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Determinants of Foreign Direct Investment in Brazil

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DETERMINANTS OF FOREIGN DIRECT INVESTMENT IN BRAZIL

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“Learning never exhausts the mind.”

Leonardo da Vinci

ABSTRACT

The role of Foreign Direct Investment (FDI) in the Brazilian economy has become increasingly important over the last decades. Still, the distribution of the investment projects across the Brazilian federation units demonstrated significant heterogeneity. The purpose of this work is to investigate the determinants for the allocation of foreign direct investment across Brazilian states. To achieve this goal is made a literature review on the economic theories developed over foreign direct investment (FDI) and on the empirical literature on the locational determinants for FDI. Additionally, is described the role of foreign investment in the development of the Brazilian economy focusing on the industrialization process and the distribution across sectors, investor country, and regional distribution. Then, the determinants found in the literature are evaluated through a discrete econometric model, applying the conditional logistic regression to an investment-level database for greenfield projects across Brazilian states from 2003 to 2018, highlighting the differences in the determinants among the industry activity of investing companies.

Keywords: Foreign Direct Investment; FDI location choice; Brazilian states; conditional logit model.

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LIST OF ABBREVIATIONS

ANM	Brazilian National Mining Agency (*Agência Nacional de Mineração)*
ANP	Brazilian National Agency for Oil, Natural Gas, and Biofuels (*Agência Nacional do Petróleo, Gás Natural e Biocombustíveis*)
BCB	Central Bank of Brazil (*Banco Central do Brasil*)
CAGR	Compounded Annual Growth Rate
CFEM	Financial Compensation for the Exploration of Mineral Resources (*Compensação Financeira pela Exploração de Recursos Minarais*)
CNT	Brazilian National Confederation of Transport (*Confederação Nacional do Transporte*)
ECLAC	Economic Commission for Africa and that for Latin America and the Caribbean
EU	European Union
FDI	Foreign Direct Investment
FU	Federation Unit
GDP	Gross Domestic Product
IBGE	Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*)
ICRG	International Country Risk Guide
ICT	Information and Communication Technology
IPCA	Extended National Consumer Price Index (*Índice Nacional de Preços ao Consumidor Amplo*)
Ipea	Institute of Applied Economic Research (*Instituto de Pesquisa Econômica Aplicada*)
LATAM	Latin America
M&A	Mergers and Acquisitions
MNE	Multinational Enterprises

OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OLI	Ownership, Location, and Internalization
PNADC/A	Continuous National Household Sample Survey - Annual Release (*Pesquisa Nacional por Amostra de Domicílios Contínua - Divulgação Anual*)
PNADC/T	Continuous National Household Sample Survey - Quarterly Release (*Pesquisa Nacional por Amostra de Domicílios Contínua - Divulgação Trimestral*)
R&D	Research and Development
SELIC	Special System for Settlement and Custody (*Sistema Especial de Liquidação e de Custódia*)
SOE	State-owned enterprises
UK	United Kingdom
UNCTAD	United Nation Conference on Trade and Development
US	United States

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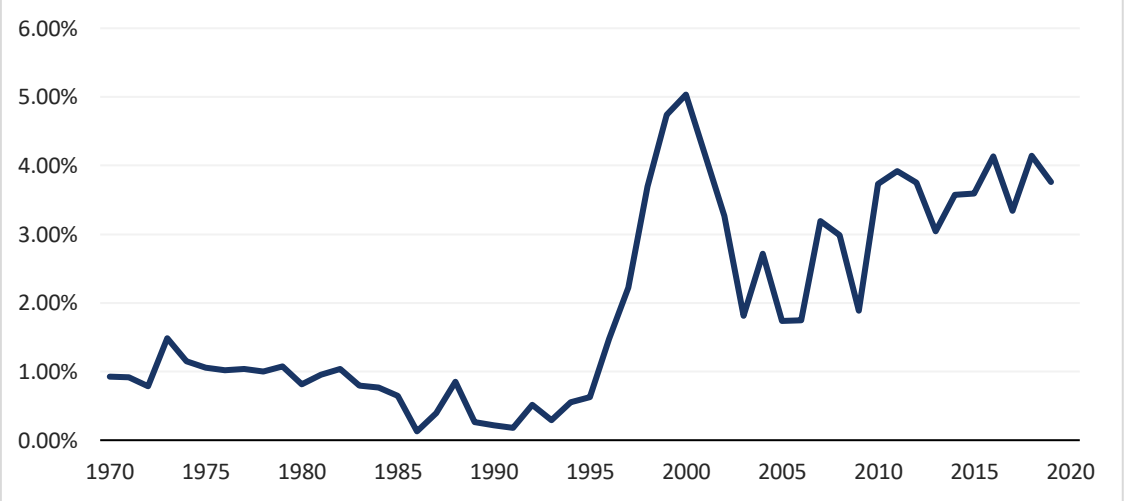
1. INTRODUCTION

Foreign Direct Investment (FDI) has become increasingly relevant in Brazil over the last decades. The net inflows to Brazil accounted for less than one percent of the Brazilian Gross Domestic Product (GDP) in the 1980s, increasing significantly in the 1990s, explained by the shifts in the macroeconomic perspectives in Brazil and Latin America, and representing more than 3% of the GDP in the 2010s, as shown in Figure 1. The total inflows to Brazil increased 20% from 2018 to 2019, reaching a total amount of 72 billion dollars. This figure leads Brazil to be the 6th recipient of FDI in the world, and the first in Latin America and the Caribbean in 2019 (UNCTAD, 2020).

The literature on FDI seeks to understand the relationship between FDI and the economic growth of the host economy. The effect of the FDI may take the form of an increase in productivity of the host economy, because of the transfers of knowledge, organizational structures, practices, or access to new markets. But also, the spillovers with the training of the human capital, technology transfers, the development of local suppliers, or the influence on the domestic investment, by the crowding-in effect on the local economy (Dunning & Lundan, 2008).

Figure 1 – Net FDI Inflows as a percentage of GDP in Brazil (%)



Source: World Bank (2020a).

Several studies on the determinants of FDI focus on the factors that influence the decision of multinational enterprises (MNEs) to which country to go to establish their productive investments. Few studies have been conducted with to examine the determinants of FDI regarding the location across the regions in the country. For the Brazilian case, the study of Bortoluzzo et al. (2013) investigate the determinants for FDI across Brazilian states is the only work found in previous literature dedicated to the theme. In China, analogous studies were conducted by Head and Ries (1996), Sun et al. (2002), and Du et al. (2012) assessing the determinants for FDI across China's provinces. Hence, given the scarcity of studies on the theme, and the heterogeneity of the distribution of the FDI across Brazilian states reinforces the importance of this current work on the theme.

Hence, the main objective of this work is to investigate what are the determinants of the location of FDI across Brazilian states, using investment-level data. In order to accomplish this goal, a process of learning and developing analysis is required. First, the main economic theories on FDI and international businesses should be comprehended, alongside the review of the empirical studies over the theme. Then the particularities of Brazil and the characteristics of foreign investment in the country should also be understood. Using this knowledge, and the theory on econometrics, a regression model will be applied to the data to assess the empirical evidence of the determinants of FDI.

To accomplish each of those steps a methodology will be employed in each phase. First, is conducted a literature review on multinational enterprises, the definitions regarding FDI, the economic theory for foreign investment, and the global trends for investment. Then, a review on the industrialization of Brazil and in the role of FDI is made, alongside an analysis on the characteristics of FDI in Brazil, including the countries of origin, the sectors, and the regional distribution, with is based mainly on data from the Banco Central do Brasil (BCB) including all the stock of foreign capitals in the country.

In the sequence, a review of the empirical literature on the determinants of FDI is carried out, which has the objective to comprehend the relevant variables that should be considered in the econometric analysis. Furthermore, a review of the econometric models is made, focusing on the conditional logistic regression model that will be applied in the current work.

Using the literature and methodology reviewed in the previous steps, the econometric model was built. First, the data is collected using the empirical literature review as the reference for the selection of the variables. Then is made a descriptive analysis of the database, which is envisioned to give a better understanding of the database. In order to provide a better interpretation of the results of the model, and to detect outliers that should be removed from the analysis. Finally, the model is constructed using the statistical freeware R, generating the results that will be evaluated.

Hence, the work is organized in the following chapters. Chapter 2 contains a review of the definitions and economic theories on FDI. The third chapter synthesizes the industrialization process of Brazil, the impact, and the characteristics of FDI, based on the data from the BCB on the sectors, regional distribution, and countries of origin of inward FDI. The fourth chapter revises the empirical literature on determinants of FDI. In chapter five, is made a review of the literature on econometric analysis and defines a methodology and model for analysis. In chapter six, the variables and data for the model are described and analyzed, followed by the model results. Chapter seven presents a conclusion with the main takeaways of the work.

2. FOREIGN DIRECT INVESTMENT DEFINITIONS AND THEORIES

This chapter provides an overview of the FDI trends, and the theories developed to explain the nature of those investments and multinational enterprise's activity. First, the basic definitions for multinationals are settled, then is presented on overview of how FDI evolved over time, followed by the classifications of FDI, and a review of the economic theory and international commerce developed to explain the nature of the foreign investment.

2.1. Multinational Enterprises and Foreign Direct Investment

Multinational enterprises are those that engage in Foreign Direct Investment (FDI) activities, owning value-added activities in more than one country (Dunning & Lundan, 2008). Some other definitions base the transnational character of the company based on the percentage of ownership on equity of a foreign-based company, but this definition varies among countries and entities. For example, in the OECD Benchmark Definition of Foreign Direct Investment, foreign investment can be defined when the foreign investor detains at least 10% of ordinary shares, which indicates long term interest in the investment in the country and significant influence in managerial decisions (OECD, 2008).

Another relevant point is the nature of the investment, if it is a production only facility, or if the company have strong commitment and pursue a clear strategy for that investment in overseas investment. For this reason, some factors indicate the degree of transnationality of an enterprise: the size of the subsidiaries, the number of countries it operates, the degree of creation and usage of assets devolved to foreign affiliates, the proportion of global assets, the internationalization of management and ownership, and the internationalization of high-value activities (Dunning & Lundan, 2008).

