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Inward Foreign Direct Investments in Africa: characteristics, country determinants and the recent upsurge of R&D activities

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ABSTRACT

For many years, governments in developing countries, such as the African ones, tried to boost Foreign Direct Investment (FDI) inflows, believing that this type of investment could have a key role in the transfer of innovative technologies in their country and thus encourage their economic growth.

However, even though over the past decades there has been an important improvement of FDI inflows to African countries, there is little evidence of a positive impact of FDI on technological innovation in these developing countries. The reason is that technology transfer can be mainly achieved if the foreign investment regards Research & Development (R&D) activities, which are proved to stimulate innovation among domestic firms. Most of FDI inflows to African countries are instead concentrated on manufacturing, extraction, and construction activities.

Nevertheless, stylized facts show that, after 2017, there has been an important growth of FDI inflows related to R&D activities, in Africa.

The aim of this research is to understand if the determinants of the location of FDI inflows to Africa, related to R&D activities, are changing over time. In particular, since there has been this significant variation in FDI related to R&D after 2017, it has been decided to split the analysis into two different time spans, even though the number of investments is not comparable.

First of all, it will be created a "choice set" made by the most important determinants that usually influence the foreign investor in the choice of the host country.

Secondly, for studying the determinants of the investments, it will be implemented a set of conditional logic models to estimate the probability that an FDI will be made in a certain country on the basis of observable country's features.

Lastly, in order to assess the peculiarity of FDI related to R&D activities with respect to the others, it will be studied the effects of the interaction between the determinants and a dummy "R&D" variable, in the two time spans if possible.

Summarizing, if findings will show that the choice of FDI related to R&D activities, in the second time frame, is driven by different determinants, it could be affirmed that foreign firms are more willing to invest in innovation and thus to transfer technology to African countries.

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CHAPTER 1: INTRODUCTION

1.1 Foreign Direct Investments in a nutshell

Different definitions of Foreign Direct Investments, abbreviated with FDI, have been introduced over the years. According to the Financial Times, one of the most ancient and internationally recognized newspaper in the world which focuses on business and economic current affairs, it is "an investment in the form of a controlling ownership in a business in one country by an entity based in another country" (Financial Times, n.d.).
It can be seen as the concept of "controlling ownership" should be further defined. Especially, controlling ownership occurs when there is an ownership interest in a corporation with enough voting stock shares to prevail in any stockholders' motion. However, this last concept can be perceived differently based on the situation. "Standard definitions of control use the internationally agreed 10 percent threshold of voting shares, but this is a grey area as often a smaller block of shares will give control in widely held companies" as stated by the Financial Times (Financial Times, n.d.).

Before entering in detail, it should be clear the distinction between FDI and foreign portfolio investments which sometimes, can lead to misunderstandings.
As a matter of fact, a foreign portfolio investment is, in an economics sense, the entry of funds into a country where foreigners deposit money in a country's bank or make purchases in the country's stock and bond markets, sometimes for speculation (Sheffrin & Steven M., 2003).
The main distinction regards the element of "control" which can be exercised with the so-called voting power.
This is why, it should be briefly analyzed how a foreign investor can acquire voting power in an enterprise. This can be done mainly through one of the following four methods (Bhattacharyya & Srijanee, 2012).
The first one regards the incorporation or creation of a wholly owned subsidiary in the host country. Similarly, it can be also created a manufacturing base.
The second method is related to the acquisition of shares in the associated enterprise. The importance is to buy shares with voting right and if it is the case, the amount of control that the investor will have upon the corporation depends on the percentage of voting share which he owns.

The third way to acquire voting rights in an enterprise is through the so-called M&A, i.e. merger or acquisition of an unrelated business.
Lastly, voting rights can be obtained also participating in an equity joint venture with an enterprise based in the host country.

Coming back to the main issue of FDI, a distinction between the notions of inorganically and organically investments should be introduced. In particular, the former is referred to the acquisition of a company in the target country while the latter is instead only the expansions of the operations of an existing business, already owned by the investor in the foreign country.
Consequently, common investments which can be daily red in newspapers such as mergers and acquisitions, the construction of new facilities from a foreign company, the reinvestments of profits earned from overseas operations and intra company loans are all part of the more generic term of FDI.
Based on the relation between the investment and its position in the company's value chain three types of FDI have been found (Paul Boyce, 2020).
According to Paul Boyce, a horizontal FDI occurs when a firm invests in operations, in a foreign country, at the same level of the value chain.
A vertical FDI occurs instead when through an investment in a foreign country, the firm moves upstream and downstream in its value chain. On the one hand, in case of purchase of a supplier of the parent company, it is called backward vertical integration. For instance, when Hershey's, a US chocolate manufacturer decided to buy a cocoa beans producer based in Brazil. On the other hand, when the parent company decides to invest in a distribution channel it is called forward vertical integration. Taking into account the same company of before, Hershey's could buy a share in Alibaba where its products are sold.
It should be outlined as in both examples, the parent firm is making investments related to its core operations.
In case of investments in a completely different industry which is not related to the investor's business at all, there is talk of conglomerate FDI. In particular, this last type of investments offers to companies the opportunity to explore new and diversified businesses.

Among all the effects already mentioned which are connected to FDI, such as the participation in the management of a foreign company or the creation of a joint venture, an aspect which is fundamental in this thesis is the transfer of technology.

1.2 FDI Global Trend

Since the 1950, it has been seen an increase in FDI all over the world. This trend is explained by an improved economic growth coming from the influx of capital and increased tax revenues for the host country, as stated by Sarkodie et al. (2019).

Usually governments try to promote inward FDI and channel them into the construction of new infrastructure useful for the society or other project we could enhance the country's development.

Another advantage which is usually brought by FDI is an increase in the local competition due to the arrival of foreign competitors. This fact can lead all companies in the industry to try to reach higher levels of productivity and efficiency. According to Sarkodie et al. (2019), it has been also proved that the application of a foreign entity's policies to a domestic subsidiary may improve corporate governance standards.

As already mentioned, FDI can eventually imply a technological transfer. It can involve the transfer of soft skills which happens through training for instance, the availability of more advanced technologies for the domestic market and even the access to research and development resources.

Furthermore, the arrival of new foreign businesses can also bring new job opportunities for locals (UNCTAD, 2010).

Analyzing the FDI trend after the 2008 financial crisis, following a partial recover in 2015, since then there has been a general decrease in global FDI (UNCTAD, 2019). This trend can be seen in Annex 1.

As a matter of fact, apart from the estimate significant decrease in global FDI in this year, i.e. 2020, which is mainly due to the crisis brought by the Covid-19, already the 2018 was the third consecutive year's fall in FDI. According to UNCTAD's 2019 World Investment Report, this trend was mainly due to a significant decrease of FDI inflows in developed countries. For instance, US inflows decreased due to the consequences of tax reforms introduced at the end of 2017 and similarly there has been a decrease in the United Kingdom inward FDI.

Only the 2019 has seen a marginal increase of FDI flows, which rose by 3 percent respect to the previous year. This trend was coming from a high level of investments from European countries, in particular Ireland and Switzerland (UNCTAD, 2020).

Regarding the developing countries, up to the 2018, FDI flows registered a slight but constant increase (UNCTAD, 2019). Only the 2019 has seen a marginal decrease in FDI inflows by 2 per cent respect to the 2018 (UNCTAD 2020).

Besides, it should be outlined the growth of greenfield projects in developing economies. Greenfield investments are a type of foreign direct investment in which the MNC builds its operations from the ground up, thus starting with the creation of subsidiary in the host country and then expanding its operations, i.e. investing in the construction offices, plants and distribution hubs, for instance.

In developing countries, there has been an important increase in announced greenfield investments in manufacturing, in particular the value of these announced projects rose by 68 per cent. These manufacturing projects are defined to be extremely important for the industrial progress of developing countries. Although it must be said that most of these announced investments are concentrated in Asia, as it can be seen by Annex 4, there has been also a significative rose of the value of FDI greenfield projects in Africa in 2018, actually by 60 per cent to a value of $ 33 billion (UNCTAD, 2019).

What is more, the effective number of manufacturing projects in developing countries rose by only 12 per cent, outlining that the high value of announced greenfield investments is likely to be an effect of the plan of a few large-scale projects.

Regarding announced greenfield projects in lower skill industries, the trend in developing countries is not satisfying. For instance, there has been a decline of the value of projects in the textile industry by 36 per cent (UNCTAD, 2019).

This decrease in the value of greenfield project in low-income countries like the African ones, especially in early-industrialization industries like the textile one, represents a concern for African economies. Consequently, African governments are implementing more and more industrial policies and special economic zones, in order to attract more FDI in these sector and support country's industrialization.

Due to Covid-19 crisis, the future for the entire world is expected to be tough.

In terms of impact on FDI in the short-term, lockdown measures will slow down the implementation of ongoing projects, M&As and new projects starts. Then the problem will be the demand shock which will further negatively impact FDI flow (UNCTAD 2020).

As a result of these considerations, according to UNCTAD's 2020 World Investment Report, in 2020 FDI flow is forecasted to decrease up to 40 percent respect to the previous year and it

is expected to be followed by a further decrease in 2021 by 5-10 percent. Hopefully, the recovery will start in 2022. These considerations can be seen in the Annex 2.

1.3 FDI Flow to Africa

The main issue of this thesis is to analyze the FDI in Africa and how did they change over the years.

First of all, it should be distinguished two temporal situations, the one before and after the crisis brought by Covid-19.

According to data retrieved from UNCTAD's 2019 World Investment Report, in Africa recent results showed that, in 2018, inward FDI rose to $46 billion after two years of falls. However, this achievement is mostly related to an increase of FDI directed to South Africa and also due to non-resource-seeking investments which are increased lately. The major investors in the whole continent were still from developed economies, as it is proved by the fact that France kept its supremacy, remaining the largest foreign investor in Africa, followed by the Netherlands. Especially, the majority of investments, coming from these two nations, involved the major hydrocarbon-producing economies, such as Nigeria and Angola.

Investments in the energy sector are instead coming from Italy, which is recently investing more in Sub-Saharan African (SSA) countries.

However, many MNEs coming from developing countries, like China, Singapore, India and Hong Kong started to invest more and more in this region and entered the top 10 of African's investors. Later in these papers, some significant considerations will be done regarding the increase of the stock of China's FDI in Africa, which substantially augmented over the last five years. Although this growth could have helped the whole Africa's growth, the share of FDI in Africa respect to the total amount in the world decreased over the years. This result showed how, over time, the gap between developed countries and Africa's developing countries only increased.

Concerning the sub-Saharan countries, in 2018, there was a slight increase of FDI inflows, by 13 percent respect to 2017. In particular, FDI amounted to $32 billion (UNCTAD, 2019).

Nevertheless, it should be highlighted how this trend is more due to a recover from South Africa's economy rather than a significant improvement from the subregion, which instead suffered a bit from political uncertainty and unfavorable economic fundamentals, as stated by UNCTAD's 2019 World Investment Report.

However, already in 2019, there was a 10 percent decrease in FDI flows to SSA respect to the previous year. According to UNCTAD's 2020 World Investment Report, the main reasons are the moderate GDP growth of this area and a decrease of the demand for commodities, which negative affected developing countries relying on diversified and natural resource-oriented investments.

It could have been imagined, since the Covid-19 crisis negatively affected the world economy, how much this had an impact on the Africa continent and in particular on those developing countries which relied on FDI coming from developed economies. According to UNCTAD 2020 report, "FDI flows to Africa are forecast to decline by 25 to 40 percent to $25-$35 billion" (UNCTAD 2019). Consequently, there will be a slowdown in the attempt to improve African economic diversification and industrialization.

1.4 Prospects for Africa

The next years will be mark by a recovery period and as a result there will be almost no growth in the flow of FDI to Africa.

However, the prospects for the long- term period are positive, and this will be highlighted with the following considerations.

First of all, the implementation and ratification of the African Continental Free Trade Area Agreement (AfCFTA), signed by forty-four out of fifty-five African countries and representing the biggest agreement since the creation of the WTO in 1995.

It will remove tariffs for most of the goods allowing a sort of free access to commodities and services (The Economist, 2018).

Since the short-term consequences of this agreement is supposed to be a decrease in the price of goods, this should encourage investments which are market-seeking.

Nevertheless, according to UNCTAD's 2018 World Investment Report, this FDI's stimulation could be reach only if the other purpose of the AfCFTA will be reached, which is to find a solution for the numerous non-trade barriers, such as poor infrastructure, inefficient border posts and Intellectual Property Rights defense.

Secondly, foreign investors have the intention to develop recently discovered mineral mines and hydrocarbon fields.

Lastly, it should be also mentioned the US implementation of the "Better Utilization of Investments Leading to Development Act", which created a corporation authorized to make equity investments. In particular this act is made with the intent to mitigate the risk of

investments in large-scale projects by private US firms and supporting them with administrative special funds (UNCTAD, 2019).

However, this last consideration must take into account the strong negative consequences that Covid-19 will have on US economy.

1.5 Determinants of FDI flows to Africa in the past

It has been seen in the previous paragraphs as, apart the COVID-19 period, there has been an increase of FDI flows to Africa over the time. Consequently, with the purpose of further improving this level, various researches in the past were aimed to find the determinants of inward FDI to African countries.

According to the "industrial organization theory", which states that in the internationalization process foreign firms have to face inconveniencies respect to local firms which are already in the market, a set of advantages, i.e. the FDI's determinants, are required (Hymer, 1976; Kindleberger, 1969). These advantages include lower transaction costs, the ability to minimize technology imitation and to maintain reputation by effective management and quality control (De Beule & Bulcke, 2009).

A previous theory was based on the differential rate of return hypothesis, i.e. among countries exist differences in relative factor intensities and factor endowment and thus capital will flow from a country which is capital abundant to one which is not, enjoying an higher rate of return since capital is less abundant (Calvet, 1981).

The location theory states that FDI derive from the international immobility of some factors like labor, knowledge, markets and natural resources (Nagesh, 1994).

Lastly, the eclectic theory (OLI) is a combination of the previous mentioned theories and it is based on the idea that foreign firms, owning specific assets that can be internalized and exploited in the host country, in case of FDI will have an advantage in starting to produce abroad (Dunning, 1980; Dunning, 1998).

Regarding the Africa, there are some theories that in the past were trying to explain the relation between FDI and African countries, in particular SSA ones (Sub-Saharan African countries).

On the one hand, the small share of FDI was mainly attributed to the fear, from SSA countries, of the injection of foreign capital which could have led to loss of political sovereignty, an increase in competition and thus a threat for domestic firms and the exploitation of their natural resources (Dupasquier & Osakwe, 2005).

On the other hand, at the same time foreign investors were seeing SSA as an unattractive market due to political and economic risks, low quality of labor, the lack of infrastructures, highly

inefficient and costly financial systems and the distance from export markets (Ezeoha & Cattaneo, 2011; Pigato, 2000).

However, according to the recent empirical research of Godwin Okafor et al. (2015), which used a sample of SSA countries for the period 1996-2010, FDI in SSA countries are positive related to factors such as market size, return on capital, human capital and trade openness.

A negative relationship with FDI is instead related to other factors like rent from natural resources, corruption, inflation and cost of fuel.

The research found out that the motivations of FDI in SSA are mostly market, efficiency and strategic assets seeking while FDI are less motivated by resource seeking.

CHAPTER 2: AFRICAN COUNTRY TRENDS

This chapter has the intent to analyze the recent FDI trend for the most significant African countries and which are the industrial sectors that are gathering most of investments.
In particular they are taken into account a few countries for the West, East, Central and Southern regions of Africa. In this way, it can be also seen an overview of the regions where FDI inflows tend to go mostly.
The implications brought by Covid-19, being still quite unpredictable, they are intentionally not taken into consideration.
Before starting the analysis, it should be underlined that most of the data used in this thesis is retrieved from FDI market, which takes into account also investments which are not yet realized but where there is a strong intention to realize them.

2.1 Nigeria

Recently FDI flows to Nigeria have been negatively affected by the political instability that the country suffered due to the government's election and the risks that these elections entailed.
According to UNCTAD's 2019 World Investment Report, there have been also a few conflicts between foreign MNEs and Nigeria's government. UK and Swiss companies, respectively HSBC and UBS, closed their local representative offices in the country and MTN, a South-African telecommunication company, had issues related to the repatriation of profit (UNCTAD, 2019).
However, a positive aspect is the diversification of FDI inflows due to the launch of new technology start-ups, supported by South Africa and by international venture capitalist (UNCTAD,2018).
Types of market seeking FDI which should be mentioned are the ones made by some US firms such as Uber, Facebook, Emergent Payments and Meltwater group. There are also some Chinese investments which are efficiency-seeking manufacturing FDI, mainly focused on the textile, automotive and aerospace industries (UNCTAD, 2018). Even though international oil companies had to pay $20 billions of back taxes, this industry remained the leading one in terms of investments, as it can be seen by the grey column in the following graph.
Moreover, lately the government implemented new policies to achieve a desired digital economy (Nigerian Communications Commission, 2020).

The first step was identified with the necessity of growing in the ICT sector and this is why, in the FDI graph, the amount of investments in communication represents the second traction for foreign investors. The third sector attracting most of FDI is the chemical one with significant investment coming from "Office Cherifien des Phosphates (OCP)", Moroccan company specialized in the production of phosphate fertilizer, and "Indorama Eleme Fertilizer & Chemicals", Singapore based company which represents the largest producer of granular urea in Sub-Saharan Africa. The product is fundamental for agriculture reasons.

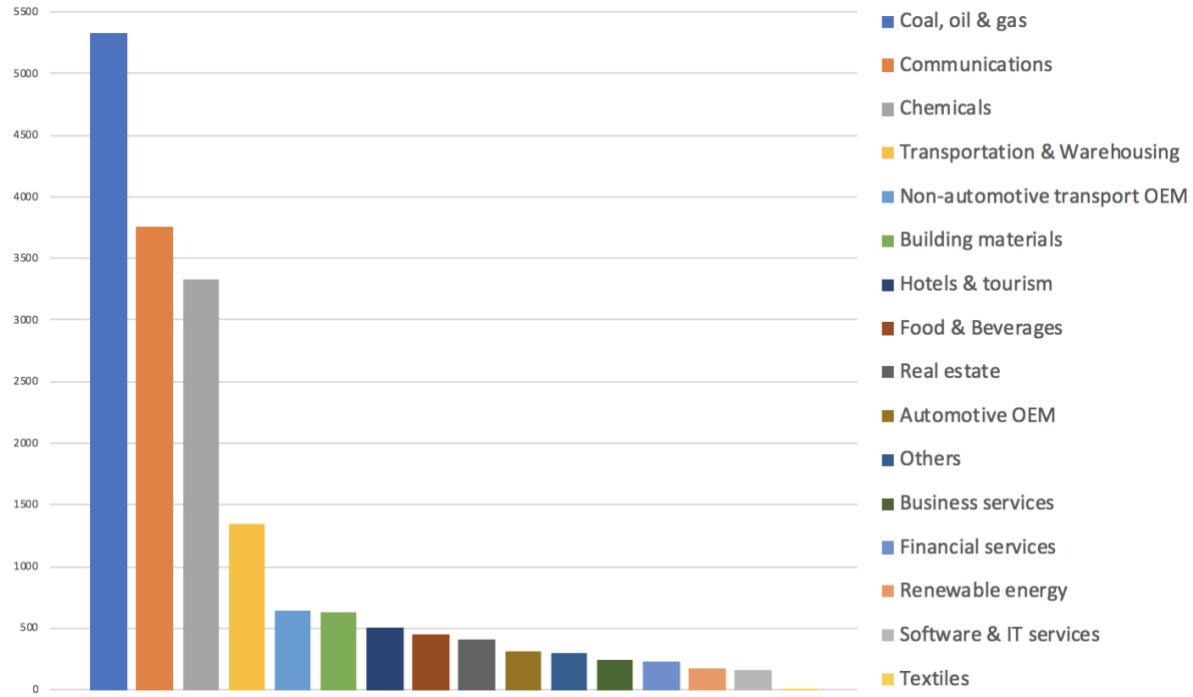


Figure 1. 2018-19 Nigeria's FDI inflow by industrial sector (Source: own elaboration from FDI market) [1]

2.2 Ghana

According to UNCTAD's 2018 World Investment Report, since the 2000s Ghana has seen an increase in its FDI inflows due to the diversification in its economy.

