The effect of foreign direct investment on growth in Sub-Saharan Africa

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Abstract

Many studies have attempted to estimate the impact of foreign direct investment (FDI) on growth around the world, but very few have focused on Sub-Saharan Africa. Accordingly, this thesis explores the effect of FDI on economic growth in the region, using data from 43 countries over the period 1980-2009.

I employ ordinary least squares regressions with country fixed effects to answer my primary research question, using real GDP growth as the dependent variable and gross FDI inflows as a percentage of GDP as the key explanatory variable. My regressions control for time-variant characteristics across the countries in my sample, such as terms of trade, trade openness, and government expenditure. All variables are averaged over non-overlapping three-year intervals to reduce business cycle effects, and FDI is lagged to address endogeneity.

My results indicate that FDI is associated with higher growth in Sub-Saharan Africa, particularly after the exclusion of outliers. I test for a difference in the effect of FDI on growth in mineral-rich versus mineral-poor countries, and do not find that there is a statistically significant difference between the two sets of countries. For robustness, I repeat my analysis on five-year averaged data, and find these results to be consistent with those found using the triennial data. Thus, I conclude that FDI has had a positive effect on growth in Sub-Saharan Africa, and that African policy makers are justified in seeking FDI as a way to accelerate growth in the future.

Keywords: Foreign Direct Investment; Economic growth; Sub-Saharan Africa

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Contents

1 Introduction

The third (and current) wave of financial globalization is generally considered to have begun in the 1980s (Collier, Dollar and World Bank 2002). What has made this wave particularly special is the rapid growth in international trade and investment that has been experienced across the globe. Foreign direct investment (FDI), defined as "investment made to acquire a lasting interest in or effective control over an enterprise operating outside of the economy of the investor" (International Monetary Fund 1993), has increased exponentially in developing countries. According to data from the United Nations Conference on Trade and Development (UNCTAD), gross inward FDI stocks in these nations have risen from $297 billion in 1980 to $5.1 trillion in 2009, a remarkable seventeen-fold increase[1].

In Sub-Saharan Africa as a whole, total inward FDI stock has increased from $29.8 billion in 1980 to $317.2 billion in 2009, a comparatively smaller increase of ten-fold. This indicates that the region has not been as successful at attracting FDI as other parts of the developing world. Nevertheless, FDI has become an important part of the discourse on development in Africa. The New Partnership for Africa's Development (NEPAD), a program set up by a group of heads-of-state from across the continent in 2001, remarks that in order to "achieve the estimated 7 per cent annual growth rate needed to meet the IDGs (International Development Goals) - particularly, the goal of reducing by half the proportion of Africans living in poverty by the year 2015 - Africa needs to fill an annual resource gap of 12 per cent of its GDP, or US $64 billion"

[1] UNCTAD 2012, author's calculations. All subsequent figures are based on data from UNCTAD, unless otherwise stated.

(NEPAD 2001). NEPAD clearly states that the "the bulk of the needed resources will have to be obtained from outside the continent," and accordingly, seeks to increase the amount of non-aid private capital flows and foreign investment to Africa. Proposed plans to help accelerate this process include initiatives to repair Africa's reputation as an investment-worthy location, by working with national governments to lower risks which are commonly associated with investing on the continent, such as poor property rights and inadequate regulatory frameworks.

Given the enthusiasm with which FDI is being sought in Africa, it is important to step back and assess the actual impact of FDI on growth in the continent thus far. If FDI has not successfully enhanced economic growth in the past, then African policy makers should not expect a sudden improvement in its performance in the future. Otherwise, if FDI has indeed had a positive effect on growth, then policy makers are at least partially justified in pursuing initiatives to attract FDI as they hope for sustained economic progress. This estimation is precisely what this study aims to accomplish.

The selection of Sub-Saharan Africa as the region for consideration in this study is particularly important. Despite the numerous studies on the FDI-growth nexus, there is a significant dearth of literature on FDI focusing solely on Sub-Saharan Africa. A quick search of the Econlit database reveals that the few papers which highlight FDI in Africa either examine the determinants of FDI to the region or are case studies of the performance of FDI in particular countries. This shortage presents me with the opportunity to explore the effect of FDI on growth in the region as a whole, and to contribute to the small body of existing literature on the region.

To study the effect of FDI on economic growth in Sub-Saharan Africa, I employ ordinary least squares regressions with fixed effects on pooled panel data covering forty-three countries over the period 1980-2009. Blonigen and Wang (2005) find that the inappropriate pooling of developed and developing country data has caused the estimated impact of FDI on growth and domestic investment to be obscured in many FDI-growth studies, because FDI seems to have a higher effect on growth in developing countries than in developed countries. Since the vast majority of countries in Sub-Saharan Africa are considered to be developing countries in income terms (World Bank 2012a), I consider pooling them in this study to be a valid approach[2].

I average the data over three-year periods to lessen business cycle effects, and lag my measure of FDI in all regressions in order to reduce possible endogeneity. My results indicate that FDI is positively associated with economic growth in Africa, particularly after the exclusion of countries with extreme values of FDI and growth. I also find that the estimated impact of FDI has not been significantly different in mineral-rich countries, as opposed to their mineral-poor counterparts. These findings provide some supportive context for the FDI-attracting efforts of NEPAD and the governments of African countries.

1.1 Outline

The paper proceeds as follows: Section 2 gives a brief overview of FDI in Sub-Saharan Africa, while Section 3 summarizes some selected literature on FDI and growth. Section 4 outlines the theoretical framework, and explains the testable hypotheses that

[2] Currently, the only exception is Equatorial Guinea, considered to be a high-income economy because GNI per capita exceeds US $20,000. The country is however considered to be a developing nation in other respects, since it has relatively low human development and extremely high income inequality.

result. Section 5 describes the data used in my empirical analysis, while Section 6 summarizes the empirical methodology. Section 6 discusses the results of my analysis and some robustness checks. Finally, Section 7 concludes.

2 Brief overview of FDI in Sub-Saharan Africa

Sub-Saharan Africa has historically received the smallest amount of FDI globally. The region accounted for only 5.1% of total world FDI inflows in 2009, compared to 26.0% for Asia and 11.9% for Central and South America (UNCTAD 2012). When compared to GDP levels, this figure is less surprising; since the region accounts for just 2.44% of World GDP, it is reasonable to expect that it should have a smaller share of global FDI than other regions. Nevertheless, inward FDI flows as a share of African GDP have increased rapidly over the course of the years, rising from 0.09% in 1980 to 1.84% in 2000, and accelerating even further to 4.22% in 2009.

There are several possible explanations for the increase in FDI inflows seen in Africa over the past few decades. After the 1960s, when most African countries gained independence, nations were initially reluctant to open up their borders to foreign investment, driven by post-colonial nationalism and wary of the wounds dealt by extractive colonialism. Many countries enforced capital controls and put indigenization or nationalization policies in place to prevent dependence on foreign resources and ensure national economic independence. In Nigeria, for example, the Nigerian Enterprises Promotion Decree was promulgated in 1972, with the explicit aims of increasing ownership of businesses among Nigerian citizens and reducing foreign participation in certain sectors of the economy (Federal Republic of Nigeria, 1972). Similar policies were

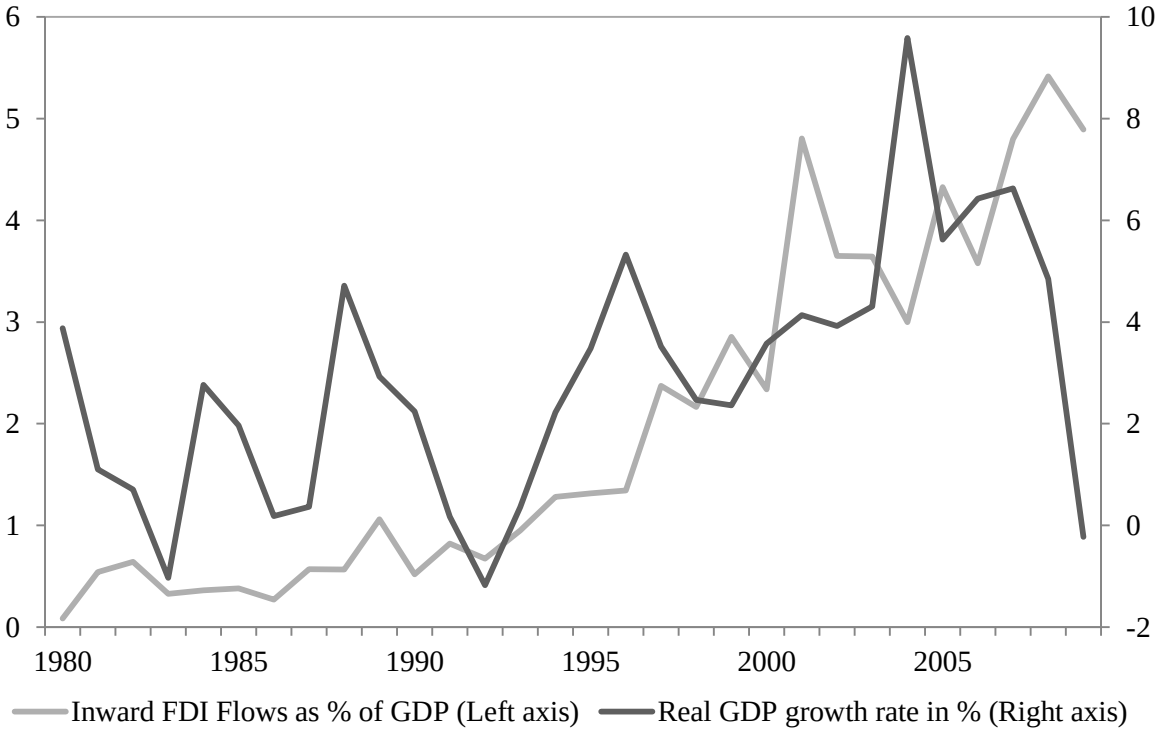
put in place in countries like Ghana, Kenya, Tanzania, Uganda, Zambia, and Zimbabwe (Ndongko 1980). These policies collectively led to low levels of foreign investment across the continent in the 1970s and 1980s.

