Foreign Direct Investment and Economic Growth in Africa

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Abstract

Foreign direct investment (FDI) is a valuable source of external finance to complement domestic savings, enhance domestic investment and increase employment in developing countries. It can potentially promote long-term growth and development through knowledge and technology transfers from foreign firms to domestic agents in host countries. With these benefits in mind, especially in relation to low-income African countries characterized by underdeveloped domestic financial markets, this thesis investigates the determinants of FDI, evaluates how well local firms can be integrated in FDI projects to enhance productivity growth and determines whether these investments have contributed to increasing productivity growth of host African countries. These issues are analysed in three constituent chapters of the thesis.

The first study explores whether FDI from the different group of economies, stratified into the Organization of Economic Cooperation and Development (OECD), non-OECD emerging markets and intra-African economies, are driven by market-seeking, natural resource-seeking and efficiency-seeking motivations into host African countries. Evidence suggests that market-seeking and efficiency-seeking FDI are more growth enhancing than natural-resource seeking FDI. This study exploits recent bilateral FDI data to examine the underlying motivations and determinants of FDI into African economies. In doing so, the study contributes to the empirical literature by providing evidence on the specific factors that influence FDI into resource-rich and non-resource rich African economies. The study finds that the size of host markets and presence of natural resources have important influence on FDI into resource-rich countries, with market size determining FDI into non-resource rich countries, while investments from non-OECD emerging markets economies are also explained by the presence of lower labour costs. It is also evident that there are significant differences in determinants of FDI into African countries, between investors from African economies and counterparts from the OECD and non-OECD emerging markets. The results show significant differences between the drivers of FDI to South Africa and other African countries.

The second study complements the first in analysing the determinants of FDI activity, by determining the sectors through which foreign affiliates and local firms are more likely to undertake joint activities in FDI projects. This is important in light of the growing need to

promote knowledge and technology transfers from FDI in order to boost productivity in host sub-Saharan African countries. Over the years, FDI in sub-Saharan Africa were mostly undertaken in high technology sectors, which are presumably capital-intensive, by joint-venture firms formed between transnational corporations and domestic firms. This pattern of investment has called into question whether foreign affiliates and local firms have greater propensity to jointly engage in FDI projects in capital-intensive activities. Considering this question, the study contributes to the empirical literature by determining the sectors through which such integration is more likely to occur. In trying to understand this relationship, the analysis used a large survey dataset on manufacturing and services firms for 19 sub-Saharan African countries. The survey was conducted by the United Nations Industrial Development Organization (UNIDO) in 2010. This data allows us to evaluate the integration decisions of firms, considering how physical capital intensity of foreign affiliates and skill intensity of the local workforce affect such decisions. The results reveal remarkably consistent finding that there is a higher likelihood that these firms will integrate production through capital-intensive than labour-intensive activities in sub-Saharan Africa.

The third study investigates the growth enhancing effects of FDI into African countries, considering whether such impact depends on human capital capacity across countries. This study contributes to the empirical literature by exploiting host country heterogeneity in human capital capacity in explaining whether there are differences in the effect of FDI on productivity growth across countries. To consider such differences, recent country level data on total factor productivity growth and human capital stock, which is used as proxy for host country absorptive capacity, were used in a panel of 25 countries over the period 1996-2011. The analysis employed the Panel Smooth Transition Regression (PSTR) which allows for host country heterogeneity in human capital capacity to determine whether the relationship between FDI and productivity growth is nonlinear. The results strongly support the nonlinearity between FDI and productivity growth. This suggests that the impact of FDI on productivity growth differs across African countries. The heterogeneity is explained by the variation in human capital capacity across these economies. The study reveals a minimum threshold of 6.94 average years of schooling for FDI to accelerate productivity growth in host African countries. The analysis suggests that FDI will raise productivity growth in countries which have attained or exhibited human capital capacity

closer to this threshold, when further efforts are applied to enhance such capacity. Countries with human capital capacity far below the threshold, however, will not experience productivity gains from these investments.

Dedication

To the loving memory of my father.
May Allah grant you eternal rest.

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List of Abbreviations

AfDB	African Development Bank
AERC	African Economic Research Consortium
BRICS	Brazil Russia India China South Africa
EU	European Union
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
MNEs	Multinational Enterprises
OECD	Organization for Economic Co-operation and Development
PSTR	Panel Smooth Transition Regression
PWT	Penn World Tables
R&D	Research and Development
SADC	Southern African Development Community
SSA	Sub-Saharan Africa
TFP	Total Factor Productivity
UNCTAD	United Nations Conference on Trade and Development
UNIDO	United Nations Industrial Development Organization
WDI	World Development Indicators
WTO	World Trade Organization

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CHAPTER ONE

1.1 Introduction and Motivation

Foreign direct investment (FDI) is recognized as a catalyst for stimulating growth and development, especially in many developing countries that have limited capacity to promote domestic investment and finance long-term development (UNCTAD, 2013a). FDI is viewed as an integral component of financial globalization (Brahmhatt and Dudush, 1996; Campos and Kinoshita, 2010) due partly to potential benefits to host countries. In recent decades, it has grown at a faster pace than trade flows between countries (Blonigen, 2005). Among academics, the theoretical arguments on the contribution of FDI to host economies have been extensively articulated, with the overall benefits broadly categorized into direct macroeconomic effects and indirect effects. Direct macroeconomic effects occur through increases in investment, tax revenues, creating employment and increasing foreign exchange receipts; while indirect effects or micro level contributions to long-term growth and development occur through technology spillovers to domestic firms (Farole and Winkler, 2014; Paus and Gallagher, 2008). In particular, FDI can accelerate growth through increases in total factor productivity, and thus overall efficiency of resource use in host countries (OECD, 2002).

Over the past few decades, global inward FDI was mostly concentrated in developed countries. However, this pattern has changed in recent years, particularly following the global financial crisis in 2007/2008 and the successful implementation of structural reforms in some developing countries. Inflow of FDI to developing countries surged over the past 25 years, from 17 percent of global FDI inflows in 1990 to 55 percent in 2014. The share of these investments is however unevenly distributed across developing countries, with Asia receiving the bulk of the flows, an average of 65 percent for the period 1990-2014, compared to Latin America and the Caribbean with 27 percent and Africa just under 8 percent. Even though Africa's share of inward FDI to developing countries is quite low, the continent also witnessed significant expansion in FDI inflows over the past 25 years, increasing almost 19-fold. These investments can be extremely important to the economies that receive them. Africa's share of inward FDI flows in gross fixed capital formation is relatively high, averaging over 11 percent for the period 1996-2014. The share of inward FDI stock in GDP rose significantly, from 13 percent in 1996 to 29 percent in

2014, averaging 25 percent over the period. Across Africa, the distribution of FDI inflows is far from uniform, with South Africa receiving 63 percent of all inward FDI flows to sub-Saharan Africa from the European Union (EU), between 2001 and 2012; and Nigeria attracting 37 percent of US FDI flows (Sy et al., 2014).

This thesis provides three up-to- date studies of FDI flows in Africa. Chapter two of the thesis primarily focuses on investigating the motivations underpinning FDI from different groups of economies, categorized into intra-African, OECD and non-OECD emerging markets economies, into resource-rich and resource-poor countries. In trying to understand the motivations for FDI into host countries, the literature has focused on four theoretical perspectives: market-seeking, resource-seeking, efficiency-seeking and strategic asset-seeking (Cleeve, 2008; Dunning, 1993; Faeth, 2009). For small developing countries, emphasis is placed mostly on market-seeking, resource-seeking and efficiency-seeking considerations (Dunning, 1998; Chen et al., 2015), but it has also become clear that foreign investors in most developing countries exhibit different characteristics.

Empirical studies have argued that there are differences in FDI motivations and determinants. These differences are relative to the nationality of investors and across the different host countries (Zhen and Tan, 2011), as well as the levels of economic development and geographic location of countries of origin (Zheng, 2009). One would expect differences in investor motivations and determinants in Africa, given that most countries have attracted FDI from different sources. Yet, despite a large literature exists on the determinants of FDI in Africa (e.g. Anyanwu, 2012; Asiedu, 2002, 2006, 2013; Loots and Kabundi, 2012; Morrisset, 2000), there is little systematic evaluation of the underlying motivations for FDI inflows. This remains an important issue as investments that are mostly driven by efficiency-seeking and market-seeking considerations have relatively stronger growth effects than resource-seeking FDI (Chen et al., 2015) and there are also potential differences in the size of productivity effects of FDI from the different groups of economies (Pfeiffer et al., 2014). By investigating these issues, chapter two contributes to the debate on FDI determinants, providing clear evidence on the specific factors attracting FDI from these source economies into resource-rich and non-resource-rich African countries. It further analyses whether there are differences in motivations and determinants of FDI between investors from African economies and counterparts from the OECD and non-

OECD emerging markets, which to our knowledge has not been explored in the empirical literature.

In order to explain such differences in FDI determinants, host countries are first segmented into resource and non-resource rich countries and source countries categorized in OECD, non-OECD emerging markets and intra-African countries. In this way, chapter two explores source and host country heterogeneity in explaining the determinants of FDI across host African countries. This analysis is complemented with an estimation strategy that explicitly establishes whether there are differences in the determinants of FDI between investors from African economies and OECD, and African economies and non-OECD emerging market economies. The study uses an unbalanced panel data on bilateral FDI stocks from 72 source economies into 45 host African countries over the period 2001-2012. Applying a Hausman-Taylor instrumental variable estimation strategy, study finds strong evidence suggesting that intra-African FDI to non-resource rich countries are mostly driven by market-seeking considerations. This finding suggests that the market size of host countries is a relevant determinant of these investments in these economies. For FDI to resource rich countries, the results show that the size of host markets and natural resources are important drivers of these investments from all different groups of economies. Interestingly, while natural resources attract FDI into the extractive industries, they also undermine investments in the non-resource sectors of countries that receive them. The analysis further reveals that there are significant differences in the determinants of FDI between investors from intra-African economies and OECD and non-OECD emerging markets economies in resource rich countries. It suggests also that FDI from the OECD and non-OECD emerging markets into non-resource rich countries are both market-led, while FDI from non-OECD economies are also driven by lower cost motives.

While chapter two establishes the motivations and determinants of FDI from the different source economies, to better understand the determinants of FDI activity, it is useful to explore how well these investments can be integrated in host countries. Answering this question is important given that increased participation of local firms in FDI projects will promote knowledge and technology transfers from foreign affiliates to domestic firms and thus facilitate spillovers (Blomstrom and Sjoholm, 1999). Along these lines, chapter three ties in closely with the second chapter by investigating how the relative input contributions of foreign affiliates and local firms

affect ownership decisions of these firms. The study is motivated by theoretical predictions in the intra-firm trade literature which point to greater propensity for FDI through intra-firm trade flows in capital-intensive industries instead of labour-intensive activities (Antras, 2003). This pattern of intra-firm trade is explained by the relative ease with which investments in physical capital can be shared between contracting parties compared to investments in labour-inputs which are inalienable and characterized by severe hold-up problems. Along these lines, a growing body of studies have investigated how the input intensities of foreign firms and input supplying firms affect their decision to keep production within firm boundaries (e.g. Antras, 2003; Fernandes and Tang, 2012; Nunn and Trefler, 2013; Antras and Yeaple, 2014). These studies all provide evidence that strongly supports these theoretical predictions. From these arguments, it follows that local firms are more likely to be integrated in FDI projects through capital-intensive sectors than labour intensive sectors. Surprisingly, this issue has greatly been neglected in the empirical literature, with most studies focusing on how the relative input investments of firms influence intra-firm trade flows and not explicitly investing how these inputs affect ownership structure.

Chapter three contributes to the empirical literature by investigating the question of whether foreign affiliates and local firms can integrate production in FDI projects through capital intensive sectors instead of labour-intensive sectors in sub-Saharan Africa. In these economies, the reform measures adopted by most countries have led to greater openness to foreign equity ownership than other regions (see World Bank, 2010). One would therefore expect increased participation of domestic firms in FDI projects, since such investments are less likely to be discouraged by restrictive government policies on foreign ownership. Over the years, foreign investments in sub-Saharan Africa were mostly undertaken in high technology sectors by firms that are jointly owned by TNCs and domestic firms. These joint-venture firms are more productive than wholly-owned foreign firms (UNIDO, 2011). Such a pattern of investment raises the question of whether these firms can integrate production in FDI projects through capital-intensive activities, given that foreign investments in high technology activities are physical capital intensive.[1] Additionally, local managers have had greater control over recruitment of

[1] Note that with recent advancements in Information, Communication and Technology (ICT) and digital services, sectors described as physical capital intensive, such as high-tech manufacturing are becoming increasingly less

workers for foreign affiliates (UNIDO, 2011). This suggests that the skill intensity of local managers or supervisors can proxy the input contribution of domestic firms. To my knowledge, there is no research on how input intensity of the foreign affiliates and local firms affect ownership decisions of these firms in sub-Saharan Africa.

To investigate how input intensity of the foreign affiliates and local firms influence ownership decisions of these firms, chapter three uses a large firm-level dataset on manufacturing and services firms for 19 African countries in sub-Saharan Africa collected by the United Nations Industrial Development Organization (UNIDO) in 2010. This data makes it possible to comprehensively analyze the underlying relationship, providing evidence from a broader perspective of countries. The analysis relies on estimates of the linear probability model, probit and fractional response models. The results strongly support the prediction that domestic firms are more likely to be integrated through capital-intensive than labour-intensive sectors.

While chapters two and three analyzed the determinants of FDI activity, it is far from clear from the literature whether these investments have contributed to enhancing productivity growth in host African countries. Chapter four explores the effect of FDI on productivity growth, determining whether there are differences in such impact depending on host human capital capacity. This research matters to the debate on the FDI-growth nexus, given that human capital enhances the capacity of host countries to absorb knowledge and technology from FDI. As some African countries have successfully attracted a sizeable amount of FDI in recent years, it is the expectation of policymakers that these investments will enhance growth of these economies. Such expectations are deeply rooted in the endogenous growth literature which suggests that FDI will enhance growth in host countries through technology transfer and spillover effects (see De Mello, 1997; Nair-Reichert and Weinhold, 2001). This issue is intensely debated in the empirical literature, with the positive effect of FDI on economic growth found not to be robust in some studies (Adam, 2009; Carkovic and Levine, 2005; Lensink and Morrissey, 2006), while others point to the growth-enhancing effect of FDI on economic growth in host countries (Li and Liu, 2005; Neuhaus, 2005).

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capital intensive as these services become cheaper over time. However, the underlying assumption is still valid for most African countries characterized by limited degree of technological development.

In trying to understand the growth effects of FDI across countries, there has been research on how local conditions affect the capacity of host countries to absorb these investments. The research points to little or no growth effect of FDI in the absence of a minimum threshold level of development in absorptive capacities. Most studies capture the role of absorptive capacity in promoting growth through linear interactions between FDI and human capital capacity (Blonigen and Wang, 2005; Borensztein et al., 1998), level of domestic financial markets development (Alfaro et al., 2004, 2009; Hermes and Lensink, 2003) and quality of institutions (Durham, 2004; Olofsdotter, 1998). A second strand of literature has attempted to deal with the issue of host country heterogeneity by splitting countries according to some defined threshold of absorptive capacity or level of economic development (e.g. Karunaratne, 2013) or through linear interaction between a dummy variable for a group of countries and the variables of interest in the estimation (Blonigen and Wang, 2005).

One problem that is overlooked in these studies is the fact that in estimating the growth effect of FDI, host country heterogeneity in absorptive capacity is not effectively captured through linear interactions between FDI and the measures of absorptive capacity. Such an approach assumes that the growth effect of FDI is the same across countries and over time. This is misleading when host countries are characterized by considerable differences in absorptive capacity. With such potential differences, one would expect that countries with greater capacity can absorb spillovers from FDI more than other countries. This is evident in the mutually reinforcing relationship between human capital capacity and quality of FDI. Accordingly, when human capital capacity is enhanced, the host economy is more likely to attract higher quality FDI, which in turn feeds into human capital capacity through training and on-the-job learning activities undertaken by MNEs in host countries (see Blomstrom and Kokko, 2003; OECD, 2002). Moreover, studies that have considered sub-groups of countries have also ignored the fact that there may be considerable heterogeneity in absorptive capacities across countries within groups. This could explain the variation in the effect of FDI on growth across countries. Nair-Reichert and Weinhold's (2001) study supports this view as they find considerable heterogeneity across developing countries. It follows from these arguments that the relationship between FDI and productivity growth may be nonlinear depending on human capital capacity of host countries.

Surprisingly, only a few studies have explored the nonlinearities in the relationship between FDI and economic growth, with studies addressing host country heterogeneity through the quality of institutions (Brahim and Rachdi, 2014; Jude and Levieuge, 2016) and human capital capacity (Kottaridi and Stengos, 2010). Although the study by Kottaridi and Stengos (2010) explores the variation in the effect of FDI on economic growth across countries, it does not determine the minimum threshold level of human capital capacity that enhances economic growth as non-parametric techniques were used. Looking at the African continent shows that there is considerable variation in human capital capacity across countries, with relatively high average years of schooling in South Africa (9.69 years in 2010) compared to Niger (1.88 years).[2] Given the marked differences in such capacity, one would expect the effect of FDI on productivity growth to differ across countries. To my knowledge, this issue has not been investigated in the empirical literature on African economies.

Chapter four fills the gap identified above. It investigates these issues by first determining whether human capital enhances the growth effect of FDI through linear interactions between these two correlates of growth based on the 5-year averages of the series on a panel of 25 African countries over the period 1996-2011. It then uses a Panel Smooth Transition Regression (PSTR) model, which allows for host country heterogeneity through variation in human capital capacity, to evaluate whether the relationship between FDI and productivity growth is nonlinear and conditional on such capacity. This study presents novel contribution to this debate by providing evidence supporting the nonlinear effects of FDI and determining the threshold level of human capital that enhances the growth effect of FDI. The analysis reveals that host African countries need to achieve a threshold level of 6.94 years of average schooling in order to benefit from FDI. The finding suggests that FDI increases productivity growth in countries that have attained the minimum threshold of human capital, while countries with human capital capacity well below the threshold will not realize an increase in productivity growth, unless human capital capacity is enhanced closer to this threshold level. In this case, efforts by host countries with human capital capacity very close to this threshold level will significantly raise productivity growth if further efforts are applied to improve human capital. The study shows that only 7 out of the sample of 25 countries had achieved this threshold of human capital capacity in 2010.

[2] See Barro and Lee (2013).

1.2 Organization of Thesis

Following the introduction of the research issues in this chapter, the rest of the thesis is structured as follows. Chapter 2 investigates whether FDI from the different source economies is influenced by market size, presence of natural resources and lower labour costs in host African economies. It further explores the question of whether there are differences in the response of foreign investors from the different sources to these factors. These issues are dealt with using bilateral FDI stocks from the different source economies into 45 host African countries over the period 2001-2012 and employing the Hausman-Taylor instrumental variable (IV) estimation technique.

Chapter three determines the sectors through which foreign affiliates and local firms are more likely to integrate in FDI projects in sub-Saharan Africa. The analysis relies on a survey data of manufacturing and services firms, using alternative estimation techniques, particularly fractional response models to evaluate this issue.

Chapter four investigates the growth enhancing effect of FDI across African countries, determining whether such impact depends on human capital capacity and differs across countries. These issues are tackled using the panel smooth transition regression (PSTR) model on a panel of 25 African countries over the period 1996-2011. Chapter 5 concludes by offering some policy implications and suggestions for future research works.

CHAPTER TWO

Foreign Direct Investment in Africa: Markets, Natural Resources and Efficiency-Seeking

2.1 Introduction

Since the 2000s, foreign direct investment (FDI) flows to low-income countries have increased substantially as commodity prices surged in international markets in the face of adequate liquidity in the global economy, accompanied by the adoption of market-oriented reforms in many countries (Dabla-Norris et al., 2010). However, in recent years, global FDI inflows have decreased due to the global financial crisis in 2007/2008. This downward trend has heightened competition among developing countries as they seek to attract these investments from different sources (Jude and Levieuge, 2016). Policies designed to attract FDI have become an integral part of the broader policy priority of developing countries, partly due to potential benefits of these investments to host economies (Newman et al., 2015). FDI is particularly important for Africa especially in the sub-Saharan African region where most countries are characterized by underdeveloped financial markets. Due to this problem, the majority of countries in this region have not been able to mobilize sufficient internal resources to meet domestic investment requirements. As a result, FDI is considered as an important vehicle for gaining access to foreign resources in order to bridge the financing gap and complement domestic investments, thereby promoting growth, job creation and alleviating poverty in host countries (UNCTAD, 2013a). In light of the perceived benefits of FDI, most African countries have adopted policy reforms in order to reduce barrier and attract these investments (Moss et al., 2005).

At the same time, there has been a growing debate about the factors driving FDI to developing economies, with the arguments on the African continent largely centered on whether FDI is mostly attracted into large and/or resource-rich countries (see UNCTAD, 2013a). These arguments have gained prominence in the African discourse in the last decade, especially fueled by strong demand for natural-resource extractive commodities by emerging market economies such as China and India (see Brautigam and Gallagher, 2014; Broadman, 2007; Brown, 2012). To explore the drivers of FDI, the eclectic paradigm of FDI (Dunning, 1979) offers a useful framework for explaining FDI based on three types of advantages that multinational enterprises (MNEs) have: ownership (O), location (L) and internalization (I) or OLI advantages. Drawing

from this framework, the literature distinguishes among four motivations behind FDI in host countries: market-seeking, resource-seeking, efficiency-seeking and strategic-asset seeking (Cleeve, 2008; Dunning, 1993; Faeth, 2009). To fully understand these motivations, an alternative strand of theoretical literature on FDI has explored two forms of FDI: horizontal FDI and vertical FDI. In the horizontal model of FDI, which originates from the work by Markusen (1984), FDI is mainly driven by market-seeking motivations and desire to avoid trade costs. The vertical model of FDI developed by Helpman (1984) suggests that FDI can be explained by MNEs desire to take advantage of factor-cost differences. Both of these forms have been combined into one theoretical model, known as the knowledge-capital model of FDI (Carr et al, 2001; Markusen et al, 1996; Markusen, 1997). Such a framework has provided the basis for investigating the motivations and determinants of FDI in host countries, as evidenced in many empirical studies on FDI (e.g. Baltagi et al, 2008; Blonigen and Wang, 2005; Egger and Pfaffermayr, 2004; Lankhuizen, 2014; Martinez et al, 2012). The framework suggests that the market size of host countries is a relevant factor driving FDI when these investments are dominated by horizontal (market-seeking) motivations while the presence of efficiency-seeking FDI is an indication that lower labour costs matter for attracting FDI.

Although there is an extensive empirical literature on how markets, natural resources and policy in affect FDI in Africa (e.g. Asiedu, 2002, 2006, 2013; Morisset, 2000; Naude and Krugell, 2007; Anyanwu, 2012), these studies have not explored the motivations behind these investments from different groups of economies. There is suggestive evidence that compared to investments from the OECD and non-OECD emerging market economies, there are more intra-African investments concentrated in manufacturing and services sectors than in the extractive industries (see UNCTAD, 2014a). In addition, intra-African investments are mostly less capital-intensive and technology intensive and are relatively more diverse than investments from the OECD (see AfDB et al., 2014). This suggests that there are different investment patterns among investors from the different source countries. Yet, the question of what drives FDI from the different groups of economies into resource and non-resource rich African countries remains an empirical issue. Across Africa, there are differences in income levels and economic structures, particularly the presence of resource wealth (Leibfritz, 2015). This suggests that the determinants for FDI may vary across host countries depending on these characteristics. That said, studies have argued that the motivations and determinants of FDI in developing countries could differ among

investors because of differences in the nationality of the transnational corporations (TNCs) (Zheng and Tan, 2011) and levels of economic development and geographic locations (Zheng, 2009). However, it remains to be determined whether there are differences in FDI motivations and determinants among the different investors in resource and non-resource rich host African economies.

This chapter contributes to this debate along two lines. It determines whether intra-African and interregional investments are driven by market-seeking, natural resources and efficiency-seeking considerations.[3] Apart from the concentration of intra-African FDI in the manufacturing and services sectors, these investments also tend to be concentrated in large and close proximity markets to the main drivers of these investments namely, South Africa, Kenya, Mauritius, Nigeria and Egypt. Although such an investment pattern may reflect the sensitivity of these investments to market size and efficiency-seeking objectives, it is not clear what is driving these investments to resource and non-resource rich host African countries. This study fills the gap.

Given the different sources of FDI into African economies, the issue of determining the factors explaining FDI is critical for understanding the growth potential of these investments, as the empirical literature suggests that market-seeking and efficiency-seeking FDI have stronger growth impact than resource-seeking FDI (see Chen et al., 2015). While previous studies have investigated the determinants of FDI in the region using aggregate FDI inflows or stocks, this study uses relatively disaggregated data on bilateral FDI stocks. The strength of this approach is that it avoids heterogeneity bias in FDI determinants by separately determining the drivers of FDI from the different groups of economies into resource and non-resource rich African countries. This chapter considers source and host country heterogeneity given that foreign investments into African economies originate from different sources and there are marked differences in income levels and resource endowments across host African countries. Africa is host to natural resources such as hydrocarbons, minerals and timber, and particularly rich in some of the world's precious minerals, notably platinum, manganese and gold in South Africa; and diamonds in the Democratic Republic of Congo, South Africa and Botswana (Alden and Alves, 2009). Yet, the region has attracted only a limited share of investment inflows to developing economies, with an average of just above 8 percent over the period 2000-2014

[3] Interregional FDI comprises investments from the OECD and non-OECD emerging markets economies.

compared to an average of 65 percent in Asia and 25 percent in Latin America and the Caribbean.[4]

The study makes a second contribution to the literature by determining whether the motivations and determinants of FDI differ among the different groups of investors in African economies. To our knowledge, only a few studies have explored a similar issue in developing countries. For example, Asiedu (2002) finds that SSA countries behave differently from non-SSA destination countries as FDI to the former is not driven by return on investment and better infrastructure. These factors, however, matter in explaining FDI in other developing countries. Zheng and Tan's (2011) study investigates the differences in FDI motivations and determinants in China among investors from the OECD and non-OECD developing countries. Andres et al. (2013) investigates the motivations behind FDI from traditional and emerging economies to developed and developing host countries. Aleksynska and Havrylchyk (2013) consider the role of institutional distance and natural resources in explaining FDI from developing and developed countries. Despite these studies, it remains unclear whether intra-African investors behave differently from their counterparts from the OECD and emerging market economies with respect to the size of host markets, natural resources and efficiency-seeking objectives in host African countries. Investigating this issue would contribute to deeper understanding of what drives FDI to African economies from the different source economies. It will also provide an important perspective to the current debate over location factors in the region. The evidence is useful to facilitate engagements with different investors in African countries.

To analyze this issue, this study uses bilateral FDI stock data compiled by UNCTAD in 2014, on a panel of 45 African countries from 72 source countries over the period 2001-2012. Using a Hausman-Taylor instrumental variable (IV) estimation strategy, the results suggest that market size and natural resources are important determinants of FDI in resource-rich countries, and FDI into non-resource-rich countries from the different source economies are mostly market-led. The analysis further reveals significant differences in the determinants of FDI in resource-rich countries between intra-African investors and those from the OECD and non-OECD emerging markets economies.

[4] Own calculations based on UNTAD statistics.

The paper proceeds as follows. Section 2 analyses the trends in FDI in Africa. The literature is reviewed in Section 3. Section 4 describes the methods and data. The results are analysed in Section 5 and Section 6 concludes the paper.

2.2. FDI in Africa

As noted above, there are differences between resource rich and non-resource rich African countries in terms of economic structures. This is an indication that foreign investments from the different source economies may be driven by different location factors. In light of these differences, this section briefly analyses the trends in FDI stocks across countries and regions to assess the drivers of these investments in the continent.[5]

Policy designed to promote FDI in Africa have focused on providing generous incentives with limited efforts towards creating the enabling domestic environment in order to attract these investment (UNCTAD, 2013a). This has partly contributed to a considerably low share of Africa's FDI in global FDI compared to other regions in the developing world. During the period 2001-2013, the continent's share in global FDI stock was 3 percent compared to Asia (23 percent) and Latin America and the Caribbean (12 percent). Foreign investments to the continent have been unevenly distributed across countries and the different sub-regions. Figure 2.1 displays the geographical distribution of FDI stocks across sub-regions. Despite recent political upheavals, Northern Africa remains a leading host of foreign investments in the continent. The share of the North's FDI stock averaged 33.99 percent during the period 2001-2013, followed by Southern Africa (28.67 percent), West Africa (18.20 percent), Central Africa (9.86 percent) and East Africa (9.28 percent). Recent privatization reforms and policies designed to improve efficiency have partly contributed to promoting FDI to North Africa, in addition to investments directed to oil exploration in Egypt, Libya, Algeria and Morocco (Loots and Kabundi, 2012). Increased FDI to East Africa in recent years have been driven by resource-seeking investments, in oil and gas exploration in Tanzania, Kenya, Uganda and Mozambique (UNCTAD, 2013b). The West African region continued to attract resource-seeking investments during the period particularly in the oil sector in Ghana. The Southern region, however, experienced a downturn in

[5] FDI stocks are measured by accumulated values of FDI flows over a period of time. FDI flows capture three components of FDI i.e. equity capital, reinvested earnings and intra-company loans. See UNCTAD's definitions, available at http://unctad.org/en/Pages/DIAE/Investment%20and%20Enterprise/FDI_Flows.aspx

the share of FDI stock, which is partly explained by disinvestments in Angola induced by unfavorable government policy designed to promote local partnerships (UNCTAD, 2014).

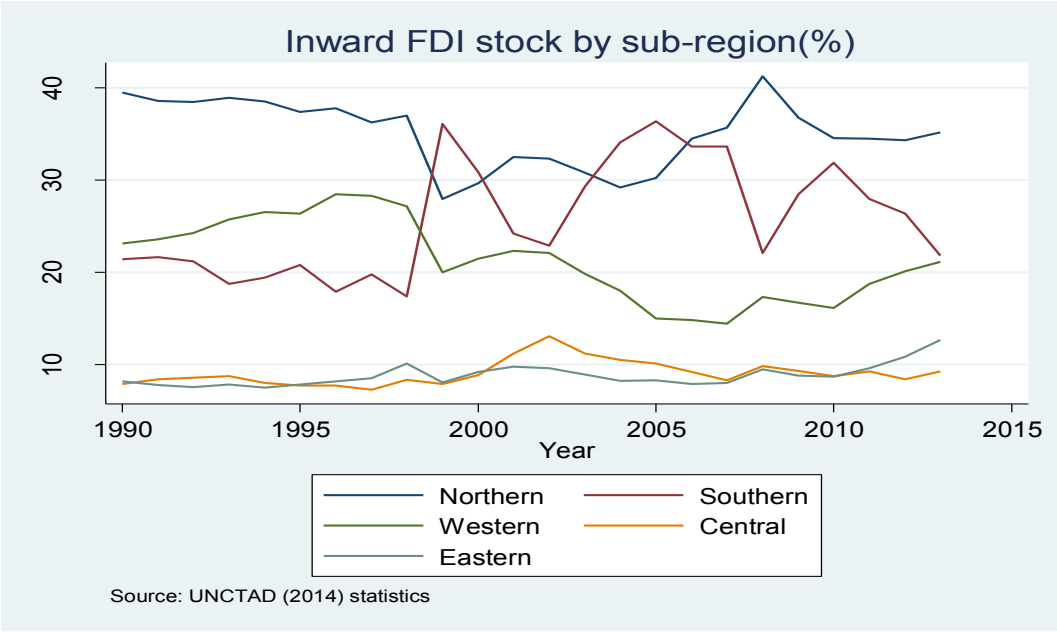

Figure 2.1: Geographical distribution of FDI across sub-regions (share)

Large and resource rich economies tend to attract much of the foreign investments to the continent (UNCTAD, 2013a). During the period 2001-2012, South Africa attracted 63 percent of inward FDI flows to sub-Saharan Africa from the EU and 17 percent of US inflows, while Nigeria accounted for 37 percent of US inflows (Sy et al., 2014). South Africa is the second largest economy in Africa and particularly endowed in some of the world's most precious minerals. Nigeria and Ghana are large resource-rich countries in West Africa, which collectively represented 71.65 percent of the stock of FDI in the sub-region over the period 2001-2012. The Egyptian economy is the largest in North Africa and remains the leading recipient of FDI to the region. Inward FDI to Egypt are driven by its population size and the presence of cheap labour costs (UNCTAD, 2014).

Countries of the OECD remain the largest investors in African economies. The stock of FDI from three leading investing economies in 2012 (USA, United Kingdom and France) represented 64 percent of the total FDI stock to the continent (AfDB et al., 2014). Availability of natural resources is an important factor driving the OECD to the continent. Investors from the USA have directed a significant proportion of investments into mining and extractive industries, 58 percent

in 2011 (Sy et al., 2014). The share of US investments in FDI stock averaged 46.23 percent in Algeria and 33.51 percent in Equatorial Guinea during the period 2001-2012. Although not a resource-rich country, Egypt was a key destination of FDI from the USA to the North African region. The share of these investments in the country's FDI stock averaged 16.94 percent over the period 2007-2012. Collectively, the United States, Italy, France and Norway contributed a share of 59.82 percent of FDI stock in Algeria during the period 2001-2012. South Africa and Nigeria were the top recipients of foreign investments from the United Kingdom. The share of FDI stock of the UK attracted by Nigeria averaged 14.54 percent during the period 2001-2012. France contributed the largest share of FDI stock in Gabon and the Republic of Congo, which amounted to 64.5 percent of FDI stock in Gabon during the period 2008-2012 and 23.65 percent in the Republic of Congo over the period 2007-2012.

Availability of natural resources remains a key attraction for foreign investors from two emerging economies (China & India) (UNCTAD, 2011). Among the top recipients of Chinese investments in Africa economies are countries endowed with natural resources including South Africa, Nigeria, Sudan, Niger and Democratic Republic of Congo (Brown, 2012). China has undertaken significant investments in oil or gas production or exploration in some African countries, namely, Gabon, Chad, Democratic republic of Congo, Equatorial Guinea, Nigeria and Tanzania (Brown, 2012). India has invested in the oil industry in Sudan.

Although natural resource-driven constitutes a greater share of investments from the OECD and emerging markets, there are suggestions of some efficiency seeking investments to the region. Efficiency-seeking has been facilitated by the adoption of preferential schemes granted under "the United States' African Growth and Opportunity Act (AGOA), the European Union's (EU's) Everything But Arms (EBA) and China's zero-tariff measures for African LDCs (least developed countries" (UNCTAD, 2013c). Mauritius is a major recipient of efficiency-seeking FDI, which serves as a platform for facilitating interregional FDI to other countries in sub-Saharan Africa. The country seeks to promote these investments through the signing of bilateral treaties with other countries such as Double Taxation Avoidance Agreements (DTAA) and Investment Promotion and Protection Agreements (IPPA) (OECD, 2014). Some non-resource rich African countries, such as Mauritius, Lesotho, Swaziland, Madagascar and Kenya, had attracted investments in the clothing and textile industries from garment firms in Asia in order to gain

access to the EU markets guaranteed under the multifiber (MFA) agreement which ended in 2004 (Kaplinsky and Morris, 2007). The investments are less skill-intensive which suggests that they could be driven by lower labour costs in host countries. Recent investments by Chinese companies in the automotive sector in Kenya have been driven by efficiency-seeking considerations (Barton and de Bellefroid, 2015). For example, the Foton manufacturing company was setup to assemble vehicles in Kenya in order to avoid payment of 25 percent import duty on cars (Juma, 2011). Foreign investments to Egypt are partly driven by lower labour costs (UNCTAD, 2014). Similarly, the garment industry in Madagascar has attracted investments from foreign firms in Mauritius, partly to exploit lower labour costs (Fukunishi and Ramiarison, 2014).

Moving to intra-African FDI, a striking feature of these investments is that they are concentrated in the manufacturing and services sectors rather than the extractive industries (UNCTAD, 2014). This suggests that intra-African FDI are more likely to be driven by market-seeking and efficiency-seeking intents than natural resource-led. This is reflected in the pattern of these investments, which are attracted by large markets and close proximity markets or neighbouring countries. During the period 2003-2012, intra-African investments were largely driven by transnational corporations (TNCs) from South Africa, Mauritius, Egypt, Nigeria and Kenya (AfDB et al., 2014).

Market-seeking is primarily the key force driving South Africa's outward FDI to other African economies.[6] Much of the investments from South Africa are largely concentrated in member States of South African Development Community (SADC). Recently, these investments have been extended beyond the borders of the SADC region and targeted markets in West Africa. Examples include the Retail Groups such as Shoprite and Woolworths, which have expanded to large markets in West Africa such as Nigeria and Ghana. The South African food and beverage company (SABMiller) has acquired a significant stake in the food industry in Nigeria (Disenyano and Sogoni, 2014). A plausible explanation for the concentration of intra-African investments in proximate and large markets is to exploit economies of scale. Intra-African investors from other sources include the Dangote Group from Nigeria. The Dangote Group is

[6] Based on survey analysis of 30 large South African firms conducted by TNS Research Surveys and DNA Economics (2012).

engaged in building materials and financial services especially in the West African sub-region. Companies such as the Comcraft and Sameer Groups from Kenya operate in the service sectors. Sameer Groups is active in agriculture, manufacturing, distribution, high-tech, construction, transport and finance (UNCTAD, 2014).

Like investments from the OECD and emerging markets, the distribution of intra-African FDI is not even across African countries. They tend to be concentrated in large markets and resource rich countries. Table 2.1 shows that the two resource rich and the largest economies in Africa (South Africa and Nigeria) were the top hosts of intra-African FDI in 2012.[7]

Table 2.1: Intra-African FDI stock (US$ billion)

Year/Country	2008	2010	2011	2012
South Africa				163.5
Nigeria				111.4
Morocco			44.5	
Mozambique				13.3
Zambia				12.4
Tanzania			9.2	
Uganda				7.7
Ghana			7.1	
Namibia				5.8
Madagascar			4.9	
Botswana				2.8
Kenya	2.8			
Mali				2.3
Lesotho		1.6		
Burkina Faso				1.2
Senegal				1.2
Malawi		1.2		
Benin				1.0
Togo			0.9	
Rwanda			0.8	
Guinea-Bissau			0.1	

Source: Extracted from UNCTAD (2014). Note: FDI stock values were only reported for the respective countries in the years indicated. The missing values reflect positions not reported, although these countries may have attracted new FDI.

Investors from South Africa are the largest contributors of intra-African FDI to African economies. If we consider the geographical distribution in table 2.2, it is clear that these investments serve as an important source of foreign capital for SADC member countries. Swaziland hosted the largest share of FDI stocks from South African in 2012 (49.06 percent) and Zimbabwe (34.83 percent). In the case of Mauritius, a close look at the country's distribution of

[7] Intra-African investments to Mauritius were not reported since the country serves as an investment platform for interregional investors (UNCTAD, 2014).

FDI in table 2 reveals that a greater of share these investments in 2012 were held in close proximity markets (Seychelles, 32.57 percent) and large markets (Nigeria, 25.04 percent).

Table 2.2: FDI stock from South Africa to selected African countries

Year/Country	2009		2010		2011		2012	
	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)
Botswana	185	6.86	268	9.12	438	12.49	408	11.53
Ghana	725	9.60	1243	12.33	1340	10.05		
Kenya	194	9.22	222	9.73	241	9.21	309	10.74
Malawi	159	15.46	181	15.74				
Mozambique	1280	32.42	1309	27.46	1861	22.30	2605	18.62
Nigeria	0.00	0.00	667	1.11	972	1.40	1944	2.55
Swaziland	238	29.42	406	41.52	461	50.53	470	49.06
Tanzania	2330	28.89	1891	21.58	2178	23.47		
Uganda	332	6.60	349	6.26	364	5.63	389	5.07
Zimbabwe	372	22.57	856	47.18	1199	54.46	906	34.83

Source: Extracted from UNCTAD (2014).

Table 2.3: FDI stock from Mauritius to selected African countries

Year/Country	2009		2010		2011		2012	
	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)	FDI stock ($ M)	Share (%)
Botswana	75	2.78	35	1.19	93	2.65	102	2.88
Madagascar	252	6.38	257	5.86	419	8.53		
Mozambique	288	7.30	974	20.44	597	7.15	810	5.79
Nigeria	0	0.00	1773	2.94	2333	3.37	19125	25.04
Seychelles	488	32.65	575	33.71	560	29.27	677	32.57
Tanzania	379	4.70	434	4.95	650	7.01		
Uganda	295	5.86	388	6.96	493	7.62	499	6.50
South Africa	460	0.33	483	0.27	1400	0.88	1101	0.67

Source: Extracted from UNCTAD (2014).