Consequently, even though in 2017 the country has seen a slight decrease because self-imposed reductions in government investment spending, in 2018 Ghana overcame Nigeria as recipient of FDI in West Africa.

The country took advantage of greenfield investments made by Eni Group, one of the largest in Ghana's history and with the specific intention to expand the Sanfoka gas field (UNCTAD 2019).

[1] https://www.fdimarkets.com

Aside investments in the gas field, there have been also investments in the mineral industry, in particular with the M&A between Gold Fields Ltd, a South African firm, and Asanko Gold Ghana Ltd, a gold mine operator.

Data retrieved from FDI market shows that the industrial sector which attracted most of foreign investments in the last two years, it was the one regarding paper, printing and packaging.

This particular outcome is explained by the fact that a huge investment in this field has been made by the Swedish MNE Greenland Resources, seeking to establish a pulp business complex in Ghana, including a pulp plantation and paper mill as well. (FDI market)

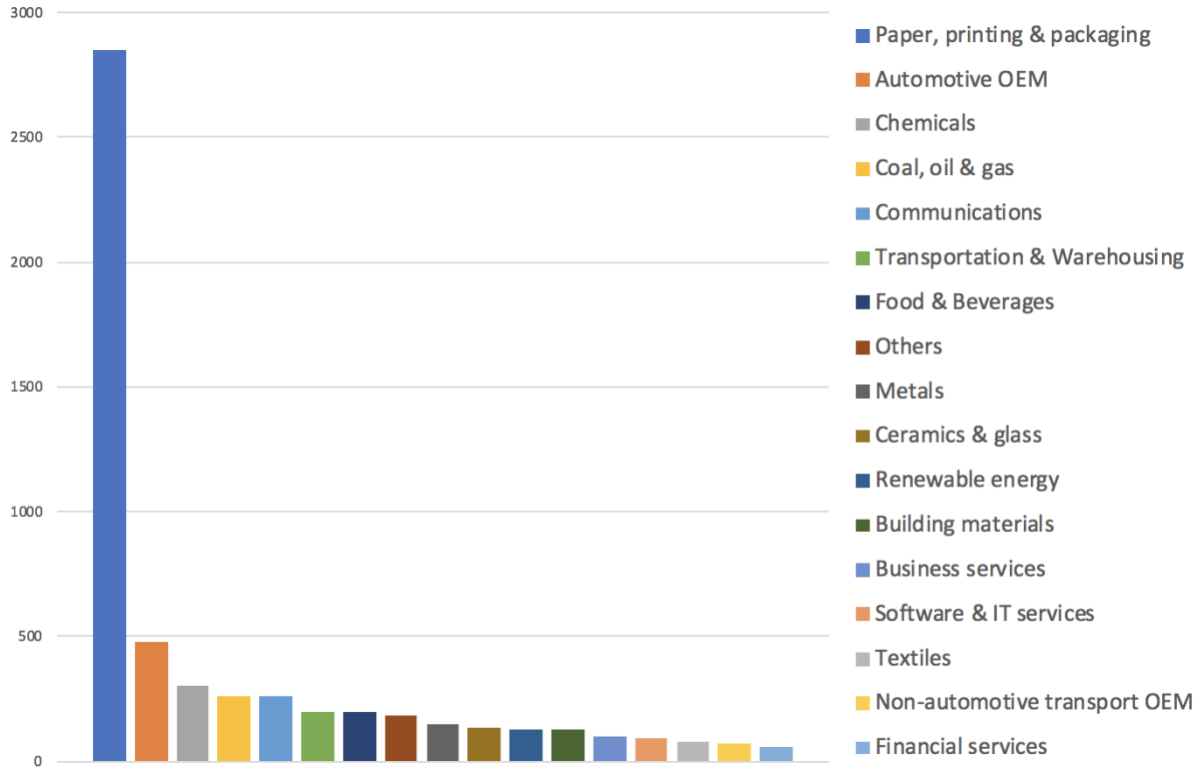


Figure 2. 2018-19 Ghana's FDI inflow by industrial sector (Source: own elaboration from FDI market) [2]

2.3 Ethiopia

Although the country suffered a contraction of FDI inflows lately, it still remained the biggest recipient of FDI in East Africa and until the 2017 the second one in the whole Africa. This achievement is due to the country advantages regarding economic liberalization and investments facilitation, two measures implemented by the government.

There have been significant investments in the clothing industry, with United States fashion supplier PVH, Dubai-based Velocity Apparelz Companies and China's Jiangsu Sunshine

[2] https://www.fdimarkets.com

Group setting up their own factories in 2017, as stated by UNCTAD's 2018 World Investment Report.

Moreover, among all other investments, it should be mentioned the first manufacturing plant opened by Hyundai Motor Company in East Africa, in 2018 (UNCTAD 2019).

Ethiopia registers investments in many and diversified sectors, such as in petroleum refining, mineral extraction, real estate, manufacturing and renewable energy.

However, among the sectors mentioned, those which are part of the coal, oil and gas field are the ones which gather the majority of investments.

In particular, the US based investment firm Fairfax Africa Fund entirely contributed to this result, with a $4 billion investment in the construction of an oil refinery.

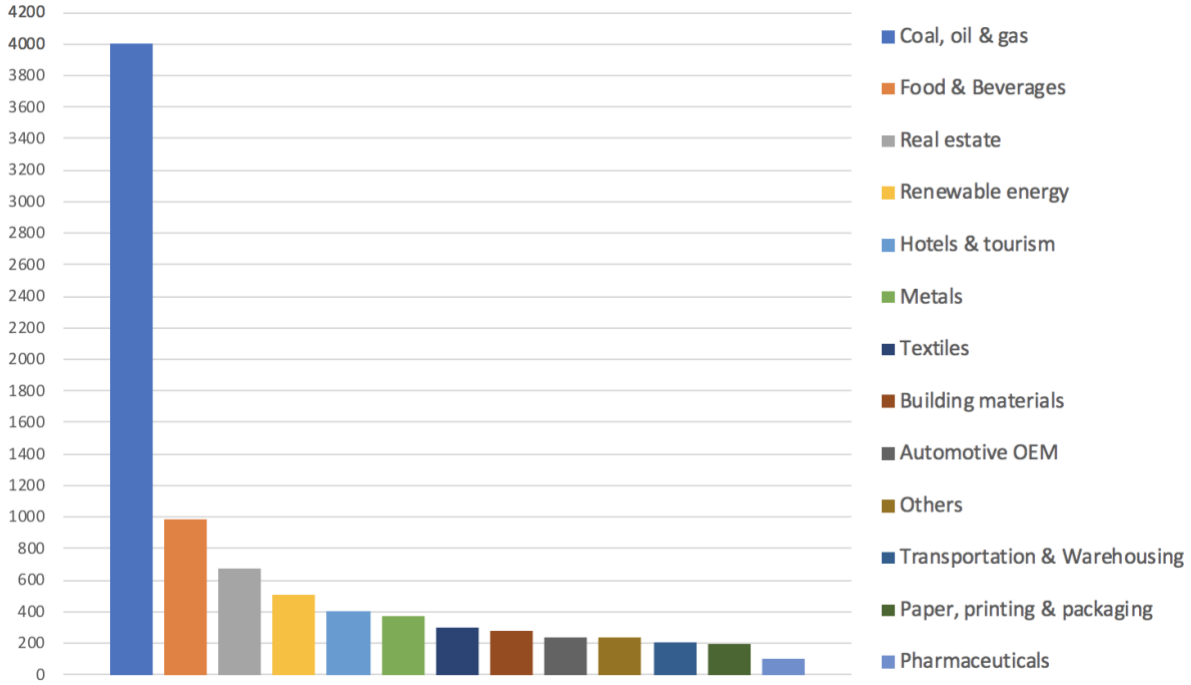


Figure 3. 2018-19 Ethiopia's FDI inflow by industrial sector (Source: own elaboration from FDI market) [3]

2.4 Kenya

Kenya, another country part of the East Africa, is rising its FDI inflows over time, as it can be shown by the 27 percent increase in 2018 respect to the past year.

This is the result of various policies, like the one which delivered tax incentives, which were aimed to facilitate private enterprise and foreign investors, as stated by UNCTAD's 2019 World Investment Report.

[3] https://www.fdimarkets.com

Since the Kenya was able to improve its "ease of doing business" ranking, an indicator which shows the easiness of doing operations in a certain environment, it received investments in various fields like manufacturing, chemicals, hospitality, oil and gas (UNCDTA, 2019).

Examples can be done for investments related to commodities, like the UK company Diageo and the US company Johnson and Johnson in the beer and pharmaceutical sectors respectively, and for tech-oriented investments like the ones made by Boeing, Microsoft and Oracle.

According to data retrieved from FDI market, one of the most substantial investment in Kenya, in the recent years, has been made by Beijing Damei Investment, a Chinese corporation operating in the real estate sector. The company wanted to build a mega city in Nairobi's Athi River area, as stated in the plan known as the "Friendship City", willing to take advantage of the fresh tax incentives policy (Xinhua, 2019).

Another interesting sector collecting a decent amount of investment from foreigners is the one related to renewable energy, with primarily FDI coming from some European companies, like the Dutch company Gigawatt Global, the British one Globeleq Generation and the Finnish company Nocart.

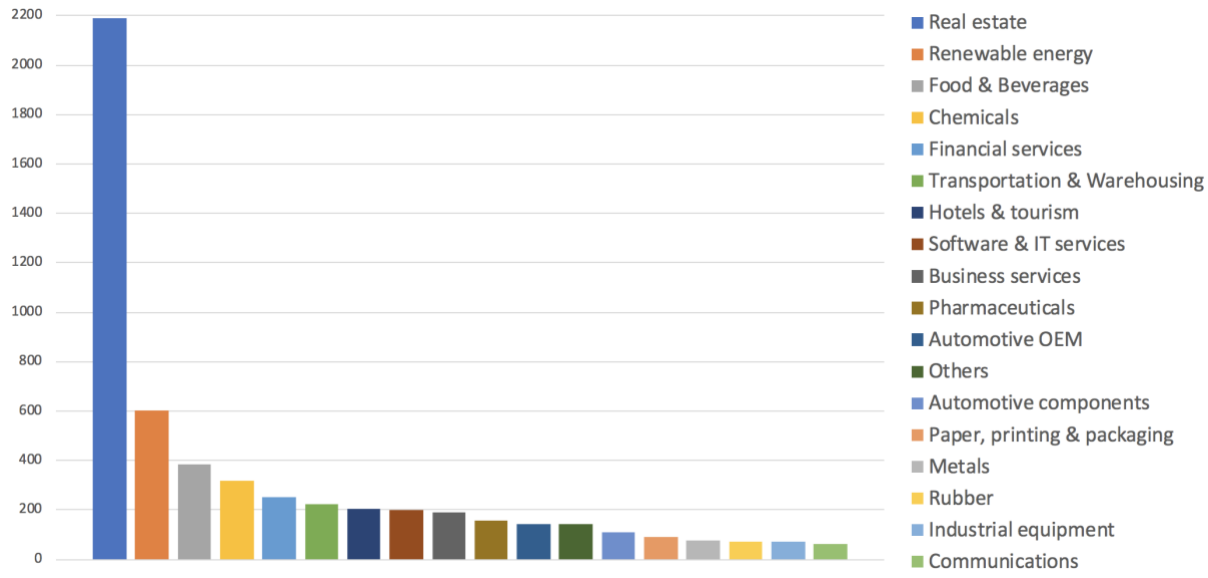


Figure 4. 2018-19 Kenya's FDI inflow by industrial sector (Source: own elaboration from FDI market) [4]

[4] https://www.fdimarkets.com

2.5 Republic of Congo

The biggest recipient of FDI in the central region of Africa is the Republic of the Congo. While in 2017 the country has suffered a period of economic crisis which negative affected FDI inflows, in 2018 the country reached the highest level of FDI inflows, i.e. $4.3 billion (UNCTAD 2019).

The sectors, that foreign investors wanted to exploit, were the oil exploration and production. Moreover, the Congo Offshore Licensing Round came into effect only in 2018, with the purpose of promoting investment in the country, especially for the exploitation of mineral and energy resources, boosting in this way Congo's industrial development (Thystere Tchicaya, 2019). Unfortunately, in the case of the Republic of the Congo, there is little data retrieved from FDI market which is not enough to further analyze FDI inflows in the country in the recent years.

2.6 Republic Democratic of Congo

It is the second country with the highest level of inward FDI in Central Africa. Most of investments come from international mining companies, such as the Swiss company Glencore and the Chinese company Molybdenum, which are willing to exploit mineral sites in the country. In particular, these investors want to take advantage of the biggest cobalt reserve in the world, accounting to 60 percent of the world's known quantity (UNCTAD, 2019).

Nowadays cobalt is becoming a fundamental resource due to its use in the production of batteries for electric cars.

This trend in terms of FDI by industrial sector is reflect by the data retrieved from the FDI market, with the mineral sector gathering the majority of investments.

Furthermore, the industrial sector related to transportation & warehousing collected significant FDI, especially with an investment which came from DP World, the multinational logistic company based in Dubai which won a 30-year concession for the development and management of the greenfield port, the first deep-sea port in the country.

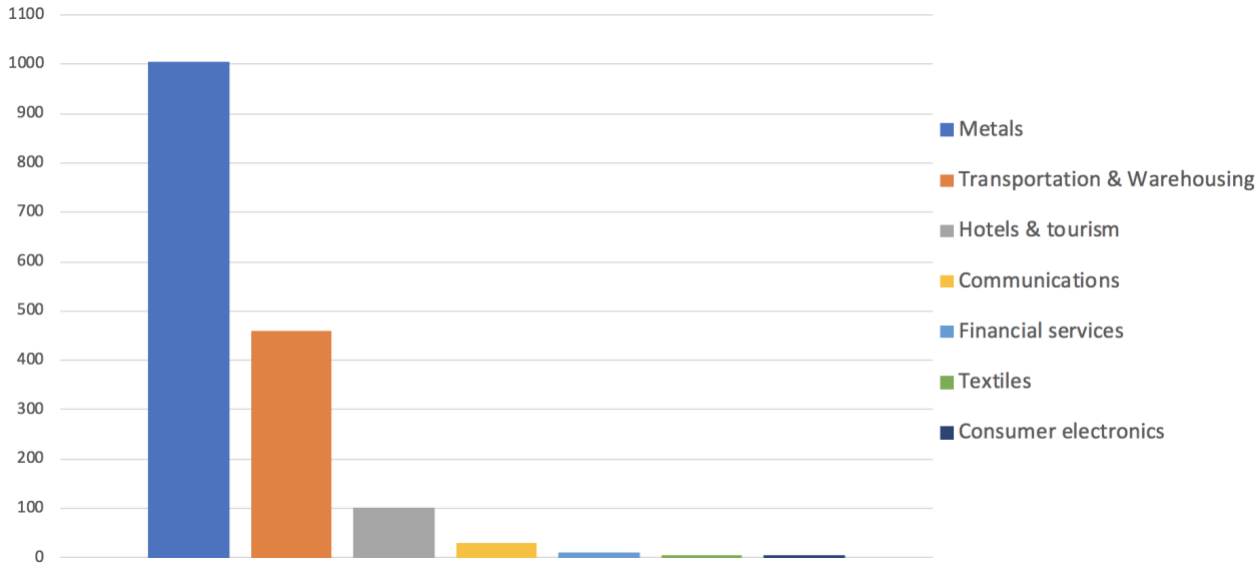


Figure 5. 2018-19 Democratic Republic of Congo's FDI inflow by industrial sector (Source: own elaboration from FDI) [5]

2.7 South Africa

The country represents not only the one with the highest level of FDI outflows, but recently it has also become the second biggest recipient of FDI inflows in the whole Africa, just after Egypt. This is the result of a recent campaign started by South Africa which aims to reach the amount of $100 billion in 2023. This campaign seemed to be profitable, at least until the Covid-19 crisis, since the country in 2018 more than doubled its inward FDI, getting to $5.3 billion (UNCTAD, 2019).

Significant investments in 2018, that are also consequences of the previous mentioned government's incentives, come from the automotive sector where the Chinese company Beijing Automotive Industry Holding opened a plant in the Coega Industrial Development Zone, for instance. Others worldwide famous automakers company such as BMW and Nissan also expanded their existing facilities in the country, as stated by UNCTAD's 2019 World Investment Report. The aim of these investments is related to the will of developing regional value chain for South African auto manufacturers, with the country of Lesotho producing car seats and the country of Botswana producing ignition wiring seats, for instance.

Analyzing data retrieved from FDI market, it can be seen as respect to the other SSA countries which were mostly characterized by huge singular investments concentrated in one or maximum two industrial sectors, in South Africa this circumstance is less pronounced.

[5] https://www.fdimarkets.com

As a matter of fact, in recent years, there are at least five sectors where FDI are predominantly distributed, like the ones related to automotive OEM, coil, oil and gas, communications, metals and renewable energy.

Examining the graph, the first sector to catch the attention since it attracted most of the FDI, it is the one associated to communications. Several investments in this field have been made by the Chinese company Huawei, strengthening partnerships with business partner in the country, in its global attempt of overcoming US-tech companies.

As previously mentioned, the Italian company Enel Green Power is significantly investing in renewable energy in the whole Africa, and one of these investments has been recently made in South Africa, explaining the significant level of FDI in the country.

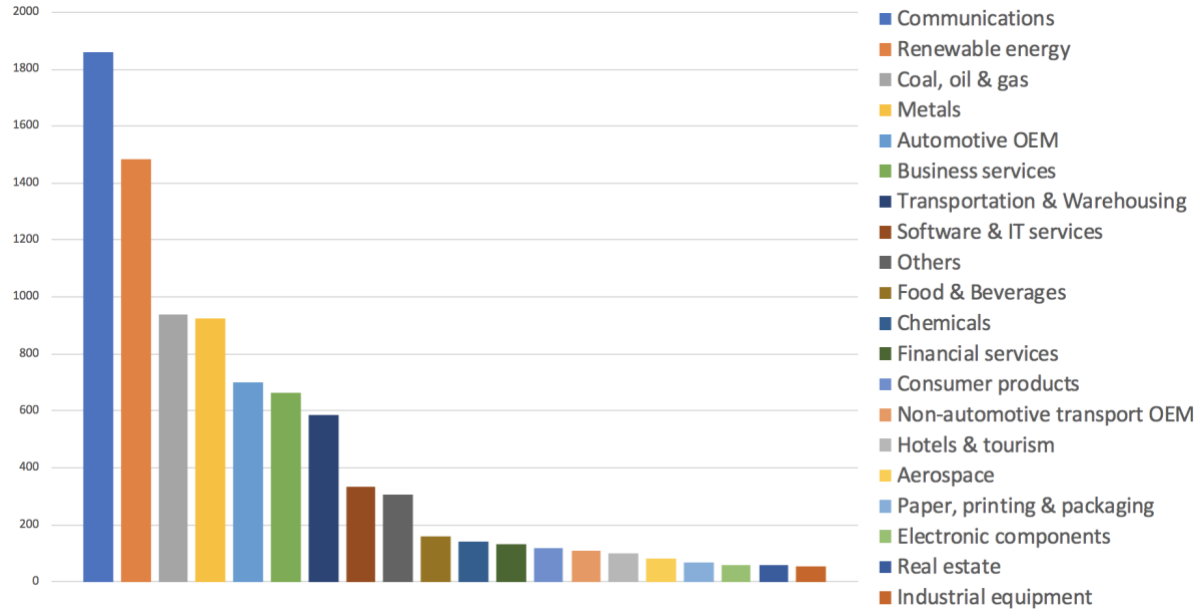


Figure 6. 2018-19 South Africa's FDI inflow by industrial sector (Source: own elaboration from FDI market) [6]

[6] https://www.fdimarkets.com

CHAPTER 3: FDI AND TECHNOLOGICAL INNOVATIONS

3.1 Theoretical correlation between FDI and firm innovation

Governments in developing countries encourage FDI with the intent of boosting technological innovations and thus productivity growth.

