Determinants Of Foreign Direct Investment In African Countries: An Analysis Through Geographically Weighted Regression

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Abstract: Foreign Direct Investment (FDI) is all monetary input from abroad, applied in the domestic productive structure of a country, which tends to have a direct impact on its economic growth. In this context, the objective of this article is to analyze the determinants of foreign direct investment in 53 African countries during the period from 1996 to 2016. For this, the Geographically Weighted Regression (GWR) was used. The main results show that the size of the market and natural resources are determinant for the attraction of FDI in all countries, while the importance of regulatory quality and macroeconomic stability have different impacts among the countries analyzed. Finally, education was not statistically significant.

Keywords: Geographically Weighted Regression (GWR), Africa, Foreign direct investment (FDI)

Resumo: O investimento direto estrangeiro (IED) é todo aporte monetário vindo do exterior, aplicado na estrutura produtiva doméstica de um país, o qual tende a impactar diretamente no seu crescimento econômico. Neste contexto, o objetivo deste artigo é analisar os determinantes do investimento direto estrangeiro em 53 países africanos durante o período de 1996 a 2016. Para isso, foi utilizada a Regressão Geograficamente Ponderada (GWR). Os principais resultados demonstram que o tamanho do mercado e os recursos naturais são determinantes para a atração do IDE em todos os países, enquanto que a importância da qualidade regulatória e da estabilidade macroeconômica apresentaram impactos diferenciando entre os países analisados. Por fim, a educação não foi estatisticamente significativa.

Palavras-chave: Regressão ponderada geograficamente (RPG), África, Investimento direto estrangeiro (IDE)

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1.   Introduction

The countries of the African continent show great ethnic, cultural, social and political diversity. This continent comprises 54 independent countries, which are divided into five regions: Northern Africa, Western Africa, Central Africa, Eastern Africa, and Southern Africa (WORLD BANK, 2011).

Over the decade prior to the global economic crisis of 2007, sub-Saharan Africa's[4] average economic growth rate was 5% annually. Although growth has declined since then, African countries are recovering from the crisis thanks to prudent macroeconomic policies and financial support from multilateral agencies (WORLD BANK, 2011). The forecast for 2019 and 2020 projects an average economic growth rate of 3.6% annually to sub-Saharan Africa's, however this is not expected to be distributed equally among countries. (UNCTAD, 2018).

Data from the World Bank (2018) also demonstrates this extreme heterogeneity. Some African countries have a per capita income greater than $37,000 USD while others African countries have a per capita income are less than $700 USD. African economic production is also top heavy. Four countries (Egypt, Nigeria, South Africa and Algeria) account for more than 58% of the total amount of all goods and services that originate from the continent.

African countries continue to face long term developmental challenges which lead to serious structural problems, including non-diversified production structures, increasing levels of public debt, low levels of human capital formation, fragility of the state, and underemployment among young people among other factors (UNCTAD, 2018).

Mohamed (2017) emphasizes the importance of foreign direct investment (FDI) as a means to overcome underdevelopment and generate sustainable economic growth in Africa. Infusions of capital directly directly into the local economy, coupled with exogenous inversions in productive activity, increase employment and domestic investment by linkage and multiplier effect of income. This also allows for technological spillovers which also potentially translates to gains in productivity.

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[4] Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Congo, Côte d'Ivoire, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, South Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

Kamara (2013) has highlighted the effects of FDI on economic growth in Africa, particularly when institutions and financial development are improved. Most sub-Saharan African countries possess fragile economies which have only recently recovered from a period of stagnation state. FDI inflows have, according to the author's findings, been vital to accelerating the process of economic growth.

A historical analysis of FDI inversions in African countries reveals heterogeneity in their distribution, with 22% of countries accounting for more than 50% of all foreign investment attraction for the region over the last ten years.

Given this uneven distribution and the great importance of FDI for economic growth in Africa, it is important to understand the variables that have the most impact on the attraction of these investments to the continent.

The goal of this paper is to attempt to answer these questions by analyzing the determinants of foreign direct investment in the 53 countries of the African continent. To achieve this goal, we employed geographically weighted regression in order to control spatial heterogeneity.

We identified that regulatory quality and Macroeconomic stability increase the attraction of FDI to some countries. Already the market size and the existence of natural resources have been relevant in all African spaces. The variable of human capital did not have a statistically significant effect on the attraction of FDI to any country we analyzed. Impacts of the selected variables on the attraction of FDI are disparate.

The main contribution of this paper is to consider the space in the estimates, controlling the effect of spatial heterogeneity, which is not done in any other study that investigated the attraction of FDI to African countries. Socioeconomic phenomena are inconsistent across regions, and in the case of the African continent this effect is even more pronounced. A global analysis, therefore, is not the best option (ALMEIDA, 2012). This is why we chose to use geographically weighted regression (GWR).

The remainder of the paper is organized as follows: Section 2 briefly reviews about FDI. Section 3 describes the data and variables. Section 4 presents the empirical results. Section 5 concludes

2.   Foreign Direct Investment

Financial markets have evolved into a more integrated global structure over time as a result of increased liberalization of exchange controls and improved access to foreign markets. Increased competition among participants and technological developments in the market led to the introduction of new financial instruments with broader market access and lower costs. These factors have proven to be attractive to foreign investors. (OECD, 2008).

Foreign direct investment (FDI) is any monetary input from abroad that is applied in the domestic productive structure of a country in the form of equity participation in existing companies or in the creation of new companies.

In this way, foreign direct investment is a key element in this international evolution of economic integration, also known as globalization. It provides the means to create stable and lasting bonds between economies. This potential for stability stands in direct contrast to speculative investment, which is characterized by ephemeral investments which do not necessarily remain in the local economy on a long-term basis. (OECD, 2008).

There are two types of FDI, vertical and horizontal. The former arises when the international investor distributes portions of the production process across multiple countries, locating each stage of the process in the country where it can be made at the lowest cost. Horizontal direct investment occurs when the investor completes the entire production process in multiple separate countries (AIZENMAN; MARION, 2004).

Caves (1996) identifies two channels in literature that FDI can benefit the recipient country. First, FDI can promote economic growth by creating gains in productivity and transfer of new technology. Second, FDI in which foreign direct investment exerts a positive effect on economic growth can allow for the introduction of new production processes, managerial skills and technical know-how into the domestic market, along with enhanced employee training, access to an international production network and improved market access.