Overall, the trends reveal that the top recipients of FDI from the different source economies are large and resource-rich African countries. Efficiency-seeking, however, appears to be a key motivation behind FDI to non-resource rich countries.

2.3. Literature Review: Theory and Evidence

Over the past few decades, researchers have devoted considerable attention to explaining the factors driving FDI behaviour. There is a large body of literature on the determinants of FDI, making it absolutely difficult to undertake a complete review of what drives FDI into host countries. The literature suggests that the determinants of FDI can be explained by a combination of theories instead of a single theory (Faeth, 2009; Antonakakis and Tondl, 2015).[8] As noted in chapter one, FDI is an important component of financial globalization (Campos and Kinoshita, 2010). Firms undertake FDI primarily to advance their competitive position, seeking to expand

[8] See Faeth (2009) for comprehensive review of nine (9) theoretical models of the determinants of FD1.

markets or for purposes of achieving production efficiency objectives (Luiz and Charalambous, 2009). In the eclectic paradigm of FDI (Dunning, 1977, 1979), the factors affecting FDI behaviour are explained in terms of three advantages that MNEs possess: Ownership (O), location (L) and internalization (I) advantages or OLI paradigm. The ownership specific advantages depict the competitive advantages that foreign firms possess over domestic firms as they invest in host markets. These advantages manifest themselves in firms' possession of tangible and intangible resources, including technology, which ensures the efficiency of resource usage (Dunning, 1988). Some other intangible assets that constitute these ownership advantages include patents, technical knowledge, management skills and reputation (Faeth, 2009). The ownership advantages of foreign firms, combined with location endowments of source and host countries, have an important influence on MNEs activity, determining the extent to which these firms engage in foreign production relative to local firms in host countries (see Dunning, 1988).

Location advantages relates to the issue of where the MNE decides to invest in a host market. MNEs are motivated to direct their activities to host countries or regions that provide more location advantages, such as gaining access to restricted markets, benefiting from lower production costs and favourable tax treatments (Faeth, 2009). This suggests that countries that offer more of these advantages are more likely to become attractive destinations when MNEs undertake FDI. Internalization relates to the question of how MNEs decide to undertake production in host markets. It refers to the advantages associated with a multinational entering a host market through a wholly-owned foreign subsidiary instead of operating through other modes such as exports, licensing or joint ventures (Neary, 2009).

Dunning's OLI framework provides an important conceptual mechanism to analyse the determinants of FDI, depending on whether the focus of investigation is on firm or host country characteristics, or explaining the different forms of FDI (see Faeth, 2009). While the ownership and internalization advantages explore firm-specific determinants of FDI, the location advantages have a significant influence on inflows of FDI into host countries (Luiz and Charalambous, 2009). This framework establishes four motivations behind MNEs activities in host countries: market-seeking, resource-seeking, efficiency-seeking and strategic-asset seeking (Cleeve, 2008; Dunning, 1993; Faeth, 2009).

Market-seeking FDI are undertaken to serve host markets and regional markets to ensure that foreign customers are easily accessible. This type of FDI is predominantly attracted into large markets with greater growth prospects, seeking to produce consumer-oriented goods and industrial products. In serving local and regional markets, MNEs of market-seeking FDI type replicate production facilities established at home in host markets. This explains why these investments are known as horizontal FDI (Campos and Kinoshita, 2003). The existence of large host markets encourages foreign firms to concentrate manufacturing production in these countries in order to take advantage of scale economies and overcome trade costs (Amiti, 1998). The size of host market reflects the degree of sophistication and breath of the markets in host economies (Sahoo, 2006). A large host market creates greater opportunity for increased sales and profitability of multinational firms, and higher market growth raises the prospects for increased FDI in the host economy (Sahoo, 2006; Zheng, 2009). Market-seeking FDI is geared towards consolidating a firm's presence in existing markets or exploit new markets. This could take the form of acquisition of domestic assets in order to strengthen the firm's competitive advantages in specific markets (Cui et al., 2014).

Differences in factor costs between source and host countries such as labour costs can have significant influence on firms' decision to locate FDI in a country. Efficiency-seeking FDI is undertaken to take advantage of differences in availability and costs of factor endowments between countries or to exploit economies of scale and scope (Dunning, 1993). Resource-seeking FDI serves to ensure that MNEs gain access to resources such as natural resources, raw materials or low cost labour. Having access to these resources ensures reliable supply of natural resource inputs to the firm which helps to protect its current competitive position (Cui et al., 2014). Strategic-asset seeking FDI focuses on protecting or augmenting prevailing ownership specific advantages of the firm relative to its competitors instead of exploiting these advantages or assets (Dunning, 1998; 2000). To protect such advantages, the firm needs to acquire knowledge-based assets outside its operations such as technology, brand names and managerial know-how (see Cui et al., 2014), which enhance core competence and strengthen its competitive position. Strategic-asset seeking FDI are mostly undertaken in the advanced economies and large developing countries, given that these investments are driven by strategic considerations in the presence of

oligopolistic industries, coupled with availability of knowledge-based assets in these economies (Dunning, 1998).

The international trade literature has advanced two strands of models to explain why MNEs decide to locate in a foreign market. This literature distinguishes between horizontal or market-seeking FDI and vertical FDI which relates to efficiency-seeking and resource-seeking FDI. The horizontal model of FDI developed by Markusen (1984) suggests that FDI occurs when MNEs replicate the production facilities at source country in the host markets or close to customers to enhance market opportunities and avoid transport costs and trade barriers. Arguably, domestic host markets can be well served when the MNEs produce for these markets. This suggests that the size of host markets and market growth are important determinants of horizontal FDI. The flow of horizontal FDI into host countries is expected to be greater with restrictive access to host markets, such as high transportation costs and tariffs. This model predicts greater bilateral FDI when source and host countries are similar in market size and relative skill endowment (Blonigen and Wang, 2005; Lankhuizen, 2014; Yeaple, 2003). In relatively small host markets, MNEs would prefer to undertake exports instead of FDI, since the fixed costs associated with establishing a production facility in host markets are potentially greater than the savings in trade costs (Glass, 2008). The horizontal motivation of FDI is associated with the proximity-concentration hypothesis, which predicts the case of horizontal type MNEs when the benefits associated with operating a plant in the domestic host market (reduction in trade costs) outweigh the advantages of production scale economies that arise from operating a single plant in the source country (Brainard, 1997).

Considering the vertical motivation of FDI developed by Helpman (1984), FDI is predicted to occur when there are differences in relative skill endowments between the source and host economies. In this case, the MNEs relocate part of the production chain from headquarters to domestic host markets in order to exploit relative factor-cost differences between these countries. The availability of low labour costs is an important factor driving vertical or efficiency-seeking FDI (Antonakakis and Tondl, 2015; Campos and Kinoshita, 2003; Zheng, 2009), which partly explains the flow of FDI from developed to developing economies with dissimilarity in relative skill endowments. In other words, vertical FDI seeks to explore low cost or relatively abundant

unskilled labour locations in order to undertake labour-intensive production activities (Blonigen and Piger, 2014; Faeth, 2009).

In order to determine whether MNEs activities are driven by horizontal or vertical motivations in host markets, recent works by Markusen et al. (1996) and Markusen (1997) have integrated both predictions into a unified theoretical model known as the knowledge-capital model of FDI. The empirical specification of FDI based on this framework was proposed by Carr et al (2001). It has been extensively used in empirical research to analyze the determinants of FDI. The framework provides some modification to the standard gravity model, which relates bilateral FDI to be positively associated with the market size of host and source countries and negatively predicted by a measure of trade costs such as bilateral distance. More specifically, in the knowledge-capital model of FDI, horizontal FDI is determined by similarity in market size, relative factor endowments and transport costs; while vertical FDI is explained by differences in relative factor endowments between source and host countries (Faeth, 2009). Baltagi et al (2007) augmented the knowledge-capital model to capture the role of third-country effect in explaining FDI. This refers to the view that bilateral FDI is not only determined by host and host country characteristics but also those of the third market. In a similar manner, Bergstrand and Egger (2007) included third-country effect in analyzing bilateral trade and FDI relationships.

The gravity model developed by Kleinert and Toubal (2010) provides theoretical explanations for the framework of the knowledge-capital model. This model explicitly allows for relative size effects in the specification, predicting that bilateral FDI will be greater when the market size of host country is large relative to the source country. The model further predicts a positive relationship between bilateral FDI and relative factor endowment, which reflects the presence of vertical or efficiency-seeking motivation of FDI.

The empirical evidence appears to support this prediction. In China, Zheng and Tan (2011) found that the relative market size positively predicted bilateral FDI from both OECD developed and non-OECD developing countries. This suggests that these investments are market-seeking. Empirical studies based on aggregate FDI into host African countries showed significant positive effect of host market size on FDI (Asiedu, 2006; Nude and Krugell, 2007; Anyanwu, 2012; Loots and Kabundi, 2012). As noted, the results of these studies are susceptible to heterogeneity

bias, due to potential heterogeneity across host countries and among investors from the different source economies. From the review, we hypothesize that the larger the markets size of host countries relative to source countries, the greater the volume of bilateral FDI from source to host countries.

As noted, the knowledge-capital model predicts that vertical FDI is driven by differences in relative factor endowment between source and host economies. This suggests that relative skill endowment should positively affect bilateral FDI (Blonigen and Wang, 2005; Braconier et al., 2005; Kleinert and Toubal, 2010; Lankhuizen, 2014). The expected positive relationship is a reflection of the fact that unskilled –labour-abundant countries will attract more FDI due to lower wages (Blonigen and Piger, 2014). Due to limited data on skill endowment, vertical or efficiency-seeking FDI is proxied by the difference in wage costs between the source and host country. In the absence of information on labour costs, a body of research has also considered the difference in real GDP per capita between the source and host countries as a proxy for vertical FDI (Andres et al., 2013; Busse et al., 2010). Across Africa, there is scarce evidence on the question of whether intra-African FDI is driven by efficiency-seeking considerations. The trends discussed above suggest that intra-African FDI tends to be concentrated in neighbouring markets and large markets. These investments may have been facilitated by regional trade agreements which promote efficiency-seeking FDI, as well as the need to exploit economies of scale and scope in large markets. The trend analysis further suggests that some non-resource rich countries have attracted FDI in clothing and textile industry from Asia that, largely employ low cost unskilled local workforce. Given these facts, this study hypothesizes that FDI from the different groups of economies are driven by efficiency-seeking considerations into domestic host markets.

The empirical literature on the effect of natural resources on FDI in African economies shows mixed results. Using the share of fuel and minerals in merchandise exports and a panel of 22 countries in sub-Saharan Africa, Asiedu (2006) shows that natural resources is a significant factor that attracts FDI to host countries. Loots and Kabundi (2012) present the same conclusion using a dummy variable for oil exporters and panel of 46 countries over the period 2000-2007. In a similar manner, Anyanwu (2012) employs a dummy variable for oil exporters for a sample of 53 African countries, over the period 1996-2008 and finds strong positive effect of natural resources on FDI to African countries.

Another strand of empirical literature has shown that resource dependence can undermine FDI flows. Proponents of the FDI-natural resource curse theory argue that natural resources attract FDI but crowd out non-resources FDI; and aggregate FDI in resource -rich countries would be lower when the effect of the decrease in non-resource FDI offset the increase in resource FDI (Poelhekke and van der Ploeg, 2010). The study used sector level data on outward FDI from the Netherlands and found that subsoil assets boost resource FDI but exerts a negative effect on non-resource FDI. The adverse effect of natural resources and FDI is attributed to a number of factors. Natural resource boom leads to currency appreciation and consequent loss of export competitiveness, which, in turn, induces crowding out of investment in the non-natural resource tradable sectors (Asiedu and Lien, 2011). Volatility in global commodity prices causes macroeconomic uncertainty which has a dampening effect on foreign investments in the country. Natural resource extraction involves large capital expenditures at the onset of extraction, but revenues generated in subsequent operations are minimal and may not provide sufficient resources to promote investments in the non-resource sectors.

Evidence on African economies has shown an adverse effect of natural resources on FDI to the region, using aggregate FDI (Asiedu, 2013) and bilateral FDI from the USA into African countries (Nwaogu and Ryan, 2014). However, these studies have not taken into account potential differences in resource seeking motives of MNEs from the different groups of economies. There appears to be some differences between investors from the different economies in terms of the portfolio of investments directed to African economies. As noted, a sizeable proportion of FDI from the OECD and non-OECD emerging markets appears to have been directed towards the extractive industries, compared to intra-African FDI which is largely concentrated in manufacturing and services sectors. From the discussion, a third hypothesis tested is that natural resource endowment is likely to undermine non-resource FDI in host resource-rich countries. A related hypothesis explored is that there are differences in the nature of natural resource-seeking FDI between investors from African economies and the OECD economies and non-OECD emerging market economies.

There are further differences in the pattern of FDI into host African economies between investors from African countries and the OECD developed economies. The patterns point to potential

differences in market-seeking motivations of FDI. It is argued that intra-African FDI uses relatively less sophisticated technology to produce consumer-oriented products and that these investments are less capital intensive (see AfDB et al., 2014). This suggests that intra-African FDI may be less sensitive to the level of development of host countries, compared to FDI from OECD developed economies which produces technology intensive products, and are attracted into host countries with higher level of income, educated workforce and good quality infrastructure (see Antonakakis and Tondl, 2015). Given this pattern of FDI, we hypothesize that the nature of market-seeking FDI from intra-African investors is likely to be different from investors from the OECD economies.

Overall, the literature reveals a clear relationship between FDI, relative market size, endowment of natural resources and labour costs in host countries. It further suggests that the effect of these factors on FDI could be explained by an integrated framework that captures the different arguments on these drivers of FDI.

2.4. Methods and Data

2.4.1 Methods

The literature surveyed above suggests that the motivations for FDI, market-seeking, efficiency-seeking and resource-seeking FDI, are not all explained by one theoretical framework. It is therefore useful to consider an empirical specification that integrates all the predictions of the underlying motivations of FDI. A gravity-type model is estimated, which has become the workhorse of empirical research in analyzing bilateral relationships not only FDI, but trade, imports and exports (see Shepherd, 2013). The basic gravity model is akin to Newton's Law of gravity and relates FDI directly to economic mass (GDP) of the host and source countries and inversely to the trade costs between the two countries. As noted, bilateral FDI stock is measured by the accumulated value of FDI flows over a period of time. On the other hand, FDI flows capture three components of FDI i.e. equity capital, reinvested earnings and intra-company loans. As such, a negative value of FDI suggests that the negative amount of at least one of these

components more than offset the positive amounts of the other components.[9] This is an indication that the host economy is facing reverse investments or disinvestments.

Given the definition above, one would argue that FDI stocks are not likely to be explained by contemporaneous variables. A gravity-type model with one-period lags of the explanatory variables (excluding distance and dummy variables) is estimated. Along these lines, it is important to indicate that specifying a gravity model using bilateral FDI stocks allows us to capture the time lag effects of the explanatory variables (see Dauti, 2015). In its log-linear form, the basic gravity model of bilateral FDI stocks can be expressed as:

$$\log \mathrm{FDI}_{\mathrm{ijt}} = \beta_0 + \beta_1 \log \mathrm{GDP}_{\mathrm{jt-1}} + \beta_2 \log \mathrm{GDP}_{\mathrm{it-1}} + \beta_3 \log \tau_{\mathrm{ij}} + \varepsilon_{\mathrm{ijt}} \qquad (2.1)$$

Where FDI_{ijt} is bilateral FDI stock from source country i to host country j at time t; GDP_{jt-1} and GDP_{it-1} denote one-period lags of real GDP of host and source countries respectively, τ_{ij} denotes trade costs proxied by distance between host and source countries.

Most empirical studies investigating the motivations and determinants of FDI have specifically adopted the framework of the knowledge-capital model (Carr et al., 2001), partly due to its theoretical predictions (see Blonigen and Wang, 2005). Three alternative specifications of FDI have emerged in the empirical literature to explain both horizontal and vertical motivations of FDI (see Martinez et al., 2012). In line with this literature, our empirical specification is based on the knowledge-capital model along the lines of specifications by Kleinert and Toubal (2010) and Baltagi et al. (2008), with some modifications to include natural resources and control variables. The estimation equation is specified in log-linear form as:

$$\begin{aligned} \log FDI_{ijt} = \alpha + \beta_1 log\left(RGDP_{it-1} + RGDP_{jt-1}\right) + \beta_2 log\left(SIZE_{ijt-1}\right) + \beta_3 RFE_{ijt-1} \\ + \beta_4 \log\left(D_{ij}\right) + \gamma' Y_{ijt} + \varepsilon_{ijt} \qquad (2.2) \\ \varepsilon_{ijt} = u_{ij} + v_{ijt} \end{aligned}$$

Where $\log\left(\mathrm{RGDP}_{\mathrm{it-1}} + \mathrm{RGDP}_{\mathrm{jt-1}}\right)$ is the log of the sum of source and host country real GDPs lagged by one time period, $\log\left(\mathrm{SIZE}_{\mathrm{ijt-1}}\right)$ is one-period lag of the log of the relative market size of the host and source countries, $\mathrm{RFE}_{\mathrm{ijt-1}}$ is relative factor endowment also lagged by one period

[9] See UNCTAD's definitions, available at http://unctad.org/en/Pages/DIAE/Investment%20and%20Enterprise/FDI_Flows.aspx

and D_{ij} is bilateral distance. u_{ij} captures country-pair invariant factors not included in the model, such as the existence of common official language, common border and colonial links. Y_{ijt} is a vector of control variables that captures one-period lags of bilateral exchange rates and trade, and dummy variables denoting the existence of a ratified bilateral investment treaty (BIT) and whether host and source countries belong to regional trade agreements (RTAs). Country-pair fixed effect (u_{ij}) are included in the specification of the error component to help guard against potential omitted variable bias that may arise when bilateral characteristics, such as existence of common language and colonial links between countries are not added as explanatory variables (Bergstrand and Egger, 2007). Similarly, Baltagi et al. (2014) echo the view that it would be appropriate to include the country-pair fixed effects to deal with endogeneity issues when cross-sections of country- pairs are observed repeatedly over time.

In this framework, FDI increases with the total income of both countries $(\mathrm{RGDP}_{it-1} + \mathrm{RGDP}_{jt-1})$ and relative market size, defined as the ratio of host to source countries' real GDP lagged by one time period $(\mathrm{RGDP}_{jt-1}/\mathrm{RGDP}_{it-1})$. Both variables capture horizontal motivations of FDI, which occur between large countries of similar size, and the coefficients on these variables are expected to be positive (see Baltagi et al., 2008). More FDI is expected from large countries and host countries with relatively large markets will receive more FDI (Leibracht and Riedl, 2012). It implies also that horizontal FDI takes place between countries of similar factor abundance (Yeaple, 2003). Due to limited data on unit labour costs of host countries, relative factor endowment (RFE_{ijt-1}), measured by the difference in real GDP per capita between source and host countries is used as a proxy for relative labour costs (Andre`s et al, 2013). This variable captures vertical FDI (Busse, 2010) and therefore used to assess the importance of lower labour costs in driving these investments in host countries (efficiency-seeking motives). The vertical model of FDI predicts that bilateral FDI increases when there are large differences in relative factor endowments (Yeaple, 2003), suggesting that the coefficient on RFE_{ijt-1} should be positive. The coefficient on geographic distance (D_{ij}) between the host and source country is ambiguous as it reflects both export costs and investment and monitoring costs (Carr et al., 2001). Given these costs, Leibracht and Riedl (2012) argue that the sign depends on whether FDI is driven by efficiency-seeking or market-seeking motivations. For market-seeking FDI, which

serve as substitute for exports, larger distance is associated with higher bilateral FDI. Since efficiency-seeking FDI are export-oriented, a larger bilateral distance can discourage FDI.

Note that the gravity specification in equation (2.2) does not include natural resource endowment, which is one of the explanatory variables of interest, since this model only includes bilateral characteristics of host and source countries. To capture the effect of natural resources on FDI and additional determinants of FDI, an alternative gravity model is estimated, which includes country specific fixed effects and time fixed effects as specified in equation (2.3):

$$\log FDI_{ijt} = \alpha + \beta_1 log\left(RGDP_{it-1} + RGDP_{jt-1}\right) + \beta_2 log\left(SIZE_{ijt-1}\right) + \beta_3 NRES_{jt-1} + \beta_4 RFE_{ijt-1} + \beta_5 \log\left(D_{ij}\right) + \gamma' Y_{ijt} + \vartheta' Z'_{jt-1} + u_i + v_j + \delta_t + v_{ijt} \quad (2.3)$$

Literature suggests that it is desirable to include country specific fixed effects u_i and v_j and time fixed effects (δ_t) in the estimation of the gravity model, with the latter controlling for business cycle effects (Egger, 2000; Egger and Pfaffermayr, 2003; Matyas, 1997). This specification allows for potential endogeneity of bilateral characteristics in equation (2.2) through unobserved country-pair fixed effects $\left(u_i, v_j\right)$ and host country-specific factors such as $NRES_{jt-1}$ through correlation with unobserved country effects v_j. Z_{jt-1} is a vector of variables that control additional determinants of FDI in host countries, such as the quality of institutions, trade openness, macroeconomic stability, financial development, surrounding market potential, quality of infrastructure and a dummy variable to capture episode of internal armed conflict. In order to attest to the differences between intra-African investors and counterparts from OECD and non-OECD emerging market economies in the determinants of FDI, equation (2.3) is augmented to include a dummy variable for investments originating from either OECD or emerging markets, and interaction terms between such a dummy variable and relative market size, natural resource dependence and relative factor endowments as specified in equation (2.4) as:

$$\log FDI_{ijt} = \alpha + \beta OECD_i + \theta' X_{jt-1} + \emptyset' \text{OECD} * X_{jt-1} + \vartheta' Z_{jt-1} + \gamma' Y_{ijt} + u_i + v_j + \delta_t + v_{ijt} \quad (2.4)$$

Where $OECD$ a dummy variable is coded 1 if FDI originates from the OECD and zero if intra-African; and X_{jt-1} is a vector of the factors of interest (relative economic size, natural resources

and relative factor endowments). Next, OECD is replaced with EME where the latter takes a value of 1 if the source of FDI is an emerging market economy and zero if intra-African. In a similar manner, we determine whether the factors explaining FDI to South Africa (SA) are different from the drivers of FDI to other African countries, by replacing the OECD dummy in equation (2.4) with SA dummy and interacting with the variables of interest.

As a first step, the estimation equation (2.2) can be estimated using the pooled ordinary least squares (OLS) technique. However, one problem with this approach is dealing with potential endogeneity issues, such as distance, which is correlated with unobserved country-pair fixed effects u_{ij}. The resulting parameter estimates are biased if such correlation is ignored. Attempts to deal with the problem of unobserved effects have led to different estimation techniques, including the estimation of linear panel data models such as random effects and fixed effects, which take into account the panel structure of the data. To explain the underlying assumptions of these models, consider the linear panel model specification in equation (2.5):

$$y_{it} = v_j + x'_{jt}\beta + \varepsilon_{jt} \qquad (2.5)$$

Where v_j is unobserved country-specific effects and x'_{jt} is a vector of explanatory variables. The random effects model makes the strong assumption that v_j is not correlated with the explanatory variables x'_{jt}. Such an assumption is unrealistic given the potential correlation of v_j with natural resource dependence. It is well documented in the resource-curse literature that natural resources affect the quality of institutions in host countries (see e.g. Blute et al., 2005; Brunnschweiler and Blute, 2008), which suggests that v_j will be correlated with measures of natural resources and institutional quality. Such a problem is mitigated by estimating the fixed effects model, which assumes that the unobserved country fixed effects v_j are correlated with the explanatory variables. To determine whether the fixed effects or the random effects model should be estimated, the Hausman specification test is performed with rejection of the hull hypothesis of this test suggesting that the estimates of the fixed effects and not the random effects are consistent (Cameroon and Trivedi, 2010).

The fixed effects estimator is akin to the first-differenced model, which implies that using FDI stock as dependent variable will generate net inflows through the differences in stocks (see Egger and Merlo, 2007). While the fixed effects model provides consistent estimates, the parameters of

the time-invariant explanatory variables in the gravity model (e.g. distance) are not estimated. In addition, although the fixed effects model tends to mitigate potential endogeneity issues, there are however endogeneity concerns even after taking one-period lag of the explanatory variables. To address these concerns and the limitations inherent in both the random effects and fixed effects models, the Hausman-Taylor instrumental variable (Hausman and Taylor, 1981) is estimated. The Hausman-Taylor estimation technique addresses the problem of endogeneity by allowing some explanatory variables to be endogenous, and ensures the estimation of coefficients of both time-variant and time-invariant regressors. It is suitable in estimating unbalanced panel data when such data are randomly missing (Baltagi et al., 2014). Following the specification of the Hausman-Taylor estimator by Cameron and Trivedi (2010) and Baltagi et al. (2014), the Hausman-Taylor gravity model of bilateral FDI stock from equation (2.2) is specified as:

$$FDI_{ijt} = X_{1it-1}\beta_1 + X_{2it-1}\beta_2 + Z_{1i}\delta_1 + Z_{2i}\delta_2 + \varepsilon_{ijt} \qquad (2.6)$$
$$\varepsilon_{ijt} = u_{ij} + v_{ijt}$$

Where X_{1it-1} is a set of time varying explanatory variables that are uncorrelated with the country-pair fixed effects u_{ij} and the error term v_{ijt}. X_{2it-1} is a set of time-varying explanatory variables which are potentially correlated with u_{ij} but not v_{ijt}. Z_{1i} denotes a time-invariant exogenous variable and Z_{2i} captures the time-invariant endogenous variables. The Hausman-Taylor model will yield consistent estimates when the explanatory variables are properly separated into exogenous and endogenous variables and the model is over-identified (Baltagi et al., 2014). This approach uses an instrumental variable (IV) estimation technique, with a set of instruments derived internally from information within the model (Cameron and Trivedi, 2010). For identification of the parameters of the model, the approach requires that the number of time-varying exogenous regressors (X_{1it-1}) must be at least as large as the number of time-invariant endogenous regressors (Z_{2i}) (Cameron and Trivedi, 2010). In order to guard against the problem of weak instruments, it is helpful to ensure that there is sufficient correlation between the instruments (X_{1it-1}) and the time-invariant endogenous regressors Z_{2i}. The Sargan-Hansen test is performed to test for over-identifying restrictions in the Hausman-Taylor model. Failure to reject the null hypothesis of this test is an indication that the over-identifying restrictions are valid.

Possible set of explanatory variables in the vector X_{2it-1} that are potentially endogenous due to correlation with the country-pair-specific effects (u_{ij}) are the sum of real GDPs of source and host countries, relative market size, relative factor endowments, as well as dummy variables that capture the effects of bilateral investment treaty and regional trade agreements on bilateral FDI stocks (see Bergstrand and Egger, 2007; Egger, 2004). The existence of ratified BIT may proxy for the quality of institutions in host economies and potentially endogenous (Busse et al., 2010). Similarly, bilateral distance is a proxy for cultural similarity between the source and host country and affects trade or transaction costs. This variable is correlated with the omitted country-pair-specific effects and potentially endogenous (Z_{2i}).

If one considers the second estimation equation (2.3), other time-varying host country factors included in the vector X_{2it-1} are also potentially endogenous through possible correlation with country-specific effects v_j. For example, the resource curse theory predicts that natural resources negatively correlate with the quality of institutions in host economies, implying that natural resources and corruption are endogenous explanatory variables. Well-functioning domestic financial markets would lower the costs of transactions and thus enhance the efficiency of financial resources allocated to investment projects. It also facilitates internal mobilization of capital from domestic markets to finance the operations of MNCs, suggesting that countries with well-developed financial markets are more likely to attract more FDI. This implies that the ratio of domestic credit to the private sector to GDP, which is a proxy for domestic financial markets development, is potentially endogenous. Similarly, good quality infrastructure reduces transaction costs and enhances the efficiency of FDI (Kinishita and Lu, 2006). The internal armed conflict dummy is also considered here as potentially endogenous variable given that armed conflict affects commodity prices, which in turn determines the profitability of MNE activities and influences their investment decisions (see Lee, 2014). In the case of variables in the vector X_{1it-1}, they are treated as uncorrelated with the unobserved effects. Possible candidates are the surrounding market potential and bilateral real exchange rate.[10]

[10] Measures of macroeconomic instability (volatility in inflation and real exchange rate) are weakly correlated with the time-invariant endogenous distance variable. These variables were not included in the model to avoid the problem of weak instruments. As such, the bilateral real exchange rate is used in the estimation of the Hausman-Taylor models.

The gravity model of FDI is often estimated in its natural logarithm form rather than in levels in order to deal with the problem of skewed FDI data. This approach reduces the weights of outliers and the estimated parameters of the continuous explanatory variables can be easily interpreted as elasticities (Levy-Yeyati et al., 2007; Dinga and Dingova, 2011). However, one limitation of this approach is that zero and negative FDI stock values are eliminated. Dropping these observations from the regression may result in biased estimates, given that zeros may not be random observations and could be driven by investment indivisibilities and fixed costs (Dabla-Norris et al., 2010). Santos-Silva and Tenreyro (2006, 2011) and Westerlund and Wilhelmsson (2011) address the issue of zero trade flows using the Poisson pseudo- maximum likelihood (PPML) estimator. This approach requires that the dependent variable is non-negative (Santos-Silva and Tenereyro, 2011). Our data, however, contains negative FDI stock values, which cannot be discarded since these observations could reflect existing institutional environment that discourages FDI.[11] To retain zero and negative observations on the dependent variable, the semi-log transformation proposed by Levy-Yeyati et al. (2007) is adopted. It takes the form:

$$LFDI = sign(FDI)\log(1 + |FDI|) \qquad (2.7)$$

The first part of the transformation $sign(FDI)$ returns a component equals -1 when FDI stock is negative, 0 when it is zero and 1 when greater than zero. This transformation ensures that zero and negative values on bilateral FDI stock are preserved after taking the logs of the variable.

2.4.2 Data

The dependent variable is defined in terms of bilateral FDI stocks instead of FDI flows. FDI stock variable is measured by accumulated values of FDI flows over a period of time. FDI flows comprises three components of FDI i.e. equity capital, reinvested earnings and intra-company loans.[12] As noted, using FDI stocks allows us to capture the time lag effects of the explanatory variables. The data on bilateral FDI stock is sourced from UNCTAD (2014) database.[13] Real

[11] Negative values of FDI reflect reverse investments or disinvestments. For example, recent disinvestments in Angola were induced by government policy that requires foreign affiliates to team with local partners. The projects, however, were not successfully implemented due to lack of local partners (UNCTAD, 2014).

[12] See UNCTAD's definitions, available at http://unctad.org/en/Pages/DIAE/Investment%20and%20Enterprise/FDI_Flows.aspx

[13] UNCTAD's Bilateral FDI Statistics (2014) is available at http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx

GDP of host and source countries (constant 2005 US$) are obtained from the World Development Indicators (WDI). Data on real GDP per capita (constant 2005 US$) is also sourced from the WDI. Bilateral real exchange rates were calculated using annual nominal exchange rates of source and host countries to the US$ and corresponding consumer price indices (2005=100) and both series are obtained from the WDI. The level of development of domestic financial markets is proxied by the ratio of domestic credit to the private sector to GDP and sourced from the Global Financial Development (2015) database. Institutional quality is proxied by control of corruption index sourced from the Governance Indicators of the World Bank (Kauffman Index). Surrounding market potential is constructed using real GDP per capita and distance (see appendix A2.1), with the latter obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) database.

Trade openness is obtained as the ratio of the sum of exports and imports in nominal GDP, for which data is obtained from the WDI database. Regional trade agreement (RTA) is represented by a dummy coded 1, if both host and source countries have free trade agreement or belong to a customs union or an economic integration agreement. This variable is constructed using data from the World Trade Organization (WTO). Similarly, bilateral investment treaty (BIT) is proxied by a dummy reflecting the existence of a ratified treaty between source and host country. To construct the variable, data was obtained from the UNCTAD database.

The resource-curse literature distinguishes between measures of natural resource dependence or intensity and natural resource abundance. Natural resource dependence is proxied by the ratio of resource exports in total exports or GDP, whereas natural resource abundance is measured by resource stocks (Brunnschweiler and Blute, 2008). Given that resource stock measures are relatively static, this study follows recent literature and considers more dynamic measures of natural resource dependence. Two measures of natural resource dependence are used: sum of the share of fuel exports, ores and metal exports in total merchandise exports (Asiedu, 2006; Asiedu and Lien, 2011; Nwaogu and Ryan, 2014) and the sum of the share oil rents and mineral rents in GDP.[14] Sets of data on the variables are collected from the World Bank's WDI. Appendix A 2.1 provides a summary description of the variables used in the regression.

[14] Oil rents is used in some empirical studies as a measure of natural resources (Poelhekke and Van der Ploeg, 2010; Asiedu, 2013). However, due to limited number of oil exporting countries and the diversity in natural resource

The study uses an unbalanced panel of 46 host countries and the gravity model is estimated over the period 2001-2012. To guard against potential heterogeneity bias arising from the differences in economic structures between the resource and non-resource rich countries, host countries are sub-divided into resource-rich countries (24 members) and non-resource rich countries (21). Similarly, source countries are categorized into interregional, OECD and non-OECD emerging market economies. This classification yields a sample of 23 OECD and other developed economies, 14 non-OECD emerging markets and 33 intra-African source countries with a total of 8952 observations. The separation of host countries into resource and non-resource rich in sub-Saharan Africa was based on the criterion that resource exports exceeded 25 percent of total merchandise exports in 2005-2010 (Thomas and Trevino, 2013). In addition, Mozambique is considered as a resource-rich country due to recent exploration of gas deposits in the country. Appendix A2.2 shows the different classifications of host African countries and source countries from the different groups.

Table 2.4 compares the distribution of inward FDI stock and explanatory variables of interest between resource and non-resource rich host African countries over the period 2001-2012. In particular, resource-rich countries received greater volume of FDI than non-resource rich countries, averaging US$516.9 million and US$ 409.1 million, respectively, over the review period. Similarly, the relative market size of resource rich economies is larger in resource-rich than non-resource rich countries. This is prima facie evidence that large and/or resource-rich countries may have attracted more FDI than small and/or non-resource rich countries.

Table 2.4: Descriptive statistics for resource and non-resource rich countries (2001-2012)

Panel A: Resource rich countries					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Bilateral Inward FDI stock (US$ millions)	4,031	516.9	3480	-1527	80439
Relative market size	4,932	4.125	26.89	0.000	468.7
Sum real GDP (US$ billions)	4,932	1491	2895	7.406	14454
Relative factor endowment	4,932	2.521	1.534	0.000	5.599
Fuel, ore & metals (% merchandise exports)	4,572	52.32	31.49	3.799	99.67
Oil & mineral rents (% GDP)	4,932	15.01	19.30	0.000	93.11
Panel B: Non-resource rich countries					
Bilateral Inward FDI stock (US$ millions)	2,465	409.1	2339	-1344	51193
Relative market size	3,624	0.230	0.808	0.000	11.88
Sum real GDP (US$ billions)	3,624	1625	3156	2.475	14264
Relative factor endowment	3,624	2.725	1.581	0.000	6.153
Fuel, ore & metals (% merchandise exports)	3,396	10.18	13.80	0.000	58.69
Oil & mineral rents (% GDP)	3,624	1.347	2.860	0.000	14.13

endowments across host economies, an alternative measure of natural resource dependence is constructed by combining oil rents (% GDP) and mineral rents (% GDP).

2.5. Results and Discussion

The descriptive analysis above suggests that large and resource rich countries may have attracted more FDI than non-resource rich countries. Given such a trend, it is helpful to empirically evaluate the role of markets, natural resource endowments and efficiency-seeking considerations in driving FDI from the different sources to host countries. The analysis here uses both static panel and dynamic panel estimation techniques. In the case of the static panel data analysis, three (3) approaches are employed - fixed effects model (FEM), random effects model (REM) and Hausman-Taylor (HT) estimation techniques. These approaches are widely used in the empirical literature to explain the motivations and determinants of FDI.

As a first step, the determinants of intra-African and interregional FDI are analyzed using the full sample of all inward FDI stock to resource and non-resource rich African countries. As noted, when determining whether to use the FEM or REM, the Hausman test statistic is used. Rejection of the null hypothesis is an indication that the FEM is preferable to the REM. In both estimations of intra-African and interregional FDI, the Hausman test statistics strongly rejects the null hypothesis that the individual effects are random. Table 2.5 displays the results of the estimation of the drivers of both intra-African and interregional FDI. Column (1) of the results in table 2.5 shows that relative market size and sum of real GDP of host and source countries positively affect bilateral intra-African FDI. However, the coefficient on relative market size is not statistically significant. The result does not provide conclusive evidence in support of horizontal (market-seeking) motivations of intra-African FDI. Note that the FEM approach does not identify time-invariant factors such as distance which are relevant in the empirical estimation of gravity models.

Table 2.5: Determinants of Intra-African and Interregional FDI

Variables	(1) FEM-all	(2) REM-all	(3) HT-all	(4) FEM-all	(5) REM-all	(6) HT-all
	Intra-African FDI			Interregional FDI		
Lagged log relative market size	0.677	0.059	0.708*	1.647***	0.704***	1.595***
	(0.483)	(0.065)	(0.385)	(0.275)	(0.064)	(0.264)
Lagged log sum real GDP	3.302***	1.245***	3.286***	4.326***	1.557***	4.330***
	(0.474)	(0.123)	(0.480)	(0.324)	(0.113)	(0.324)
Lagged relative factor endowment	0.071	0.057	0.078	-0.082***	0.007	-0.084***
	(0.134)	(0.038)	(0.118)	(0.019)	(0.005)	(0.019)
Regional trade agreement dummy	-0.584	0.241	-0.598			
	(0.378)	(0.338)	(0.373)			
Bilateral investment treaty dummy	0.633***	1.345***	0.746***	0.460**	0.654***	0.451**
	(0.105)	(0.318)	(0.256)	(0.216)	(0.167)	(0.217)
Lagged trade openness	-0.013**	-0.003	-0.013***	-0.002	0.002	-0.001
	(0.005)	(0.003)	(0.005)	(0.002)	(0.002)	(0.002)
Log distance		-0.595***	-1.180		-0.160	4.250***
		(0.201)	(0.809)		(0.198)	(1.639)
Landlocked		0.527	2.572***		0.067	0.075
		(0.356)	(0.994)		(0.231)	(0.689)
Constant	-78.504***	-23.906***	-68.930***	-107.274***	-36.202***	-144.594***
	(11.746)	(3.737)	(14.764)	(8.666)	(3.190)	(17.919)
Observations	1,134	1,134	1,134	4,396	4,396	4,396
R-squared	0.140			0.124		
Number of country-pairs	163	163	163	550	550	550
Hausman test	77.39***			246.45***		
Overidentifying restrictions test (p-value)			0.89			0.14

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log relative market size, lagged log sum real GDP and lagged relative factor endowment. Time-varying exogenous regressors: lagged trade openness, bilateral investment treaty and regional trade agreement dummies. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

While the REM reports such estimates, it makes the strong assumption that the country fixed effects are not correlated with the explaining variables, which is problematic. Estimation of the Hausman-Taylor model avoids the problems inherent in both the REM and the FEM. To estimate the parameter estimates of the Hausman-Taylor model, one needs to ascertain whether there is sufficient correlation between the time-invariant endogenous variable (log distance) and potential time-varying exogenous variables. This is done by analyzing the statistical significance of the correlations between the log of distance and all the explanatory variables, since potential time-varying endogenous explanatory variables may otherwise turn out to be exogenous, as determined by the test of over-identifying restrictions. Appendix A2.3 presents such correlations, which shows that the distance variable is strongly correlated with all independent variables, except the ratio of domestic credit to GDP and internal armed conflict dummy.

Given the reported association between distance and the explanatory variables, a further step in analyzing the parameter estimates of the Hausman-Taylor model is to evaluate whether the orthogonality condition is satisfied using the Sargan-Hansen test for over-identifying restrictions. It tests for validity of the instruments and in both specifications of intra-African and interregional FDI, the null hypothesis is not rejected suggesting that that the over-identifying restrictions are valid.