Moreover, technological innovation is also fundamental for employment growth, export growth, customer orientation and firm competitiveness (Emmanuel Adu-Danso & Emmanuel Abbey, 2020).

Before entering in detail with the correlation between innovation and FDI, a description of what is meant by technological innovation is needed. "Innovation occurs when firms are able to create new processes in producing existing products more efficiently or differentiating existing products or introducing entirely new products so as to increase sales and market performance", as stated by Girma, Gong & Gorg (2005).

All these effects, strictly related to new technology and innovations, require special inputs such as a huge capital base of skilled labor of domestic firms. These inputs are hardly owned by firms in developing countries and this is why, those firms hope to gain access to these technologies through FDI (Liu Z., 2008). What is more, multinational corporations (MNC), which are the ones investing in developing countries, they own, control and produce 80 per cent of the world's technology.

According to the literature, when MNC interact through FDI, the firm in the host country somehow acquire new technologies and knowledge (Liu Z., 2008).

The reasons that explain why a foreign ownership would increase the likelihood of technological innovations are the following.

Foreign-owned firms should have access to technological resources of the parent company since the subsidiary markets, where foreign-owned firms operate, they are evaluated by the parent company as part of its core business (Choi et al. 2011).

In particular, access to technological resources is meant in terms of employee transfer or technology transfer. In this way, subsidiary firms are more able to innovate, since they are part of these MNEs and thus they have better technologies and organizational skills respect to local firms (Smarzynska, 2003).

Aside the previous mentioned technological resources, foreign-owned firms benefit from FDI by a capital base enhancement. Why is it related to host firm's innovation?

Because having access to foreign capital put the foreign-owned firm in the financial position to hire the best local workforce and to implement the bests processing methods for its operations. (Glass & Saggi, 2002).

Moreover, according to Guadalupe, Kuzmina, and Thomas (2012), already foreign firms tend to choose, among domestic firms, the ones more attractive and innovative, thus the ones which are more easily able to implement innovative products or processes since they can adapt quickly to changes of situation.

It should be mentioned that technology and intellectual property can be acquired by firms also through other international trade means, e.g. with the transfer of specialized goods and services or by leasing and franchising agreements, for instance. Yet, FDI is the most effective way to transfer those technologies which are hard to measure and obtain (Sinani & Meyer, 2004).

Besides, FDI is also seen by other authors as the cheapest and one of the quicker means to transfer technology to firms belonging to developing countries. This comes from the fact that foreign-owned firms, most of the time, do not have to finance the acquisition of newer technologies, usually bought by the parent company (Mansfield & Romeo, 1980).

However, all previously mentioned effects of FDI are related to technological innovations only for the specific foreign-owned firm. As a consequence, why the government would like to attract FDI if they seem to benefit only subsidiary firms?

The answer is that FDI have also a positive impact on local firms. Foreign investors push local firms to increase their efficiency and try to reach economies of scale since the competition becomes higher. As a consequence, productivity of local firms become higher and therefore more resources are used for innovation to try to better compete in the industry. This statement has been proved by evidences found in the US automobile industry where, the entrance of Japanese automobile firms, it pushed US firms to face the new foreign competitors through many investments in technological innovations (Chung et al. 2003).

The result is that FDI, leading to a higher local competition, induce innovation among local companies (Blomström & Kokko, 1998).

Moreover, another way through which local firms are stimulated to innovate, it is the imitation of the technological innovations implemented by foreign-owned firms. Although it seems a banal achievement by local companies, to imitate it is needed the capacity to observe, learn from foreign firms during interactions and most of the time it can be required also reverse engineering of the foreign products (Salomon, 2006).

3.2 Issues in implementing FDI's benefits

Respect to other capital flows, which could involve only a transfer of capital, an FDI usually involves also transfers in the form of technology diffusion and processing methods, managerial expertise about production, markets and enhancement of labor skills, as stated by Oliver Morrissey (Oliver Morrissey, 2011).
Consequently, after having analyzed what is an FDI and why governments want to attract it so much, it will be highlighted which problems rise when benefits must be implemented.

The first problem underlined in the literature is related to the fact that all previously mentioned transfers not always can involve a benefit for the domestic economy, i.e. they can be growth enhancing.
Taking into account developing economies such as the ones belonging to SSA, it depends on various conditions, such as the environmental industrial policy (Oliver Morrissey, 2011).
Among these policies there are compulsory licensing laws (enabling to purchase patented technologies), protectionist policies (encouraging FDI and hoping in spillover effects) and other policies which could eventually weak Intellectual Property Rights protection (encouraging imitations in the local market) (Vishwasrao S. & Bosshardt W. 2001).
Moreover, in order to implement these transfer's benefits, another condition is that governments must ensure that in the local market an absorptive capacity exists, which means that is already present the right level of human capital, local financial markets and domestic investments' effects. According to Oliver Morrissey, only if these conditions are verified, domestic firms are able to adopt new and superior technologies, gaining productivity benefits and thus economy growth (Oliver Morrissey, 2011).

The second problem highlighted by other authors in the literature, it is the fact that, in certain situations, foreign ownership can decrease the likelihood of technological innovation (Love et al. 2009).
Some authors states that foreign-owned firms may not receive benefits from R&D activities and thus they cannot realize technological innovations (Love et al. 2009). This statement comes from the idea that R&D activities tend to be centralized, i.e. in the company's headquarters, in the early stage of a product development and, to be decentralized only in the latter stage of product's development (Malecki, 1980; Howells, 1984; Kleinknecht & Poot, 1992).
This does not stimulate innovation in the foreign-owned firms due to the fact that most of the financial resources, dedicated to R&D, are spent in the early stage of a product life cycle (Vernon,

1966). Moreover, it can happen that the parent company migrate to the foreign developing country when the product is completely developed, and it is needed only a market where the final processing would be done at a cheaper price and then it would be distributed (Yang et al., 2013).

In this case, innovation is almost not needed at all. Consequently, FDI could prevent foreign-owned firms to invest in R&D activities, since the parent company do not require to do so, and thus retarding innovation (Dery Nyeadi J. & Adjasi C. 2020).

Aside this theory which is related to different stages of the product life cycle, there is another theory which aims to explain the negative relationship among FDI and firm innovation.

This theory, known as "pull factor theory", is based on the idea that foreign firms move to host countries in search for better technologies to transmit to the parent firm. As a consequence, foreign investors do not have the intention to invest in R&D activities in the foreign-owned firm but rather to replicate or transfer the superior technology from the host firm to the parent firm (Dunning, 1995).

This last theory, it could hardly be applied to the case of developing African countries. However, it can happen the case where the foreign firm decide to move some high skills and talented workers, which can belong to an African country, from the foreign-owned firm to the parent one which can offer higher wages. Consequently, the removal of the best brains of the foreign-owned firm would further prevent the develop of technological innovations (Dery Nyeadi J. & Adjasi C. 2020).

3.3 FDI-Technological Innovation relationship explained by a possible framework

Having introduced many different cases in which FDI can either boost the likelihood of technological innovation or decrease it, the literature needed a framework to explain when these two opposite situations would occur.

A potential explanation has been introduced by Yang et al. (2013), who reconciled FSA/CSA framework with Dunning's four motives of FDI to explain the mixed link between FDI and firm innovation. The following figure represent the framework introduced by the authors.

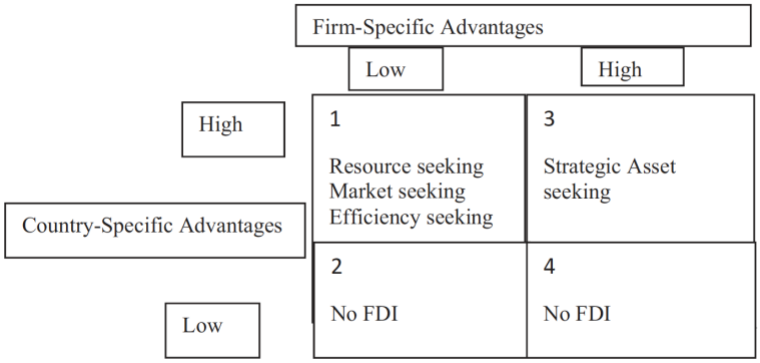


Figure 7. The reconciled FSA/CSA framework

On the one hand, the x-axis represents the level of FSA, which stands for firm-specific advantages, which represent those resources and capabilities, owned by the parent firm, which are valuable and difficult to imitate by other companies (Barney, 1991). In particular, among these resources and capabilities, there are those technological innovations take into account for the purpose of this thesis. On the other hand, the y-axis represents the level of CSA, which stands for country-specific advantages and it represents all strengths, in the form of land, labor and capital, for example, owned by the host country or firm (Barney, 1991).

As it can be seen by the graph, cells two and four are not interesting, since foreign firms are not interested in investing in countries with a relative low level of CSA respect to other countries. A different analysis will be instead provided for cells one and three.

Cell one represents the case in which FSA are low while CSA are high and thus, since it is not important to have an FSA, the motives of investments are natural resource seeking FDI, market seeking FDI and efficiency seeking FDI (Rugman, 2010). Consequently, there will not be a transfer of a superior/innovative technology from the parent firm to the host firm, and the latter could only benefit from a capital enhancement.

Cell three occurs when both CSA and FSA are higher respect to their competitors. In this case, the purpose of the expansion is a strategic asset seeking FDI, which means the research of a

superior resource, including upward-technological knowledge, downward marketing knowledge, administrative knowledge or reputational resources.
Since the parent firm owns a high level of FSA, thus a superior technology, this can boost innovation for the host firm. However, it is specified by Yang et al. (2013) that this will happen only if FSAs are internationally transferable into the host firm. Otherwise, parent firm could exploit the resources of the host firm without transferring any kind of technology/knowledge advantage to the local firm. What is more, it could happen that removing the host firm's specific resource will destroy its capability to innovate.
A further distinction of the FDI takes into account Blind and Jungmittag (2004) statement, which wants to distinguish between traditional and "greenfield investments", i.e. investments in new business, which should positively affect R&D activities of foreign-owned firms and therefore firm innovation.

3.4 Linkages and Spillovers

The literature in the past years carefully underlined how different types of transfers risk to be confused, since it was not present a clear definition (Oliver Morrissey, 2011).
The two concepts that should be distinguished are the linkages and spillovers. While the former has been widely used in the past for various types of economic analysis, the latter has been introduced quite recently.
The basic idea under the distinction among these two terms is that while a spillover, somehow, always involves a transfer of knowledge, a linkage, which can still be beneficial, may not entail any kind of learning (Oliver Morrissey, 2011).
An example of a linkage can be the improvement of a performance like the productivity as a consequence of the use of inputs belonging to the foreign investing firms, without the presence of some kind of transfer of knowledge.

In order to identify when a linkage can imply a spillover, also three types of linkages are identified. The first type occurs when a foreign firm, investing in a developing country, provides skilled employees for the domestic firm. This would upgrade single firm's labor skills and in case of labor mobility would benefit the whole local market.
The second type of linkage occurs when foreign firms, that supply inputs to local producers, are able to deliver also technologies that will improve producers' outcomes. Similarly, the third linkage is related to demand of inputs from foreign firms to local suppliers and it occurs when

foreigners provide technologies to encourage improvements in standards and in the processes (Oliver Morrissey, 2011).

The question now is related to the conditions that make the passage from linkages to spillovers happen. A spillover can occur only if the foreign firm owns a useful technology or know-how for the domestic firm and both of them are willing to transfer this knowledge and take advantage of it (Oliver Morrissey, 2011).
Regarding these conditions applied to the linkages previously explained, it can be said that in the case of linkages related to labor mobility, it usually happens that workers leaving an organization for another, they will spillover knowledge absorbed in their previous job (Görg & Strobl, 2005).

However, limitations in this knowledge transfer occurs when there is the possibility that the foreign firm would provide only firm-specific skilled workers, limiting benefits provided by the hypothetic labor mobility. The word hypothetic regards the last limitation of this spillover, since labor mobility in developing countries should not be taken as granted.

Concerning the other two types of linkages, spillovers can emerge when local firms are able to observe, learn and imitate foreign-owned firms new processes and methods (Salomon, 2006).
Spillover's limitation arises if local firms does not own the necessary competences to extract and learn from this transfer, e.g. they do not have reverse engineering competences.
However, it can also happen the case where foreign firms do not have any advantage in providing an embodied technology to local producers or suppliers because it could advantage its competitors, for instance.

After having defined by what is characterized a spillover respect to a linkage, a definition of the former can be introduced. According to Thomas Farole and Deborah Winkler (2014), with spillover is meant the diffusion of knowledge, technology, and work practices from foreign investors operating near the global frontier to local firms and workers.
Then, two initial types of spillovers can be identified. Spillovers can either take place at the same industry-level, known as intra-industry or horizontal spillovers, or can take place in another industry, being called as inter-industry spillovers or vertical spillovers. Regarding the horizontal spillover, the transfer of technology and knowledge can happen through the demonstration effect or the competition effect. In case of the former, domestic firms learn from

MNCs through observation and imitation of product innovation, management novelties and efficient organization processes. Demonstration effect has a positive impact on local firm's productivity. With regard to the latter, it can have either a positive or negative effect on domestic firms' performances. A positive effect since the entrance in the market of MNCs forces local firms to be more efficient and productive if they want to continue to compete. Nevertheless, competition effect can also have a negative impact on local firms, mainly in the short-medium term, since there is an increase of the market size and competition in the local market (Aitken & Harrison, 1999).

Concerning the vertical spillover, there is a further distinction between backward spillovers, affecting local inputs or suppliers thus operating upstream in the value chain, and forward spillovers which occurs downstream in the value chain, affecting local customers (Farole T. & Winkler D. 2014). As it has been previously mentioned, vertical spillovers happen intra-industry, i.e. across different industries in the production line, hence competition demonstration effects do not usually exist. A chance of technology transfer can exist if a local firm and the MNCs are somehow complementary in the production cycle.

In particular, backward spillovers occur when the MNCs provide technical training to workers of the local suppliers to receive from them a better quality of raw materials.

When instead MNCs, being the suppliers, provide to domestic firms, which are the buyers, training related to the best marketing and sales practices, it is the case of forward spillovers.

MNC want to boost their buyers' sales since they are strictly linked to the level of their business success.

3.5 FDI related to R&D activities

The focus becomes now on those industrial activities, among all, which can lead foreign-owned firms to have a technological innovation. The Research & Development activities of firms is one of them (Lundvall & Dosi, 1988). Moreover, R&D does not only stimulate innovation, but it also allows the firm to identify, assimilate and exploit outside knowledge, which may be already part of the local market, for instance (Kinoshita, 2000).

Half of the R&D expenditures in the world are made by MNC, those previously mentioned companies which are involved in FDI and global innovation. This is why, it is important to understand, among all FDI in Africa, which are the ones implemented in the R&D sector. The analysis will be done dividing the total time frame in two temporal periods, before and after the 2017, being in this year crucial changes in the FDI inflows to Africa.

This statement can be clearly seen by the graph which represents the trend just mentioned, in terms of number of millions of dollars spent by foreigners in R&D.

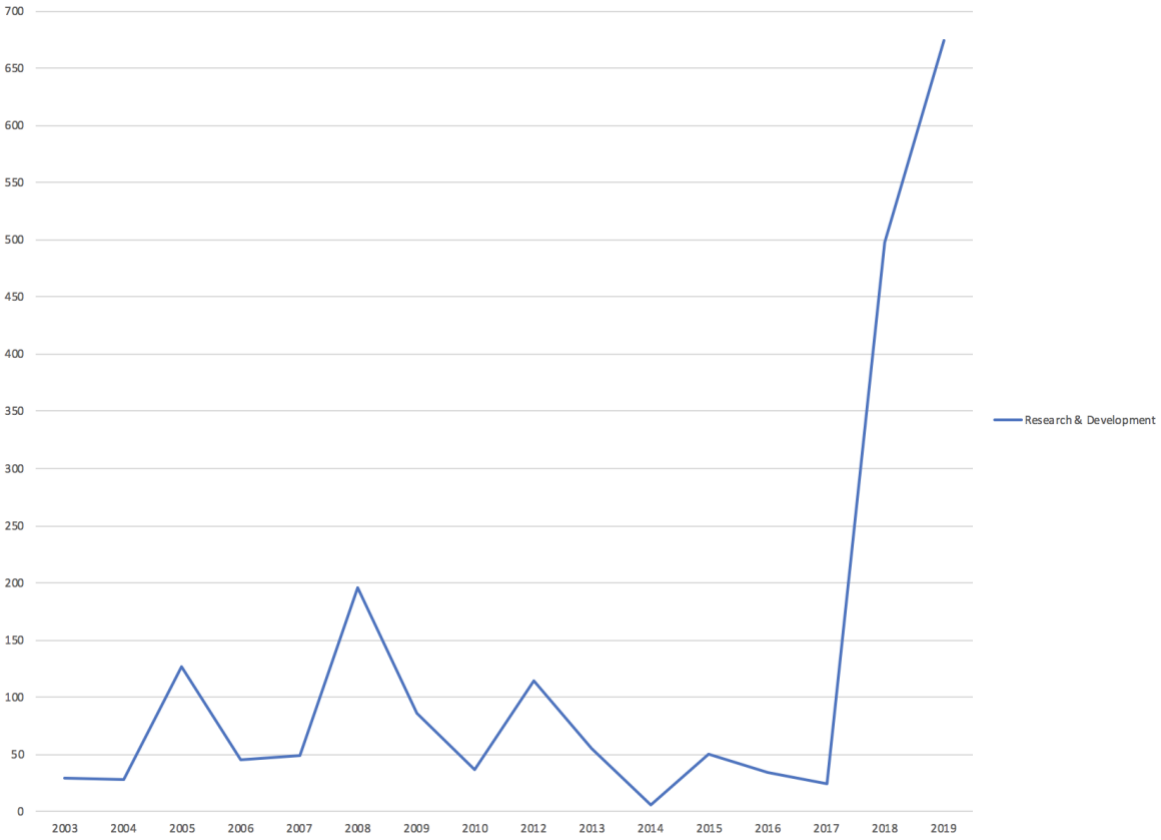


Figure 8. Trend of amount of FDI flows to Africa with R&D as purpose (Source: own elaboration from FDI market) [7]

Beginning the analysis from the 2003, while in 2004 this FDI related to R&D activities remained more or less constant, in 2005 there has been an increase of 3.44 percentage points, with the FDI focused on R&D that reached the amount of $126.3 million. After a slight decrease in 2006, the FDI slightly increased in 2007 and there was also a boost in 2008, with a percentage increase respect to the previous year of 2.95 percentage points, as a symptom of a will of improve innovation in these developing countries.

After the 2008's financial crisis, all FDI decreased for a few years, including the ones R&D related. Having the economy some difficulties in recovering, in the following years there was an even lower focus on R&D activities in African countries. Other factors, like the ones regarding local environment and policies affected also the FDI's type of activities.