2.2. Evolution of FDI

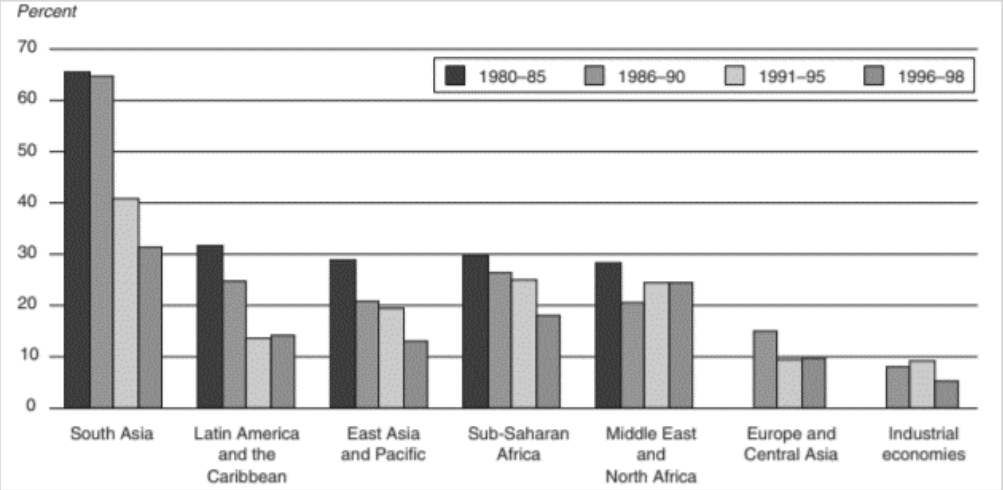
The first multinational companies, those that engage in FDI, can be dated to 2500 b.C. as the Sumerian merchants that had their agents in foreign ports to facilitate the selling process. In the 16th century, the trading companies emerged as multinationals. The most famous case of these was the British East India Company, which has dominated the Asian market. After that, the most significant period for FDI was when the Europeans went to North America, with relatives growing subsidiaries (Goldstein & Piscitello, 2007).

A relevant shift happened with the First Industrial Revolution, which was the creation of industrial multinationals. In the following centuries, the United States became a big player in FDI, getting closer to the European countries. A remarkable moment for FDI was the beginning of the 20th century, in which the railway companies from England and France made high investments in many countries.

The time between the 1st World War and the 2nd World War was a time of decrease for FDI flows. In this period, many countries adopted austerity and restrictive policies, which supported this decrease. Also, in this period, many investments in natural resources were made in Africa and Asia, because these continents remained open for investments as Latin America tended to the nationalization of natural resources. In the following years, the United States was the global leader of the FDI, with many big companies engaging in FDI. The main host country for those movements was Brazil, due to its policy of import substitution. Apart from that, the 1973 Economic Crisis showed that the model of the American companies was not the most suitable for the crisis as the Japanese companies for example. In Europe, the trend seen was the flows of FDI to other European countries. The level of FDI in the post-crisis period was lower than it was at the beginning of the century (Goldstein & Piscitello, 2007).

From 1980, the FDI flows intensified. The main reason for that was the globalization processes, a consequence of the technology development, principally in the communication and transport fields. However, the flows of FDI began to increase more significantly in the '90s as countries made substantial reforms in removing trade barriers and changing exchange rate policies, Figure 2 shows the variation of the unweighted tariffs by region, the unweighted tariff is the simple mean of the effective applied rates for all products subject to tariffs. These changes took place principally in Asia and Latin America, for example, Colombia reduced import tariffs by 65 percent in one year in 1991. Also, Argentina and Nicaragua went from 110 percent to 15 percent in 1992 (World Bank, 2002).

Figure 2 – Average unweighted tariff rates by region

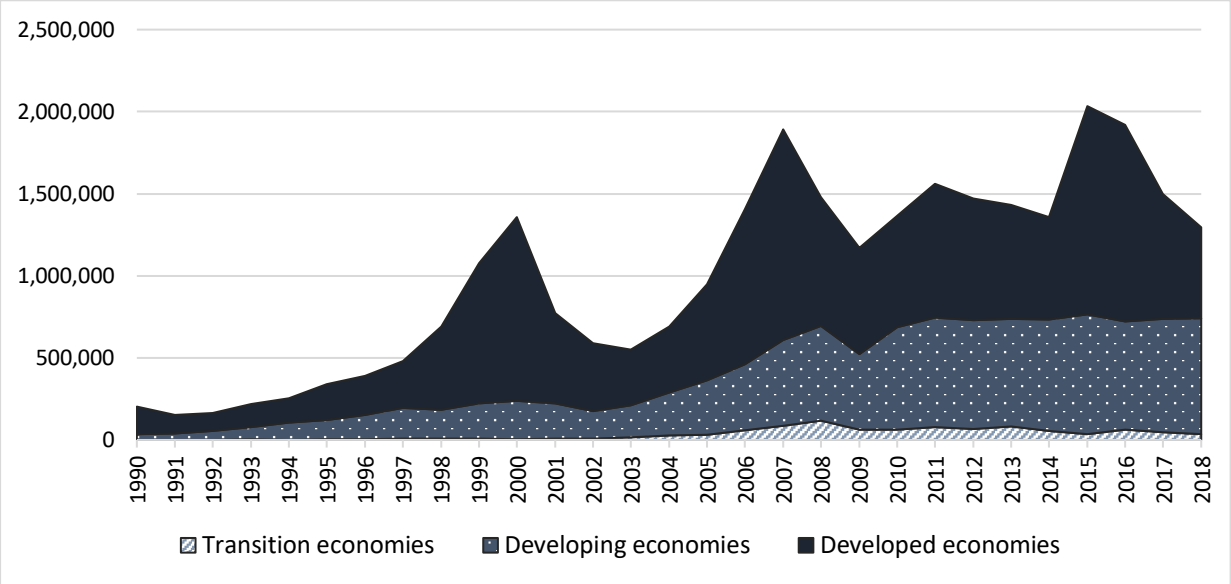


Source: World Bank (2002)

The global FDI inflows in 2000 were almost 1.4 trillion dollars, which represented an increase of 560% compared with the FDI inflows in 1990, shown in Figure 3. Also, we can measure the Compounded Annual Growth Rate (CAGR) for this period, resulting in a value of 20.8%, showing the effects of the global policies in this period (UNCTAD, 2009). In 2001, FDI plunged over its peak in 2000, as the dot-com bubble burst in 2001. From 2000 to 2003, FDI Flows decreased by 59%, going from 1.3 billion dollars to 550 million dollars, the decrease

was greater in the developed economies. Also, in this period, China and India increased its outflows of FDI, equilibrating better the inflows and outflows (te Velde, 2006).

Figure 3 – Global FDI Inflow by Economic Group (USD millions)



Source: UNCTAD (2019).

In 2008, with the burst of the financial crisis, the deepest since World War 2. The multinationals' foreign affiliates sales decreased by 4.6%, compared to the growth of 24% in 2007 (UNCTAD, 2009). The collapse in the economy affects more severely the developed nations and as a result, the FDI inflows decrease more in those countries. In the period from 2007 and 2009, the FDI inflows for developed countries decreased by 49%, on the other hand, the inflows for developing economies decreased by 12% (UNCTAD, 2009).

After the 2008 crisis, the levels of FDI recovered, getting to 1.5 trillion dollars in 2011, still lower than 2007 figures. In those years, the variation in FDI inflows for developed countries oscillated a lot more than in the developing countries, which was stable over the years. Also, we note that the inflows of FDI to developing countries become a more significant share of FDI compared to the values before the 2008 financial crisis. In 2015 and 2016 the level of FDI in developed nations was at a peak, getting close to 2 trillion dollars, but in 2017 and 2018, it came back to the level of 2014.

In 2018, the share of investments in developed countries was 42.9%, for developing economies it was 54.4%, and for transition economies, it was 2.6%. This change in the participation of developing economies can be explained by the positive prospects seen in the BRICS and other emerging countries, also, by regional integration processes. The outlooks can also be explained by the continued offshoring of service functions and manufacturing (UNCTAD, 2015).

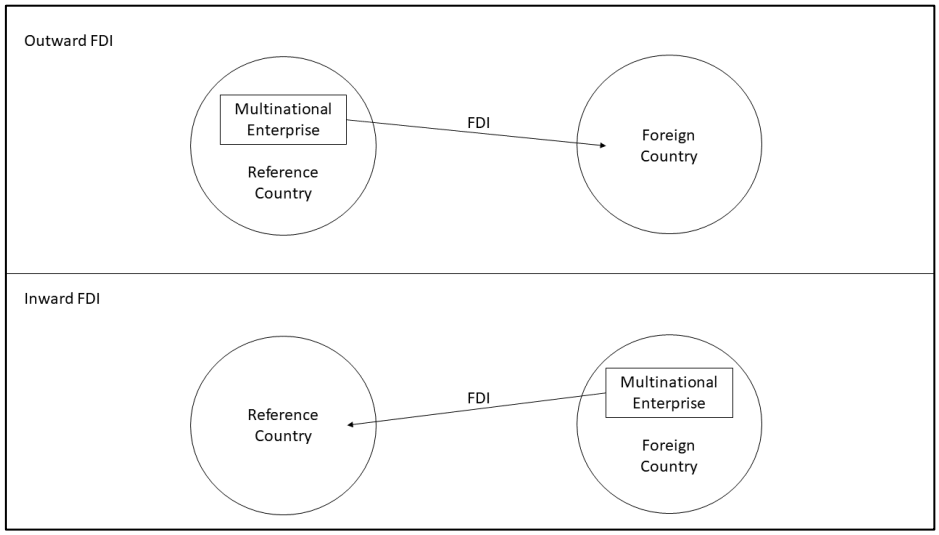
2.3. Typology of FDI

The literature classifies the FDI typology based on different aspects. This section aims to give an explanation of those classifications, based on direction, objective and the structure.

2.3.1. Classification based on the direction

The possibilities of FDI direction are the Outward and Inward Foreign Direct Investment. The **Outward FDI** refers to the investment that companies from a certain country have made abroad. Also called, Direct Investment Abroad. The **Inward FDI** refers to the investments made by foreign companies in the country. Figure 4 illustrates the classification based on direction.

Figure 4 – Inward vs Outward FDI



Source: author elaboration.

2.3.2. Classification based on the objective

We can identify four types of multinationals investment activities abroad (Dunning & Lundan, 2008): natural resource seeking, market seeking, efficiency seeking, and strategic asset or capability seeking. But many multinationals pursue multiple objectives in their FDI ventures.

The natural resources seeking investments are from companies trying to acquire specific natural resources with higher quality or for a lower real cost (if those are available in the home country). Commonly those resources tend to be exported to a more developed country, where high value-added activities take place. According to Dunning (2008), there are three main types of resource seeking investments:

- Those seeking physical resources. Including primary producers and manufacturers mainly with the motivation of cost-reducing or security of supply sources;

- Those seeking supply of cheap unskilled or semi-skilled labor. MNEs from countries with high real labor costs tend to set up or buy subsidiaries in countries with lower real labor costs for labor-intensive activities;
- The third type of resource seeking investments are those that aim to acquire technological capabilities, management or marketing expertise, and organizational skills.

The market seeking investment look for a certain country or region intending to sell their goods or services in the local market or adjacent countries. Frequently those markets were already served by the company but costs with barriers from host countries or the market growth or the region may justify the investment. There are four main reasons why companies engage in the market seeking investments (Dunning and Lundan, 2008):

- One reason is that the main suppliers or customers of the company have shifted their activities to a foreign country and to retain their business they are forced to follow them;
- The second reason is that companies need to adapt their products to certain characteristics to be valuable in foreign markets, like local tastes or needs, and cultural factors. Foreign producers may face a disadvantage to local firms;
- The third reason is the possibility of reducing production and transportation costs compared to supplying it at distance. These benefits depend on transport costs being relevant, and on the quantity demanded in that region being enough for the company to operate (economies of scale);
- The fourth reason is that MNE, to compete in the global production and marketing strategy, may find necessary to be physically present in leading markets that are served by its main competitors.