Looking at the estimates of the Hausman-Taylor model for intra-African FDI, column (3) of the results in table 2.5 shows that relative market size and sum of real GDP of host and source countries have the expected positive signs and are statistically significant at 10 percent and 1 percent, respectively. This is evidence suggesting that the market size of host countries is an important factor determining intra-African FDI. The evidence supports the view that the size of host market should be large enough to ensure that MNEs offset the fixed costs of setting-up production in the domestic host markets (Blonigen and Wang, 2005). The same is true qualitatively for the estimates of interregional FDI reported in column (6) of the results in table 2.5 based on the Hausman-Taylor estimation strategy. The results do not reject the hypothesis that FDI to African countries are driven by market-seeking considerations. The presence of positive and significant coefficients on relative market size and sum of host and source real GDP is consistent with previous studies (e.g. Martinez et al., 2012 for the European Union). Large markets offer more profitable investment opportunities compared to smaller markets. The larger the markets the more sales are generated by MNEs. This subsequently attracts other firms to invest in the host economy.

While our result on markets agrees with the findings of previous studies which used aggregate data on FDI flows (Asiedu, 2006; Anyanwu, 2012; Loots and Kabundi, 2012), it differs from these studies in that disaggregated bilateral FDI is used in the estimation. The results show that relative factor endowment is not statistically significant with respect to intra-African FDI (column 3) while it is negatively associated with interregional FDI (column 6). This latter result further reinforces the fact that interregional FDI is market-seeking.

Although separating source countries into intra-African and interregional groups is a useful approach to analyzing the determinants, combining the sample of host countries may be prone to

heterogeneity bias and obscure the underlying relationships, given the differences in levels of income and economic structures across African countries. To avoid such heterogeneity bias, host African countries are categorized into resource and non-resource rich countries. This allows us to analyze the factors driving FDI from the different source economies into these specific groups of host countries. Breaking the sample down by resource and non-resource rich countries and extending the model to include additional control variables (equation 3) without time fixed effects, the results of intra-African FDI are reported in table 2.6.

Table 2.6: Determinants of Intra-African FDI to resource rich (RR) and non-resource rich (NRR) countries

Variables	(1) HT-all	(2) HT-all	(3) HT-RR	(4) HT-RR	(5) HT-NRR
Lagged log relative market size	0.537***	0.418**	0.431**	0.485**	1.468***
	(0.203)	(0.197)	(0.210)	(0.210)	(0.510)
Lagged log sum real GDP	3.750***	3.599***	3.526***	3.658***	3.535***
	(0.591)	(0.617)	(0.744)	(0.735)	(0.895)
Lagged relative factor endowment	0.070	0.067	0.275*	0.266*	-0.101
	(0.136)	(0.140)	(0.155)	(0.146)	(0.276)
Lagged oil and mineral rents	-0.083**			-0.088***	
	(0.033)			(0.034)	
Lagged fuel, ores & metal exports		-0.007	-0.007		
		(0.008)	(0.009)		
Bilateral Investment treaty dummy	0.438*	0.673***	0.791**	0.516	-0.004
	(0.256)	(0.225)	(0.346)	(0.416)	(0.505)
Regional trade agreement dummy	-0.803**	-0.682*	-0.068	-0.467	-0.265
	(0.369)	(0.397)	(0.179)	(0.373)	(0.538)
Lagged trade openness	-0.008**	-0.016***	-0.020***	-0.007	-0.010
	(0.004)	(0.005)	(0.006)	(0.005)	(0.007)
Lagged log bilateral exchange rate	0.226**	0.219**	0.211**	0.223***	0.022
	(0.093)	(0.100)	(0.088)	(0.079)	(0.177)
Lagged electricity infrastructure index	-0.001***	-0.001***	-0.001***	-0.001***	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Lagged surrounding market potential	0.012	0.009	0.014	0.020	0.014
	(0.014)	(0.013)	(0.014)	(0.015)	(0.044)
Lagged domestic credit to GDP ratio	-0.006*	-0.003	-0.003	-0.008**	0.014
	(0.003)	(0.003)	(0.003)	(0.003)	(0.022)
Lagged control of corruption index	-0.354	-0.197	-0.173	-0.341	-0.653
	(0.245)	(0.275)	(0.320)	(0.295)	(0.510)
Internal armed conflict dummy	0.228	0.176	0.333**	0.381	0.092
	(0.229)	(0.134)	(0.160)	(0.368)	(0.241)
Landlocked dummy	0.830	0.559	1.700	1.746*	2.852
	(0.809)	(0.842)	(1.070)	(1.019)	(1.886)
Log distance	-2.069***	-2.214***	-1.357***	-1.318**	-2.038*
	(0.614)	(0.648)	(0.526)	(0.536)	(1.135)
Constant	-71.593***	-66.458***	-73.223***	-76.942***	-67.403***
	(15.402)	(16.283)	(18.160)	(17.062)	(23.659)
Observations	1,134	1,104	786	806	328
Number of country-pairs	163	160	102	104	59
Over-identifying restrictions test (p-value)	0.49	0.62	0.78	0.46	0.18
Time fixed effects	No	No	No	No	No

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log sum real GDP, lagged relative factor endowment, fuel, ores & metals exports, oil and minerals rents, lagged surrounding market potential, lagged domestic credit to GDP, lagged control of corruption index and internal armed conflict dummy. Time-varying exogenous regressors: lagged relative market size, lagged trade openness, lagged log bilateral exchange rate, lagged electricity infrastructure index, bilateral investment treaty and regional trade agreement dummies. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

The results provide remarkable evidence in support of market-seeking motivations for intra-African FDI in both resource and non-resource rich African countries. As is clear from table 2.6, the Hausman-Taylor model shows that relative market size and sum of host and source countries real GDP positively affect intra-African FDI to both resource-rich and non-resource rich

countries respectively. This finding suggests that large markets encourage bilateral FDI to these economies. Such a market-seeking motivation for intra-African FDI is likely, given that the observed pattern of these investments are mostly concentrated in manufacturing and services sectors of host African economies. In recent years, TNCs from the leading source on intra-African FDI, South Africa, have expanded activities beyond the SADC sub-region to large markets in West African markets particularly Nigeria and Ghana. The impact of market size on intra-African FDI is economically more significant in non-resource rich countries than resource rich countries. It shows that one percent increase in the relative market size of non-resource rich countries increases bilateral FDI by 1.47 percent in non-resource rich countries (column 5), compared to less than proportionate increase (0.49 percent) in bilateral FDI into resource-rich countries (column 4), ceteris paribus.

A look at the result displayed in columns (3) and (4) of table 2.6 provides evidence supporting that intra-African FDI has been driven by efficiency-seeking objectives, as the coefficient on relative factor endowment positively affects intra-African FDI in resource rich countries although at the 10 percent level. This suggests that intraregional FDI are driven by lower cost considerations in host countries. As discussed previously, intra-African FDI are concentrated in neighbouring countries of the major source countries, and in large markets in order to take advantage of economies of scale.

Moving to the results of natural resource dependence, column (4) shows that the coefficient on share of oil and mineral rents in GDP is significantly negative. This outcome is consistent with the FDI-resource curse hypothesis, suggesting that natural resources promote resource FDI but undermines FDI in the non-resource sectors (Poelhekke and van der Pleg, 2010). The results are consistent with recent evidence on the adverse effects of natural resources in African economies (Asiedu, 2013; Nwaogu and Ryan, 2014). As surveyed in the literature, the mechanisms through which natural resources could exert an adverse effect on FDI are well documented, including loss of competitiveness through appreciation of the local currency, macroeconomic instability induced by adverse movements in global commodity prices and limited investments in the extractive industries in subsequent periods following initial investments. Nonetheless, few studies on African economies using aggregate FDI found that natural resources positively influence FDI to African countries (Anyanwu, 2012; Asiedu, 2006; Loots and Kabundi, 2012).

However, the coefficients on fuel, ores and metal exports in columns (2 and 3) show a negative sign but not statistically significant.

Taking a sensitivity analysis of the determinants of intra-African FDI, the alternative specification in equation (2.3) is estimated with time fixed effects. The results are presented in table 2.7.

Table 2.7: Determinants of Intra-African FDI to resource and non-resource rich countries

	(1)	(2)	(3)	(4)	(5)
Variables	HT-all	HT-RR	HT-NRR	HT-RR	HT-NRR
Lagged log relative market size	0.537***	0.485**	1.468***	0.396**	0.805**
	(0.203)	(0.210)	(0.510)	(0.185)	(0.387)
Lagged log sum real GDP	3.750***	3.658***	3.535***	3.254***	2.111***
	(0.591)	(0.735)	(0.895)	(0.802)	(0.769)
Lagged relative factor endowment	0.070	0.266*	-0.101	0.251*	-0.100
	(0.136)	(0.146)	(0.276)	(0.150)	(0.298)
Lagged oil and mineral exports	-0.083**	-0.088***		-0.084**	
	(0.033)	(0.034)		(0.036)	
Bilateral investment treaty dummy	0.438*	0.516	-0.004	0.445	-0.070
	(0.256)	(0.416)	(0.505)	(0.451)	(0.487)
Regional trade agreement dummy	-0.803**	-0.467	-0.265	-0.424	-0.197
	(0.369)	(0.373)	(0.538)	(0.342)	(0.521)
Lagged log trade openness	-0.008**	-0.007	-0.010	-0.012**	-0.005
	(0.004)	(0.005)	(0.007)	(0.005)	(0.004)
Lagged log bilateral exchange rate	0.226**	0.223***	0.022	0.189**	0.066
	(0.093)	(0.079)	(0.177)	(0.078)	(0.151)
Lagged electricity infrastructure index	-0.001***	-0.001***	0.001	-0.001***	-0.000
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Lagged surrounding market potential	0.012	0.020	0.014	0.019	0.005
	(0.014)	(0.015)	(0.044)	(0.015)	(0.044)
Lagged domestic credit to GDP	-0.006*	-0.008**	0.014	-0.009**	0.004
	(0.003)	(0.003)	(0.022)	(0.004)	(0.024)
Lagged control of corruption index	-0.354	-0.341	-0.653	-0.218	-0.594
	(0.245)	(0.295)	(0.510)	(0.344)	(0.547)
Internal armed conflict dummy	0.228	0.381	0.092	0.313	0.049
	(0.229)	(0.368)	(0.241)	(0.371)	(0.293)
Landlocked dummy	0.830	1.746*	2.852	1.530	1.147
	(0.809)	(1.019)	(1.886)	(1.001)	(1.360)
Log distance	-2.069***	-1.318**	-2.038*	-1.275***	-1.370
	(0.614)	(0.536)	(1.135)	(0.483)	(0.912)
Constant	-71.593***	-76.942***	-67.403***	-67.142***	-37.027*
	(15.402)	(17.062)	(23.659)	(19.001)	(19.416)
Observations	1,134	806	328	806	328
Number of country-pairs	163	104	59	104	59
Over-identifying restrictions test (p-value)	0.49	0.46	0.18	0.47	0.24
Time fixed effects	No	No	No	Yes	Yes

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log sum real GDP, lagged relative factor endowment, oil and minerals rents, lagged surrounding market potential, lagged domestic credit to GDP, lagged control of corruption index, internal armed conflict dummy and time dummies. Time- varying exogenous regressors: lagged relative market size, lagged trade openness, lagged log bilateral exchange rate, lagged electricity infrastructure index, bilateral investment treaty and regional trade agreement dummies. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

As seen from columns (2) and (4) of this table, the results of intra-African FDI are remarkably consistent qualitatively when additional control variables are included without and with time fixed effects respectively. The coefficients on relative market size and sum of real GDP show statistically significant and positive effects on bilateral FDI stock for resource rich countries. This further confirms that intra-African FDI are driven by the size of host economies. In a similar manner, column (3) and (5) indicate that the size of host markets is a relevant factor attracting intra-African FDI to non-resource rich countries.

Turning to the effect of relative factor endowment on bilateral FDI to resource rich countries, the coefficient shows a positive sign and it is statistically significant (column 4). This suggests that bilateral FDI is encouraged by lower labour costs in resource rich countries. Consistent with the previous estimates (column 2), oil and mineral rents (% of GDP) negatively predicts intra-African FDI in resource rich countries even after controlling for business cycle effects (column 4). Although intra-African FDI is perceived to be mostly channeled into manufacturing and services sectors, this result is likely given the resource-seeking investments undertaken by TNCs from South Africa, such as Anglo Ashanti and Exxaro Resources. These TNCs have directed investments to extractive industries in Ghana, Mali, Zimbabwe and Democratic Republic of Congo (see Disenyano and Sogoni, 2014).

As for the control variables, the coefficient on the landlocked dummy is quite large although marginally significant at the 10 percent level for resource-rich countries when time fixed effects are not captured (column 2 of table 2.7). This finding is difficult to interpret but a plausible explanation could be that intra-African FDI serves as an important source of foreign capital in landlocked countries, especially when investors are more concerned about natural resources availability than the associated costs of investing in these countries. The results on the distance variable are consistent with the predictions in the gravity model that distance impedes bilateral FDI (for resource-rich countries). This finding provides support for the trends analysis that intra-African FDI are concentrated in neighbouring countries and large markets, possibly reflecting the sensitivity of these investments to transport costs. It is worth noting that resource-seeking FDI in host African countries are primarily export-oriented, which suggests that long distance could impede these investments.

One of the problems with combining data on interregional FDI (as shown in table 2.5) is that it may mask important differences between the OECD and emerging markets economies, since the motivations and determinants of FDI from these sources may differ due to differences in nationality of investors as well as levels of income and geographic locations of source countries. To guard against such heterogeneity bias and disentangle the effects of market size, relative factor endowment and natural resource dependence on bilateral FDI from OECD countries and non-OECD emerging market economies, interregional investments are further separated into these groups of economies. Table 2.8 presents estimates of the determinants of non-OECD emerging markets FDI in resource and non-resource rich African countries. Focusing on the parameters of the Hausman-Taylor estimation in columns (2-5), the coefficients on relative market size and sum of host and source country real GDP show remarkably positive sign and statistically significant for resource rich countries (columns 3 and 4), in line with those reported in column (2) when these source economies are aggregated. This finding is consistent with the results of Zheng and Tan (2011), which indicate that FDI from OECD developed economies and non-OECD developing economies to China are market-seeking. Similarly, the results show strong support for market-seeking motivations of FDI from non-OECD to non-resource rich countries. This is confirmed in column (5), which clearly indicates significant positive coefficients of relative market size and sum of real GDP on FDI to non-resource rich countries.

Moving to relative factor endowment, the coefficients in columns (3 and 4) show negative signs and statistically significant at the 1 percent and 5 percent level respectively. This variable captures the market size differentials between source and host countries, differences in relative factor endowments and also reflects the differences in consumer tastes between these countries (see Dauti, 2015). The result indicates that bilateral FDI is encouraged when host and source countries are similar in relative factor endowment. This is consistent with market-seeking motivations of FDI. However, there are noticeable differences in the results of relative factor endowment between resource rich and non-resource rich countries, with the coefficient on this variable showing that relative factor endowments positively affect FDI from non-OECD emerging markets to non-resource rich countries although significant at 10 percent level (column 5). This signals that these investments may have been encouraged by lower cost motives in non-resource rich countries. As the trend analysis suggests, a number of countries especially non-

resource rich African economies, have attracted efficiency-seeking investments, such as the garment industry in Madagascar.

Table 2.8: Determinants of non-OECD emerging markets FDI to resource and non-resource rich countries

Variables	(1) FEM-all	(2) HT-all	(3) HT-RR	(4) HT-RR	(5) HT-NRR
Lagged log relative market size	1.418**	1.543***	1.306**	1.709***	2.341***
	(0.654)	(0.463)	(0.615)	(0.608)	(0.850)
Lagged log sum real GDP	5.045***	4.911***	5.075***	5.308***	3.450***
	(0.537)	(0.439)	(0.635)	(0.596)	(0.558)
Lagged relative factor endowment	-0.055**	-0.047*	-0.071***	-0.062**	0.070*
	(0.025)	(0.025)	(0.026)	(0.029)	(0.041)
Lagged fuel, ores & metals exports	-0.012**		-0.013*		
	(0.006)		(0.007)		
Lagged oil and mineral exports		-0.050**		-0.060***	
		(0.021)		(0.022)	
Lagged surrounding market potential	-0.008	-0.006	-0.011	-0.013**	0.135***
	(0.015)	(0.007)	(0.013)	(0.006)	(0.043)
Bilateral investment treaty dummy	-0.740	-0.927**	-0.948**	-1.517***	0.255
	(0.557)	(0.456)	(0.443)	(0.507)	(0.807)
Lagged log trade openness	-0.022***	-0.004	-0.020***	-0.001	-0.011*
	(0.006)	(0.005)	(0.006)	(0.007)	(0.006)
Lagged log bilateral exchange rate	-0.171	0.095	0.136	0.255*	1.483**
	(0.389)	(0.154)	(0.160)	(0.145)	(0.741)
Lagged domestic credit to GDP	-0.005	-0.009	-0.009	-0.014	0.028
	(0.011)	(0.012)	(0.013)	(0.014)	(0.023)
Lagged control of corruption index	-1.476***	-1.573***	-1.441***	-1.727***	-0.695
	(0.338)	(0.363)	(0.354)	(0.363)	(0.685)
Internal armed conflict dummy	0.132	0.120	0.151	0.110	-0.032
	(0.158)	(0.147)	(0.216)	(0.186)	(0.225)
Lagged electricity infrastructure index	-0.000	-0.001	-0.000	-0.001	0.002*
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Landlocked dummy		1.279	2.421*	1.843*	7.244*
		(1.143)	(1.338)	(1.089)	(4.119)
Log distance		-13.669*	-14.436***	-9.248*	40.753***
		(6.980)	(5.358)	(5.404)	(15.494)
Constant	-126.268***	-0.539	1.614	-50.651	-447.827***
	(12.844)	(63.814)	(51.446)	(52.957)	(138.482)
Observations	1,090	1,190	680	730	460
R-squared	0.244				
Number of country-pairs	145	155	82	87	68
Hausman test	148.03***				
Over-identifying restrictions test (p-value)		0.21	0.33	0.10	0.10
Time fixed effects	No	No	No	No	No

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log sum real GDP, lagged relative factor endowment, lagged oil and minerals rents, lagged fuel, ores & metals exports, lagged domestic credit to GDP, lagged control of corruption index and internal armed conflict dummy. Lagged log bilateral exchange rate is endogenous in column (5). Time- varying exogenous regressors: lagged relative market size, lagged surrounding market potential, lagged trade openness, lagged log bilateral exchange rate, lagged electricity infrastructure index and bilateral investment treaty. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

With respect to the effect of natural resource dependence on bilateral FDI, it is clear in columns (3 and 4) that this variable negatively affects bilateral FDI from non-OECD emerging markets

economies. This is evidence in support of the adverse effects of natural resources in African economies. The finding agrees with suggestive evidence that two of the leading investors from non-OECD economies, China and India, have significantly invested in the extractive industries in African economies.

In trying to further check for robustness of the determinants of FDI from non-OECD emerging markets, equation (2.3) is estimated with time effects. Table 2.9 presents remarkable evidence in support of market-seeking motivations for non-OECD FDI in both resource and non-resource rich African countries.

Table 2.9: Determinants of non-OECD emerging markets FDI to resource and non-resource rich countries

Variables	(1) HT-RR	(2) HT-NRR	(3) HT-RR	(4) HT-RR	(5) HT-NRR
Lagged log relative market size	1.709***	2.341***	1.208*	1.878***	1.976***
	(0.608)	(0.850)	(0.641)	(0.639)	(0.708)
Lagged log sum real GDP	5.308***	3.450***	5.489***	6.539***	2.690**
	(0.596)	(0.558)	(1.330)	(1.279)	(1.343)
Lagged relative factor endowment	-0.062**	0.070*	-0.073***	-0.074**	0.078**
	(0.029)	(0.041)	(0.028)	(0.030)	(0.039)
Lagged fuel, ores & metals exports			-0.007		
			(0.006)		
Lagged oil and mineral exports	-0.060***			-0.066***	
	(0.022)			(0.023)	
Lagged surrounding market potential	-0.013**	0.135***	-0.008	-0.013*	0.095***
	(0.006)	(0.043)	(0.013)	(0.007)	(0.035)
Bilateral investment treaty dummy	-1.517***	0.255	-1.113**	-1.583***	0.250
	(0.507)	(0.807)	(0.493)	(0.540)	(0.913)
Lagged log trade openness	-0.001	-0.011*	-0.019***	0.004	-0.005
	(0.007)	(0.006)	(0.007)	(0.007)	(0.005)
Lagged log bilateral exchange rate	0.255*	1.483**	0.077	0.221	1.926**
	(0.145)	(0.741)	(0.180)	(0.167)	(0.774)
Lagged electricity infrastructure index	-0.001	0.002*	-0.000	-0.001	0.003*
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Lagged domestic credit to GDP	-0.014	0.028	-0.007	-0.009	0.033
	(0.014)	(0.023)	(0.013)	(0.013)	(0.025)
Lagged control of corruption index	-1.727***	-0.695	-1.282***	-1.861***	-0.770
	(0.363)	(0.685)	(0.337)	(0.368)	(0.687)
Internal armed conflict dummy	0.110	-0.032	0.446**	0.318*	0.180
	(0.186)	(0.225)	(0.227)	(0.192)	(0.260)
Landlocked dummy	1.843*	7.244*	2.853*	2.700*	6.680
	(1.089)	(4.119)	(1.713)	(1.640)	(4.402)
Log distance	-9.248*	40.753***	-18.449**	-15.758**	41.762**
	(5.404)	(15.494)	(7.688)	(7.577)	(16.647)
				(0.429)	(0.972)
Constant	-50.651	-447.827***	25.711	-25.078	-436.480***
	(52.957)	(138.482)	(54.868)	(56.582)	(150.587)
Observations	730	460	680	730	460
Number of country-pairs	87	68	82	87	68
Over-identifying restrictions test (p-value)	0.10	0.10	0.61	0.29	0.16
Time fixed effects	No	No	Yes	Yes	Yes

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log sum real GDP, lagged relative factor endowment, lagged oil and minerals rents, lagged fuel, ores & metals exports, lagged domestic credit to GDP, lagged control of corruption index and internal armed conflict dummy. Lagged log bilateral exchange rate is endogenous in columns (2) and (5). Time- varying exogenous regressors: lagged relative market size, lagged surrounding market potential, lagged trade openness, lagged log bilateral exchange rate, lagged electricity infrastructure index and bilateral investment treaty. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

As shown in columns (3) and (4) of table 2.9, non-OECD FDI is positively predicted by relative market size and qualitatively similar to the estimates without time fixed effects (columns 1). This reinforces the above analysis that these investments are market-led to resource rich countries. The finding suggests that the inclusion of time fixed effects does not change the qualitative relationship between bilateral FDI stocks and economic size of host countries. A number of empirical studies have estimated gravity models with time fixed effects to capture business cycle effects (see e.g. Egger, 2000; Egger and Pfaffermayr, 2003; Matyas, 1997). In a similar manner, column (5) indicates that the size of host markets is a relevant factor attracting non-OECD FDI to non-resource rich countries. While the significant and negative sign on the coefficient of relative factor endowment reaffirms the market-seeking nature of these investments in resource rich countries (columns 3 and 4), the coefficient is strongly positive (column 5) as previously indicated (column 2). This confirms that these investments are encouraged by lower labour costs in non-resource rich countries. However, measures of natural resource dependence show contrasting results, with oil and mineral rents (% of GDP) negatively predicting non-OECD emerging markets FDI (column 4), while the coefficient on fuel, ore and mineral rents (% of merchandise exports) in column (3) is not statistically significant.

Looking at the control variables, we observe strong positive coefficient of distance on bilateral FDI to non-resource rich countries. This finding offers further support for the market-seeking nature of FDI in these economies, since bilateral FDI is encouraged when there is large distance between source and host countries. The coefficient on control of corruption index, which is a proxy for the quality of institutions in host countries, shows a strong negative effect on bilateral FDI to resource rich countries (columns 3 and 4 of table 2.9). This finding suggests that foreign investors may not be deterred by the level of corruption in host markets. The result supports the suggestive evidence that foreign investors from some emerging market economies, notably China, India and Malaysia, have invested in African countries with some of the worst quality of institutions in the world (see Aleksynska and Havrylchyk, 2013).

A similar analysis is undertaken for investments from OECD economies to resource and non-resource rich African countries. Columns (3 and 4) of table 2.10 show strong support for the market-seeking motivations of FDI from OECD economies to resource rich African countries. It

is seen that relative market size and sum of host and source countries real GDP positively influences bilateral FDI from OECD economies. The same holds for bilateral FDI to non-resource rich countries, suggesting that these investments are driven by marketing seeking considerations in both resource and non-resource rich countries.

Table 2.10: Determinants of OECD FDI to resource and non-resource rich countries

Variables	(1) FEM-all	(2) HT-all	(3) HT-RR	(4) HT-RR	(5) HT-NRR
Lagged log relative market size	2.661***	2.718***	3.100***	2.875***	2.182***
	(0.455)	(0.439)	(0.637)	(0.501)	(0.827)
Lagged log sum real GDP	4.199***	3.825***	3.132***	3.208***	3.608**
	(0.991)	(0.925)	(0.942)	(1.113)	(1.797)
Lagged relative factor endowment	-0.106***	-0.091***	-0.087**	-0.103**	-0.064*
	(0.028)	(0.026)	(0.037)	(0.040)	(0.038)
Lagged fuel, ores & metals exports			-0.005*		
			(0.003)		
Lagged oil and mineral exports	-0.033***	-0.033***		-0.033***	
	(0.009)	(0.009)		(0.010)	
Lagged surrounding market potential	-0.017***	-0.016***	-0.028**	-0.020***	0.065**
	(0.005)	(0.005)	(0.011)	(0.005)	(0.033)
Bilateral investment treaty dummy	0.402*	0.394	0.650*	0.898***	-0.305
	(0.241)	(0.241)	(0.343)	(0.332)	(0.276)
Lagged log trade openness	0.001	0.001	-0.015***	-0.003	0.002
	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)
Lagged log bilateral exchange rate	-0.404*	-0.422**	-0.853***	-0.655***	-0.348
	(0.209)	(0.207)	(0.257)	(0.223)	(0.425)
Lagged domestic credit to GDP	0.001	0.002	0.010**	0.006	-0.012
	(0.005)	(0.005)	(0.004)	(0.004)	(0.014)
Lagged control of corruption index	-0.376*	-0.390*	-0.143	-0.181	-0.431
	(0.219)	(0.218)	(0.281)	(0.263)	(0.364)
Internal armed conflict dummy	0.033	0.036	0.103	0.121	-0.072
	(0.125)	(0.125)	(0.145)	(0.153)	(0.234)
Lagged electricity infrastructure index	0.001**	0.001**	0.001**	0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Landlocked dummy		13.052	7.192***	9.225*	-12.272
		(9.430)	(2.626)	(4.909)	(16.630)
Log distance		-36.728	-8.871	-23.759	34.940
		(30.801)	(6.388)	(18.088)	(42.904)
Constant	-99.766***	229.606	5.934	134.459	-388.251
	(26.783)	(273.424)	(59.490)	(166.527)	(371.135)
Observations	3,206	3,206	1,635	1,854	1,352
R-squared	0.105				
Number of country-pairs	395	395	197	220	175
Hausman test	146.22***				
Over-identifying restrictions test (p-value)		0.29	0.19	0.29	0.39
Time fixed effects	No	No	No	No	No

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: lagged relative market size, lagged log sum real GDP, lagged oil and minerals rents, lagged fuel, ores & metals exports, lagged domestic credit to GDP, lagged control of corruption index, lagged log bilateral exchange rate, lagged electricity infrastructure index, bilateral investment treaty and internal armed conflict dummy. Time- varying exogenous regressors: lagged relative factor endowment, lagged surrounding market potential and lagged trade openness. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked

As seen from columns (3 and 4), the coefficients on relative factor endowment show a negative sign and statistically significant, supporting the market-seeking motivation for OECD investments. This outcome reflects the preferences of OECD investors for relatively more developed markets with higher GDP per capita for specific products and services, and enhanced

human capital capacity and higher quality infrastructure in host economies in order to produce relatively more technologically intensive products (see Antonakakis and Tondl, 2015). The finding partly supports the large inflow of FDI to South Africa from the EU over the period 2001-2012, given the country's relatively high real GDP per capita, better quality infrastructure and human capital capacity than other countries in the region. As concerns the estimates of the non-resource rich economies in column (5), the coefficient on relative factor endowment also shows market-seeking motivations of bilateral FDI from the OECD countries to non-resource rich African countries.

One needs to also explore empirically the behaviour of foreign investors from the OECD with respect to resource wealth. The coefficients on the measures of natural resource dependence reported in columns (3) and (4) show statistically significant and crowding-out impact on non-resource seeking FDI. In another exercise of robustness checks on the determinants of bilateral FDI from the OECD, equation 2.3 is estimated by allowing for time fixed effects as presented in table 2.11. As shown in columns (3 and 4), the relative market size remains strongly positive, revealing that host resource rich countries are attractive destinations for FDI from the OECD. Similarly, column (5) shows strong positive coefficient on relative market size, suggesting that OECD investments are flowing to large non-resource rich countries. The result in column (4) further shows a clear negative link between natural resource dependence and bilateral FDI from the OECD. This is consistent with the crowding-out impact of resource-seeking FDI as discussed above.

Table 2.11: Determinants of OECD FDI to resource and non-resource rich countries

Variables	(1) HT-RR	(2) HT-NRR	(3) HT-RR	(4) HT-RR	(5) HT-NRR
Lagged log relative market size	2.875***	2.182***	2.069***	2.333***	1.268**
	(0.501)	(0.827)	(0.676)	(0.558)	(0.567)
Lagged log sum real GDP	3.208***	3.608**	0.368	1.360	-1.144
	(1.113)	(1.797)	(1.700)	(1.655)	(1.863)
Lagged relative factor endowment	-0.103**	-0.064*	-0.097**	-0.144***	-0.071**
	(0.040)	(0.038)	(0.039)	(0.048)	(0.034)
Lagged fuel, ores & metals exports			-0.005		
			(0.003)		
Lagged oil and mineral exports	-0.033***			-0.033***	
	(0.010)			(0.010)	
Lagged surrounding market potential	-0.020***	0.065**	-0.016	-0.021***	0.049**
	(0.005)	(0.033)	(0.011)	(0.005)	(0.020)
Lagged log trade openness	-0.003	0.002	-0.021***	-0.003	0.000
	(0.003)	(0.003)	(0.005)	(0.003)	(0.003)
Bilateral investment treaty dummy	0.898***	-0.305	0.532*	0.729**	-0.273
	(0.332)	(0.276)	(0.321)	(0.329)	(0.318)
Lagged log bilateral exchange rate	-0.655***	-0.348	-0.733***	-0.472*	-0.357**
	(0.223)	(0.425)	(0.269)	(0.246)	(0.162)
Lagged domestic credit to GDP	0.006	-0.012	0.005	0.002	-0.025
	(0.004)	(0.014)	(0.004)	(0.004)	(0.016)
Lagged control of corruption index	-0.181	-0.431	0.118	-0.070	-0.561
	(0.263)	(0.364)	(0.262)	(0.265)	(0.351)
Internal armed conflict dummy	0.121	-0.072	0.131	0.115	-0.036
	(0.153)	(0.234)	(0.149)	(0.159)	(0.249)
Lagged electricity infrastructure index	0.001*	0.000	0.001**	0.001*	-0.001
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Landlocked dummy	9.225*	-12.272	4.559*	6.145	-0.217
	(4.909)	(16.630)	(2.446)	(3.921)	(1.294)
Log distance	-23.759	34.940	-4.160	-13.769	-1.452
	(18.088)	(42.904)	(5.633)	(14.525)	(2.150)
Constant	134.459	-388.251	38.121	98.127	55.110
	(166.527)	(371.135)	(56.179)	(134.988)	(60.516)
Observations	1,854	1,352	1,635	1,854	1,352
Number of country-pairs	220	175	197	220	175
Over-identifying restrictions test (p-value)	0.29	0.39	0.45	0.12	0.43
Time fixed effects	No	No	Yes	Yes	Yes

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered at country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: lagged relative market size, lagged log sum real GDP, lagged oil and minerals rents, lagged fuel, ores & metals exports, lagged domestic credit to GDP, lagged control of corruption index, lagged log bilateral exchange rate, lagged electricity infrastructure index, bilateral investment treaty and internal armed conflict dummy. Time- varying exogenous regressors: lagged relative factor endowment, lagged surrounding market potential and lagged trade openness. The over-identifying restrictions test suggests that bilateral investment treaty, lagged log bilateral real exchange rate and lagged electricity infrastructure index are also exogenous in column (5). Time-invariant endogenous regressor is log distance and time-invariant exogenous regressor is landlocked dummy.

Having determined how market size, resource-seeking and efficiency seeking considerations influence foreign investments from the different source economies, it is particularly interesting to determine whether there are differences in FDI behaviour between investors from intra-African economies and the OECD and non-OECD emerging market economies. As suggested in the literature, there are potential differences among investors from the different groups of economies due to differences in nationality, income levels and geographic location of source countries. The determinants of FDI can also differ across resource and non-resource rich countries because of differences in income and resource wealth across African countries. Along these lines, the

analysis above points to likely differences in FDI behaviour between intra-African investors and those from emerging markets and the OECD countries. While large markets and the presence of natural resources are important determinants of FDI from the different sources into resource rich economies, further evidence shows that intra-African investments are driven by efficiency-seeking objectives. Looking at FDI into non-resource rich countries, the analysis suggests that FDI from the different sources are mostly attracted into destinations with large markets, while the availability of cheap labour increases the attractiveness of non-OECD emerging markets FDI to non-resource rich economies.

To analyze these differences, we derive the marginal effects of relative market size, relative factor endowments and natural resource dependence separately from estimating equation (2.8):

$$\log FDI_{ijt} = \beta_0 + \beta_1 EME + \beta_2 \log(SIZE_{ijt-1}) + \beta_3 \log(SIZE_{ijt-1}) * EME + \beta_4 NRES_{jt-1} + \beta_5 NRES_{jt-1} * EME + \beta_6 RFE_{ijt-1} + \beta_7 RFE_{ijt-1} * EME + \vartheta' R_{jt-1} + \varepsilon_{ijt} \quad (2.8)$$

Where EME is a dummy variable coded 1, if FDI originates from emerging markets and zero if intra-African country, and R_{jt} denotes a vector of control variables. The inclusion of the interaction terms implies that the marginal effects of the variables of interest depend on the respective coefficients without the interaction terms and coefficients on the interaction terms. For example, the marginal effect of one percent change in relative market size on FDI from intra-African and emerging markets is given by:

$$\frac{\delta log FDI}{\delta log SIZE} = \beta_2 + \beta_3 * EME$$

Meaningful conclusions about the differences between the groups of investors can be drawn from determining whether the estimated marginal effects are statistically different from zero (Brambor et al., 2006). Accordingly, the marginal effects of relative market size, natural resources and relative factor endowments are displayed table 2.12. As can be seen in column (2) for resource rich countries, there are significant difference between investors from non-OECD and Intra-African economies regarding natural resource availability in host countries. The combined coefficient (-0.055) is strongly negative, indicating the adverse effect of natural resource dependence on FDI as analyzed above. This difference is expected given that intra-African FDI are mostly in manufacturing and services sectors, whereas investors from the non-

OECD emerging markets have significant investments in extractive industries. The same explanation can be said for the significant differences in FDI behaviour between intra-African and OECD source countries with respect to the presence of natural resources (column 4).

Table 2.12: Differences between Intra-African and Interregional FDI (marginal effects)

	EME=0	EME=1	OECD=0	OECD=1
Variable	Coefficients	Coefficients	Coefficients	Coefficients
Panel A: Resource Rich Countries				
Lagged log relative market size	1.092*	0.726	1.018	1.484***
	(0.618)	(0.619)	(0.624)	(0.493)
Lagged oil and mineral rents	-0.096***	-0.055**	-0.092***	-0.027***
	(0.034)	(0.022)	(0.035)	(0.009)
Lagged relative factor endowment	0.150	-0.075***	0.196	-0.154***
	(0.161)	(0.029)	(0.155)	(0.049)
Panel B: Non-Resource rich countries				
Lagged log relative market size	0.830	1.313***	-0.172	1.150**
	(0.566)	(0.446)	(0.967)	(0.586)
Lagged log relative factor endowment	-0.029	0.046	-0.125	-0.126***
	(0.264)	(0.034)	(0.277)	(0.042)

Note: Standard errors in parenthesis '*', '**', and '***' denote significant at 10, 5 and 1 percent respectively.

The analysis further reveals significant differences in the influence of relative market size between intra-African and OECD FDI into both resource and non-resource-rich countries. The coefficient on relative market size in column (4) indicates an overall strong positive effect of relative market size on bilateral FDI from these source economies. Such differences could be explained by the fact that market-seeking FDI from the OECD are mostly attracted into destinations with relatively more developed markets, higher human capacity and better infrastructure for sustained demand for products, with technology that allows some of these goods to be produced locally. A typical example is the automobile industry in South Africa which assembles cars from some OECD countries. On the contrary, market-seeking FDI driven by intra-African investors is more oriented towards providing less technology intensive consumer products and services across African countries. This is evident in the expansion of retail groups such as Shoprite and Woolworths beyond South Africa to neighbouring countries and large markets in West Africa.

Regarding the effect of relative factor endowments on bilateral FDI, it is shown in column (2) of table 2.12 for non-OECD emerging markets to resource rich countries and column (4) of OECD FDI to both resource and non-resource rich countries that there are significant differences between FDI from intra-African and these sources. The results reveal an overall strong negative coefficient for relative factor endowment variable. This finding is in line with the Linder

hypothesis, which suggests that firms reveal a bias in FDI by directing such investments to host markets with income levels similar to their home markets (see Aleksynska and Havrylchyk, 2013; Fajgelbaum et al., 2015). Detailed results on the differences between the groups of investors are reported in appendix A2.4 and A2.5.

As indicated in the trend analysis, South Africa is a leading destination of FDI to African economies. A useful extension of the analysis is to consider whether the factors driving FDI to South Africa are different from other host African countries. We analyze these differences with respect to the influences of relative market size, relative factor endowment and natural resources on bilateral FDI from the different source economies using equation 2.9:

$$\log FDI_{ijt} = \beta_0 + \beta_1 SA + \beta_2 \log(SIZE_{ijt-1}) + \beta_3 \log(SIZE_{ijt-1}) * SA + \beta_4 NRES_{jt-1} + \beta_5 NRES_{jt-1} * SA + \beta_6 RFE_{ijt-1} + \beta_7 RFE_{ijt-1} * SA + \vartheta' R_{jt-1} + \varepsilon_{ijt} \quad (2.9)$$

where SA is a dummy variable coded 1 for South Africa and 0 for all other host African countries. To evaluate the marginal effects of relative market size, natural resources and relative factor endowments, the different sources of FDI are considered as presented in table 2.13. It is clear from column (2) that there are significant differences between FDI to South Africa and other African countries with respect to natural resources. The results reveal an overall significant negative influence on bilateral FDI to these countries. The significant difference is attributed to the differences in the nature of FDI from South Africa and other leading sources of these investments such as Kenya and Nigeria. It is worth noting that foreign investments from other African countries are mostly concentrated in producing consumer goods and services, while investors from South Africa have also invested in the extractive sectors of other African countries.

Table 2.13: Differences between FDI to South Africa and other African countries (marginal effects)

Variables	Intra-African countries		Non-OECD emerging markets economies		OECD countries	
	SA=0	SA=1	SA=0	SA=1	SA=0	SA=1
	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients	Coefficients
Lagged log relative market size	0.672 (0.754)	0.082 (0.467)	1.687*** (0.632)	0.142 (1.146)	2.844*** (0.462)	4.392*** (1.438)
Lagged oil and mineral rents	-0.085** (0.035)	-0.383*** (0.124)	-0.056** (0.022)	-0.241 (0.199)	-0.035*** (0.009)	-0.077 (0.084)
Lagged relative factor endowment	0.050 (0.225)	-0.033 (0.069)	-0.013 (0.025)	-0.154*** (0.040)	-0.086*** (0.025)	0.012 (0.048)

Note: Standard errors in parenthesis '*', '**', and '***' denote significant at 10, 5 and 1 percent respectively.

Results in column (6) show a significant difference between FDI from the OECD to South Africa and other African countries. The combined coefficient (4.392) suggests a strong positive effect of relative market size on these investments. As analyzed above, such a difference may be attributed to the fact that OECD FDI is directed towards well-developed host markets with enhanced skills capacity and infrastructure to ensure a sustainable demand for goods and services. It is seen also from column (4) that there is a significant difference between FDI to South Africa and other African countries originating from non-OECD emerging markets. The overall coefficient on relative factor endowment is strongly negative, which further reinforces the argument that foreign firms undertake investments in host markets with per capita GDP similar to home markets.