Borenstein *et al*. (1998) considers technology transfer to be the most important mechanism for FDI's contribution to domestic economic growth. For us, however, the presence of a minimum level of human capital is a bigger factor in FDI's contribution to economic growth. Such growth only occurs when the recipient economy possesses sufficient capacity to absorb the advanced technologies that FDI introduces.

Blomström *et al*. (2003, p.20) state that "Foreign direct investment can play an important role in raising a country's technological level, creating new jobs and promoting economic growth." The authors explain that while some countries are actively trying to attract foreign investors to promote their economic development, developing effective incentive programs is a complicated task since it is not always possible to increase national welfare in an efficient manner.

2.1 Foreign Direct Investment in the African Continent

While evaluating the challenges that domestic economies face in attracting foreign direct investment, Cotton and Ramachandran (2001) point out that small economies are not entirely different from those of the larger economies of the developing. The authors propose that the lack of infrastructure, burdensome government regulations, and restrictions on foreign shareholdings are common to all economies regardless of size. They further conclude that foreign direct investment flows could be substantially increased in sub-Saharan Africa if governments in the region were to implement adequate regulations that would enable foreign investors to do business on a fair and consistent basis.

Differently, Asiedu (2002) shows that factors affecting the attraction of FDI in developing countries elsewhere in the world have different outcomes in sub-Saharan Africa. The author infers that the implementation of policies that have succeeded in other regions may not apply in Africa due to reduced levels of investment on the continent as a result of the perceived increased risk of doing business in Africa.

Bende-Nabende (2002) suggests that the most dominant long-term determinants of foreign direct investment in sub-Saharan Africa are market growth, export orientation policy and foreign direct investment liberalization, followed by real exchange rates and market size. The long-term implication is that Sub-Saharan African countries can attract more foreign investment by improving their macroeconomic stability.

Asiedu (2006) states that FDI is promoted by large local markets, abundant natural resources, good infrastructure, low inflation, an efficient legal system. In contrast, corruption and political instability have the opposite effect.

Dupasquier and Osakwe (2006) echo some of these same concepts. They point out that factors such as political and macroeconomic instability, low growth, poor infrastructure, poor governance, inhospitable regulatory environments and

ill-conceived investment promotion strategies are responsible for the poor record of attracting FDI by many African countries.

Adams (2009), analyzed foreign direct investment in Africa, particularly in sub-Saharan countries. He emphasizes that FDI contributes to the economic development of the recipient economy through an increase in domestic capital and via the transfer of new technologies.

According to Anyanwu (2012), foreign direct investment in Africa is primarily directed towards African countries which receive foreign aid. The author notes that these countries tend to have superior infrastructure compared to other countries in the region who do not receive these benefits. Infrastructure, however, is not the only important factor. Effective governance and high levels of institutional quality not only are powerful attractants of FDI to Africa, but also create the conditions under which domestic multinational enterprises can emerge and grow.

Michałowski (2012, p. 690), says "One of the most important problems is limited diversification of production, exports and budget revenues. The region's economies are much more dependant on primary commodities than the rest of the world." For the author, Sub-Saharan African countries should strengthen their efforts to not only to attract more FDI, but also to actively direct these foreign investments to more diversified and value-added activities which benefit their domestic economies.

Kamara (2013) investigated the effects of four factors: human capital, financial development, infrastructure and institutions on attracting foreign direct investment in 44 sub-Saharan African countries for the period 1981-2010. His results indicated that improved institutions and financial development intensify the effects of foreign direct investment on growth in this region.

Chiatchoua and Pegou (2015) argue that market size, inflation, taxes, and wages significantly affect the attraction of foreign direct investment to Sub-Saharan African countries. In addition, corruption, countries openness, and infrastructure development could not be seen as factors that absolutely impede on countries ability to attract FDI.

Okafor (2015) agrees that market size has a positive and significant impact on foreign direct investment in SSA countries Additional variables such as a positive return on capital, high levels of human capital and trade liberalization also

had a positive effect on FDI. In a way that is different, rent from natural resource, corruption, high inflation and high fuel costs are all negative influences on FDI.

Adams and Opoku (2015) argue that the growth effect of foreign direct investment in sub-Saharan Africa is stimulated by effective and sound business laws and regulations. To that end, the authors suggest that measures should be implemented to strengthen economic regulations in Sub-Saharan Africa in order to maximize the influx of FDI to the region.

Additionally, Anyanwu and Yameogo (2015) demonstrated that trade liberalization positively affects the inflow of foreign direct investment; countries that export more goods and services tend to attract more foreign investors. They suggest that countries improve their trade partnerships with the rest of the world in order to reap the benefits of increased levels of FDI.

> Foreign investors are attracted to natural resource endowed countries in West Africa. Given that oil, gas and mineral resources are non-renewable resources, it is vital to negotiate more beneficial and transparent contracts with oil / mining operating in West Africa, and ensure that these companies do not evade taxes. (ANYANWU; YAMEOGO, 2015, p. 211).

When considering institutional variables, it appears that foreign investors tend to consider the level of political stability to be of critical importance in determining whether or not to invest in a given economy. Interestingly, this factor appears to be more important in this decision than the specific political ideology espoused by a domestic regime or government.

Malikane and Chitambara (2017) analyzed eight countries in Southern Africa and concluded that the presence of a democratic government in the recipient country is a driver of economic growth, and that the relative level of democracy corresponds to both the effectiveness and the volume of FDI that a domestic economy receives. For this reason, countries with strong democratic institutions derive more benefits from foreign direct investment.

Rodríguez-pose and Cols (2017) show that the quality of local governance plays an important role in the distribution of FDI in sub-Saharan Africa. Once again, it appears that stable, more credible, and less corrupt regimes which possess effective business legislation foster the influx of FDI. The authors also note that the positive effects on FDI engendered by these political and legal qualities are often sustained for a considerable period of time.

3. Methodology

According to Almeida (2012, p.348), "socioeconomic phenomena are likely not to be constant across regions", an analysis of the data utilizing only an average or global response might not provide enough insight, particularly in the case of African countries where there is significant heterogeneity in terms of economic variables.