The efficiency-seeking FDI is the rationalization of established resource and market seeking activities, gaining from common governance of physically dispersed activities, the benefits are mainly economies of scale and scope and risk diversification (Dunning and Lundan 2008). Usually, they are experienced, large, and diversified multinationals producing standardized products with a globally accepted process. Efficiency-seeking FDI has two main forms: first is the ability to take advantage of the availability of tradition factor endowments in different regions; the second is to take advantage of economies of scale and scope in similar countries, with similar economic structures, income levels, consumer tastes and supply capabilities.

The strategic assets seeking focus on engaging in FDI usually by acquiring assets of foreign corporations, developing their strategy, especially maintaining, or enhancing their global competitiveness. The main motive, in this case, is to enhance the company global portfolio of assets and human competences, sustaining their ownership-specific advantages or weakening those of their competitors.

2.3.3. Classification Based on the Structure

Concerning the structure of FDI, we have mainly horizontal, vertical, and conglomerate. Regarding the Horizontal FDI, it is characterized when a firm establishes a subsidiary in a foreign country that does the same activities as the company in the home country.

The Vertical FDI is represented by a company that engages foreign investment doing a different business than in the home country, but it does an activity that goes into the supply chain of the parent company. For example, when a manufacturing company acquires a supplier of parts for its products.

The Conglomerate FDI is defined when a company enters in a different line of business that is not related to its business in the home country. As the company does not have previous experience in this market, sometimes they might engage in a joint venture with another firm of the host country.

2.3.4. Greenfield and brownfield FDI

The classification of the FDI can be made by the form that the investment was made in the host economy. The greenfield FDI is defined as the set up of a new firm in the destination country, whereas the brownfield FDI is to acquire existing companies in the foreign country. In this last case, the investment can take the form of mergers and acquisitions (M&A), but it is important to highlight that brownfield is a broader concept, as any purchase that corresponds to more than 10% of the target company is considered a direct investment (Ragoussis, 2020).

In the current work, the studies made in chapter three considers both, greenfield and brownfield investments in Brazil. But the econometric model and analysis developed later in the work consider only greenfield investment projects toward Brazil.

2.4. Economic Theories of FDI

The recent history of investment theories is marked by two distinct phases. The first one is configured by the development of the theories of investment, mainly Neoclassical and Keynesian theories, then FDI analysis is made with the same instruments that domestic investments. Here the main approaches are the capital theory, the international differential interest rate theory, and the portfolio theory.

The second phase that we can identify is the frameworks used to analyze the internationalization of production. That taken into consideration also the volatility of the FDI with the special conditions of the different markets. The main theories in this phase are Hymer's contribution (1960), Vernon's Product Cycle Theory (1966), Buckley and Casson's Internalization theory (1976), and Dunning's Eclectic Model (1976) that will be described in this section.

2.4.1. Hymer's Contribution

Stephan Hymer (1960) is considered the founder of the studies of International Business. The main contribution of his work is the framework to understand why a firm engages in foreign investments. His work shifted the view from the country to the firm level (Buckley, 2010). He considered that the previous theories were not sufficient to explain the expansion of the companies. The analysis of Hymer is based on the industrial economics approach, especially that from Bain (1956), for this author, the degree of competitive advantage.

To understand the motivation of companies to decide to control activities in foreign markets, Hymer works with the hypothesis that companies must have some specific advantages in these activities because they already have some disadvantages compared to the local companies. The other question in Hymer's study is why companies benefit from the property instead of export, license, or other forms of serving markets at distance.

Some contributions of the Hymer are: based on industrial organization theory he finds that multinationals aim for international production and not exchange; firms must have some advantages over local producers, and because of the imperfections on the market they

can better exploit those advantages (Buckley, 2010). The downside of this theory is the limitation in explaining the location factors in the FDI decisions.

2.4.2. Vernon's Product Cycle

The product life cycle theory is attributed to Vernon, based on his study published in 1966. He recognized the importance of new trade theories and explored a macroeconomic theme based on a microeconomic phenomenon, the product cycle. In the study, it is also argued that the capability of a company to innovate, in new products and processes, is determined by the home country factor endowments, institutions, and market. Also, it is possible to imagine that the competitive advantage of innovative companies may be lost due to the ability of local firms to serve its local market.

Hence, the theory is based on the cycle. The firm starts to produce to its home country, and in a later stage of the product life cycle, it starts to export its products to other countries with similar demand patterns and supply capabilities. Eventually, with the maturation of the product, the ability to reduce costs and marketing expertise, become more important than the product itself. And with an increasing number of imitators in the foreign country, the innovative firm finds reasonable to produce there. In the study, Vernon argues that eventually, the affiliate might replace exports from the parent company, finding the right condition in the foreign country (Dunning & Lundan, 2008).

2.4.3. Internalisation Theory

The Internalisation Theory, proposed by Peter Buckley and Mark Casson in 1976, focuses on the imperfections existing in intermediary goods markets. The basis for the theory

is that in some specific situations is better for the same firm to carry out operations with certain intermediate products than operate through the market mechanisms. Also, is described by the theory that firms engage FDI when they notice that there are net benefits from operating in a foreign country and that the value of transactions is higher than the external trading relationships, hence, the internalization of the production becomes more attractive (Buckley & Casson, 2009).

2.4.4. Eclectic Paradigm

The eclectic paradigm (Ownership, Location, Internalization theory) presented by Dunning in 1976, divides the decision in going for FDI in three key elements. These points are ownership-specific, location-specific, and internalization. Hence the eclectic paradigm defines that the level of value-added activities of a company in foreign countries, depends on four conditions to be satisfied, they are:

- The degree which it possesses a sustainable competitive advantage in ownership-specific (O) advantages in comparison to firms of other nationalities, in attending the demands from foreign markets;
- If the first condition is satisfied. Then we may look at the extent to which the firm perceives that it is more beneficial to increase the ownership-specific advantages instead of selling them or selling the right to use them. If this advantage exists, we call it market internalization (I) advantages;
- If both previous conditions are met. Then the extent to which the firm serves its global interest by operating overseas being leveraged by its ownership-specific advantages, the location-specific advantages are the host country aspects that turn the place in an attractive place to set production facilities;

- Given the OLI advantages for a firm, the degree of confidence of a company in the alignment of its strategy and stakeholders objectives with the foreign production is the last relevant factor to determine the level of value-added activities that the firm may take abroad (Dunning & Lundan, 2008).

2.4.5. Uppsala Model

In 1977, Johanson and Vahlne, researchers of the University of Uppsala (Sweden), studied the internationalization process of some firms asking how the firms choose their markets and entry modes. Their research come up with a model based on the assumption of internationalization as a result of company growth. They have found the process not a sequence of steps organized logically but as a sequence of incremental phases of commitment to foreign markets, where the expansion starts with countries with lower psychic distance from the home country. The psychic distance refers to the difference between home and host countries in terms of culture, language, political and economic environments. Hence, with the increase in the experience of the company in foreign markets, the commitment of the company to these markets also increases, leaving room for more investments in value-added activities overseas (Johanson & Vahlne, 2009).

The main contributes of this theory to the FDI studies were the introduction of new factors such as the psychic distance, and by focusing on the process of internationalization, entrepreneurial and organizational factors were determinants in shaping the strategies of investment overseas.

3. INDUSTRIALIZATION PROCESS IN BRAZIL AND THE ROLE OF FDI

Now the perspective of FDI is turned to the Brazilian case, aiming to understand the FDI nature in the country. Also, as the literature suggests the economic policies of a country play a significant role in foreign investment. Hence, this chapter is organized in the following way. First, it discusses the process of industrialization in Brazil, focusing on the economic policies that took place, then the focus is shifted to the FDI evolution in Brazil and the understanding of its characteristics.

Is important to highlight that the data used in the analysis of the distribution of FDI in Brazil in this chapter includes all the stock of foreign capital in Brazil, provided by the Census of Foreign Capitals in the Country, and Direct Investment Reports both published by the Banco Central do Brasil (Banco Central do Brasil, 2016, 2020). That data differs from the database used in the econometric model, which will be discussed later in the current dissertation, which in turn includes only the greenfield investment projects.

3.1. Historical Perspective of the Economic Policies in Brazil

Brazilian industrialization process had an important point, the Great Depression in 1930. At this moment, the FDI inflows dropped as the developed economies were responsible for the larger part of FDI, and the more affected by the crisis. This situation, associated with the decrease in exports, made the developing countries engage in industrialization stimulus policies with imports substitution. In this period the consumer goods sector and intermediate sector experienced significant growth. But with some restrictions regarding the quality of labor,

industrialization was concentrated in the state of São Paulo. Also, the shift from traditional sectors was not high, as the low level of FDI at that time.

After the Second World War Brazil had accelerated industrial growth, the strategy that got this was the imports-substitution by the internal production, focusing on sophisticated consumer goods and energy, for example. The expansion in the 1950s was high, also fostered by the high level of FDI, supported mainly in the government of Juscelino Kubitschek. Even though, at the end of the decade, some problems in the balance of payments become apparent. Mainly caused by the lack of exportations because of the super valuation of the exchange rate, and the drop in the price of coffee, the main product that Brazil was exporting at that time (Fishlow, 2002).

From 1964 to 1974, in the dictatorship period, the policymakers worked towards the correction of some imperfections that arose from the previous decades, with the imports-substitution. The answer they got for this problem was the promotion of a more open economy and the foster of exports. Hence, they decreased the taxes, facilitated administrative procedures, and introduced a tax incentive program for exportations.

After the oil shock, there was a shift back to the imports-substitution policy and the foreign countries were searching for secure supplies of raw material. Also, the country faced an economic stagnation in the 1980s, marked by high inflation, very low GDP growth (average of 2% annual growth compared to 7% annual growth in the 1970s), high volatility in the market, and an increase in social inequality. For these reasons, this period is called the "Lost Decade".

After the end of the dictatorship period, there were several attempts to control inflation that was high since the 1970s and kept growing. These plans failed mainly because of the lack of effectiveness in the fiscal control, which leads to even further deficits of the government that were financed by the Brazilian Central Bank. The several tryouts made lead

to even higher levels of inflation in the country. Until the policy has shifted again, now focusing on the openness of the economy, this shift is related to the following economic growth and increased attractiveness for FDI. From the 1990s, the Brazilian economy started to be involved internationally, not only with the increase in imports and export but also with the growing inflow of FDI. The reforms that made this possible were the Real Plan, economic openness, and regional integration (Baer, 2002).

The first part, the Real Plan, was one of the most important measures to contain high levels of inflation. The plan was based on three pillars the inflation targeting system, the law of fiscal responsibility, and the floating exchange rate regime. The pillars made the macroeconomic scenario more stable and the environment to support economic growth. As an immediate result of the plan, the annual inflation , the IPCA measured by the IBGE, decreased from 4922% in June 1994 to 916% in December the same year, in 1995 the annual inflation rate decreased to 22% (IBGE, 2020c).