In the 1980s and 1990s, African countries started to open up their borders and remove capital controls and restrictions on foreign investment (UNCTAD 1998). Indigenization decrees were repealed in many countries, paving the way for increased FDI in the 1990s and beyond. To continue with the previous example, the Nigerian Enterprises Promotion Decree was abolished in 1995, followed by the enactment of the Nigerian Investment Promotion Commission (NIPC) Act later in the same year. The NIPC was tasked with the precise objective of initiating and supporting measures which would "enhance the investment climate in Nigeria for both Nigerian and non-Nigerian investors" among other things (Nigerian Investment Promotion Commission 2012). This signaled a distinct shift in the country's attitude towards foreign investment.

As mentioned earlier, the African Union, in partnership with the United Nations, set up a program called The New Partnership for Africa's Development (NEPAD) in 2001, tasked with the objective of improving economic conditions in African economies. NEPAD has emphasized that foreign direct investment is a crucial component of the development process, and has been working with African countries to create conducive infrastructural and legal environments for both foreign and domestic investors. It is plausible that the formation of NEPAD prompted the increase in FDI inflows to Africa seen in the 2000s, as it may have indicated that African governments were increasingly accommodative of foreign investment and were committed to improving the continent's growth prospects.

The rapid rise in FDI inflows that African nations experienced in the 2000s was further bolstered by rising commodity prices. As oil prices reached $60 per barrel in 2005, Nigeria and Angola, Sub-Saharan Africa's top oil exporters, collectively saw inward FDI flows exceed $10 billion. In the five years after 2005, Angola experienced average GDP growth of about 12%, compared to 7% in the preceding five years. Though we can attribute some of this remarkable growth to the commodity boom, it is distinctly possible that the nation's higher growth was led by the prior boost in FDI.

Figure 1: GDP growth and FDI in Sub-Saharan Africa (Total)



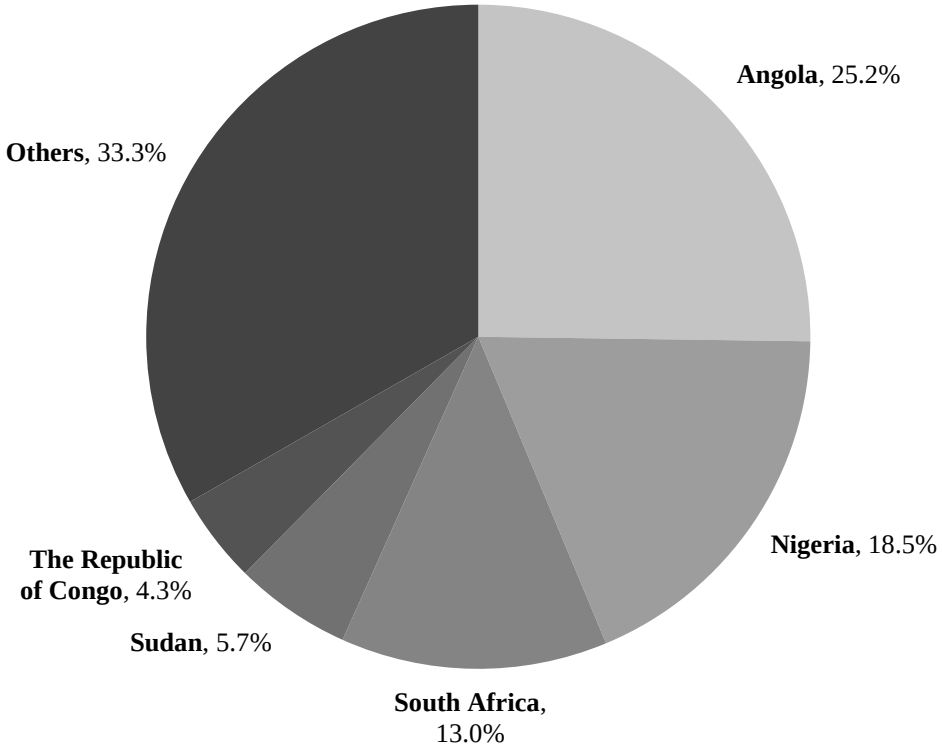
Source: UNCTAD (2012)

To extend this preliminary analysis beyond Angola, Figure 1 compares annual FDI inward flows as a percentage of GDP to real GDP growth in Sub-Saharan Africa

over the past 30 years. Looking at the general trend in GDP growth, we can see that growth is generally higher in the years following 1995, corresponding with the increase in FDI that has been discussed thus far. This indicates that there is some positive correlation between FDI and GDP growth in Sub-Saharan Africa, as the surge in FDI in the 1990s and 2000s corresponds to higher growth in the years that follow.

It is worth highlighting that FDI inflows to Africa are concentrated in a select group of countries. The largest five recipients of FDI over the past thirty years (Angola, Nigeria, South Africa, Sudan and The Republic of Congo) have accounted for an astonishing two-thirds (66.7%) of total FDI to Sub-Saharan Africa, as shown in Figure 2 below. This indicates that there is a tendency for FDI to flow to countries with abundant mineral resources; Angola, Nigeria, Sudan and The Republic of Congo are oil exporters, while South Africa exports other minerals such as gold, diamonds, and coal. Asiedu (2006) confirms this observation, finding that in addition to political stability, market size and good infrastructure, natural resource availability is a key determinant of FDI inflows to African countries. Keeping this in mind, I test to see if there is a difference in the performance of FDI in mineral-rich (or mineral-dependent) economies compared to mineral-poor economies. This approach is further supported by arguments made by Wang (2002) and Alfaro (2003), which are discussed in more detail in Section 3.

Figure 2: Country shares of FDI flows to Sub-Saharan Africa (1980-2010)



Source: UNCTAD (2012), author's calculations.

In summary, Africa has seen a considerable rise in FDI inflows over the past few decades. FDI inflows have increased from $400 million in 1980 to $60.2 billion in 2009, rising by a factor of fifteen. Over the past 30 years, real GDP across the continent has doubled, rising from about $505 billion in 1980 to $1,196 billion in 2009. This provides some a priori evidence that there is a positive correlation between GDP growth and FDI inflows.

3 Literature review

Though my thesis focuses on FDI in Sub-Saharan Africa, this section gives a brief introduction to the body of economic literature that has explored the effect of FDI on growth at a macroeconomic level. Due to the fact that few studies actually focus solely on FDI in Sub-Saharan Africa, I highlight some of the typical studies exploring the FDI-growth nexus regardless of geographical scope. Subsequently, I review a few of the studies which highlight FDI in Africa.

3.1 Does FDI lead to growth?

The results of macroeconomic studies on FDI and growth have generally been mixed. Though most studies find some positive correlation between FDI and growth, these results are not always significant. Carkovic and Levine (2005) attempt to estimate the impact of FDI on growth, using data from seventy-two developing and developed countries. Their paper uses two related samples to test the hypothesis that FDI inflows affect growth. Firstly, the authors use cross-sectional data by averaging the data for each country over the full time frame under consideration, and then modify the data by averaging over five-year intervals to exploit time variation. After controlling for variables such as existing economic conditions, the level of human capital and financial development, the authors find that FDI does not exert an independent, positive effect on growth. A different sample specification (developing countries only) and a different dependent variable (the log level of GDP) also yield unchanged results, leading the authors to conclude that inward FDI inflows have no robust effect on host country economic growth.

Other studies have emphasized the importance of host country characteristics in allowing the absorption of FDI's beneficial effects. Balasubramanyam et al (1996) introduce the idea that FDI might have different effects on growth in countries pursuing export-promoting versus import-substituting policies, and find that FDI has a higher effect on growth in export-promoting countries. Blomstrom et al. (1992) find that FDI has a significant effect on growth in higher-income developing countries, suggesting that countries have to pass a certain income threshold in order to benefit from FDI.

Borensztein et al (1998) examine the effect of foreign direct investment on economic growth in sixty-nine developing countries, finding that while FDI is positively correlated with real per capita GDP growth, the relationship is modified when levels of human capital are taken into account. In particular, the coefficient of FDI is larger when countries have higher levels of human capital (measured as the average years of secondary schooling for each country's male population), leading the authors to conclude that countries with more educated workforces are better equipped to take advantage of the advanced technologies that might be gained as a result of FDI.

