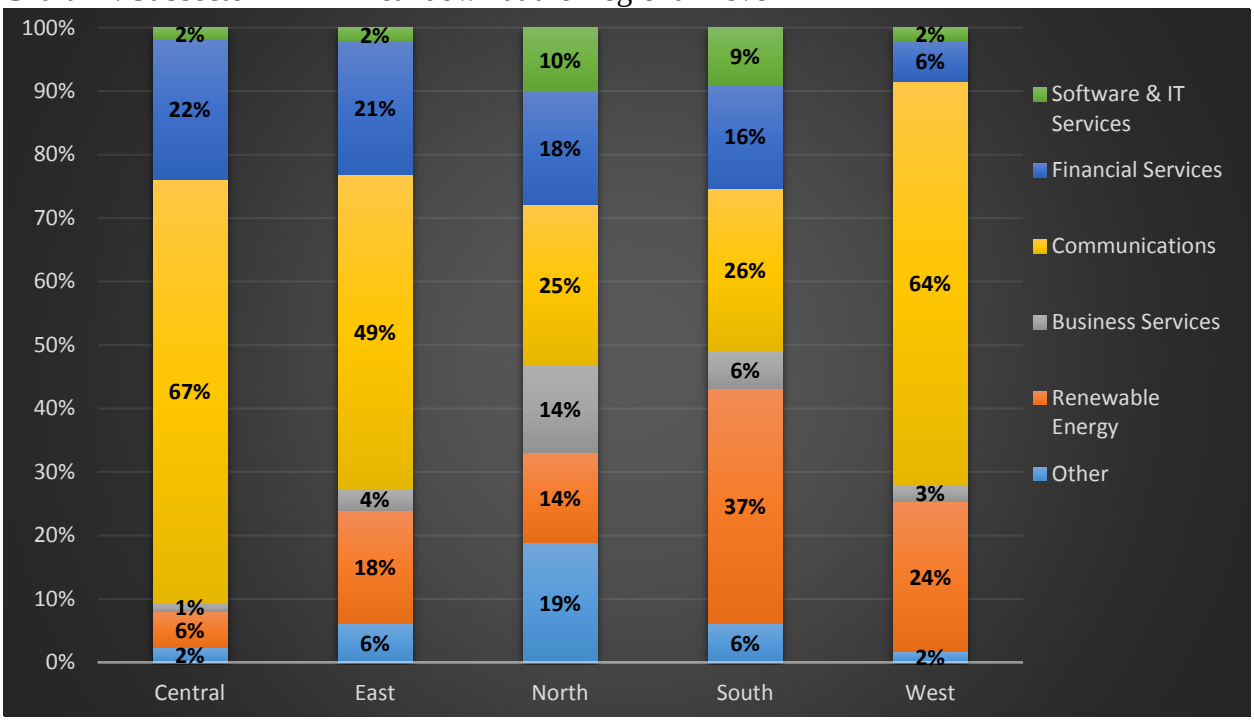
Chart 10. Regional Breakdown of Annual KFDI Count into Africa



Source: Author, 2016. Bases on fDi Markets

To further investigate regional differences, Chart 11 illustrates the regions' historical proportions of KFDI into subsectors of the knowledge-based economy. From the results of answering the first sub-question, the top five subsectors of the knowledge-based economy in Africa (Software & IT Services, Financial Services, Communications, Business Services, Renewable Energy) have been highlighted along with the Other group that includes the other industries of the knowledge-based economy. The totals have been aggregated from 2005 to 2014. As seen in the analysis of the overall KFDI inflows into Africa, the Communication sector receives the most KFDI in all regions except for South Africa. In Central, East, and West Africa the huge portion of KFDI into the Communication sector can be observed. The disproportional amount of KFDI into the Communication sector could be caused by several factors. Especially in West and East Africa, there is a growing population that has disposable income which creates a market for firms in the Communication sector. Also, there may be a market for private projects in lieu of government departments not being capable of supplying public communication infrastructure. In North and South Africa there are more developed countries which could limit the potential for KFDI into infrastructure projects. In South Africa, Renewable Energy received the most KFDI, possibly highlighting a higher stage of development. Of all regions, the North had the most evenly proportional distribution of KFDI including 10 percent in Software & IT Services, 14 percent in Business Services, and 19 percent in the Other category. From the results of KFDI into non-African countries and cities it was clear that the locations that are more developed have a more even distribution of KFDI. This idea may stand true for regions in Africa. Sub-Saharan Africa (SSA) is home to some Least Developed Countries and in corresponding regions there is a lack of diversity in the KFDI breakdown. Furthermore, in SSA there are several countries that are in higher stages of development in Southern Africa and Southern Africa has the most diverse KFDI breakdown in SSA.

Chart 11. Subsector KFDI Breakdown at the Regional Level



Source: Author, 2016. Bases on fDi Markets

4.2.3 Regional Determinants of KFDI

Country level models were used to investigate if geographical locations were determinants for KFDI. Although the city level models had a city in every region, in most regions there was only one city. One city is not not a good representation of the whole region. At the country level though all the countries that received KFDI between 2006 and 2014 would be included giving a much better representation. Referring back to the first sub-question, Results Table 1 is the overall model for African Countries. In the determinants for KFDI Count it can be observed that Northern Africa has a significantly positive correlation. When the top subsectors were broken down to address the third sub-question it was found that the geographical characteristic of North Africa is significantly positive with KFDI Dollars into the Software & IT Services, see Results Table 8 below. Although different measures of KFDI, these results highlight an advantage that Northern Africa has over SSA. According to these results, hold all other factors constant, attracting greenfield investments into the knowledge-based economy is easier for North African countries and investments into the Software & IT Services sector will be greater in North Africa. The proximity to European and Middle Eastern investors may be the reason for the significance. For those investors, they may believe that they have more control and protection over their investment if they are closer to it compared to investing in SSA. The proximity may also allow for investments into North Africa to expand into European and the Middle Eastern markets.

The fact that these two models are the only ones with a significant variable for geographical location is in itself a significant finding. As SSA countries begin to compete against each other for

KFDI it is beneficial that geographically there is not an advantage observed. Also, findings from other studies suggestion that SSA location is negatively correlated to investments. This study would dispute those claims. Although North Africa was positively correlated to KFDI, there was not a negative relationship between any of the SSA regions and KFDI. However, there is room for improvement and opportunity. As the knowledge-base economy expands in Africa the opportunity to create a global brand will arise. Fostering a positive reputation and a branding strategy such as "Silicon Savanah" may be the type of regional difference that will create a geographical advantage over the other regions. In conclusion, there is a slight advantage for North African countries to attract KFDI when compared to Sub-Saharan Africa. The positive relationship is greater for the Software & IT Service subsector. Nevertheless, there are no negative relationships for any of the regions in Africa. This fact highlights that physical location only slightly matters when attracting KFDI in Africa.

Results Table 1. African Country KFDI Count Model

	KFDI Count
Technological Readiness (Log)	3.746***
	(0.489)
Innovation (Log)	1.782**
	(0.583)
Northern Africa	1.335*
	(0.581)
Southern Africa	0.373
	(0.561)
Western Africa	1.162
	(0.638)
Eastern Africa	0.767
	(0.558)
Central Africa	-
	-
Constant	-4.885***
	(0.787)
Observations	231
R^2	

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Result Table 7. African Country KFDI Dollars Model, Software & IT Services KFDI

	KFDI Dollars (Log)
Financial Market (Log)	4.738***
	(0.841)
Infrastructure (Log)	
Northern Africa	1.948***
	(0.358)
Southern Africa	0.734
	(0.388)
Western Africa	0.661
	(0.356)
Eastern Africa	-
	-
Central Africa	-
	-
Constant	-4.572***
	(1.235)
Observations	91
R^2	0.49

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculate using Stata.

4.2.4 Lessons Learned

Answering this sub-question allowed for another angle to be researched in the investigation of determinants of KFDI. It may not be overly surprising that there was only a slight significance between geographical location and KFDI. The author hypothesized that there would not be any significance because of the nature of the knowledge-based economy. Other industries rely on local natural advantages, however, there is less of an importance on geographical features for knowledge-based industries. It was interesting to find that North Africa has a positive relationship to KFDI. The proximity northern countries have with Europe and the Middle East may example this significance. A future analysis that includes other geographical characteristics such as coastal cities may contribute to these findings.

4.3 Are there determinant differences between subsectors in the knowledge-based economy?

4.3.1 Subsector Comparison Preparation

In the response to the first sub-question of this report it was found that there are significant relationships between African country and city level indicators and KFDI. At the country level, the significant determinants for KFDI Dollars were the Institutions, Market Efficiency, and Financial Market. The analysis was conducted using the aggregated annual KFDI dollar and frequency amounts of the 15 industries that are considered to be in the knowledge-based economy. Since there are multiple industries within the knowledge-based economy there was an investigation at the sector level to see if there were changes in significant determinants. Another objective of the investigation was to be able to explain any unexpected results of the overall analysis. Specifically, the negative relationship that the Institutions variable has with KFDI. Traditionally, good governance and policies that support innovation, such as intellectual property rights, attract KFDI. This theory was supported by a highly significant and positive relationship between Institutions and KFDI Dollars in the non-African Country model. Breaking down the analysis to the sector level is an important angle to answer the main question of this report.