The second part refers to measures to open the economy to foster foreign trade and foreign capital inflows. These actions made new growth opportunities, increasing Brazilian competition in the global economy, also, leaving room for expansion in trade partner countries. The third part of the framework was regional integration, made with the creation of the MERCOSUL. The creation of the block increased the trade between the members and increased the size of the regional market, which also increased the interest of foreign companies in investing in the region. Besides that, the MERCOSUR also made Brazilian business trade more with the block members and even led those companies to establish subsidiaries in those countries, increasing Brazilian outflows of FDI.

In the 2008 crisis, Brazil experienced relatively low effects, concentrated in the industrial sector. The government reacted to it by stimulating the demand. The means used

were the drop in the interest rate (SELIC) from 13.75% annually in January 2009 to 8.75% in July 2009, the reduction of taxes, and the increase in public expenditure. The government engaged in an expansionary fiscal policy, and as a result, the primary surplus decreased by 2%. But this action helped the country to emerge relatively fast from the crisis. The more significant increase in demand came from household consumption. Before this period it represented about 63% of GDP, after the crisis it rose to 66% of GDP (Pastore et al., 2013).

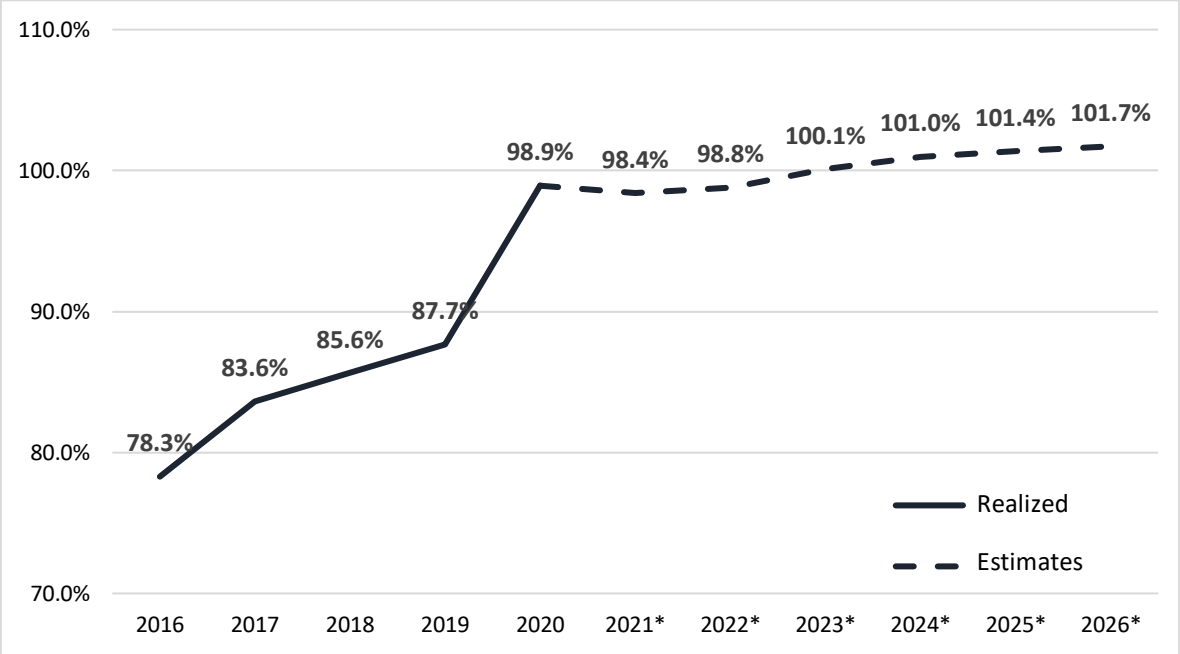
This combination of measures to stimulate the economy was called New Macroeconomic Matrix. In the following years, the industry kept losing its share in the GDP, while the measures adopted by the New Matrix kept pushing towards higher levels of public expenditure and government debt. At the same time, Brazil faced a reduction in the demand for domestic products, mainly attributed to the economic slowdown of China, and the decrease of the commodity prices at a world level.

The results were seen as an economic crisis in Brazil and the effects were: the unemployment rate rose from around 6.8% in 2014 to 8.5% in 2015; the economic recession, leading GDP to fall 3.8% in 2015 and 3.6% in 2016; the increase in economic inequality; and higher levels of emigration. Combined with that, in 2014 the federal police operation "lava-jato" uncovered a corruption scheme involving big companies in Brazil, including the oil giant Petrobras, which led to greater political instability (Amal, 2016).

The anti-crisis measures were taken by Michel Temer, that has risen in power after the impeachment of Dilma Rousseff. The most important measures were the new fiscal regime, which limits the government expenditures for the following 20 years; the outsourcing law, that permitted companies to hire employees on primary activities; the 2017 labor reform; and

pension reform that failed to be approved. But the simplified version of the pension reform was approved in November 2019.

Figure 5 – General Government Gross Debt as a percentage of GDP (2016 – 2029)



Source: International Monetary Fund (2021).

Figure 5 illustrates the projection of the International Monetary Fund on the general government gross debt of Brazil as a percentage of GDP. In this merit, the Brazilian Ministry of Economy (2021) projects the debt also to be stable on the next years, after a significant increase in 2020 due to the Covid-19 pandemic. But make a caveat, this projection is conditioned on the approval of the reforms, without it the levels of public debt tend to increase considerably above the estimated levels. These structural reforms should contribute to lower the public expenditure, but also to promote productivity gains and real economic growth (Brazilian Ministry of Economy et al., 2021).

3.2. FDI trends in Brazil

This section provides a historical view of the FDI investment in Brazil, highlighting the role of the policies described in the last section. Then is discussed the regional distribution, investor countries, and the industry distribution for the stocks of foreign capital in the country.

3.2.1. Overview of FDI in Brazil

The first relevant inflows of FDI in the Brazilian economy happened in the 19th century, from 1880. Before expressive investments happened, the focus was on the transformation industry, particularly in the wheat flour, footwear, and matches industries, but the inflows were not strong. The more relevant movements, later in the same period, focused on the railway and electricity sectors (Lacerda & Oliveira, 2008).

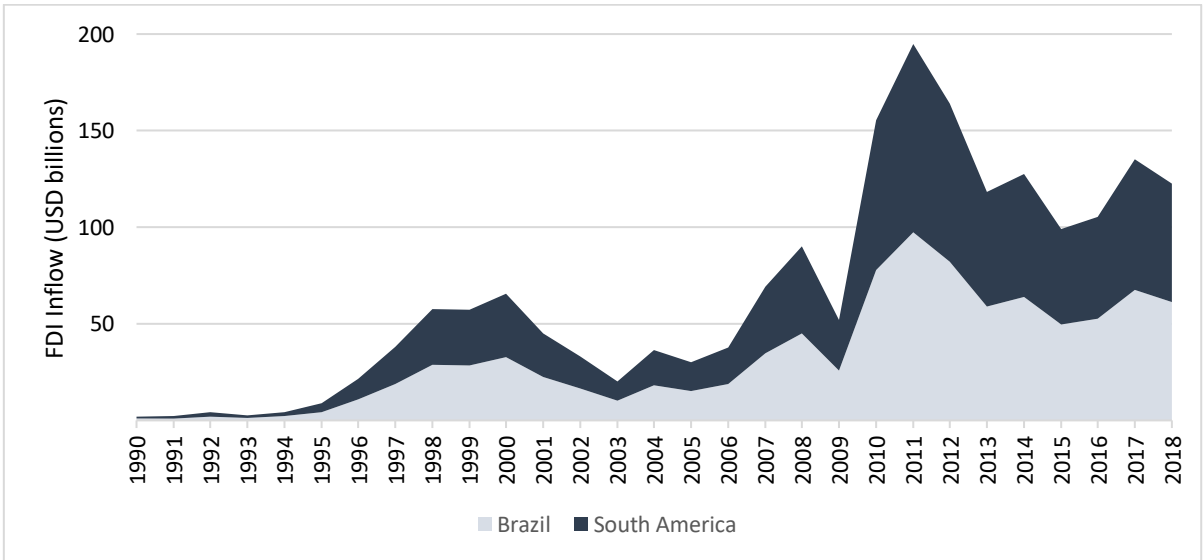
The FDI in Brazil started to gain the proportions of current levels in the 1990s, due to the market openness framework for FDI. Before, Brazil had also received significant investments at the beginning of the 1900s. Later with President Getúlio Vargas (1934), the country had its first well-known case of foreign investment with the creation of the "*Companhia Siderúrgica Nacional*", a result of an agreement between the Brazilian and American governments, to produce steel during the Second World War.

The period from 1970 to 1990 was marked by a restrictive policy on FDI. The government put pressure toward a majority in the Brazilian ownership of companies, it was done with the restriction that the company must have at least 50% national ownership to receive a government credit. Also, there was a 12% tax on remittance, technology transfer requirements, exchange rate control, and the requirement on local content on some products, especially in the automotive industry segment, with a requirement of 90% of Brazilian content (Amal, 2016).

The FDI up to this period was driven by the import substitution and "tariff-jumping" strategies, exploring the low costs of supplies and labor. The imports substitution refers to a development process that occurs in response to external trade constraints. In the four post-war decades, Latin American countries imposed several restrictions on manufactured goods aiming to provide the industrialization process of the developed countries in a shorter time. And the tariff jumping FDI refers to avoid the trade barrier imposed on the imports by the foreign company locating its production facilities in the destination country (Baumann & Franco, 2006; Blonigen et al., 2004).

This framework began to change after the end of the Military Government in 1985. The new structure for FDI in Brazil was marked by economic openness. The more important points are the removal of the ownership pressure, no tax on profit remittance, no requirements on the local content of products, and the decrease in tariffs. As in Figure 6, the FDI inflow to Brazil increase in a very significant manner from the mid-1990s mainly seen as a reflection of the policy changes. Also, the percentage of FDI Inflows to Brazil concerning the total inflows for South America increased from 19.6% in 1990 to 57.5% in 2000 (UNCTAD, 2019).

Figure 6 – FDI Inflows to Brazil and South America 1990 - 2018



Source: UNCTAD (2019).

The period from the 1990s and 2002 embodied a relevant growth in the FDI, fostered by the economic openness in Brazil and Latin America, marked by the trade agreements for regional integration, together with Argentina, Paraguay, and Uruguay. Another factor was the definition of clearer economic policies and the stabilization of the exchange rate in Brazil with the implementation of the Real Plan. The third factor in this period that led to an increase in FDI was the opening of the services sector to the participation of foreign firms, encouraging investments in a high-growth market, mainly the financial services and telecommunication. In 2002, the FDI inflow started to decrease as the investments made in the last years were not performing as expected, as the GDP growth in Latin America decreased, from 4.1% in 2000 to 0.3% in 2001 (ECLAC, 2002). The exchange rates in LATAM and Brazil were very volatile in the period, with a significant devaluation of the Real. Also, the 2000's crisis negatively affected the global economy, and the situation hindered the inflows of FDI in Latin America (ECLAC, 2002)

From 2002, the inflows of FDI started to increase again. The determinant factors in this phase are market growth and economic stability. This context enabled the middle class to grow, fostering the development of the domestic market. Multinational companies responded to this movement through the distribution of FDI in manufacturing industries, mainly the automotive and mass consumer goods industries, but also was a relevant movement in the retail trade and banking sectors (Amal, 2016). Another factor that made the host country attractive for foreign investors was the development of financial and capital markets, making local financial resources widely available. The M&A transactions in this period became more relevant, as they can speed up the process of supplying the markets and enable the control of the value chain (ECLAC, 2011).