Given that these papers specify that FDI promotes growth only under very specific conditions, other economists have considered the possibility that not all types of FDI affect growth equally. Nunnenkamp and Spatz (2003) outline a few different objectives for which multinational corporations invest outside of their home countries. Resource-seeking objectives are evident when firms invest in countries with a key resource (such as oil or cocoa); efficiency-seeking objectives are evident when firms invest in countries with comparative advantages (lower labor costs, for example); and market-seeking objectives are evident when firms invest in countries in order to access

local markets (for example, investments in telecommunications or banking). These three different objectives roughly correspond to FDI in the primary, manufacturing, and services sectors. Because of these different objectives, it is possible that the effect of each type of FDI on growth might vary as well.

Nunnenkamp and Spatz (2003) suggest that efficiency-seeking FDI is most likely to lead to economic growth due to the spillover of technology and know-how. By contrast, resource-seeking FDI in the primary sector tends to be concentrated in "enclaves dominated by foreign affiliates with few linkages to the local product and labor markets", and thus might not lead to economic growth, despite the "large up-front transfer of capital, technology and know-how, and… high foreign exchange earnings" involved. Market-seeking FDI is projected to have a similar effect, since it might benefit local markets by "introducing new products and services, by modernizing local production and marketing and by increasing the level of competition in the host economies" on one hand, but might crowd out local competitors. Due to these possibilities, it is possible that empirical studies that use only aggregated figures in their analysis might be misstating the effect of FDI on growth.

Alfaro (2003) addresses this concern by exploring the relationship between economic growth and sectoral FDI in a group of forty-seven developing countries. The study finds that while total FDI has an ambiguous effect on the real per capita GDP growth rate, manufacturing sector FDI has a positive, significant effect on growth. FDI in the primary sector has a significant, negative effect on growth, while FDI in the service sector has a negative, but insignificant effect on growth. Wang (2002) reaches similar conclusions in a study which focuses on the effect of sectoral FDI in twelve Asian

economies. The study finds that aggregated FDI has a positive effect on growth, and more specifically, that manufacturing FDI has a greater positive effect on growth and primary sector FDI has a negative effect on growth.

Alfaro (2003) partially reaffirms my motivation for exploring FDI in Sub-Saharan African countries. While the study covers a range of developing and developed countries, Nigeria is the only Sub-Saharan African country that appears in the forty-seven country sample. Though the exclusion of other Sub-Saharan African countries might have been due to lack of data availability for the variables which the author sought to emphasize, it still highlights the gap in research on FDI in Sub-Saharan African countries which this thesis addresses. On a more important note, the study's results indicate that it is important to account for the fact that many countries in the Sub-Saharan African region might attract FDI flows focused in the primary sector, due to their abundance of mineral and natural resources. In my analysis, I do this by testing if the impact of FDI in mineral-rich countries is different than in mineral-poor countries, since disaggregated FDI data for African countries are unavailable.

3.2 FDI in Africa

As stated earlier, few papers study the effect of FDI in Africa or Sub-Saharan Africa. Of the few, Akinlo (2003) considers the effect of FDI in Africa using pooled annual data from twelve countries[3]. The results in this study indicate that that twice-lagged FDI has a positive effect on growth, suggesting that it takes some time for the effects of FDI accumulation to be felt. As a next step, the author then attempts to identify

[3] Botswana, Cote d'Ivoire, Egypt, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, Swaziland, Tunisia and Zimbabwe.

the precise channel through which FDI impacts growth, and finds that FDI primarily affects growth through capital accumulation, as opposed to increasing productivity.

Brambila-Macias and Massa (2010) take a different approach by considering the effects of different types of capital inflows on growth in a select group of countries in Sub-Saharan Africa. They distinguish between FDI, portfolio equity flows, bond inflows and cross-border bank lending as forms of capital inflows, and limit their sample to fifteen countries[4] from the period of 1980-2008. The study finds that both FDI and cross-border bank lending have significant, positive impacts on growth, even after controlling for other determinants of growth, such as government spending and trade openness. By further restricting the sample to exclude South Africa and Nigeria, (Sub-Saharan Africa's largest economies by GDP, as well as the two of the largest recipients of FDI in nominal terms)[5], the paper finds that the coefficient of FDI is positive and still significant at the 1% level. While this study highlights the importance of FDI in the Sub-Saharan African region, it is essential to note that it does not include other important variables which are supposed to affect growth (e.g. domestic investment), and thus, the results should be interpreted with caution.

In attempting to estimate the impact of FDI on growth in Africa, my study supplements the work of Akinlo (2003) and Brambila-Macias and Massa (2010) by employing a much larger dataset than either study. While I do not attempt to identify the

[4] Botswana, Cameroon, Cape Verde, Ghana, Kenya, Malawi, Nigeria, Mauritius, Mozambique, South Africa, Sudan, Swaziland, Tanzania, Uganda and Zambia

[5] According to 2009 estimates published by UNCTAD, Nigeria and South Africa received inward FDI flows of $6.1 billion and $5.4 billion respectively; these figures were exceeded only by Angola's FDI inflows of $11.7 billion.

precise channel through which FDI affects growth or compare the effect of FDI to other types of capital inflows, I focus on the additional question of whether the impact of FDI varies between economies which are mineral-rich versus those which are not. I also modify my data to account for business cycle effects by averaging over three- and five-year intervals, which neither study does.

3.3 Endogeneity

Thus far, I have not mentioned the problem posed by possible simultaneity between FDI and growth in the literature. This is important because there is a lack of consensus on the direction of causality between FDI and economic growth. The argument for causation flowing from growth to FDI inflows posits that countries experiencing higher levels of growth also present higher returns to investment and more profit opportunities for firms. All things being equal, investors move resources into such economies in order to reap these more attractive returns, implying that faster economic growth attracts higher FDI. In response to this problem, Choe (2003) tries to estimate the direction of causality between economic growth and FDI by using a series of Granger causality tests. Using a sample of eighty countries in the period from 1972 to 1995, this study finds that FDI and economic growth Granger-cause each other, with slightly more evidence for causation flowing from economic growth to FDI than vice versa.

The study does not test the for causality of different specifications of the data (for example, by separating developing countries from developed countries, or rapidly growing countries from their slower growing counterparts), which might have yielded even more interesting results. In any case, the results indicate that it is still valid to consider the relationship between FDI and growth, but that it is crucial to be aware of

possible simultaneity between the two variables, and be able to account or control for this characteristic. Most studies have attempted to account for endogeneity by including lagged values of FDI in their regressions or using two standard least squares regressions. Because it is difficult to identify good instruments, I account for endogeneity by lagging FDI, as done in Wang (2002) and briefly explain some justification for doing so in Section 7.

4 Theoretical framework

4.1 Why should FDI affect growth?

There are two major theories that explain why FDI should have a positive impact on growth: the capital formation theory and the technological spillovers theory. The capital formation theory, as one might predict, emphasizes FDI's role as capital. According to the neoclassical growth model put forth by Solow (1956), an increase in the capital stock available in an economy leads to an increase in production, which then corresponds to an increase in the growth rate of output. Since FDI is a source of physical (and financial) capital to the host country, increases in FDI should raise the overall level of capital stock available for production. Thus, under the neoclassical framework, an increase in foreign-owned capital stock then leads to higher growth, since FDI is additional capital. Assuming diminishing returns to capital, however, any increase in the growth rate observed after an increase in the stock of FDI is not sustained in the long run. This implies that within the neoclassical framework, FDI acts as a driver of growth in the short term (Brems 1970).

FDI is generally believed to be more stable and beneficial than capital inflows such as direct portfolio investment and cross-border bank lending. Lipsey (1999) confirms that foreign direct investment is less susceptible to reversals than portfolio investment, making it a more reliable source of capital inflows to developing countries. Furthermore, the International Monetary Fund's official definition of FDI as "investment made to acquire a *lasting* interest in or effective control over an enterprise operating outside of the economy of the investor [emphasis added]" explicitly reflects this long-term quality. Because of its perceived stability, FDI is considered to be in a better position to contribute meaningfully to host country growth.

Beyond direct capital formation, FDI can exert an effect on economic growth through the technological/knowledge spillovers channel. FDI's projected role as a diffuser of technology or knowledge implies that it can have a direct effect on growth (Borensztein et al 1998), especially within the framework of endogenous growth theory, which emphasizes the accumulation of knowledge as the driver of long-run economic growth. Kinoshita (1999) explains that the technology diffusion process can take on any of four different forms: the imitation effect, the training effect, the linkages effect, and the competition effect. As firms from developed countries set up subsidiaries or factories in developing countries, these firms might introduce more efficient/advanced technologies to local markets. Through contact in the marketplace, local producers might copy the advanced technologies and practices that are implemented by their foreign-owned counterparts, causing increased production through the use of more efficient technology. This diffusion mechanism is called the imitation effect.