4.3.2. Country Level Subsector Results

In the following four tables are the results of the panel analysis for the four biggest industries in the knowledge-based economy: Business Service, Financial Service, Software & IT Services, and Communication sector. Although there are eleven other industries in the knowledge-based these four sectors were the only ones that had enough data points during 2006-2014 to analyze. The Software & IT sector had the least amount of observation at 91, but still substantial enough to run panel data regressions.

There are several similarities and differences between the results of the overall knowledge-based economy analysis and the subsectors. Similar to the overall KFDI model, the Market Efficiency variable is a significant determinant for KFDI Dollars into the Business Service and Financial Services sectors. Differing from the overall model, the Infrastructure variable has a positive relationship with KFDI into the Software & IT sector. This is the only subsector that had a correlation to Infrastructure. As one of the hypothesized pillars to attract KFDI, Infrastructure was expected to have a stronger correlation with investments than the results of the analysis. The Infrastructure variable was constructed with both hard and digital infrastructure, such as quality of roads and broadband subscribers respectively. Infrastructure is critical for ideas, goods, and people to move through a country and city. By upgrading systems FDI would be expected to increase, especially KFDI which is reliant on quality internet and telecommunication. However, the positive relationship to attract KFDI into the Software & IT Services sector supports this hypothesis and further investigation should be conducted to see if separating the two types of infrastructure results in more specific determinants.

Results Table 5. African Country KFDI Dollar Model, Business Service Subsector

	KFDI Dollars (Log)
Market Efficiency (Log)	4.576*
	(2.130)
Tech Readiness (Log)	3.320**
	(1.124)
Financial Market (Log)	3.021
	(2.233)
Constant	-11.13*
	(4.776)
Observations	118
R^2	0.230
Adjusted R^2	0.210

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata

Result Table 6. African Country KFDI Dollar Model, Financial Service Subsector

	KFDI Dollars (Log)
Market Efficiency (Log)	4.651***
	(1.195)
Financial Market (Log)	0.975
	(0.872)
Constant	-4.179*
	(1.979)
Observations	181
R^2	0.097
Adjusted R^2	0.087

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Continuing the comparisons, in Result Table 7 and 8 the Financial Market variable is significant for KFDI into the Software & IT Services and Communication sectors, but the relationships are opposite. There is a very strong and positive relationship between the Financial Market variable and Software & IT Services, but a weak and negative correlation with the Communication sector. The Financial Market is constructed with indicators for the availability of financing resources for companies. Especially important for the start-up companies in the technology fields, banks and venture capitalist play a crucial role in the knowledge-based economy. It is theorized that as banks and venture capitalist begin to invest and make capital more available for companies, KFDI is attracted because of the confidence that is being displayed by these stakeholders. As KFDI is attracted the process reinforces itself and financial resources become even more available for firms. The positive relationship between the Financial Market variable and KFDI supports this theory and disproves the theory that there is a "crowding out" effect.

However, for KFDI into the Communication sector there is a negative relationship with the Financial Market variable. There is also a very strong and negative correlation between KFDI into the Communication sector and Institutions. Both of these correlations are unexpected and against theories and other findings from this study. An important element to the investigation of the expected results is that Communication is the leading sector in annual KFDI Dollars. This heavy influence over the knowledge-based economy as a whole could be the reason that there was a negative relationship between Institutions and KFDI in the overall model. The author has two explanations for why there would be a negative correlation between Institutions and KFDI. First, the Institution variable is a proxy for Good Governance. A role of the government is to provide certain services throughout the country, including telecommunication. However, if there is an ineffective government that is not fulfilling its duties of supplying such necessities either through ill intentions or the lack of resources a profitable market is available to private businesses. If this was the case, the more ineffective the government, the less public communication infrastructure

being built and greater opportunities for KFDI. The second situation in which the author sees a negative relationship between Institutions and KFDI into the Communication sector is in the case of corruption. Similar to investments into the Extraction sector, the Communication sector may require a large investment into machinery and property. A corrupt political system might attract such an investment because with a small payoff of a politician production may run much smoother, cutting down the risk of losing the initial investment. Additional investigation must be conducted before such claims are considered true, but to add a stylized example, the country of Nigeria received multiple very substantial investments into the Communication sector during the 2006-2014 period. However, Nigeria is notorious for a corrupt political system and ranks very low in the African Country group in Institutions. Research to determine if Nigeria is the rule or exception will be necessary to resolve the unexpected relationship between KFDI into Communication and Institutions.

Result Table 7. African Country KFDI Dollars Model, Software & IT Subsector

	KFDI Dollars (Log)
Financial Market (Log)	4.738***
	(0.841)
Northern Africa	1.948***
	(0.358)
Southern Africa	0.734
	(0.388)
Western Africa	0.661
	(0.356)
Eastern Africa	-
	-
Central Africa	-
	-
Constant	-4.572***
	(1.235)
Observations	91
R^2	0.49

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculate using Stata.

Results Table 8. African Country KFDI Dollars Model, Communication Subsector

	KFDI Dollars (Log)
Institutions (Log)	-8.505***
	(2.260)
Financial Market (Log)	-4.341*
	(1.936)
Market Efficiency (Log)	3.800
	(3.537)
Tertiary Edu (Log)	1.545
	(1.912)
Tech Readiness (Log)	2.732
	(1.938)
Northern Africa	1.216
	(1.308)
Southern Africa	0.382
	(1.212)
Western Africa	0.395
	(1.177)
Eastern Africa	0.710
	(1.192)
Central Africa	-
	-
Constant	2.213
	(2.809)
Observations	138
R^2	.216

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata

4.3.3 City Level Subsector Results

The objective of modeling the subsectors of the knowledge-based economy is to further investigate the results of the overall model. Since the economy is greater than one or two industries, the analysis may result in determinants that are observed in the overall model, but better describe an individual sector rather than the whole economy. This was found to be the case in the country level model when the Institutions variable was found to have a negative relationship with overall KFDI, the same correlation being found only in the Communication sector model during the subsector analysis. To reiterate the findings from the African City model, Secondary Education and Technological Incubators were positive significant determinants of KFDI Dollars. The Tax Surplus was significant determinants of KFDI as well, but with an expected negative relationship.

In the Business Service model PC Possession and Technological Incubators are positively related to KFDI Dollars. In the Financial Service model, Broadband Access was positively related to KFDI Dollars. Results Table 11 highlights the results from the model for KFDI determinants of the Software & IT Services subsector. In this table, Internet Access, and the GVA (Gross Value Added) of the knowledge-based economy are positive determinants. For the Communication sector, Mobile Telephone Users and Technological Incubators were positive determinants of KFDI. Seen from the overall knowledge-based economy KFDI models and the subsector analysis, the innovative incubators in Africa have had a very positive effect on attracting KFDI. The incubators add a central location for innovators and entrepreneur (local and foreign) to come together. Business can be conducted in some of the incubators, there is an education element to incubators too. Formal classes can locate at tech incubators and the informal mentoring that happens in the tech communities can occur at incubators as well. The technological incubator dummy variable was used to proxy the Innovative and Business Environment Pillar at the city level.

Results Table 9. African City KFDI Dollars Model, Business Service Subsector

	KFDI Dollars (Log)
PC Possession (Log)	0.366*
	(0.181)
Tech Incubator	0.476*
	(0.197)
Constant	1.747**
	(0.613)
N	63
R^2	0.132

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Results Table 10. African City KFDI Dollars Model, Financial Services Subsector

	KFDI Dollar (Log)
Employment Rate (Log)	0.908
	(1.314)
Broadband Access (Log)	0.203**
	(0.071)
Constant	-0.312
	(5.078)
N	54
R^2	0.148

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Result Table 11. African City KFDI Dollars Model, Software & IT Service Subsector

	KFDI Dollars (Log)
Internet Access (Log)	0.315*
	(0.153)
K-Economy GVA (Log)	0.409*
	(0.161)
Secondary Edu (Log)	-0.173
	(0.199)
Constant	0.069
	(1.433)
N	66
R^2	0.24

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Results Table 12. African City KFDI Dollars Model, Communication Subsector

	KFDI Dollars (Log)
Mobile Telephone Users (Log)	1.895*
	(0.873)
Tech Incubator (Log)	1.249**
	(0.453)
K-Economy GVA (Log)	-0.065
	(0.223)
Constant	-4.595
	(3.912)
N	50
R^2	0.313

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Sourced: Author, 2016. Calculated with Stata

Another similarity in the determinants of KFDI is the positive relationship the GVA of the knowledge-based economy has on attracting KFDI. Although the variable has not been found significant in any other model it is a measure of the Innovative and Business Environment Pillar as well. The GVA (Goods Value Added) is the amount an industry adds to the local GDP. There may be a slight reverse causality between GVA and KFDI since greenfield investments are being analyzed, but according to theory a competitive city will attract investments resulting in an even more competitive city. A reinforcing effect that supports the results that the growth of the knowledge-based economy will attract KFDI.