The 2008 global crisis affected more severely the developed countries economies, as the main source of FDI is from those nations, the level of FDI fell 42% in 2009 compared

to 2008. After this period Brazil remained an attractive location for foreign investment, due to its domestic market growth and favorable policies envisioning FDI (ECLAC, 2011). But also, in the period from 2008 to early 2010s, changes in the economic policy and consistent intervention of the state in the economy hindered the environment for economic growth in the country. The main concern was the attempts to disrupt the general institutional and economic framework of the country, adding more uncertainty to the economy of the country. Furthermore, after the global financial crisis, the strategy of the multinational companies changed for the establishment of more independent relations with the subsidiaries, giving more autonomy to local management to interact with local companies and creating some space for investments in R&D and cooperative innovation (Amal, 2016).

At the beginning of the 2010s, FDI inflows were expanding in Latin America, as the world was recovering from the financial crisis, but the region's growth rates were robust and the commodities prices were booming, leaving room for the preeminence of those countries as recipients of investments. Making the FDI inflows for the region in 2011 and 2012 achieve a historic high. Those inflows, however, started to drop in the following year with the weak economic growth and falling commodity prices. The Brazilian economy had poor results after 2012, with high political and economic instability, also having issues with fiscal responsibility and corruption. Those factors led to a decrease from 83 billion dollars in 2012 to 61 billion dollars in 2018 (ECLAC, 2020).

3.2.2. Regional Distribution

The FDI Inflows in Brazil were historically concentrated in the southeast region, the region with the higher economic activity and population. As in Table 1, the total FDI inflows of greenfield investment projects, from 2003 to 2019, for that region accounted for

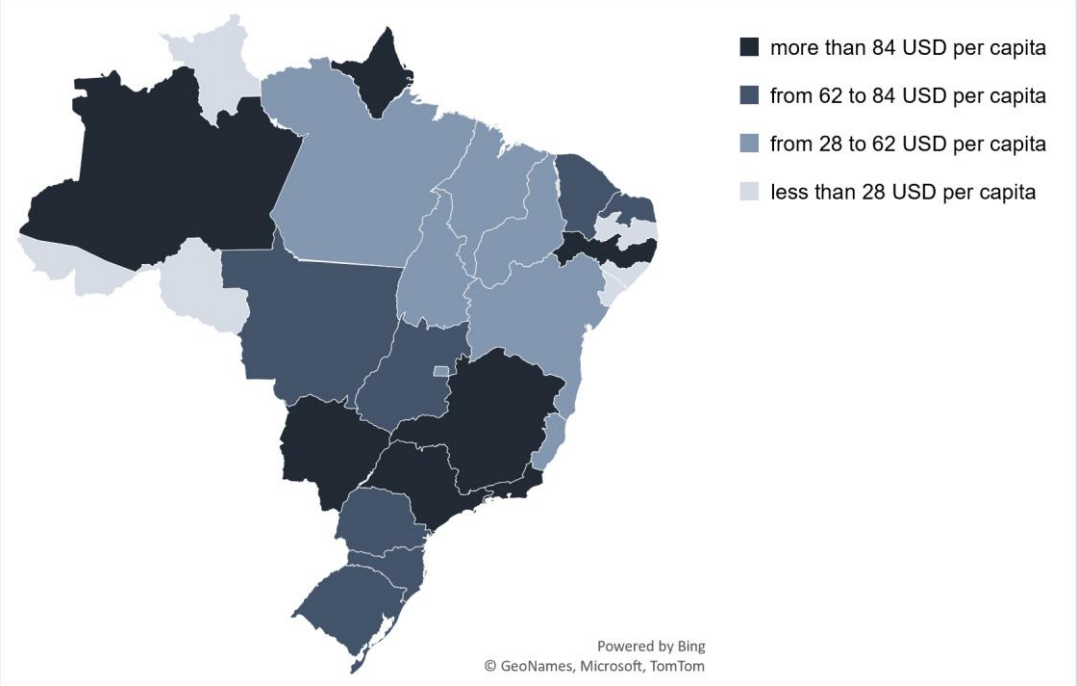
more than the sum of all other regions, just the state of São Paulo represented 35% of the inflows in this period, followed by 12.5% of Rio de Janeiro. The northeast and the south regions received comparable inflows in that period, representing together 28.8% of the FDI inflows. Finally, the central-west and the north regions received similar inflow accounting for 11.5% of FDI Inflows (fDi Markets, 2020).

Table 1 – Total FDI Inflows in USD billions per Brazilian Region from 2003 to 2019 for greenfield investments

Region	Total FDI Inflow (USD Billions)	Total FDI Inflow (%)
Southeast	173.2	59.7%
Northeast	48.9	16.8%
South	34.8	12.0%
Central-West	18.8	6.5%
North	14.5	5.0%
Total	205.5	100.0%

Source: fDi Markets (2020)

Figure 7 – FDI Inflows per capita across Brazilian states in greenfield projects (2003 – 2019)



Source: fDi Markets (2020).

Taking into consideration the population of each state, as in Figure 7, the FDI per capita also has a high discrepancy among states, but some states with little relevance in absolute

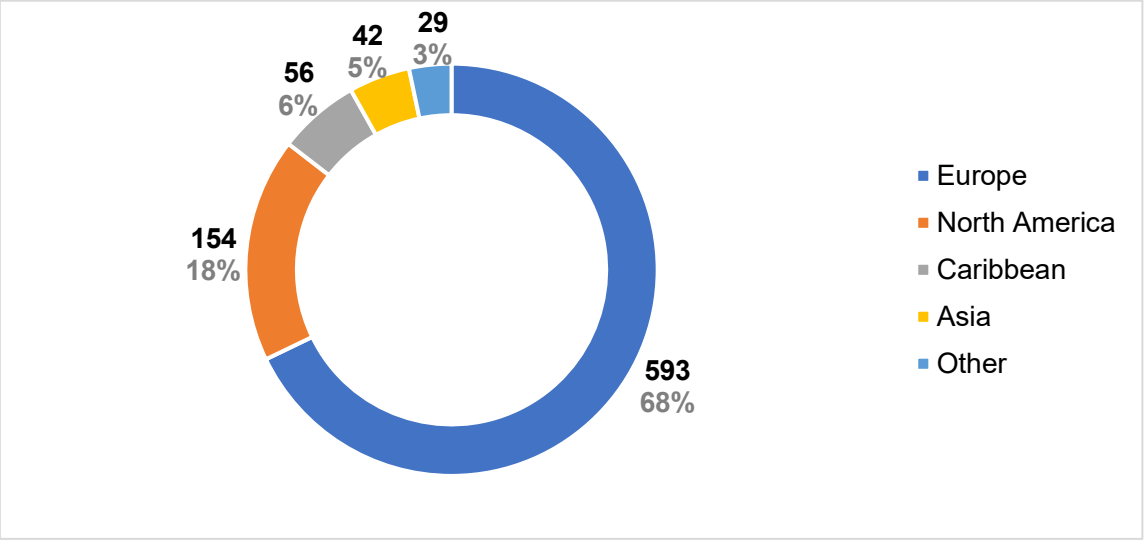
terms were more representative. The higher FDI Inflows per capita were in São Paulo (142.87 USD), Rio de Janeiro (134.61 USD), Amazonas (104.27 USD), and Minas Gerais (93.87 USD). In contrast, the lower values were in Alagoas (7.56 USD) and Acre (10.82 USD).

3.2.3. Investing Regions and Countries

The positions of direct investment of foreign countries in Brazil can be realized through debt or equity instruments. The debt instruments include marketable securities such as bonds, debentures, commercial paper, promissory notes, non-participating preference shares and other tradable non-equity securities as well as loans, deposits, trade credit and other accounts payable/receivable. The equity positions include common and preferred shares (exclusive of non-participating preference shares which should be included under debt), reserves, capital contributions and reinvestment of earnings.

The data exhibited in this section is extracted from the Brazilian Foreign Capitals Survey (Banco Central do Brasil, 2020). According to this report equity and debt positions amounted for US$874 billion in Brazil in 2019, growing 18.4% compared to 2018 figures. The criterion of immediate investor, which shows the source of funding for the investment but not necessarily reflects the country of the controller of the investment. Considering this criterion and both debt and equity instruments, as in Figure 8, Europe is the region with the highest direct investment in Brazil, representing 68% of the total stock of foreign-invested capital, followed by North America with 18%.

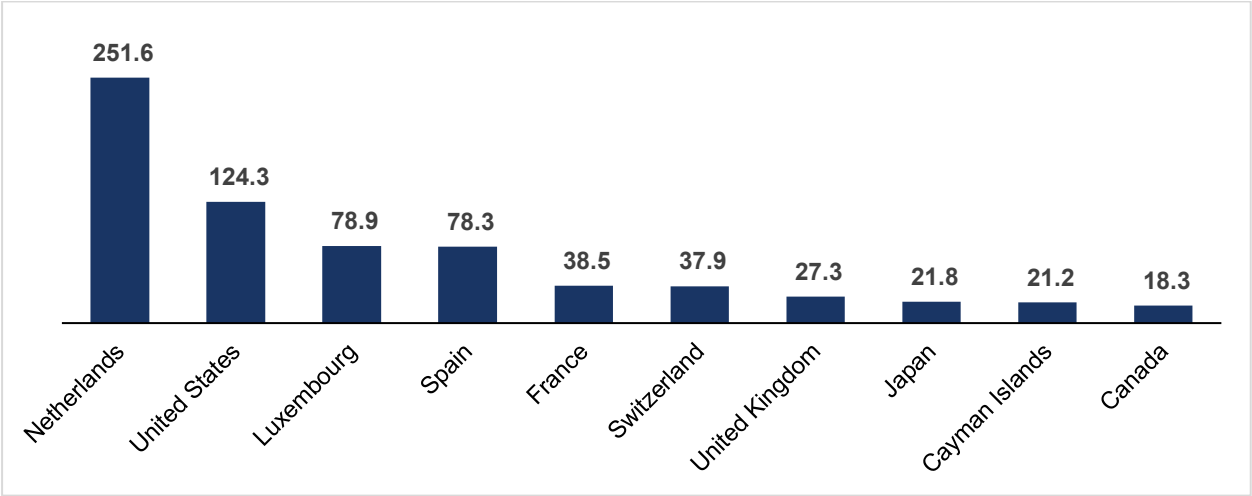
Figure 8 – Direct investment position in Brazil in 2019 – immediate investor (US$ billions)



Source: Banco Central do Brasil (2020)

Among the European direct investment positions the Netherlands stand out with US$251.6 billion, 42.4% of Europe and 28.8% of total positions. Spain and Luxembourg account for 13.3% and 13.2%. respectively. On North America, the United States represents 80.9% of positions with US$124.3 billion, followed by 11.9% immediate investors from Canada in that region.