2.5.1 Dynamic Model Estimation

One of the estimation issues arising from the static panel data models analyzed above is that the persistent effects of FDI have not been captured, through the inclusion of the lagged FDI dependent variable as an additional explanatory variable. Such persistence arises mainly from two sources: lagged FDI which explains the slow adjustment of FDI over time and the time invariant country-pair effects (Egger and Merlo, 2007). A useful extension of the static panel data analysis to capture such persistence is to estimate a dynamic panel data model of bilateral FDI stocks, which in its logarithm form is specified in equation (2.10):

$$FDI_{it} = \alpha FDI_{i,t-1} + x'_{it}\beta + u_{it}, i = 1, 2, \dots, N; t = 2, 3, \dots, T \qquad (2.10)$$

$$u_{it} = \mu_i + v_{it}$$

x'_{it} is a 1xk vector of the explanatory variables and β is a kx1 vector of parameters to be estimated and α is the adjustment coefficient. The explanatory variables in the vector x'_{it} may be correlated with the unobserved country specific effects μ_i . Equation (2.10) is characterized by the problem of endogeneity, induced by adding the lagged FDI variable. As such, the OLS estimation of this equation will produce biased and inconsistent parameter estimates.

As noted above, using the fixed effects model to estimate equation (2.10) in which the dependent variable is FDI stock translates into using net FDI flows. While the estimation of the fixed effects model eliminates the unobserved heterogeneity effects μ_i in equation (2.10), it also produces biased estimates through correlation between the differenced lagged dependent variable and the error process. These limitations are addressed in the empirical literature through the estimation of dynamic panel data models. Specifically, two approaches are widely used in analyzing FDI: the first differenced generalized method of moments (GMM) estimator (Arelano and Bond, 1991) and the system GMM approach (Arellano and Bover, 1995; Blundell and Bond, 1998).

The difference GMM approach involves first differencing the series and then applying the lagged values of the endogenous variables as instruments (see Asiedu, 2013). The estimation of the first-differenced GMM is, however, confronted with potential problems of weak instruments and correlation between the differenced lagged dependent variable and the error term. There is consensus in the literature that the lagged levels of the endogenous variables are not appropriate instruments for the first differenced variables. Attempts to address these problems have led to the estimation of the system GMM. This approach alleviates these problems by including additional moment conditions. However, the system GMM relies on very restrictive assumptions, which are not tenable especially when bilateral FDI stock is used as the dependent variable. The system GMM assumes that the dependent variable is characterized by a stationary mean process at the start of the period and the explanatory variables (in levels) are not correlated with the disturbance term (see Egger and Merlo, 2007). As noted, some of the host country characteristics are more likely to be correlated with the unobserved country specific effects μ_i . Similarly, taking bilateral FDI stock as the dependent variable, is not likely to exhibit a stationary process at the initial time period, since stocks are derived as accumulated FDI flows over a period of time. Along these

lines, the first-differenced GMM model is estimated, while the relevant tests of second order serial correlation and validity of the instruments are conducted to determine whether the model is correctly formulated. Table 2.14 presents the parameter estimates of the first differenced-GMM model and associated diagnostic statistics using the two-step approach.

Table 2.14: First difference GMM using two-step estimation

Variables	(1)	(2)
Lagged FDI stock	0.611***	0.624***
	(0.032)	(0.035)
Log relative market size	0.585**	0.919***
	(0.253)	(0.274)
Log sum real GDP	1.278***	1.763***
	(0.307)	(0.369)
Relative factor endowment	-0.009	-0.014
	(0.016)	(0.020)
Oil and mineral rents	-0.030***	-0.031***
	(0.006)	(0.007)
Surrounding market potential	-0.002	-0.004
	(0.004)	(0.004)
Trade openness	-0.001	-0.001
	(0.002)	(0.002)
Ratio of domestic credit to GDP	-0.016***	-0.014***
	(0.004)	(0.003)
Control of corruption index	-0.261*	-0.429***
	(0.137)	(0.154)
Volatility in bilateral real exchange rate	0.001***	0.001***
	(0.000)	(0.000)
Electricity infrastructure index	0.086**	0.071
	(0.036)	(0.068)
Bilateral investment treaty dummy	0.574	0.656
	(0.418)	(0.412)
Observations	4,481	4,481
Wald test (χ^2)	1083.62	1223.45
p-value	0.000	0.000
AR (1) test	-6.72	-6.73
p-value	0.000	0.000
AR (2) test	0.48	0.70
p-value	0.631	0.482
J-test-$\chi^2(545)$	576.58	
p-value	0.169	
J-test-$\chi^2(542)$		582.96
p-value		0.109
Number of country-pairs	687	687
Time effects	No	Yes

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses. Endogenous regressors: one-period lagged dependent variable, log of relative market size, log sum of real GDP, relative factor endowment, oil and mineral rents, trade openness, domestic credit to the private sector to GDP, control of corruption index and bilateral investment treaty dummy. Exogenous variables: volatility in bilateral real exchange rate, electricity infrastructure index, surrounding market potential and time dummies. AR (1) and AR (2) test for 1st and 2nd order serial correlation respectively. The p-values of the Hansen-J test are used to test for over-identifying restrictions in the estimation.

In estimating the first differenced GMM, a set of explanatory variables are treated as endogenous such as one-period lagged dependent variable, log of relative market size, log sum of real GDP, relative factor endowment, oil and mineral rents, trade openness, domestic credit to the private

sector to GDP, control of corruption index and bilateral investment treaty dummy as potentially endogenous. On the other hand, volatility in bilateral real exchange rate, electricity infrastructure index, surrounding market potential and time dummies are treated as exogenous variables. As can be seen from columns (1) and (2), the Wald test strongly rejects the null hypothesis that the explanatory variables are not jointly significant. The tests for serial correlation suggest the presence of first order serial correlation as expected, but the absence of second order serial correlation. In order words, the tests fail to reject the null hypothesis that there is no second order serial correlation. Similarly, the probability value of the Hansen-J test confirms the validity of the instruments. In both models displayed in columns (1) and (2), the Hansen's test of over-identifying restrictions cannot reject the hull hypothesis that the instruments are valid. These diagnostic tests suggest that the estimated models are well formulated.

Looking at the parameter estimates in both columns (1) and (2) of table 2.14, the coefficients on the first lagged FDI variable has the expected positive sign and statistically significant at the 1 percent level. The result underscores the importance of the persistent effects of FDI in estimating gravity models involving FDI stock. This finding confirms that the GMM estimator is a useful strategy to analyze the drivers of these investments in host markets. The result implies that FDI in the previous year plays a significant role in influencing decisions of potential investors. One could partly attribute these persistent effects to sunk costs of FDI. Firms investing in African countries often incur large initial capital outlay, especially in the exploration and extraction of minerals and these investments persist for years. The findings are consistent with previous studies on bilateral FDI (see e.g. Egger and Merlo, 2007; Dauti, 2015).

The estimates of the difference GMM for our variables of interest, that is, relative market size and oil and mineral rents (% of GDP) in both columns (1) and (2), are remarkably consistent qualitatively with those of the static panel data model (Hausman-Taylor model) analyzed above. The coefficient of relative market size and sum of real GDP of host and source countries are strongly positive as expected, supporting the hypothesis that FDI into host African markets are market-seeking. Similarly, the estimates on oil and minerals variable provide support for the hypothesis that natural resources have an adverse effect on FDI to host resource rich countries. However, the coefficient on relative factor endowment is not statistically significant in both models, estimated without and with time fixed effects (columns 1 and 2 respectively).

To shed light on the specifications of the model, the results of the first-differenced GMM estimation are compared with those obtained from the Hausman-Taylor model analyzed above. As can be seen from these results, the estimation of the first-differenced GMM model does not materially change the results of the Hausman-Taylor model analyzed above. This is an indication that the Hausman-Taylor models analyzed above are not likely to have been misspecified (see Plosser et al, 1982). However, it is important to note that the results of the first-differenced GMM estimation are only based on the full sample of bilateral FDI from the different source economies to host African countries. The sample was not disaggregated further into the three sub-groups - intra-African, non-OECD and OECD countries- due to the limited observations for each sub-group relative to the instruments used in the estimation process.[15]

Turning to the control variables in columns (1) and (2) of table 2.14, the results surprisingly display strong negative impact of the ratio of domestic credit to the private sector (% of GDP) variable on bilateral FDI to African economies. One may attribute this finding to the underdeveloped nature of the financial sector in most African economies such that some source countries have invested in banks to facilitate investments in the region. This is clearly the case with respect to China's investment in Standard Bank of South Africa to promote its investments in the African continent. The result is in line with previous studies (e.g. Anyanwu, 2012). In a similar way, the coefficient on control of corruption is strongly negative. The implication of this finding is already discussed above.

As for exchange rate volatility, proxied by the standard deviation of bilateral real exchange rate, the results clearly reveal a positive and statistically significant impact on bilateral FDI. This finding could be explained by the market-seeking nature of FDI in host markets, to the extent that volatility in the exchange rate encourages these investments. The remaining control variables, trade openness, surrounding market potential, electricity infrastructure index and bilateral investment treaty dummy are not significant.

[15] To conduct the tests for autocorrelation and validity of the instruments, it is useful to ensure that the ratio of the cross section sample size (number of country-pairs) to the number of instruments is at least 1. The assumptions underlying these tests are violated when this requirement is not met (see Asiedu, 2013).

Overall, the results are consistent with the hypotheses of the study. In both static panel and dynamic panel estimation techniques, relative market size showed the expected strong positive impact on bilateral FDI from the different groups of economies. Countries with natural resource endowments were attractive destinations of resource-seeking FDI from the different groups of investors, although these investments undermine non-resource seeking-FDI in host economies. The results further reveal significant differences in the nature of market-seeking and resource-seeking FDI between investors from African economies and the OECD. The results also show significant differences in resource-seeking FDI between intra-African investors and those from non-OECD emerging market economies. The existence of low labour costs is an important factor driving non-OECD FDI into non-resource rich countries. The results further demonstrate significant differences between the drivers of FDI to South Africa and other African countries. These findings suggest that there is heterogeneity in the motivations and determinants of FDI among investors from the different groups of economies into host African countries.

2.6. Conclusion

This study has investigated whether FDI from the different groups of economies, categorized into the Organization of Economic Cooperation and Development (OECD), non-OECD emerging markets and intra-African economies are driven by market-seeking, resource-seeking and efficiency-seeking objectives into African countries. Previous studies have looked at the determinants of FDI into African countries using aggregate data on inward FDI stocks or flows, and have not considered the heterogeneous nature of these investments. There is also hardly any empirical evidence on whether there are differences in the determinants of FDI into host African countries among investors from the different source countries. By exploiting recent data on bilateral FDI stock (UNCTAD, 2014), this study has tackled the issue of source and host country heterogeneity in explaining the determinants of FDI into resource rich and non-resource rich African countries.

This study contributes to the empirical literature by providing evidence on the specific factors that influence FDI from the different groups of economies into resource-rich and non-resource rich African countries. It further attests to the differences in the determinants of FDI between intra-African investors and those from the OECD and non-OECD emerging markets. In the same way, we determine whether there are significant differences between the factors driving FDI to

South Africa and other African countries. These issues were interrogated in order to determine which investments are most likely to be market-seeking and efficiency-seeking, which arguably generate stronger growth impact than resource-seeking FDI in host countries. In spite of its diversity in resource endowments, the African continent has received only a limited share of global FDI inflows in the past few decades, compared to Asia and Latin America and the Caribbean in the developing world.

The analysis has shown that market size of host countries and availability of natural resources are important factors attracting FDI from intra-African, OECD and non-OECD emerging markets economies into resource rich African countries. It further suggests that FDI from OECD and non-OECD emerging markets economies are mostly encouraged by the market size of host non-resource rich countries, as well as lower labour costs for non-OECD emerging markets economies, while FDI from intra-African countries are explained by large markets in these economies. Although the presence of natural resources attracts resource-seeking FDI in the extractive industries, the analysis demonstrates that these investments tend to undermine non-resource seeking FDI. The study further reveals significant differences in determinants of FDI between intra-African and non-OECD emerging markets' investors regarding the presence of natural resources in resource-rich countries and market size in non-resource rich countries. The result provide support that there are significant differences between intra-African and OECD investors in terms of market size and availability of natural resources in resource-rich countries and markets size in non-resource rich countries. The results further show significant differences between South Africa and other African countries in the drivers of FDI to these countries.

Overall, the results suggest that FDI from the different groups of economies can be enhanced through policy measures that encourage market-seeking FDI into both resource rich and resource poor countries. Along these lines, host countries can encourage market-seeking FDI through the implementation of measures such as targeted economic incentives that facilitate FDI into manufacturing and high productivity services sectors. Also, policies designed to encourage market-determined wages can also boost non-OECD FDI into non-resource rich countries.

It is important to note that the analysis is based on FDI stock data disaggregated at the bilateral level and not sectoral level due to unavailability of such data at the time of analysis. It would be

helpful in future research to consider the factors driving FDI to various sectors when data becomes available.

CHAPTER THREE

Physical Capital, Skill Intensity and Ownership Structure in FDI projects

3.1 Introduction

What drives foreign direct investment (FDI) activity has been a central question of great importance to academics and policymakers. The growing interest in understanding these determinants is evidenced by the burgeoning literature on firms' ownership of productive assets, which explains why firms undertake production of some goods in-house, such as intermediate inputs than through market transactions (see e.g. Alfaro et al, 2015; Antras, 2003; Antras, 2013; Antras and Chor, 2013; Antras and Helpman, 2004; Antras and Yeaple, 2014). As multinationals invest abroad, they have to make important decisions regarding their ownership structure, determining whether to establish subsidiaries through wholly-owned foreign affiliates or joint venture ownership with domestic firms in host countries (Raff et al., 2009). This is so because such ownership decisions have an important influence on the incentive of parties to devote resources to FDI projects (Asiedu and Esfhani, 2001) and the extent of knowledge and technology transfer from foreign affiliates to local agents. Joint ventures with local firms have been advocated as an important ownership structure that enhances technology diffusion in host countries, as increased participation of local agents in FDI projects will enable multinationals to reveal their proprietary knowledge, thereby facilitating spillovers (Blomstrom and Sjoholm, 1999).[16] Given the importance of joint ventures to host countries, establishing how the relative input investments of foreign and local firms affect their ownership decisions is helpful for understanding the sectors through which host countries can leverage FDI to boost productivity growth.

In trying to understand how relative input contributions of foreign firms and input supplying firms affect trade flows, most empirical studies have tackled this issue using the framework of property rights theory of the firm, to determine which goods are more likely to be traded within the boundaries of the firm rather than through market transactions. Pioneered by Antras (2003),

[16] Another strand of literature has emphasized that domestic firms benefit from superior foreign technology through licensing (see Nguyen et al, 2014).

this strand of literature on intra-firm trade flows suggests that there is greater propensity for foreign producing firms and input supplying firms to integrate through capital-intensive industries than labour-intensive production. This is so given that investments in physical capital are more easily shared than investments in human capital which are inalienable (see Antras, 2003). Given the features of these investments, there is reduced incentive for the parties to invest in human capital as they attempt to avoid potential holdup problem. Along these lines, this literature predicts that the firms will engage in vertically integrated production, when the contribution of headquarter firm through physical capital is more important than human capital investment undertaken by input supplying firm. On the other hand, outsourcing relationship will exist when human capital is relatively more important than physical capital investments. One would, therefore, argue that there is greater likelihood of integration in FDI projects that more intensively use physical capital of the headquarter firm than human capital provided by domestic firms.

While there is overwhelming evidence suggesting that FDI through intra-firm trade flows is mostly undertaken in capital-intensive industries (e.g. Antras, 2003; Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013), these studies have not explicitly investigated how relative input investments of foreign and local firms affect foreign equity ownership. Most empirical studies have largely explored the role of host country institutions and other characteristics in explaining ownership structure of firms (see e.g. Asiedu and Esfahani, 2001; Driffield et al., 2014; Grande and Teixeira, 2012; Meyer et al., 2009). One of the few empirical studies, Lee (2014) has examined how the skill intensity of Korean workers influences the ownership structure of Korean affiliates.

This study focuses on a different research issue, determining the sectors through which foreign subsidiaries can integrate local firms in FDI projects in sub-Saharan Africa. Given this objective, the study makes a distinctive contribution to the debate by investigating the question of whether these firms are more likely to integrate in capital-intensive activities than labour-intensive activities in these economies. Investigating these issues is particularly relevant to the debate on ownership decisions of firms for a region that has received few spillovers from FDI and little attention in the empirical literature on the integrating decisions of these firms. Partly due to structural reforms undertaken by most countries in recent years, the sub-Saharan Africa is now

relatively more open to foreign equity ownership than other regions of the world (see World Bank, 2010). One would, therefore, expect that local firms will actively participate in FDI projects following the removal of most barriers to FDI in host economies. Consequently, recent years have seen an increase in FDI in high technology sectors, particularly driven by joint ventures between domestic firms and transnational corporations (UNIDO, 2011). It is also evident that foreign affiliates use physical capital more intensively that human capital, compared to domestic firms with local managers having absolute control over recruitment decisions in these enterprises (UNIDO, 2011). This presupposes that physical capital can proxy the input investment of foreign affiliates in FDI projects while domestic firms contribute through human capital. Given these facts, one may hypothesize that there is greater likelihood of integration of local firms in FDI projects through capital intensive sectors. Due partly to relatively underdeveloped financial markets, most countries in sub-Saharan Africa have had to rely largely on foreign capital injections through FDI to boost domestic investment. One can also argue that local firms have better knowledge of the market conditions in host countries. This explains why local managers largely control matters of recruitment. To the best of our knowledge, there is no empirical work that has investigated how input investments influence ownership decisions of foreign subsidiaries and local firms in sub-Saharan Africa.

In order to explain this relationship, the study uses a rich large firm-level data on 19 countries in sub-Saharan Africa region, which was collected by the United Nations Industrial Development Organization (UNIDO) in 2010. The analysis is restricted to manufacturing and services firms. This allows us to undertake a comprehensive evaluation of the integrating decisions of firms in non-resource extractive industries. Applying different estimation techniques, particularly the fractional logit and probit models, the results provide strong evidence suggesting that foreign affiliates and local firms are more likely to integrate in capital-intensive sectors and less likely in labour-intensive sectors.

The next section reviews the literature on equity ownership and the intensity of inputs of foreign firms and local partners. The model explaining the theoretical predictions of the underlying relationship is derived in section 3. The empirical results are analyzed in section 4 and section 5 provides a summary of the chapter.

3.2 Literature Review

The question of why some activities are undertaken within the boundaries of firm and others through market transactions has been a major research issue in economics literature (see Holmstrom and Roberts, 1998; Lafontaine and Slade, 2007; Kohler and Smolka, 2015). A seminal work on firm boundaries (Coase, 1937) argues that there are efficiency gains arising from the coordination of production activities within the firm rather than through market transactions. This paper suggests that transactions will be coordinated within the firm when it becomes less costly to undertake these transactions than through the market mechanism. Following Coase (1937), there has been growing literature on different approaches to the internalization decision of multinational firms. Two leading theories of vertical integration in the literature on firm boundaries are the transaction cost theory and property rights theory (Acemoglu et al., 2010; Antras, 2015; Du et al., 2012). These theories provide insights into the transaction costs arising from contractual frictions between parties and how these costs can be mitigated depending on the organizational modes. In this section, we review the relevant literature on these theories while focusing largely on the property rights theory.

The transaction cost theory (Williamson, 1971, 1979; Klein et al., 1978) suggests that the presence of incomplete contracts and asset specificity affect the decisions of parties to engage into long-term contracts and their choice between keeping activities within the firm or through market transactions. This theory claims that an important source of transaction cost is the hold-up problem, as each party attempts to take advantage of the sunk costs or specific nature of investments that characterize the relationship. Generally, it is practically impossible for the parties to write long-term contracts that cover all contingencies arising from a relationship. When contracts are incomplete, there is a potential hold-up problem arising from the parties to undertake investments in assets that are specific to a relationship. This generates quasi-rents and, as a result, each of the parties has greater incentive to leverage these rents (Lafontaine and Slade, 2007).[17] Specifically, the presence of ex post quasi-rents increases the incentives of the parties to engage in optimistic behavior. This affects the execution of long-term contracts. As a result,

[17] Ex post quasi-rents implies that the value of the relationship- specific investments is greater in the relationship than outside the relationship (Whinston, 2003).

there are potential hold-up inefficiencies arising from such transactions, partly due to potential underinvestment in the specific assets of the relationship.

One could explain the hold-up problems arising from a relationship-specific investment using an example of a final good producer and an input supplying firm (see e.g. Aghion and Holden, 2011; Antras, 2003; Grossman and Helpman, 2002; Johnson and Houston, 2000). Assume that the input supplier makes specific investments in the relationship, specialized intermediate inputs are produced which are subsequently delivered to a final good producer. The foreign producer can renegotiate contracts for concessions regarding the price or quantity of the inputs produced by the supplying firm. It follows that the input supplying firm is exposed to a holdup problem once the specific investments are sunk into producing the specialized inputs. The input supplying firm therefore faces a relatively weak bargaining power following its relationship-specific investments (Grossman and Helpman, 2002). Anticipating such a problem, the supplier of the intermediate input will be less incentivized to make asset-specific investments in order to produce the efficient quantity of these inputs. Similarly, the buyer is exposed to potential hold-up problem when the cost of switching to a new supplier is very high (Johnson and Houston, 2000).

To mitigate the hold-up problem, the transaction cost theory suggests that the supplying firm should be vertically integrated into the foreign firm. Such an integration decision allows each contracting parties claims to the quasi-rents generated from their investments in specific assets. This theory predicts that vertical integration is more likely when there is greater asset specificity and costly holdup problem, and vertical integration enhances investments undertaken by the contracting parties (Acemoglu et al., 2010). While the transaction cost theory enhances our understanding on transaction costs from market transactions in the presence of incomplete contracts, the theory is, however, silent on the nature of such costs within the firm. This raises further questions on the costs of vertical integration and how hold-up inefficiencies are mitigated.

Building on the premises of contract incompleteness and relationship-specific investments of the transaction cost theory, the property rights theory (Grossman and Hart, 1986; Hart and Moore, 1990) claims that the allocation of ownership rights of asset can mitigate hold-up inefficiencies in a relationship. In the theoretical analysis, Grossman and Hart (1986) emphasize the costs and

benefits of vertical integration as ownership rights of assets changes ex-ante investment incentives of the contracting parties. This theory predicts that it is optimal to allocate asset ownership to the party making relationship-specific investments that are more important to generating the surplus from the relationship. With such an ownership structure, the owner making more productive investments (final-good producer) is more incentivized to undertake these investments and has relatively strong bargaining power in all contingencies. In contrast, the supplying firm has insufficient incentive to make similar investments and relatively lower bargaining power, resulting in underinvestment and consequently generating a lower surplus in the relationship. This suggests that there are opposite effects of the relative input investments of foreign producers and input suppliers on integration decisions. The net benefits of vertical integration, therefore, depend on the relative importance of the investments of the foreign producer and input supplier to generate the surplus from the relationship (Acemoglu et al., 2010). These predications imply that vertical integration does not necessarily eliminate holdup inefficiencies in the context of the property rights theory. This brings to mind a further question on the mechanisms through which these inefficiencies are mitigated.

In explaining how the holdup inefficiencies can be reduced, Antras (2003) proposes a model in which cost sharing with the final good producer alleviates the holdup problem facing the input supplying. This framework suggests that the problem is mitigated by allowing the final good producer to contribute to the relationship-specific investments of the supplying firm. Although such a cost- sharing investment also exposes the producer to potential holdup problem, Antras (2003) argues that such a problem is mitigated by assigning ownership rights of assets to the producer when cost sharing is sufficiently large. In this sense, the input supplying firm will be vertically integrated into production. Conversely, it is optimal to outsource when the contribution of the producer to the specific investments of the supplying firm is minimal. This suggests that the supplying firm has greater ownership rights of the assets. Other studies suggest that the allocation of ownership in a joint venture provides incentives to the contracting parties and encourage relationship-specific investments (e.g. Cui, 2010).

The predictions of Antras (2003) are directly related to the relationship being investigated on FDI projects in sub-Saharan Africa. It is useful to start from the premise that non-contractible investments in physical capital capture the relative contribution of foreign producers and the

local partner through education and training of the local workforce. It is also plausible to assume that a foreign producer incurs additional investment costs through its contribution to education and training of the local workforce. Because investments in physical capital are arguably more important than labour services in the sub-Saharan African context and given that investment-sharing is costly, it is optimal to allocate the residual ownership rights to the foreign producer. This implies that the foreign producer has greater incentive to invest in physical capital under vertical integration, while the local producer is more incentivized to invest in the local workforce under nonintegration or arm's length transactions. It follows then that foreign affiliates are more likely to engage in integrated production when there is greater physical capital intensity and lower the skill intensity of the local workforce.

There are few studies that have considered an integrated approach that combines physical capital and knowledge capital in explaining lateral integration decisions (e.g. Chen et al., 2012; Markusen and Xie, 2014). It is predicted in these works that knowledge-capital intensive firms undertake FDI and physical capital-intensive firms choose outsourcing. These predictions are relevant for investigating the underlying relationship in this study. The theoretical analysis of this study assumes that the owner of physical assets also owns knowledge capital of the firm. This implies that foreign affiliates can protect proprietary knowledge through vertically integrated production.

The empirical studies on the application of the property rights theory in explaining FDI determinants can be broadly grouped into studies that have examined the behaviour of FDI through intra-firm trade flows (e.g. Antras, 2003; Fernandes and Tang, 2012; Nunn and Trefler, 2013; Antras and Yeaple, 2014) and few studies that have explicitly considered FDI through backward integration (Acemoglu et al., 2010) and equity ownership (Lee, 2014). In Antras (2003), vertical integration is proxied by the share of intra-firm imports in total US imports. The results of this study show that physical capital intensity, proxied by the ratio of capital stock to employment, is positively correlated with the share of intra-firm imports. There is however no statistically significant relationship between human capital intensity (proxy for relationship-specific investments of supplying firm) and intra-firm imports. Applying Antras' (2003) framework, a number of studies have investigated the role of headquarter intensities, proxied by physical capital intensity, skill intensity and R&D intensity in determining firms' integration

versus outsourcing decisions (e.g. Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013). These studies find that intra-firm trade is larger when headquarter intensity is high.

In a similar vein, Acemoglu et al. (2010) consider a sample of UK manufacturing firms to determine how the relative importance of the technology intensities of foreign producers and input suppliers affect their decision to engage in backward vertical integration. The study finds that the likelihood of vertical integration increases in the technology intensity of the producer and decreases with the technology intensity of the supplier. Studies that have considered the role of skill-workers in determining ownership structure of FDI are rare. One of the few studies on the role of headquarter intensity in determining ownership structure (Lee, 2014) uses the share of Korean workers transferred from the parent to the affiliate as proxy for headquarter intangible assets. The study shows that equity ownership increases with the share of Korean affiliates. Capital intensity is found to be negatively associated with ownership share, which is attributed to the relative importance of the contribution of the local partner to physical capital intensity of the affiliates.

One potential problem with investigating the relative input contributions of the parties in determining integration decisions of firms is the issue of measuring relationship-specific investments or non-contractibility of these inputs. Recent literature emphasizes the importance of non-contractibility of headquarter inputs in investigating the underlying relationships (e.g. Antras, 2013; Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013). In this strand of literature, the standard measure of physical capital intensity of headquarter, proxied by total capital stock to total employment (Antras, 2003), is an imperfect proxy for headquarter intensity. Total capital stock comprises investments that are easily contractible and are therefore not relationship-specific, such as capital expenditures on structure or non-specialized equipment (e.g. automobiles and computers) which are valuable outside the relationship. This suggests that investments in machinery or specialized equipment are more relationship-specific and a better proxy for non-contractibility of headquarter input in testing the predictions of the property rights theory. The empirical evidence supports these predictions as it reveals a significant and positive relationship between machinery or equipment intensity and intra-firm trade, while non-

specialized investments show a negative association (Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013).

To conclude, the literature shows a clear relationship between FDI and the relative input investment contributions of foreign affiliates and local firms. This study tests the hypothesis that local firms are more likely to be integrated in capital-intensive production and less likely in labour-intensive activities in sub-Saharan Africa.

3.3 Model

The following framework is concerned with modelling the relationship between equity ownership and the relative input contributions of foreign affiliates and local firms in FDI projects. This framework closely follows Cui (2010) with one modification. In Cui (2010), which is an extension of Antras and Helpman (2004), the final-good variety is produced using relationship-specific inputs of the headquarter and manufactured components of supplying firms. Given the relatively limited industrial capacities of most sub-Saharan African countries, this study follows Antras (2003) and argues that local firms can contribute through labour services. In this framework, the foreign affiliate undertakes relationship-specific investments in physical capital and local firms through education and training of the local workforce.

To develop the model, this framework further assumes a world with two countries, North and South, which is populated by a unit of consumers with identical preferences represented by:

$$U = x_0 + \frac{1}{\mu}\sum_{j=1}^{j} X_j^{\mu}, 0 < \mu < 1 \quad (3.1)$$

where x_0 denotes consumption of a homogenous good and X_j is an index of aggregate consumption in j industries, which is specified as a CES function:

$$X_j = \left[\int x_j(i)^{\alpha} di\right]^{1/\alpha}, \ \ 0 < \alpha < 1 \quad (3.2)$$

Within a given industry, the elasticity of substitution is assumed to be high between industries (inter-industry) such that $\alpha > \mu$. There are location advantages associated with producing in the South, with wages in the South assumed to be lower than those in the North ($w^N > w^S$). These wages are considered to be fixed in both countries. With fixed allocation of labour in both countries, total labour income would also be fixed. This yields an inverse demand function from utility maximization as shown in equation (3.3):

$$P_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha-1} \quad (3.3)$$

There are two agents: foreign producer (N) and local agent or partner (A). Assume that a location decision has been taken by the foreign producer to produce the good in the host country (South). Following the literature on firm heterogeneity (Melitz, 2003; Antras and Helpman, 2004), the framework assumes that only the most productive foreign firms can cover the fixed costs of investing in the South. Suppose that the firm-specific productivity parameter is θ, below which the foreign firms cannot cover the fixed costs. The contribution of the firms through physical capital investments can either be undertaken by the foreign firm or local agent or both. For simplicity, assume those investments are undertaken by the foreign producer who also initially owns the knowledge in producing the good. The technology takes the following form:

$$x_j(i) = \theta \left(\frac{h_j(i)}{\eta_j}\right)^{\eta_j} \left(\frac{l_j(i)}{1-\eta_j}\right)^{1-\eta_j} \quad , 0 < \eta_j < 1 \quad (3.4)$$

where η_j is the intensity of physical capital, which denotes the relative contribution of investments of foreign affiliates in physical capital to labour services, and $1 - \eta_j$ the relative input intensity of local firms (labour inputs). Revenue (R) generated from the product is obtained from equations 3.3 and 3.4 as:

$$R_j(i) = P_j(i)x_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha} = X_j^{\mu-\alpha} \theta^{\alpha} \left(\frac{h_j(i)}{\eta_j}\right)^{\alpha\eta_j} \left(\frac{l_j(i)}{1-\eta_j}\right)^{\alpha(1-\eta_j)} \quad (3.5)$$

The foreign producer decides on the organizational form, that is, whether to engage in FDI through the integration of local firms in production or outsourcing (non-integration). When outsourcing is considered, the foreign firm and local firm exist as separate entities with the foreign firm producing with its inputs $h_j(i)$ and the local firm producing using own labour services $l_j(i)$. Antras and Helpman (2004) argue that the fixed organizational cost of vertical integration is greater than outsourcing. This is partly attributed to organizational costs associated with supervision of production by managerial staff. Letting V and O denote integrated production and outsourcing respectively, the organizational costs can be ranked as $f_V > f_O$.

In Cui's (2010) theoretical analysis, the integrating firm can either be solely owned by foreign affiliates or through joint venture ownership. In the case of wholly-owned foreign affiliate, the foreign producer owns both $h_j(i)$ and $l_j(i)$. Production of the final good is completely controlled by the foreign producer and the local partner can be fired when there is no agreement.

The foreign producer is, however, exposed to an output loss of $1-\delta_{SV}$ (Cui, 2010). This loss arises from the fact that the foreign producer cannot effectively use labour inputs $l_j(i)$ in the absence of the local agent (Antras and Yeaple, 2014). Let SV denote sole ownership under integrated production and $R_k(j),\ k=O,V$ be the revenue generated when there is an agreement between the contracting parties. If the foreign producer and local producer break up, the foreign producer can only sell a proportion δ of the output $x_j(i)$, that is, $\delta_{SV}x_j(i)$. Given the CES preferences and constant markup $1/\alpha$, revenue accruing to the foreign producer amounts to $\delta^{\alpha}R_j(i)$ (Nunn and Trefler, 2013). In the ex-post bargaining, the share of revenue received by each contracting party comprises the ex-post surplus from the relationship and their outside option (Antras and Yeaple, 2014; Cui, 2010). In this context, the foreign producer will receive an outside option $\delta_{SV}^{\alpha}R_j(i)$ and ex-post surplus from the relationship of $\left(R_j(i)-\delta_{SV}^{\alpha}R_j(i)\right)=(1-\delta_{SV}^{\alpha})R_j(i)$ while the outside option of the local producer is zero.

In the case of joint ventures, the inputs $h_j(i)$ and $l_j(i)$ are collectively owned by the foreign producer and local partner. The parties can liquidate the physical assets of the integrating firm in the outside asset market when the relationship ends and the revenue generated is distributed according to their equity share. Assume that the equity share of the foreign producer is γ and the local partner $1-\gamma$. If the foreign producer and local partner break up, the human assets of the parties will no longer be accessible to both parties. Consequently, the output loss is assumed to be greater in a joint venture than in the wholly-owned enterprise ($\delta_{JV}\leq\delta_{SV}<1$). δ_{JV} is revenue from the sale of physical assets in the outside market, expressed as a share of the output produced.

Following the above propositions, the share of revenue (β) accruing to the foreign producer under integrated production, comprising the ex-post surplus and the outside option is:

$$\beta_V(\gamma)=\gamma(\delta_V)^{\alpha}+\beta[1-(\delta_V)^{\alpha}] \tag{3.6}$$

When $\gamma\in(0,1),\ \delta_V=\delta_{JV}$. For $\gamma=0$ or 1, $\delta_V=\delta_{SV}$. In the case of outsourcing, the outside option is zero and the revenue from the relationship is $R_O(j)$ such as the resulting revenue is the

value of $0 + \beta(R_O(j) - 0) = \beta R_O(j)$ (Nunn and Trefler, 2013). Denoting $\beta_O = \beta$, the share of the revenue from outsourcing, it implies that $\beta_V > \beta_O$.

From the property rights theory, the contracts between the foreign producer and local partners are assumed to be incomplete. The assumption of contract incompleteness introduces a distortion in the relationship. It suggests that the contracting parties cannot choose optimal levels of investment in their respective inputs, given that they are exposed to a holdup problem. The model further assumes that there is a large number of identical local partners engaged in production. Each of the local partners makes a lump-sum transfer T (participation fee) to the foreign producer upon entering the market. Competition among local partners ensures continuous adjustment in T so that the local partners can break-even (Antras, 2003). The participation fee T is non-negative or negative, implying that the local partner is not cash constrained (Cui, 2010).

Given that the foreign producer cannot write enforceable contracts ex-ante, the parties have to bargain over the surplus of the relationship. This ex-post bargaining is assumed to follow a generalized Nash Bargaining, with the owner of the integrating firm (final-good producer) receiving a fraction of the surplus $\beta \in [0,1]$. The foreign producer and local partner choose non-contractible relationship-specific investments $h_j(i)$ and $l_j(i)$ independently such that the foreign producer uses own inputs $h_j(i)$ to maximize $\beta_k R(i) - w^N h(i)$ and the local partner uses labour services $l_j(i)$ to maximize $(1 - \beta_k)R(i) - w^S l(i)$. Combining the profit expressions of the parties and using equation (3.5) yields total operating profit as:

$$\pi_k = X^{(\mu-\alpha)/(1-\alpha)} \theta^{\alpha/(1-\alpha)} \psi_k - w^N f_{k,} k = O, V \tag{3.7}$$

where $\psi_k = \{1 - \alpha[\beta_k \eta + (1 - \beta_k)(1 - \eta]\} \left[\frac{(w^N)(w^S)^{1-\eta}}{\alpha \beta_k^{\eta}(1-\beta_k)^{1-\eta}}\right]^{\alpha/(\alpha-1)}$ (3.8)

When the foreign producer chooses integrated production, the total profit from equation (3.7) is:

$$\pi_V = X^{(\mu-\alpha)/(1-\alpha)} \theta^{\alpha/(1-\alpha)} \psi_V - w^N f_V \tag{3.9}$$

Following standard derivations in the literature, the optimal fraction of the foreign producer's revenue which maximizes ψ_V in order to maximize profit is:

$$\beta_V^*(\eta) = \frac{\eta(\alpha\eta+1-\alpha) - \sqrt{\eta(1-\eta)(1-\alpha n)(\alpha\eta+1-\alpha)}}{2\eta-1} \tag{3.10}$$

It follows from equation (3.10) that β_V^* increases in the investment contribution of the foreign producer η i.e. $\frac{d\beta_V^*}{d\eta} > 0$ and decreases in the local partner's investment contributions, $1-\eta$. In reality, the foreign producer observes adjustment in β_V through his equity share $\gamma \in (0,1)$. From equation (3.10), the foreign producer is only able to achieve the first-best share of revenue (β_V^*) if $\delta_V = \delta_{JV} = \delta_{SV} = 1$. Given the prior assumption that $\delta_{JV} \leq \delta_{SV} < 1$ and using equation (3.6), the optimal equity share is derived in Cui (2010) as:

$$\gamma^*\left(\beta_V^*(\eta)\right) = \begin{cases} 0 \; if \; \beta + \frac{\beta_V^* - \beta}{(\delta_{JV})^\alpha} \leq 0 \\ \beta + \frac{\beta_V^* - \beta}{(\delta_{JV})^\alpha} \; if \; 0 < \beta + \frac{\beta_V^* - \beta}{(\delta_{JV})^\alpha} < 1 \\ 1 \; if \; \beta + \frac{\beta_V^* - \beta}{(\delta_{JV})^\alpha} \geq 1 \end{cases} \tag{3.11}$$

It follows from equations (3.10) and (3.11) that the foreign producer will hold a greater equity share when these investments are relatively more important than the local partner in generating the surplus of the relationship. From equation (3.11), the foreign producer will choose sole ownership when the relative intensity of physical capital η is greater and close to 1. This suggests that ownership of physical assets and labour inputs should be assigned to the final producer when η is very high. In contrast, when labour services are more relevant to production of the final good (η is very low), it is optimal to assign ownership rights of assets to the local partner (outsourcing). Finally, joint venture ownership arises when $\gamma^*(\beta_V^*(\eta))$ lies between zero and unity. Equation (3.11), therefore, provides the basis for empirical investigation of the relationship between equity ownership and the relative contribution of the investments of the foreign producers and local partners. This model allows us to determine which sectors are foreign and local firms more likely to integrate activities in FDI projects.