In support of theories, the hypothesis of this report, and finding from the KFDI Count model (see Annex), all four subsector models found a positive relationship between digital infrastructure and KFDI. This can be seen in the Business Services with the positive relationship between KFDI Dollars and PC Possession; in Financial Services with Broadband Access; in Software & IT Services with Internet Access; and in Communication Sector and Mobile Telephone Users. As computers, high speed internet, and mobile phones become more widely used, so does the market for knowledge-based industries. The availability of digital infrastructure allows for new firms to be founded as well.

4.3.4 Lessons Learned

Through the process of answering this sub-question the influence of subsectors over the overall KFDI model was interesting to observe. There were similarities, which would be expected, but also contradictions and possible answers to unexpected results from the overall model. Understanding the reason for Institutions being negatively related with KFDI because of the Communication sector provides a plausible explanation that not all KFDI is attracted by lower Institutional rankings. Subsector analysis illustrates this as well. At the city level, subsector analysis resulted in very specific determinants that can really benefit a policy recommendation.

Chapter 5 Conclusions and Recommendations

5.1 Summary of Analysis

In recap, the objective of this report was to investigate the urban determinants of greenfield foreign direct into the knowledge-based economies (KFDI) in Africa. To gain a better understanding the analysis was completed at the country and city level. It was hypothesized that Human Capital, Infrastructure, Good Governance, and Innovative and Business Environment would be determinants, so variables were selected to proxy these pillars. The four pillars were in line with theories from many organizations and academics including: Asiedu, 2006; Aubert, 2005; Drogendijk & Blomkvist, 2013; Gani & Sharma, 2003; Mottaleb & Kalirajan, 2010; Ndikumana & Verick, 2008; The World Bank, 2012; UNCTAD, 2011, 2014. The report's core question was: to what extend, do location factors influence foreign direct investment into the knowledge-based industries in Africa? Three sub-questions were also addressed for a comprehensive approach to the core questions, those questions were:

- To what extent do African countries and cities attract KFDI differently than non-African locations?
- Do geographical regions influence KFDI in Africa?
- Are there determinant differences between subsectors in the knowledge-based economy?

In answering the first question, several significant determinants were found. The findings are summarized in the below tables, illustrating the relationship and level of significance. All the variables listed approximate one of the pillars hypothesized to attract KFDI. Several variables have a relationship that is opposite of what the report hypothesized, however, in Chapter 4 there is an interpretation and discussion of the reasons for conflicting finding. Some differences in determinants were expected because of the nature of the two locations. The knowledge-based

Comparison Table 1. African Countries vs. Non-African Countries Significant Indicators

		Good Governance	Innovation and Business Environment		
		Institutions	Market Efficiency	Technology Readiness	Financial Market
KFDI Dollars	Africa	-***	+***		+***
	Non-Africa	+***	-***	-***	

Source: Author, 2016. Model analysis

Comparison Table 2. African Cities vs. Non-African City Significant Indicators

		Good Governance	Innovation and Business Environment				Human Capital
		Tax Surplus	Incubator	Lagged KFDI	GDP Growth	Employment Rate	Secondary Education
KFDI Dollars	Africa	-*	+*				+*
	Non-Africa			+***	+*	+*	

industries in Africa are in their infancy while the Non-African locations chosen have long standing knowledge-based economies. As such, the type of KFDI flowing into these locations and the determinants of such investments would then be expected to be different as well. The purpose of analyzing non-African locations was to create a benchmark for future development in Africa. The significant variables found for Non-African counties and cities can be beneficial for long-term policy plans when African knowledge-based economies begin to mature.

There were some significant findings for the response to the second sub-question. North African countries was found to have a slight advantage over Sub-Saharan Africa (SSA) in attracting KFDI Count and a larger advantage in the Software & IT Services subsector. It was hypothesized that geographic location would only be marginally significance because of the nature of the knowledge-based economy compared to traditional tradable sectors. The advantage North African countries could be attributed to the proximity to Europe and the Middle East. The closer distances compared to SSA countries may give European and Middle Eastern investors a feeling of more control over their investments and firms in North Africa may have a higher potential to expand into the European and Middle Eastern Markets compared to SSA firms.

Lastly, the process of answering the third sub-question contributed greatly to understanding KFDI determinants in Africa. The core question was concerning the overarching knowledge-based economy, however, the third question was in terms of knowledge-based subsectors. The results allow for more specific, in-depth recommendations. Also, the findings assisted in interpreting the conflicting relationship Institutions has with KFDI in the overall model. The four largest subsectors were analyzed at country and city level with each model resulting in significant determinants for KFDI. The table below lists the significant determinants of each subsector and its relationship with KFDI.

Summary Table 5. Subsector Determinants from the KFDI Dollars Analysis

	Country Level Determinants	**City Level Determinants**
Business Services	Market Efficiency (+) Technological Readiness (+)	PC Possession (+) Technological Incubator (+)
Financial Services	Market Efficiency (+)	Broadband Access (+)
Software & IT Services	Financial Market (+) North Africa (+)	Internet Access (+) K-Economy GVA (+)
Communications	Institution (–) Financial Market (–)	Mobile Telephone Users (+) Technological Incubator (+)

Source: Author, 2016. Model analysis

5.2 Core question, to what extend, do location factors influence foreign direct investment into the knowledge-based industries in Africa?

In pursuit of answering the three sub-questions the core question has been systematically answered as well. The overall knowledge-based economy was addressed in the first question, geographical importance in the second, and subsector breakdown in the third. Country and city level was analyzed in all three questions too. Utilizing the most comprehensive databases of greenfield foreign direct investment and African data the report analyzed nearly thirty countries and the seven most monitored cities. Thus, the report is confident about its representation of the

overall population. For African countries it was found that Market Efficiency and Financial Market indices attracts KFDI Dollars. Institutions had a negative relationship, yet, the author believes this to be a product of the Communication subsector and not an accurate depiction of the overall knowledge-based economy. A follow up analysis without the Communication sector would help investigate this case.

For African cities it was found that Technological Incubators and Secondary Education attracted KFDI Dollars. A negative relationship was found for the Tax Subsidy variable, however, this was an expected outcome. Heavier tax regimes will create an unattractive environment for KFDI. In the subsector breakdown it was found that a variety of digital infrastructure attracts KFDI Dollars as well.

In the process of analyzing foreign direct investment into knowledge-based economies, a second variable was used to measure KFDI. That variable was KFDI Count. For the purposes of simplifying the report, all the statistical analysis results of KFDI Count were placed in the Annex. The results confirm that the Infrastructure and Human Capital Pillars can attract KFDI. Positive correlations were found between KFDI Count and Broadband Access and Innovation (see Annex for details).

In summary, the findings from this report agree with the hypothesis that Human Capital, Good Governance, Infrastructure, and Innovative and Business Environment are influential factors to attract investment into the knowledge-based industries in Africa. The hypothesis is inline with many theories and case studies discussed in Chapter 2. As an objective of this report is to make policy recommendations for African cities the indicators used were chosen because they related to the urban landscape. For that reason, even the findings from the country level can be applied to city policy. The following section will layout fitted line graphs of the significant variables with the African locations plotted. This method will highlight the locations that are underperforming and those that are excelling.