The training effect posits that foreign firms will need to train local workers to make good use of the advanced technologies that they introduce to local markets. The education that the workers receive causes an increase in the stock of knowledge in the host country, leading to higher output and growth in the long-run. The linkages effect is at play when domestic firms purchase intermediate goods from foreign-owned firms. If these inputs are more advanced than those previously available to local firms, then they upgrade the technology available to domestic firms, leading to increased output. Finally, as foreign, possibly more efficient, firms enter local markets, they increase competition, particularly in markets where domestic firms previously operated monopolistically. The competition effect occurs when this increased competition forces domestic firms to become more efficient in their production processes or invest more resources in upgrading their technology.

Despite the intuitive appeal of these arguments, widely varying results from empirical studies exploring the FDI-growth nexus indicate a lack of consensus on the actual effectiveness of FDI in promoting economic growth. Thus, other theories have tried to explain why FDI might not have a significant, positive effect on growth. Some stress the importance of host-country characteristics in allowing the impact/benefits of FDI to be felt; Blomstrom et al (1992) emphasize sufficient income, while Borensztein et al (1998) emphasize sufficient human capital, for example. Another argument posits that the entry of foreign firms could harm host economies if the foreign firms completely push out domestic firms from the market. Furthermore, as Nunnenkamp and Spatz (2003) explain, different types of FDI might have different impacts on growth. If a host country primarily receives resource-seeking FDI, then the extractive/enclave-like nature of such

investment might hamper its ability to generate positive spillovers for the host economy. These theories do not seem to have gained as much acceptance as those highlighted previously, as the view that FDI is beneficial for growth continues to be popular. This is evidenced by the actions of NEPAD and NIPC, for example.

4.2 FDI-growth equation

To generate an equation linking FDI and economic growth, I follow Akinlo (2003), Balasubramanyam et al (1996) and de Mello (1997) and make use of a modified production function which incorporates FDI as an input. The augmented production function is written as:

$$Y = f(K_d, K_f, L) \tag{1}$$

where Y is output, K_d is domestically-owned capital stock, K_f is foreign-owned capital stock (or the stock of FDI) and L is labor. The inclusion of FDI or foreign-owned capital in the production function is due to FDI's function as capital and its projected role as a technology diffuser, according to the capital formation and technological spillovers theories. The decomposition of capital into foreign and domestic also allows the impact of FDI to be isolated from that of domestic capital.

Assuming (1) follows a log-linear form, I take the logarithms of both sides:

$$ln(Y) = \alpha\, ln(K_d) + \beta\, ln\,(K_f) + \gamma\, ln(L) \tag{2}$$

where α, β, and γ are the output elasticities of domestic capital, foreign capital, and labor. Taking first differences of (2), I obtain the following expression for the growth rate of output:

$$\Delta ln(Y) = \alpha \Delta ln(K_d) + \beta \Delta ln(K_f) + \gamma \Delta ln(L) \quad (3)$$

Thus, the growth rate of output is a function of the growth rates of the stocks of domestic capital, foreign capital, and the labor force. This finding directly informs the econometric approach that is outlined in Section 5.

4.3 Testable hypotheses

Based on the above framework, I test the hypothesis that foreign direct investment has an effect on economic growth in Sub-Saharan Africa. The null hypothesis is that FDI does not have an effect on growth in Sub-Saharan African countries, while the alternative hypothesis is that FDI has a positive effect on growth. I do not attempt to estimate the precise mechanism through which FDI affects growth, primarily due to data limitations, and the fact that many of the mechanisms above are observationally equivalent.

I also test the hypothesis that FDI has a different effect on growth in countries which are mineral rich than in those which are not. This is consequence of Alfaro's (2003) and Wang's (2002) studies, which find that FDI to the primary/mining sector is less productive than FDI to the manufacturing or services sectors. Lacking disaggregated FDI data for the countries in my sample, I cannot attempt the same type of analysis that both papers perform. Instead, I choose to split countries into the afore-mentioned subgroups, since, all things being equal, countries with abundant mineral resources are

likely to receive a higher amount of primary sector FDI, and countries lacking such resources are likely to receive a higher amount of manufacturing and services sector FDI. Based on the afore-mentioned studies' results, I expect that FDI might have a smaller impact on growth in the mineral-rich countries than in mineral-poor countries.

5 Data

The empirical analysis uses panel data from forty-three countries in the Sub-Saharan African region over a span of thirty years (1980-2009). I choose this time period because data on FDI flows to developing countries are generally unavailable or unreliable prior to 1980. In addition, the period allows significant variation in FDI from very low levels in the early 1980s to much higher levels in the 2000s, as described in Section 1. I choose countries in the sample on the basis of data availability, giving me a total of forty-three Sub-Saharan African countries out of a possible forty-seven. Unless otherwise stated, data on all variables is obtained from UNCTADStat, a database maintained by the United Nations Conference on Trade and Development.

The dependent variable in this study is the percentage growth of GDP. For consistency, I use real GDP measured in constant 2005 US dollars across the sample. The key independent variable is the share of gross inward FDI flows as a percentage of GDP, following established practice in the literature. Domestic investment is measured by gross fixed capital formation as a percentage of GDP. The adult population (i.e. the population aged 15-64) of each country is used as a proxy for the labor force, since data on the latter are not readily available for most counties. Adult population data are obtained from the World Bank's World Development Indicators (2012).

Taking account of the fact that this study incorporates countries with vast cultural, historical and economic differences, I control for some of these differences using control variables that are commonly included in the growth literature. I include twice-lagged GDP in my panel regression, to capture the effect of convergence. Other controls include government expenditure (as a percentage of GDP), trade openness (measured as imports plus exports as a percentage of GDP), and terms of trade (measured as natural logarithm of normalized terms of trade)[6]. Terms of trade data are obtained from the World Bank (2012).

In order to avoid capturing business cycle effects which might be associated with the use of annual FDI or growth data, I average over non-overlapping three year intervals (1980-1982, 1983-1985, 1986-1988, etc.), as is commonly done in the literature, and replicate this process on all the other variable used in the study. For most of the variables, the averages are calculated simply as the sum of the values over the triennia, divided by three. For GDP growth, the averaging method is slightly different. In order to calculate GDP growth rates, I use the following modified formula:

$$growth = \frac{\left(\frac{(GDP_6 + GDP_5 + GDP_4)}{(GDP_3 + GDP_2 + GDP_1)} - 1\right)}{3} * 100$$

This has the effect of smoothing GDP values before growth rates are calculated, helping to mitigate business cycle effects as previously stated. Adult population growth rates are calculated in the same way.

[6] I divide the terms of trade for each country by the average over the full time period under consideration, in order to scale the average values to 1.

Table 1: Summary Statistics

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*	*Mean: Mineral-rich*	*Mean: Mineral-poor*
GDP growth (%)	4.08	5.96	-22.89	50.84	4.45	3.71
Lagged FDI/GDP (%)	2.77	6.30	-6.61	46.23	4.10	1.36
Lagged Gross fixed capital formation/GDP (%)	18.60	10.44	2.45	86.14	19.92	17.21
Adult population growth (%)	2.96	1.20	-4.75	10.74	2.98	2.94
Lagged GDP†	9.19	1.32	6.56	13.39	9.51	8.86
Government expenditure/GDP (%)	16.18	7.62	3.07	53.05	17.72	14.57
Trade/GDP (%)	67.90	37.31	10.73	225.83	73.08	62.47
Terms of Trade†	-0.07	0.27	-1.33	0.88	-0.07	-0.06

Note:
† means that the variable is a natural logarithm

Source: UNCTAD (2012), World Bank (2012)

Table 1 summarizes descriptive statistics for all variables used in this study. GDP growth varies significantly, ranging from -22.9% to 50.8% in the sample. Incidentally, both the minimum and maximum growth rates are experienced in Liberia, corresponding to three-year periods during and after the country's 1989-1996 civil war. FDI inflows also vary widely as well; the lowest value of FDI as a percentage of GDP (-6.61%) is observed in Liberia during the country's civil war, while the highest value of FDI (42.3%) is recorded in Equatorial Guinea during 1995-1997. This large figure is most likely attributable to the discovery of commercial quantities of oil in the central African nation in 1995 (McSherry 2006).

Since this project also attempts to estimate if the effect of FDI is different in countries that are mineral-rich, I use the classification of African nations as mineral-rich or mineral-poor which is noted in Pinkovskiy and Sala-i-Martin (2010). To confirm the

authors' classification, I construct a mineral richness index defined as follows:

$$mineral\ richness = \frac{fuel\ exports + mineral\ exports}{manufacturing\ exports + agriculture\ exports + food\ exports}$$

The index is greater than 1 when fuel and mineral exports exceed other exports, and less than or equal to one otherwise. I classify countries as mineral-rich if the index is greater than 1 and mineral-poor if the index is less than 1. Using averaged exports data from 1980 to 2009, I find this classification to be generally the same as Pinkovskiy and Sala-i-Martin's in the instances where the exports data are available, and thus proceed with their classifications. Table 2 lists all the countries of my sample and their classifications into the two groups.