[7] https://www.fdimarkets.com

As previously mentioned, in 2018 there was a boost in the investment related to R&D activities with an increase of 19.24 percentage points respect to 2017 and this is why it has been decided to analyze two different time frames.

After having highlighted a boost in the amount of FDI made in R&D activities, a graph showing the number of FDI related to R&D will underline one more time, from another perspective, how foreigners seem to have increased the will to invest in these type of activities lately.

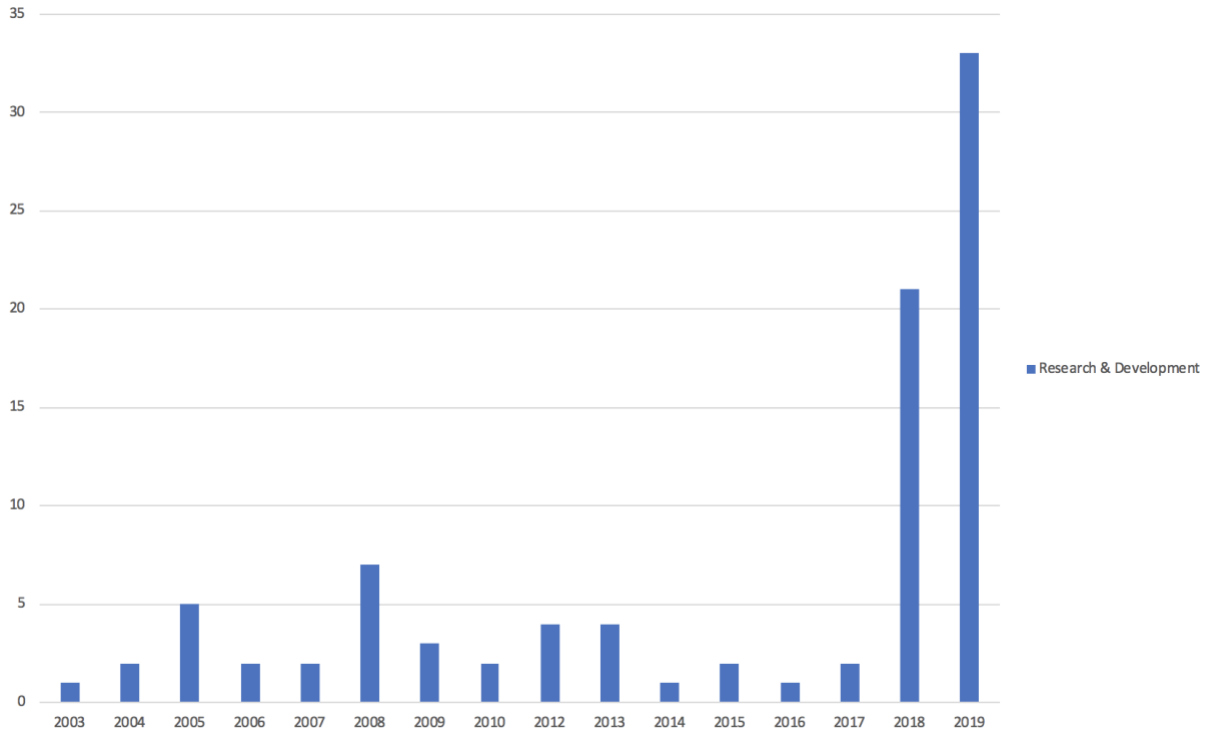


Figure 9. Trend of number of FDI flows to Africa with R&D as purpose (Source: own elaboration from FDI market) [8]

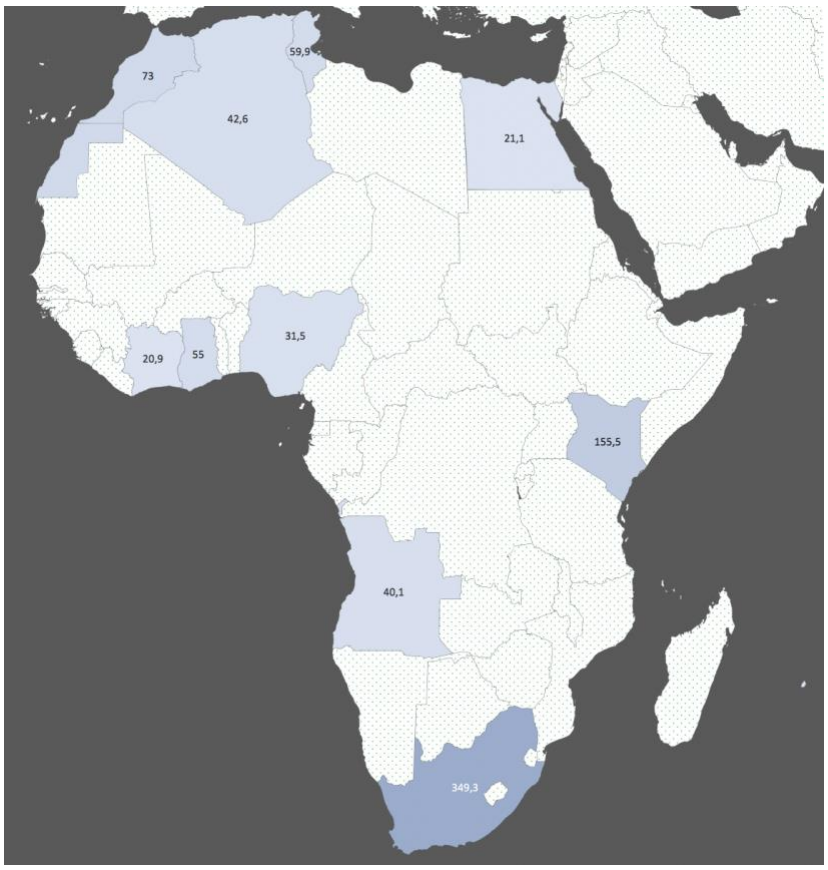
According to the graph, apart from the 2005 and 2008, there has always been a number of foreign investments in R&D activities in the African countries lower than five, while the trend changed in 2018 where the number of investments increased to twenty-one in 2018 and thirty-three in 2019.

3.6 FDI in the 2013-2017 time frame

According to data retrieved from FDI market, between 2003 and 2017, total FDI flows are $1100827,6 million with Egypt which has registered the biggest amount of FDI inflows, amounting to $223263.7 million, followed by Nigeria with $111230.5 million, and South Africa with $95259.4 million.

[8] https://www.fdimarkets.com

The following map shows how R&D expenditures are distributed among Africa's countries.



Algeria	42.6
Angola	40.1
Ivory Coast	20.9
Egypt	21.1
Ghana	55
Kenya	155.5
Mauritius	34.6
Morocco	73
Nigeria	31.5
South Africa	349.3
Tunisia	59.9
Total	**883.5**

Figure 10. FDI linked to R&D expenditures in Africa between 2003 and 2017 (Source: own elaboration from FDI market) [9]

In the time frame took into account, R&D expenses on Africa amounted to $883.5 million.
It can be seen from the graph above that South Africa resulted to be the country with the highest level of FDI made in the R&D sector, consisting of $349.3 million.
Analyzing the single FDI inflows to the country, it appeared that almost the half of investments in R&D, i.e. $173 million, has been made by the British pharmaceutical company Synexus Clinical Research, one of the largest clinical trials organization in the world. It is interesting to highlight that, in South Africa, the majority of FDI allocated to R&D activities belongs to pharmaceutical firms, being other consistent investments made by Kendle International and Parexel International, respectively in 2005 and 2010.
Apart from these R&D investments in the pharmaceutical sector, another important FDI has been made in the biotechnology field, by the vegetable breeding company Enza Zaden. In particular, the Dutch company invested $42.6 million in 2012.

[9] https://www.fdimarkets.com

The second country, in terms of FDI focused on R&D as business activity, it is Kenya where they were invested $155.5 million.
The particular aspect for Kenya is the fact that there are several diversified industry sectors where foreigners invested. Especially, over the years, important FDI came from the Thailand-based company Asia Plantation Capital, which operates in the agriculture sector, the US Columbia University operating in this case in the Business Service sector, the US corporation IBM working in the IT sector, the Finnish company Nokia operating in the communication sector and lastly, the Canadian company SkyPower operating in the renewable energy field.
Egypt, which had the highest amount of FDI, attracted only $21.1 million in R&D from foreign investors. This refers to a single investment made in the electronic field by US corporation IBM in 2008. Overall, in this time frame, the majority of FDI linked to R&D activities have been made in the pharmaceutical industry, with significant investments in Mauritius, Kenya and Ghana which must be added to the ones in South Africa previously mentioned.

Some countries attracted more FDI than others, having a wide range of business opportunities to be exploited for instance, and thus the level of R&D expenditure could be higher. However, this fact does not make these countries inclined to be more innovative than others. Actually, it is important to evaluate the share of FDI linked to R&D activities respect to total FDI which is shown by the following graph yet taking into account only the period between 2003 and 2017.

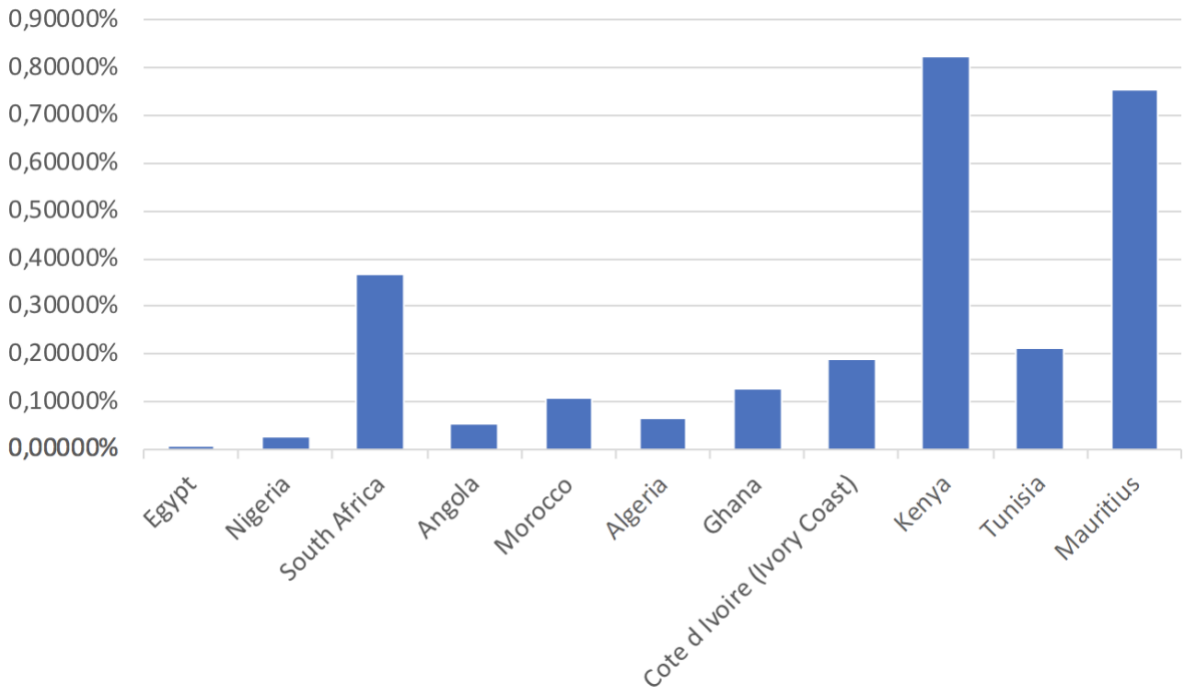


Figure 11. Share of FDI in R&D activities over total FDI between 2003-2017 (Source: own elaboration from FDI market) [10]

Taking into consideration the whole Africa, the share of FDI related to R&D activities over total FDI represents only the 0.0803 per cent.

Regarding single country's analysis, the one with the highest level, attracting in a certain sense more technological innovations respect to total investments, it is Kenya with 0.825 per cent of share of FDI dedicated to R&D. This result can be partially linked to the previous analysis of the many business sectors where foreigners were investing in R&D, in Kenya.

South Africa, with 0.367 per cent of FDI dedicated to R&D, it shows instead a will from foreign investors to dedicate less share of their total money invested in the country for R&D purposes.

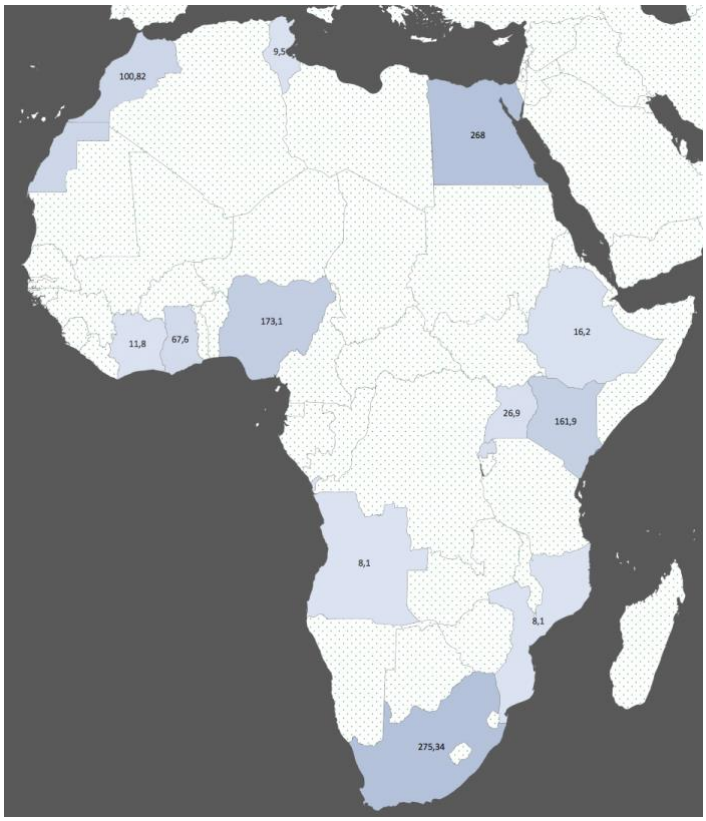
Eye-catching is the situation of Mauritius which has 0.754 per cent of FDI dedicated to R&D and they are the second country in this special ranking.

3.7 FDI in the 2018-2019-time frame

It will be now taken into account the second temporal period, the recent one which considers the 2018 and 2019 years. As previously mentioned in the trend explanation, FDI invested in R&D are much higher for these two years, respect to the previous fourteen years, amounting to $1172.6 million for the whole Africa.

The following map shows how FDI related to R&D activities are distributed in Africa.

[10] https://www.fdimarkets.com



Angola	8,1
Cote d Ivoire	11,8
Egypt	268
Ethiopia	16,2
Ghana	67,6
Kenya	161,9
Morocco	100,82
Mozambique	8,1
Nigeria	173,1
Rwanda	34,6
Seychelles	10,7
South Africa	275,34
Tunisia	9,5
Uganda	26,9
Total	**1172,66**

Figure 12. FDI linked to R&D expenditures in Africa in 2018-2019 (Source: own elaboration from FDI market) [11]

The total amount of FDI invested during this time frame, similarly to before, the country where it has been invested more in R&D is the South Africa, with an amount of $275.34 million spent in this industrial activity. Differently from the previous time frame, FDI related to R&D in the country became quite diversified, covering industry sectors like “food & beverages”, business services, biotechnology, communications, software & IT services, chemicals and metals.

In this ranking South Africa is followed by Egypt, where FDI related to R&D activities increased considerably, taking into account that in the previous time frame it has been invested only $21.1 million in this activity.

A good amount of FDI dedicated to R&D activities is registered also in Nigeria and Kenya, which had respectively $173.1 and $161.9 million invested in this activity.

The trend that can be seen respect to the previous time frame is that while in the past most of FDI related to the R&D activities were invested in the pharmaceutical sector, recently there was a shift in favor of the field regarding software and IT services. As a matter of fact, worldwide famous companies like Google, Accenture, IBM, Microsoft, Alten, Oracle and Amazon strongly invested in the whole Africa, also with R&D purposes.

[11] https://www.fdimarkets.com

Another sector which seems to attract FDI linked to R&D, is the communication one. In particular, several investments have been made in countries like Egypt, Nigeria and South Africa, respectively by Mondia Group, Universal Music Nigeria, Amazon and Platoon.
Last consideration regards the investment made by the Italian e-commerce Seeds&Chips, operating in the food and beverage sector, gathering innovators from all over the world to build a better food system. This company made several R&D investments in the whole Africa, i.e. in Angola, Egypt, Ethiopia, Ghana, Morocco, Mozambique, Nigeria, Rwanda and South Africa. It has been explained, in the "Global Food Innovation Summit", that the purpose of Seed&Chips is to invest in the growth of African economy in a sustainable way for the people and the environment (Seed&Chips, 2019).

As the previous analysis for the time frame 2003-2017, it should be considered the share of FDI related to R&D activities over total FDI to understand the will from foreign firms to allocate part of their investment into R&D and thus into technological innovations. The following graph represents this tendency over the 2018 and 2019.

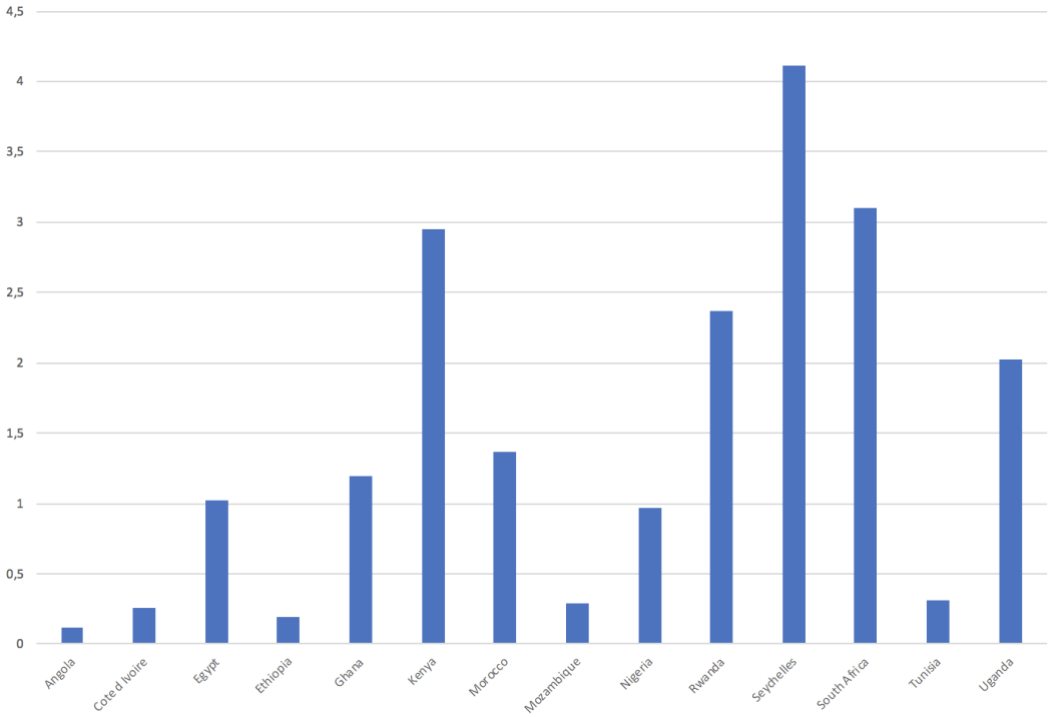


Figure 13. Share of FDI in R&D activities over total FDI in 2018-2019 (Source: own elaboration from FDI market) [12]

During this period of time, in the whole Africa the share of FDI linked to R&D activities over total FDI represents the 1.17 per cent, much higher than the 0.0803 per cent of the time frame

[12] https://www.fdimarkets.com

previous analyzed. Consequently, this percentage is already a signal that there is a recent trend to invest more in innovation in these African developing nations.