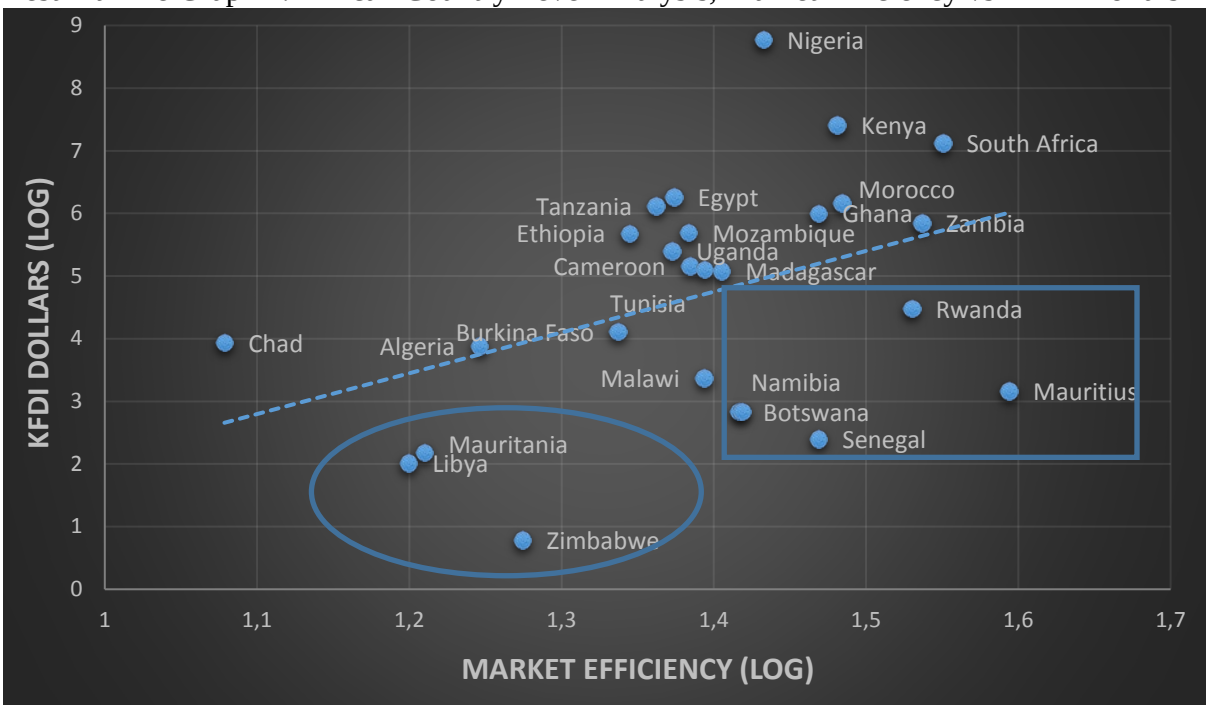
5.3 Country Best Fit Line Analysis

Only the variables that were hypothesized correctly will be investigated. There was one instance where the results of the analysis conflicted with the report's hypothesis, specifically the negative relationship that Institutions has with KFDI. The author believes that a reasonable explanation has been given in Chapter 4 for the conflict. However, since the findings are not supported by theories in Chapter 2 Institutions will not be used in the policy recommendation stage of this report. Best Fit Line graphs for the KFDI Count models can be found in the Annex.

The country level fitted line graphs will first be investigated. The determinants that have been graphed in a scatterplot with KFDI Dollars are Market Efficiency and Financial Market. The data points plotted is from the most recent year, 2014, and the 27 African countries involved in the study. In the graphs the circled countries are those that score low in the determinant variable and low in KFDI. For those countries, following the slope of the best fit line, increasing their level of the determinant may result in attracting a large amount of KFDI. Those that are boxed score relatively high in the determinant factor, but are receiving a low amount of KFDI. For these countries, there are factors that are restricting the benefits of the higher level of determinant. The

countries that lie above the best fit line are exceeding the level of expected KFDI for their corresponding determinant variable value.

Best Fit Line Graph 1. African Country Level Analysis, Market Efficiency vs KFDI Dollars



Source: Author, 2016. Bases on fDi Markets and WEF

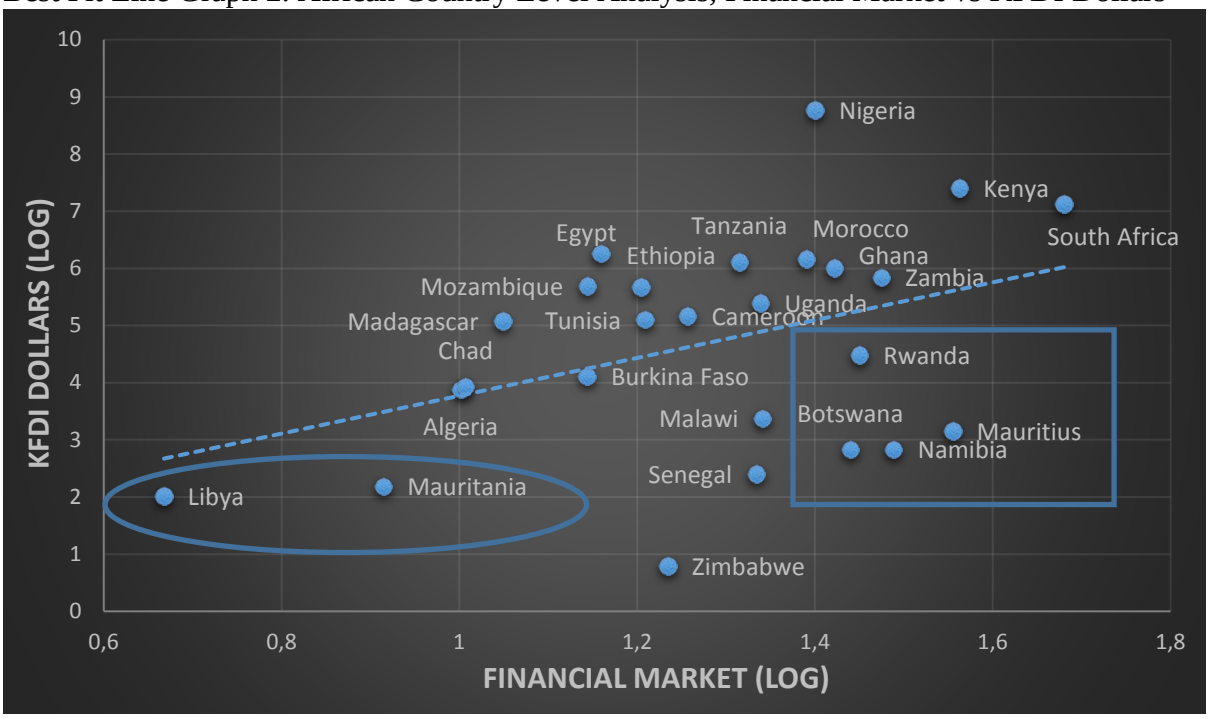
In the Best Fit Line Graph 1, the Market Efficiency variable has been plotted with KFDI Dollars. A positive relationship was found during the analysis and support for the correlation can be observed in the positive slope of the best fit line. Mauritania, Libya, and Zimbabwe have been circled because they rank low in both Market Efficiency and KFDI Dollars. These countries would be candidates for a policy to attract KFDI that includes increasing the indicators that are constructed to make the Market Efficiency variable. Addressing issues such as trade tariffs, barriers restricting business activity, and local economy competition would help increase their Market Efficiency score. Since they fall well below the best fit line, a large increase in KFDI could be expected from an increase in Market Efficiency.

Namibia, Botswana, Senegal, Rwanda, and Mauritius are highlighted because they rank quiet well in Market Efficiency, yet received below average KFDI Dollars. A policy to attract KFDI may be more successful for these countries if the restricting factors were addressed rather than focusing further on Market Efficiency indicators. Those above the best fit line may receive less than expected returns on increases in Market Efficiency and it is recommended that these countries focus efforts towards weaker determinants.

The analysis between Financial Market and KFDI Dollars can be seen below in Best Fit Line Graph 2. Libya and Mauritania are circled for their low scores in Financial Market and KFDI Dollars, while Botswana, Rwanda, Namibia, and Mauritius have been boxed because of their high Financial Market scores yet low KFDI. To attract KFDI, those that are circled should focus on

developing their financial markets, such as introducing financial services and making business loans more affordable. The boxed countries should identify the factors that are limiting the benefits of a good Financial Market score.

Best Fit Line Graph 2. African Country Level Analysis, Financial Market vs KFDI Dollars



Source: Author, 2016. Bases on fDi Markets and WEF

Comparing Best Fit Line Graph 1 and 2, similarities can be found in the countries that are circle, boxed, and those that are exceeding the expected value of KFDI. Although the analysis' aim was to identify opportunities for growth to attract KFDI, there was also a trend of certain countries being well over the best fit line. These countries were: South Africa, Kenya, Mozambique, Tanzania, Nigeria, Egypt and Morocco. The level of the determinant variables ranged, with some of the countries ranking in the bottom third while others consistently ranked very high. These seven countries are taking full advantage of their determinant levels and have other factors that are positively effecting how they attract KFDI.

5.4 City Level Best Fit Analysis

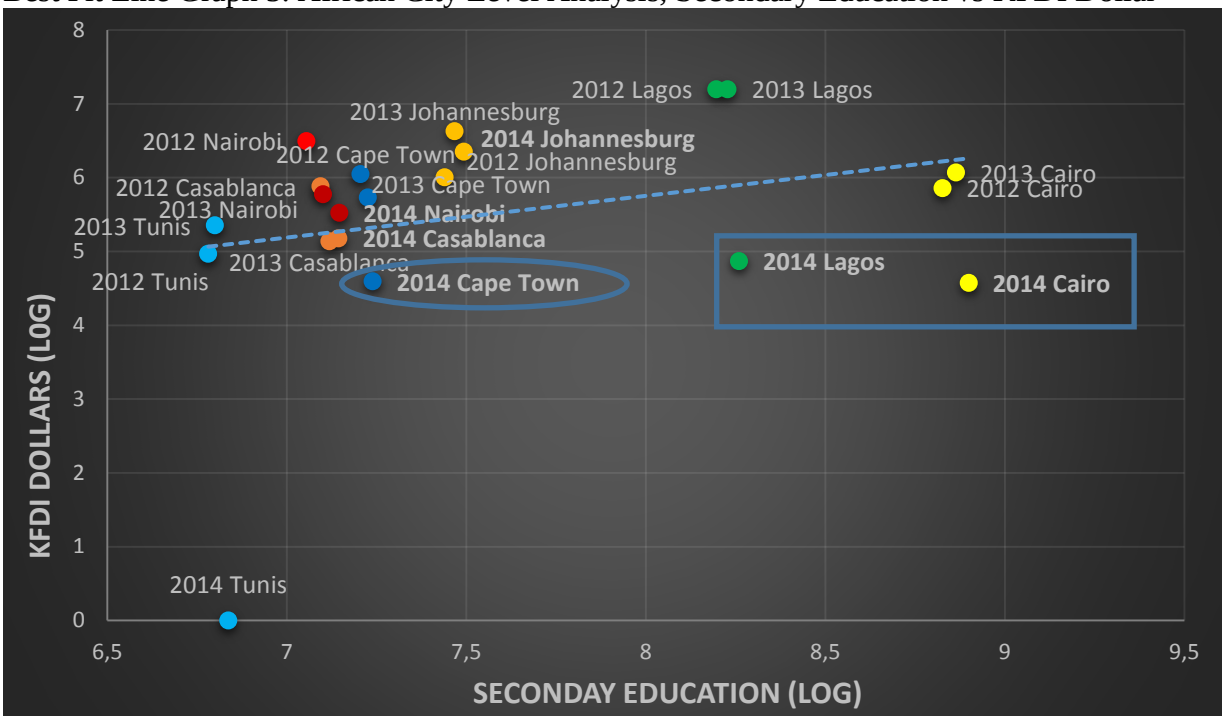
The following analysis will be done in the same manner, but utilizing the findings and data from the city level models. Although the Technology Incubator has a positive relationship with KFDI Dollars it is a dummy variable with only two values, 0 and 1. For this reason Technology Incubator will not be graphed. The city level model concerns only seven cities, so the 2012, 2013, and 2014 years have been plotted to better understand the relationship between the two variables and slope of the best fit line.