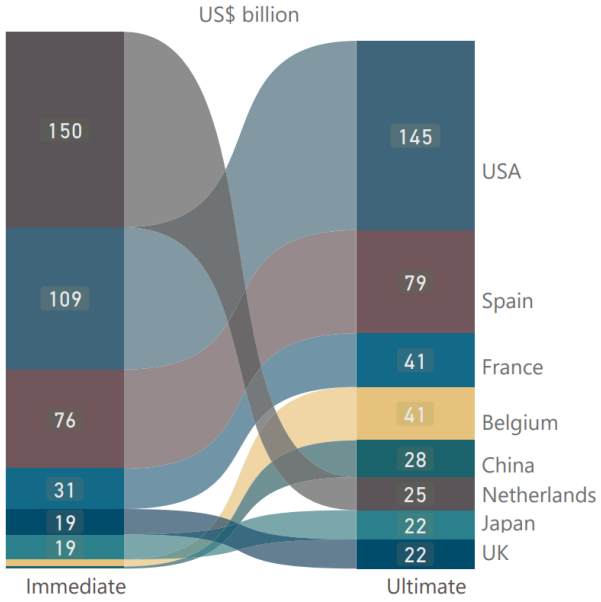
Figure 9 – Direct investment position in Brazil selected countries in 2019 – immediate investor (US$ billions)



Source: Banco Central do Brasil (2020).

Although, when comparing the immediate investor criterion with the ultimate controlling parent (investor that holds the effective interest and economic interest in the invested enterprise), some economies hold higher positions in the first criterion rather than the latter. That is the case for the Netherlands and Luxembourg.

Figure 10 – Direct investment equity positions in Brazil 2019 – Immediate Investor vs. ultimate controlling parent for selected economies



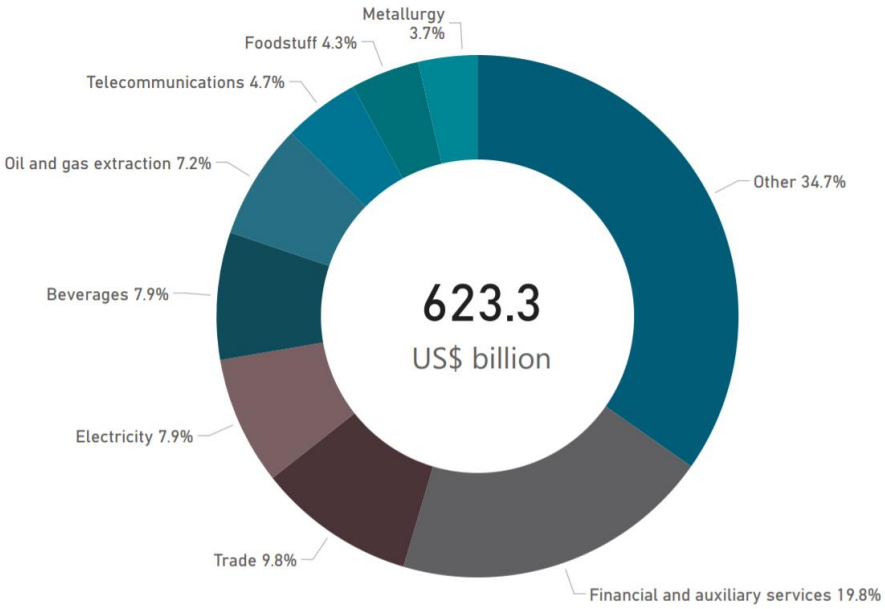
Source: Banco Central do Brasil (2020).

As in Figure 10, when we compare the equity positions according to different criteria, some economies reflect a higher position as the ultimate controlling parent, the case of the United States, Spain, Belgium (the bigger difference), France, and China. Those countries are the residence of the companies that use intermediate economies to make the investments in Brazil (Banco Central do Brasil, 2020). The Netherlands, for example, holds the biggest direct investment equity position as the immediate economy with US$150 billion, but only US$25 billion as the ultimate controller.

3.2.4. Industry Distribution

The information provided in this section is extracted from the Foreign Direct Investment Report of 2020 (Banco Central do Brasil, 2020) reporting 2019 figures and from the Census of Foreign Capitals in Brazil (Banco Central do Brazil, 2016) reporting data from 2015, which includes the discrimination of industrial activities per Brazilian state.

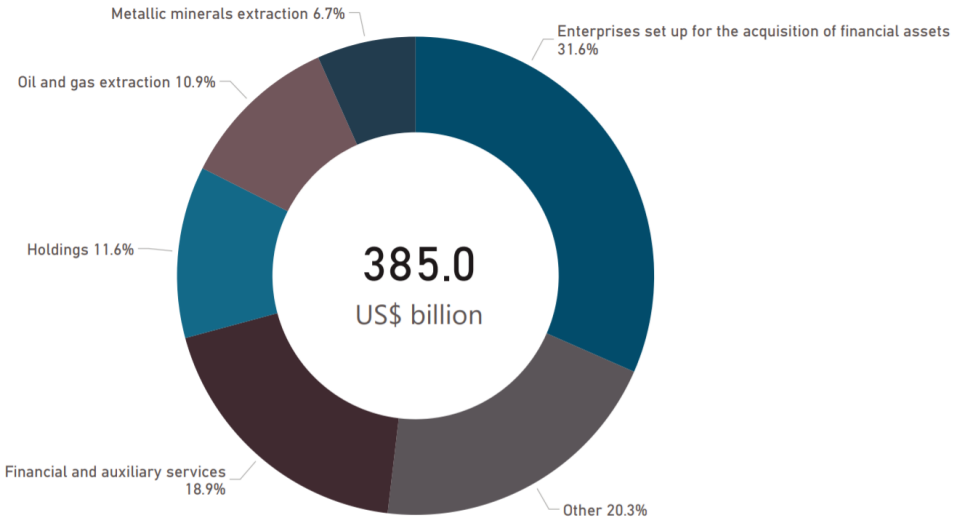
Figure 11 – Direct investment equity liabilities position by industry in 2019



Source: Banco Central do Brasil (2020).

From the equity liabilities point of view, the direct investment has the biggest contribution from the financial and auxiliary services, including in this segment the investment funds, accounting for 19.8% of the equity liabilities, as Figure 11, the main state receiving these investments is São Paulo, with a relevant contribution from Rio de Janeiro, this industry was highly profitable in 2019, with returns of 13.6% on the positions, following an increase in profitability in the recent years. Furthermore, trade, electricity, and beverages industries represented relevant positions.

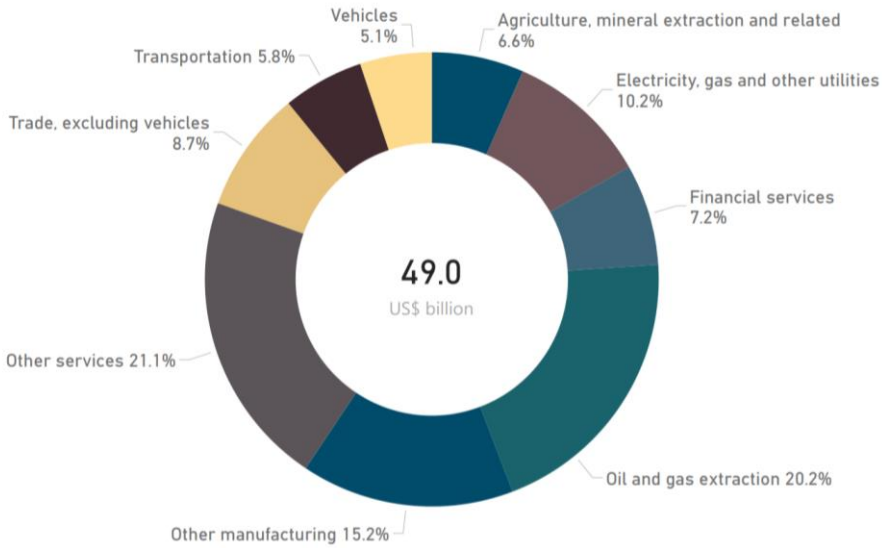
Figure 12 – Direct investment equity assets position by industry in 2019



Source: Banco Central do Brasil (2020).

The direct investments equity assets (Figure 12) were concentrated in the enterprises set up for the acquisition of another company, accounting for almost a third of total assets positions. The financial sector remained highly significant, followed by holding and the oil and gas extraction industry, which concentrated its investments in Rio de Janeiro and São Paulo.

Figure 13 – Direct investment equity liabilities, excluding reinvested earnings – Gross inflows by industry in 2019



Source: Banco Central do Brasil (2020).

Finally, the inflows of foreign capital not considering reinvested earnings, as in Figure 13, are concentrated, with 20.2%, in the oil and gas extraction industry. But other sectors such as agriculture, vehicles, and transportation become more relevant in the analysis of the recent inflows to Brazil.

4. EMPIRICAL LITERATURE REVIEW

The objective of this section is to provide a review of the empirical literature on the location of inward FDI. Since the introduction of the Eclectic Model of Dunning (1976), many studies on the topic were conducted. The authors aim to analyze the factors that are more relevant to the location of FDI, the methods, countries, years of study, and variables utilized do change a lot among the works. Also, the conclusions over the effects of the variables are not the same across the studies, hence those differences will be mentioned in this section.

The variables considered in these studies and the conclusion the authors derive will be an input for the construction of the model of the present dissertation. Those variables will be relevant in the selection of the independent variables of the model. As most of the studies are based at a country level, some variables studied in this chapter will not be relevant for the analysis at a state level, because the effects should be equal for all the states.

4.1. Market Size and Development

The market size can be a measure of the economic development in a market, and for that reason, it has been used by several authors as a variable to explain the patterns of FDI. In this line of thinking is expected that the economically developed markets will receive more inflows of FDI as the disposable income is higher and so is the consumption. In the last decades studies as Trevino et al. (2002) shown that economic development, measured through the GDP, is a significant factor in the explanation of FDI inflows, the specific study show that evidence for Latin America countries (Trevino et al., 2008).

The work of Sun, Tong and Yu (2002) looked at the determinants for the FDI across China's provinces found a strong relationship between the GDP and FDI, what the authors

marked is that the studies for periods before 1991 do not find significant relationship between those variables, but the effect becomes highly positive in the studies after this year, reflecting the change in FDI trends. The positive effect of GDP can be explained because it affects directly the return that the foreign firm will have with the investment, as the firm will benefit from a larger market (Sun et al., 2002).

In a study for the determinants of FDI in Latin America, Amal and Seabra (2007) also find a significant relation using GDP expressed in terms of purchasing power parity. Also, the work of Krifa-Schneider and Matei (2010) found a positive relationship between the market size, given by GDP, and the inwards FDI.

4.2. Infrastructure

Infrastructure is a factor discussed in many works regarding the location of FDI. The Eclectic Paradigm from Dunning & Lundan (2008) highlights the importance of this factor in the "Location" step of the analysis. Furthermore, a location that is not provided with adequate infrastructure leads to an increase in the production and distribution costs discouraging the investments (Bortoluzzo et al., 2013).