Analyzing single countries, the one that has the highest percentage is the Seychelles. This result comes from the fact that there have been only a few investments in the country beyond the one in the R&D field, in particular in business and construction. The one in R&D has been made in the healthcare sector by the Sri Lanka chain of private hospitals named Hemas Hospitals.

South Africa effectively improve under this aspect, shifting from a low 0.367 per cent of share to a value of 3.1 per cent of FDI dedicated R&D activities over total FDI in the country.

In this respect, great improvements can be seen also in Kenya, which had in the previous analysis the highest percentage but it was able to further improve it, and Nigeria which instead in the prior time frame did not have many R&D investments respect total FDI but it could improve this aspect significantly.

It is interesting to analyze what happened to Ghana. The country, in terms of number did not improve that much the amount of FDI related to R&D. However, if it is considered the share of FDI invested in this activity, the improvement is considerable, with the passage from 0.1269 per cent to 1.193 per cent, meaning an increase of more than 1 percentage point.

CHAPTER 4: THE IMPACT OF FDI ON INNOVATION IN AFRICA

4.1 Can FDI stimulate economic growth of African countries?

Up to now, it has been stated that governments all over the world want to attract FDI to boost economy growth through methods like technological innovation. However, even though FDI could eventually entail technological transfers, it is not yet demonstrated if FDI has always a positive impact on a developing countries economic growth. Here it is the necessity to clarify this aspect.

In the past, literature focused on searching which types of relationships between FDI and economic growth exist.

A few researches wanted to unravel if FDI lead to economic growth or it is economic growth of a country which attracts FDI. This type of study is based on the fact that foreign investors are attracted by those economic with higher growth rates. According to Choe (2003), which used data from eighty countries over a period of twenty-five years (1971-1995), there is a bi-causal relationship between FDI and economic growth, i.e. FDI inflows Granger-causes economic growth but, at the same time, it is also true that economic growth also Granger-causes FDI inflows. Moreover, it is interesting the fact that, according to this empirical research the granger causality is stronger for the latter.

In support of this study, Kombui & Kotei (2019) stated that developing country's factors such as interest rate, natural resource endowment, government expenditure, inflation and international reserves, which are all strictly related to the country's economic growth, Granger-causes FDI inflows.

According to Nair-Reichert & Weinhold (2001), which looked at the relationship between FDI and economic growth from country to country using a sample of twenty-four developing countries over a period of twenty-five years (1971-1995), it exists a casual relation between FDI and economic growth which is affected by the economic openness of the country took into account, i.e. bigger this aspect, higher the FDI.

With respect to African countries, the impact of FDI on economic growth is not straightforward. According to Adams (2009), which considered a panel of forty-two SSA over the period 1990-2003, the effect of FDI on economic growth was not proportionate to the increase of FDI inflows. In particular, while there was a significative positive impact using the OLS model, for the fixed effects models, findings did not show a positive impact.

Empirical research made by Gui-Diby (2014), considering a panel of fifty African countries and using a generalized method of moments, distinguished two different periods of time. During the first one, i.e. 1980-1994, findings showed a negative impact of FDI on innovation while during the second and more recent one, 1995-2009, findings showed a positive effect of FDI on innovation. Similar results but related to Kenyan firms over 1970 to 2000 and using a dynamic analysis to investigate the correlation, have been found by Abala (2014).

Further researches outlined that the relation between FDI and economic growth in Africa is positive only if there is the presence of other elements. This fact has been outlined by Adjasi et al. (2012), analyzing a panel regression on 32 African countries, whose results show that FDI has a positive impact on economic growth only if it is interacted with financial market variables.

Interesting results have been found by Inekwe (2013), analyzing Nigeria between 1990 and 2009, whose findings show different FDI's effects with respect to the industry sector. As a matter of fact, while FDI registered a positive impact on the servicing sector, it resulted to be an impediment for the manufacturing sector.

According to Diallo (2018), which investigate only the impact of Chinese FDI on economic growth in SSA, there is a positive influence of these investments on the countries' economy growth, even though the impact found is weak.

To summarize, empirical researches from the literature seems to reveal that the impact of FDI on economic growth in SSA, strongly depends on various specific conditions in the host country.

4.2 Innovation effects on country's performance

Having considered innovation as a source of economic growth, past literature wanted also to analyze how innovation affected some important country's performance such as the employment and the domestic firms' productivity. In order to understand which governmental policies are efficient, it is fundamental to review which are the most important findings, from the literature, regarding these relationships.

With respect to the hypothetic influence of innovation on employment, the long-run economic impact is positive since many decades and centuries of innovation, in those economies considered nowadays as advanced, have just led to employment growth (Harrison, 2008). Moreover, evidence suggests that innovative firms tend to survive more than not-innovative firms.

At the firm-level, the effect of innovation on employment will influence the behaviors of managers and workers in case of the implementation of a product or process innovation. As a

matter of fact, they could either resist or encourage these accomplishments. Consequently, it will be affected the frequency of introduction of innovation, the type of innovations introduced and even their price.

According to Harrison et al. (2008), considering data from manufacturing firms belonging to four European countries, even though it seems that process innovation tends to displace employment, there are some strong compensation effects which usually prevail. In particular, these compensation effects are related to the increase in productivity, resulting in lower unit costs and a stimulation of the demand, thus firm's efficiency and employment growth.

Regarding product innovation, there are no evidence of displacement effect for employment while there are still present compensation effects and for the same reason of before, employment growth.

Another study examines innovation behavior of German manufacturing firms considering a period of time of twenty years (Lachenmaier & Horst, 2007). The empirical research takes into account input and output innovations, respectively R&D expenditure and patents or new products introduced in the market. Results show that, generally, effects of innovation on employment are positive and robust to several specifications, with process innovation having a stronger impact on employment growth than product innovation.

Another empirical research on this subject has been made by Benavente & Lauterbach (2008), which considered data coming from firms in Chile. According to the authors, while product innovations positively affected employment growth, no evidence of growth has been found in case of process innovation. What is more, the study shows that for both types of innovation, the cause of a moderate employment growth is the greater labor productivity of the existing employees, associated with firm's innovation.

After having wide analyzed the relationship between innovation and employment growth, a similar analysis from the literature will be reported to explain how innovation and firm's productivity are linked.

Literature in the past focused on performing two separate analysis to explain this relationship; the first one starts from the idea that R&D activities drives technological innovation while the second one is related to innovations brought by organizational changes.

Regarding the first type of analysis, most of the empirical researches on this subject are based on the contribution made by Crépon, Duguet, and Mairesse in 1998, known as CDM.

According to CDM (1998), innovation inputs, i.e. R&D expenditures, will generate knowledge which may manifest in innovation outputs, i.e. new innovative products and processes methods.

Then, using these last factors inside the production process, the empirical researches from the authors confirmed an increase of the productivity. Thus, it can be said that innovation has a positive impact on productivity at the firm level.

Some authors outlined that empirical researches, such as the one proposed by the CDM, were mostly concentrated on the output produced by product or process innovation, since it is easily measurable using for example the share of innovative products in total sales or patent data.

However, there are some empirical researches which are focused on the relation between productivity and other types of innovation, such as the organizational one.

Most of studies analyzed the innovative change in the organization, starting from investments in information technology. According to Brynjolfsson and Hitt (2000), investments in information technology are the drivers of organizational innovations, enabling firm to implement new ways of doing business, e.g. B2B, new services, e.g. internet banking, new ways of producing goods and services, e.g. integrated management, and new marketing techniques, e.g. electronic cataloguing. Therefore, all these new implementations should generate production efficiency and factor savings, leading to productivity gains.

Similarly, to this previous empirical research, the study made by Polder et al. (2010) considers investment in information and communication technology at the same level of R&D expenditures, i.e. an innovation input. Their findings show that productivity gains cannot be achieved only through product innovation, but process and organizational innovation are required as well. According to the authors, these other two types of innovations are enabled only by the previous mentioned investments in information and communication technology.

This last point has a sort of confirm also at higher aggregation level. In particular, Polder et al. (2010) underlined that a possible explanation of the much higher productivity growth of the United States respect to the rest of the world, in the last two decades, can be related to the success that the US had in investing and implementing information and communication technologies.

4.3 Overview of the empirical literature for Africa

Over the years, various empirical researchers have been addressed to understand the impact of FDI on innovation in African countries, even with dissimilarity in the results.

The study presented by Managi et Bwalya (2008), using data coming from manufacturing firms in Kenya, Tanzania and Zimbabwe, it was aimed to examine productivity spillovers in the previously mentioned countries. Regarding horizontal spillovers (intra-industry), findings show that there have been productivity spillovers, through horizontal channels, in Kenya and

Tanzania, while no significant results emerged for Tanzania. This fact, according to the author, may indicate that inward FDI in Tanzania have increased adverse competition in the sector, thus reducing productivity. Similar results have been found in terms of vertical productivity spillovers (inter-industry), indicating in particular that there is a transfer of knowledge, throughout backward linkages and therefore from foreign firms in upstream sectors to local ones in downstream sectors. As already mentioned, this finding is consistent with the idea that foreign firms are willing to transfer their knowledge to take advantage of a cheapest price of the intermediate inputs from domestic firms, which will be able to produce them more efficiently. Last outcome from this research is the fact that technology spillovers tend to spread more easily in firms which are located in region with a high presence of foreign firms. Especially, this last result has been proved for Kenya and Tanzania.

Another study was proposed by Joseph Dery Nyeadi & Charles Adjasi (2020) and it was aimed to empirically examine the impact that FDI inflows had on firm innovation in Nigeria and South Africa. Regarding the former, the model showed that FDI had a positive impact on process and product innovation of Nigerian firms due to a transfer of knowledge, technology and capital.

However, no evidence of a positive impact of FDI on firm innovation in South Africa. According to the authors, this finding is the result of the "pull factor theory" previously mentioned (Dunning, 1995). As a matter of fact, many foreign firms investing in South Africa did not own a superior technology respect to the one already present in the domestic firms. Consequently, technology transfer is not possible, and it can even happen that foreigners want only to acquire the best brains from local firms, somehow reducing their innovation abilities.

After having introduced a few studies which prove the positive relationship between FDI and technological innovation, it should be also outlined another school of thoughts with different opinions.

According to the empirical research of Emmanuel Adu-Danso & Emmanuel Abbey (2020), who tested their hypothesis relying on a sample of 1157 manufacturing firms from SSA countries, foreign owned firms are less likely to introduce product innovation. Instead it has not been found a significant relationship between FDI and process innovation.

Authors claimed that these findings are coherent with the previously mentioned idea linked to the "product life cycle theory", which stated that MNEs tend to keep R&D in the headquarters in the early stage of a product development and decentralized these activities only when the product is already mature, lowering R&D expenditures in a consistent way. However, the authors also outlined that FDI are still important for technological progress but only if the accurate governmental policies are implemented, thus attracting the right type of FDI.

Cyrielle Auffray & Xiaolan Fu (2015) presented an empirical study which showed how the transfer of managerial knowledge from Chinese MNEs to the firms from Ghana operating in the African construction sector is limited. Even though the paper showed how Chinese MNEs are willing to hire local workers, these investors have to face particular issues, mainly related to the linguistic and cultural distance. This, if added to historical factors, makes local communication and trust-building among domestic firms and Chinese MNEs pretty hard to achieve.

4.4 Additional requirements for firm's innovation

Defined the hypothetic positive impact that technological innovations would have on a country's economic growth, last points to be covered regards those conditions that are fundamental to transfer these technologies.

If these conditions are not present, it can happen that these transferred technologies are not suitable for developing economies like the ones in Africa, resulting in the creation of inequalities in jobs, income and consumption patterns (Chataway et al., 2014).

Appropriateness of these innovative technologies, transferred by MCNs, is the first point needed by foreign owned firms in developing countries. With appropriate technology is meant "any form of hard and soft technology that is accessible, affordable and simple to use, with its embodied knowledge and skills easy to acquire and transferred to users of the technology" (Hazeltine & Bull, 2003). Actually, the concept of appropriate technology for developing countries refers to those technologies which are less labor intensive, less skills intensive and less reliant on infrastructures. However, being factor's endowments different among developing countries, it is required that appropriate technologies, requiring a certain level of financial, human and infrastructural resources, will meet the proper level of factor's endowment present in the developing country where they are transferred (Willoughby, 1990).

For instance, if a developing country has a high skilled human resource, it can classify some skills intensive technologies among the appropriate ones.

According to Botchie et al. (2017), whose examined the appropriateness of hard and soft ginning technologies transferred from US and India MNCs to local firms in Uganda, both the "hard" and "soft" components of a technology must be appropriated. In particular, "hard" technology is related to the machines and equipment used in the production process while "soft" technology is related to the experience and knowledge necessary for the efficient function of this innovative technology.

Another important condition that should be satisfied, alongside with the implementation of technological innovation, it is the adoption of innovative complementary behaviors from the firm. These activities are also known as non-technological innovations, as stated by Bartoloni & Baussola (2015). According to their empirical research, in order to maximize the impact of technological innovations on firm's performance, the firm requires new marketing and organizational orientations. In particular, a new marketing innovation is defined as "the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing" while with a new organizational innovation is meant "the implementation of a new organizational method in the firm's practices, workplace organization or external relations", as stated by the Oslo manual (OECD-Eurostat 2005).
It has been highlighted, in previous chapters, the importance of the absorptive capacity of domestic firms in order to implement new innovative technologies coming from MNCs. First of all, a definition of absorptive capacity is needed. Actually, it is defined as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends", as stated by Cohen & Levinthal (1990). In particular, authors state that the development of absorptive capacity is history or path dependent. They argue that the lack of investments, e.g. R&D expenditures, in a certain area of expertise, may prevent in future the development of technical capabilities and high-skills levels in that area. Consequently, if a firm wants to acquire and use technologies which are completely unrelated to its ongoing activities, they must previously focus on creating the proper absorptive capacity. However, it may not be as easy as thought since, according to the authors, it could entail the sacrifice of the current level of output and the loss of specialization in other areas, where the technical personnel will have to acquire knowledge in the area where the absorptive capacity is unappropriated.
Apart from the conditions mentioned in the last paragraph, literature underlined that many African governments implemented inefficient policies to boost technological innovation through FDI.

4.5 Stylized facts on FDI

Stylized facts are observations found in so many contests that, at a certain point they become empirical evidences, from which the theory must just adapt. They are mostly used at a macroeconomic level (Cooley & Thomas, 1995).
In this paragraph, a descriptive approach will be used to propose some facts, suggested by the literature, and others which are interpretations of what has been observed in the previous chapters. Respect to the initial chapter of this thesis, where it has been used data by UNCTAD,

this paragraph will sometimes use data retrieved from FDI market, to describe these previously mentioned facts. This utilization, even though has some limitation since FDI market takes also into account plans for future investments and thus could sometimes have different data from the more reliable UNCTAD, it is needed since it is the only data available which can be disaggregated in order to explain some trends.

I. *African countries rely on FDI for capital injections*

According to the paper of Kotey (2019), which uses for his statement different data retrieved from previous analysis, FDI became one of the most important source of capital injections for the whole Africa and in particular, for SSA countries. On the one hand, the authors outlined as, while in the past foreign loans represented the best source of finance for these countries, these loans decreased over the years, in particular by 24 per cent between 1990 and 1999 (Asiedu, 2002). This was mainly due to the complex regulations and requirements which were linked to these foreign loans.

On the other hand, FDI inflows in SSA in the same period increased by 180 per cent more or less, representing a clear sign of the fact that SSA countries rely much more on this type of source to obtain capital injections.

UNCTAD too confirmed that, for developing economies and thus including SSA countries, the main source of external finance is represented by FDI. Moreover, apart from remittances, the other sources of finance for these regions, i.e. portfolio investments and official development assistance (ODA), registered a decrease, lately (UNCTAD, 2019). Further details can be seen in Annex 3.

II. *FDI in SSA is growing but it's still a low percentage of the world's FDI*

As previously mentioned, respect to the 90', FDI flows to African countries grew considerably. However, this trend is not comparable with the growth that occurred in other developing countries. Taking into account the study of Asiedu (2002), between the 1990 and the 1999, the amount of FDI inflows that SSA countries obtained are only the 37 per cent of what the other developing countries got in the same decade.

Even later in the years, this difference among developing countries kept existing. For instance, as reported by the Africa Investment Report (2014), total amount of FDI inflows in SSA was $ 87 billion while, in the same year, other developing regions like Asia & Oceania and Latin America, received much higher FDI, respectively $470 billion and $ 170 billion.

This difference can be also seen between African countries and the rest of the world since the former received abound the 1 per cent of total FDI in the world in the 1990s and about 3 per cent in the 2000s.

The following graph clearly shows this disparity between the growth of FDI inflows.

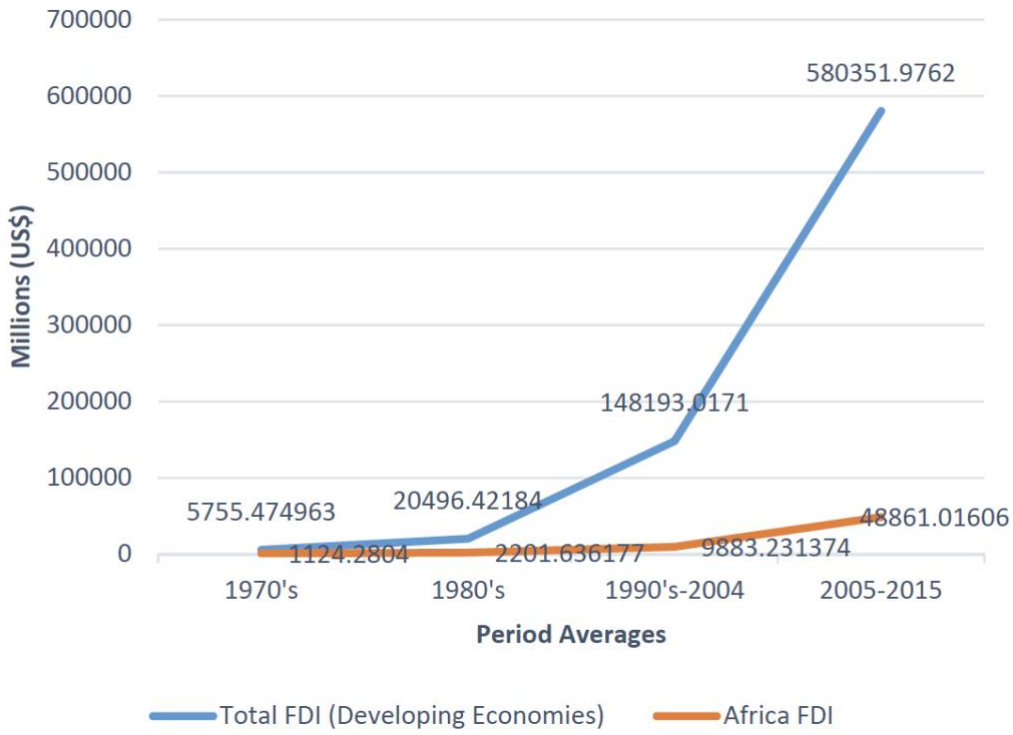


Figure 14. FDI inflows: comparison between trend in Africa and in the World (Source: Kotey, 2019)

What is more, Kotey (2019) in his study outlined also a paradox in this disparity between African countries and the other developing economies. Previous studies showed how return on investment in African countries is much higher if compared to countries belonging to the previous mentioned developing regions. In particular, in the 1990s, average ROI amounted to 30 per cent more or less in the Africa region, while it was about 21 per cent for the investments in Asia Pacific, 14 per cent for investments in Latin America, and 16 per cent for all others developing economies on average.