For this reason, geographically-weighted regression was employed to identify the key determinants of FDI in the African countries. This methodology allows for a local version of the linear regression analysis to be constructed. Obtaining, with the aid of sub-samples of observations weighted by the geographical distance, local coefficients for each point of space, describing the marginal effects of each variable, as explained in the following subsections.

3.1 Geographically Weighted Regression (GWR)

Consider the classical linear regression model for spatial data in cross-section:

$$y_i = \beta_0 + \sum_k \beta_k x_{ik} + \varepsilon_i \qquad (1)$$

Where: **i** indicates the regions; β_k global coefficient.

The GWR model generates a linear regression sequence, estimated for each region, using sub-samples of the distance-weighted data. The model is specified by (2).

$$IDE_i = \beta_0(u_i, v_i) + \beta_1(u_i, v_i)REG_{ik} + \beta_2(u_i, v_i)PIB_{ik} + \beta_3(u_i, v_i)INF_{ik} + \beta_4(u_i, v_i)RN_{ik} + \beta_5(u_i, v_i)EDU_{ik} + \varepsilon_i \qquad (2)$$

Where u_i, v_i, represents the coordinates of the point i in space; $\beta_k(u_i, v_i)$ is the local coefficient at the point **i**;

ε_i is the random error term that follows normal distribution with zero mean and constant variance; **IDE** foreign direct investment; **REG** Regulatory Quality; **PIB** Gross Domestic Product; **INF** Inflation rate; **RN** natural resources; **EDU** education.

By means of (2) a sequence of linear regressions was generated, with estimates made for each country and its subsamples, determined from individual weights assigned from a regression point (distance), with the hypothesis that the

influence of observations is decreasing in the distance from that point. Therefore, each observation was weighted according to its distance from a predetermined point.

In addition to the specification of this point, the GWR estimate determines the bandwidth (made through the spatial kernel), presented as a smoothing parameter, so that the larger the band, the more observations are used as the calibration point and higher tends to be the smoothing of local coefficients (ALMEIDA, 2010). In this work the adaptive Kerner was used, which extends in areas of little observation and shrinks in the denser spaces of information.

In certain situations, it is theoretically expected that some coefficients are global, while others are supposedly local. The local variables to be inserted are those that prove to be structurally unstable by means of a coefficient variability test. For this, we used the Monte Carlo test, whose null hypothesis is that the coefficients are spatially stable, with results presented in the analysis. Moreover, in the ANOVA test it obtained a value equal to 2.46 (statistically significant at 5%), indicating that the GWR model represents an improvement over the classical linear regression model. In this way, we first presented the results of the global model, and then, local coefficients only for the variables that were structurally unstable

3.2   Data and variables

To achieve the goal of this paper, table 1 summary of the variables used in the analysis. The database considers the following countries: Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan[5], Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe.

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[5] South Sudan was not considered by the sample because the country had its independence in 2011, and the data analysis considered the independent countries considering the initial period of study, the year 1996.

Table 1 - Summary Of The Variables Used In The Econometric Analysis

Variable	Measure	Source
FDI	Foreign direct investment: Inward and outward flows and stock	UNCTAD
Good governance variable	REG- Regulatory Quality (-2.5 para 2.5)	World Bank
market size	PIB- Gross Domestic Product current prices (Purchasing power parity; billions of international dollars)	IMF
Macroeconomic stability	INF- Inflation rate, end of period consumer prices (em %)	IMF
Natural resources	RN- Fuels and mining products (US dollar at current prices)	WTO
Human capital	EDU - Primary completion rate, both sexes (%)	World Bank

Source: search result.

As the geographically weighted regression only accepts data in Cross section, the means of variables were calculated from the years 1996 to 2016. The software used for the regression was the GRW4 and for the maps was Geoda.

The variables described below follow the model proposed by Rodríguez-Pose and Cols (2017).

3.2.1 Foreign Direct Investment

The dependent variable is represented by the Foreign direct investment of the 53 countries mentioned above. According to Rodríguez-Pose e Cols (2017, p. 69) "FDI inflow are preferred to stocks as they present a snapshot of the current situation without (or only marginally) taking into account the historical events that have influenced a country's FDI stock".

In 1996, the country that received the most FDI expressed as a percentage of GDP was Equatorial Guinea with 72.79%, and the lowest FDI as a percentage of GDP was Liberia, a relative difference of 53.53%. In 2016 the country that received the highest FDI as a percentage of GDP was the Congo with 45.83% and the least was the Gambia with a decrease of 2.80%.

3.2.2 Regulatory Quality

Regulatory Quality captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development. Estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5 (WORLD BANK, 2019).

In 1996, the African country with the best regulatory quality was Botswana at 0.65. Somalia had the worst performance, with -2.35. By 2016, the country with the best performance was Mauritius, with 1.02 and Libya with -2.27 performed the worst performance. On average (between 1996 and 2016), Mauritius showed the best performance with 0.70 and the worst performance overall belonged to Somalia with -2.35 over the period studied.

Figure 1 – Regulatory Quality: 1 (a) 1996, 1 (b) 2016, 1 (c) Average 1996 to 2016 - Countries
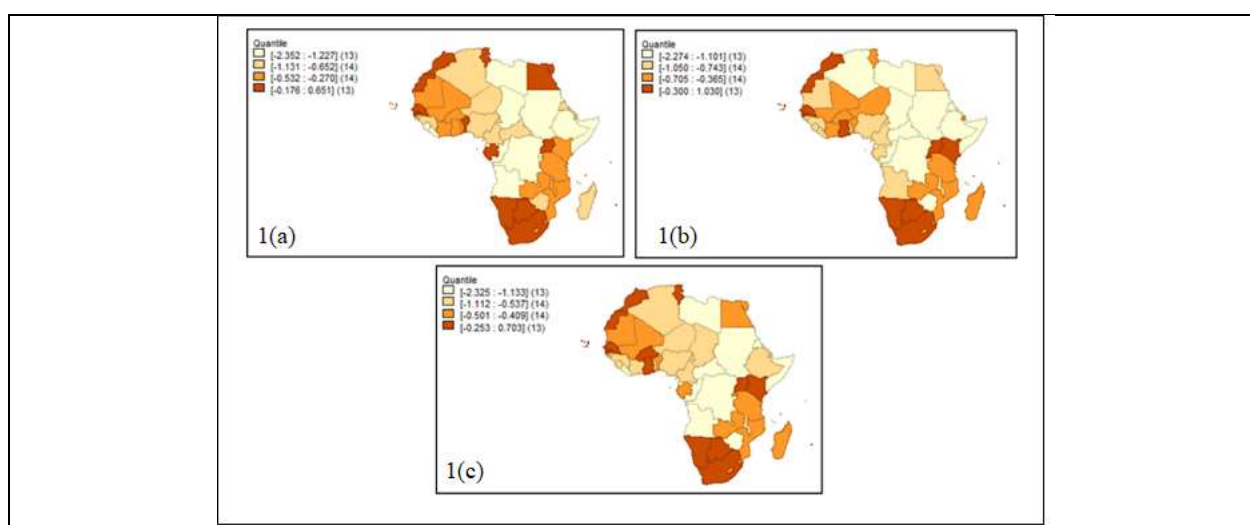
Source: Own elaboration using World Bank data.