Table 2: Classification of countries

Mineral-rich economies		*Mineral-poor economies*	
Angola	Mauritania	Benin	Malawi
Botswana	Namibia	Burkina Faso	Mali
Cameroon	Niger	Burundi	Mauritius
Central African Republic	Nigeria	Cape Verde	Mozambique
Chad	Republic of Congo	Comoros	Rwanda
Democratic Republic of Congo	Sierra Leone	Cote d'Ivoire	Senegal
Equatorial Guinea	South Africa	Ethiopia	Swaziland
Gabon	Sudan	Ghana	The Gambia
Guinea	Tanzania	Guinea-Bissau	Togo
Lesotho	Uganda	Kenya	Zimbabwe
Liberia	Zambia	Madagascar	

Source: Pinkovskiy and Sala-i-Martin (2010)

6 Econometric model

I begin with a simple OLS fixed effects regression following the theoretical framework set forth in Section 2, specified as:

$$growth_{i,\,t} = \beta_0 + \beta_1\, lngdp_{i,\,t-2} + \beta_2 gfcf_{i,\,t-1} + \beta_3 fdi_{i,\,t-1} + \beta_4 adultpop_{i,t} + \eta_i + \varepsilon_{i,t} \qquad (4)$$

where *growth* is the percentage growth of GDP, *lngdp* is the natural logarithm of GDP, *gfcf is* gross fixed capital formation as percentage of GDP, *fdi* is gross inward FDI as a share of GDP, *adultpop* is the percentage growth of the adult population, η is a country-specific effect, ε is the error term, and the subscripts *i* and *t* represent countries and time periods respectively. I choose the fixed effects model in order to reduce omitted variable bias and to control for differing time-invariant characteristics across the countries in my sample.

In essence, equation (4) is identical to equation (3) in Section 4, except for the fact that I replace the growth rates of foreign and domestic capital stock by the share of FDI inflows and gross fixed capital formation in GDP respectively. This decision is due to the problems associated with measuring the stock of capital available in a country, and follows established practice, as FDI inflows and gross fixed capital formation are good approximations for the growth rates of foreign and domestic capital stock respectively. I also include twice-lagged GDP as an independent variable in the equation above to capture the effect of convergence, as is commonly done in the literature.[7]

[7] Since the growth rate of GDP is calculated using current GDP and the previous period's GDP, I lag GDP twice to avoid any disturbance that might be created by the relationship between once-lagged GDP and GDP growth

It is important to highlight the choice of lagged FDI and gross fixed capital formation in all of the regressions. This specification reduces the simultaneity or endogeneity bias that would result if contemporaneous FDI was used as an independent variable, especially since the results of Choe (2003) indicate that growth induces FDI in some countries. Furthermore, this choice is justified theoretically, if we make the simple but plausible assumption that new capital generally has an effect on output in the period subsequent to that in which it is received, or that it takes some time for new capital to be used in production.

Taking account of the fact that this study incorporates countries with vast cultural, historical and economic differences, I then control for some of these differences using the variables described in the previous section: government expenditure (*govt*), trade openness (*trade*), and terms of trade (*lntot*).

$$growth_{i,t} = \beta_0 + \beta_1 lngdp_{i,t-2} + \beta_2 gfcf_{i,t-1} + \beta_3 fdi_{i,t-1} + \beta_4 adultpop_{i,t} + \beta_5 govt_{i,t} + \beta_6 trade_{i,t} + \beta_7 lntot_{i,t} + \eta_i + \varepsilon_{i,t} \quad (5)$$

As a last step, I include time dummies to account for possible differences related to the specific time periods.

The coefficient of interest is β_3, which captures the effect of changing FDI inflows on growth. If I find that β_3 is significantly greater than zero, then I can conclude that FDI has a positive effect on economic growth in my sample. In order to test the hypothesis that FDI has a different effect on growth in mineral-dependent economies versus non mineral-dependent economies, I run the same set of regressions above, but

include an interaction term *fdi*mineral-rich.* The *mineral-rich* variable is a dummy variable simply defined as:

$$mineral\text{-}rich = \begin{cases} 1 & \text{if the country is classified as mineral-rich} \\ 0 & \text{if the country is classified as mineral-poor} \end{cases}$$

Consequently, the modified version of (4) becomes:

$$growth_{i,\,t} = \beta_0 + \beta_1\, lngdp_{i,\,t-2} + \beta_2 gfcf_{i,\,t-1} + \beta_3 fdi_{i,\,t-1} + \beta_4 adultpop_{i,\,t} + \beta_5 fdi*mineral\text{-}rich_{i,\,t-1} + \eta_i + \varepsilon_{i,\,t} \quad (6)$$

The estimated effect of FDI in a mineral-rich country according to (4) is $\beta_3 + \beta_5$, while the estimated impact of FDI in a mineral-poor country is just β_3. If the coefficient, β_5, is significantly different from zero, then I can conclude that FDI has a different effect in mineral-rich countries than it does in mineral-poor countries.[8]

7 Results and discussion

I present regression results obtained using the specifications described above in Table 3. This and all subsequent tables include estimated regression coefficients with White's heteroskedasticity-corrected standard errors, R^2 values, number of observations, and F-statistics with corresponding p-values. I use fixed effects panel regressions in all instances. The time dummies for 1980-1982 and 1983-1985 do not appear any regressions due to use of lagged values of GDP, FDI and gross fixed capital formation.

[8] Please note that since all regressions include country fixed effects, I cannot include the *mineral-rich* dummy, a time-invariant variable, by itself.

7.1 Benchmark results

The results of Regression 1.1 in Table 3 indicate that FDI is positively associated with growth, though its coefficient is not statistically significant. Adult population growth has a highly significant coefficient that is greater than 1, implying that an increase in the labor force is associated not only with an increase in GDP, but also with an increase in GDP per worker. Gross fixed capital formation has a positive (though marginally significant) coefficient, as expected, while lagged GDP has a negative but insignificant coefficient.

With the addition of control variables in Regression 1.2, the coefficient of FDI remains positive and statistically insignificant. Government expenditure has a negative, significant coefficient, indicating that higher government spending is associated with lower GDP growth across the sample. The coefficient of lagged GDP is negative and significant at the 1% level in this regression, lending support to conditional convergence theory (i.e. that countries grow faster when at lower levels of GDP). Trade share and terms of trade have significantly positive coefficients, implying that trade openness and improving terms of trade and are both associated with higher growth in Sub-Saharan Africa. In Regression 1.3, I add time dummies to account for differences in growth that arise for external reasons common to all countries in the sample across time, such as global business cycles. Particularly noteworthy are the positive and significant coefficients on the dummies for 2001-2003, 2004-2006 and 2007-2009. These coefficients indicate that growth rates were generally higher in the 2000s, possibly due to the effect of the commodity boom. The coefficient of FDI still remains insignificant, though positive, in this regression.

Table 3: FDI and Growth (full sample, triennial averages)

Dependent Variable: Real GDP growth						
	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
Lagged FDI/GDP	0.156	0.134	0.044	0.248	0.313	0.114
	(0.200)	(0.179)	(0.221)	(0.162)	(0.172)*	(0.141)
FDI * Mineral-rich				-0.095	-0.190	-0.073
				(0.282)	(0.281)	(0.230)
Lagged Gross fixed capital formation/GDP	0.223	0.160	0.203	0.222	0.160	0.203
	(0.128)*	(0.105)	(0.111)*	(0.128)*	(0.107)	(0.111)*
Adult population growth	1.926	1.594	1.440	1.918	1.580	1.435
	(0.724)**	(0.526)***	(0.453)***	(0.709)***	(0.511)***	(0.447)***
Lagged GDP	-1.344	-1.922	-5.723	-1.437	-2.135	-5.780
	(0.910)	(0.674)***	(1.683)***	(1.132)	(0.827)**	(1.829)***
Government Expenditure/GDP		-0.180	-0.099		-0.182	-0.100
		(0.083)**	(0.073)		(0.085)**	(0.074)
Trade/GDP		0.050	0.024		0.050	0.025
		(0.029)*	(0.033)		(0.029)*	(0.032)
Terms of Trade		1.871	3.025		2.084	3.098
		(1.024)*	(1.220)**		(1.172)*	(1.331)**
31989			0.703			0.693
			(0.507)			(0.504)
31992			-0.422			-0.425
			(0.788)			(0.784)
31995			2.328			2.327
			(0.858)***			(0.857)***
31998			3.137			3.128
			(1.596)*			(1.574)*
32001			3.436			3.401
			(1.366)**			(1.290)**
32004			4.741			4.716
			(1.774)**			(1.716)***
32007			4.907			4.869
			(1.968)**			(1.879)**
Constant	6.200	13.502	46.538	7.023	15.434	47.056
	(8.087)	(5.661)**	(16.357)***	(9.952)	(7.414)**	(17.665)**
Observations	343	334	334	343	334	334
R-squared	0.32	0.34	0.41	0.32	0.34	0.41
F statistic	11.75	7.53	21.40	12.21	8.15	20.65
p(>F)	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
All regressions are ordinary least square regressions with country fixed effects. White heteroskedasticity-consistent standard errors in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels respectively. Constant term not reported; time dummy for 1986-1988 dropped from all regressions due to multi-collinearity

In Regressions 1.4, 1.5 and 1.6, I include the *FDI*mineral-rich* interaction term to capture any difference in the effect of FDI in mineral-rich countries as opposed to