The first graph below illustrates the relationship between Secondary Education and KFDI Dollars. In 2014, Cape Town's KFDI drops below the best fit line and the city only has a mediocre level of Secondary Education. Additionally, since 2012 there has actually been a slight increase in

education in Cape Town, but a decrease in KFDI. A similar trend is observed for Lagos and Cairo. However, these two cities rank very high in Secondary Education. Relative to the other cities, Cape Town could still improve its Secondary Education and possibly follow the trend of the best fit line resulting in more KFDI. For Lagos and Cairo, there may be negative factors which are restricting the level of KFDI below the best fit line.

In 2014, Tunis did not receive any KFDI, but the 2012 and 2013 data points for Tunis suggest that it was following the trend of the best fit line. It can be observed that there was an overall positive trend for Secondary Education in every city. Also, from the results of Chapter 4 there was an overall decline in KFDI into Africa in 2014. This dip in overall KFDI is expected to be an exception and future KFDI will realign with the upward trend. Nevertheless, Tunis, Nairobi, Casablanca, Cape Town, and Johannesburg are well behind Lagos and Cairo in Secondary Education. Since there is a positive relationship between Secondary Education and KFDI, the five cities lagging behind should make a point of emphasis on education or Lagos and Cairo will establish a very valuable advantage for attracting KFDI into Africa.

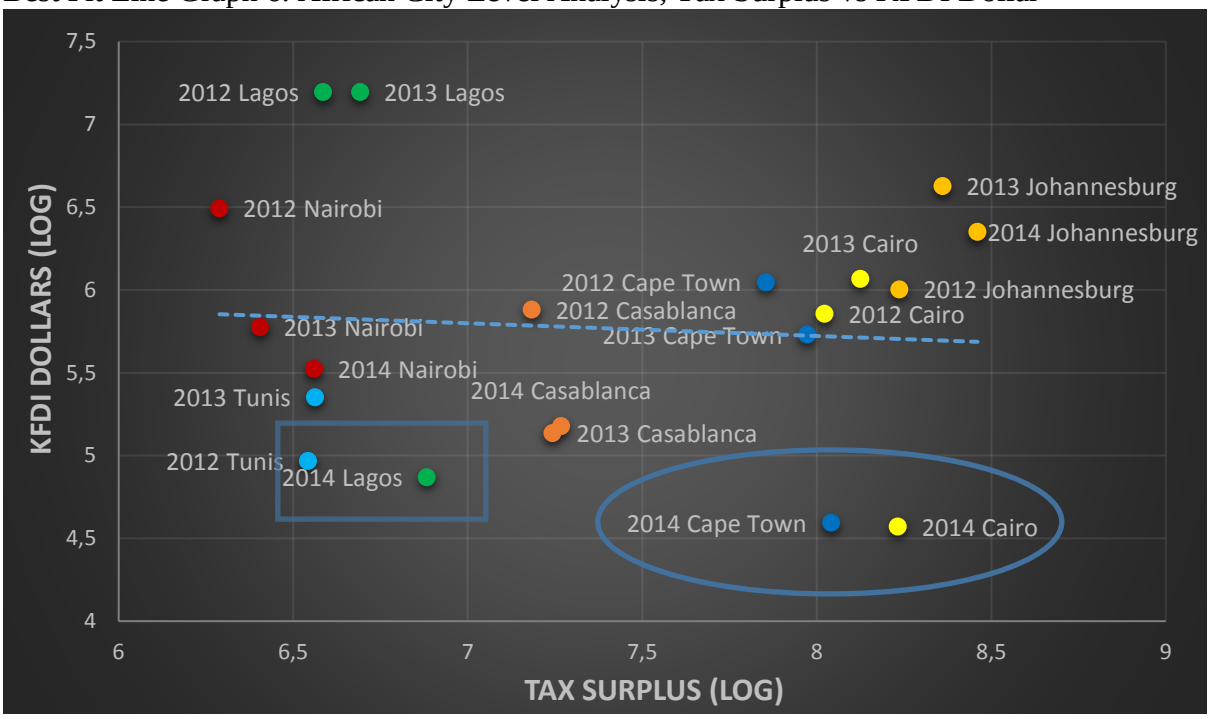
Best Fit Line Graph 5. African City Level Analysis, Secondary Education vs KFDI Dollar



Source: Author, 2016. Bases on fDi Markets and Euromonitor International

The next graph, Best Fit Line Graph 6, shows the negative relationship between the Tax Surplus variable and KFDI Dollars. As hypothesized, as Tax Surplus gets larger there will be a negative effect on KFDI. In 2014, Cape Town and Cairo had high levels of Tax Surplus and low levels of KFDI. An emphasis on restructuring government intervention through taxes and subsidies may drastically help to attract KFDI for these cities. Lagos is highlighted because there was an extreme drop from 2013 to 2014 in KFDI and an increase in Tax Surplus. Although this drop may be accounted for by the overall trend of less KFDI in 2014, due to the size of the drop a portion may be explained by the increase in the determinant.

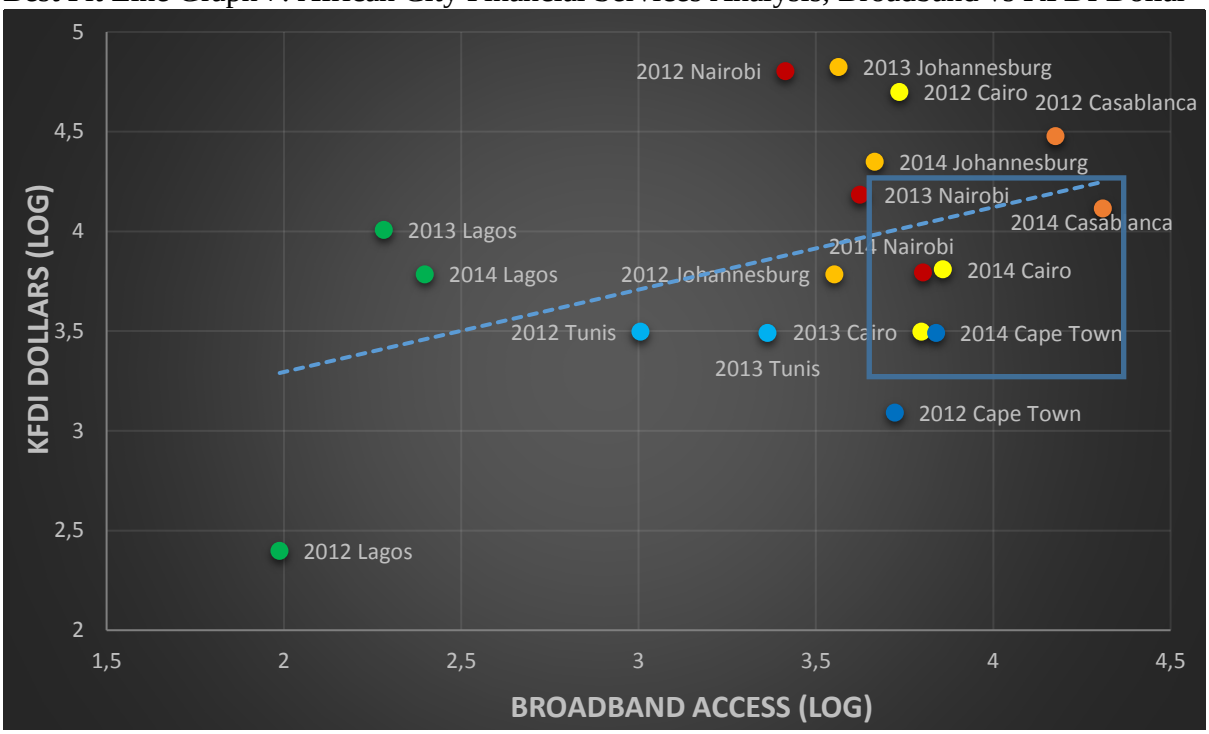
Best Fit Line Graph 6. African City Level Analysis, Tax Surplus vs KFDI Dollar