The work of Bortoluzzo, Sakurai, and Bortoluzzo (2013) which evaluates the determinants of FDI across Brazilian states, found that infrastructure is an important factor to attract foreign investors, using as a proxy for that variable the kilometers of road per Brazilian state. Also, it highlights that the public policies may focus on giving tax incentives for the attraction of FDI and not give enough importance to the investments on the quality of infrastructure.

Sun, Tong, and Yu (2002), reinforces the importance of infrastructure for FDI expecting a positive relationship between those variables. In the study the authors used as a

proxy for the infrastructure the GDP per square kilometers, the highway per km² and railway per km², concluding that these were relevant factors for the allocation of foreign investments.

On the other hand, the work of Krifa-Schneider and Matei (2010), which studied the FDI inflows of 33 developing or transitioning economies from 1996 to 2008, found a negative or not significant relation between hard infrastructure and FDI, although the authors did not expect the result as the previous work revealed a positive and relevant relationship with the infrastructure factor.

4.3. Human capital

Educational levels in certain society play a fundamental role in FDI inflows The educational levels may be used as a proxy of the labor quality and the foreign investors should be interested in establishing their firms in countries with higher levels of education, up to the point which the cost is so high it is prohibitively. Also, the degree of educational attainment can show how open a country is to foreigners, with nations changing the orientation from ethnocentric-based to geocentric-based as they increase the educational attainments (Trevino et al., 2008). In the same study, the author evaluates the quantitative relationship between inward FDI and educational levels, using the percentage of students enrolled in tertiary education, and conclude that was a significant and positive relationship between the variables for the countries in Latin America (Trevino et al., 2008).

The study of Bortoluzzo, Sakurai, and Bortoluzzo (2013) used as a proxy for the human capital level the illiteracy rate, as the percentage of illiterate individuals aged 15 years or above per Brazilian state, and concluded that this variable is important in the explanation of FDI levels, as they expect an increase of at least 7% in the FDI per capita with a 1% decrease in the illiteracy rate. Furthermore, the work of Cleeve (2008) uses as a proxy for human capital

the illiteracy levels and secondary school enrolment, for countries in Sub-Saharan Africa. The results obtained are significant relationships being positive, for secondary school enrolment and negative for illiteracy levels. Another variable explored in the empirical literature is the number of research engineers, scientists, and technicians as a percentage of total employees, finding a relevant and positive relationship of this variable with FDI inflows (Sun et al., 2002).

4.4. Cost of Labor

Among the production costs that play a relevant role for FDI, the literature addresses attention to the cost of labor. Among the empirical studies conducted on the theme, the conclusion obtained from the impact of this factor is not the same. The study of Krifa-Schneider and Matei (2010) found a positive but no significant relationship between the unit labor costs and FDI, which goes in line with the results of Lipsey (1999). The latter argues that in some sectors, such as manufacturing, the need to attract better-skilled workforce offsets, to some extent, the effect of looking for the lowest wages location (Lipsey, 1999).

Another work from Cheng and Kwan (2000), on the determinants of FDI across 29 Chinese regions from 1985 to 1995, concluded that the labor costs harm inwards FDI and that a change of 1% in wages results in a 0.5% decrease in the inflows. Moreover, the study of Sun, Tong, and Yu (2002) unearthed a positive relationship before 1991 and a negative relationship afterwards.

Regarding labor costs, Klein and Rosengren (1994) describe the effects of exchange rates on wages in the context of foreign investment linking those variables based on two theories. First, the imperfect-capital-markets theory gives that the wealth of a firm relative to the foreign counterpart is increased when the local currency appreciates. Secondly, the relative-labor-cost theory gives that the depreciation of the local currency increases inwards

FDI. Hence, both of those theories agree that a weaker exchange rate may lead to an increase in FDI inflows, and a stronger exchange rate hinders FDI inflows.

4.5. Macroeconomic stability

A multinational company faces several risks, many of which are the same faced by the local firms, but others are unique for the firm operating abroad. A broad classification proposed by Ghoshal (1987) is the macroeconomic risks, which are the variables that the company cannot control in any way. This includes the cataclysmic events and the movements in wages, interest rates, exchange rates, unemployment, inflation, and so on (Ghoshal, 1987).

The main variables explored in the literature about those factors are the GDP (discussed earlier in this chapter), the inflation rate, the currency exchange rate, and unemployment. Regarding the inflation rate, elevated levels of this variable is a sign of instability in the internal economy of the host country and a lack of capability to maintain a consistent monetary policy. In Latin America from 1970-1980 during the imports substitution period, hyperinflation was present because the producers did not have to compete with imports Trevino, Thomas, and Cullen (2008). For Asiedu (2013) the inflation is a measure of the uncertainty of the macroeconomic stability, and in the study for 99 developing economies from 1984 to 2011, the result was that inflation is significant and negative related to FDI.

Concerning the exchange rate effects, the literature points to distinct conclusions. First, possible reasoning is based on the wealth effect and the relative production cost effects, in which depreciation in the host country's currency leads to an increase in foreign investment because the foreign company will enjoy a lower cost of production and higher wealth comparing to the local firms. The second line of thought is that, in this situation of depreciation on local currency, the subsidiary profit will have a lower discounted value. Hence, the main

concern should be the nominal returns the asset generates valued at the foreign currency, leading to lower FDI inflows Boateng et al. (2015). On the studies conducted by Boateng (2015), over the Norwegian FDI Inflows, the conclusion was that the exchange rate plays a positive and significant role in the inflows. On the other hand, Krifa-Schneider and Matei (2010) got a negative but not significant relationship, showing that there is not a consensus on the effect of the exchange rate.

About the unemployment rate in the host economy, Billington (1999) remarks that a foreign investor may be attracted to higher availability of labor locally. Hence, it is reasonable that higher levels of unemployment will lead to higher FDI. But also, assumes that the high levels of unemployment can signal an erosion of skilled labor locally, which affect negatively the FDI. The study conducted in the UK, by the same author, indicates a positive and significant relationship between FDI and unemployment (Billington, 1999). Conversely, the results from Boateng et al. (2015), shows a negative relationship between the variables.

Therefore, the empirical literature on the macroeconomic determinants of FDI does not seem to have a consensus. The studies conducted on the topic diverge on some points, but it shows that, out of common sense, greater macroeconomic stability not always can be correlated with higher levels of FDI inflows. A certain level of instability can offer higher returns (with higher risk) in some situations.

4.6. Policies

From the governmental policies perspective, Trevino, Thomas, and Cullen (2008) bring a closer look at the changes that happened in Latin America from the 1970s to the late 1990s, also the case for Brazilian policies. The study takes into consideration four changes and analyses the impact on FDI: privatization, tax reform, trade reform, and financial account

liberalization. The first one refers to the privatization of state-owned enterprises (SOEs), considered a fundamental step for the development of transitional economies, and left more opportunities for foreign companies to invest in Latin American countries, by indicating that the government's willingness to leave room for the private sector on the economy.

The tax reform adopted by the majority of countries contained the value-added tax and marginal tax on corporate and personal income, the reform took place concurrent with the switch from the imports substitution policy to open markets in the region and represents a benefit for FDI stop favoring domestic companies over MNEs. The third aspect, the trade reform, happened at the same period as described for the tax reform. As part of the imports substitution policy, heavy tariffs were used to protect selective industries, and by 1995 the tariff rates fell massively. The fourth factor is financial account liberalization, the governments in Latin America imposed controls on capital movements and international activities of the financial industry and restricted the establishment of foreign financial institutions. The end of these controls and restriction marked the financial account liberalization. The study conducted found a significant and positive relationship between the FDI and all the four factors described (Trevino et al., 2008).

4.7. Incentives

Among the policies that governments can implement intending to foster the FDI, are the fiscal incentives, given in most of the times through tax benefits. The literature over the theme has different points of view, the first one is that it can increase investment, create new jobs, and promote other social-economic benefits, under certain conditions. The second view is that this alternative should now be prioritized, the reasoning is that the costs of incentives exceed the potential benefits, moreover this group believe the incentives may increase

problems such as corruption and governance issues, and that it is better to improve local factors such as infrastructure (Cleeve, 2008).

The empirical study of Cleeve (2008) takes into consideration 16 countries from Sub-Saharan Africa and concludes that there is an important relationship between fiscal incentives and FDI. The author segregates profit repatriation, tax holidays, and tax concessions, the first and the second factors with a positive relationship, but the third with a negative relationship. Arguing that the countries that offer too many concessions may harm the attractiveness for FDI, calling for a balanced approach to lever growth and development. The work of Head and Ries (1996) evaluated the effectiveness of the incentive areas in China, as the benefits were among a wide range of possibilities, the authors condensed in dummy variables for incentive zones and found a positive relationship between governmental incentives and FDI.

4.8. Economic openness

The increase in the level of trade flows between countries creates an environment of learning and knowledge creation, facilitating the involvement of FDI activities. The economic openness of a country, generally measured by the trade flows, tends to be positively correlated to FDI inflows (Amal, 2016). To empirically demonstrate these effects, the study of Asiedu and Lien (2011) used the ratio of trade over GDP to measure economic openness and, for data on 117 developing countries between 1982 and 2007, the result was a positive and significant relationship with this determinant and FDI inflow.

Similarly, the work of Al-Sadig (2009) used the total exports and imports over GDP to proxy economic openness and found a positive and significant relationship. As hypothesized, most of the studies on the theme find a positive relationship between FDI and economic

openness. The Brazilian case shows evidence from this relationship as in the 1990s the policy in direction for economic openness can be a strong factor in the explanation of the increase in FDI inflows in the country over the following years.

4.9. Corruption

The literature highlights several adverse effects of corruption on the economic performance of a country. Impacting the economic growth, the infrastructure developments, the productivity of public investments, the quality of education services and favor the inequality growth. All of these being related to FDI growth in the empirical literature. Furthermore, the adverse effects can be also a higher cost for a foreign company, for the case of bribes for licenses as an example (Al-Sadig, 2009).

The study from Al-Sadig (2009) confirms this hypothesis. Using data on FDI inflows from 117 countries from 1984 to 2004, the author tries to understand if countries with higher corruption tend to receive more or fewer investments, after evaluating other determinants for FDI location. The result was statistically significant showing that a 1% increase in corruption level tends to reduce FDI inflows by approximately 11%, using the International Country Risk Guide (ICRG) index to estimate corruption levels. The works of Asiedu (2013) and Sun, Tong, and Yu (2002), used the ICRG index as a measure for country risk, considering corruption and the effectiveness of the rule of law. The results of both studies were a negative and statistically significant relationship with FDI inflows.