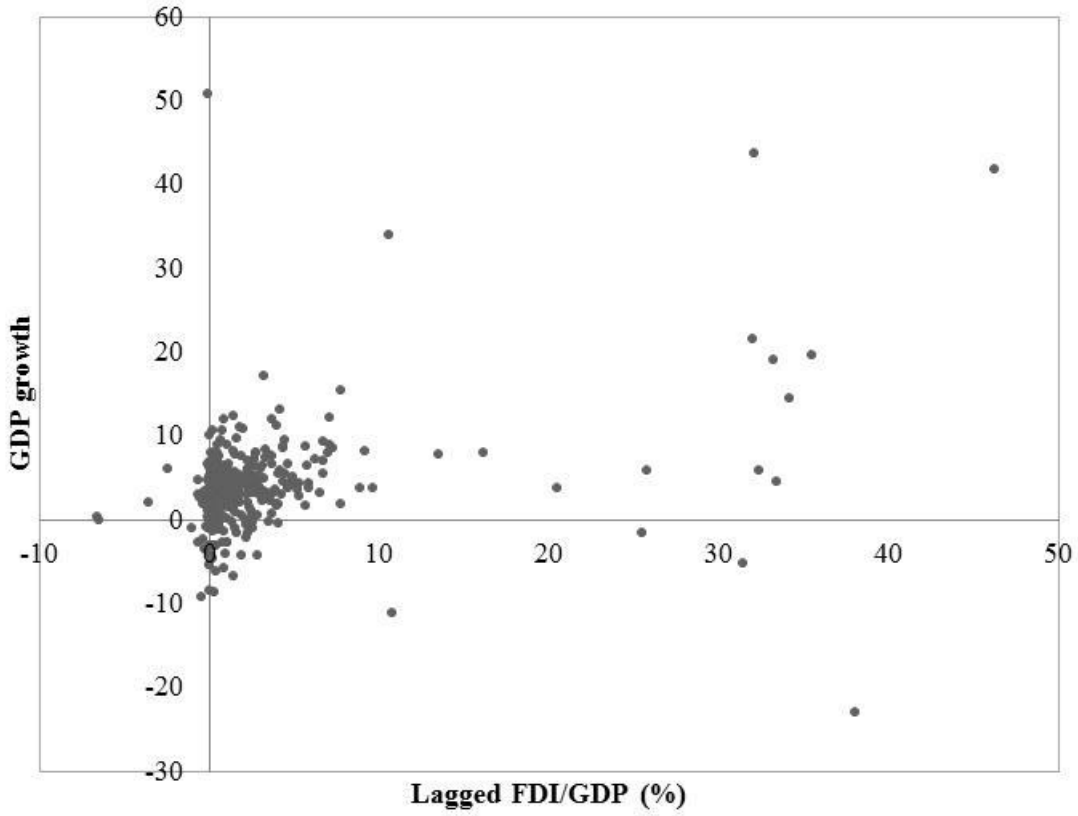
mineral-poor countries. The coefficient of this term is negative and insignificant in all of the specifications, ranging from -0.182 in Regression 1.5 to -0.073 in Regression 1.6. This implies that we cannot conclude that FDI has a different effect in mineral-rich countries than it does in mineral-poor countries. The coefficient of FDI, on the other hand, remains positive in this set of regressions and picks up significance at the 10% level in Regression 1.5. All other variables retain their signs and their significance levels.

Thus, these first stage regressions indicate that FDI is positively associated with growth in a typical Sub-Saharan African country, but that the results are not strong enough to draw any firm conclusions about its actual impact in the full sample of countries.

7.2 Varying Samples/Robustness

A major concern is that countries with extreme values of FDI inflows and GDP growth are influencing my results. As noted earlier, Liberia (1998-2000) experienced growth of about 50.1%, a value that is eight standard deviations higher than the mean growth rate of 4.08%. Equatorial Guinea (1995-1997) received inward FDI/GDP of 46%, about seven standard deviations higher than the mean of 2.77%. Figure 3, which plots GDP growth against lagged FDI/GDP, shows that some observations lie very far away from the general trend in the sample, indicating that they might be obscuring the results by pushing up standard errors and pushing down estimated coefficients.

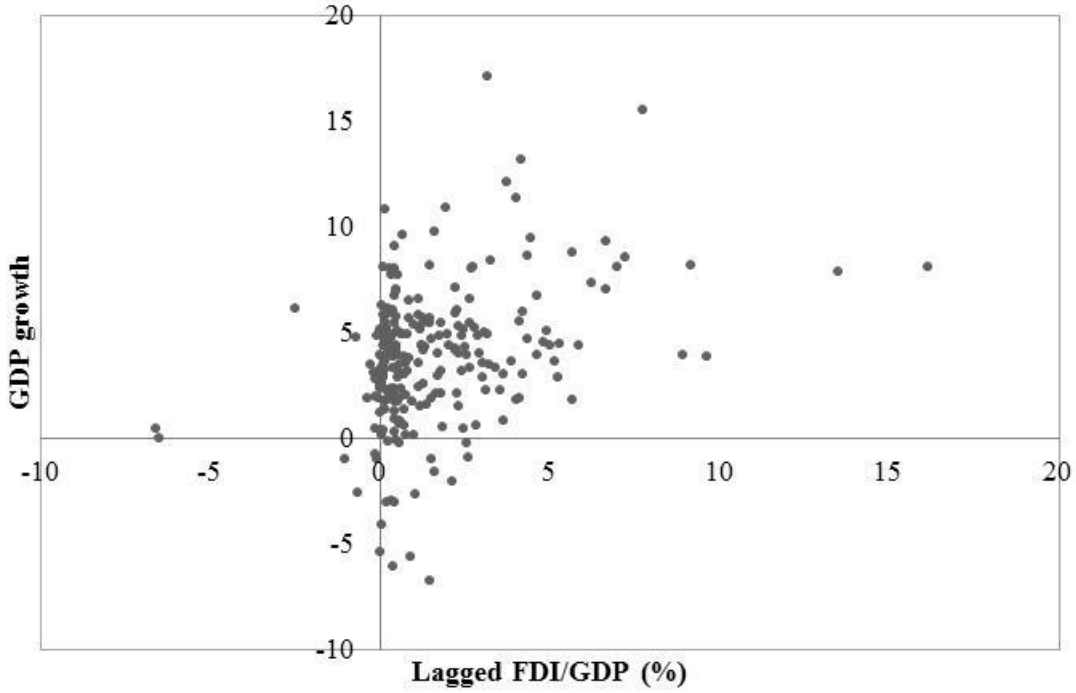
Figure 3: GDP growth against Lagged FDI/GDP (triennial averages)



Source: Author's calculations, UNCTAD (2012)

The extreme figures are exceptional situations which do not reflect normal output growth or FDI inflows experienced by African nations. Liberia's high economic growth of 50.1% immediately follows a civil war, while Equatorial Guinea's high FDI inflows follow the discovery of a major oil well. Conversely, Liberia's negative growth rates and FDI inflows reflect extremely poor economic conditions during its civil war. In order to make policy recommendations that can be generalized across Africa, it is necessary to use data that reflect typical growth and investment scenarios. Consequently, I exclude outliers from the next set of regressions, in terms of both growth and FDI received.

Figure 4: GDP growth against Lagged FDI/GDP, excluding outliers



Source: Author's calculations, UNCTAD (2012)

I define outliers simply as points which lay more than 2.5 standard deviations away from the mean observations of growth or FDI as a percentage of GDP[9]. This effectively excludes a total of fifteen observations from the initial sample: Angola (growth and FDI outliers; 3 observations), Republic of Congo (FDI outlier; 1 observation), Equatorial Guinea (growth and FDI outliers; 4 observations), Liberia (growth and FDI outliers; 5 observations), Mauritius (FDI outlier; 1 observation), and Chad (growth and FDI outlier; 1 observation). In Figure 4 above, which excludes these observations, it is clear that there is a strong positive correlation between GDP growth

[9] This implicitly assumes that FDI and growth are distributed normally. Indeed, a subsequent histogram of the remaining points revealed a very normal-looking distribution.

and lagged FDI. Accordingly, regression results using the sub-sample generated by the exclusion of outliers are presented in Table 4 below.