3.2.3 Market size

Market size is represented by gross domestic product (GDP) measured in billions of dollars at current prices. GDP is the most commonly used single measure of the global economic activity of a country and has long been considered a key element of foreign direct investment worldwide (IMF, 2008).

For 1996, Egypt had the highest GDP in Africa, while Sao Tome and Principe had the lowest GDP in Africa. These two countries maintained their relative positions throughout the study period.

Per capita GDP[6], is defined as the total value in terms of purchasing power parity (PPP) of final goods and services produced within a country during a specified period of time divided by the average population for the same year. For 1996, the country with the best per capita GDP was Libya with $19152 and the country with the lowest per capita GDP was Mozambique with $338.

For 2016, the country with the highest GDP per capita was Equatorial Guinea with $38923 and the country with the lowest GDP per capita of $652 was Central Africa. On average, Equatorial Guinea continues to have the highest GDP per capita, while the Democratic Republic of Congo has the lowest GDP per capita.

Figure 2 – Gross Domestic Product: 2 (a) 1996, 2 (b) 2016, 2 (c) average 1996 to 2016 - African countries
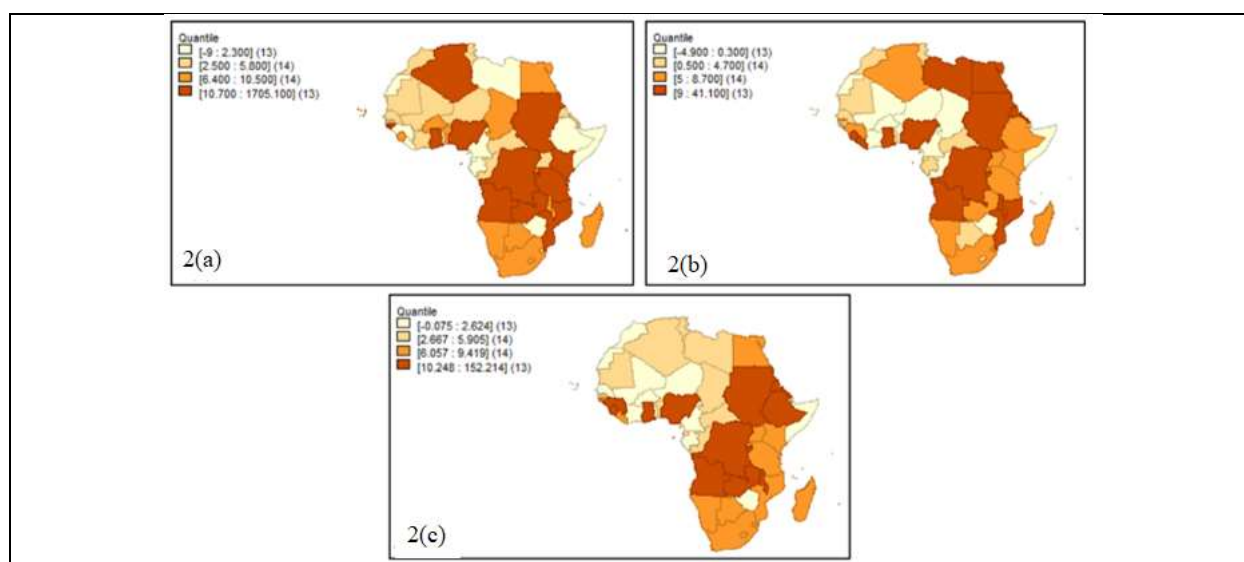
Source: Own elaboration using IMF data.

3.2.4 Macroeconomic stability

Macroeconomic stability of the recipient country is also a powerful driver of FDI. Economic stability is an important consideration for foreign investors as it provides the potential investor reasonable reassurance of a reliable return on investment and the sustainability of their investment.

For this paper, we used the inflation rate as a proxy for macroeconomic stability. Aseidu (2006) stated that the expected signal for this variable is negative because it affects negatively attracting foreign direct investment, whereas for

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[6] Purchasing Power Parity (PPP) is a theory which relates changes in the nominal exchange rate between two countries currencies to changes in the countries' price levels (IFM, 2018).

Chiatchoua and Pegou (2015), the expected inflation signal is positive, because those countries are growing economies, with purchasing power parity being relatively low.

In 1996 the Democratic Republic of Congo had the highest inflation rate (1705% per annum), and Ethiopia had negative inflation of -9%. For the year 2016 Angola presented the highest inflation rate per year (41%) and Chad the lowest variation (-4.9%). On average (1996 to 2016), the Democratic Republic of Congo had the highest rate of inflation (152%) and Gabon had the lowest rate (1.35%).