However, it seemed that foreigner investors have always been scared by the African issues related to the instability of political economy in addition to the concern of the proper functioning of rule of law (Bartels et al. 2009).

III. Most of FDI inflows into Africa are focused on a few industry activity

As previously mentioned, FDI flows to Africa grew in the last decades and what is more, they were addressed to many sectors, as it has been analyzed in the paragraph referred

to the recent African country trends. However, the greatest amount of foreign investments is concentrated only on a few industrial activities, as it can be seen by the following table which shows the market share of the FDI inflows into Africa by industrial activity.

FDI Inflows by Activity	US $ (millions)	Market share (%)
Manufacturing	**367.453 €**	29,27%
Extraction	**278.181 €**	22,16%
Construction	**240.226 €**	19,14%
Electricity	**155.161 €**	12,36%
ICT & Internet Infrastructure	**59.644 €**	4,75%
Logistics, Distribution & Transportation	**55.565 €**	4,43%
Business Services	**28.716 €**	2,29%
Sales, Marketing & Support	**23.296 €**	1,86%
Retail	**22.699 €**	1,81%
Recycling	**5.429 €**	0,43%
Headquarters	**5.302 €**	0,42%
Design, Development & Testing	**5.222 €**	0,42%
Other business activities	**3.708 €**	0,30%
Education & Training	**2.535 €**	0,20%
Research & Development	**2.056 €**	0,16%
Total	**1.255.190 €**	100,00%

Figure 15. FDI flows to Africa by industry activity in the timeframe 2003-2019 (Source: own elaboration from FDI market) [13]

According to the table, the three industry activities which gathers about 70 per cent of total FDI inflows into Africa are the manufacturing, the extraction and the construction ones.

Already the literature has found out that the majority of FDI inflows into Africa are concentrated into the primary sector (Bartels et al. 2009).

As already mentioned, FDI can be grouped into three main categories in terms of purpose of the investment, which are market seeking FDI, natural resource seeking FDI and efficiency seeking FDI. The last two types can be also called non-market seeking FDI because, respect to the market-seeking ones, they do not serve the demand of the local market and thus they do not seek local factors such as a high demand, high-income levels and a large market size. Instead, they aim to serve external and more attractive markets (Asiedu, 2002).

[13] https://www.fdimarkets.com

The analysis is consistent with the figure 15, since African countries are considered small and developing economies and therefore they attract FDI linked to the extractive and manufacturing activity in order to satisfy other external markets.

However, it should be also outlined the importance of the raw material industry in attracting FDI inflows, which still represent a source of capital injections for these developing economies.

IV. Recent growth of FDI related to R&D activities

The previous stylized fact has shown that FDI inflows into Africa are still concentrated in business activities such as manufacturing, extraction and construction while they keep being low the ones regarding R&D activities, fundamental for the African economy growth.

However, it must be highlighted how this trend is slightly changing in the last years.

The following graphs compare the share of FDI flows to Africa dedicated to R&D activities respect to total FDI, in the 2003-2017 time span (the first graph) and in the 2018-2019 time span (the second graph).

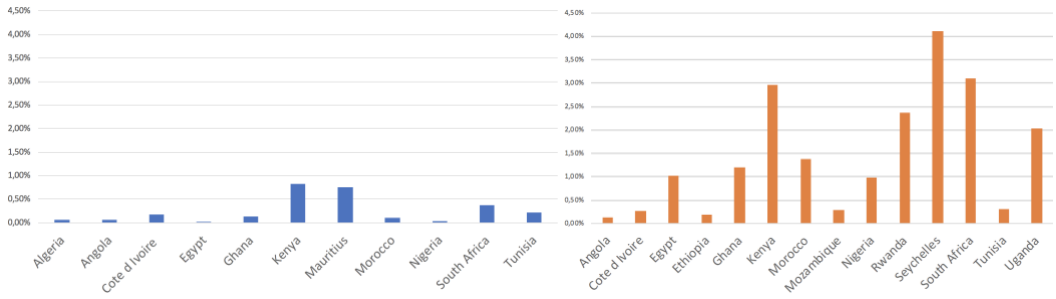


Figure 16. Share of FDI flows to Africa dedicated to R&D activities before and after the 2017 (Source: own elaboration from FDI market) [14]

Comparing the two graphs, it can be seen how FDI dedicated to R&D activities consistently increased in the last two years respect to the past. In particular, Kenya increased its share of FDI related to R&D respect to total FDI, from a percentage around 0,8 point in the first timeframe to a percentage pretty close to 3 point in the second and more recent timeframe, resulting in a 2.58 percentage increase. Another country which saw a boost of this type of FDI is South Africa with a rise from 0.367 per cent to 3.10 per cent in the share, resulting in a 7.45 percentage increase.

[14] https://www.fdimarkets.com

Ghana too improved its share of FDI related to R&D, passing from a very low percentage of 0.12 point to a percentage of 1,19 point. Even though the level reached by this country seems to be still low, it resulted in an 8.92 percentage increase.

Moreover, the graph displays also that there have been FDI inflows dedicated to R&D activities in much more countries in the second and recent time frame respect to the first one.

In conclusion, increase in R&D investments from foreigners into Africa is emphasized by the fact that while the first graph considers a time frame of fifteen years the second one is related only to a two years period of time.

Proofs of what has been stated come also from the trend of total FDI flows to Africa, according to data retrieved from FDI market.

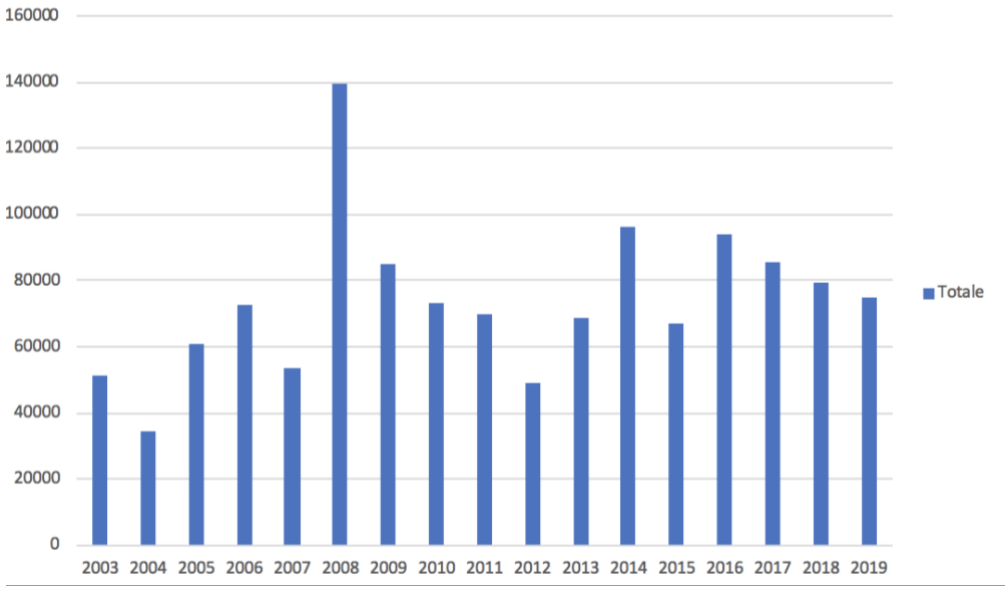


Figure 17. Trend of total FDI flows to Africa in the timeframe 2003-2019 (Source: own elaboration from FDI market) [15]

As a matter of fact, someone can say that the increase in FDI dedicated to R&D could be due to a general increase in FDI. However, as it can be seen by this graph, this hypothetic increase in FDI, in 2018-2019, did not happen.

This is a further point which support the fact that, with respect to the past, foreign investors tend to invest more of their capital available for a certain business sector, into R&D activities.

V. Technology from FDI is extremely important for African countries

[15] https://www.fdimarkets.com

African countries and mostly, SSA ones, being developing economies, most of the time do not own the human and financial resource to boost their innovation and hence obtain an economic growth.

In order to take care of this lack, SSA countries rely on foreign MNCs to absorb, as mentioned in the previous paragraphs, the desired technology innovations through FDI. As a matter of fact, the level of R&D in the whole Africa, even if increased in the last years, it is not enough to produce significant innovations, measured in terms of patents, for instance.

Consequently, domestic firms in African countries, which do not own sufficient resource to invest in R&D, can only benefit from the presence of foreign-owned firms, through imitation of their new acquired innovative technologies.

CHAPTHER 5: THE PROPOSED MODEL

5.1 The Conditional Logit model

The aim of this study is to assess if the determinants of the location of FDI inflows to Africa, related to R&D activities, are changing over time.
In order to reach this target, various Conditional Logit econometric models will be implemented, throughout the use of STATA Analytics and Data Science software.
After an introduction of the Conditional Logit model, they will be presented the dependent and the independent variables used in the model and extracted from a Dataset previously created.
Finally, results obtained through different models will be shown and analyzed, enabling to derive some important conclusions.

First of all, it will be estimated the probability that an FDI will be made in a certain country on the basis of observable country's features. In particular, the foreign investors choose the country which produces the highest possible utility.
The utility for a certain investment *n* generated by locating in an African country *i* at time *t* and made by a foreign country *o,* it is described through the following linear function:

$$U_{nit} = \alpha' x_{it} + \beta' y_{0it} + \gamma' z_{nit} + \varepsilon_{nit} \qquad \textbf{(1)}$$

In this function, x_{it} is a vector representing the exclusive features of the domestic country (e.g. market size, GDP growth etc.), Y_{oit} is a vector used to describe bilateral characteristics between the host and the foreign country (e.g. geographic, institutional and cultural distance) and z_{nit} is a vector made by investor-destination regressors.
Alpha, Beta and Gamma are the coefficients to be estimated.
The deterministic component of the utility is identified with

$$D_{nit} = \alpha' x_{it} + \beta' y_{0it} + \gamma' z_{nit} \qquad (2)$$

The Conditional Logit model, respect to the logit model, takes into account the heterogeneity of the investments, i.e. it considers the different relative utility yielded by a certain location of the investment, respect to the utility yielded by another location.

As already mentioned, it must be computed the probability that an investment *n* will be made in a certain African country *i* at time *t,* which in this model is the probability that the utility yielded by choosing country *i* is greater than the one yielded by all other African countries j, representing the "alternatives". These alternatives are made by all African countries chosen at least once by a foreign investor.
Thus, the function of the probability will be in the form:

$$P_{nit} = P(\text{Choice}_{nit} = 1|x, y) = \frac{e^{D_{nit}}}{\sum_j e^{D_{njt}}}$$

with $j \neq i$

Especially, the dependent variable called "Choice" is equal to one for a certain alternative that will be selected, and it will be zero for the other alternatives. Consequently, it will be found the probability that an FDI will be made in a specific African country (*table 1*).

In order to include in the model the FDI only related to R&D activities, regressors will be interacted with a dummy variable rd which will be equal to one if the investment is related to an R&D activity and zero otherwise.
However, since in the African region the FDI specifically related to R&D activities are not in a significant number to be analyzed in the regression model, it has been considered also other FDI made in industry activities that, according to the literature, are somehow strictly related to R&D activities. These industry activities are "Education and Training", "Headquarters" and "Design, Development and Testing".
It will be analyzed the interaction between some regressors, identified by the literature as the ones mainly attracting investments in R&D, and the dummy variable. Initially, it will be separately interacted each regressor with the dummy $rd,$ in order to focus on their single effect on the R&D investments. Subsequently, it will be performed an interaction between all regressors that theoretically affect the decision of the location of R&D investments and the dummy variable rd.

Lastly, it must be analyzed if an effective change in the determinants of FDI made in R&D as occurred over the time (*table 2*). Since stylized facts outlined that there has been a significant increase in FDI related to R&D after 2017, it has been decided to split the analysis into two different time spans.

The initial and more congruent idea would have been to implement two conditional logit models, before and after the year 2017, interacting all regressors with the dummy R&D. This hypothetic implementation would have revealed how the impact of the various determinants has changed in the two-time frame. However, this analysis could have not been performed due to the lack of data regarding investments in R&D, being considered in the second period only the 2018 and the 2019.

In order to avoid this lack of data, they have been implemented two models, S_1 and S_2, still considering the two different time spans but interacting all FDI with some regressors. In particular, the focus of the interpretation will be on those variables that have been identified by the previous analysis (*table 1*) and by the literature, as the ones which should mostly affect FDI related to R&D activities. As a consequence, comparing the results from the two models, it can be seen if there has been a real change in the impact brought by these determinants over the time.

5.2 Data description

The first action implemented was the creation of the dataset, that has been used to extract the data for the creation of the dependent and the independent variables which will be following described.

As already mentioned, the dependent variable called "Choice" is a binary one, thus it can have only two possible values, zero and one. In order to define this variable, data has been retrieved from the Financial Times Ltd fDi Markets, in particular considering the period of time between the 2003 and the 2019, due to availability of data. [16]

Moreover, the model takes into a consideration the hypothesis of a time discrepancy between the regressors and the dependent variable, in order to explain the choice of an FDI in a certain country through the determinants of the previous year.

[16] https://www.fdimarkets.com

The independent variables, i.e. the regressors representing the choice set of the foreign investor, are instead retrieved from different sources which will be specified for each variable.
Initially, there will be presented the location regressors, exclusively characterizing the features of the destination country (Okafor et al. 2015*)*.

- ***Market Size*** **represented by the population**

The variable of total GDP will be used to evaluate the market size of a certain African country. Market size can be considered an important determinant influencing a foreign investor's choice and in this model is described by the variable "*lpop",* representing the logarithm of the population.
Data has been retrieved from the World Development Indicators databank (WDI). [17]

- ***The purchasing power*** **represented by the GDP per capita**

Another variable that, similarly to the previous one, is needed to assess the domestic market, is the gross domestic product per capita. This variable gives the purchasing power parity (PPP) value of all final goods and services produced in a country in a given year divided by the average population of the same year. In the model, it will be included the logarithm of this variable, i.e. "*lgdp_pc*".
Data has been retrieved from the World Development Indicators databank (WDI).[18]

- ***Potential Growth*** **represented by the GDP per capita, yearly variation**

GDP per capita growth rate is another important measure since significant growth is a sign of good economic health and therefore of future opportunities for the investor. This variable is present in the model with the label "*gdp_growth*".
Data has been retrieved from the World Development Indicators databank (WDI). [18]

- ***The Labor Cost*** **described by the log wage**

Another determinant which should influence the foreign investor in the choice of the location of the investment is the labor cost. This determinant will be represented by the logarithm of a value which gathers all wages paid to employees, as well as the cost of

[17] https://databank.worldbank.org/source/world-development-indicators
[18] https://databank.worldbank.org/source/world-development-indicators

employee benefits and payroll taxes paid by an employer. This variable will be present in the model with the label "*ln_wage"*.

Data has been retrieved from the ILOSTAT database.[19]

- ***The Cost of Doing Business*** **measured by the stock of inward FDI**

The stock of inward FDI is a variable took into account in order to evaluate the cost of doing business in e a certain country. This is an important feature that a foreign investor is considering when he has to choose the location of his investment, somehow enabling him to approximate the value of expenses that he will face investing there. This variable will be included in the model with the label "*bfdi_stock",* together with its square value "*bfdi_stock2*".

Data regarding the stock of inward FDI has been retrieved from UNCTAD 2019 World Investment Report. [20]

- ***Availability of natural resources*** **described by Fuel exports and Ores exports**

In the empirical model, they are also present two variable assessing the availability of natural resources. The two variables, "*fuel_exports_stock*" and "*ores_exports_stock*", describe respectively the fuel and the mineral (metals included) esports, as a percentage of all merchandise exports, at the beginning of the 2002. They have been included in the model the square of these two regressors as well, i.e. "*ores_exports_stock2"* and *"fuel_exports_stock2"*.

Data has been retrieved from the WDI.[21]

- ***The Institutional Quality*** **represented by the political stability**

There has been also the necessity to find a variable which would describe the institutional quality of each African country. The variable decided to better measure this feature has been identified with the political stability indicator, defined by the variable "*pol_stability*" in the model. Especially, political stability is related to the possibility that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism, as stated by WGI.

Data has been retrieved from the World Governance Indicator database (WGI). [22]

[19] https://ilostat.ilo.org/topics/labour-costs/
[20] https://unctad.org/webflyer/world-investment-report-2019
[21] https://databank.worldbank.org/source/world-development-indicators
[22] https://info.worldbank.org/governance/wgi/

Then, bilateral variables must be considered, in order to assess the relationship between the parent and the host country. The data regarding the following variables is retrieved from the CEPII CHALEM database.

- ***Geographical Distance*** **described by the "ldist"**

  In particular, geographical distance between the two countries is measured by the regressor called "*ldist*". This variable has been defined as the logarithm of a variable previously defined as "distcap", which is computed measuring the distance between the geographic coordinates of the capital cities.[23]

- ***Common Language*** **and** ***Colony***

  Then two dummy variables have been added to the model. Especially, the common language dummy, i.e. "*comlang_ethno",* will be equal to one if the host and the foreign country speak the same language for at least 9 per cent of the population, zero otherwise. Similarly, the colonial relationship dummy, i.e. "*colony*", will be equal to one if there has been a colonial relation among the two countries.[24]

Moreover, it has been considered a set of variables which could influence the choice of the location of FDI related to R&D activities, which is still the main focus of this research.
According to the literature, the following regressors will be used (Damioli, 2017).

- ***The Quality of the Infrastructures*** **represented by the AIDI index**

  According to the literature, a high level of infrastructure should attract FDI related to R&D activities. This is why, it has been added, as a variable, the Africa Infrastructure Development Index, i.e. "*AIDI*" in the model. According to the Africa Infrastructure Knowledge Program, the AIDI index, computed by African Development Bank, serves a number of key objectives, like "to monitor and evaluate the status and progress of infrastructure development across the continent; to assist in resource allocation within the framework of ADF replenishments; and to contribute to policy dialogue within the Bank and between the Bank, RMCs and other development organizations".[25]

[23] http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp
[24] http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp
[25] http://infrastructureafrica.opendataforafrica.org/rscznob/africa-infrastructure-development-index-aidi-2020

- ***Quality of Human Capital*** **described by the human capital index**

Another variable which is still part of the exclusive characteristic of the domestic country, is the quality of human capital. This measure can be well approximated by the human capital index, represented in the model by "*hc_imp"*. This variable mainly takes into account the average years of schooling and an assumed rate of return to education in a certain country. According to the literature, the rate of return to education is the increase in the earnings from an additional year of education for an individual who makes the investment decision on education. Data has been retrieved from the Penn World Table (pwt). [26]

However, since the most recent data from pwt covered only up to the 2017, the data for the years 2018 and 2019 has been imputed in order to cover the lack of data available.

- ***Innovativeness*** **represented by the number of patents**

Another variable which is fundamental for the main objective of this empirical research is the number of patents, which represents the innovativeness of a country. Since it is interesting to discover if foreign investors tend to go where it is already present an absorptive capacity of knowledge, this regressor will be included in the model.

Furthermore, in order to have a good fit of the model, this regressor has been imputed to cover the lack of data for the year 2019 and it is named "*patent_imp"*.

Data has been retrieved from the World Intellectual Property Organization (WIPO).[27]

In terms of investor-destination regressors, it has been included in the C-logit models the variables "*cum_activity"*, "*cum_bilateral"* and "*cum_inv"*.

The first one is a measure of the functional agglomeration, the second one is a measure of the external agglomeration and the third one is a measure of the firm-internal agglomeration. These regressors will be added starting form Model 2, so as to further augment the specification.

In order to construct these regressors, data has been retrieved from Financial Times Ltd fDi Markets.[28]

Lastly, it has been included two dummy variables.