Table 4: FDI and growth (excluding 2.5 standard deviation outliers)

Dependent Variable: Real GDP growth						
	(2.1)	(2.2)	(2.3)	(2.4)	(2.5)	(2.6)
Lagged FDI/GDP	0.491	0.474	0.310	0.255	0.313	0.192
	(0.096)***	(0.089)***	(0.101)***	(0.156)	(0.146)**	(0.098)*
FDI * Mineral-rich				0.334	0.255	0.194
				(0.197)*	(0.207)	(0.208)
Lagged Gross fixed capital formation/GDP	0.027	0.011	0.035	0.028	0.012	0.036
	(0.034)	(0.036)	(0.031)	(0.033)	(0.035)	(0.030)
Adult population growth	1.167	1.085	1.028	1.189	1.101	1.042
	(0.213)***	(0.173)***	(0.169)***	(0.212)***	(0.174)***	(0.176)***
Lagged GDP	-0.061	-0.637	-3.025	0.153	-0.467	-2.831
	(1.220)	(0.899)	(1.909)	(1.212)	(0.921)	(2.006)
Government Expenditure/GDP		-0.080	-0.035		-0.077	-0.034
		(0.049)	(0.058)		(0.050)	(0.058)
Trade/GDP		0.029	0.013		0.027	0.012
		(0.018)	(0.018)		(0.019)	(0.018)
Terms of Trade		1.911	2.167		1.714	2.002
		(0.869)**	(0.784)***		(0.888)*	(0.761)**
1989-1991			0.400			0.394
			(0.484)			(0.485)
1992-1994			-1.117			-1.160
			(0.628)*			(0.643)*
1995-1997			1.094			1.042
			(0.691)			(0.718)
1998-2000			1.016			0.960
			(0.780)			(0.812)
2001-2003			1.554			1.517
			(0.991)			(1.007)
2004-2006			2.805			2.715
			(1.249)**			(1.299)**
2007-2009			2.926			2.831
			(1.243)**			(1.284)**
Constant	-0.573	4.857	26.182	-2.567	3.336	24.462
	(11.295)	(8.009)	(17.345)	(11.196)	(8.176)	(18.171)
Observations	328	321	321	328	321	321
R-squared	0.26	0.29	0.39	0.27	0.30	0.39
F statistic	14.86	11.58	10.22	11.20	10.06	9.50
p(>F)	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
All regressions are ordinary least square regressions with country fixed effects. White heteroskedasticity-consistent standard errors in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels respectively. Constant term not reported; time dummy for 1986-1988 dropped from all regressions due to multi-collinearity

In Regression 2.1, the coefficient of FDI is positive and significant at the 1% level. The coefficient of 0.491 implies that an average increase in FDI/GDP of one percentage point over a three-year period is associated with an increase in growth of about 1.473 percentage points (3*0.491) over the subsequent three-year period. In order to convert the triennial increase to a precise annual estimate, I solve for *g* in the following equation:

$$(1+g)^3 = 1 + \frac{1.473}{100} \tag{7}$$

Accordingly, the triennial increase of 1.473 percentage points corresponds to an increase in the annual growth rate of 0.489 percentage points. After adding control variables and time dummies in Regressions 2.2 and 2.3, the coefficient of FDI still remains positive and significant at the 1% level. In Regression 2.2, the coefficient of FDI is 0.474, corresponding to an increase in annual growth of 0.472 percentage points, while the coefficient of 0.310 in Regression 2.3 corresponds to an increase of 0.309 percentage points. These results are non-negligible and economically significant.

To illustrate, consider two Sub-Saharan African countries, A and B, which both have annual growth rates of 5%, and assume that in a particular three-year period, Country A receives one additional percentage point of FDI/GDP per year. All other things held constant, Country A would subsequently experience annual growth of about 5.31% (i.e. supplemental growth of 0.31 percentage points) according to Regression 2.3, while Country B would still experience 5% growth. Given its new annual growth rate, Country A would have about 9.2% higher GDP than Country B at the end of a thirty-year period. Using the results of Regression 2.2 gives even more divergent figures, as Country

A would have 14.4% higher GDP than Country B. This indicates that the additional growth due to increased FDI inflows is indeed economically significant.

Adult population growth and terms of trade continue to have positive and statistically significant coefficients as in prior regressions, while lagged GDP loses its significance. The coefficient on the time dummies for 2004-2006 and 2007-2009 remain positive and significant.

In Regressions 2.4 to 2.6, I include the *FDI*mineral-rich* interaction term as is done in Table 3. The coefficient of the interaction term is positive and marginally significant at the 10% level in Regression 2.4, which excludes control variables. After the inclusion of control variables and time dummies in the subsequent regressions, however, the coefficient loses significance, consistent with the results of prior regressions. The coefficient of standalone FDI remains positive and significant in the regressions which include control variables and time dummies.

For further robustness, I perform the same analysis above, but exclude observations that lay 2 standard deviations from the mean values of growth and FDI/GDP instead. This excludes five additional observations from Equatorial Guinea (1 observation), Liberia (1 observation), Nigeria (1 observation), Sierra Leone (2 observations), and Democratic Republic of Congo (1 observation). I find that this altered definition of outliers yields very similar results to the previous definition, as shown in Table 5.

Table 5: FDI and growth (excluding 2 standard deviation outliers)

Dependent Variable: Real GDP growth						
	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)
Lagged FDI/GDP	0.515	0.488	0.384	0.251	0.291	0.217
	(0.088)***	(0.083)***	(0.087)***	(0.152)	(0.140)**	(0.102)**
FDI * Mineral-rich				0.424	0.332	0.290
				(0.176)**	(0.190)*	(0.190)
Lagged Gross fixed capital formation/GDP	0.028	0.014	0.029	0.028	0.014	0.028
	(0.033)	(0.035)	(0.031)	(0.030)	(0.033)	(0.029)
Adult population growth	1.124	1.067	1.017	1.167	1.097	1.045
	(0.157)***	(0.147)***	(0.142)***	(0.154)***	(0.145)***	(0.149)***
Lagged GDP	0.033	-0.499	-2.401	0.210	-0.336	-2.169
	(1.172)	(0.844)	(1.815)	(1.155)	(0.865)	(1.866)
Government Expenditure/GDP		-0.069	-0.034		-0.066	-0.033
		(0.049)	(0.058)		(0.050)	(0.058)
Trade/GDP		0.029	0.019		0.027	0.017
		(0.016)*	(0.016)		(0.017)	(0.016)
Terms of Trade		1.670	1.836		1.422	1.596
		(0.755)**	(0.694)**		(0.752)*	(0.671)**
1989-1991			0.420			0.428
			(0.461)			(0.453)
1992-1994			-1.089			-1.132
			(0.565)*			(0.583)*
1995-1997			0.918			0.862
			(0.660)			(0.686)
1998-2000			0.998			0.929
			(0.739)			(0.769)
2001-2003			1.039			0.997
			(0.890)			(0.896)
2004-2006			1.889			1.763
			(1.060)*			(1.087)
2007-2009			2.345			2.236
			(1.201)*			(1.216)*
Constant	-1.317	3.451	20.375	-3.028	1.910	18.246
	(10.921)	(7.736)	(16.559)	(10.718)	(7.910)	(16.991)
Observations	323	317	317	323	317	317
R-squared	0.27	0.30	0.38	0.29	0.31	0.39
F statistic	24.45	20.64	16.32	28.86	21.20	16.60
p(>F)	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
All regressions are ordinary least square regressions with country fixed effects. White heteroskedasticity-consistent standard errors in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels respectively. Constant term not reported; time dummy for 1986-1988 dropped from all regressions due to multi-collinearity

The coefficient of FDI remains positive and significant through most of the regressions, ranging from 0.217 to 0.515. This associates a one percentage point increase

in FDI/GDP with a subsequent increase in the annual growth rate of 0.22 to 0.51 percentage points. The coefficient of the interaction term is positive but insignificant once control variables and time dummies are included in the regressions. Thus, the results of the regressions excluding outliers indicate that FDI is positively associated with output growth in Sub-Saharan Africa, but that there is no significant difference in its effect in mineral-rich versus mineral-poor countries. The results also confirm that outliers were indeed influencing my initial estimates.

As my final robustness check, I average my data over non-overlapping five year intervals, (1980-1984, 1985-1989, etc.) to ensure that my results are not being driven by my selection of three-year intervals. Regressions using this data are presented below in Table 6. FDI has a consistently positive, significant coefficient, ranging from 0.390 to 0.644 across the different specifications. This indicates that a percentage-point increase in FDI/GDP leads to a subsequent increase of 0.39 to 0.64 percentage points in the annual GDP growth rate. These results are very comparable to those found using the triennial data. The coefficient on my interaction term for FDI and mineral richness is generally negative, though insignificant, again indicating that my regressions do not detect a difference in the impact of FDI in mineral-rich countries versus mineral-poor countries. Other variables generally retain their signs.