Source: Author, 2016. Bases on fDi Markets and Euromonitor International

In Best Fit Line Graph 7, the relationship between Broadband Access and KFDI Dollars into the Financial Service subsector can be observed. Previous graphs depicted overall investments into the knowledge-based economy, but the same method can be used for the subsectors of the knowledge-based economy. Broadband Access was chosen to be illustrated because it is a significant determinant for the Financial Service and Business Service subsectors. Internet Access is closely related to Broadband Access and is significantly related to KFDI into the Software & IT Service subsector as well. Highlighted in the graph above, in 2014 Nairobi, Cape Town, Cairo, and Casablanca's Financial Services subsector received below average KFDI for their level of Broadband Access. However, Cape Town, Cairo, and Johannesburg are trending positively with their increases in Broadband Access. Conversely, Nairobi and Casablanca are trending opposite of the best fit line though. This highlights the fact that factors exist that are restricting KFDI into the Financial Service sector. Additionally, while Lagos is trending positively, it is in need of increasing its level of Broadband Access more quickly. In 2013 and 2014, Lagos received higher than expected levels of KFDI into its Financial Service sector, yet it is well behind the other cities in this study. If this low level of Broadband Access continues it will be a detriment to future inflows into the Financial Service sector and most likely the Business Service and Software & IT Service sectors as well.

Best Fit Line Graph 7. African City Financial Services Analysis, Broadband vs KFDI Dollar



Source: Author, 2016. Bases on fDi Markets and Euromonitor International

5.5 Recommendations

It is evident from the country level graphs that there are several countries struggling more than others to attract KFDI. Specifically, Mauritania, Libya, and Zimbabwe could focus on either of the two determinants and expect increases in KFDI. Such as improving the ease of doing business or creating a better market for firm to access capital could be positive policy focuses. Especially important for Mauritania and Libya, it was found that North African countries have an upper hand in attracting KFDI into the Software & IT Service sector. This is an advantage that North African countries and cities should capitalize on. In all regions of Africa, locally tailored software programs and mobile applications will have an increasing demand in the coming decades as the knowledge-based economies grow and populations begin to incorporate more technologies into their lives. North African countries also have the advantage of being the closest region to the European and Middle Eastern markets. Collaborations and partnerships across the Mediterranean Sea could create the necessary knowledge and technology transfers to propel the North African Software & IT Services subsector. North Africa could be the physical and virtual link between Europe and Africa.

There was also a collection of African countries that scored well in the significant determinants, yet received far less KFDI than expected. Those countries were Rwanda, Botswana, Mauritius, Senegal, and Namibia. Although, it would be expected that an increase in a significant determinant would attract KFDI, there seems to be other factors that are limiting these countries' attraction of KFDI. Addressing these limiting factors may bring a higher return of KFDI. These

underperforming countries could use the excelling countries, South Africa, Kenya, Mozambique, Tanzania, Nigeria, Egypt and Morocco, as examples.

It has been well documented that education levels rising is necessary for sustainable economic growth. It was the focus on lower levels of education for the general population then transitioning the focus to higher levels of technical education that contributed to the recent economic boom observed in some Asian countries. From this report, education was found to attract KFDI as well. Secondary education was observed to be significantly related in African cities, while tertiary education was significantly related for the non-African city sample. According to the low levels of education in Tunis, Nairobi, Casablanca, Cape Town, and Johannesburg a greater emphasis needs to be put towards this instrumental aspect of growth. Specific agendas should be created to promote STEM curriculums and English, which was found to have a positive effect on attracting KFDI in other developing regions. It is obvious that it education is a long-term strategy that may be at risk during political regime changes, so apolitical agencies should be in place to combat changes in the political environment. Furthermore, creating international country and city partnerships would strength the assets and resources that education systems have to grow. Teacher relocation programs would help bridge resource gaps and student exchanges could spur future relationships between locations.

Another aspect that needs to be addressed for future KFDI development is digital infrastructure. There has certainly been progress made to bring faster internet to the continent, but for the knowledge-based industries to continue growing so does the infrastructure. Better digital infrastructure is necessary within and outside of the major cities. The progress made has been in part because of private firms and for the future expansion of digital infrastructure these partnerships should continue. In the authors opinion, if the needed infrastructure is put into place a leapfrog effect may occur. As we saw telephone landlines become instantly obsolete when the mobile phone became possible, the television may lose traction in Africa to computers or advanced mobile phones. Information, entertainment, and commerce are being digitalized in all parts of this world and the gradual shift to computers from televisions that happened in the West could happen much quicker in Africa if the infrastructure is put into place. In terms of attracting KFDI, this transition would have an incredible effect for consumer goods and services and for generating innovative firms. The digital marketplace would expand dramatically and so would KFDI. Governmental bodies should actively be searching for partnerships with private firms to develop and enhance digital infrastructure all across their countries. There is the potential for unique partnerships because of the benefits of expanded digital infrastructure. From the examples given in Chapter 2, expansions in the past have lead to improvements in health, education, farming, and safety. With this evidence, organizations from all these sectors could come together to form a consortium in efforts to expand the services of digital infrastructure. This strategy would result in substantial social benefits and greater increase the attraction of KFDI.

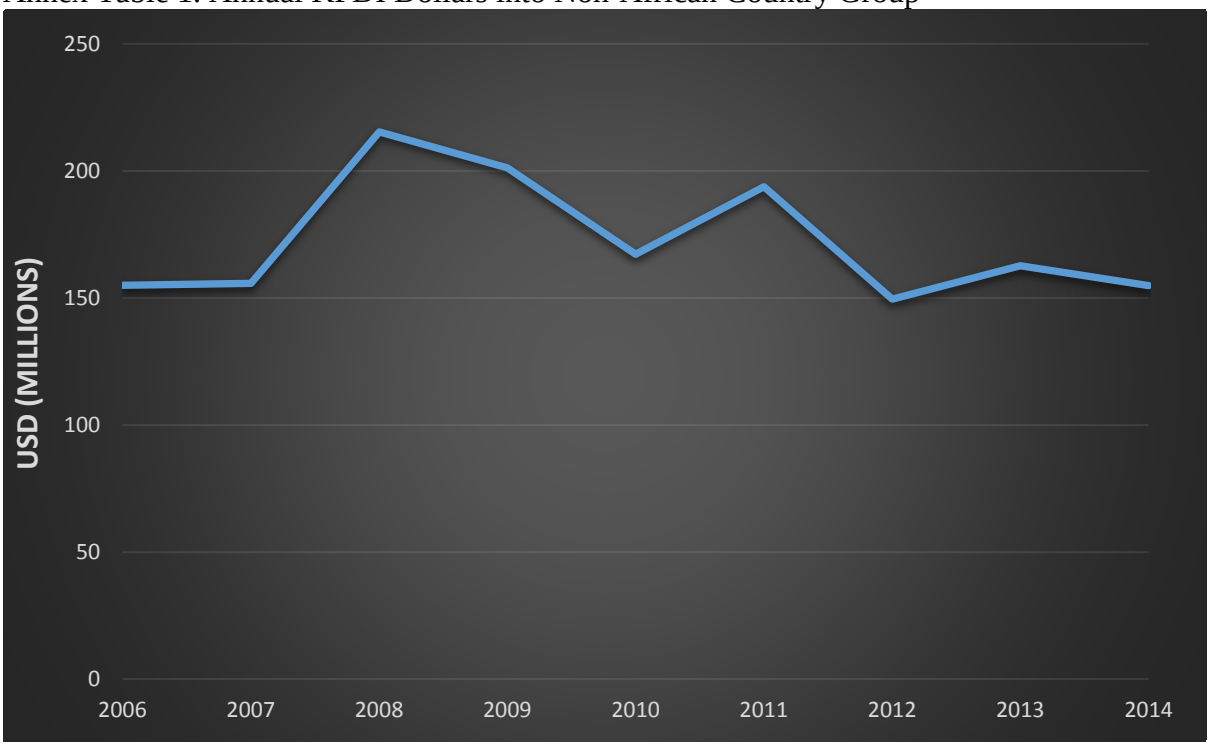
Technology incubators may be the best cost effective strategy to begin the process of growing the necessary ecosystem to attract further KFDI. It was found that incubators are significantly related to KFDI and rightfully so. These spaces have the ability to combine all the fundamental ingredients (digital infrastructure, education, and accessible capital). Economies of scale would benefit cities that focus advanced digital infrastructure to areas where there is clustering, or agglomeration, of incubators. Incubators can design educational outreach programs

that are open to the public and can act as a center for financial services. Moreover, this strategy does not need to be solely handled by the government. Partnering with private firms and academic institutions can bring further educational and financial support. The newness of these technology incubators and hubs in Africa has produced unanswered questions, including what is the right balance between these three actors (public, private, and academic). While still under investigation, the answer may be determined by the city and country's context. The famous incubator cluster in Nairobi was formed without government intervention, yet Amman's technology ecosystem can be credited to top-down planning (Kelly & Firestone, 2016). In the Kelly & Firestone study, which is credited for compiling the incubator database used in this report, out of the 117 incubators only nine were led by academic institutes and ten by governments. The authors argue that this is a positive sign of entrepreneurialism, but partnerships with these other actors will lead to a much more sustainable incubator. The study also argues that cohesion between the incubator's goals, business plan, and operating environment is critical to success.