It is important to note that inflation data for Zimbabwe was only available from 2009 onwards. The absence of this data has an unknown impact yet most likely very significant impact on determining which African country had the highest inflation rate during the study period, particularly since the Zimbabwean economy went through a period of hyperinflation from 2008 to 2009

Figure 3 – Inflation rate: 3 (a) 1996, 3 (b) 2016, 3 (c) average from 1996 to 2016 - African countries
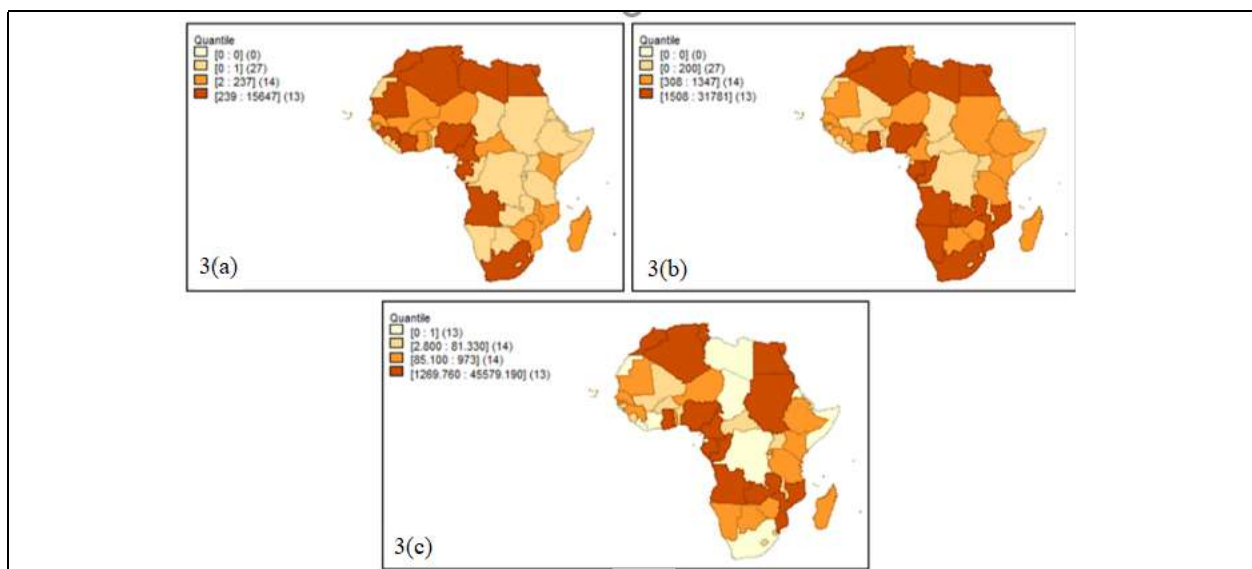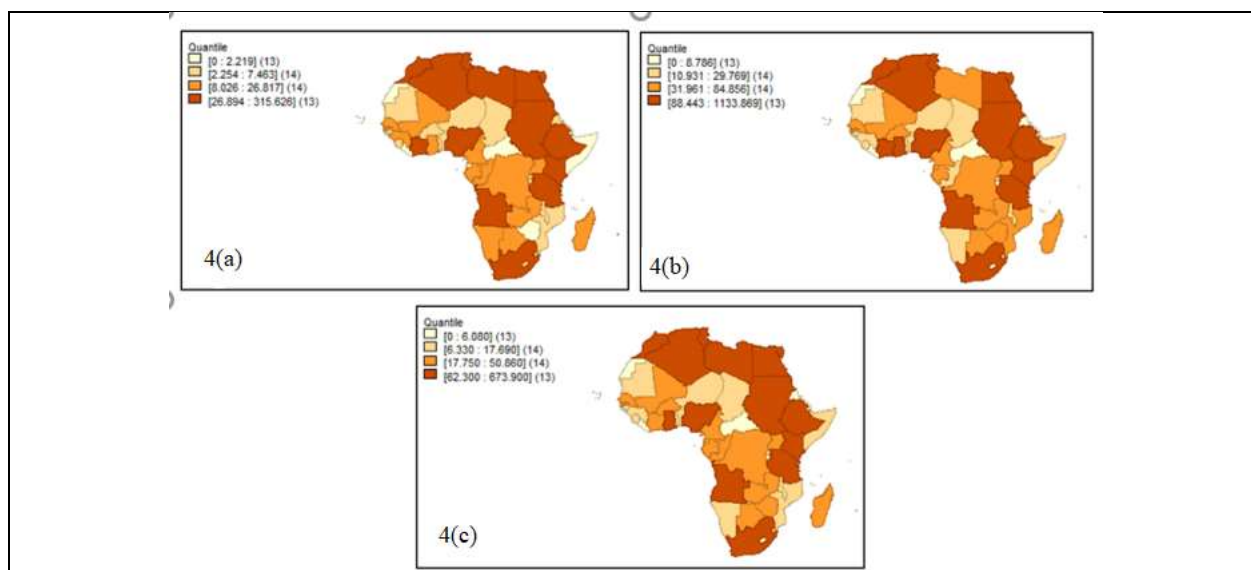

Source: Own elaboration using IMF data.

3.2.5 Natural resources

The African continent is rich in natural resources, and historically the income from these resources has been a substantial source of revenue for these countries. Therefore, the variable Oil and minerals was used in this analysis

Aseidu (2006) shows that the expected sign of this coefficient is positive, concluding that the presence of exploitable natural resources attracts FDI to

recipient country. Okafor (2015), in contrast, cautions that the cost of natural resources, specifically fuels, may have a negative impact on FDI. As demonstrated in Figure 5, Africa's largest exporter of fuel is Nigeria, this occurred both in 1996 and 2016.

Figure 4 – Oil and minerals: 4 (a) 1996, 4 (b) 2016, 4 (c) average 1996 to 2016 - African countries

Source: Own elaboration using WTO data.

3.2.6 Human capital

Human capital is represented by the primary completion rate[7]. According to Rodríguez-Pose and Cols (2017), the human capital endowment has a direct relation with the level of FDI. However, this association is likely to be mediated by the type of investment that comes to the country and therefore it is not always clear that the association would always be positive, depending on the type of productive activity that is attracted.