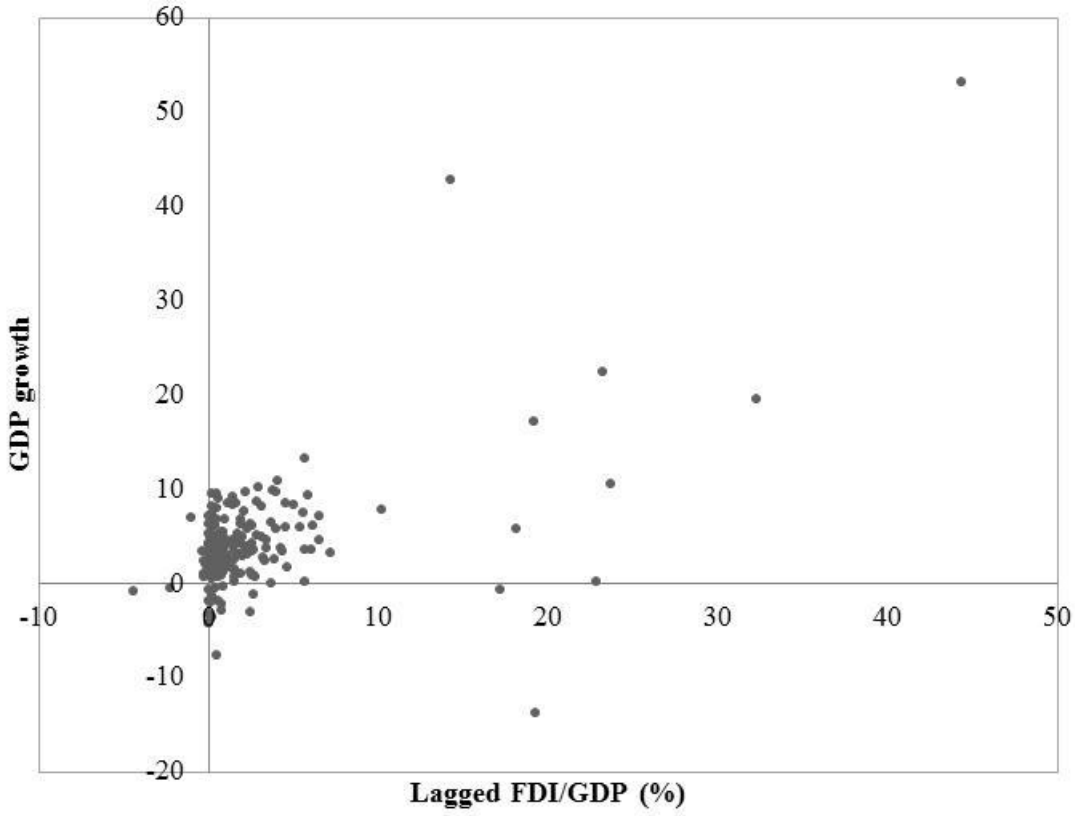
Table 6: FDI and growth (full sample, quinquennial averages)

Dependent Variable: Real GDP growth						
	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)
Lagged FDI/GDP	0.567	0.576	0.489	0.631	0.644	0.390
	(0.100)***	(0.093)***	(0.114)***	(0.196)***	(0.190)***	(0.162)**
FDI * Mineral-rich				-0.067	-0.074	0.105
				(0.206)	(0.238)	(0.175)
Lagged Gross fixed capital formation/GDP	0.116	0.065	0.104	0.117	0.066	0.104
	(0.106)	(0.079)	(0.074)	(0.108)	(0.079)	(0.073)
Adult population growth	1.703	1.343	1.213	1.698	1.339	1.218
	(0.490)***	(0.225)***	(0.215)***	(0.489)***	(0.227)***	(0.220)***
Lagged GDP	-2.599	-3.315	-7.993	-2.661	-3.399	-7.952
	(1.488)*	(1.920)*	(0.971)***	(1.527)*	(1.859)*	(0.984)***
Government Expenditure/GDP		-0.068	-0.009		-0.070	-0.006
		(0.077)	(0.076)		(0.076)	(0.078)
Trade/GDP		0.064	0.030		0.064	0.030
		(0.060)	(0.065)		(0.060)	(0.066)
Terms of Trade		0.304	1.046		0.390	0.926
		(1.359)	(1.004)		(1.510)	(1.086)
1995-1999			2.083			2.088
			(0.531)***			(0.532)***
2000-2004			3.182			3.213
			(0.953)***			(0.949)***
2005-2009			4.197			4.266
			(1.125)***			(1.106)***
Observations	172	168	168	172	168	168
R-squared	0.54	0.57	0.62	0.54	0.57	0.62
F statistic	41.12	29.96	44.55	34.21	26.10	41.44
p(>F)	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

All regressions are ordinary least square regressions with country fixed effects. White heteroskedasticity-consistent standard errors in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels respectively. Constant term not reported; time dummy for 1990-1994 dropped from all regressions due to multi-collinearity.

Figure 5: GDP growth against Lagged FDI/GDP (quinquennial averages)



Source: Author's calculations, UNCTAD (2012)

Figure 5, which plots GDP growth against FDI/GDP using the quinquennial data, shows that the outliers might not be as influential as in the triennial sample, as observations with extremely high or low values lie in the same general direction as other observations. Regressions using the sub-sample that excludes outliers (in this case, 2.5 standard deviation outliers) give very similar results to the specifications on the full sample, as presented in Table 7.

Table 7: FDI and growth, quinquennial averages excluding outliers

Dependent Variable: Real GDP growth						
	(5.1)	(5.2)	(5.3)	(5.4)	(5.5)	(5.6)
Lagged FDI/GDP	0.717	0.595	0.310	0.576	0.652	0.345
	(0.137)***	(0.118)***	(0.108)***	(0.218)**	(0.210)***	(0.157)**
FDI * Mineral-rich				0.207	-0.091	-0.056
				(0.252)	(0.301)	-0.22
Lagged Gross fixed capital formation/GDP	-0.009	-0.031	0.009	-0.007	-0.033	0.008
	(0.044)	(0.041)	(0.030)	(0.043)	(0.041)	-0.029
Adult population growth	1.335	1.271	1.093	1.356	1.261	1.087
	(0.205)***	(0.145)***	(0.151)***	(0.201)***	(0.153)***	(0.159)***
Lagged GDP	-1.032	-1.596	-6.798	-0.890	-1.656	-6.828
		(0.829)*	(0.758)***		(0.812)**	(0.794)***
Government Expenditure/GDP		-0.126	-0.050		-0.126	-0.05
		(0.051)**	(0.062)		(0.051)**	-0.061
Trade/GDP		0.045	0.009		0.046	0.01
		(0.017)**	(0.015)		(0.018)**	-0.016
Terms of Trade		1.606	1.711		1.700	1.767
			(0.614)***			(0.667)**
1995-1999			1.420			1.42
			(0.342)***			(0.344)***
2000-2004			2.719			2.714
			(0.404)***			(0.405)***
2005-2009			4.556			4.552
			(0.622)***			(0.621)***
Observations	163	160	160	163	160	160
R-squared	0.42	0.49	0.66	0.43	0.49	0.66
F statistic	19.77	19.38	29.50	17.04	16.89	29.45
p(>F)	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
All regressions are ordinary least square regressions with country fixed effects. White heteroskedasticity-consistent standard errors in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels respectively. Constant term not reported; time dummy for 1990-1994 dropped from all regressions due to multi-collinearity.

FDI continues to have a positive and significant coefficient, ranging from 0.310 to 0.717. This corresponds to an annual increase in the annual growth rate of GDP of about 0.309 to 0.707 percentage points. The interaction term of FDI and mineral richness has an insignificant coefficient in all specifications, echoing the results of prior regressions.

Given the positive, significant coefficient that FDI has in most of the regressions above, I conclude that FDI has a positive an effect on growth in Sub-Saharan African

countries. However, this impact has not differed from mineral-rich to mineral-poor economies, as the coefficient of the FDI/resource-rich interaction term remains insignificant in a majority of my regressions, and does not have a consistently positive or negative sign.

8 Conclusion

This paper contributes to the empirical literature on FDI and growth by focusing solely on Sub-Saharan Africa. I employ a larger dataset than other FDI studies on the region, by covering forty-three countries over 1980-2009. The growth rate of real GDP is the dependent variable in all regressions, while gross inward FDI flows as a percentage of GDP is used as the key explanatory variable. I use triennial and quinquennial averages of all variables to reduce business cycle effects, following established practice.

I find that increased FDI inflows are generally associated with higher growth in Sub-Saharan African countries, particularly after the exclusion of outliers. This finding would be further strengthened by readily-accessible data on institutional variables, which might have helped to account for the extraordinary situations in the countries with extreme values of growth and FDI. Nevertheless, my results are of economic significance, as they show that a percentage point increase in FDI as a share of GDP is associated with a subsequent increase in annual GDP growth of between 0.30 and 0.71 percentage points. This positive correlation is consistent with the findings of other studies on FDI and growth, such as Borensztein et al (2003), Wang (2002) and Brambila-Macias and Massa (2010).

The primary implication of my results is that African leaders are justified in enacting initiatives to attract FDI to their economies, as FDI has had a positive, economically significant impact on growth thus far. If the past is a reasonable predictor of the future, it is conceivable that FDI will enhance economic growth in Africa in the years to come. In addition, the coefficient of FDI remains higher than the coefficient of government expenditure in all of the regressions, and suggests that FDI is a better policy alternative to the governments' own spending.

I also consider whether the effect of FDI has been different in mineral-rich countries compared to their mineral-poor counterparts. The lack of statistical significance on the FDI/mineral-rich interaction term across the majority of my regressions indicates that I cannot conclude that the impact of FDI is different in mineral-rich African countries. I believe that this inconclusiveness highlights the need for further research. Because many African nations are dependent on primary commodities, it is crucial to estimate the impact of FDI on growth by sector.

As they aim to meet the Millennium Development Goals and pull their populations out of poverty, African countries need to be able to attract the kind of FDI that augments economic growth. Research that estimates FDI's effectiveness by sector will equip governments with the information necessary to establish policies that channel FDI to the appropriate sectors of their economies. As the World Bank and United Nations work hand-in-hand with agencies in developing countries to improve their statistical capacity (World Bank 2012b, United Nations 2012), I am hopeful that disaggregated FDI data that will permit such research will be available in the near future.

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