3.4. Estimation Strategy

This section describes the estimation strategy used in analyzing the relationship between equity ownership and the input contributions of foreign affiliates and local firms in sub-Saharan Africa. The theoretical framework derived in the previous section predicts opposing effects of physical capital intensity and skill intensity of the local workforce on the integration decisions of firms. To obtain an empirical model explaining this relationship, this study follows the standard approach in the literature, replacing the unobserved optimal equity share $\gamma^*(\beta_V^*(\eta))$ specified

in equation (3.11) with a dummy variable (V) for integrated production. As a first step in establishing this relationship, a baseline specification is considered with the dependent variable, foreign equity ownership, measured as a dummy variable coded 1 if foreign firms choose either wholly-owned foreign affiliate or joint venture entity, and 0 for non-integration or locally owned firms.[18] An integrated production structure confers appropriate incentives to the contracting parties and, therefore, generates a higher variable profit for the parties (Cui, 2010). This implies from equation (11) that the optimal equity share is $\gamma^*(1) > \gamma^*(0)$. Following the literature, the estimation strategy for integrated production is derived by adding a zero-mean random error term ϵ to both sides of the inequality: $\gamma^*(1) + \epsilon_1 > \gamma^*(0) + \epsilon_0$ or $\Delta = \gamma^*(1) - \gamma^*(0) > \epsilon_0 - \epsilon_1$ (see Lafontaine and Slade, 2007). If $\epsilon_0 - \epsilon_1$ follows a cumulative distribution function $F(.)$, the probability of choosing integrated production is:

$$Prob[V] = Prob[V = 1] = F(\Delta) \tag{3.12}$$

Given that the dependent variable in equation (3.12) is an indicator variable, the underlying relationship can be estimated using a linear probability model and probit/logit approaches:

$$Prob[V = 1] = F\left(KL_{ijc}, SKL_{ijc}, D_{ijc}\right) + \varepsilon_{ijc} \tag{3.13}$$

Where KL_{ijc} is physical capital intensity for firm i in sector j and host country c, SKL_{ijc} denotes the skill intensity of the local workforce, and D_{ijc} is a vector of control variables, such as other proxies for headquarter intensity (skill intensity of the foreign firms and research and development (R&D) intensity), and firm characteristics such as age and productivity.

The literature uses physical capital intensity and human-capital intensity as proxies for the relationship-specific investment contributions of final-good producers and supplier firms, respectively (Antras, 2003). From equation (3.10), it follows that the decision to choose integrated production is greater when there is a higher intensity of headquarter services η and lower skill intensity of the local workforce.

[18] The classification of FDI into wholly-owned foreign affiliates and joint venture ownership is based on the approach adopted by UNIDO (2011), which defines wholly-owned foreign firms as those entities with foreign equity ownership exceeding 90 percent and joint venture ownership lying between 10 percent and 90 percent. Locally owned firms are those that have not attracted FDI i.e. zero foreign equity ownership.

In the intra-firm trade literature, physical capital intensity is measured as physical capital per employee (Antras, 2013; Bernard et al., 2010; Antras and Yeaple, 2014; Fernandes and Tang, 2012). Following this literature, physical capital intensity is proxied by the ratio of fixed assets to total full time employees and total assets (current plus fixed assets) to total full time employees. There are generally two measures of skill intensity considered in the literature. For the first measure, skill intensity is proxied by the share of non-production workers in total employment (Berman et al., 1994). Head and Ries (2002) use the share of the wage bill of high-skilled workers and log of average wage of the firm as measures of skill intensity. Depending on data availability, the empirical literature on intra-firm trade use both measures of skill intensity, with some studies considering Berman et al.'s (1994) measure (Antras, 2003; Bernard et al, 2010) while others have used the measure developed by Head and Ries (2002) (e.g. Fernandes and Tang, 2012; Nunn and Trefler, 2013). In some specifications, human capital-intensity of the supplier firms is proxied by the ratio of non-production workers to production workers (Antras, 2003) and ratio of non-production workers to total employment (Antras and Chor, 2013). However, these measures capture both the effects of headquarter skill intensity and the skill intensity of the local workforce on foreign equity ownership. Our data allows us to separately explore how human capital capacity of the local firms influences foreign equity ownership. Following Berman et al. (1994), the skill intensity of the local workforce is measured as the ratio of local staff employed in technical, managerial or supervisory positions to total full time employment.

To control for the effects of other factors on the decision to choose integrated production, the specification in equation (3.13) includes other headquarter services such as foreign skill intensity and research and development (R&D) intensity. These variables are used as proxies for managerial inputs and R&D inputs of headquarter respectively (Nunn and Trefler, 2013). R&D intensity is proxied by the ratio of R&D expenditures over total sales. Foreign skill intensity is measured by the share of foreign technical and managerial/supervisory level staff in total full time employment. Similarly, to capture the characteristics of firms, some commonly used control variables are included in the model, such as productivity and the age of the firm. The age of the firm captures the international experience of the subsidiary and is measured by the number of

years since the firm was established (Asiedu and Esfahani, 2001). Productivity is defined as total sales in the previous year divided by total number of full time employees in the previous year.

3.5 Data and Descriptive Analysis

The study uses firm-level survey data, Africa Investor Survey (2010), collected by the United Nations Industrial Development Organization (UNIDO) on both local and foreign firms operating in 19 countries in sub-Saharan Africa. The survey covers all private and public for-profit firms with more than 10 employees, operating mainly in manufacturing and services sectors, but also in agriculture, mining and construction sectors (UNIDO, 2011). The data used covers manufacturing and services firms only, while agriculture, fishing, mining and quarrying sectors are excluded. It was collected based on a stratified sampling technique, using information on three dimensions or strata: sector, size and ownership. The enumerators collected firm information through face-to-face interviews with managers or top-level-management staff. The dataset provides information on the variables of interest, ownership structure of firms, employment composition and fixed assets, as well as control variables such as productivity and firm age, etc. Specifically, on employment composition, the dataset contains information on total number of full time employees, total number technical and managerial/ supervisory staff and the number of foreign staff employed in these positions. The data categorizes ownership structure of firms into wholly-owned foreign subsidiaries, joint ventures and wholly-owned local firms. The total number of firms contained in the database is 6,492 firms. However, the data was restricted to cover manufacturing and services firms only, while omitting sectors such as agriculture and fishing, mining and quarrying. This reduces the sample size to 6133 firms, out of which 81 percent are domestically owned firms, 12 percent wholly-owned foreign affiliates and joint venture firms slightly above 6 percent.

Table 3.1 reports the descriptive statistics of the explanatory variables considered in the regression. It is clear that the skill intensity of the firms' workforce is considerably low. On average, 16 percent of the local workforce of firms is skilled labour and 1.5 percent is foreign skilled workforce. The standard deviation of 0.71 and 0.19 for local and foreign skill intensity respectively suggest that there is reasonable variation in skill composition across firms.

Table 3.1: Descriptive statistics

Variable	Mean	Std. Dev.
Foreign ownership share (%)	19.605	1.935
Local skill intensity (%)	16.210	0.712
Foreign skill intensity (%)	1.529	0.191
Physical capital intensity (US$/L)	93409.7	17761.43
Ratio of R&D over sales (%)	4.219	1.823
Firm productivity (US$/L)	77861.29	14502.68
Firm age (years)	18.507	0.863

The above literature review shows that physical capital intensity should be positively associated with foreign equity ownership and skill intensity of the local workforce negatively correlated with foreign equity ownership. To get some insights into the direction of the effect of the relative investment contributions of foreign affiliates and local firms on the integration decisions of firms, the correlations between the variables are analyzed. The correlations are displayed in table 3.2. A look at these correlations suggests strong negative association between skill intensity of local workforce and ownership share of foreign affiliates. There is a strong positive association between foreign ownership share and headquarter intensity (foreign skill intensity and physical capital intensity). From these correlations, it is helpful to investigate empirically whether the underlying relationship between equity ownership and input contributions holds for sub-Saharan Africa countries. This is analyzed in the next section.

Table 3.2: Correlation matrix

	1	2	3	4	5	6	7
1. Ownership	1						
2. Local skill intensity	-0.11*	1					
3. Foreign skill intensity	0.39*	-0.10*	1				
4. Capital intensity	0.04*	0.01	0.01	1			
5. R&D intensity	0.00*	0.01	-0.02	0.00	1		
6. Firm productivity	0.10*	-0.02	0.05*	-0.00	-0.00	1	
7. Firm age	-0.04*	0.00	-0.07*	0.02	-0.00	-0.01	1

Note: '*' denotes significant at the 5 percent.

To understand the analysis, it is helpful to present some stylized facts regarding foreign equity ownership and the input intensities of foreign affiliates and local firms. As noted, physical capital intensity is used as a proxy for relative investment contribution of foreign affiliates, while skill intensity of the local workforce is a proxy for investment contribution of local firms. Table 3.3 presents country-level distribution of foreign equity ownership and physical capital intensity and skill intensity of the local workforce of firms.

Table 3.3: Foreign ownership and input intensities of firms across countries

Country	Foreign ownership (%)	Physical capital intensity (US$/L)	Skill intensity of local workforce (%)
Burkina Faso	12	25,689	25
Burundi	21	31,260	28
Cameroon	37	47,781	27
Cape Verde	23	38,768	16
Ethiopia	19	44,764	17
Ghana	38	370,676	16
Kenya	33	152,423	24
Lesotho	40	6,562	16
Madagascar	45	20,967	24
Malawi	28	70,232	21
Mali	25	117,213	22
Mozambique	36	11,932	18
Niger	11	160,270	33
Nigeria	15	47,717	22
Rwanda	35	30,348	23
Senegal	31	128,080	28
Tanzania	28	156,402	17
Uganda	45	1,656,151	22
Zambia	27	32,333	15

Source: Own calculations based on UNIDO (2010). Foreign ownership-percentage of country sample of FDI projects wholly foreign owned; physical capital intensity and skill intensity of local workforce represent country sample averages of all firms surveyed.

As can be seen from column (2) of this table, foreign affiliates in Uganda had the highest share of foreign equity ownership (jointly with Madagascar) and had used physical capital more intensively than firms in other countries (column 3). Physical capital intensity is proxied by the ratio of total fixed assets to total number of full time employees (L).

Looking at the sector level composition of FDI across large sector groups of 2-digit ISIC (International Standard Industrial Classification Rev. 3), table 3.4 shows the three leading capital intensive investments as high-technology manufacturing, electricity, gas and water and construction services (column 3). Column (4) indicates relatively low intensity in the use of local skilled workforce in high technology manufacturing compared to electricity, gas and water and construction services sectors. This pattern of input usage tends to suggest that more physical capital intensive foreign affiliates use local skill workforce less intensively. This is in line with

the opposing effects of the relative input contributions of these firms as predicted in the theoretical model derived above.

Table 3.4: Foreign ownership and input intensities of firms across sectors

Main sectors	Foreign ownership (%)	Physical capital intensity (US$/L)	Skill intensity of local workforce (%)
Manufacturing (Low-tech)	26	64,777.21	15
Manufacturing (Medium-tech)	34	45,128.60	14
Manufacturing (High-tech)	36	2,804,621.00	16
Electricity, gas and water supply	27	1,039,875.00	27
Construction	28	370,726.20	25
Wholesale trade and Vehicle trade	35	30,069.05	21
Retail trade	28	17,562.23	21
Hotels and restaurants	29	63,450.50	16
Transport	29	44,200.45	26
Post and telecommunications	44	87,565.45	44
Financial institutions	35	89,699.62	37
Real estate, consulting, IT	30	35,164.71	39
Public admin, education, health etc.	19	164,464.70	27

Source: Own calculations based on UNIDO (2010)

Table 3.5 displays the sectoral distribution of ownership structure of foreign affiliates, physical capital intensity and skill intensity of local workforce of all enterprises surveyed in selected sectors in the respective countries. Data on the remaining countries surveyed are shown in appendix A3.1. The analysis demonstrates that physical capital intensity of FDI projects in sub-Saharan Africa is mostly explained by investments in the manufacturing sector, which are broadly categorized as low-technology intensity, medium-technology and high technology intensity manufacturing. There is wide variation in physical capital intensity across sectors in these countries. It can be seen from appendix A3:1 that firms in Uganda use physical capital more intensively in high-tech manufacturing (column 4, US$28,500,000 per employee) compared to firms in Rwanda (US$6,946 per employee).

In a similar manner, there is considerable heterogeneity across sectors in each country, with Ghana for instance, revealing physical capital intensity of US$5,721,698 per employee in the construction sector compared to US69,492 in the electricity, gas and water supply sector and a combined capital intensity of US$344,502 per employee in the manufacturing sector (column 4 of table 3.5). While such difference may be partly explained by the nature of investments in the

respective sectors, it would be useful to capture such heterogeneity through the inclusion of sector and country dummies in the estimations.

Table 3.5: Foreign ownership and input intensities of firms across sectors

Country	2-Digit ISIC Sectors	Foreign ownership (%)	Physical capital intensity (US$/L)	Skill intensity of local workforce (%)
Burkina Faso	Manufacturing (Low-tech)	15	46,254	13
Burkina Faso	Manufacturing (Medium-tech)	33	31,641	10
Burkina Faso	Manufacturing (High-tech)	0	27,428	24
Burkina Faso	Electricity, gas and water supply	0	3,125	0
Burkina Faso	Construction	0	14,615	30
Burundi	Manufacturing (Low-tech)	16	12,457	21
Burundi	Manufacturing (Medium-tech)	51	55,929	19
Burundi	Manufacturing (High-tech)	61	718,253	13
Burundi	Electricity, gas and water supply	0	21,139	0
Burundi	Construction	12	20,942	31
Cameroon	Manufacturing (Low-tech)	29	45,398	18
Cameroon	Manufacturing (Medium-tech)	32	67,811	15
Cameroon	Manufacturing (High-tech)	47	25,828	38
Cameroon	Electricity, gas and water supply	20	37,050	36
Cameroon	Construction	22	20,955	35
Cape Verde	Manufacturing (Low-tech)	19	23,321	13
Cape Verde	Manufacturing (Medium-tech)	27	27,558	15
Cape Verde	Manufacturing (High-tech)	17	40,856	9
Cape Verde	Electricity, gas and water supply	50	421,530	11
Cape Verde	Construction	20	19,599	16
Ethiopia	Manufacturing (Low-tech)	15	19,670	12
Ethiopia	Manufacturing (Medium-tech)	19	43,548	15
Ethiopia	Manufacturing (High-tech)	29	27,635	13
Ethiopia	Electricity, gas and water supply	70	32,844	7
Ethiopia	Construction	23	98,850	21
Ghana	Manufacturing (Low-tech)	26	17,751	15
Ghana	Manufacturing (Medium-tech)	42	20,884	10
Ghana	Manufacturing (High-tech)	35	305,867	15
Ghana	Electricity, gas and water supply	0	69,492	22
Ghana	Construction	32	5,721,698	19

Source: Own calculations based on UNIDO (2010)

3.6 Empirical Analysis

This section investigates whether foreign affiliates can integrate local firms through capital-intensive industries in sub-Saharan Africa. In the descriptive analysis above, foreign affiliates that intensively use physical capital tend to also use local skilled workforce less intensively. This is a striking pattern of investment that calls for further investigation empirically to determine whether such a relationship exists in sub-Saharan Africa. As a first step to testing this hypothesis, a baseline model of the underlying relationships in equation (3.14) is estimated using the linear probability model (LPM):

$$Prob[V = 1] = F\left(KL_{ijc}, SKL_{ijc} \right) + \varepsilon_{ijc} \tag{3.14}$$

where KL_{ijc} denotes physical capital intensity and SKL_{ijc} is the skill intensity of the local workforce.

Columns (1-3) of table 3.6 present results of the linear probability model showing the relationship between physical capital and human capital intensity of local firms and integrated production. In column (1), human capital intensity is proxied by the log of the ratio of nonproduction workers to production workers. Physical capital intensity of headquarter firms is measured as the log of the ratio of total assets to total number of employees. For columns (2-3), alternative measures are employed, with skill intensity of local firms denoted by the log of the ratio of non-production workers to total number of full time employees, and physical capital intensity proxied by the log of the ratio of fixed assets to total number of full time employees. The coefficients on the measures of physical capital intensity show the expected positive sign and statistically significant at the 1 percent level. This is evidence suggesting that the likelihood of integrating local firms in FDI projects is higher in capital intensive sectors in sub-Saharan Africa. This finding is an indication that foreign affiliates' investments in physical capital are more important than the skill intensity of the local workforce in driving FDI projects in sub-Saharan Africa. In other words, the headquarter firm will choose to integrate production, either through wholly-owned foreign affiliates or joint venture ownership in capital intensive sectors, when their input contribution to generating the surplus from the relationship is more important than the human capital investment of local firms. In column (1) of table 3.6, the coefficient on physical capital intensity shows that increasing this variable by 1 percent is associated with a 0.061 percentage point increase in the probability of integrating in FDI projects.

Table 3.6: Results of linear probability model (LPM) and probit

Variables	(1) LPM	(2) LPM	(3) LPM	(4) Marginal effects	(5) Marginal effects
Log nonproduction to production workers	-0.049***				
	(0.015)				
Log nonproduction workers to employment		-0.078***	-0.069***	-0.077***	-0.068***
		(0.024)	(0.024)	(0.023)	(0.024)
Log total assets to employment	0.061***	0.061***		0.062***	
	(0.008)	(0.008)		(0.009)	
Log fixed assets to employment			0.051***		0.051***
			(0.009)		(0.009)
Constant	-0.397***	-0.460***	-0.312***		
	(0.082)	(0.089)	(0.086)		
Observations	2,293	2,293	2,293	2,293	2,293
R-squared	0.054	0.054	0.042		
F(2, 269)	28.46***	29.62***	19.07***	22.11***	17.04***
Time fixed effects	No	No	No	No	No

Notes: "***"and "**" denotes significant at 1 and 5% respectively. Dependent variable: dummy 1 wholly-owned foreign subsidiary or joint venture ownership, 0 otherwise. LPM means linear probability model. Standard errors are in parentheses and adjusted for cluster effects.

As can be seen from columns (1-3), the coefficient on human capital intensity has the expected negative sign and is strongly significant. Intuitively, this result indicates that it will be optimal for foreign affiliates to outsource from local firms when the contribution of local firms through human capital is relatively more important than physical capital investment of foreign affiliates. The evidence agrees with the stylized facts that suggest that foreign affiliates are more capital intensive and less intensive in human capital. This outcome is an indication that local firms are less likely to be integrated in FDI projects through labour-intensive activities. Results on the opposing effects of physical capital intensity and human capital intensity on the probability of integration support the hypothesis of this chapter. These findings are qualitatively similar to empirical evidence on intra-firm trade, which suggests that the bulk of these trade flows occur through capital intensive industries (Antras, 2003; Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013) while labour-intensive goods are outsourced. In a similar manner, Acemoglu et al. (2010) found positive association between R&D intensity of the foreign producing firm and vertical integration, while R&D intensity of input supplying firms was negatively associated with vertical integration for a sample of firms in the UK manufacturing sector.

One potential problem with the linear probability model estimation is that it can generate predicted probabilities beyond the (0,1) range (Wooldridge, 2009). To avoid this problem, the specification in equation (3.14) is estimated using the probit estimation technique, with the

resulting marginal effects of these variables reported in columns (4-5) of table 3.6. The direction of the effects of physical capital and human capital intensity are essentially the same as the results of the linear probability model. However, it is important to mention that unlike the linear probability model, the effect of these variables on the probability of choosing integrated production depends not only on the magnitudes of the respective coefficients, but on all the coefficients and values of the independent variables. This suggests that the relationship is not constant, but could possibly change for particular values of physical capital and human capital intensity. This issue is addressed in the subsequent sub-section using the fractional probit model.

3.6.1 Robustness

To evaluate the robustness of the above findings, this section deals with several issues arising from the estimation of the baseline model. One issue arising from the estimates of the linear probability model and the probit model is potential omitted variable bias problem due to the omission of firm, industry and host country characteristics. To minimize this problem, equation (3.14) is augmented by including additional control variables such as firm age, labour productivity and R&D intensity as specified in equation (3.15).

$$own_{ijc} = f\left(KL_{ijc}, SKL_{ijc}, HSKL_{ijc}, \ SIZE_{iijc}, AGE_{ijc}, R\&D_{ijc}, \alpha_c, \alpha_j \right) + \varepsilon_{ijc} \qquad (3.15)$$

where own_{ijc} denotes a fractional response dependent variable $[0,1]$ to capture the different equity share of firms.

One may also be concerned about potential endogeneity issues due to reverse causality between foreign equity ownership and human capital. The quality of human capital in the host economy has an important influence in attracting FDI. These investments in turn play an important role in human capital formation, as foreign affiliates influence the demand and supply of skilled labour in host countries (Teixeira and Tavares-Lehmann, 2014). A second source of endogeneity arises from the inclusion of firm productivity variable, as the literature on firm heterogeneity argues that the most productive firm are more likely to undertake FDI, since they are more likely to cover the fixed costs of investing in host countries (see Antras and Helpman, 2004; Melitz, 2003). As a result, the endogeneity problem is mitigated through the inclusion of industry and country fixed effects in the estimation as specified in equation (3.15). The inclusion of country

fixed effects also controls for the effects of host factors, such as market size, labour costs, institutional and infrastructure quality, government policy on foreign equity ownership restriction as well as unobserved country specific effects. These factors determine the relative attractiveness of host countries or bargaining power of local partners in FDI projects (Asiedu and Esfahani, 2001). In a similar manner, sector fixed effects dummies control for unobserved sector specific characteristics in the estimation (Defever and Toubal, 2013). Productivity variable is measured by total sales in total number of employees. In relation to this, the issue of endogeneity is further mitigated by considering this variable as reported in the year preceding the survey period.

Another concern with the estimation of the linear probability and probit model is that the firms' integration decision is modelled as an indicator variable representing both wholly-owned foreign affiliates and joint venture firms. One may argue that such a categorization will not capture the true nature of foreign equity ownership in the region, since these governance structures are different. From equation (3.15), the dependent variable, foreign equity ownership, is bound between zero and one $(0 \leq own_{ijc} \geq 1)$. Given the bounded nature of own_{ijc}, the linear probability model is not appropriate, because it cannot guarantee that the predicted values of own_{ijc} will lie within the unit interval (see Defever and Toubal, 2013; Gallani et al, 2015; Ramalho et al, 2011). This is particularly the case when observations are clustered at the boundaries of zero or one. In a similar manner, the logit, probit or Tobit models are also not suitable, since they rely on restrictive distributional assumptions and also use ad hoc transformations for observations at the boundaries (Gallani et al, 2015). This problem is clearly evident in the data given that a significant proportion of local firms have not received FDI. In order to deal with these issues, foreign equity ownership modelled in equation (3.15) is represented as a fractional response variable, denoting 0 for domestically owned firms (non-integration), 1 for wholly-owned foreign integrating firms and between 0 and 1 for joint venture ownership shares. This model is estimated using the fractional logit estimation technique (see Papke and Wooldridge, 1996; Wooldridge, 2010).

The data indicates that over 80 percent of the observations on foreign equity ownership are either 0 or 1. This suggests a strong binary case. As such, the results of the fractional response models can be interpreted in terms of likelihood (Defever and Toubal, 2013). As a first step in

interpreting this relationship, the average marginal effects of the variables are computed. These are reported in table 3.7 using the different measures of physical capital and human capital intensity. A look at the marginal effects of physical capital intensity and skill intensity of the local workforce shows that these estimates have the opposing effects as predicted. In all cases, the results indicate a positive and significant marginal effect on physical capital intensity. This suggests a greater likelihood of firms integrating in FDI projects in capital-intensive sectors. The results are qualitatively the same as the estimates of the linear probability model and the probit model estimations. In column (4) of table 3.7, the estimates on physical capital intensity indicate that an increase in this variable by 1 percent increases the probability to integrate in capital-intensive sectors by 0.041 percentage points.

Similarly, across all the estimations in table 3.7, the average marginal effects on the measures of human capital intensity reveal that there is a lower likelihood of firms integrating in labour-intensive industries in sub-Saharan Africa. To some extent, these results are qualitatively similar to Lee (2014) for a sample of Korean affiliates. For Lee (2004), headquarter intensity is proxied by the share of Korean workers, which was found to be positively associated with the ownership share of Korean affiliates. This finding is qualitatively the same as the strongly positive association between foreign equity ownership and physical capital intensity of headquarter firm shown in this chapter. In a similar manner, Lee (2014) showed strongly negative association between the share of inputs sourced locally (proxy for the relative input contribution of the local partner) and ownership share of these affiliates.

Table 3.7: Average marginal effects of fractional logit model

Variables	(1)	(2)	(3)	(4)
Log nonproduction to production workers	-0.049***			
	(0.009)			
Log nonproduction workers to employment		-0.080***	-0.070***	-0.062***
		(0.013)	(0.014)	(0.014)
Log total assets to employment	0.016**	0.017**	0.056***	
	(0.008)	(0.008)	(0.006)	
Log fixed assets to employment				0.041***
				(0.006)
Log R&D intensity	-0.002	-0.002	-0.005	-0.005
	(0.003)	(0.003)	(0.003)	(0.003)
Firm age	-0.002***	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Log labour productivity	0.073***	0.073***		
	(0.009)	(0.008)		
Sector fixed effects	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Observations	2,390	2,390	2,390	2,390
Wald test (χ^2)	501.13	504.79	502.55	431.21
p-value	0.000	0.000	0.000	0.000
Pseudo R^2	0.13	0.13	0.11	0.09
Log pseudolikelihood	-1338.25	-1335.89	-1374.60	-1389.45

Note: Dependent variable-foreign equity share. "***", "**" denote significant at 1 and 5% respectively. Standard errors are in parentheses and clustered at firm level.

One may also argue that the measures of human capital intensity of local firms may mask headquarter skill intensity, which is a proxy for the managerial inputs of foreign subsidiaries. To disentangle these effects, human capital intensity is further decomposed into the skill intensity of foreign affiliates and the local workforce. Table 3.8 reports the average marginal effects of the variables after decomposing human capital intensity variable. As can be seen across the specifications in columns (2 and 3), the average marginal effects are remarkably consistent with the estimates in column (1) in the qualitative terms. This is further evidence in support of our argument that there is greater propensity to integrate local firms in physical capital intensive projects and lower likelihood for such integration in labour-intensive investments.[19]

[19] The following transformation on R&D intensity is used in order to maintain firms with zero observations-log (R& D) intensity=log (0.001+R&D expenditures/total sales). A similar transformation is also done on foreign skill intensity and skill intensity of the local work to avoid dropping these firms from the estimations.

Table 3.8: Average marginal effects of fractional logit model

Variable	(1)	(2)	(3)
Log nonproduction workers to employment	-0.070***		
	(0.014)		
Log foreign skill intensity		0.100***	0.101***
		(0.003)	(0.003)
Log local skill intensity		-0.014**	-0.013**
		(0.005)	(0.005)
Log total assets to employment	0.056***	0.019***	
	(0.006)	(0.005)	
Log fixed assets to employment			0.012**
			(0.005)
Log R&D intensity	-0.005	-0.005*	-0.005*
	(0.003)	(0.003)	(0.003)
Firm age	-0.002***	-0.001	-0.001
	(0.001)	(0.000)	(0.000)
Sector fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	2,390	2,390	2,390
Wald test (χ^2)	502.55	940.81	945.42
p-value	0.000	0.000	0.000
Pseudo R^2	0.11	0.30	0.30
Log pseudolikelihood	-1374.60	-1072.56	-1075.92

Note: Dependent variable-foreign equity share. "***", "**", '*' denote significant at 1, 5 and 10 % respectively. Standard errors are in parentheses and clustered at firm level.

A useful approach to understanding the direction of the relationship between equity ownership, physical capital intensity and skill intensity of the local workforce is to also consider the predictive margins of the fractional probit model. In order to plot the predictive margins of physical capital intensity and skill intensity of the local workforce, we allow for 10 standard deviations in the log of each variable below the mean as the starting point and 10 standard deviation increase in each variable, while the other explanatory variables are evaluated at their mean values. The plots clearly confirm the opposing effects of physical capital intensity and the skill intensity of the local workforce, thereby supporting the hypothesis of this study. Figure 3.1 shows a positive relationship between physical capital intensity and foreign ownership. This further confirms a higher probability of integration in capital-intensive sectors. Conversely, figure 3.2 suggests a lower likelihood of integration in labour-intensive activities.

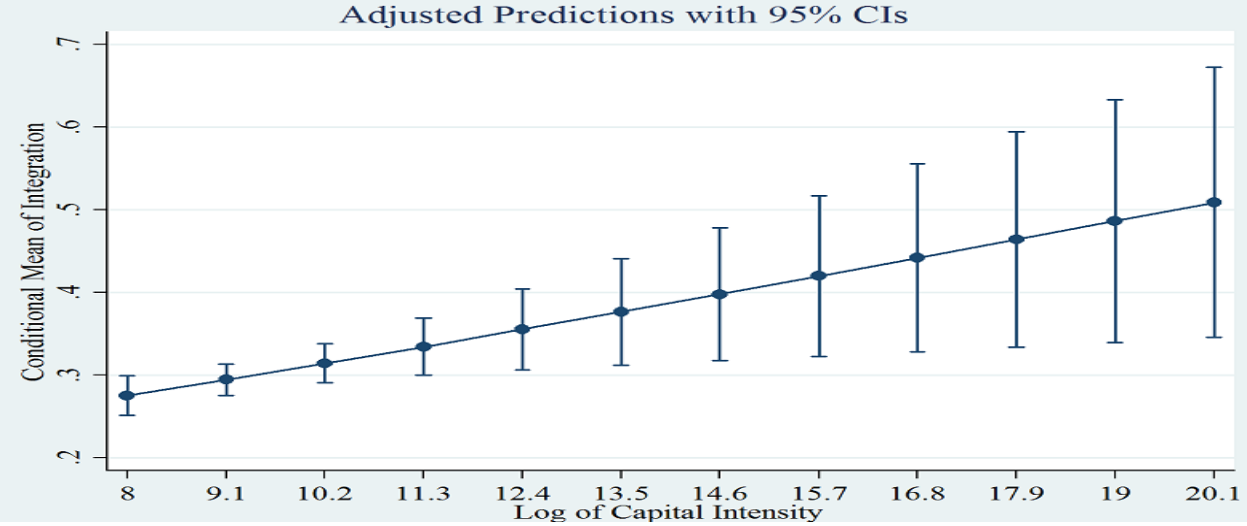

Figure 3.1: Predictive margins of physical capital intensity

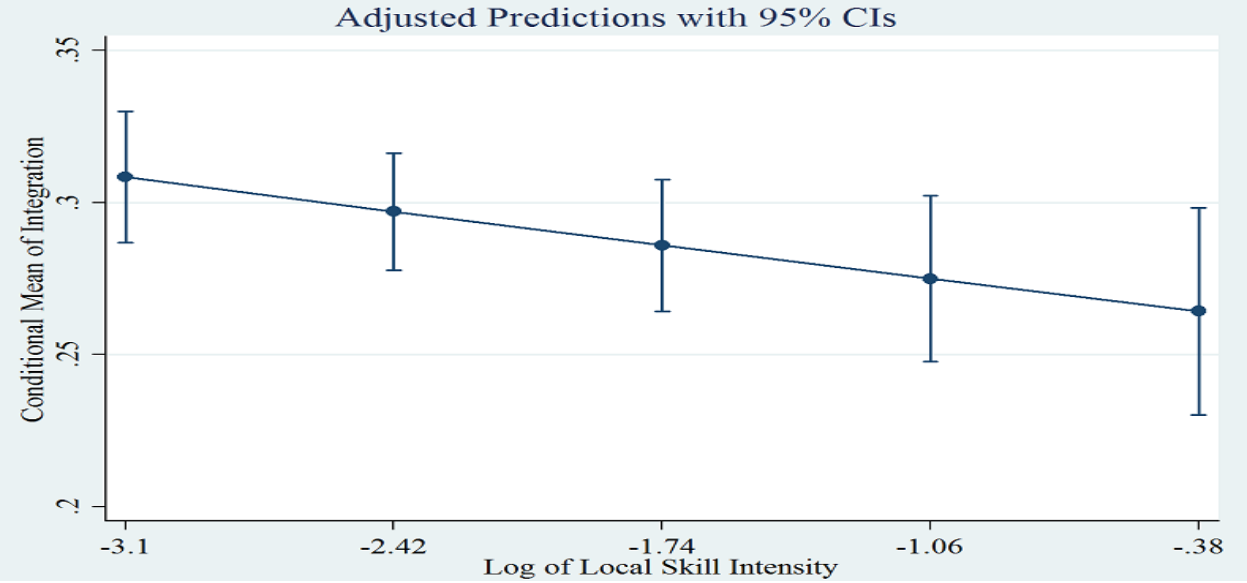

Figure 3.2: Predictive margins of skill intensity

One may also be concerned about the appropriateness of the ratio of total assets to total full time employees as a proxy for the relationship-specific investments of foreign producers. Recent literature on intra-firm trade argues that the measures of physical capital intensity may not be perfect measures of headquarter physical capital intensity, given that these expenditure components (such as automobiles, computers) are fairly easily contractible and, therefore, not purely relationship-specific (see Antras, 2013; Antras, 2015; Antras and Yeaple, 2014;

Fernandes and Tang, 2012; Nunn and Trefler, 2013). However, our dataset comprises not only manufacturing firms for which investments in machinery and specialized equipment are more relationship-specific, but also different services sectors such as construction, trade, consulting and information, communications and technology (ICT). This suggests that while investments in computers and automobiles are not relationship-specific in the manufacturing sectors, they could well be useful in different services sectors. The data does not allow for separation of fixed assets in these specific components as reported in the year of the survey. Nevertheless, we utilize the information on these components as reported in the year preceding the survey date.

In trying to further check for robustness of the results, the analysis includes specific components of capital expenditure, such as those on machinery and equipment, transport equipment and information, communication and technology (ICT). The intensity of machinery and equipment is proxied by the log of the ratio of capital expenditure on machinery and equipment to total number of full time employees. Similarly, the intensity of ICT and transport components is measured by the log of the ratio of capital expenditures of these components per employee (see Antras, 2015).

Table 3.9 reports the average marginal effects of the fractional logit models explaining the relationship between foreign equity share and the relationship-specific investments of firms. As seen from this table, the results of our variables of interest are qualitatively similar to those reported in previous estimations. Columns (2) and (5), show that the average marginal effects of machinery and equipment are positive and statistically significant. This supports the prediction that investments in machinery and equipment are relationship-specific. This is evidence indicating that there is a higher likelihood that foreign affiliates and local firms can integrate in sectors that intensively use equipment and machinery. These investments are most likely to be undertaken in manufacturing and construction sectors. The direction of the effect of machinery and equipment on foreign equity ownership agrees with the empirical literature on intra-firm trade flows (e.g. Antras, 2015; Antras and Yeaple, 2014; Fernandes and Tang, 2012; Nunn and Trefler, 2013). Looking at column (3) also reveals strong positive average marginal effects of transport intensity. This is inconsistent with some empirical studies that show a negative effect for automobile intensity (e.g. Antras and Yeaple, 2014; Nunn and Trefler, 2013). A reason for this may be because the analysis here uses both manufacturing and services sectors, including

trade (wholesale and retail) and transportation sectors in which these investments are extremely important. The average marginal effects of ICT intensity presented in columns (4 and 5) are not statistically significant.[20]

Table 3.9: Average marginal effects of fractional logit model

Variables	(1)	(2)	(3)	(4)	(5)
Log foreign skill intensity	0.101***	0.104***	0.103***	0.104***	0.101***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Log local skill intensity	-0.013**	-0.016***	-0.014**	-0.020***	-0.016*
	(0.005)	(0.006)	(0.006)	(0.008)	(0.008)
Log fixed assets to employment	0.012**				
	(0.005)				
Log machinery & equipment intensity		0.015***			0.013*
		(0.004)			(0.007)
Log transport intensity			0.020***		0.024***
			(0.004)		(0.006)
Log ICT intensity				0.000	-0.011
				(0.005)	(0.007)
Log R&D intensity	-0.005*	-0.003	-0.006*	-0.003	-0.007*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Firm age	-0.001	-0.001	-0.001*	-0.001	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Sector fixed effects	Yes	No	No	No	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	2,390	2,158	1,790	1,559	1,358
Wald test (χ^2)	945.42	715.07	612.28	490.53	519.50
p-value	0.000	0.000	0.000	0.000	0.000
Pseudo R^2	0.30	0.28	0.29	0.26	0.29
Log pseudolikelihood	-1075.92	-1004.18	-840.29	-763.05	-642.53

Dependent variable-foreign equity share; '***', "**" and "*" denote significant at 5 and 10% respectively. Standard errors in parentheses and clustered at firm level.

[20] A similar analysis on the different ownership structure was carried out using the multinomial logit model. Literature suggests that the reliability of the estimates of this model hinges on the test of the independence of irrelevant alternatives (IIA) assumption. This assumption implies that the ratio of the probabilities of choosing between two alternatives is independent of the third alternative. The analysis shows strong rejection of the null hypothesis that the IIA holds using the suest test. This suggests a violation of the assumption and that the results of the model are not valid. A second problem is that data used in this analysis (UNIDO, 2010) does not support the estimation of a multinomial nested logit model as alternative estimation technique. Also, estimation of the multinomial probit model requires further restrictions on the error variance matrix which otherwise will lead to imprecise parameter estimates (Cameron and Trivedi, 2010). The estimates of the multinomial probit model are qualitatively similar to the multinomial logit model. Given these limitations, the analysis was restricted to the fractional response models which accurately capture the different ownership structures of firms.

3.7 Conclusion

This paper has empirically investigated how input investments of foreign subsidiaries and local firms affect their decision to integrate in FDI projects in sub-Saharan Africa. The consideration of such relative input investments in explaining foreign equity ownership has allowed us to determine the sectors through which local firms are more likely to be integrated in FDI projects in order to boost productivity growth. Specifically, this study has explored the question of whether foreign subsidiaries and local firms have greater propensity to integrate production in capital-intensive industries than labour intensive activities. While the intra-firm trade literature has shown unequivocal support for integrated production in capital intensive industries, none of the previous studies has explicitly considered whether such integration is more likely in FDI projects that use physical capital more intensively than labour inputs in sub-Saharan Africa. Focus was on sub-Saharan Africa where recent reforms have encouraged investments in high technology sectors which are capital-intensive in nature, with the bulk of these investments undertaken by joint ventures between local firms and transnational corporations (TNCs).

This study contributes to this literature by providing evidence on the sectors through which foreign affiliates and local firms can jointly undertake production in sub-Saharan Africa in order to promote knowledge and technology transfers to local firms. The results show remarkable support for the theoretical predictions. It reveals that foreign affiliates are more likely to integrate local firms in capital-intensive activities and less likely in labour-intensive activities. The results are robust to the use of alternative estimation techniques and different measures of physical capital and human capital intensity.

In this study, foreign equity ownership was not separated in backward and forward integration decisions due to data limitations. It would be interesting in future research to examine how input contributions of these firms affect these ownership decisions separately. A second caveat of this study is that there are potential endogeneity issues arising from feedback causality between foreign equity ownership and human capital intensity. Although this problem is mitigated through the inclusion of industry and country fixed effects, it would be helpful to explore the dynamics in the underlying relationship using panel data analysis, as it allows for proper treatment of this endogeneity problem.

CHAPTER FOUR

Foreign Direct Investment and Nonlinearity in Productivity Growth in Africa

4.1 Introduction

Recent decades have witnessed a growing debate over the contribution of foreign direct investment (FDI) to growth and development in developing countries. This issue remains controversial in both the academic literature and policy discussions. FDI is perceived to offer valuable contributions to growth and development of a host country through a macro channel, such as increasing investment, employment, foreign exchange receipts and tax revenues; and micro level through the transfer of knowledge and technology to recipient countries (Farole and Winkler, 2014; Paus and Gallagher, 2008). In specific terms, FDI enhances growth by increasing total factor productivity and improving the overall efficiency of resource use in host countries (OECD, 2002). Given these potential contributions to host economies, examining whether FDI positively affects productivity growth has become a priority research issue, especially in developing countries.

In the endogenous growth literature, FDI has a greater potential to promote long-run growth through knowledge and technology spillovers to host countries (de Mello, 1997; Nair-Reichert and Weinhold, 2001). While there is a large body of studies on growth effect of FDI, the empirical literature is inconclusive. Most studies did not show any robust positive relationship between FDI and economic growth (e.g. Adam, 2009; Carkovic and Levine, 2005; Lensink and Morrissey, 2006), while others support the growth-enhancing effect of these investments (Li and Liu, 2005; Neuhaus, 2005; Olofsdotter, 1998). Given the conflicting findings, the debate has focused on establishing whether host country heterogeneity could explain differences in the growth effect of FDI across countries (e.g. Brahim and Rachdi, 2014; Jude and Levieuge, 2015; Nair-Reichert and Weinhold, 2001). Such heterogeneity is reflected in the differences in the capacities of host countries to absorb FDI. The basic argument underlying the absorptive capacity view is that FDI tends to generate smaller or no growth effect in host developing countries, unless these countries have attained a certain minimum level of development in human capital capacity (Borenzstein et al., 1998), domestic financial markets development (Alfaro et al., 2004, 2009; Hermes and Lensink, 2003), quality of institutions (Durham, 2004;

Brahim and Rachdi, 2014; Jude and Levieuge, 2015) and trade policies (Balasubramanyam et al, 1996).