For the year 1996[8], Mauritius has the highest index of 93% and the lowest index belonged to Niger at 14%. In 2016[9] Seychelles has the highest rate of 126%,

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[7] Total number of new entrants in the last grade of primary education, regardless of age, expressed as percentage of the total population of the theoretical entrance age to the last grade of primary. This indicator is also known as "gross intake rate to the last grade of primary education." World Bank, 2018)

[8] Data not available for 1996 for the following countries: Cape Verde, South Africa, Zimbabwe, Ghana, Nigeria, Sao Tome and Principe, Zambia, Tanzania Sierra Leone, Comoros, Cameroon, Liberia, Sudan, Democratic Republic of Congo, Uganda, Rwanda, Mali, Burundi, Guinea Bissau, Equatorial Guinea, Angola, Mozambique, Central Africa, Libya, Somalia

[9] Data not available for 2016: Ethiopia, Chad, Guinea, Eritrea, Benin, Togo, Congo (Rep), Swaziland, Malawi, Gabon, Namibia, Tunisia, Botswana, South Africa, Zimbabwe, Ghana, Nigeria, Zambia, Tanzania,

and Central Africa with 42%. The average Seychelles has the highest rate of 109%, and the lowest rate is represented by Chad with 27%. This rate may exceed 100% due to children under 18 and under who enter elementary school late or early, repeat grades, or both.

Figure 5 – Primary completion rate: 5(a)1996, 5(b) 2016, 5(c) average 1996 a 2016 – African countries
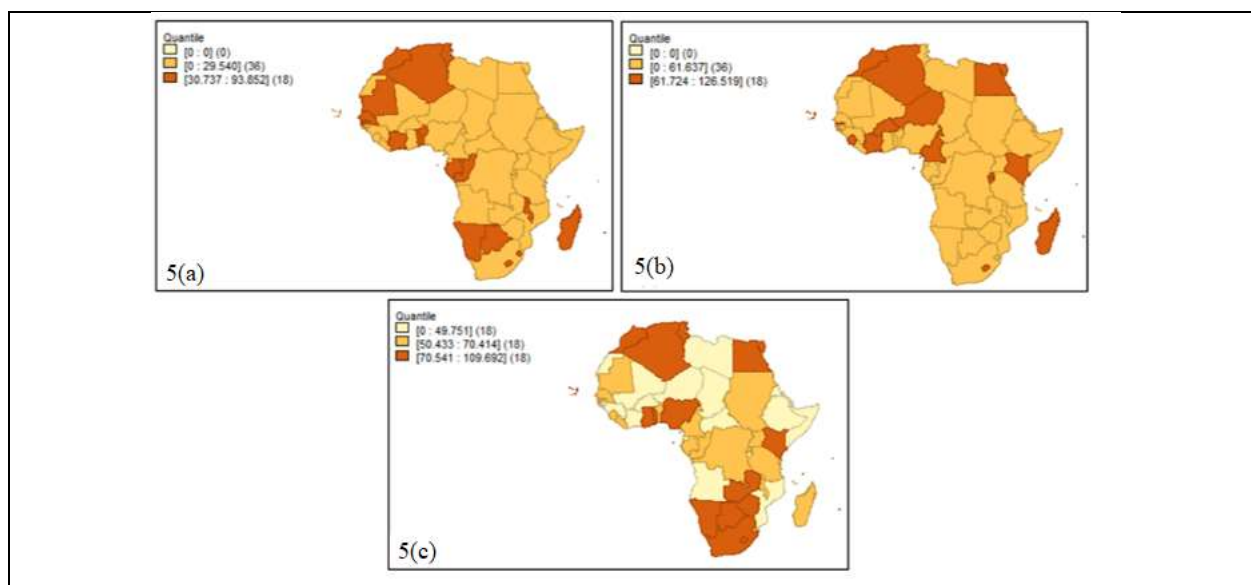
Source: Own elaboration using World Bank data.

4.   The Fdi Determinants In African Countries: Local Analysis

The FDI is an important channel for the contribution of economic growth of an economy especially for injecting inversions in the domestic productive activity, promoting a stimulus, direct and indirect, in local production, with the generation of jobs and income. In addition, it can create an environment conducive to technological overflows, raising the overall productivity of the economy. It is in this context that different authors refer to FDI as being fundamental to the process of economic growth in a region, especially those with low investment rates.

On the African continent (Chart 1), there is a positive trend in the growth of foreign investment, rising from 1.4% in 1996 to 6.8% in 2011, with annual averages of 5% from 2010 onward. Even in periods of crisis (2007/2008), the increases in external investments in productive activity were positive, evidencing

Comoros, Liberia, Sudan, Democratic Republic of Congo, Equatorial Guinea, Guinea, Angola, Mozambique, Libya, Somalia

internal characteristics of the region that continue to attract investments even when conditions are suboptimal.

Table 2 confirms this evolution. The average FDI of the continent from 1.43% in 1996 to 4.65% in 2016. In addition, the minimum percentage of FDI flows also increased. confirming the intensification of these investments' countries.

Chart 1 – Average FDI flow in African countries - 1996 to 2016
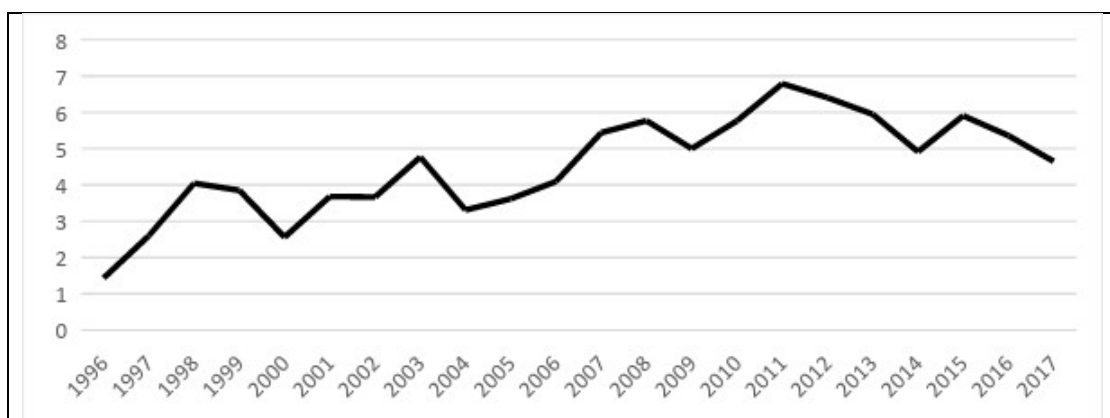
Source: Own elaboration using UNCTAD data.

Table 2 – Descriptive statistics on the flow of FDI - African countries – 1996 e 2016 (%)

| Statistics	1996	2016
Mean	1.434	4.649
Standard deviation	3.659	3.662
Coefficient of variation	255.224	78.769
Maximum	72.793	27.009
Minimum	-53.534	-2.929

Source: Own elaboration using UNCTAD data.