In addition, incubators can be supported by local strategies. In the scale at which incubators operate, city governing bodies may have an advantage over federal agencies to facilitate the growth. Local policy makers have a better understanding of the local dynamics and will be able to act in a more effective manner. However, the balance at which governing bodies intervene must be well understood. The author agrees that the participation of the three actors (public, private, and academic) would create the most sustainable synergy, but to what degree should be determined by the participants in the incubator. Leydesdorff (2010) describes the actors as a Triple Helix and through partnerships complex dynamics can self-reinforce or constrain growth. At the very least, the Triple Helix should actively support the infrastructure necessary for success and intervene if the collapse of the incubator is imminent. However, if there is too much intervening, participants may lose the feeling of independence and the possibilities of serendipitous interactions between innovators will be squandered. The right balance between the Triple Helix and the participants of the incubator will lead to a sustainable innovation environment thus attract further KFDI.

Annex

Annex Table 1. Annual KFDI Dollars into Non-African Country Group



Source: Author, 2016. Bases on fDi Markets

Methodology for calculating the P2 Distance

The computation of the pillars used the P2 distance index, a synthetic index that combines all of these indicators into a single value (Garcia et al., 2015). This approach has also been used to build synthetic indicators in other disciplines such as well-being (Garcia et al, 2015). It allows comparisons between entities (both temporal and spatial) and is considered to be an exhaustive synthetic indicator because it is not based on a reduction of information. It considers all the valuable information contained in the variables used allowing the inclusion of a large number of variables. This process is used to combine similar indicators that exhibit multicollinearity (Montero et al., 2010; Garcia et al., 2015).

To calculate the P2 distance, start with a matrix X of order (m, n) in which m is the number of spatial units (countries) and n, the number of variables. Each element of this matrix, xri, is the value of the variable i in the spatial entity r. The P2 distance indicator calculates the distance of each spatial entity with regard to a theoretical spatial entity of reference. Initially, a distance matrix D is calculated as:

dri=|Xri-X*i|

where x⁄i is the r-th element of the reference base vector X⁄ = (x⁄1, x⁄2, . . ., x⁄n). For each variable a reference value must be defined to compare different spatial entities (Garcia et al. 2015).

KFDI Count Analysis

1.1 Sub-question 1, to what extent do African countries and cities attract KFDI differently than non-African locations?

1.2 Country Level Findings

The KFDI Count models will be using the fixed/random effect approach, but with the negative binomial method not OLS. The addition of the negative binomial method is to account for the nature of count data. Count data conflicts with normal OLS assumptions on the bases that there are many zeroes in the dependent variable, greatly skewing the distribution, and the dependent variable it is not continuous. The negative binomial method accounts for these characteristics during the analysis. Since the negative binomial method is being used for the KFDI Count analysis a log transformation was not necessary and no observations for KFDI Count had a blank value compared to the KFDI Dollars analysis. Below are the summary tables for the African and Non-African Country Models.

Summary Table 1. African Country KFDI Count Model

	N	Mean	SD	Min	Max
KFDI Count	231	1.8	1.2	0	4.4
Innovation (Log)	231	1.0	.26	.39	1.6
Tech Readiness (Log)	231	1.0	.16	.63	1.4
Northern Africa	243	.22	.42	0	1

Source: Author, 2016. Calculated with Stata.

Summary Table 2. Non-African Country KFDI Count Model

	N	Mean	SD	Min	Max
KFDI Count	243	2.5	.18	1.8	2.7
Good Market Efficiency	243	4.7	.57	3.6	5.8

Source: Author, 2016. Calculated with Stata.

Different than the dollar amount analysis, Technology Readiness and Innovation were both significant variables. The Technological Readiness and Innovation variables measure how well businesses and research institutes are absorbing and creating new technologies. As local organizations and the population as a whole become more tech savvy this should attract investments into such industries because of their growing economic potential. The Technological Readiness variable is used to proxy the Innovation and Business Environment Pillar and the Innovation variable is part of the Human Capital Pillar. Consequently, both variables were hypothesized to have a positive correlation to KFDI. Similar to the KFDI Dollar findings, in the Non-African Country KFDI Count model, Market Efficiency had a negative correlation. This negative relationship goes against the findings for African countries and the hypothesis of this report. The Market Efficiency index is a composite of several smaller measurements, including competition. The author believes that since competition is quite high in the Non-African sample group, that it may have reached a level that is deterring KFDI.

Results Table 1. African Country KFDI Count Model

	KFDI Count
Tech Readiness (Log)	3.746***
	(0.489)
Innovation (Log)	1.782**
	(0.583)
Northern Africa	1.335*
	(0.581)
Southern Africa	0.373
	(0.561)
Western Africa	1.162
	(0.638)
Eastern Africa	0.767
	(0.558)
Central Africa	-
	-
Constant	-4.885***
	(0.787)
Observations	231

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Results Table 2. Non-African Country KFDI Count Model

	KFDI Count
Market Efficiency	-0.164**
	(0.052)
Financial Market (Log)	0.141
	(0.124)
Constant	3.010***
	(0.251)
Observations	243
R^2	0.040

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Author, 2016. Calculated with Stata.

Comparison Table 1. African Countries vs. Non-African Countries Significant Indicators

		Innovation and Business Environment		Human Capital
		Market Efficiency	Technology Readiness	Innovation
KFDI Count	Africa		+***	+**
	Non-Africa	-**		

Source: Author, 2016. Model analysis

1.3 City Level Analysis

Below are the summary and results tables for the KFDI Count analyses. Found in Results Table 3, the African City KFDI Count model, Technology Incubator and Broadband Access are positively related to KFDI. These represent the Innovation and Business Environment and Infrastructure Pillars, respectively. In Results Table 4, Lagged Year KFDI, GDP Growth, and Tertiary Education were found to have positive correlation with KFDI Count. Lagged Year KFDI and GDP Growth representing the Innovation and Business Environment Pillar and Tertiary Education representing the Human Capital Pillar. In Comparison Table 2, the results for both locations are illustrated.

Summary Table 3. African City KFDI Count Model

	N	Mean	SD	Min	Max
KFDI Count	64	2.5	.57	1.1	3.7
Broadband Access (Log)	64	4.4	.23	3.5	4.6
Incubator Dummy	64	.42	.50	0	1

Source: Author, 2016. Calculated using Stata.

Summary Table 4. Non-African City KFDI Count Model

	N	Mean	SD	Min	Max
KFDI Count	500	3.4	.83	.69	5.7
Lagged Year KFDI (Log)	500	6.3	1.0	1.8	9.1
GDP Growth	500	4.0	4.8	-12.5	23.3
Tertiary Edu (Log)	500	7.2	.94	4.7	9.6

Source: Author, 2016. Calculated with Stata.

Results Table 3. African City KFDI Count Model

	KFDI Count
Tax Surplus (Log)	0.097
	(0.142)
Incubator Dummy	0.372*
	(0.157)
Broadband Access (Log)	0.144*
	(0.063)
Previous Year KFDI	0.004
	(0.069)
Constant	1.985
	(1.136)
Observations	64

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Results Table 4. Non-African City KFDI Count Model

	KFDI Count
Lagged Year KFDI (Log)	0.258***
	(0.025)
GDP Growth	0.06***
	(0.004)
Tertiary Edu (Log)	.209***
	(0.796)
Constant	-.694**
	(.567)
Observations	500

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Comparison Table 2. African Cities vs. Non-African City Significant Indicators

		Innovation and Business Environment			Human Capital	Infrastructure
		Incubator	Lagged KFDI	GDP Growth	Tertiary Education	Broadband Access
KFDI Count	Africa	+*				+*
	Non-Africa		+***	+***	+***	

Source: Author, 2016. Model analysis

2.1 Sub-question 3, are there determinant differences between subsectors in the knowledge-based economy?

The following tables are the results from the KFDI Count analysis of the main subsectors in the knowledge-based economy.

Results Table 5. African Country KFDI Count Model, Business Service Subsector

	KFDI Count
Tech Readiness (Log)	3.933***
	(0.822)
Institutions (Log)	0.784
	(0.961)
Constant	-1.65**
	(2.002)
Observations	113

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata

Result Table 6. African Country KFDI Count Model, Financial Service Subsector

	KFDI Count
Tech Readiness (Log)	2.905*
	(1.183)
Institutions (Log)	0.972
	(1.297)
Constant	13.147
	(1015.766)
Observations	159

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata.