While the findings of most studies have supported the thesis that human capital capacity enhances the growth effect of FDI (e.g. Borenzstein et al, 1998; Li and Liu, 2005), none of these studies has addressed the question of whether the effect of FDI on productivity growth could be heterogeneous depending on differences in human capital capacity across countries. Such a heterogeneous relationship is expected, given that there is reciprocal externality between human capital capacity and FDI. One would expect that countries that have enhanced their human capital capacity to attract higher quality or more technology intensive FDI, which, in turn, enhances the local workforce through learning and skills development initiatives (see Blomstrom and Kokko, 2003; OECD, 2002). At the opposite, countries with lower level of human capital will attract low technology intensity investments, which ultimately will have limited impact on local skills development. Given such relationship, it is expected that the relationship between FDI and productivity growth is most likely to be nonlinear and conditional on human capital capacity across countries. Few studies have recently confirmed the nonlinear relationship between FDI and economic growth, with host country heterogeneity explored through quality of institutions (Brahim and Rachdi, 2014; Jude and Levieuge, 2015) and human capital capacity (Kottaridi and Stengos, 2010). However, the study by Kottaridi and Stengos (2010) employed non-parametric techniques and, therefore, did not determine the threshold level of human capital capacity that should enhance the growth effect of FDI in recipient countries.

This paper argues that the effect of FDI on productivity growth is not homogeneous as assumed in previous studies, but nonlinear and depends on the human capital capacity of host countries. Human capital stock raises total factor productivity growth by enhancing domestic innovation and accelerating the pace of technological catch-up process from leading countries (Benhabib and Spiegel, 1994). Given the limited technology capacity in most developing countries, FDI can promote technology change through knowledge and technology transfers, with such transfers enhanced by the stock of human capital of recipient countries.

A distinctive feature of this study is consideration of host country heterogeneity in human capital capacity to determine whether the effect of FDI on productivity growth is conditional upon such

capacity. In this way, this study contributes to the empirical literature by determining the minimum threshold of human capital capacity that accelerates the effect of FDI on productivity growth in African countries and evaluating whether there is heterogeneity in the growth enhancing effects of these investments. To achieve these objectives, this study uses a nonlinear approach, the PSTR introduced by Gonzalez et al. (2005) and Fok et al. (2005), which allows for host country heterogeneity in the stock of human capital. The estimation of such a nonlinear model enables us to exploit the variation in human capital absorptive capacity across countries. As such, it provides a useful approach to resolving the conflicting results in the empirical literature (see Alfaro, 2015; Alfaro et al., 2009). Although most studies have looked at the FDI-economic growth nexus, this study considers the relationship between FDI and total factor productivity growth. The focus on productivity growth is motivated by arguments suggesting that FDI accelerates growth by raising total factor productivity (OECD, 2002) and that total factor productivity is relatively more important than factor endowments in explaining the differences in income across countries (see e.g. Alfaro et al., 2009; Easterly & Levine, 2001; Klenow and Rodriguez-Clare, 1997).

While FDI is perceived to have generated few linkages and spillovers in host sub-Saharan African countries (Morrissey, 2012), there is suggestive evidence that in recent years, African economies have significantly benefited from FDI, in terms of contribution to value added and wages, more than other regions in the world (UNCTAD, 2012). At the same time, there is considerable heterogeneity in the human capacity, as evidenced by wide differences in educational attainment across African countries. For example, the average years of total schooling in South Africa was 9.69 years in 2010 and 1.88 years in Niger (Barro and Lee, 2013). Given such marked differences in capacity, one would expect that the growth-enhancing effect of FDI may differ across countries. To the best of my knowledge, none of the empirical studies on productivity growth in African economies (see e.g. Abdychev et al., 2015; Loko, and Diouf, 2009; Sacerdoti et al., 1998; Senbeta, 2009) have looked at these issues.

To conduct the analysis, this study uses recent country level data on total factor productivity growth and human capital stock for a panel of 25 African countries spanning 1996-2011 (Feenstra et al., 2015). The data allows us to comprehensively analyze the role of human capital in promoting the growth effect of FDI for a relatively large number of countries in Africa. The

period captures increase in FDI in the mid-1990s following the adoption of economic liberalization policies in most African countries in the early 1990s. The analysis reveals that the effect of FDI on productivity growth is conditional on human capital capacity and such effects are heterogeneous across African countries. In other words, it relies on host countries' achieving a minimum threshold level of 6.94 years of average schooling.

The rest of the chapter is organized as follows. Section 4.2 explores the trends in FDI, human capital and productivity growth in Africa. Section 4.3 reviews the literature on FDI growth, while the empirical model and estimation strategy are described in section 4.4. Section 4.5 analyses the regression results and section 4.6 concludes the chapter.

4.2 FDI, Human Capital and Growth in Africa

Since the early 1990s, several African countries have adopted wide ranging policies to improve resource allocation and enhance productivity growth. The SSA sub-region, for example, have implemented policies designed to improve overall economic management, quality of institutions and increase investments by both public and private sectors (see IMF, 2013). Partly as a result of these policy reforms, there was a 75 percent increase in median per capita GDP in sub-Saharan African economies during the period 2000-2013. In particular, a group of countries that were categorized as non-resource rich economies during the period 1995-2010, notably Burkina Faso, Ethiopia, Mozambique, Rwanda, Tanzania and Uganda, showed significant turnaround in economic performance, with real GDP growth and real per capita GDP averaging 5 percent and 3 percent respectively during the period (IMF, 2013).

While most countries in the region have received increased inflows of FDI, these investments have not been evenly distributed across countries in Africa. There are also considerable differences in human capital capacity across African economies. Table 4.1 shows the distribution of FDI, human capital and productivity growth in selected African countries over the period 1996-2011. As can be seen in column (3), the share of inward FDI stock in GDP is significantly higher in Tunisia, averaging 59.4 percent over the period 1996-2011 and considerably low in Burundi (3 percent). Similarly, as shown in column (4), average human capital stock was highest in Botswana (2.7) during the review period compared to 1.2 in Niger and Mozambique. Given this variation, it is possible that the effect of FDI on productivity growth could differ across

countries, since countries have different capacity to absorb knowledge and technology spillovers from FDI.

Table 4.1: Distribution of FDI, TFP growth and human capital stock in selected African countries

Country	TFP growth (%)	FDI stock (% GDP)	Average human capital stock (Composite index)
Burundi	1.1	2.9	1.5
Benin	1.0	6.9	1.6
Botswana	1.0	22.3	2.7
Central African Republic	1.0	15.2	1.6
Ivory Coast	1.0	24.5	1.7
Cameroon	1.0	16.4	2.0
Egypt	1.1	28.2	2.2
Gabon	1.0	4.6	2.4
Kenya	1.0	5.8	2.1
Lesotho	1.0	33.2	2.1
Morocco	1.0	33.8	1.8
Mozambique	1.0	32.1	1.2
Mauritania	1.0	35.3	1.7
Mauritius	1.0	16.6	2.4
Namibia	1.0	43.4	2.1
Niger	1.0	13.3	1.2
Rwanda	1.0	4.3	1.6
Senegal	1.0	8.0	1.8
Sierra Leone	0.9	23.9	1.5
Swaziland	1.0	30.1	2.4
Togo	1.1	15.1	1.9
Tunisia	1.0	59.4	2.2
Tanzania	0.9	22.6	1.9
South Africa	1.0	31.9	2.6
Zimbabwe	1.3	18.0	2.4

Sources: Feenstra et al. (2015), UNCTAD statistics and Barro and Lee (2013).

The ongoing structural reforms will contribute to enhancing competitiveness, thereby creating an enabling environment to attract FDI and increase productivity growth in African countries. According to the Global Competitiveness Index (GCI) 2010-2011, top competitive countries in Africa are Tunisia, South Africa, Mauritius, Namibia, Morocco, Botswana, Rwanda and Egypt (Sala-I-Martin et al., 2010).[21] Countries, such as Mauritius, Tunisia and South Africa, are at the

[21] Competitiveness is defined as "*... the set of institutions, policies, and factors that determine the level of productivity of a country" (*Sala-I-Martin et al., 2010 p.4). The overall ranking of each country is based on a weighted average of 12 structural factors: (1) quality of institutions (2) Infrastructure quality (3) Macroeconomic environment (4) Health and primary education (5) Quality of higher education and training (6) Goods market

efficiency-driven stage of development. This implies that these countries need to adopt more efficient production processes to improve the quality of local products in order to enhance their competitiveness (Sala-I-Martin et al., 2010). This further suggests that human capital capacity plays an important role in the adoption of technology from FDI to ensure that they remain competitive. Botswana and Egypt are in transition from factor-driven to efficiency-driven stage of development, while the bulk of the countries in table 4.1 are at the factor-driven stage of development. This reveals that these countries compete on the basis of factor endowments, such as the presence of natural resources and unskilled labour. Countries in this category include Burundi, Cameroon, Ivory Coast, Kenya, Lesotho, Mauritania, Mozambique, Rwanda, Senegal and Tanzania.

In order to assess the relative attractiveness of host countries to foreign investments, it is helpful to consider three (3) indices on FDI: attraction, potential and contribution indices. The FDI attraction index assesses the extent of success of host countries in attracting FDI relative to their market size, whereas the FDI potential index evaluates the relative attractiveness of host countries to FDI based on the underlying determinants of FDI. Specifically, the FDI potential index is based on an equal weighted score of the indicators of four key determinants of FDI-market attractiveness, availability of low-cost labour and skills, presence of natural resources and enabling infrastructure (UNCTAD, 2012).

Table 4.2 compares the performance of the countries in attracting FDI over a three-year period using the FDI potential index. A careful look at the pattern suggests that there are considerable differences in the attractiveness of the host countries to FDI. Similarly, there are wide differences across host countries regarding the extent to which they have succeeded in attracting FDI. Clearly, South Africa shows significant investment potential, but tends to have attracted investments below potential. Several countries in the sample have received FDI in line with their respective investment potential, while Niger and Mozambique have attracted significant investments above expectations, in spite of their relatively low investment potential. This is partly explained by recent exploration and extraction of Uranium and Gas deposits, respectively. Other SSA countries have attracted FDI below expectations, including Gabon, Kenya, Senegal,

efficiency (7) Labour market efficiency (8) Financial market development (Technological readiness (10) Market size (11) Business sophistication and (9) Technological innovation.

Namibia and Tanzania. Among the North African countries, Egypt and Tunisia were attractive destinations for foreign investors during the review period, and have shown stronger FDI performance, while Morocco has received FDI below expectations.

Table 4.2: FDI attraction and potential indices

FDI Attraction Index	High	1st quartile	Niger (a)	(a) Mozambique		
		2nd quartile		(c) Namibia, Tanzania	(b) Egypt, Tunisia	
		3rd quartile	Central African Republic	(b) Botswana, Cameroon, Mauritius, Uganda, Zimbabwe	(c) Gabon, Morocco	(c) South Africa
		4th quartile	(b) Benin, Burundi, Cote d'Ivoire, Lesotho, Mauritania, Rwanda, Sierra Leone, Togo	(c) Kenya, Senegal		
	Low		4^{th} quartile	3^{rd} quartile	2^{nd} quartile	1^{st} quartile
		Low	FDI Potential Index			High

Source: UNCTAD (2012). Table includes only countries in the sample. (a) Above expectations; (b) In line with expectations; (c) Below expectations.

The third index, FDI contribution index, is helpful for qualitatively assessing the extent to which foreign affiliates may have contributed to host countries. This index captures a number of indicators, such as value added, wages and salaries, employment, exports, research and development (R & D) activities, domestic capital formation and tax receipts (UNCTAD, 2012). Table 4.3 presents the contribution of FDI across the various regions in the world. A look at column (5) shows that foreign affiliates in African economies have significant impact on wages and salaries in host economies, as they offer higher wage premium over those paid in host countries. This ratio, together with the relatively higher capital expenditures, as shown in column (7), point to the fact that foreign affiliates in African economies engage in capital-intensive production processes (UNCTAD, 2012).

Table 4.3: FDI contribution index by region, 2009

Region	Value added	Employment	Exports	Tax revenue	Wages and salaries	R & D expenditures	Capital expenditures
Developed countries	12.7	7.5	19.3	13.9	14.6	24.2	10.5
Developing countries	12.2	7.9	17.3	14.6	15.4	24.1	11.6
Africa	21.7	7.3			21.7	37.2	18.4
East & South-East Asia	10.5	9.9	30.9	7.7	8.9	22.5	6.2
South Asia	10.3	6.1			16.0		3.8
West Asia	16.8	5.5	1.9		15.0		3.8
Latin America & Caribbean	15.9	6.0	17.9	18.9	16.0	35.0	14.8
Transition economies	21.7	3.0			11.2	15.4	25.7

Source: UNCTAD (2012)

4.3. Literature Review

Two strands of theoretical literature, neoclassical and endogenous growth theories, provide the basis for explaining the positive effect of FDI on productivity and economic growth (De Mello, 1997; Ilhan, 2007; Li and Liu, 2005; Nair-Reichert and Weinhold, 2001). In the neoclassical growth theory, FDI raises growth through increases in the volume of investment and/or its efficiency (Li and Liu, 2005; Nair-Reichert and Weinhold, 2001). As developing countries are characterized by lower initial level of capital stock, increased inflow of foreign capital through FDI will increase the marginal productivity of investment and promote economic growth. However, due to the onset of diminishing returns to physical capital inputs, as assumed in the traditional neoclassical Solow (1956) model, increased inflow of FDI will affect the level of income in the long-run, while the growth rate of the economy is unaffected (De Mello, 1997). As such, the neoclassical framework is not helpful for understanding the mechanisms through which FDI contributes to long-term growth, since growth in the long-run is perceived to be determined by an exogenous technological change. Given these limitations, there is an extensive literature within the endogenous growth theory on the channels through which FDI enhances technology progress that determines long-run economic growth of recipient countries.

One would broadly classify the theoretical underpinnings of the endogenous growth literature into two sets of arguments. The first relates to those models explaining growth through positive externalities arising from capital accumulation-physical and human capital (e.g. Romer, 1986). The second strand of theory emphasizes the role of technological progress through innovation and technological diffusion in determining long-run economic growth (e.g. Barro and Sala-i-

Martin, 2004; Borenzstein et al., 1998; Grossman and Helpman, 1991; Romer, 1990). The endogenous growth theory generally assumes constant or increasing returns to reproducible factors due to knowledge accumulation (Blomstrom and Kokko, 2003). It suggests that there are spillover effects generated through investment in human capital which mitigate diminishing returns to capital accumulation. Apart from investment in human capital, this literature emphasizes the importance of investments in innovation as critical factors determining long-term growth of countries. In developing countries, however, there is limited capacity for sustainable investments in R&D activities and knowledge. FDI is, therefore, perceived as providing valuable source of capital to promote domestic investment and technological progress in host countries. In the endogenous growth framework, diminishing returns to capital accumulation is offset by constant/increasing returns to human capital and technology. This theory thus provides a useful framework for analyzing long-run growth effects of FDI through transfer of technology externalities or spillover effects (see De Mello, 1997; Nair-Reichert and Weinhold, 2001).

There are various channels through which FDI can potentially improve productivity in host countries via spillovers to local firms, including capital accumulation, vertical linkages between foreign and local firms, labour turnover, demonstration and competition effect (see Hermes and Lensink, 2003; Kinoshita, 1999; Farole and Winkler, 2014). FDI contributes to technological progress through a capital accumulation channel via the transfer of technology embodied in intermediate inputs or capital goods imported into host countries by foreign affiliates (Borensztein et al., 1998; De Mello, 1997; Li and Liu, 2005). This allows for a range of intermediate inputs to be used in domestic production, which enhances productivity through increased division of labour in recipient countries (Feenstra and Markusen, 1994). There are potential productivity gains to local firms through the supply chain effect via backward and forward linkages, which occur through transactions between foreign subsidiaries and local input suppliers and customers (Farole and Winkler, 2014; Kinoshita, 1999). When local firms are directly engaged with foreign affiliates, technology spillovers may occur through imitation or reverse-engineering. Increased imitation of technology reduces the technology gap between countries, thereby enhancing domestic capacity to absorb FDI with advanced technologies. Similar knowledge spillovers may arise through labour turnover from foreign subsidiaries to local firms. Foreign affiliate can contribute to enhancing the capacity of the local workforce

through training, acquisition of management skills and exposure to new technology, and movement of labour from foreign affiliates to local firms can facilitates such spillovers (see Dasgupta, 2012; Farole and Winkler, 2014; Fosfuri et al., 2001).

The empirical literature based on aggregate data reveals mixed evidence on the growth-enhancing effects of FDI. There is evidence indicating a positive impact of FDI on growth in host countries (Lensink and Morrissey, 2006; Li and Liu, 2005; Nair-Reichert and Weinhold, 2001; Neuhaus, 2005). This evidence is however not universally shown, as other studies have arrived at the conclusion that this relationship is not robust. For example, Carkovic and Levine (2005) find no support for the positive effect of FDI on growth after controlling for endogeneity bias. A similar conclusion is reached by Adam (2009) for a sample of 42 sub-Saharan African countries after controlling for country specific factors. Studies on the FDI-productivity nexus based on aggregate data share similar mixed findings. Amann and Virmani (2015) find that FDI enhances productivity growth in emerging economies and OECD countries. A similar conclusion is reached in other studies which reveal that there are productivity spillovers from FDI (Baltabaev, 2014; Woo, 2009). However, some studies have echoed the view that FDI will not accelerate productivity growth in the presence of low absorptive capacity, such as underdeveloped domestic financial markets (Alfaro et al., 2004; 2009).

At the level of the firm, the evidence on the technology spillovers from the presence of foreign firms in host countries is again mixed. While some studies have identified the presence of FDI spillovers in developed countries (e.g. Bitzer and Kerekes, 2008; Haskel et al., 2007; Javorcik, 2004) and developing countries (Bwalya, 2006; Blalock and Gertler, 2008; Newman et al., 2015), other studies suggest that foreign-firm presence has not generated productivity growth in local firms, as evident in the Moroccan manufacturing sector (Haddad and Harrison, 1993). The seminal paper by Aitken and Harris (1999) produce evidence suggesting that negative spillovers from foreign to domestic firms, is attributed to a market-stealing effect. This happens when foreign firms capture a greater share of the domestic market at the detriment of domestic firms.

The apparent inconclusive evidence on the accelerating effects of FDI on productivity growth of domestic firms has given rise to different approaches to studying this relationship. The literature points to host-country heterogeneity as a plausible reason for the conflicting results (e.g. Jude

and Levieuge, 2015; Nair-Reichert and Weinhold, 2001). Three different approaches have been adopted in the empirical literature to address the problem of heterogeneity in order to determine whether FDI enhances productivity growth. The first approach relates to splitting the sample of countries into some homogeneous groups in line with some measures of absorptive capacity. In their study of a sample of developed countries and least developed countries, Blonigen and Wang (2005) find no positive effect of FDI on growth using the pooled sample of these countries. Their work accounts for heterogeneity across countries through the linear interactions of FDI and schooling variables with a dummy variable for least developed countries. The results provide evidence indicating that developing countries should attain a threshold level of human capital for FDI to generate growth. In the same vein, Ghosh and Wang (2010) consider a group of 25 OECD countries over the period 1980-2004 and find positive effect of FDI on economic growth in these countries. In a similar manner, Karunaratne (2013) investigates a sample of 25 OECD countries based on some threshold effects in determining whether FDI generates positive productivity growth effects. The study finds that FDI raises growth in total factor productivity in these countries.

One problem with splitting the sample of countries into groups is that there may be considerable heterogeneity in absorptive capacity across countries within these groups. Such heterogeneity is confirmed by Nair-Reichert and Weinhold (2001) in a panel of 24 developing countries. Allowing for heterogeneity effect of FDI across countries, through a mixed fixed and random coefficient approach, the study finds a positive impact of FDI on economic growth. Recognizing such heterogeneity across countries, another line of studies argue that productivity spillovers generated through FDI depend on the absorptive capacity of host countries such as human capital capacity (Borensztein et al., 1998) and domestic financial markets development (e.g. Alfaro et al., 2004; Hermes and Lensink, 2003). It can be inferred from this literature that differences in the capacity of host countries to absorb technology spillovers from FDI could explain the differences in the growth impact of FDI. For instance, the stock of human capital affects the capacity of countries to innovate and speeds up the technology "catch-up" with technology leading countries (Nelson and Phelps, 1996). Consistent with this view, Benhabib and Spiegel (1994) identify two channels through which human capital increases productivity growth: via

improving domestic innovation and enhancing the capacity of countries to absorb foreign technology and knowledge. These channels facilitate the technological catch-up process.

Similar view is echoed in Engelbrecht (1997), whose study recognizes the role of human capital in promoting growth through innovation and the absorption of international knowledge spillovers. By including an interaction term between FDI and human capital stock, the study by Borensztein et al. (1998) finds that developing countries need to attain a threshold of human capital in order to reap productivity gains from FDI. Other studies have shown that human capital enhances technology spillovers and hence the growth effect of FDI in host countries (see Lai et al., 2006; Li and Liu, 2005). Improving the human capital capacity allows countries to benefit from spillovers of knowledge and technology associated with the adoption of trade openness policies (see Keller, 1996; Lai et al., 2006; Miller and Upadhyay, 2000). A related body of studies supports the hypothesis that technology spillovers from the presence of foreign firm can accelerate productivity and growth, only when host countries have achieved a threshold level of financial markets development (Alfaro et al., 2004; 2009; Hermes and Lensink, 2003), quality of institutions (Brahim and Rachdi, 2014; Durham, 2004; Jude and Levieuge, 2015; Olofsdotter, 1998) and degree of openness (Balasubramanyam et al., 1996).

The literature at the firm level suggests that the spillovers generated from FDI are conditional on the type of linkages generated in the host economy and the absorptive capacity of local firms (Bruno and Campos, 2013; Farole and Winkler, 2014). The absorptive capacity of local firms that allows the assimilation of technology and knowledge from FDI is measured by human capital capacity, investment in R&D activities and the technology gap between local and foreign firms (see Blalock and Gertler, 2009; Damijan et al., 2014). While there is evidence supporting the presence of positive spillovers from FDI, as noted above, studies that have explored intra-industry (horizontal) productivity spillovers find that these spillover effects depend on the absorptive capacity of domestic firms (Damijan et al, 2014; Laio et al, 2012; Pfeiffer et al, 2014).

One limitation in cross-country studies that have explored the linear interactions between FDI and measures of absorptive capacity arises from the implicit assumption of homogenous impact of FDI across countries over time. Because there is heterogeneity in developing countries in terms of the levels of absorptive capacity, one would expect the effect of FDI to be

heterogeneous and nonlinear, conditional on the threshold level of absorptive capacity. This view is confirmed by Kottaridi and Stengos (2010) who found nonlinear effect of FDI for a sample of OECD and non-OECD countries using non-parametric techniques. In contrast to most studies using linear interactions between human capital and FDI, where the effect of FDI is conditional on human capital capacity, Kottaridi and Stengos (2010) found that such effects do not depend on host countries achieving a minimum threshold of human capital. A second line of studies explores host country heterogeneity using the Panel Smooth Transition Regression (PSTR) and returns evidence confirming the nonlinear effect of FDI on economic growth in developing countries, which depends upon attaining a minimum threshold level of institutional development (Brahim and Rachdi, 2014; Jude and Levieuge, 2015). By applying the same estimation strategy, Fracasso and Marzetti (2014) find that human capital increases total factor productivity by accelerating R&D spillovers generated in OECD countries. This study reports a minimum threshold level of 8.33 average years of schooling in order to absorb international R&D spillovers.

In sum, the above literature review shows that there are differences in the level of absorptive capacity across countries, which could explain heterogeneity in the impact of FDI on productivity growth. The review reveals that human capital absorptive capacity matters for enhancing productivity spillovers of FDI in host countries. Thus, it would be interesting to allow for host country heterogeneity in human capital capacity to determine whether such differences will explain variation in the effect of FDI on productivity growth across countries.

4.4. Methods and Data

4.4.1 Methods

A useful starting point of the empirical estimation is to consider a theoretical framework within the endogenous growth theory to explain how human capital stock increases productivity spillovers in host countries. Borensztein et al. (1998) provide a framework for explaining the role of human capital stock in the absorption of technology from FDI through the interaction between human capital and FDI. This framework recognizes that technological progress occurs through a capital deepening process via the importation of capital goods by foreign firms. This

increases the number of varieties of capital goods in recipient countries. The production form takes the following form:

$$Q_t = AH_t^{\alpha} K_t^{1-\alpha} \tag{4.1}$$

Where Q_t is output, A denotes a vector of control and policy variables reflecting the host country environment, H is human capital and K represents physical capital. Physical capital is accumulated through increases in the number of capital goods' varieties in the local economy, which can be represented by:

$$K = \left\{ \int_0^N x(j)^{1-\alpha} \, dj \right\}^{\frac{1}{1-\alpha}} \tag{4.2}$$

Where $x(j)$ is total capital representing a series of varieties of capital goods totaling N in the local economy. The production of capital goods through FDI can be split between domestic and foreign firms. Domestic firms are assumed to produce n varieties of capital goods, while foreign firms' varieties n^*. This yields the total number of varieties produced in the local economy as:

$$N = n + n^* \tag{4.3}$$

Capital goods are produced by specialized firms and they receive a rental rate $m(j)$ from final goods producers for use of the capital goods produced. Demand for capital goods is given by the optimality condition in perfectly competitive factor markets, that is, the marginal productivity of capital goods equals the rental rate. From equation (4.1), the marginal productivity of capital is derived as:

$$\frac{\delta Q_t}{\delta K_t} = A(1-\alpha) H_t^{\alpha} K_t^{-\alpha} = A(1-\alpha) H_t^{\alpha} x(j)^{-\alpha} \tag{4.4}$$

In order to produce new varieties of capital goods, firms need to adopt technology from technology leading countries. In doing so, the firms incur a fixed setup cost (F) of production, which is assumed to be inversely related to the ratio of the number of foreign firms in total firms in the host country($\frac{n^*}{N}$). Greater presence of foreign firms facilitates the transfer of knowledge to local firms which enhances domestic production of capital goods. In other words, FDI is an important vehicle for enhancing technological progress in host developing countries. It promotes local knowledge in the production of capital goods through the transfer of advanced technology.

This framework assumes a catch-up effect in technological progress, given that it is relatively less costly to imitate the capital goods already produced than engaging in the production of new goods. Given the catch-up effect, the setup cost is assumed to be positively related to the number of varieties of capital goods produced in the local economy in relation to those produced in the advanced countries N^*. This assumption suggests that countries with lower $\left(\frac{N}{N^*}\right)$ face a lower cost of adopting technology from FDI through imitation. The composition of the setup cost function can be represented as:

$$F = F\left(\frac{n^*}{N}, \frac{N}{N^*}\right), \text{ where } \frac{\delta F}{\delta(n^*/N)} < 0 \text{ and } \frac{\delta F}{\delta(N/N^*)} > 0 \tag{4.5}$$

In the production of capital goods, each firm also incurs a maintenance cost which is assumed to be constant over time. Intuitively, the marginal cost of producing $x(j)$ can be assumed to be 1 with full depreciation of capital goods. Defining a constant steady state interest rate (r), the profit generated from producing a capital good j is specified as:

$$\pi(j)_t = -F\left(n_t^*/N_t, N_t/N_t^*\right) + \int_t^{\infty}[m(j)x(j) - x(j)]\, e^{-r(s-t)}ds \tag{4.6}$$

In solving the problem of the firm, the profit function in equation (4.6) is maximized subject to equation (4.4) which yields a level of capital good produced as:

$$x(j) = HA^{1/\alpha}(1-\alpha)^{2/\alpha} \tag{4.7}$$

If we consider a competitive market economy, the representative firm optimally produces capital goods when the marginal productivity of capital equals the rental rate r. To derive an expression for the rental rate of capital, equation (4.7) is substituted into the expression for the demand for capital goods (4.4). This gives:

$$m(j) = 1/(1-\alpha) \tag{4.8}$$

In a competitive market, firms make zero profit and the associated rate of return r from maximizing the profit function presented in equation (4.6) is derived as:

$$r = A^{1/\alpha}\theta F(n^*/N\,, N/N^*)^{-1}H \tag{4.9}$$

The framework further assumes that capital accumulation occurs through saving behavour of households, which is captured by an intertemporal utility function:

$$U_t = \int_t^{\infty} \frac{C_s^{1-\sigma}}{1-\sigma} e^{-\rho(s-t)} ds \tag{4.10}$$

In solving the problem of the household, equation (4.10) is maximized subject to the household budget constraint, yielding the optimal consumption path as follows:

$$\frac{\dot{C}_t}{C_t} = \frac{1}{\sigma}(r - \rho) \tag{4.11}$$

For an economy on a balanced growth path, output, consumption and capital will be growing at the same rate. This implies that productivity growth of the economy can be specified as:

$$g = \frac{1}{\sigma}(r - \rho) \tag{4.12}$$

Substituting the rental rate (4.9) into equation (4.12) gives an equation for productivity growth of the economy as:

$$g = \frac{1}{\sigma}\left[A^{1/\alpha}\theta F(n^*/N\,, N/N^*)^{-1}H - \rho\right] \tag{4.13}$$

Equation (4.13) establishes the theoretical framework explaining how human capital supports the growth effect of FDI in host countries. The effect of FDI on productivity growth is captured by fraction of goods produced domestically by foreign firms (n^*/N). N/N^* represents the catch-up effect, suggesting that countries with relatively lower level of production of capital goods benefit from lower costs of technology adoption and would tend to grow faster (Borensztein et al., 1998). From equation (4.13), the empirical model follows the model in Borensztein et al. (1998) which is specified as:

$$g_{it} = \alpha_0 + \alpha_1 FDI_{it} + \beta_2 H_{it} + \alpha_3 FDI_{it} * H_{it} + \alpha_4 Y_0 + \alpha_5 A_{it} + \varepsilon_{it} \tag{4.14}$$

Where FDI denotes the share of inward FDI stock in GDP (proxy for n^*/N), Y_0 is initial real GDP per capita as a proxy for catch-up effects (N/N^*) and A is a vector of control variables, such as the quality of institutions, level of financial markets development, trade openness, and growth in government consumption. The model specified in equation (4.14) suggests that there is a direct effect of FDI on productivity growth (α_1), which could arise through capital accumulation, and indirect impact via spillovers of foreign technology and knowledge enhanced through the accumulation of human capital. This specification shows how human capital capacity accelerates the growth effect of FDI through an interaction term between human capital

stock and FDI, thereby determining whether the growth-enhancing impact of FDI is conditional on the human capital stock of host countries.

4.4.2 Data Description

This study uses a balanced panel set of 25 African countries over the period 1996-2011. The choice of the sample of countries was driven by the availability of annual series on total factor productivity growth and human capital from the Penn World Tables (PWT 8.1) (Feenstra et al., 2015). The study period 1996-2011 was chosen to determine whether FDI has supported productivity growth following the adoption of economic and structural reforms in the 1990s in most African countries. This period also captures the time span of the measures of the institutional quality of the World Bank, which are widely used in empirical research. Data on these indicators are available for most African countries since 1996, unlike other measures of institutional quality such as International Country Risk Guide (ICRG), which, although provides a relatively longer time span, covers only a limited number of African countries. The quality of institutions is proxied by control of corruption, which is collected from the World Bank's governance indicators. This variable ranges from -2.5 to 2.5, indicating poor quality institutions to good quality institutions.

Data on total factor productivity growth are obtained from PWT 8.1 (Feenstra et al., 2015), which are computed for each country j as:

$$RTFP_{j,t,t-1}^{NA} = \frac{RGDP_{jt}^{NA}}{RGDP_{jt-1}^{NA}} / Q_{jt,t-1}^{T} \tag{4.15}$$

where $RGDP_t^{NA}$real GDP at constant national prices and $Q_{t,t-1}^{T}$ is an index of factor inputs (labour and capital) between period t and $t-1$ for a given country. FDI is measured by the ratio of inward FDI stock to GDP. The data is taken from the United Nations Conference on Trade and Development (UNCTAD) database. Data on inward FDI stocks is used to analyze the effect of FDI on productivity growth, since it captures the medium-long term or sustaining growth effects of FDI compared to new FDI which mostly reflects the short-term effects of these investments (see Bitzer and Gorg, 2009). Additionally, new FDI inflows do not automatically translate into increased economic growth since some of the benefits of these investments, such as the transfer of ownership skills and management expertise, are not immediately absorbed in the

real sector of the economy (see Neuhaus, 2006). That said, stocks also reflect the effect of existing institutional environment or structural policies in host countries, which may encourage or inhibit the accumulation of FDI flows.

Data on average human capital stock of countries is obtained from the Penn World Tables 8.1. The variable is computed based on the average years of schooling for the population aged 15 and older and an assumed rate of return to education as follows:

$$hc_{it} = e^{\theta(s_{it})} \tag{4.16}$$

Where s_{it} average years of schooling; and according to Psacharopoulos (1994) and Hall and Jones (1999), the function $\theta(s_{it})$ is piece-wise linear function based on the rates of return to schooling.[22] The data on government consumption were collected from the PWT 8.1, which is measured by its growth rates (Thanh, 2015). Data on trade openness is taken from the World Bank's World Development Index (WDI). It is defined as the sum of exports and imports (as a share of GDP). Initial real GDP per capita figures are collected from the WDI and measured by the logarithm of real GDP per capita in the first year of each five-year sub-period (Jude and Levieuge, 2015). Domestic financial markets development is proxied by the ratio of domestic credit to the private sector to GDP (Alfaro et al., 2009). This is taken from the Global Financial Development database.

Table 4.4 presents the descriptive statistics for the variables used in the repression. It shows considerable variation in total factor productivity growth, average human capital stock and the ratio of inward FDI stock in GDP across countries. With a standard deviation of 16.22, the share of inward FDI stock in GDP varies substantially across countries, which ranges from -6.08 percent in Gabon in 2001 to 73.63 percent in Mauritania in 2005. Similarly, the average human capital varies significantly across countries, ranging from 1.136 in Mozambique in 1996 to 2.846 in Botswana in 2011. Likewise, a standard deviation of 0.115 for productivity growth shows that there are large differences across countries, ranging from 0.66 percent in Sierra Leone in 1999 to 1.78 percent in Zimbabwe in 1996.

[22] The function $\emptyset(s) = 0.134 \times s$ if s$\leq 4, \emptyset(s) = 0.135 \times 4 + 0.101(s-4)$ if $4 < s \leq 8, \emptyset(s) = 0.135 \times 4 + 0.101 \times 4 + 0.068(s-8)$ if $s > 8$, where the return to one extra year of schooling for the first 4 years of education is 13.5%, 10.1% for the next 4 years of education and 6.8% beyond 8 years of education.

Table 4.4: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Total factor productivity growth (%)	400	1.009	0.115	0.657	1.784
Human capital index	400	1.934	0.411	1.136	2.846
Ratio of inward FDI stock to GDP (%)	400	21.92	16.22	-6.084	73.63
Initial real GDP per capita (US$)	400	1659	1920	143.3	7963
Trade openness (%)	400	74.58	36.62	20.96	209.9
Ratio of domestic credit to GDP (%)	400	28.15	28.55	1.620	160.1
Control of corruption index	400	-0.435	0.585	-1.389	1.250
Government spending growth rate (%)	375	1.557	14.14	-89.275	98.87

Table 4.5 displays the correlation among the variables used in the analysis. There is no significant positive association between FDI and productivity growth and the interaction term between human capital and FDI does not show the expected positive association with TFP growth.

Table 4.5: Correlation matrix

	1	2	3	4	5	6	7	8	9
1. TFP growth rate	1								
2. Human capital	0.10*	1							
3. FDI stock in GDP	-0.07	0.20*	1						
4. Interaction	-0.05	0.43*	0.96*	1					
5. Initial RGDPPC	-0.06	0.71*	0.16*	0.31*	1				
6. Trade openness	0.03	0.45*	0.39*	0.45*	0.33*	1			
7. Domestic credit	0.05	0.50*	0.38*	0.50*	0.50*	0.09	1		
8. Corruption	-0.06	0.46*	0.32*	0.42*	0.56*	0.38*	0.51*	1	
9. Consumption growth	-0.06	-0.03	0.02	0.01	0.04	0.01	0.03	0.04	1

Note: '*' denotes significant at the 5 percent.

Figure 4.1 shows how average total factor productivity growth and average share of inward FDI stock are compared over the period 1996-2011. The line is fitted by ordinary least squares (OLS) using average total factor productivity growth and inward FDI stock as a share of GDP. The plot shows no clear positive relationship between TFP productivity and inward FDI stock. It does not suggest that countries that have a greater average share of inward FDI stock have also experienced higher productivity growth. For example, on average Tunisia attracted the highest share of inward FDI stock, but experienced a relatively low productivity growth during the period. In contrast, Zimbabwe received moderate levels of inward FDI stock, but had the highest productivity growth during the review period. The graph shows a total of 15 countries out of 25

countries lying below the curve. This reveals that these countries experienced productivity growth rates below the average share of inward FDI stock received during the period.

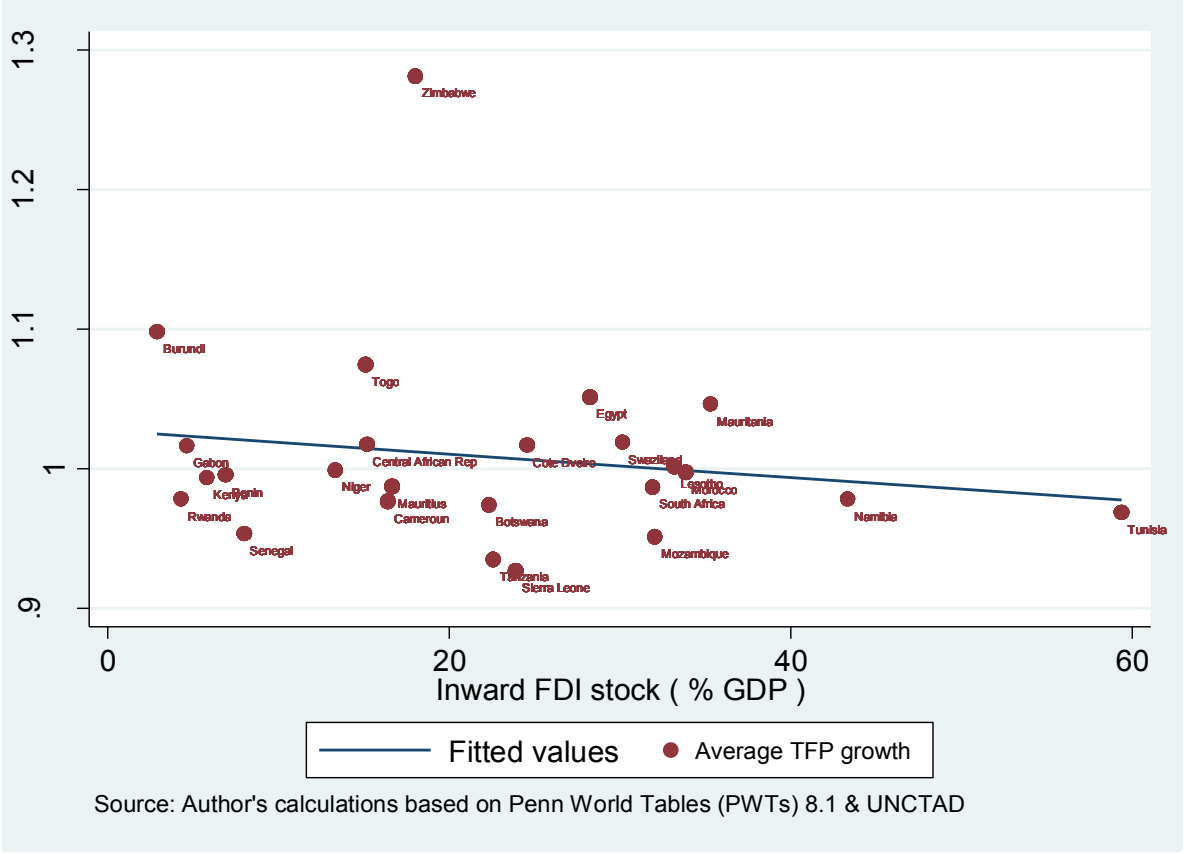

Figure 4.1: Distribution of average inward FDI stock (% GDP) and TFP growth

To further analyze whether human capital can potentially accelerate the growth effect of FDI, TFP growth is plotted against the interaction between human capital and FDI. Human capital stock at the beginning of each 5-year period is used instead of the average of this variable over time, for example, 1995 for the period 1996-2000, 2000 for 2001-2005, etc. As noted, human capital was computed based on 5-year average years of schooling of these countries. Figure 4.2 shows how TFP growth is associated with FDI through human capital absorptive capacity. The graph is plotted using OLS of TFP growth on the interaction between average share of inward FDI and human capital stock. The plot does not show that human capital has enhanced the effect of FDI on productivity growth, as the plot is not upward sloping and suggests that the relationship between FDI and productivity growth may not be linear.