However, not all countries have also received these flows of FDI. In 1996, only Equatorial Guinea eclipsed 5% FDI, whereas by 2016 there were fourteen countries with flows in excess of 5%. This data demonstrates the spatial concentration of this attraction; foreign direct investment tends to be concentrated in a few select countries in the region. This finding is further confirmed in Figure 6, which demonstrates that the largest FDI inflows have tended to cluster in the same cluster of countries over time.

It should be noted that even though there is a consistent pattern of FDI being distributed unevenly among African countries, this variability in FDI between

nations is diminishing over time. In 1996, the coefficient of variation (Table 2) of the FDI flow was 255%. This value decreased to 78% by 2016. In other words, African countries managed to raise the average of attraction, which also served to simultaneously reduce the heterogeneity in FDI amongst them.

Figure 6 – Foreign Direct Investment: 6 (a) 1996, 6 (b) 2016, 6 (c) Average 1996 to 2016 - African countries
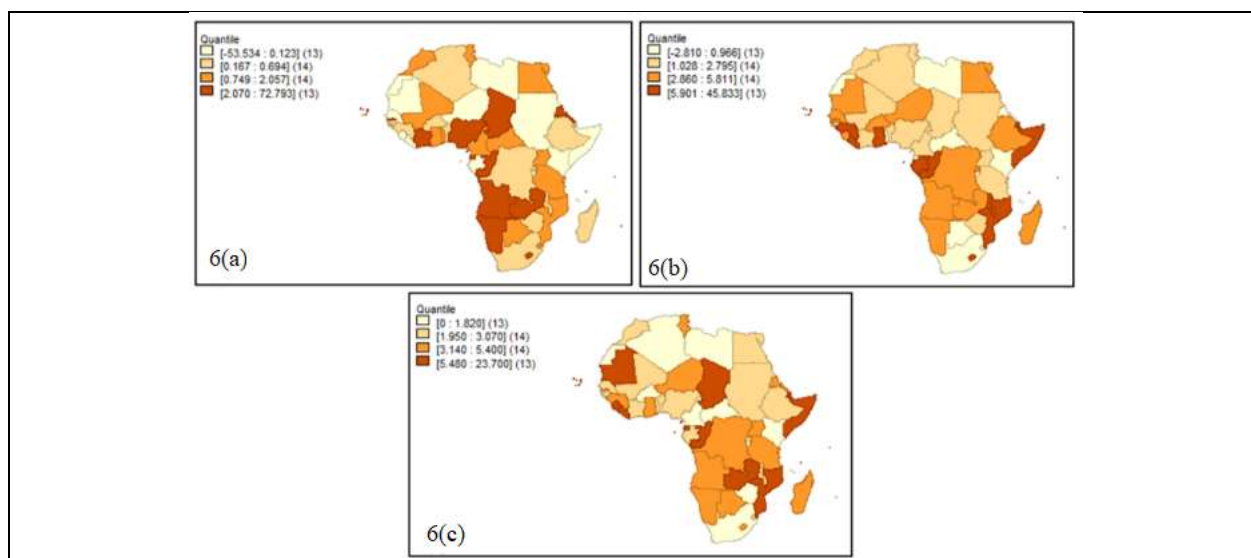
Source: Own elaboration using UNCTAD data.

From these results, it is reasonable to conclude that some African countries have a greater potential to attract foreign investment than others. It can also be inferred that, over time, this gap is being bridged as African countries become more successful at attracting foreign investors. Given these observations, is it possible to determine which factors are driving the induction of these inversions?

In order to verify the determinants of foreign direct investment, we employed both global and local linear regression models. The results of the global model (Table 3) confirm the hypothesis that market size exerts a positive effect on the FDI. Additionally, the presence of onerous or ineffective business law that stifles development in the private sector has a negative effect on foreign direct investment as well as domestic production.

Notably, variable inflation and natural resources were found to possess coefficients with signs contrary to our expected findings. Considering positive sign for inflation, Chiatchoua and Pegou (2015) infer that this may finding may be the be due to the fact that these countries have growing economies with relatively-low purchasing power parity. Regarding natural resources, our findings echo those

of Okafor (2015) and Hayat (2018), each of whom determined that poor domestic economic growth in regions that depend heavily on natural resources also has a negative impact on the attraction of FDI to the region.

Table 2 – Global Coefficients Results - Model (2)

IDE	Estimate
Intercept	7.898***
	(8.198)
REG	-2.198**
	(-2.120)
PIB	11.750
	(10.945)***
INF	2.589
	(2.326)***
RN	-3.574
	(-4.194)***
EDU	-0.274
	(-0.236)
Classic AIC	371.829
AIC	374.264
R^2	0.780
Adjusted R^2	0.752

Note: t statistics is in parentheses. *, **, and ***denote significance at 0.10, 0.05 and 0.01 respectively.

After considering data from the global models, we next investigated the impact of local conditions on the inflow FDI in African countries, particularly with respect to the economic heterogeneity that exists on the continent. In order to corroborate the assumption of better fit of the GWR model in relation to the global coefficients model, the ANOVA test was performed, obtaining a value equal to 2.46, rejecting the null hypothesis, thus suggesting that the GWR model is the more suitable for estimating foreign direct investment for African countries.

The results of the local coefficient test provide guidance on whether it is more accurate to assume either a local or global term to each variable. We determined that the only variable to assume a global term is human capital. Table 3 presents these results.

Table 3 – Test of local coefficients

Variables	*DIFF of Criterion*
Intercept	-2.028
REG	-2.710
PIB	-1.364
INF	-1.481
RN	-0.877
EDU	2.221

Note: positive value of diff-Criterion suggests no spatial variability in terms of model selection criteria.

GWR was estimated by a coefficient for each country for each variable. Figure 7 shows the distribution of these local coefficients. In Figure 7a, we show that positive levels of "economic stability" (for which we used the inflation rate as a proxy), reached statistical significance in only 44% of African countries in our study from a standpoint of the local model's data. We feel that this indicates a negative correlation between economic instability and inflow of FDI. The explanation of this may lie in the superior economic dynamics that are found in these spaces. Even though they oscillate economically, these countries also have superior economic dynamics due to their economy existing in a growth phase. This robustness appears to be a strong attractor of the observed external inversions (CHIATCHOUA; PEGOU, 2015).