[26] https://www.rug.nl/ggdc/productivity/pwt/?lang=en
[27] https://www.wipo.int/portal/en/index.html
[28] https://www.fdimarkets.com

The first one is called "*zaf*" and it accounts for the central role of South Africa in the investment decision. As a matter of fact, without the inclusion of this variable, since South Africa attracts most of the FDI, all results would have been excessively influenced from the FDI's determinants of this country.

The second one is instead called "*Fuel exporter*" and it is required to control for the high heterogeneity among destination countries regarding the endowment of natural resources. In particular, this dummy is equal to one if the share of fuel export is higher than 60 per cent, zero otherwise.

Variables Name	Determinant	Source
Lpop	Market Size	WDI
lgdp_pc	GDP per capita	WDI
gdp_growth	Potential Growth	WDI
ln_wage	The Labor Cost	ILOSTAT
bfdi_stock	The Cost of Doing Business	UNCTAD
bfdi_stock2		
fuel_exports_stock	Availability of natural resources	WDI
ores exports_stock		
fuel_exports_stock2		
ores_exports_stock2		
pol_stability	Political Stability	WGI
Ldist	Geographical Distance	CEPII
comlang_ethno	Common Language	CEPII
Colony	Colonial relationship	CEPII
AIDI	The Quality of the infrastructure	African Development Bank
hc_imp	Quality of Human Capital	PWT
patent_imp	Innovativeness	WIPO
cum_activity	Functional Agglomeration	fDi Markets
cum_bilateral	External Agglomeration	fDi Markets
cum_inv	Firm-Internal Agglomeration	fDi Markets
Zaf	South Africa	fDi Markets
fuel exporter	Fuel Exporter	WDI

Figure 18. Independent variables chosen for the regression

After having decided the variables inside the analysis, in order to apply the Conditional Logit model, there was the necessity to create a unique dataset.

First of all, the excel files containing the data required for the research have been imported on Stata. Then some actions to make the data all uniform have been applied.

The next step was to merge all files.dta, thus creating a unique dataset. Once the availability of the data has been checked, the regression could have started.

Moreover, summary statistics can be seen in the Annex 5.

5.3 Empirical Results

Empirical results are summarized in *Table 1* and *Table 2*.

It is fundamental to underline that the focus of the analysis will be on the evaluation of the coefficients of regressors and in particular of their signs.

However, a certain result should be seen as relevant only if the p-value will be lower than certain values, i.e. $p< 0.1$ or $p<0.05$ or $p<0.01$. On the one hand, higher the p-value of a certain regressor, lower it will be its impact on the dependent variable and so on attractiveness for FDI in a given country. On the other hand, if the p-value is low, i.e. below 1 per cent, the variable will have a positive or negative effect on attracting FDI.

In both the two tables containing the results, it will be present the positive or negative coefficient of each regressor, with the number in the brackets representing the standard errors. As it is written in the legend on the bottom, the number of asterisks nearby each coefficient shows a different level of significance for the regressor considered.

It can be seen, in *Table 1*, seven columns representing seven conditional logit models, realized in order to better analyze the impact of the various model's determinants. Results of the implementation of each model will be separately reported. The first model will present a list with the explanation of all those variables evaluated as relevant by the p-value, each of them followed by an attempt of justification considering what has been said by the literature. Afterwards, for the other model, only significant variations in the coefficients will be underlined.

Table 1	(1) c1	(2) c2	(3) c3	(4) c4	(5) c5	(6) c6	(7) c7
Lpop	0.605***	0.634***	0.626***	0.628***	0.628***	0.631***	0.634***
	(0.0519)	(0.0524)	(0.0528)	(0.0528)	(0.0528)	(0.0529)	(0.0531)
lgdp_pc	0.304***	0.485***	0.542***	0.557***	0.560***	0.564***	0.575***
	(0.0645)	(0.0679)	(0.0690)	(0.0691)	(0.0691)	(0.0692)	(0.0699)
gdp_growth	0.0642***	0.0682***	0.0706***	0.0711***	0.0709***	0.0710***	0.0712***
	(0.00762)	(0.00756)	(0.00761)	(0.00760)	(0.00761)	(0.00761)	(0.00761)
ln_wage	-0.117***	-0.0795***	-0.0630**	-0.0601**	-0.0599**	-0.0592**	-0.0585*
	(0.0293)	(0.0296)	(0.0299)	(0.0299)	(0.0299)	(0.0299)	(0.0299)
bfdi_stock	0.392***	0.271***	0.234***	0.228***	0.226***	0.224***	0.222***
	(0.0449)	(0.0452)	(0.0455)	(0.0454)	(0.0454)	(0.0454)	(0.0455)
bfdi_stock2	-0.0159***	-0.0105***	-0.00878***	-0.00849***	-0.00839***	-0.00830***	-0.00823***
	(0.00190)	(0.00191)	(0.00193)	(0.00192)	(0.00193)	(0.00193)	(0.00193)
fuel_exports_stock	-0.00629	0.00275	0.00600	0.00619	0.00629	0.00607	0.00626
	(0.00976)	(0.00968)	(0.00975)	(0.00975)	(0.00975)	(0.00975)	(0.00975)
ores_exports_stock	0.0251***	0.0243***	0.0234***	0.0233***	0.0231***	0.0230***	0.0230***
	(0.00697)	(0.00703)	(0.00707)	(0.00707)	(0.00707)	(0.00707)	(0.00707)
ores_exports_stock2	-0.000798***	-0.000806***	-0.000788***	-0.000790***	-0.000786***	-0.000784***	-0.000784***
	(0.000154)	(0.000154)	(0.000154)	(0.000153)	(0.000153)	(0.000153)	(0.000153)
fuel_exports_stock2	-0.000414*	-0.000623***	-0.000677***	-0.000685***	-0.000687***	-0.000685***	-0.000689***
	(0.000225)	(0.000224)	(0.000225)	(0.000225)	(0.000225)	(0.000225)	(0.000225)
1.fuel_exporter	0.350*	0.0127	-0.121	-0.146	-0.147	-0.148	-0.157
	(0.205)	(0.209)	(0.210)	(0.211)	(0.210)	(0.210)	(0.211)
Zaf	7.673***	4.242***	3.337***	3.134***	3.087***	3.019***	2.972***
	(1.034)	(1.058)	(1.066)	(1.066)	(1.067)	(1.067)	(1.068)
pol_stability	0.259***	0.229***	0.210***	0.208***	0.208***	0.208***	0.207***
	(0.0540)	(0.0534)	(0.0536)	(0.0535)	(0.0535)	(0.0535)	(0.0535)
Ldist	-0.624***	-0.604***	-0.561***	-0.563***	-0.564***	-0.562***	-0.563***
	(0.0293)	(0.0286)	(0.0295)	(0.0295)	(0.0295)	(0.0295)	(0.0295)
comlang_ethno	1.178***	0.979***	0.935***	0.943***	0.941***	0.944***	0.945***
	(0.0499)	(0.0516)	(0.0524)	(0.0525)	(0.0525)	(0.0525)	(0.0525)
Colony	0.547***	0.524***	0.548***	0.552***	0.552***	0.547***	0.550***
	(0.0767)	(0.0786)	(0.0789)	(0.0789)	(0.0789)	(0.0789)	(0.0789)
AIDI	0.00587**	-0.00204	-0.00370	-0.00451	-0.00522*	-0.00469	-0.00505
	(0.00286)	(0.00305)	(0.00311)	(0.00312)	(0.00314)	(0.00313)	(0.00315)
hc_imp	0.257**	0.163	0.0630	0.0152	0.0483	0.0417	0.0196
	(0.111)	(0.113)	(0.114)	(0.115)	(0.114)	(0.114)	(0.115)
patent_imp	0.0000787	0.000205*	0.000186	0.000196	0.000191	0.000182	0.000185
	(0.000116)	(0.000119)	(0.000121)	(0.000121)	(0.000121)	(0.000121)	(0.000122)
cum_activity		0.000606**	0.000870***	0.00109***	0.00111***	0.00116***	0.00119***
		(0.000251)	(0.000255)	(0.000258)	(0.000259)	(0.000261)	(0.000261)
cum_bilateral		0.00506***	0.00427***	0.00417***	0.00417***	0.00413***	0.00413***
		(0.000358)	(0.000367)	(0.000367)	(0.000367)	(0.000368)	(0.000368)
cum_inv			0.583***	0.583***	0.583***	0.583***	0.584***
			(0.0299)	(0.0299)	(0.0299)	(0.0299)	(0.0299)
1.rd#c.hc_imp				0.929***			0.605
				(0.201)			(0.426)
1.rd#c.AIDI					0.0145***		0.00425
					(0.00304)		(0.00684)
1.rd#c.patent_imp						0.000420***	0.000373**
						(0.0000819)	(0.000183)
1.rd#c.lpop							-0.0844
1.rd#c.lgdp_pc							-0.224
N	91258	91258	91258	91258	91258	91258	91258

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

Model 1 considers only the exclusive location variables and the bilateral variables mentioned before.

- The presence of mineral and metals (*ores_exports_stock*) promotes the location of FDI, since the coefficient of the regressor is positive and the estimation significant (p-value lower than 0.01). However, the effect of this determinant is diminishing returns, being the coefficient of *ores_exports_stock2* negative. This is coherent with the previous descriptive analysis regarding the main industry activities on which FDI are implemented, which include the extraction one.

  Moreover, foreign investors seem to be attracted by the African countries which are gathered in the group represented by the dummy *Fuel exporter*, even though this variable has a p-value not so significant, i.e. the p-value is lower than 0.1.

  This is comprehensible, as the literature and the descriptive analysis highlight that countries which are considered as fuel exporters have on average a greater probability to attract FDI.

- The results underline that the cost of doing business is a determinant important and significant for the foreign investor when he must choose the location of his investment. This statement can be seen looking at the coefficient of the regressor representing the stock of inward FDI which is highly significant and strongly positive, i.e. influencing a lot the decision regarding the FDI's location. However, similarly to the results previously underlined for the regressor representing the export of the stock of mineral and metals, the effect of the stock of inward FDI is diminishing returns, being the coefficient of its square value negative.

- The literature underlines as, in the past, foreigners had doubts to invest in Africa due to issues strictly related to factors like corruption, terrorism or governments destabilization. Consequently, it is coherent that, nowadays as well, institutional quality described by the regressor of the political stability results to be evaluated as an important and significant determinant from the point of view of the foreign investor. As a matter of fact, its coefficient is positive and with a p-value lower than 0.1.

- As it is highlighted in the literature, factors which have a strong impact on the choice of the FDI's location are the market size, the purchasing power and the potential growth

of a certain African country. The assessment is proved by the positive and significant coefficients of the regressors describing these determinants, respectively the logarithm of the population, the GDP per capita and the GDP growth.
Among these variables, the one describing the market size, i.e. *lpop*, seems to have the greatest impact on the promotion of the location of FDI.

- As it was initially supposed, South Africa has a critical role in the decision of the investment's location, confirmed also by the positive and significant coefficient of the dummy *zaf.*

- The coefficient of the regressor *ln_wage* is negative and highly significant. This means that, as it could have been imagined, foreign investors consider the determinant represented by the labor cost an important factor inside their choice set. In particular, lower these costs in a certain country, higher the chance that the FDI will be implemented in this location.

- Important deductions can be done analyzing the coefficient of bilateral regressors, i.e. the one of *ldist*, *comlang_ethno* and *colony*. As a matter of fact, being all these coefficients positive and highly significant, it can be said that if the host country and the foreign one have a limited geographical distance, they share a common language and there has been a colonial relationship in the past, it's likely the choice of this country for the FDI.

- Last considerations for the Model 1 regard the variable which, according to literature, should influence FDI related to R&D activities. However, also for Model 1 which did not consider R&D investments, it has been registered a positive and significant coefficient of the variable related to the quality of human capital (*hc_imp*) and of the variable assessing the quality of all infrastructures *(AIDI).* These two important results seem to go against the popular idea that foreigners invest only in those African country where they can exploit low labor costs, or they can take advantage of weak governmental restrictions against child labor.
  Thus, results show that foreigners are evaluating in a strong way country's aspects included in these two regressors, such as the level of education, the rate of literacy and also how developed are ICT, electricity and transport edifices and means. In particular,

being the 70 per cent of FDI inflows to Africa related to manufacturing, extraction and construction activities, it is clear why for foreigners the quality of physical infrastructures become fundamental.

Even though the coefficient of the regressor *patent_imp* is positive, its p-value is higher than 0.1 and thus, it cannot be considered significant for the first model.

Differently from the first model, Model 2 takes into account two additional regressors, *cum_activity* and *cum_bilateral.* The former is a measure of the functional agglomeration and so, evaluating the cumulated number of previous foreign investments, implemented in a certain country, within the same industrial activity. Being the positive coefficient quite significant, with a p-value lower than 0.1, it can be said that investors are influenced by the effects of an agglomeration economy based on industrial activity.

The latter is a measure of the external agglomeration and therefore, it is the cumulated number of previous investments realized in a certain destination country and coming from the same origin country. Being the coefficient of this regressor positive and significant, it can be said that investors tend to go to those countries where they are facilitated to invest, for instance already owning information about the country and knowing the legal procedures to invest there.

With respect to the previous model, there is an increase in the positive effect exerted by country's determinants such as the market size, GDP growth and the GDP per capita. In particular, the increase in the impact of this variable on the choice of the location, it is coherent with a slight decrease (in absolute value) in the coefficient of the *ln_wage,* since it could be affirmed that there is a decrease in the importance given to the cost of labor while it seems to become more important the wealth of the country.

Model 3 takes into account another variable, which is part of the investment-decision regressors, and it is labeled *cum_inv.* As previously mentioned, this variable measure the firm-internal agglomeration economies, i.e. it is evaluating the cumulated number of previous FDI, made by the same investor in a certain destination country.

As the two investment-decision regressors introduced in the previous model, this regressor is promoting the location of FDI as well, since its coefficient is positive and significant. Thus, it can be said that a foreign investor tends to locate where he has already made an FDI in the past.

It can be underlined also an attenuation in the effect of the human capital regressor, since there is correlation among these variables.

Model 4 starts to consider the role of R&D, central point of the empirical analysis. In order to include in the model the FDI only related to R&D activities, the first regressor, identified by the literature as a driver of the attraction of this type of investments and that has been interacted with the dummy variable rd, is the *hc_imp.*

The first fundamental result for the scope of this empirical research is found. Since the coefficient is strongly positive and the estimation is significant, it can be said that as anticipated by the literature, the FDI related to R&D activities seem to be more affected by the quality of human capital respect to the FDI related to all other industrial activities.

The explanation for this effect comes from the fact that the foreign investor, willing to start an R&D activity, would need a proper level of high skilled human resource in the destination country to implement new technologies and save costs. As a matter of fact, skilled workers can be also transferred and employed from the origin country, but this would imply higher costs for the investor.

In Model 5, it has been performed the interaction between the dummy variable rd and *AIDI,* which is the second regressor outlined by the literature as a determinant on which foreigners rely on at the moment of the choice of the location of an R&D investment. Here it comes the second important result for this empirical research, since the coefficient of this regressor is positive and it shows a significant estimation. Consequently, it appears that for R&D investments, compared to FDI implemented in other industrial activities, the quality of infrastructure has a greater weight.

This statement can be interpreted with the fact that foreign investors, before implementing FDI in R&D activities, they want to be sure that the level of electricity, transport and ICT infrastructures are good enough to support the development of innovative products or processes, without adding additional costs for instance.

Similarly to the two previous models, in Model 6 it is confirmed that R&D investments seem to be more affected by the innovativeness of a country respect to FDI implemented in other industrial activities. This statement can be shown by the significant estimation of the regressor *patent_imp*, representing the number of patents implemented in the time frame considered, which turned to be positive, even if with a small coefficient.

In order to get this result, it has been performed an interaction between the regressor *patent_imp* and the dummy variable rd.

Nevertheless, it remains the doubt if these effects on FDI related to R&D activities, coming from from *hc_imp, AIDI* and *patent_imp,* are direct effects or they depend on other country's features like the the market size and the GDP per capita. As a matter of fact, it is probable that there is a correlation among the level of GDP which is a sign of a developed country, and quality of infrastructures, human capital and the level of innovation.

Consequently, in order to check the robustness of the results coming from the previous models, in Model 7 it is performed an interaction between all regressors that theoretically affect the decision of the location of R&D investments and the dummy variable $rd,$ in order to highlight if a differential effect, from these regressors, it exists or not.

Regarding the two regressors just included, i.e. *lpop* and *lgdp_pc*, which according to the literature should attract FDI related to R&D activities in developed countries, the estimations are not significant since the p-value is greater than 0.1. Therefore, FDI related to R&D activities are affected by the market size and GDP per capita in the same way of FDI made in all other industry activities.

This result can be interpreted with the point that usually the output of R&D activities, i.e. technologically modified products, are rarely realized to be sold exclusively in the local developing market and thus, these factors do not have a particular impact on the location's choice. Moreover, the quality of human capital and the level of infrastructure do not show a differential effect.

However, a fundamental result occurs looking at the last determinant considered.

It must be underlined that the regressor *patent_imp,* remaining fairly significant and with a positive coefficient, indicates that there is a positive differential effect of this determinant which does not depend on the previous mentioned country's features.

Hence, from the point of view of foreign investors, in order to invest in R&D, it becomes important to choose a so-called innovative country, where there is more capacity to absorb knowledge, hence boosting and facilitating the implementation of R&D outputs.

In order to analyze if an effective change in the determinants of FDI made in R&D as occurred over the time, it has been performed an analysis which takes into account the two different time spans previously underlined (*Table 2*). Especially, two C-logit models have been implemented, S_1 before the 2017 (included) and S_2 after the 2017, to identify if the determinants of FDI in the two time spans have changed, with a specific attention on those determinants which were identified in the previous part as the ones mainly attracting FDI related to R&D.

Table 2	(1)	(2)
	s1	s2
lpop	0.660***	-0.156
	(0.0587)	(0.314)
lgdp_pc	0.564***	-0.147
	(0.0756)	(0.420)
gdp_growth	0.0675***	0.0217
	(0.00794)	(0.0499)
ln_wage	-0.0725**	-0.475
	(0.0308)	(0.320)
bfdi_stock	0.227***	1.167***
	(0.0489)	(0.306)
bfdi_stock2	-0.00854***	-0.0556***
	(0.00207)	(0.0144)
fuel_exports_stock	-0.00385	-0.0159
	(0.0110)	(0.0435)
ores_exports_stock	0.0331***	0.123
	(0.00751)	(0.0766)
ores_exports_stock2	-0.000952***	-0.00464
	(0.000160)	(0.00304)
fuel_exports_stock2	-0.000461*	0.0000738
	(0.000255)	(0.000909)
zaf	3.681***	29.94***
	(1.144)	(8.025)
pol_stability	0.190***	-1.022*
	(0.0562)	(0.538)
ldist	-0.564***	-0.495***
	(0.0317)	(0.0803)
comlang_ethno	0.917***	0.781***
	(0.0568)	(0.141)
colony	0.552***	0.553**
	(0.0849)	(0.221)
AIDI	-0.000187	0.0256*
	(0.00348)	(0.0134)
hc_imp	0.0404	1.712***
	(0.125)	(0.484)
patent_imp	-0.000129	0.0000971
	(0.000142)	(0.000563)
cum_activity	0.00101***	0.00154***
	(0.000311)	(0.000503)
cum_bilateral	0.00516***	0.00340***
	(0.000450)	(0.000678)
cum_inv	0.566***	0.659***
	(0.0333)	(0.0690)
N	81458	9800

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

First of all, an introduction must be done. This second part of the empirical analysis is an analysis entirely explorative since it is based on an enormous limitation for this type of research, which is the scarcity of FDI for the second time span. Especially, as it can be seen in *Table 2*, the number of observations for S_1 amounts to 81458 while the number of observations for S_2 amounts only to 9800.
However, it has been included these following C-logit models with the intent of encouraging further and future researchers on the matters, since findings seem to somehow align what has been seen in the descriptive analysis to what has been tried to outline in the empirical analysis.