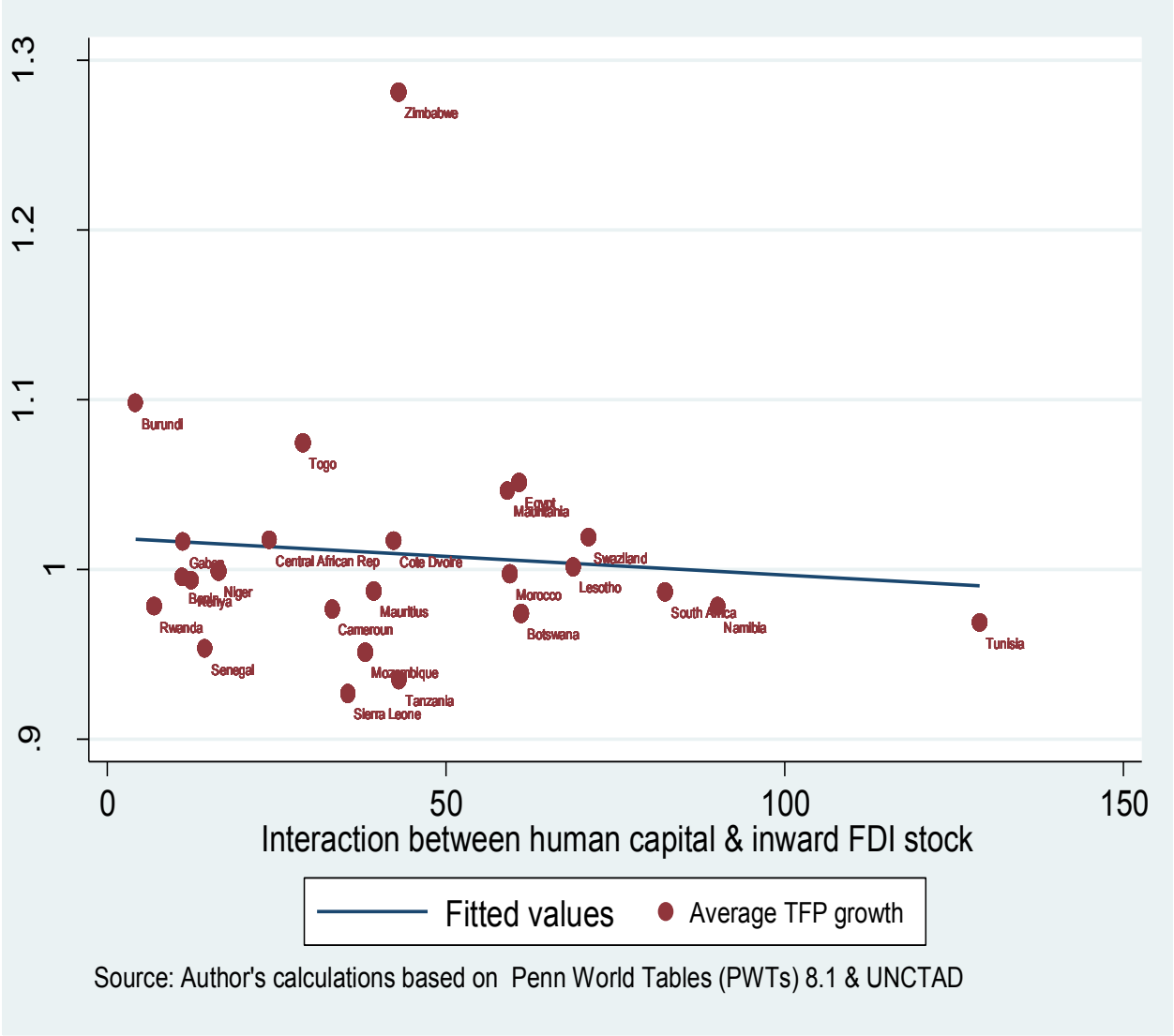

Figure 4.2: Distribution of average TFP growth and FDI-human capital interaction

One may be concerned about potential problems of outliers in the data, which can significantly influence the least squares estimates. As a first step in analyzing the underlying relationship, prior analysis is undertaken to tackle the problem of any outliers. The analysis here relies on evaluating the plot of leverage-versus-residual-squared, which describes the plot of leverage against the normalized residual squared. The plot is derived following the OLS estimation of TFP growth and FDI stock, using 5-year averages over the period 1996-2011 including observations for 2011. Figure 4.3 displays the plot of leverage against the residuals using TFP. It shows large residuals but low leverage for Zimbabwe (ZW), and high leverage but low residuals for Tunisia (TUN). However, none of the observations show high leverage and large residuals,

which suggests that our estimates will not be influenced by problems of outliers. A similar conclusion can be reached when one looks at the plot in figure 4.4 following the OLS regression of average TFP growth and human capital.

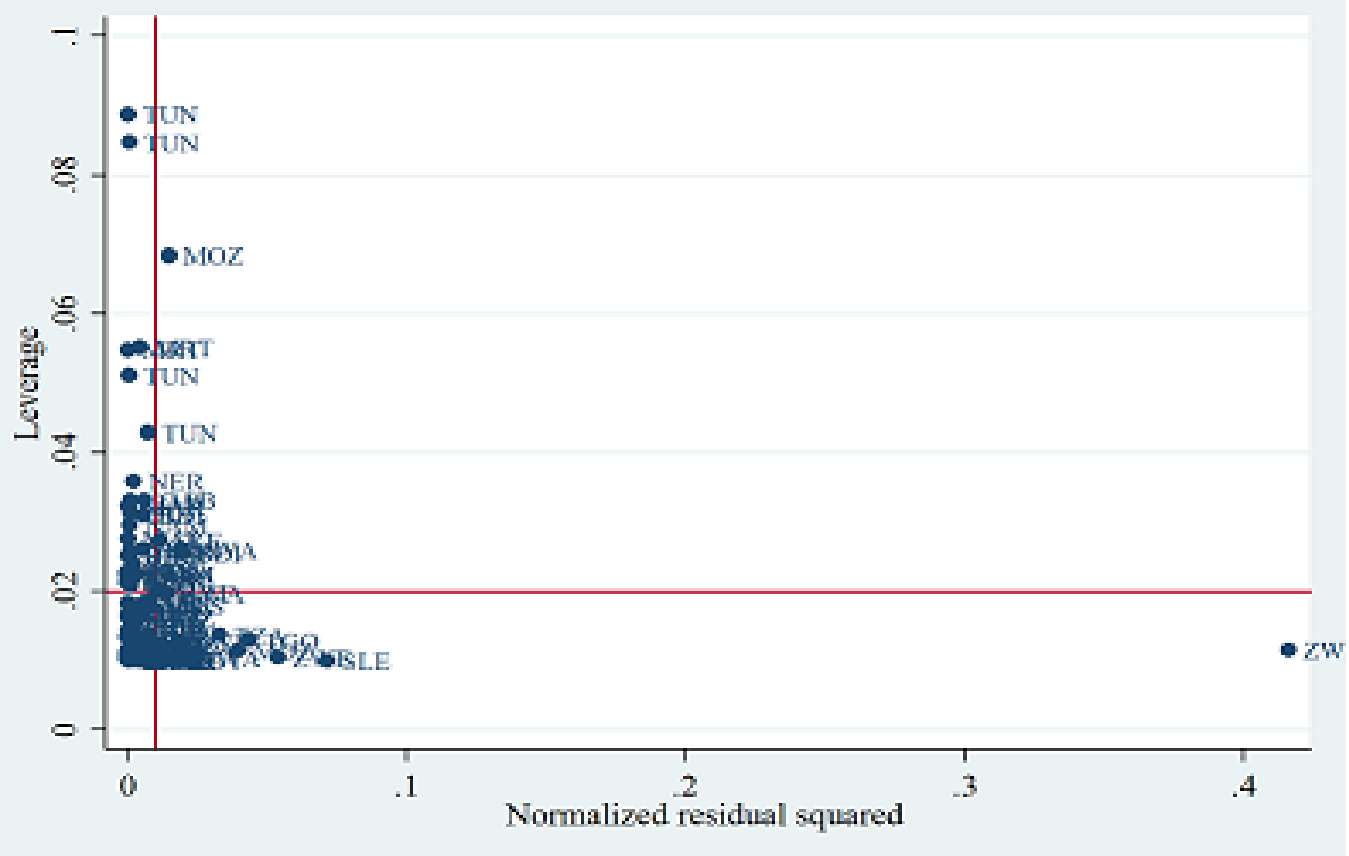

Figure 4.3: TFP growth and FDI stock

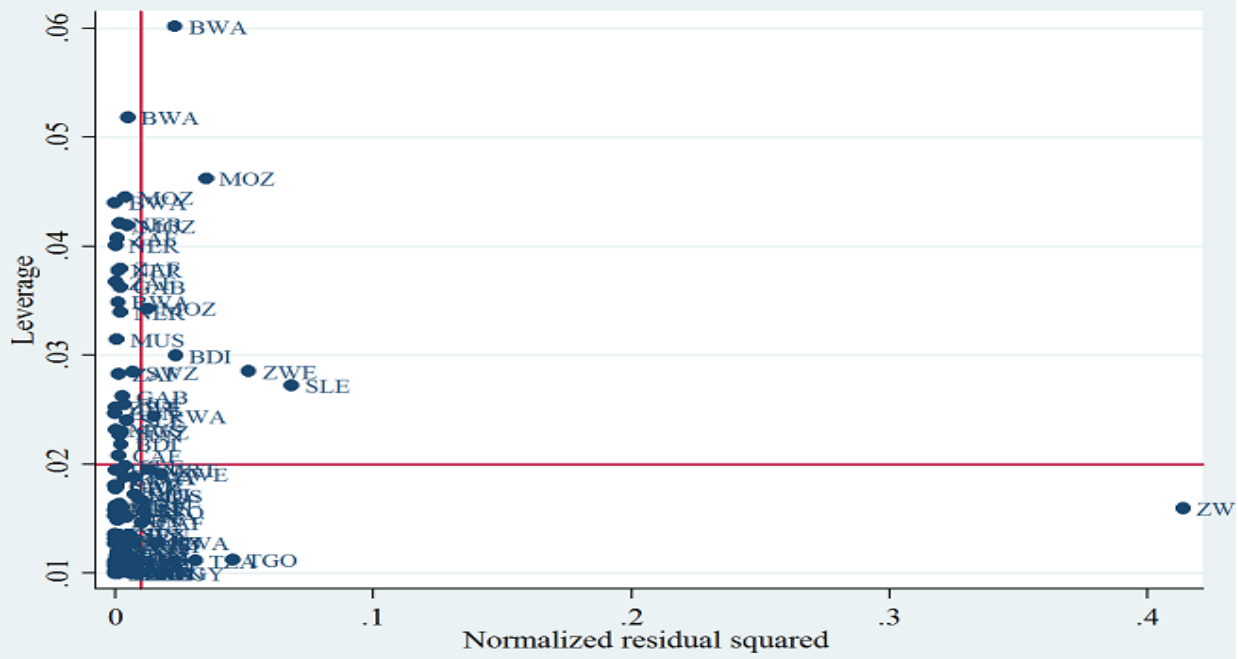

Figure 4.4: TFP growth and human capital

4.5 Empirical Analysis

The correlation analysis above suggests that inward FDI stock is not significantly associated with TFP growth and the interaction term between FDI and human capital does not show the expected positive correlation. Similarly, the scatter plots do not show any clear relationship between FDI, human capital and productivity growth. The analysis, thus, evaluates empirically whether FDI has contributed to enhancing productivity growth or whether such effects depend on human capital stock of host countries. In analyzing this relationship, equation (4.14) is first estimated using OLS while allowing for the linear interaction between FDI and human capital to determine whether the growth effect of FDI is conditional on human capital. Table 4.6 presents the results of the baseline regression on the relationship between TFP growth, FDI and human capital using the pooled OLS estimation techniques. The OLS regression is run on the data averaged over a 5-year period spanning 1996-2011 (i.e. 1996-2000, 2001-2005, and 2006-2010). To increase the sample size, additional observations on the series for 2011 are included in the regression since the stock of human capital in 2010 is the same as in 2011. Observations on human capital at the start of each 5-year period are used instead of the average of human capital over the respective periods e.g. human capital stock in 1995 is used for the period 1996-2000; 2000 for 2001-2005,

etc. This is so given that this variable was obtained based on the 5-year average years of schooling data (Barro and Lee, 2013).

Table 4.6 presents the results on the relationship between TFP growth, FDI and human capital capacity. As shown in column (1), the coefficient on FDI stock shows a negative sign and not statistically significant. This suggests that FDI does not raise productivity growth in host countries. To determine whether the growth effect of FDI depends on human capital capacity of host countries, an interaction term between FDI and human capital is included in the baseline regression. As noted, the human capital stock should enhance the growth impact of FDI through the assimilation and adoption of foreign technology and knowledge from these investments.

Table 4.6: Pooled OLS estimation of baseline specification (1996-2011)

Variables	(1)	(2)
Human capital	0.063	0.135*
	(0.053)	(0.072)
Share of FDI stock in GDP	-0.048	0.518**
	(0.062)	(0.260)
Interaction between human capital & FDI		-0.310**
		(0.139)
Log initial real GDP per capita	-0.038*	-0.041*
	(0.021)	(0.021)
Trade openness	0.046	0.040
	(0.033)	(0.032)
Private sector credit in GDP	0.060*	0.086**
	(0.031)	(0.034)
Control of corruption	-0.016	-0.014
	(0.021)	(0.021)
Government consumption	0.025	0.101
	(0.169)	(0.159)
Constant	1.096***	0.979***
	(0.100)	(0.107)
Observations	100	100
R-squared	0.079	0.106

Note: ***, **,* denote 1%, 5% and 10 % respectively. Standard errors in parentheses are corrected for heteroscedasticity.

Column (2) of table 4.6 reports the regression results after adding a linear interaction term between FDI stock and human capital capacity. The coefficient on FDI turns out to be strongly positive, albeit the coefficient on the interaction term is negative. The negative coefficient for the interaction term could be due to potential nonlinearity between FDI and human capital, rather than the linear relationship assumed in the estimation. The total effect of FDI on productivity growth shows a positive impact, although the relationship is not statistically significant. This is obtained by combining the coefficient on FDI and the interaction term between FDI and human

capital, yielding a coefficient of 0.208 and probability value of 0.105.[23] The result clearly indicates that FDI does not raise productivity growth directly, but the effect depends on human capital capacity (i.e. through its interaction effects with human capital). However, the negative coefficient on the interaction term is not consistent with previous studies which find a complementary effect of human capital and FDI on economic growth (e.g. Borensztein et al., 1998; Li and Liu, 2005). These studies looked at the interaction effects of human capital and FDI on economic growth, but not productivity growth. Woo (2009) presents evidence suggesting that the effect of FDI on productivity growth is not conditional on human capital capacity of host countries, while Xu (2000) finds that host countries should achieve a minimum threshold of human capital to facilitate technology transfer from US MNEs and increase productivity growth. Nevertheless, our results are not directly comparable with these studies since a different measure of human capital is used. Our measure comprises schooling attainment and returns to schooling, while previous studies considered schooling attainment.

One possible explanation for the statistically insignificant overall effect of FDI on productivity growth could be due to the presence on nonlinearities between FDI and productivity growth. As the descriptive analysis suggests, there are considerable differences in human capital stock across countries in Africa, ranging from 1.136 in Mozambique in 1996 to 2.846 in Botswana in 2010. This suggests that human capital capacity can reasonably explain host country heterogeneity in determining whether the effect of FDI on productivity growth is heterogeneous across countries.

In order to analyze such heterogeneity, the empirical model (equation 4.14) is estimated using a Panel Smooth Transition Regression (PSTR) model. This approach allows us to determine the threshold level of human capital capacity above which FDI would increase productivity growth in host countries. The PSTR was developed by Gonzalez et al (2005) and Fok et al (2005) and represents a generalization of the Panel Transition Regression (PTR) proposed by Hansen (1999). One advantage of the PSTR relative to the PTR is that it allows for the coefficient on the variables to smoothly change between one regime (lower bound) to the next (upper bound), based on the different values of an observable variable known as transition function. In addition, since the PSTR model allows for time varying and heterogeneity in the parameters, it is also

[23] Equation 4.14 was also estimated using fixed effects model on the panel of 25 countries, but the coefficient on FDI was not statistically significant.

suitable for dealing with the problem of few outliers which can significantly distort the results from the estimation of linear interactions between human capital and FDI (see Gainelli et al., 2015).

In estimating the parameters of the PSTR, the first step involves testing for homogeneity between FDI and productivity growth against the PSTR model. This implies determining whether the underlying relationship is linear, which suggests that impact of FDI is homogenous across countries and time invariant. Considering a basic model with one threshold or two regimes, the PSTR model is specified as:

$$g_{it} = \alpha_i + \beta_0' z_{it} + \beta'_1 z_{it} \theta\left(h_{i,t-1};\ \gamma, \vartheta\right) + \varepsilon_{it} \qquad (4.17)$$

Where $i = 1, \ldots, N$, and $t = 1, \ldots, T$; N and T denote cross-section units and time dimension of the panel respectively. α_i is the country fixed effects and ε_{it} is an error term. g_{it} is total factor productivity growth and z_{it} is a vector of time varying explanatory variables, which comprises the share of FDI stock in GDP, initial real GDP per capita, trade openness, control of corruption index, ratio of private sector credit to GDP and growth in government consumption. To guard against potential endogeneity bias, all explanatory variables are lagged one period, except growth in government consumption. For instance, the share of inward FDI stock in GDP is a potentially endogenous variable. This arises from the fact that FDI is most likely to be attracted to countries with greater total factor productivity growth than their counterparts with relatively lower productivity. Greater productivity is driven by technology innovations in host countries which enhance the assimilation and adoption of technology from FDI, thereby attracting more of these investments. Such potential endogeneity bias problem is however mitigated through estimation of the PSTR model, since it allows for time-varying effect of FDI on productivity growth at different levels of the transition variable (Jude and Levieuge, 2015). The function $\theta\left(h_{i,t-1};\ \gamma, \vartheta\right)$ is a continuous function of the threshold variable, human capital stock. This function is bounded between 0 and 1, with these extreme values associated with the regression parameters β_0 and $(\beta_0 + \beta_1)$. The threshold variable is also lagged one period ($(h_{i,t-1})$; γ is a slope parameter, which determines the smoothness of the transition function and c is a location or threshold parameter. Following Gonzalez et al. (2005), the analysis uses a logistic transition function which is specified as:

$$\theta(h_{i,t-1};\ \gamma,\vartheta) = \frac{1}{\left(1+\exp(-\gamma\prod_{j=1}^{m}(h_{i,t-1}-\vartheta_i))\right)},\ \gamma > 0 \qquad (4.18)$$

Where $\vartheta_1 \leq \vartheta_2 \leq \cdots \leq \vartheta_m$ and $\vartheta = (\vartheta_1, \ldots, \vartheta_m)'$ is an m-dimensional vector of threshold parameters. With one threshold parameter $(m = 1)$, the logistic transition function takes the form:

$$\theta(h_{i,t-1};\ \gamma,\vartheta) = \frac{1}{\left(1+exp\left(-\gamma(h_{i,t-1}-\vartheta)\right)\right)},\ \gamma > 0 \qquad (4.19)$$

In this case, there are two extreme regimes associated with low and high values of the threshold variable $h_{i,t-1}$ with a single monotonic transformation of the coefficients from β_0 to $(\beta_0 + \beta_1)$ as $h_{i,t-1}$ increases. Note that from equation (4.18), when $\gamma \to \infty$, the transaction function $\theta(h_{i,t-1};\ \gamma,\vartheta)$ converges to an indicator function, depicting the Hansen (1999) PTR model. For $m = 2$, the transition function reaches its minimum at $(c_1 + c_2)/2$ and is associated with a value of 1 at both low and high values of the threshold variable $h_{i,t-1}$ (Gonzalez et al., 2005). As a result, when $\gamma \to \infty$, the model becomes a three-regime threshold model. In general, for any value of m, the transaction function is constant when $\gamma \to 0$, and the model can be estimated as a homogeneous or linear fixed effects panel regression.

To estimate the parameters of the PSTR, the individual fixed effects α_i in equation (4.17) are eliminated by de-meaning the variables and nonlinear least squares estimation applied to the transformed model. In order to evaluate the presence of nonlinearities FDI and productivity growth, the null hypothesis of homogeneity, $H_0: \gamma = 0$ or $H_0: \beta_0 = \beta_1$, is tested against the alternative of the PSTR model from equation (4.17). However, the test statistics evaluating the null hypothesis are nonstandard and the PSTR has unidentified nuisance parameters. In order to conduct the test, an auxiliary regression is derived by replacing the transition function in equation (4.17) with a first-order Taylor expression around $\gamma = 0$ as specified in equation (4.20) (Collettaz and Hurlin, 2006; Gonzalez et al., 2005; Jude, 2010; Thanh, 2015):

$$g_{it} = \alpha_i + \beta_0' z_{it} + \beta'_1\, z_{it} h_{i,t-1} + \beta_2' z_{it} h_{it-1}^2 \ldots + \beta'_m z_{it} h_{i,t-1}^m + \varepsilon_{it}^* \qquad (4.20)$$

Where the parameter vectors $(\beta_1' \ldots, \beta_m')$ are multiples of γ and $\varepsilon_{it}^* = \varepsilon_{it} + R_m' z_{it}$, R_m is the reminder of the Taylor expansion. The test for linearity in equation (4.20) against the PSTR implies testing the null hypothesis $H_0: \beta_1 = \cdots = \beta_m = 0$, using the Wald and Likelihood ratio

tests statistics. Non-rejection of the null hypothesis of linearity implies that the effect of FDI on productivity growth is homogenous and the model should be treated as the linear panel with fixed effects.

To ensure that the nonlinearity between FDI and productivity growth is not driven by omitted variables, equation (4.17) captures not only the interaction between FDI and human capital but also the interaction terms between human capital and all the explanatory variables. These interactions can be justified from theoretical perspectives. For instance, literature suggests that the presence of good quality institutions encourages investment in physical and human capital and facilitates the efficient use of these factors to achieve greater level of income (Acemoglu et al, 2001). The inclusion of the interaction between control of corruption index, which is used as proxy for institutional quality, and human capital follows the argument that high level of corruption increases uncertainty and discourages talented people from engaging in productive activities (Rogers, 2008). Trade openness enhances the growth effect of human capital especially in poor countries. Inclusion of the interaction term between trade openness and human capital is in line with the argument that greater trade openness encourages competition, increases the demand for high-skilled labour, promotes learning by doing and associated use of modern technology (Miller and Upadhyay, 2000). Because improving human capital enhances the capacity of countries to absorb foreign technology, its interaction with initial real GDP per capita captures the catch-up effect.

The test for nonlinearity involves testing a linear model $(r = 0)$ against the PRST model with one threshold $(H_0: r = 1)$ or two regimes. The results of the linearity test are reported in table 4.7, which show strong rejection of the null hypothesis of linearity. All test statistics suggest the presence of nonlinear effect of FDI on productivity growth. This indicates that it is more helpful to explore host country heterogeneity through nonlinear estimation technique, to determine the role of human capital capacity in accelerating technology spillovers in host African countries, rather than relying on inferences based on the linear interactions between FDI and human capital capacity.

Table 4.7: Linearity tests

Test	Statistic	P-value
Wald Test (LM)	25.99	0.000
Fisher Test (LMF)	4.270	0.000
LRT Tests (LRT)	26.94	0.000

Note: H_0: linear model $(r = 0)$ vs H_1: PSTR model with at least 1 threshold $(r = 1)$

Having confirmed the presence of nonlinear effect of FDI on productivity growth, the second step in estimating the PSTR model is to determine whether there is no remaining heterogeneity in the data. In other words, this test is performed to ascertain whether the PSTR model with one threshold of human capital captures host country heterogeneity. It involves testing a single threshold model $(H_0: r = 1)$ or two regimes against a double threshold model $(H_1: r = 2)$ or three regimes. In the case of 2 transition functions or 3 regimes, the PSTR model is specified as:

$$g_{it} = \alpha_i + \beta_0 z_{it} + \beta'_1 z_{it}\theta_1(h_{i,t-1};\ \gamma, \vartheta) + \beta'_2 z_{it}\theta_2(h_{i,t-1};\ \gamma, \vartheta) + \varepsilon_{it} \quad (4.21)$$

To derive the auxiliary regression of the test, the second transition function is replaced by its first-order Taylor expansion around $\gamma = 0$ as specified in equation (4.22):

$$g_{it} = \alpha_i + \beta_0 z_{it} + \beta'_1 z_{it}\theta_1(h_{i,t-1};\ \gamma, \vartheta) + \delta\, z_{it} h_{i,t-1} + \varepsilon_{it} \quad (4.22)$$

The test for no remaining heterogeneity implies testing the linear constraints on the parameters $H_0: \delta = 0$. The testing procedure is described as follows. Suppose that there is a PSTR with r^* transition functions. The hull hypothesis of no remaining nonlinearity is specified as $H_0: r = r^*$against the alternative hypothesis $H_1: r = r^* + 1$. The testing procedure ends when the null hypothesis is not rejected. Otherwise, the test is performed on the null $H_0: r = r^* + 1$ against the alternative hypothesis $H_1: r = r^* + 2$ until all the test statistics fail to reject the null hypothesis.

Results of the test for remaining nonlinearities are displayed in Table 4.8. All the test statistics fail to reject the null hypothesis of no remaining heterogeneity. The test results indicate that heterogeneity in the effect of FDI on productivity growth is completely captured by estimating a PSTR with one threshold value or two regimes. On these grounds, it is appropriate to analyze the underlying relationship using a logistic function. As noted, the PSTR based on a logistic

specification is a regime-switching model that allows for two regimes which depict low and high levels of human capital capacity.

Table 4.8: Test for remaining nonlinearity

Test	Statistic	P-value
Wald Test (LM)	7.977	0.240
Fisher Test (LMF)	1.203	0.304
LRT Tests (LRT)	8.063	0.234

Note: H_0: PSTR with one threshold $(r = 1)$ vs H_1: PSTR with at least 2 thresholds $(r = 2)$

In the next step, the PSTR model in equation (4.17) is estimated using nonlinear least squares, which is further expanded as stated in equation (4.23):

$$g_{it} = \alpha_i + \beta_0 FDI_{i,t-1} + \beta_1 FDI_{i,t-1}\theta\left(h_{i,t-1};\, \gamma, \vartheta\right) + \beta_{01} R_{it} + \beta'_{11}\, R_{it}\theta\left(h_{i,t-1};\, \gamma, \vartheta\right) + \varepsilon_{it} \qquad (4.23)$$

Where $FDI_{i,t-1}$ is one period lag of the share of inward FDI stock in GDP and R_{it} is a vector of control variables as defined above. The results of the estimated parameters from the PSTR model with one threshold of human capital capacity are presented in table 4.9. Like the case of the probit or logit models, the values of the parameters are not directly interpretable. It is therefore helpful to interpret the signs of the parameters, which reflect an increase or decrease in the value of the explanatory variables associated with an increase in human capital capacity. Considering FDI variable, a positive (negative) sign on this coefficient suggests that elasticity of TFP growth increases (decreases) respectively as human capital capacity is enhanced. Table 4.9 reports the estimates of the PSTR for a sample of 25 countries over the period 1996-2011. The results clearly suggest a non-linear effect of FDI on TFP growth. As can be seen from column (1) of table 4.9, the coefficient on FDI (0.069) has the expected positive sign but not statistically significant, suggesting that FDI does not significantly influence TFP growth at low levels of human capital capacity. The estimated parameter of FDI only becomes positive and statistically significant at the 5 percent level when human capital exceeds the estimated threshold of average human capital stock of 2.31 (column 2). This is an indication that the effect of FDI on TFP growth depends on human capital capacity. Intuitively, host African countries will only experience an increase in productivity growth from FDI when they have attained this minimum threshold level of human capital capacity. The threshold level of human capital (2.31) is relatively close to the sample mean (1.93), ranging from 1.136 in Mozambique in 1996 to 2.85 in Botswana in 2010.

Table 4.9: PSTR model estimation

	β_0	β_1
Location (threshold) parameter (ϑ)	2.31	
Slope parameter (γ)	63.82	
Lagged share of FDI stock in GDP	0.069	0.182**
	(0.057)	(0.084)
Lagged log initial real GDP per capita	0.222***	-0.0202*
	(0.047)	(0.0104)
Lagged trade openness	-0.099**	0.199***
	(0.047)	(0.053)
Lagged control of corruption	0.072***	0.209 ***
	(0.016)	(0.048)
Lagged private sector credit in GDP	0.177	-0.324***
	(0.096)	(0.102)
Growth in government consumption	-0.047	0.013
	(0.044)	(0.071)

Note: ***, **,* denote 1%, 5% and 10 % respectively. Dependent variable-Productivity growth
Standard errors in parentheses are corrected for heteroscedasticity.

Contrary to previous studies that have assumed homogenous effect of FDI on economic growth through the linear interactions with human capital (Borenzstein et al., 1998; Li and Liu, 2005), our analysis reveals a heterogeneous and time-varying effect of FDI on productivity growth. This finding suggests that the assumption of homogeneity could be misleading and inferences on the threshold of human capital capacity, through such linear interaction between FDI and human capital stock, should be interpreted with caution.

Given that test of no remaining nonlinearity establishes a single threshold value, it is important to analyze the elasticity of productivity growth with respect to FDI between the extreme regime of low human capital capacity and the upper extreme regime. Using the logistic function, analyzing TFP growth allows us to comprehensively evaluate the extent to which the effect of FDI on productivity growth varies across countries. This is defined in equation (4.24) and obtained from equation (4.23). The elasticity of TFP growth with respect to FDI ranges from β_0, that is, zero to $(\beta_0 + \beta_1)$ as human capital increases from low to high capacity.[24]

$$\epsilon_{it} = \frac{\delta g_{it}}{\delta FDI_{i,t-1}} = \beta_0 + \beta_1 * \theta\left(h_{i,t-1};\ \gamma, \vartheta\right) \tag{4.24}$$

[24] The coefficient on FDI (β_0) associated with low human capital (0.069) is not significantly different from zero.

Literature suggests that when the estimated slope or smoothness parameter (γ) of the transition function is low, the speed of transition from low to high human capital regime will be relatively smooth. Under this condition, human capital enhancement will gradually support the growth effect of FDI in host countries. On the contrary, when the slope of the transition function γ is relatively large, depicting relatively sharp slope, the transition from low to high regime tends to be rapid. In this case, host countries that exhibit human capital capacity just below the threshold can realize significant increases in the growth effect of FDI when such capacity is enhanced, while those far below the established threshold will experience productivity gains from FDI.

To analyze such differences, a useful approach is to first establish more informative threshold of human capital in terms of average years of schooling, given that this variable is measured as a composite variable comprising average years of schooling and returns to education. This is calculated from the function in equation (4.25), since the average years of schooling (s) was estimated at 5.23 years for sub-Saharan Africa in 2010 and 7.25 years for North Africa and Middle East countries. From this perspective, equation (4.25) is as follows:

$$hc_{it} = e^{\theta(s_{it})} \tag{4.25}$$

where $\emptyset(s) = 0.135 \times 4 + 0.101(s-4)$ if $4 < s \leq 8$ and s is average years of schooling. Given the estimated threshold of human capital stock (hc) of 2.31, solving for s from equation (4.25) translates into 6.94 average years of schooling. This result indicates that FDI will accelerate productivity growth in host African countries that have achieved this threshold level. By the same token, host countries that exhibit human capital capacity very close to the threshold will experience a sharp increase in the growth effect of FDI when measures are undertaken to further enhance human capital. Conversely, countries with capacity far below this threshold level will not reap such productivity gains, unless human capital is enhanced closer to or at the threshold level. In other words, host African countries should attain a minimum of 6.94 average years of schooling in order to assimilate the knowledge and technology embedded in FDI and experience productivity gains from these investments. Using the PSTR model, Fracasso and Marzetti (2014) found a threshold of 8.33 average years of schooling for OECD countries to absorb spillovers from international R&D activities. Our analysis reveals a relatively lower threshold of 6.94 average years of schooling for African countries. This is expected since OECD economies have higher human capital capacity than African countries. The average years of total

schooling in the OECD was 11.30 years in 2010, compared to 5.23 years in sub-Saharan Africa and 7.25 years in the Middle East and North Africa countries.

Given this threshold, it is important to analyze the variation in the effect of FDI on productivity growth across countries using the plot of the logistic function associated with the estimated slope parameter γ (63.82). Figure 4.5 displays the plot of elasticity of TFP growth with respect to FDI conditional on human capital capacity across countries. This plot reveals a relatively sharp slope of TFP growth elasticity, given a relatively higher value of the slope parameter γ of the transition function. As noted above, this slope of the logistic function suggests that countries with human capital capacity very close to the threshold of 6.94 average years of schooling will realize a sharp rise in the elasticity of productivity growth with respect to FDI from 0.00 to 0.182, as efforts at further improving human capital capacity are intensified. For countries with human capital capacity some distance below this threshold, the elasticity of productivity growth with respect to FDI is not significant. This evidence suggests that there is heterogeneity in the effect of FDI on productivity growth, which is explained by the variation in human capital capacity across countries.

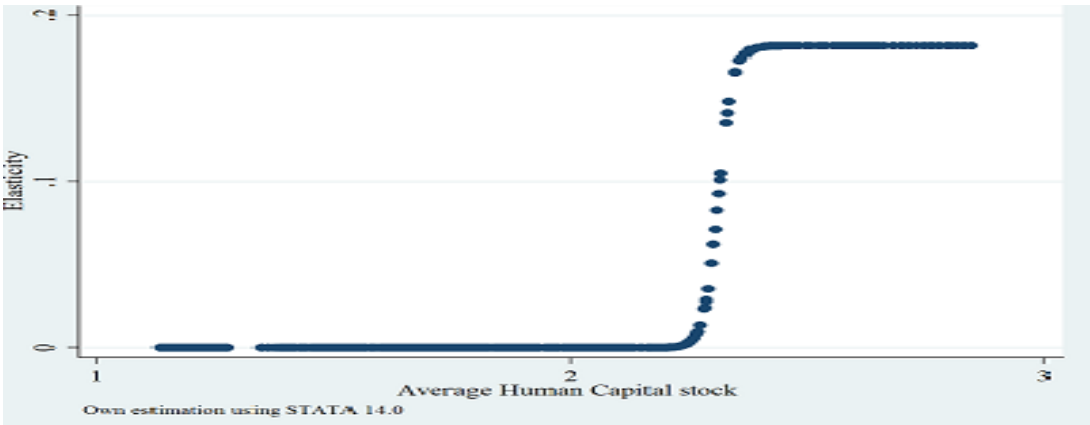

Figure 4.5: Elasticity of TFP growth with respect to FDI

Looking at the average human capital capacity of countries in column (4) of table 4.10 suggests that out of the sample of 25 countries, only 7 countries had attained the threshold of 6.94 average years of schooling in 2010. These are South Africa, Botswana, Gabon, Mauritius, Zimbabwe, Tunisia and Egypt. Interestingly, as can be seen from column (5) of table 4.10, these countries

were not major recipients of FDI at the initial stage.[25] The exceptions are the two North African countries (Tunisia and Egypt). As discussed previously, countries such as Mauritius, Tunisia and South Africa are at the efficiency-driven stage of development, while Botswana and Egypt are in transition from factor-driven to efficiency-driven stage of development, and Zimbabwe is factor-driven economy (Sala-I-Martin et al., 2010). Countries with human capital capacity below the threshold are mostly at the factor-driven stage of development, and include Burundi, Cameroon, Ivory Coast, Kenya, Lesotho, Mauritania, Mozambique, Rwanda, Senegal and Tanzania. Few of the countries below the minimum human capital threshold are at the transition stage from factor-driven to efficiency-driven development (e.g. Morocco), while Namibia is at the efficiency-driven stage of development.

Table 4.10: Human capital stock and initial FDI across countries

Country	Human capital stock (2011)	Average human capital stock 1996-2011	Average years of total schooling (2010)	FDI stock (% GDP) in 1996
Botswana	2.85	2.74	9.55	20.95
South Africa	2.64	2.58	9.69	8.97
Gabon	2.59	2.40	8.39	4.01
Mauritius	2.53	2.36	8.86	6.55
Zimbabwe	2.48	2.38	7.61	18.42
Swaziland	2.48	2.36	5.06	26.94
Tunisia	2.38	2.35	7.48	52.53
Egypt	2.31	2.17	7.15	22.66
Kenya	2.23	2.15	6.14	5.54
Lesotho	2.23	2.14	5.85	24.31
Cameroon	2.14	2.02	6.15	11.26
Namibia	2.13	2.08	6.17	42.16
Tanzania	2.05	1.91	5.81	7.65
Togo	2.04	1.91	5.49	19.99
Senegal	1.93	1.81	2.74	7.48
Morocco	1.89	1.76	4.96	13.16
Ivory Coast	1.82	1.72	4.65	14.71
Mauritania	1.80	1.67	4.53	6.55
Benin	1.77	1.60	4.43	2.64
Rwanda	1.70	1.59	4.36	3.93
Central African Republic	1.64	1.58	3.76	9.39
Sierra Leone	1.58	1.49	4.23	17.66
Burundi	1.57	1.46	3.35	3.16
Niger	1.28	1.23	1.88	17.51
Mozambique	1.27	1.19	1.93	11.86

Source: Penn World Tables 8.1 (Feenstra et al, 2016); Barro and Lee (2013) and UNCTAD (2016).

One may argue that the inclusion of the interaction term between human capital and FDI without the direct effect of human capital on TFP growth may not capture adequately the nonlinearity in

[25] The sample is restricted to only African countries with data on both productivity growth and human capital. Note also that the composition of FDI may partly explain the extent to which host African countries benefit from these investments. However, the ability of these countries to leverage FDI hinges on their absorptive capacity. Due to the absence of data on the sectoral composition of FDI, this thesis does not thoroughly discuss how such 'composition effects' in the seven (7) countries may have contributed to explaining TFP gains over time.

the relationship between FDI and TFP growth (see Fauquau et al.l, 2008; Fracasso and Marzetti, 2014). As noted, human capital directly affects TFP growth by enhancing the capacity of host countries to innovate new technologies and indirectly by facilitating technology diffusion through FDI. To address this concern, equation (4.17) is augmented by adding one period lag of human capital ($h_{i,t-1}$) as an additional explanatory variable in addition to its interaction with FDI and other explanatory variables. This is specified in equation (4.26) as:

$$g_{it} = \alpha_i + \left[\beta_0' z_{it} + \delta_0 h_{i,t-1}\right] + \left[\beta_1' z_{it} + \delta_1 h_{i,t-1}\right]\theta\left(h_{i,t-1};\ \gamma, \vartheta\right) + \varepsilon_{it} \qquad (4.26)$$

Table 4.11 presents the results of the test for linearity of the relationship between FDI and productivity growth when the direct effects of human capital are included in the PSTR specification. All the test statistics suggest strong rejection of the null hypothesis of linearity. This confirms the preceding analysis that the relationship between FDI and productivity growth is nonlinear. The result suggests that the omission of the direct effects of human capital on TFP growth does not influence the nonlinear relationship between FDI and TFP growth.

Given the existence of such a nonlinear relationship, a second step in the estimation of the PSTR is to determine whether there is no remaining heterogeneity in the data. The results of this test strongly reject the null hypothesis of a PRST model with one transition function or two regimes should be used. This is reported in table 4.11. Further tests for no remaining heterogeneity fail to reject the null of the presence of two transition functions. The existence of two transition functions with one threshold each or three-regime threshold model is in line with arguments in the literature that the presence of reciprocal externality between human capital and FDI can lead to multiple equilibria (see Blomstrom and Kokko, 2003).