In the case of regulatory quality, only 48% of the countries had positive and statistically significant effects (figure 7 (b)). The governments of these countries were able to formulate and implement sound policies and regulations that fostered private sector development, which in turn become crucial in attracting FDI.

Natural resources (Figure 7c) and market size (Figure 7d) each reached statistical significance in all of the countries that we studied. These two variables are considered by multiple authors to be of extreme importance in attracting foreign direct investment, and this is especially true of countries in Africa.

This explains, in part, the discrepancy of some countries in their ability to attract FDI. In comparing Figure 2 (relative to GDP) with Figure 6 (referring to FDI), it can be seen that the highest values of FDI occur in the spaces with the most dynamic economies. Theoretically, part of the production carried out by transnational companies occurs in those countries, so high economic dynamism is required to attract investment from these companies. Krugman (1991) argues as a

determinant of the attraction of companies to a locality, that is, to have a near consumer market.

Human capital is represented in Figure 7e, which did not reach statistical significance for any country in this study. This can be justified by countries having a very low human capital level. As indicated by Rodríguez-Pose and Cols (2017), there is a positive correlation between human capital endowment and FDI for a given country. This association is likely to be mediated by the type of investment that arrives in the country, and it the association is not always positive with respect to economic growth. Depending on the activity that is attracted to the region, the differentiation of labor productivity is not the differential attraction of these investments.

Figure 7 – Local coefficients for estimation (2) - African countries
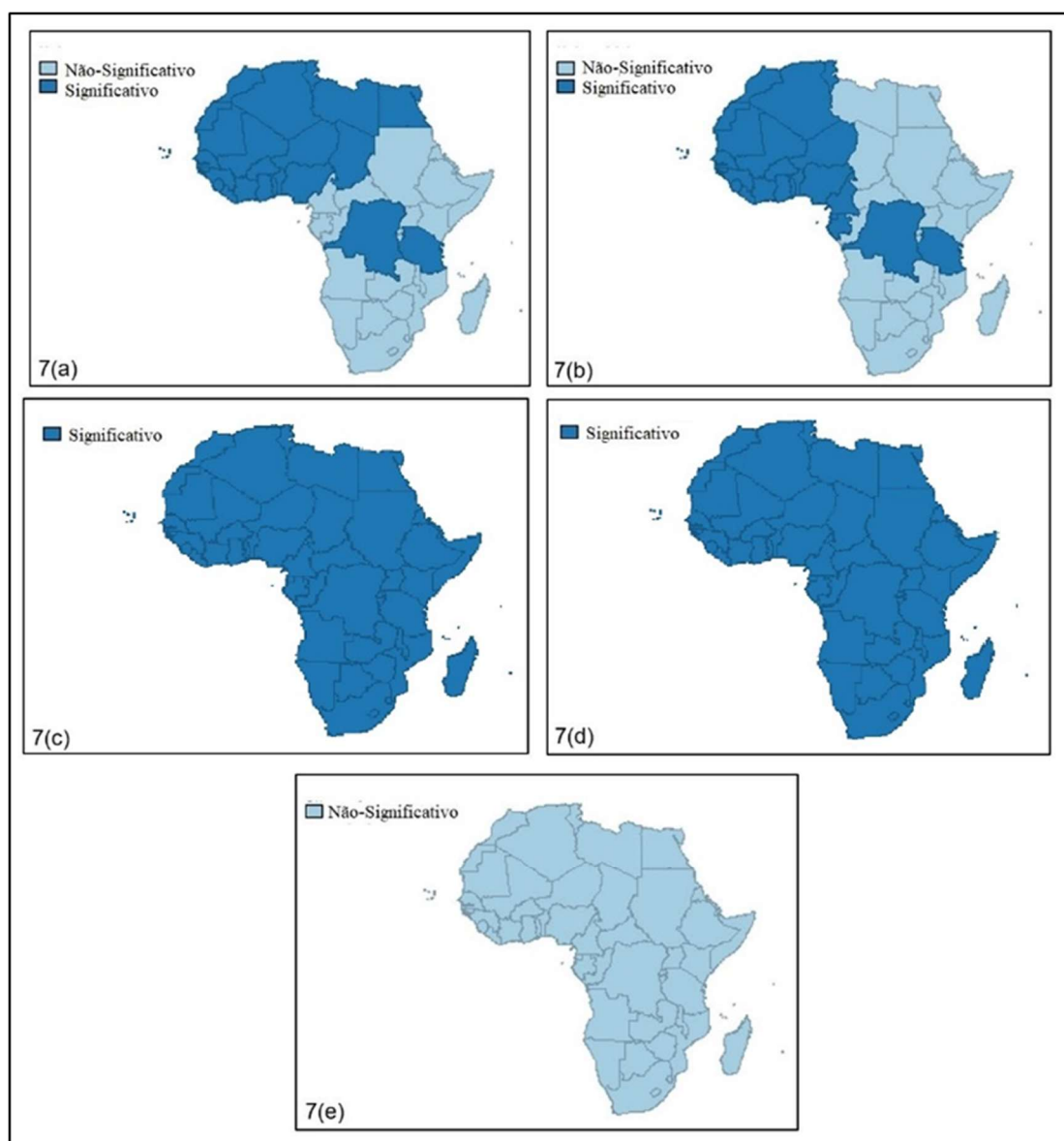
5.   Conclusions

The countries of Africa have been characterized by extreme heterogeneity on economic and many other levels. This paper represents an initial attempt employing geographically-weighted regression models to analyze the determinants of foreign direct investment in 53 countries in the period of 1996 to 2016

The hypothesis that market size has a positive effect on FDI has been verified. Additionally, the importance of regulation that allows and promotes private sector development was also shown to stimulate FDI. In contrast, both

variable inflation and natural resources demonstrated an opposite coefficient to our expectations when a global regression model was employed.

For the local analysis, the primary results show that the key variables for the attraction of FDI are market size and natural resources. Each of these variables was statistically significant for all the countries of this sample. In this way, the creation of public policies that induce the local market expansion, improvement of human capital, and the improvement of regulatory are very important channels for attracting FDI to the countries of Africa.

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