For the S_1, results are similar to the ones of the C-logit models implemented for *Table 1.* In particular, promotion of the location of FDI seems to be driven by the same location determinants identified before like the market size, the GDP per capita, the GDP growth, the political stability, the presence of mineral and metals, the stock of inward FDI and the labor cost.
Regarding the bilateral variables, it can be said that the regressor of the geographical distance has a negative coefficient while the coefficients of the common language and of the colonial tie result to be both highly positive. All estimations result to be significant.
Furthermore, investor-destination regressors, i.e. *cum_activity*, *cum_bilateral* and *cum_inv*, are significant and they have as expected all a positive sign of their coefficient.
Since results are coherent with what have been found in Table 1, the interpretation of the effect of these determinants are analog at the ones made before.
Nevertheless, what should be interesting is that, in this time frame, neither one of the regressors identified before as driver of R&D investments result to have a significant estimation.

As a consequence, it must be compared the results found in the S_1 with the results found for the second time frame, in order to see if there has been a change in the effect of some determinants.
It should be immediately underlined the giant role exerted by South Africa, as it can be seen by the coefficient of the regressor *zaf*, which attracted a good share of FDI in the period considered.
Regarding the other regressors, it remains significative the effect of the stock of inward FDI, the geographical distance, the common language, the colonial relationship, the functional agglomeration, the external agglomeration and the firm-internal agglomeration. The effect of the other variables is not significative, but this result can come from the issue of the scarcity of data available, as already mentioned.

However, what is interesting to outline is that the estimation for the regressors *AIDI* and *hc_imp* becomes significant. The former, with a p-value lower than 0.1, it has a coefficient with a positive sign, indicating that, if compared to the past, in the recent years foreign investors are more attracted by those countries offering a good quality of infrastructure.
The latter shows result which are more than interesting, since there is not only a p-value lower than 0.01, but the coefficient of the regressor *hc_imp* resulted to be positive and large in magnitude while for the S_1 it was not significant at all.
This fact can highlight, over the years, a radical change in the evaluation of the quality of human capital from a foreign investor point of view, who seems to be more than attracted by a positive value of this determinant.
Moreover, even though the estimation does not result to be significant, it can be underlined also that the coefficient of the regressor *patent_imp* experienced a change of sign, from negative in S_1 to positive in S_2.

5.4 Concluding remarks

A short summarization is required to make the reader aware of the importance of the findings, successively explained.
In order to encourage an economic growth, African countries are trying to boost their level of technology mainly targeting FDI inflows. However, literature outlined that in order to achieve important technology transfers which could support the innovation of the whole domestic market, not all types of FDI should be targeted. As a matter of fact, some authors have outlined that FDI do not bring only benefits to the local market, since there can be situations where parent company even prevent the innovation of foreign-owned firms.
Consequently, there has been the necessity to define which are the type of FDI leading domestic firms toward to technological innovations. FDI related to R&D activities have been identified by the literature as the driver of this boosting.
Thus, throughout an initial descriptive analysis of FDI flows to Africa, it has been highlighted a crucial increase in FDI related to R&D activities after the 2017.
In order to understand if this trend is related to a change in the determinants of the location of FDI related to R&D activities, several C-logit models have been implemented.
Among all results, some of them should be further explained.
The first important finding regards the positive and significant effects that the quality of human capital and the level of infrastructures have in attracting FDI. On the one hand, these results

seem to go against the popular idea that foreigners invest only in those African country where they can exploit low labor costs, or they can take advantage of weak governmental restrictions against child labor. On the other hand, being a majority of FDI dedicated to manufacturing, extraction and construction activities, it can be easily understood the growing importance of transportation, ICT and electricity infrastructure as well as the associated workers.

In terms of determinants of the location of the FDI related to R&D activities, the direction suggested by the literature has been proved. As a matter of fact, in models four, five and six, coefficients of the regressors interacted with the dummy variable rd result to be positive and the estimation significant in terms of p-value. Consequently, the FDI related to R&D activities are affected more by determinants like the quality of human capital, the level of infrastructures and the innovativeness of the country, respect to the FDI related to all other investment activities. An interpretation for the effect of these determinants can be developed. The literature suggests that, in order to develop an innovation throughout its entire lifecycle, a good level of "hard" technology and "soft" technology should be present. Thus, regarding the former, before to invest in R&D, foreign investors will evaluate if the level of electricity, transport and ICT infrastructures are good enough to support the development of innovative products or processes, without adding additional costs.
Concerning the latter, an interpretation is that foreign investor, willing to start an R&D activity, would need a proper level of high skilled human resource in the destination country to implement new technologies and save costs. As a matter of fact, skilled workers can be also transferred and employed from the origin country, but this would imply higher costs for the investor.

What is more, Model 7, used to check if these regressors are correlated to the level of GDP, underlines that the variable representing the number of patents remain, even in this model, significant and with a positive sign, meaning that there is a positive differential effect of this determinant which does not depend on features of the destination country like GDP.
Consequently, FDI related to R&D activities tend to be implemented in countries which are more innovative than others, i.e. where there is more capacity to absorb knowledge which could boost and facilitate the implementation of R&D outputs.

Model 7 outlines that determinants like the market size and the purchasing power do not affect the choice of the location of FDI. The interpretation is as follows.

On the one hand, the literature outlined that FDI in R&D activities in developed economies seem to target the local R&D market and they are therefore concerned about factors like market size, purchasing power and competition with local technology. On the other hand, results from the previous regression model underlines that FDI in R&D activities are made in developing countries to establish an R&D center in order to modify MNC own products or technology for the local but mostly for the export markets.
This fact can be interpreted with the point that usually the output of R&D activities, i.e. technologically modified products, are rarely realized to be sold exclusively in the local developing market and thus, factors like GDP or market size do not have a particular impact on the location's choice.

Another fundamental finding, even though with its already mentioned limitations, is the change in the determinants of the location of FDI over the years. This finding has been elaborated comparing the two different time spans, outlined in the descriptive analysis.
In particular, this change regards the quality of human capital and of the infrastructures which are the determinants that, according to the literature and the previous part of this empirical analysis, should promote the location of FDI related to R&D activities.
Consequently, over the years, foreign investors who want to start to establish R&D centers in African country, seem to evaluate more country's features such as an high quality of human capital and an high level of infrastructure.

This last point outlines that, lately, some African governments have started to understand the importance of R&D activities, slightly encouraging their development. However, the literature underlined that many countries are still implementing inefficient policies to boost technological innovations through FDI.
As a matter of fact, once it has been identified the determinants that result to be crucial for the choice of the location of FDI related to R&D activities, governmental policies should be focus on boosting this factor. According to the results found in this empirical research, it should be implemented policies targeting a development of the education system, in order to improve the quality of human capital, and targeting an enhancement of the infrastructure system, in all its components, to decrease the gap with the developed countries.
Regarding the innovativeness, governments should provide incentives to local firms in order to push them to invest in in R&D activities, following the example of MNC, boosting patents and thus increasing the absorptive capacity of knowledge.

Last but not least, it should be underlined some limits of this study.

First of all, since the number of FDI only related to R&D activities was not enough to obtain significant result, it has been considered in the dummy variable rd, FDI undertaken in other industrial activities. Although these industrial activities should be somehow related to R&D activities according to the literature, they cannot be considered purely R&D investments.

Secondly, there could have been other determinants of the location of FDI related to R&D activities in Africa, as stated by the literature. For instance, the regression model could have included determinants like R&D expenditures from the government, the level of university students representing a more accurate level of education in each country, and also a split of the various infrastructure components in order to better identify the weight of ICT, electricity and transport. However, this inclusion has not been possible because the data available for those regressors was too little, with missing value for several years. This lack of data could not be imputed due to the fact that it was unknown if data was missing because information was not provided or because the R&D expenditures was not occurred, for instance.

Furthermore, as already mentioned, the second part of the empirical research is purely explorative, since it is based on a minute number of FDI which do not make the results 100 per cent reliable.

Indeed, this analysis has the intent of encouraging further researchers on the matters, since findings seem to be interesting and suggestion for governmental policies can, in future, support the technological boost of African countries.

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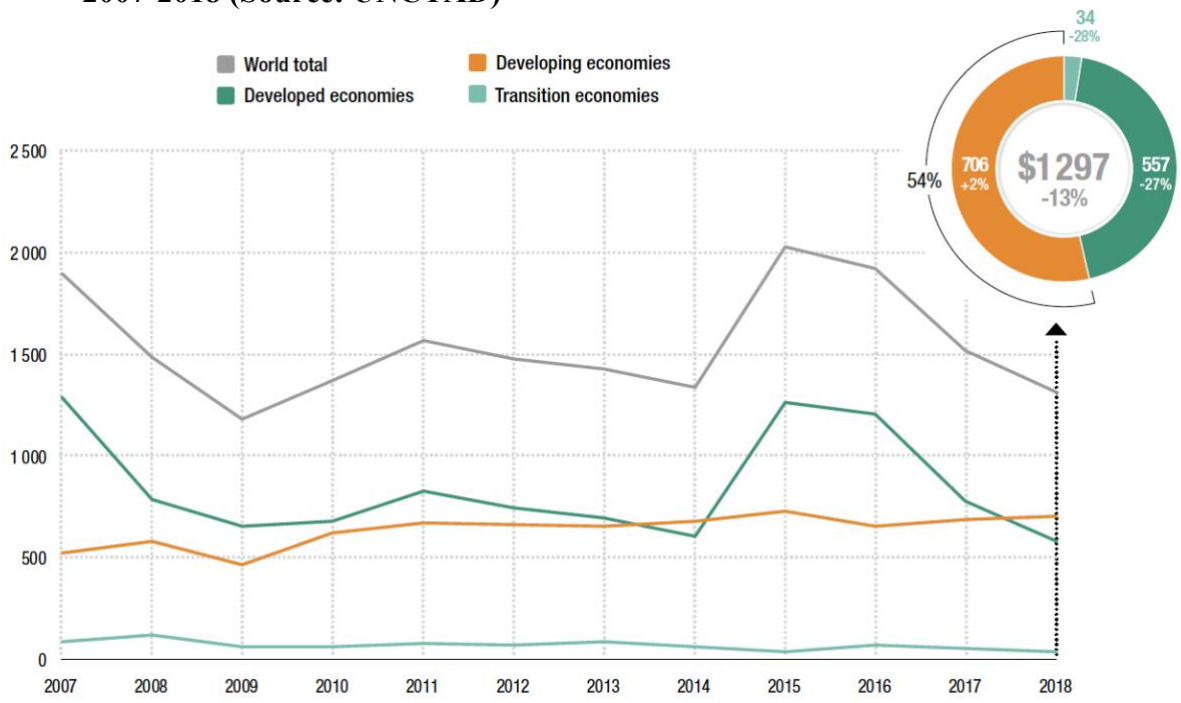
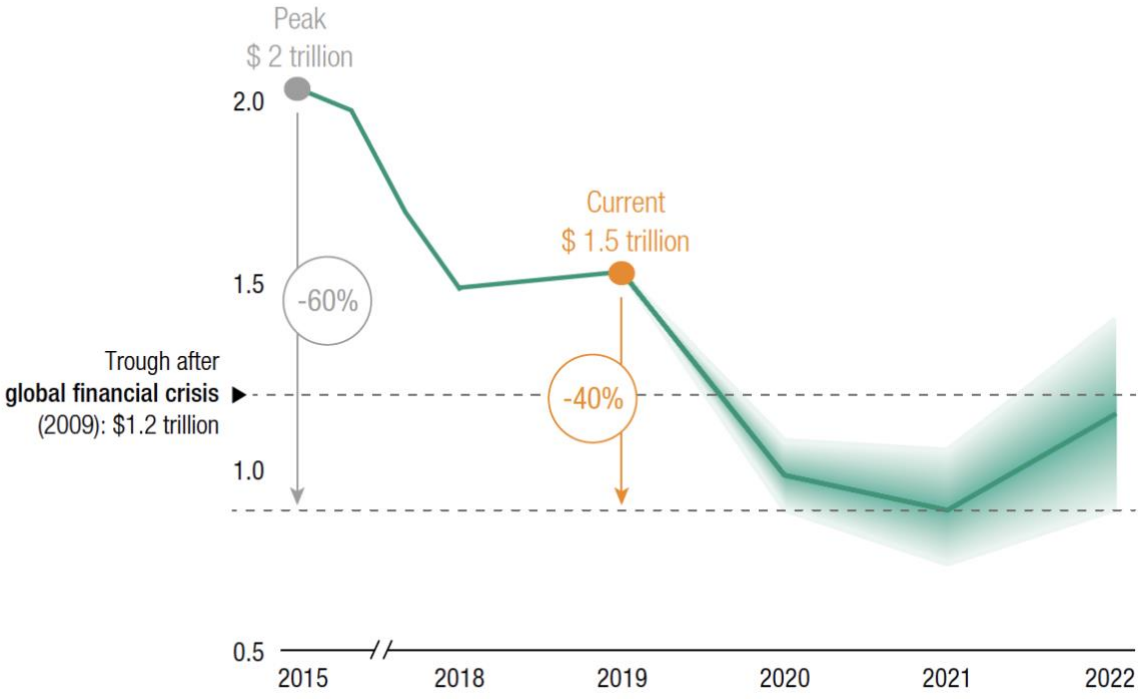
ANNEXES

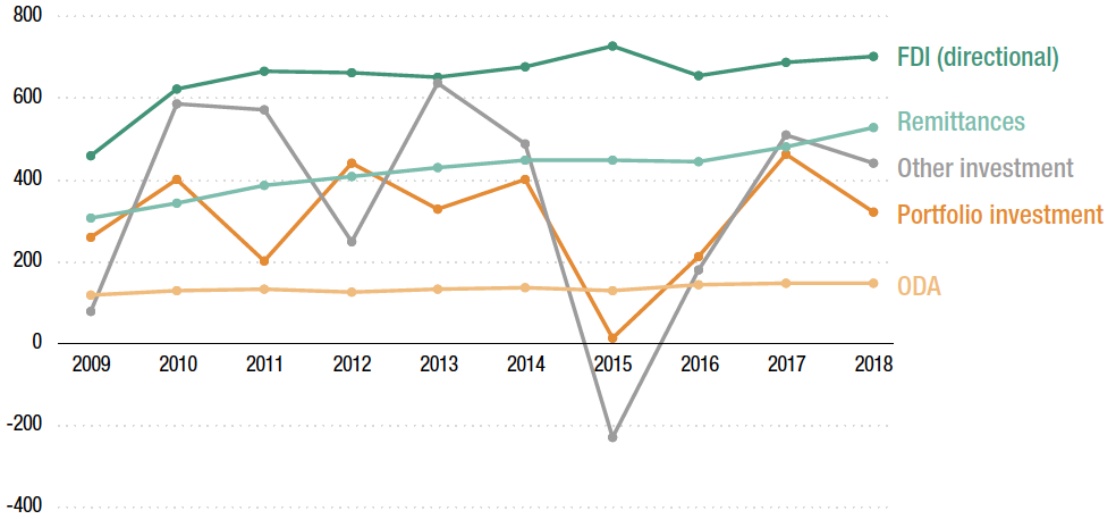
1. **FDI inflows (billions of dollars), global and by economic group in the time frame 2007-2018 (Source: UNCTAD)**



2. **Global FDI inflows (trillion of dollars), 2015-2019 and 2020-2022 forecast (source: UNCTAD)**

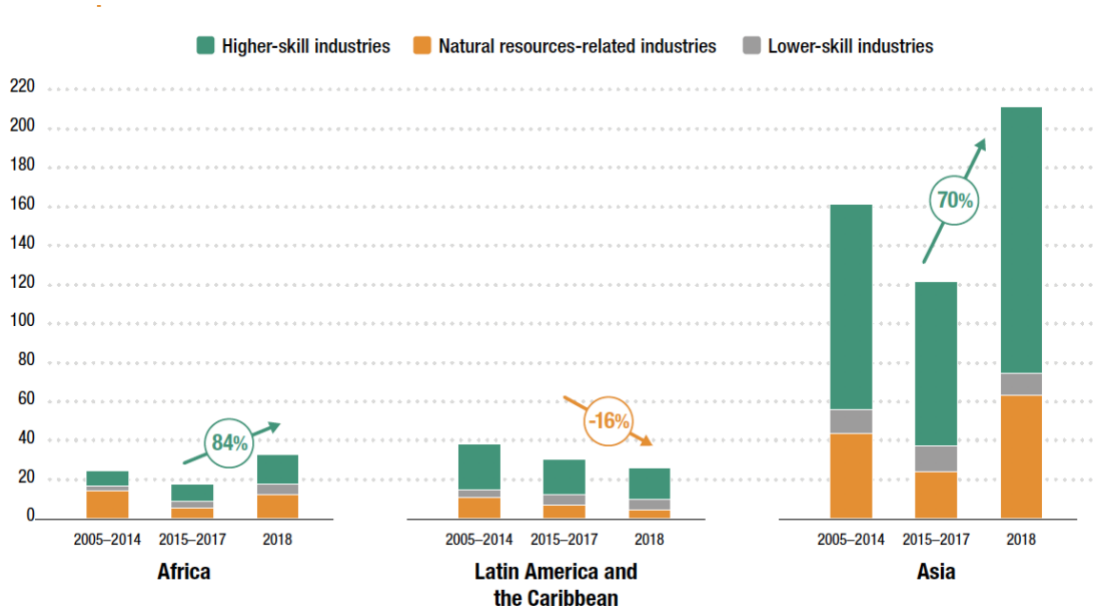


3. **Source of external finance for developing economies in the time frame 2009-2018 (Source: UNCTAD)**



Note 1. Remittances and ODA are approximated by flows to low- and middle-income countries, as grouped by the World Bank.

4. **Value of global announced greenfield investments (billions of dollars) in manufacturing, in the time frame 2005-2018 (Source: UNCTAD)**



Note 2. Natural resources-related industries include (i) coke, petroleum products and nuclear fuel; (ii) metals and metal products; (iii) non-metallic mineral products; and (iv) wood and wood products. Lower-skill industries include (i) food, beverages and tobacco and (ii) textiles, clothing and leather; higher-skill industries include all other manufacturing industries.

5. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lpop	477,498	16.2373	1.316269	13.00121	19.09299
lgdp_pc	477,498	7.092731	1.013602	4.717849	9.327118
gdp_growth	477,498	4.591816	4.153668	-36.39198	26.41732
ln_wage	284,225	5.144611	1.595507	.8501509	9.061446
bfdi_stock	488,867	3.823354	7.520729	-.279522	35.88495
bfdi_stock2	488,867	71.17929	229.1963	.0005447	1287.73
fuel_expor~k	420,653	15.24767	28.30784	0	97.30093
ores_expor~k	443,391	11.44927	19.03501	.0121876	73.87083
ores_expor~2	443,391	493.4168	1287.774	.0001485	5456.9
fuel_expor~2	420,653	1033.823	2569.601	0	9467.472
fuel_expor~r					
0	374,723	.8800314	.3249253	0	1
1	374,723	.1199686	.3249253	0	1
zaf	488,867	.0232558	.1507151	0	1
pol_stabil~y	488,867	-.5559542	.8597259	-2.699193	1.200234
ldist	488,867	8.679592	.6286584	2.349362	9.84973
comlang_et~o	488,867	.2866219	.4521838	0	1
colony	488,867	.0858904	.2802025	0	1
AIDI	463,806	20.57859	16.8284	.3687802	85.84677
hc_imp	466,129	1.826588	.4350664	1.088122	2.911158
patent_imp	474,849	113.3164	328.9267	0	2317

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