Table 4.11: Test for remaining nonlinearity

Hypothesis	Test	Statistics	P-value
H_0: $(r = 0)$; H_1: $(r = 1)$	Wald Test (LM)	43.19	0.000
	Fisher Test (LMF)	6.378	0.000
	LRT Tests (LRT)	45.886	0.000
H_0: $(r = 1)$; H_1: $(r = 2)$	Wald Test (LM)	19.778	0.006
	Fisher Test (LMF)	2.617	0.012
	LRT Tests (LRT)	20.318	0.005
H_0: $(r = 2)$; H_1: $(r = 3)$	Wald Test (LM)	8.091	0.325
	Fisher Test (LMF)	1.014	0.421
	LRT Tests (LRT)	8.179	0.317

The estimates of the parameters of the PSTR with two threshold values of human capital are reported in table 4.12. In this case, the interpretation of the direction of the effects of the explanatory variables is slightly different. An increase in human capital capacity of host countries can generate the same effect of FDI or other independent variables on productivity growth when the coefficients in columns β_1 and β_2 have the same sign. On the other hand, enhancing human capital will reveal the opposing effects of a variable on productivity growth when these coefficients in columns β_1 and β_2 have different signs.

Table 4.12: PSTR model estimation

	β_0	β_1	β_2
Location (threshold) parameter (ϑ)	2.30	1.44	
Slope parameter (γ)	87.83	307.37	
Lagged human capital	-0.647 ***	-0.583***	0.759***
	(0.249)	(0.112)	(0.261)
Lagged share of FDI stock in GDP	-0.328***	0.152**	0.405***
	(0.111)	(0.059)	(0.118)
Lagged log initial real GDP per capita	0.182***	0.123***	-0.030
	(0.063)	(0.031)	(0.062)
Lagged trade openness	0.508***	0.305***	-0.714***
	(0.109)	(0.051)	(0.115)
Lagged control of corruption	-0.325***	0.076**	0.401***
	(0.064)	(0.032)	(0.066)
Lagged private sector credit in GDP	1.893***	-0.040	-1.916***
	(0.255)	(0.076)	(0.246)
Growth in government consumption	0.006	-0.100	0.025
	(0.094)	(0.067)	(0.100)

Note: ***, **denote 1% and 5% respectively. Standard errors in parentheses are corrected for heteroscedasticity. Dependent variable-Productivity growth

A look at the results of the PSTR reported in column (1) of table 4.12 shows that the coefficient on FDI on productivity growth is strongly negative at low level of human capital capacity. The result confirms the above analysis that FDI will not accelerate productivity growth when host countries have not attained a threshold of human capital capacity. As can be seen from column (2), the parameter turns out to be positive and statistically significant at 5 percent level, after the threshold of human capital capacity is achieved. In column (3), the parameter for FDI remains to be positive and statistically significant at the 1 percent. This reflects the nonlinear interaction between FDI and human capital capacity, revealing that FDI does not show any significant impact on productivity growth at low levels of human capacity and its contribution to productivity growth increases rapidly at higher levels of human capital capacity. It suggests that

improving human capital capacity enhances the impact of FDI on total factor productivity growth. The estimation with direct effects of human capital establishes a threshold of 2.30 average human capital stock for the first transition function. This translates into 6.90 average years of schooling and slightly lower than the threshold estimated above. The results further support the above analysis that host countries will not maximize the benefits of FDI from FDI when human capital capacity is far below the threshold necessary to absorb technology spillovers. The estimated slope parameters of the first transition function $(\gamma = 87.83)$ is relatively sharp, indicating that FDI can significantly raise productivity growth in countries with human capital capacity closer to this threshold level once efforts to further enhance such capacity are undertaken. As shown in table 4.12, the threshold value of human capital of the last regime (1.44) has very high smoothness parameter $(\gamma = 307.37)$. This suggests that only few countries will reach this additional regime of human capital capacity.

In determining the optimal threshold variable among the explanatory variables, the literature suggests that it is appropriate to choose the variable with the strongest rejection of the hypothesis of linearity (Gonzalez et al., 2005). In this study, the threshold variable (human capital) is chosen a priori given the objectives of study, and the PSTR models estimated differ depending on whether the direct effects of human capital are introduced or not. As shown in table 4.13, a comparison of the linearity test statistics for these PSTR specifications shows that both groups of test statistics reject the null hypothesis of linearity at 1 percent significance level. It can also be seen from this table that the introduction of direct effects of human capital on TFP growth results in relatively higher values of the test statistics. Nevertheless, it is important to note that the estimation of PSTR model with either one transition function and one threshold or two transition functions with one threshold each is sufficient to capture the commonly encountered types of variation in the parameters (Gonzalez et al., 2005). This is so because such specifications properly capture host country heterogeneity and time variability in the effect of FDI on productivity growth. On these grounds, our results can be analyzed using either the logistic function which allows for two extreme regimes associated with low and high values of human capital, or the three-regime PSTR model, which allows for two threshold values of human capital. If one considers the results of the later model as reported in table 4.12, the transition

function of TFP growth elasticity has its minimum at $(2.30 + 1.44)/2 = 1.87$, which is converted to 4.85 average years of schooling.

Table 4.13: Test for linearity with and without direct effects of human capital

Hypothesis	Test	Statistics		P-value	
		Without	With	With	Without
$H_0: (r = 0);\ H_1: (r = 1)$	Wald Test (LM)	25.99	43.19	0.000	0.000
	Fisher Test (LMF)	4.270	6.378	0.000	0.000
	LRT Tests (LRT)	26.94	45.886	0.000	0.000

One may also argue that nonlinearity in the relationship between FDI and productivity could be sensitive to the number of observations. To explore this issue, the test for nonlinearity is further conducted by dropping Zimbabwe from the sample, given the economic crisis that characterized the country during the period. The results of such tests as displayed in table 4.14 shows a remarkably consistent nonlinear relationship.

Table 4.14: Test for linearity with direct effects of human capital (excluding Zimbabwe)

Hypothesis	Test	Statistics	P-value
$H_0: (r = 0);\ H_1: (r = 1)$	Wald Test (LM)	31.31	0.000
	Fisher Test (LMF)	4.48	0.000
	LRT Tests (LRT)	32.75	0.000
$H_0: (r = 1);\ H_1: (r = 2)$	Wald Test (LM)	27.52	0.006
	Fisher Test (LMF)	3.72	0.001
	LRT Tests (LRT)	28.63	0.000
$H_0: (r = 2);\ H_1: (r = 3)$	Wald Test (LM)	6.44	0.489
	Fisher Test (LMF)	0.80	0.587
	LRT Tests (LRT)	6.49	0.483

A useful extension of the analysis is to determine whether such a nonlinear relationship is sensitive to the measure of FDI used. Table 4.15 presents the results of such estimation, further confirming the existence of nonlinearity between FDI and productivity growth.

Table 4.15: Test for linearity without direct effects of human capital (including Zimbabwe)

Hypothesis	Test	Statistics	P-value
H_0: $(r = 0)$; H_1: $(r = 1)$	Wald Test (LM)	31.31	0.000
	Fisher Test (LMF)	4.48	0.000
	LRT Tests (LRT)	32.75	0.000
H_0: $(r = 1)$; H_1: $(r = 2)$	Wald Test (LM)	27.52	0.006
	Fisher Test (LMF)	3.72	0.001
	LRT Tests (LRT)	28.63	0.000

Overall, the analysis supports the view that the effect of FDI on productivity growth is nonlinear and depends on human capital capacity of host countries. This evidence suggests that there is heterogeneity in the effect of FDI on productivity growth, which is explained by the variation in human capital capacity across African countries. The results demonstrate that enhancing human capital capacity of African countries is critical for absorbing technology spillovers from FDI.

4.6. Conclusion

This study has explored the question of whether the effect of FDI on productivity growth varies across African countries depending on their human capital capacity. The empirical literature on the growth-enhancing effect of FDI, using linear estimation techniques has shown inconclusive results. In order to resolve these mixed findings, this study has exploited the variation in human capital capacity across African countries in investigating the nonlinear effect of FDI on productivity growth. In so doing, this study makes an important contribution to the empirical literature by determining whether the effect of FDI on productivity growth across is heterogeneous across host African countries.

Recent country level data on total factor productivity growth and human capital stock were analyzed to comprehensively investigate these issues for a panel of 25 countries over the period 1996-2011. Results of the linear model showed that the overall impact of FDI on productivity growth is positive, but not statistically significant. This is attributed to the presence of nonlinearity in the effect of FDI on productivity growth. Given this finding, the study allowed for nonlinearity using the Panel Smooth Transition Regression (PSTR) model. Evidently, there is strong support for the existence of nonlinear relationship between FDI and productivity growth.

The study revealed that host countries should achieve a minimum threshold of 6.94 average years of schooling for FDI to accelerate productivity growth. Analyzing this threshold, the results revealed considerable heterogeneity in the effect of FDI on productivity growth across countries. The evidence suggests that countries with human capital capacity far below the threshold will not experience productivity gains from FDI, while those with human capital capacity very close to or above the threshold will realize an increase in productivity growth as efforts to improve human capital capacity are enhanced.

On a policy perspective, the results clearly underscore the importance of human capital capacity in attracting FDI and absorbing technology spillovers. Thus, it would be helpful for countries with human capital capacity well below the threshold to consider such capacity enhancement as a prerequisite for the attraction of FDI in order to reap the benefits of such investments. On the other hand, countries with human capital very close or above the threshold should ensure that human capital enhancement is an important part of the overall policy framework to attract FDI. These countries can simultaneously embark on improving human capital capacity and the attraction of FDI. This finding corroborates the analysis in chapter three and suggests that African countries should enhance capacity in science, technology, engineering and mathematics (STEM) education and skills in order to absorb higher quality FDI.

While this study has not focused on other measures of absorptive capacity (e.g. development of domestic financial markets and institutional quality), it is not clear from the empirical literature whether such capabilities could explain the heterogeneous effect of FDI on productivity growth. Such issues can be explored in future research to explain the variation in the effect of FDI on productivity growth across countries.

CHAPTER FIVE

CONCLUSION

5.1 Summary of Findings

Over the past two decades, most countries in the African continent have successfully attracted increasing amounts of foreign direct investment (FDI) from different source economies. While there is growing recognition that the determinants of FDI into host countries could vary across the different groups of investors, there is scarce empirical evidence on the factors encouraging FDI into African countries from the different source countries. There is also little empirical evidence on how foreign affiliates can be integrated in host countries to enhance productivity spillovers to local firms and whether such investments have contributed to increasing productivity growth in recipient countries. This thesis has attempted to provide answers to these questions in three chapters. Chapters two and three investigated the determinants of FDI activity in host African countries and chapter four explored the growth enhancing effect of FDI in these economies. In chapter two, emphasis was placed on identifying the drivers of FDI from the different source economies into resource and non-resource rich African countries. This chapter was complemented by chapter three in analyzing the determinants of FDI activity, by determining the sectors through which foreign affiliates are more likely to integrate local firms in FDI projects. Chapter four explored the question of whether FDI has contributed to promoting productivity growth in host African countries.

Chapter two analyzed whether FDI from the different source economies, categorized into investments from intra-African economies, the OECD and non-OECD emerging markets economies, are driven by the size of host markets, presence of natural resources and lower labour costs considerations in resource-rich countries. In a similar manner, this chapter explored whether FDI from these different sources are also attracted by large markets and lower labour costs in non-resource rich countries. There are arguments pointing to potential heterogeneity in the factors determining FDI into host countries from the different groups of investors, which could be explained by differences in nationality of investors, levels of income and geographical

locations of the countries of origin. From this perspective, chapter two contributes to the empirical literature on FDI determinants by providing evidence on the factors that specifically determine FDI from the different source economies into resource and non-resource rich economies. Chapter two further argued that the determinants of FDI could vary due to differences in income levels and resource wealth across host African countries. This chapter makes an important contribution to the empirical literature by providing evidence on the differences in the motivations and determinants of FDI among investors from the different source economies.

The results in chapter two showed remarkable differences between groups of investors from intra-African economies and those from the OECD and non-OECD emerging markets economies. The size of markets matters for attracting FDI from the OECD and non-OECD emerging markets economies into resource and non-resource rich countries. Foreign investments from non-OECD emerging markets economies are also encouraged by the presence of lower labour costs in non-resource rich countries. Similarly, host African countries with large markets are major destinations of FDI from intra-African economies. These findings underline the importance of intra-African FDI as potential source of external finance to promote growth of African economies. Partly due to similarity in institutional environment in host countries, intra-African investments can be readily integrated into host markets. This has the potential to boost productivity growth. Generally, while the presence of natural resources has a significant influence on FDI into resource-rich countries, the analysis showed that resource-seeking FDI into the extractive industries could undermine FDI into non-resource sectors of host countries.

The heterogeneous nature of FDI is further confirmed by analyzing the differences in motivations and determinants of FDI among investors from the different source economies. The analysis revealed significant differences in FDI behaviour between groups of investors from intra-African and OECD economies in terms of their response to market size and the presence of natural resources. Additionally, there are significant differences between intra-African investors and those from the non-OECD emerging markets economies with respect to natural resources in host countries. The analysis was extended to investigate the question of whether FDI to South Africa is different from FDI to other African countries. When intra-African FDI were considered, the results showed significant differences between FDI to South Africa and other

African countries with respect to natural resources availability. Similarly, there are significant differences in market-seeking considerations between these countries for FDI from the OECD and natural resources availability for FDI from non-OECD emerging markets economies. These findings confirm the hypothesis that there is heterogeneity in the determinants of FDI in African countries. The results highlight the importance of differentiating the factors driving FDI among the different groups of investors for more informed decisions on engagement with these investors.

Establishing such heterogeneity is an important step in understanding the extent to which host countries can maximize the benefits of these investments. This is so as the empirical evidence suggests that foreign investments driven by large markets (market-seeking) and availability of lower labour costs (efficiency-seeking) are more growth enhancing than resource-seeking FDI. Besides exploring the heterogeneous nature of FDI, chapter two has also brought to the fore the question of how well local firms can be integrated in FDI projects in order to facilitate knowledge and technology spillovers to local firms in host countries. Chapter three has furthered the debate on the determinants of FDI activity, providing evidence on the specific sectors through which foreign and domestic firms are most likely to undertake joint production in sub-Saharan Africa. This is particularly relevant for a region that has received fewer spillovers from FDI and little attention in the empirical literature on the ownership decisions of these firms. The sub-Saharan African region has attracted significant investments in high technology sectors in recent years, which are capital-intensive in nature and were mostly undertaken by joint venture firms formed between local firms and TNCs. With this pattern of FDI in mind, chapter three investigated whether foreign affiliates are more likely to integrate local firms in capital-intensive than labour-intensive projects in sub-Saharan Africa.

In trying to answer this question, chapter three exploited a large firm level data on manufacturing and services firms for 19 countries, which has not been extensively used in the empirical literature. The results showed remarkably consistent finding that there is greater likelihood of integrating local firms in capital-intensive FDI than in labour-intensive investments. This is further confirmed by a sensitivity analysis that allowed for different estimation techniques and different measures of the relative input investment of foreign affiliates and local firms used to determine how these investments influence firms' decisions to integrate in FDI projects. The

findings are consistent with the hypothesis of the study, and suggest that there is greater potential for productivity spillovers from FDI to domestic firms to be enhanced through non-extractive capital-intensive sectors in host countries.

Given the evidence presented in chapter three and the volume of investments attracted into host African countries in recent years, chapter four analyzed whether FDI has contributed to raising productivity growth of African countries. This chapter argued that the effect of FDI on productivity growth is not homogeneous, but varies across host African countries. Such heterogeneity in the impact of FDI is hypothesized to be explained by the differences in human capital capacity in absorbing foreign technology from FDI. This argument is premised on the view that the existence of reciprocal externality between FDI and human capital can explain the nonlinear interactions between these factors. From this perspective, it is expected that the effect of FDI on productivity growth could vary across countries depending on human capital capacity. A distinctive contribution of this chapter lies in consideration of host country heterogeneity in human capital capacity to determine whether the effect of FDI on productivity growth is conditional upon such capacity.

Considering these differences, chapter four exploited the variation in human capital capacity across countries. This allowed us to resolve the problem of nonlinearity not tackled in previous studies. In doing so, the study provided a comprehensive analysis of the effect of FDI on productivity growth, determining the threshold of human capital that enhances such growth impact on African economies. Taking advantage of country level data on productivity growth and human capital stock on 25 African countries over the period 1996-2011, this analysis showed strong support for the nonlinearity between FDI and productivity growth. The study revealed that FDI will not raise productivity growth unless host countries attain a threshold of 6.94 average years of schooling. Analyzing this threshold, the analysis showed that there is considerable heterogeneity in the growth effects of FDI. It revealed that host countries with human capital capacity well below this threshold will not experience productivity gains from FDI, unless human capital is enhanced to the threshold level. Conversely, those closer or above the threshold would realize significant productivity gains from these investments as further efforts are taken to enhance human capital. The results are in line with our hypothesis that there are differences in the impact of FDI on productivity growth across host countries, determined by

the variation in the human capital capacity of host African countries. The findings suggest that enhancing human capital capacity is vital to raise productivity spillovers from FDI in host African countries. Overall, the analysis revealed that only 7 out of a sample of 25 African countries used in the study-South Africa, Botswana, Gabon, Mauritius, Zimbabwe, Tunisia and Egypt-had attained the minimum threshold of 6.94 average years of schooling in 2010. This suggests that the effect of FDI on productivity growth will be stronger in these countries.

5.2 Policy Implications

There are important policy implications to be drawn from the findings of this thesis. The findings from chapter two indicate that there is heterogeneity in motivations and determinants of FDI between investors from African economies and the OECD and non-OECD emerging market economies. This outcome suggests that policies designed to attract FDI should take into account the specific characteristics of investors from these groups of economies. More sustainable FDI from the various sources can be encouraged through policies that promote market-seeking investments, possibly through targeted economic incentives to encourage investments in manufacturing and higher productivity services sectors. Such a policy can be accompanied by measures that enhance human capital capacity and tackle the specific technology requirements of these investors. The presence of low cost labour is also important to non-OECD emerging markets investors in non-resource rich countries. This finding points to the role of policy in encouraging more market-determined wages in host countries in order to attract these investments. By adopting different policy measures according to the specific characteristics of investors, host countries are more likely to be successful in attracting FDI from the different source economies into non-resource sectors and possibly offset the crowding-out impact of resource-seeking FDI into host African economies.

As foreign affiliates are more likely to integrate local firms in FDI projects through capital intensive than labour intensive activities, this finding points to an important role of policy in encouraging joint ventures between these firms in capital-intensive sectors. Arguably, joint venture ownership can facilitate knowledge and technology transfers to domestic firms and boost productivity in the host economy. However, the evidence presented in chapter three does not suggest that labour intensive investments should not be simultaneously encouraged. Instead, it

points to the fact that host countries can potentially benefit from non-natural resource oriented capital-intensive investments, if local skills are enhanced to leverage the technology embedded in higher quality FDI undertaken in capital-intensive sectors.

The composition of FDI attracted into host African countries matters for sustainable growth and development of these economies. For these countries to attract the appropriate form of FDI and adopt more sophisticated technology through joint ventures, licensing arrangements or direct purchase of such technologies, host countries need to enhance human capital capacity to absorb these technologies. This underlines the importance of promoting STEM education and skills to enhance the capacity of African countries to absorb high-tech FDI.

The benefit of human capital enhancement in attracting FDI and assimilating technology from these investments is reinforced in chapter four. The evidence suggests stronger effects of FDI on productivity growth for countries that have enhanced such capacity above the threshold of 6.94 average years of schooling. It reveals that there is heterogeneity in the impact of FDI on African economies, with FDI positively affecting productivity growth in countries that have attained this threshold, while countries well below the threshold will not maximize the benefits from these investments. From this perspective, one would conclude that it would be extremely helpful for host countries that have not achieved this threshold to enhance their human capacity as a first step towards attracting these investments. For countries with human capacity levels that are closer to or above such threshold, policies can be designed to simultaneously attract FDI and enhance human capital capacity.

5.3 Limitations and Suggestions for Future Research

This thesis provides important directions for consideration in future research works. In chapter two, the analysis was based on bilateral FDI stock between source and host countries, given that sectoral data was not available at the time of the analysis. It would be useful in future research to explore the factors influencing FDI into the different sectors of host economies in order to determine whether there are differences in these determinants when such data is available.

The analysis in chapter three is not without caveats. This paper hinges on the underlying assumption that joint ventures between foreign affiliates and local firms are more likely in

physical capital intensive sectors, such as manufacturing and less likely in labour-intensive sectors. However, with advancements in ICT and digital services, the manufacturing sector is gradually becoming less physical capital intensive as some investors in technologically advanced countries can now afford the costs of these services. Nonetheless, the theory sits well with the sub-Saharan African context where most countries are still lagging behind in terms of capacity to absorb technology. Additionally, this paper assumes that local firms contribute to FDI projects through human capital, as local managers have complete control over recruitment decisions in foreign affiliates. One needs to note that foreign affiliates operating in sub-Saharan Africa have contributed immensely to training of workers and managers in this region. There are also other channels through which local firms can benefit from superior technology, through licensing arrangements or direct purchase (see Nguyen et al, 2014), in addition to forming joint ventures with foreign affiliates.

It is also worth noting that information on foreign equity ownership did not allow for categorization of ownership into backward and forward integrating decisions of firms. It would be interesting in future research to consider how input investments of foreign and local firms affect both backward and forward integration decisions of these firms. Another caveat of this analysis is dealing with endogeneity issues due to reverse causality between FDI and skill intensity of the local workforce. While this issue is mitigated through the inclusion of industry and country fixed effects in the estimations, a fruitful avenue for extension of future research will be to explore the dynamics in the relationship between ownership structure and firms' input investments while dealing with endogeneity issues using panel data. Additionally, as noted in chapter three, the analysis relied on the results of the fractional response models which accurately capture the different ownership decisions of firms. Attempts to analyze such decisions using the estimates of the multinomial logit model were not successful, since the assumption of independence of irrelevant alternatives (IIA) was not fulfilled. It is important to also note that the data did not allow the estimation of a multinomial nested logit model as an alternative approach to analyzing this relationship.

Lastly, chapter four explored the role of human capital in explaining heterogeneity in the impact of FDI on productivity growth across African countries. Analyzing how other measures of absorptive capacity, such as the level of development of domestic financial markets and quality

of institutions, can explain the variation in the effect of FDI on productivity growth, will provide an interesting perspective to the underlying relationship between FDI and productivity growth.

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Appendix A: Appendix for Chapter 2

Appendix A 2.1: Description of variables

Variable	Description	Source
FDI –Dependent	Bilateral Inward FDI stock to host economies from source countries	UNCTAD (2014)
Real GDPs	Gross domestic product (constant 2005 US$)	World Bank (WDI)
Relative factor endowments	Difference in real GDP per capita between source and host countries.	WDI
Natural resources	Sum of fuel (% of merchandise exports) and ores and metals (% of merchandise exports); sum of oil rents (% of GDP) & mineral rents (% of GDP).	World Bank (WDI)
Control variables		
Surrounding Market potential	$SMP_i = \sum_{j=1}^{j} \frac{GDP}{dist_{ij}}$ sum of inverse-distance-weighted real GDP per capita of host countries in sample, excluding host country.	WDI and CEPII
Bilateral real exchange rate	$\frac{EXC_{it}/US\$}{EXC_{jt}/US\$} \times \frac{CPI_{jt}}{CPI_{it}}$	WDI
Exchange rate volatility	Standard deviation of bilateral real exchange rate	Own calculations using WDI data
Control of corruption	Estimate- over the range -2.5 (weak) and 2.5 (strong) governance performance.	World Bank (Kauffman)
Trade cost	Inverse of trade openness	Own calculations using WDI data
Financial development	Domestic credit to the private sector (% of GDP).	Global Financial Development database
Infrastructure	Information, Communication and Technology (ICT) index	AfDB (2013)
Agglomeration	Share of total inward FDI stock in GDP (%)	UNCTAD & WDI
Distance	Distance between cities weighted by the share of principal cities' population in total population.	CEPII
BIT	Dummy= 1 if bilateral investment treaty between source and host country entered into force, 0 otherwise.	UNCTAD
RTA	Dummy=1 if free trade agreement between host and source entered in force, or host belong to a customs union or an economic integration agreement, 0 otherwise.	WTO
Landlocked	Dummy=1 if host country is landlocked, 0 otherwise.	CEPII
Internal armed conflict	Dummy=1 if armed conflict is internal, 0 otherwise.	UCDP Dyadic Dataset Version 1 (2014)

Appendix A2.2: List of countries

Source country sample
OECD & other developed countries -Australia, Austria, Belgium, Canada, Croatia, Cyprus, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States of America.
Non-OECD Emerging Markets - Brazil, China, Cyprus, Hong Kong China, Croatia, India, Kuwait, Lebanon, Malaysia, Pakistan, Qatar, Russia, Saudi Arabia, Singapore and United Arab Emirates.
Intra-African Economies- Angola, Burkina Faso, Botswana, Cameroon, Cote d'lvoire, Democratic Republic of Congo, Egypt, Equatorial Guinea, Ethiopia, Gabon, Ghana, Kenya, Liberia, Libya, Madagascar, Mali, Morocco, Mauritius, Mozambique, Malawi, Namibia, Nigeria, Sudan, Senegal, Swaziland, Seychelles, Togo, Tanzania, Tunisia, Uganda, South Africa, Zambia and Zimbabwe.
Host country sample
Natural resource-rich -Algeria, Angola, Botswana, Cameroon, Central African Republic, Congo Republic, Democratic Republic of Congo, Chad, Equatorial Guinea, Gabon, Ghana, Guinea, Libya, Mauritania, Mozambique, Namibia, Niger, Nigeria, Sudan, Sierra Leone, Tanzania, South Africa, Zambia and Zimbabwe.
Non-resource rich-Burundi, Cote d'lvoire, Comoros, Cape Verde, Djibouti, Egypt, Ethiopia, The Gambia, Kenya, Liberia, Lesotho, Morocco, Madagascar, Mauritius, Malawi, Senegal, Sao Tome and Principe, Swaziland, Seychelles, Tunisia and Uganda.

Appendix A2.3: Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. LogFDI	1																
2. Log dist	-0.02	1															
3. RTA	0.20*	-0.07*	1														
4. BIT	0.26*	-0.03*	0.11*	1													
5. Trade	-0.05*	0.06*	-0.04*	-0.09*	1												
6. Log RER	-0.001	-0.19*	0.22*	-0.06*	0.11*	1											
7. ICT	0.31*	-0.06*	0.17*	0.19*	0.19*	0.27*	1										
8. Log size	0.03*	-0.49*	0.47*	-0.02	-0.22*	0.39*	0.24*	1									
9. Log sum GDP	0.27*	0.50*	-0.40*	0.21*	-0.03*	-0.30*	0	-0.71*	1								
10. REL	-0.04*	0.30*	-0.30*	0.08*	-0.20*	-0.47*	-0.36*	-0.40*	0.34*	1							
11. NRES	-0.04*	-0.06*	-0.08*	0.03*	-0.22*	0.03*	-0.08*	0.16*	0.12*	-0.03*	1						
11. SMP	0.11*	0.04*	0.04*	-0.02	0.40*	0.16*	0.43*	0.11*	0.05*	-0.41*	0.03*	1					
12. Credit	0.31*	0.01	0.24*	0.17*	-0.01	0.29*	0.55*	0.39*	-0.01	-0.29*	-0.19*	0.38*	1				
13. Corruption	0.14*	-0.04*	0.21*	0.03*	0.19*	0.32*	0.47*	0.20*	-0.20*	-0.28*	-0.49*	0.29*	0.57*	-0.02	1		
14. Lag FDI	-0.01	0.04*	-0.05*	-0.03*	0.25*	0.014	-0.15*	-0.22*	0.06*	0.11*	0.11*	-0.02	-0.08*	-0.04*	-0.09*	1	
15. Conflict	-0.01	-0.02	-0.07*	0.03*	-0.17*	-0.09*	-0.15*	-0.04*	0.10*	0.08*	0.15*	-0.13*	-0.16*	0.08*	-0.24*	0	1

Note: "*" denotes significant at the 5 percent.

Appendix A2.4: Differences between Intra-African and non-OECD FDI

Variables	(1) Resource rich	(2) Non-resource rich
Non-OECD emerging markets dummy	-3.489	-2.895
	(5.783)	(2.444)
Lagged log relative market size	1.092*	0.830
	(0.618)	(0.566)
Interaction between non-OECD dummy & lagged log relative market size	-0.366	0.482
	(0.904)	(0.653)
Lagged log sum real GDP	4.861***	2.648***
	(0.890)	(0.788)
Lagged oil and mineral rents	-0.096***	
	(0.034)	
Interaction between non-OECD dummy & lagged oil and mineral rents	0.042	
	(0.040)	
Lagged relative factor endowment	0.150	-0.029
	(0.161)	(0.264)
Interaction between non-OECD dummy & lagged relative factor endowment	-0.224	0.075
	(0.164)	(0.264)
Lagged surrounding market potential	-0.006	0.038**
	(0.008)	(0.018)
Bilateral investment treaty dummy	-1.010**	0.018
	(0.495)	(0.620)
Lagged trade openness	-0.003	-0.005
	(0.005)	(0.004)
Lagged log bilateral real exchange rate	0.284**	0.351
	(0.132)	(0.262)
Lagged electricity infrastructure index	-0.001**	0.000
	(0.000)	(0.001)
Lagged domestic credit to the private sector to GDP	-0.011	0.004
	(0.006)	(0.018)
Lagged control of corruption index	-1.115***	-0.928*
	(0.243)	(0.514)
Internal armed conflict dummy	0.269	0.104
	(0.180)	(0.186)
Landlocked dummy	1.638*	3.662*
	(0.977)	(1.999)
Log distance	-2.618	1.066
	(4.890)	(2.887)
Constant	-96.963***	-71.305**
	(32.625)	(31.362)
Observations	1,536	788
Number of country-pairs	191	127
Time effects	Yes	Yes
Over-identifying restrictions (p-value)	0.63	0.08

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered around country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log of relative market size, interaction between OECD dummy & lagged log of relative market size, lagged log sum real GDP, lagged oil and mineral rents, interaction between OECD dummy & lagged log oil and mineral rents, lagged relative factor endowments, interaction between non-OECD dummy and lagged relative factor endowment, lagged domestic credit to GDP, lagged control of corruption index, internal armed conflict and time dummies. Time-varying exogenous regressors: bilateral investment treaty, lagged log bilateral exchange rate, lagged trade openness, lagged surrounding market potential and lagged electricity infrastructure index. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressors are landlocked dummy and non-OECD dummy.

Appendix A2.5: Differences between Intra-African and OECD FDI

Variables	(1) Resource rich	(2) Non-resource rich
OECD dummy	27.589*	5.273
	(14.211)	(7.982)
Lagged log relative market size	1.018	-0.172
	(0.624)	(0.967)
Interaction between OECD dummy & lagged log relative market size	0.466	1.321
	(0.838)	(1.315)
Lagged log sum real GDP	1.796**	1.093
	(0.792)	(1.436)
Lagged oil and mineral rents	-0.092***	
	(0.035)	
Interaction between OECD dummy & lagged oil and mineral rents	0.065*	
	(0.036)	
Lagged relative factor endowment	0.196	-0.125
	(0.155)	(0.277)
Interaction between OECD dummy & lagged relative factor endowment	-0.350**	-0.001
	(0.166)	(0.272)
Lagged surrounding market potential	-0.010**	0.033*
	(0.004)	(0.020)
Lagged trade openness	-0.001	-0.000
	(0.003)	(0.003)
Lagged log bilateral real exchange rate	0.031	-0.269
	(0.182)	(0.171)
Lagged domestic credit to the private sector to GDP	-0.005	-0.016
	(0.004)	(0.014)
Bilateral investment treaty dummy	0.783***	-0.226
	(0.304)	(0.286)
Lagged electricity infrastructure index	0.000	-0.001
	(0.000)	(0.001)
Lagged control of corruption index	-0.031	-0.559*
	(0.220)	(0.302)
Internal armed conflict dummy	0.145	-0.041
	(0.148)	(0.199)
Landlocked dummy	2.788	-0.097
	(1.984)	(0.846)
Log distance	-18.402	1.560
	(12.363)	(6.514)
Constant	98.002	-36.646
	(90.474)	(85.511)
Observations	2,660	1,680
Number of country-pairs	324	234
Time fixed effects	Yes	Yes
Over-identifying restrictions (p-value)	0.41	0.24

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered around country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log of relative market size, interaction between OECD dummy & lagged log of relative market size, lagged oil and mineral rents, interaction between OECD dummy & lagged log oil and mineral rents, lagged relative factor endowments, interaction between OECD dummy and lagged relative factor endowment, lagged domestic credit to GDP, lagged control of corruption index, bilateral investment treaty, internal armed conflict and time dummies. Time-varying exogenous regressors: lagged log sum real GDP, lagged log bilateral exchange rate, lagged trade openness, lagged surrounding market potential and lagged electricity infrastructure index. Time-invariant endogenous regressor is log distance and time-invariant exogenous regressors are landlocked dummy and OECD dummy.

Appendix A2.5: Differences between South Africa and other African Countries (Intra-African FDI)

Variables	(1) Intra-Africa	(2) Non-OECD Emerging Markets	(3) OECD
SA dummy	-7.281	1.755	-9.817***
	(5.287)	(4.122)	(2.917)
Lagged log relative market size	0.672	1.687***	2.844***
	(0.754)	(0.632)	(0.462)
Interaction between SA dummy & lagged log relative market size	-0.590	-1.545	1.548
	(0.824)	(1.264)	(1.379)
Lagged log sum real GDP	4.029***	4.954***	3.464***
	(0.700)	(0.504)	(0.846)
Lagged relative factor endowment	0.050	-0.013	-0.086***
	(0.225)	(0.025)	(0.025)
Interaction between SA dummy & lagged relative factor endowment	-0.083	-0.141***	0.097*
	(0.224)	(0.045)	(0.052)
Lagged oil and mineral rents	-0.085**	-0.056**	-0.035***
	(0.035)	(0.022)	(0.009)
Interaction between SA dummy & lagged oil and mineral rents	-0.298***	-0.185	-0.042
	(0.102)	(0.197)	(0.082)
Lagged surrounding market potential	0.020	-0.015	-0.017***
	(0.019)	(0.010)	(0.005)
Bilateral investment treaty dummy	0.189	-0.848	0.460*
	(0.223)	(0.555)	(0.239)
Lagged trade openness	-0.007*	-0.007	0.001
	(0.004)	(0.004)	(0.002)
Lagged electricity infrastructure index	-0.001	-0.000	0.001**
	(0.000)	(0.001)	(0.000)
Lagged log bilateral real exchange rate	0.305*	-0.291	-0.512***
	(0.176)	(0.323)	(0.113)
Lagged domestic credit to the private sector to GDP	-0.003	-0.002	0.001
	(0.004)	(0.010)	(0.006)
Lagged control of corruption index	-0.707**	-1.613***	-0.334
	(0.340)	(0.366)	(0.229)
Landlocked dummy	11.393	3.898	-0.417
	(8.713)	(2.691)	(0.786)
Log distance	19.624	-39.509***	8.184***
	(15.776)	(14.733)	(2.078)
Constant	-249.122**	228.102*	-150.425***
	(124.342)	(129.135)	(33.191)
Observations	1,134	1,190	3,206
Number of country-pairs	163	155	395
Time fixed effects	No	No	No
Over-identifying restrictions (p-value)	0.60	0.15	0.13

Note: Dependent variable is log bilateral inward FDI stock. '*', '**', and '***' indicate significant parameters at 10, 5, and 1%, respectively. Robust standard errors are reported in parentheses and clustered around country-pairs. Time-varying endogenous regressors in Hausman-Taylor model: Lagged log of relative market size, interaction between OECD dummy & lagged log of relative market size, lagged oil and mineral rents, interaction between OECD dummy & lagged log oil and mineral rents, lagged relative factor endowments, interaction between OECD dummy and lagged relative factor endowment, lagged trade openness, lagged surrounding market potential, lagged domestic credit to GDP, lagged control of corruption index and internal armed conflict dummy. Time-varying exogenous regressors: lagged log sum real GDP, lagged log bilateral exchange rate, bilateral investment treaty and lagged electricity infrastructure index. Time-invariant endogenous regressors are log distance and SA dummy and time-invariant exogenous regressor is landlocked dummy.

Appendix A3.1: Foreign Ownership and Input Intensity of firms across sectors

Country	2-Digit ISIC Sectors	Foreign ownership (%)	Physical capital intensity (US$/L)	Skill intensity of local workforce (%)
Kenya	Manufacturing (Low-tech)	39	70,206	15
Kenya	Manufacturing (Medium-tech)	42	127,877	13
Kenya	Manufacturing (High-tech)	47	277,384	16
Kenya	Electricity, gas and water supply	42	1,291,789	17
Kenya	Construction	30	576,826	28
Lesotho	Manufacturing (Low-tech)	56	2,975	12
Lesotho	Manufacturing (Medium-tech)	60	8,691	5
Lesotho	Manufacturing (High-tech)	42	7,541	16
Lesotho	Electricity, gas and water supply	100	10,386	10
Lesotho	Construction	18	4,120	14
Madagascar	Manufacturing (Low-tech)	43	11,614	14
Madagascar	Manufacturing (Medium-tech)	48	17,208	7
Madagascar	Manufacturing (High-tech)	44	24,482	22
Madagascar	Electricity, gas and water supply	50	62,810	33
Madagascar	Construction	65	6,042	17
Malawi	Manufacturing (Low-tech)	13	16,862	14
Malawi	Manufacturing (Medium-tech)	35	63,060	18
Malawi	Manufacturing (High-tech)	34	39,624	25
Malawi	Electricity, gas and water supply	0	N/A	7
Malawi	Construction	50	58,892	9
Mali	Manufacturing (Low-tech)	7	23,280	14
Mali	Manufacturing (Medium-tech)	52	33,953	19
Mali	Manufacturing (High-tech)	50	46,176	12
Mali	Electricity, gas and water supply	29	2,983,692	31
Mali	Construction	21	38,430	31
Mozambique	Manufacturing (Low-tech)	36	8,576	11
Mozambique	Manufacturing (Medium-tech)	53	12,610	13
Mozambique	Manufacturing (High-tech)	44	16,454	11
Mozambique	Electricity, gas and water supply	0	45,738	37
Mozambique	Construction	34	6,657	14

Source: Own calculations based on UNIDO (2010)

Appendix A3.1: Foreign Ownership and Input Intensity of firms across sectors (Continued)

Country	2-Digit ISIC Sectors	Foreign ownership (%)	Physical capital intensity (US$/L)	Skill intensity of local workforce (%)
Niger	3. Manufacturing (Low-tech)	10	22,997	18
Niger	4. Manufacturing (Medium-tech)	22	62,587	31
Niger	5. Manufacturing (High-tech)	68	11,724	7
Niger	6. Electricity, gas and water supply	17	3,201,063	39
Niger	7. Construction	0	25,938	61
Nigeria	3. Manufacturing (Low-tech)	14	38,568	16
Nigeria	4. Manufacturing (Medium-tech)	20	31,712	16
Nigeria	5. Manufacturing (High-tech)	18	80,747	21
Nigeria	6. Electricity, gas and water supply	0	36,140	38
Nigeria	7. Construction	20	43,516	39
Rwanda	3. Manufacturing (Low-tech)	23	25,260	17
Rwanda	4. Manufacturing (Medium-tech)	41	20,551	12
Rwanda	5. Manufacturing (High-tech)	57	6,946	19
Rwanda	7. Construction	25	162,795	21
Senegal	3. Manufacturing (Low-tech)	21	42,272	19
Senegal	4. Manufacturing (Medium-tech)	26	100,478	21
Senegal	5. Manufacturing (High-tech)	37	532,492	15
Senegal	6. Electricity, gas and water supply	40	190,283	8
Senegal	7. Construction	34	21,793	31
Tanzania	3. Manufacturing (Low-tech)	25	355,097	16
Tanzania	4. Manufacturing (Medium-tech)	42	21,379	12
Tanzania	5. Manufacturing (High-tech)	24	36,531	15
Tanzania	6. Electricity, gas and water supply	0	96,994	28
Tanzania	7. Construction	8	20,618	36
Uganda	3. Manufacturing (Low-tech)	39	74,321	20
Uganda	4. Manufacturing (Medium-tech)	41	29,434	16
Uganda	5. Manufacturing (High-tech)	59	28,500,000	12
Uganda	6. Electricity, gas and water supply	100	23,015	7
Uganda	7. Construction	51	42,283	22
Zambia	3. Manufacturing (Low-tech)	23	18,270	10
Zambia	4. Manufacturing (Medium-tech)	33	55,816	10
Zambia	5. Manufacturing (High-tech)	29	17,941	16
Zambia	6. Electricity, gas and water supply	0	443,344	89
Zambia	7. Construction	33	19,177	15

Source: Own calculations based on UNIDO (2010)