Result Table 7. African Country KFDI Count Model, Software & IT Subsector

	KFDI Count
Infrastructure (Log)	1.77*
	0.862
Northern Africa	.419
	(0.434)
Southern Africa	0.473
	(0.472)
Western Africa	0.135
	(0.46)
Eastern Africa	-
	-
Central Africa	-
	-
Constant	0.414
	(1.272)
Observations	91

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculate using Stata.

Results Table 8. African Country KFDI Count Model, Communication Subsector

	KFDI Count
Institutions (Log)	-1.82
	(1.123)
Tech Readiness (Log)	3.782**
	(0.884)
Constant	1.615
	(1.911)
Observations	133

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated using Stata

Results Table 9. African City KFDI Count Model, Business Service Subsector

	KFDI Count
Employment Rate (Log)	2.325**
	(.722)
Broadband Access (Log)	0.293***
	(0.053)
Constant	-5.628
	(3.42)
Observations	63

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Results Table 10. African City KFDI Count Model, Financial Services Subsector

	KFDI Count
Employment Rate (Log)	0.339
	(1.147)
Broadband Access (Log)	0.22**
	(0.067)
Constant	1.228
	(4.976)
Observations	54

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Result Table 11. African City KFDI Count Model, Software & IT Service Subsector

	KFDI Count
Employment Rate (Log)	1.2
	(1.568)
Tech Incubator	0.922***
	(0.163)
Constant	11.16
	(720.67)
Observations	66

Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Source: Author, 2016. Calculated with Stata

Results Table 12. African City KFDI Count Model, Communication Subsector

	KFDI Count
Tech Incubator (Log)	0.861***
	(0.379)
Employment Rate (Log)	0.291
	(1.869)
Constant	14.578
	(1277.937)
Observations	50

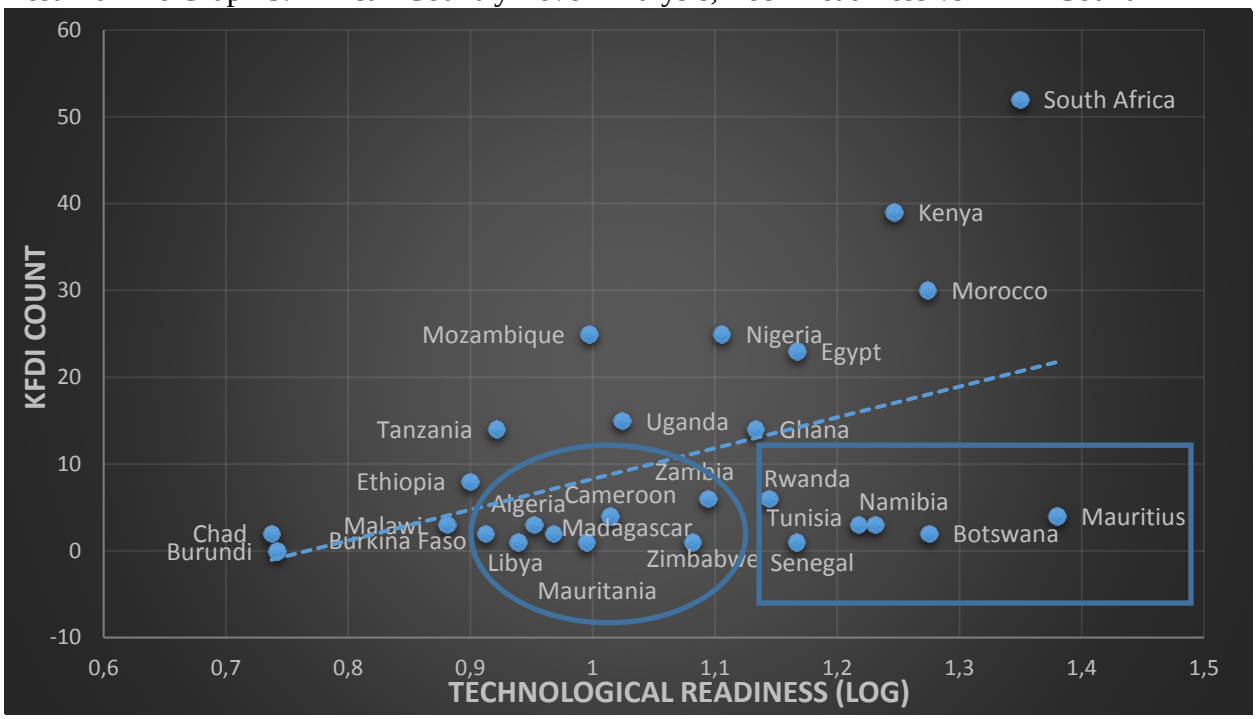
Standard errors in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001
Sourced: Author, 2016. Calculated with Stata

Best Fit Line Graph Analysis for the KFDI Count Models

Inline with the analysis of the KFDI Dollar models, best fit graphs have been constructed for the significant determinants found in the KFDI Count analysis. The Best Fit Line Graph 3 illustrates the relationship between Technological Readiness and KFDI Count. Burkina Faso, Libya, Algeria, Madagascar, Mauritania, Cameroon, Zimbabwe, and Zambia would all expect higher than average returns in KFDI investments with an increase in Technological Readiness. Currently, Rwanda, Senegal, Tunisia, Namibia, Botswana, Mauritius all have high Technological Readiness scores, so an increase in the determinant may not result in a very high return in KFDI Count. However, there must be some negative factors that are restricting the benefits of having a higher level of Technological Readiness.

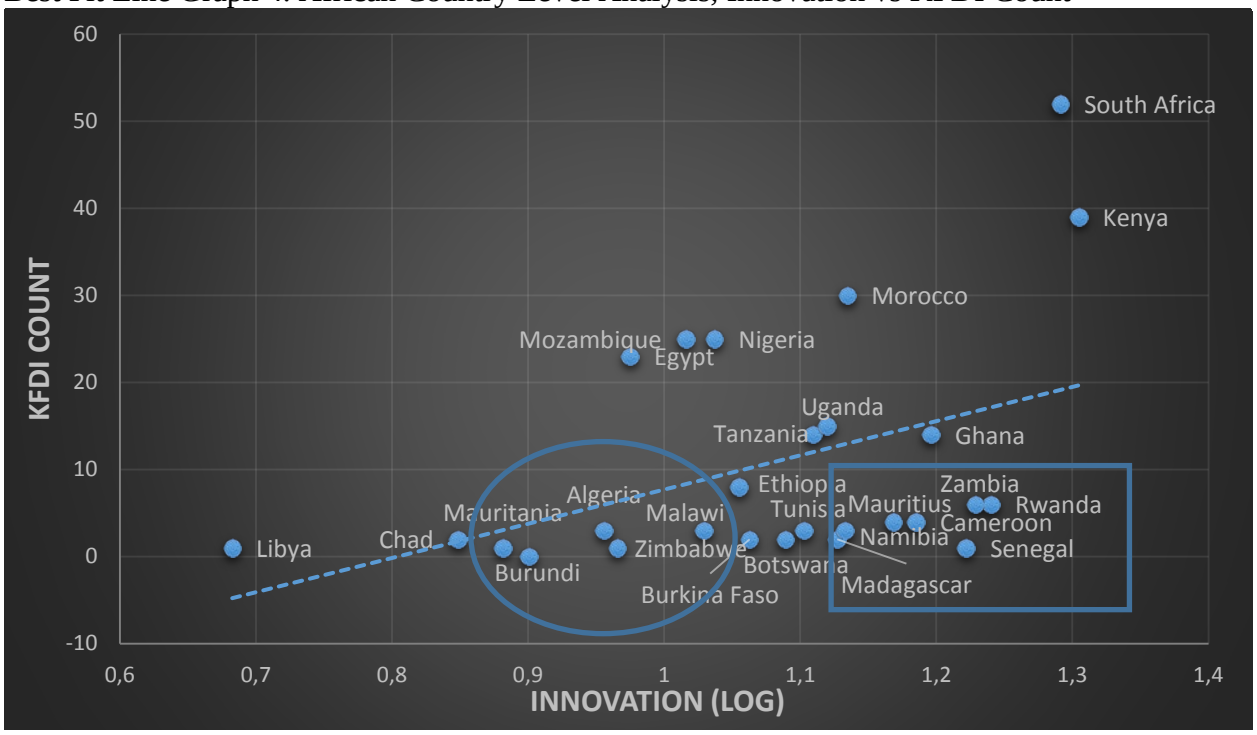
Best Fit Line Graph 4 depicts the relationship between the Innovation variable and the KFDI Count. It is here that it can be observed that Mauritania, Burundi, Algeria, Zimbabwe, and Malawi have low Innovative scores and below average KFDI Count. Many of the 27 countries are below the average KFDI amount including Madagascar, Namibia, Mauritius, Cameroon, Senegal, Zambia, and Rwanda who all have high Innovative score as well.

Best Fit Line Graph 3. African Country Level Analysis, Tech Readiness vs KFDI Count



Source: Author, 2016. Bases on fDi Markets and WEF

Best Fit Line Graph 4. African Country Level Analysis, Innovation vs KFDI Count



Source: Author, 2016. Bases on fDi Markets and WEF

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