4.10. Natural resources

Natural resources are an immobilized production factor that restricts the location of the company to explore them, but the literature on the effects on FDI inflows do not get to the same conclusion. The work of (Asiedu, 2013) finds a negative relationship between those variables. The reasoning for that is based on three points. The first one is based on the idea that a resource boom generates the appreciation of the local currency, making the exports of the country less competitive, crowding out the non-natural resources tradable sectors FDI. The second reason is concerning the volatile characteristics of commodities, in particular oil, hence a country that is highly dependent on natural resources exploration may be more vulnerable to external shocks, generating macroeconomic instability hindering FDI. The last reason is that countries rich in natural resources tends to have the FDI concentrated in this sector, which demands a high amount of capital investment in the first years but relatively low cash flow in the following years, reducing levels of FDI (Asiedu, 2013).

Conversely, the work of Aleksynska and Havrylchyk (2013) founds out a positive and statistically significant relationship associated with the presence of natural resources and FDI. But the author argues that there is an important connection between the presence of natural resources and the quality of the institutions in the country. The empirical evidence shows that countries endowed with natural resources have issues regarding their institutions and as both components are relevant in explaining the FDI inflows, both of the effects should be considered in the analysis. The results of the study, for 82 host countries from 1996 to 2007 period, shows that the effect of the presence of natural resources is positive and significant, as the quality of institutions in the same countries negative relates to FDI, but the positive effect of the first variable offsets the effect of the latter (Aleksynska & Havrylchyk, 2013).

4.11. Agglomeration and cultural distance

The agglomeration effect is described by the concentration of the economic activities in a certain location that can generate economies of scale and positive externalities, which should have a positive relationship with FDI inflows in a specific location (Sun et al., 2002). Factors such as the knowledge flow, specialized labor, and specialized intermediate suppliers are relevant for the agglomeration to occur and based on the characteristics of the industry the intensity of the effects will be different.

To access the effect of this phenomena, Head and Ries (1996) propose the evaluation of the number of foreign firms in a location, the number of domestic enterprises (as a proxy for specialized suppliers) and the output of domestic enterprises. The model created in this case for FDI is self-reinforcing, as the number of foreign firms increases in a location the probability of other foreign firms going to the same place increases. The result of the study, for the data on 931 investments over 54 Chinese cities, is that FDI is supported by agglomeration effects.

The study of Sun, Tong, and Yu (2002) uses a different approach, to determine the significance of the agglomeration effect it constructs a relative measure given by the ratio of cumulative FDI and cumulative domestic investment, indicating if the cumulative FDI is growing faster than the domestic investment or not. The results are not as expected, was found a negative relationship between FDI inflows and the ratio. The authors argue that by using this ratio the agglomeration effect may already be captured in the GDP (that was found to be highly correlated with FDI). The other hypothesis is that the exists a "crowding-in" effect of FDI on the domestic market, and if this effect is higher than the agglomeration effect, the relationship of FDI and the ratio proposed in the study will be negative.

Du, Lu, and Tao (2012) study the effects of the cultural distance for FDI, to understand if the cultural similarities can shape the investments in a country. For this study, the focus is China, and the author evaluates firm-level data for investments coming from Hong-Kong, Taiwan, Japan, Korea, the US, and the EU. Evaluating the proximities the author highlights that Hong-Kong and Taiwan share the same languages and culture as China. Japan and Korea also have some similarities with China, historically the culture and language of those countries were influenced by China. On the other hand, the US and the EU have a greater cultural distance from China. For that reason, the authors use Hofstede's cultural values index of those countries to access the impact on investments. The results of the study show that cultural distance affects the location of the investments as the more culturally distant countries present a higher aversion to areas with weaker economic institutions.

Table 2 – Summary of the empirical literature on FDI determinants

Determinant	**Author**	**Indicators**	**Impact**
Market size and development	Trevino et al., 2002	GDP	+
	Krifa-Schneider and Matei, 2010	GDP	+
	Sun et al., 2002	GDP per capita	+
	Amal and Seabra, 2007	GDP expressed as PPP	+
Infrastructure	Bortoluzzo et al., 2013	Kilometers of roads	+
	Sun et al., 2002	GDP per km²	+
	Sun et al., 2002	Highway and rail per km²	+
	Krifa-Schneider and Matei (2010)	Kilometers of roads	0
Human capital	Trevino et al., 2008	Percentage of students in tertiary education	+
	Bortoluzzo et al., 2013	Illiteracy rate	-
	Cleeve, 2008	Secondary school enrolment	+
	Cleeve, 2008	Illiteracy rate	-
	Sun et al., 2002	Engineers, scientists, and technician as a percentage of total employees	+
Cost of labor	Krifa-Schneider and Matei (2010)	Unit labor costs	+
	Cheng and Kwan, 2000	Real wage	-
	Sun et al., 2002	Average wages	-

(*Continued*)

Table 2 – Summary of the empirical literature on FDI determinants (*cont.*)

Determinant	**Author**	**Indicators**	**Impact**
Macroeconomic stability	Trevino et al., 2008	Inflation	-
	Asiedu, 2013	Inflation	-
	Boateng et al., 2015	Currency exchange rate (comparison with USD)	+
	Krifa-Schneider and Matei (2010)	Currency exchange rate (comparison with USD)	0
	Boateng et al., 2015	Unemployment rate	-
	Billington, 1999	Unemployment rate	+
Policies	Trevino et al., 2008	Privatization	+
	Trevino et al., 2008	Tax reform	+
	Trevino et al., 2008	Trade reform	+
	Trevino et al., 2008	Financial account liberalization	+
Incentives	Cleeve, 2008	Tax holidays	+
	Cleeve, 2008	Tax concessions	-
	Cleeve, 2008	Profit repatriation	+
	Head and Ries, 1996	Incentive zones	+
Economic openness	Asiedu and Lien, 2011	Trade/GDP	+
	Al-Sadig, 2009	Trade/GDP	+
Corruption	Al-Sadig, 2009	Corruption (ICRG)	-
	Asiedu, 2013	Corruption (ICRG)	-
	Sun et al., 2002	Corruption (ICRG)	-
Natural Resources	Asiedu, 2013	Percentage of oil on exports and total oil rent to GDP	-
	Aleksynka and Havrylchyk, 2013	Present value of future rents from subsoil natural resources	+
Agglomeration and cultural distance	Head and Ries, 1996	Agglomeration effects	+
	Sun et al., 2002	Agglomeration effects	0
	Du et al., 2012	Cultural distance	-

Impact meaning: (0): not statistically significant result; (+): significant and positive result; (-): significant and negative result

Source: author elaboration.

5. ECONOMETRIC LITERATURE REVIEW

The objective of this chapter is to provide a methodology and theoretical basis for the construction of the econometric model and to analyze the results, and the premises considered. With this purpose, this chapter is organized in the following way. The first section provides a general methodology to construct multivariate model, on a stage approach described by Hair et al. (2009). The second section focuses on defining the logistic regression and its differences (and similarities) from the linear regression, followed by the description of the conditional logistic regression that will be used in the model applied in this work, and the definition of the tests to assess the fit of the model.

5.1. Methodology for the multivariate model

To develop a multivariate model, Hair et al. (2009) proposes a structured approach based on six stages. The authors argue that building a successful model does not rely only on the choice of the right method but on that the researcher should interpret and validate each step of the model building. The intention of this workflow is not to provide a strict guideline in the model building, but a broader base for the model development (Hair et al., 2009). Therefore, this approach is based on the following stages:

- Stage 1 is the definition of the research problem, objectives, and the regression technique to be used. This phase involves mainly the conceptual definition of the problem and the relationship the researcher is seeking to explain;
- Stage 2 involves the development of the analysis plan. With the conceptual model and technique selected, the modeler should look at the implementation issues and the characteristics of the data to be analysed;

- Stage 3 is the evaluation of the main assumptions of the technique chosen. Statistical and conceptual assumptions of the model must be fulfilled to the model work properly and give insightful information;
- Stage 4 is the estimation of the multivariate technique and the assessment of the fit of the model. In this phase, the researcher should estimate the model using the technique chosen. Then evaluate the overall model fit to identify if it meets the acceptable levels of significance statistically required, can identify the relationships, and have practical significance. The researcher should also check for the effects of variation in the data for the model, and identify the outliers that may cause distortions to the model;
- Stage 5 is the interpretation of the variates. With an acceptable model, the interpretation of the estimated coefficients reveals the nature of the multivariate relationship of the model variables. The interpretation may lead to additional re-specifications of the variables and the model. The objective is to identify the empirical evidence of relationships;
- Stage 6 is the validation of the multivariate model. This step adds little information to the interpretation of the results but gives more security to the results. This can be done by the diagnostic analysis of the degree of generalizability of the results obtained.

5.2. Logistic regression

This section aims to introduce the logistic regression in its general form, then the model that will be used in this work will be described in the next section, the conditional logit model. The regression models are widely used in data analysis to explain the relationship between a variable of interest, called the response variable, and the explanatory variables, the independent variables of a model, that could be one or more. When the response variable

outcome assumes a discrete behavior, with two or more possible values, the model of analysis chosen is often the logistic regression (Hosmer et al., 2013).

The nature of the outcome variable, as binary or dichotomous is what characterizes the difference between the logistic regression from the traditional linear regression models. The method employed in the development of a logistic regression follows almost the same general principles used for linear regression.

Hosmer et al. (2013) illustrate the differences between the models. The first difference between the models arises from the form of the relationship between the independent and dependent variables. The conditional mean that gives the value of the outcome given the value assumed by the independent variables represents this relationship. Usually, it is expressed as $E(Y|x)$ that should be read as "the expected value of Y, given the value of x". In the linear regression model, the conditional mean can be expressed as in equation (4.1), where the expected value can be any value, and the betas represent the coefficients.

Equation 1 – Conditional mean for the linear regression model

$$E(Y|x) = \beta_0 + \beta_1 x$$

Source: Hosmer et al. (2013).

For the case with a dichotomous variable where the conditional mean ranges from 0 to 1 ($0 \leq E(Y|x) \leq 1$). The change in the conditional mean per unit variation in the independent variable (x) becomes progressively smaller when the value of $E(Y|x)$ gets closer to zero or one. Hence, the curve shaping this relationship is S-shaped (Hosmer et al. 2013), and when the response variable is dichotomous the conditional mean is modeled by cumulative distributions. Hosmer et al. used a specific form for the logistic regression, with the conditional mean given by:

Equation 2 – Conditional mean for the logistic regression model

$$\pi(x) = \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}}$$

Source: Hosmer et al. (2013).

As many properties of the linear regression model are desirable in logistic regression, the transformation of $\pi(x)$ is defined as the logit transformation (equation 4.3) that is linear in its parameters and can assume any value.

Equation 3 – Logit transformation

$$g(x) = \ln\left[\frac{\pi(x)}{1 - \pi(x)}\right] = \beta_0 + \beta_1 x$$

Source: Hosmer et al. (2013).

The second important difference between those models is the form that the distribution of the errors, from the values obtained from the conditional mean, takes place. The linear regression model has the errors given by the normal distribution, whereas in the logistic regression the errors assume a binomial distribution (Hosmer et al, 2013). Another difference is the method used to fit the model, the linear model often uses the least-squares method, as the logistic models use the maximum likelihood estimation.

5.3. Conditional Logistic Regression

An important concern of economics is the understanding of choice behavior. Hence, the conditional logistic regression seeks to analyze the choice behavior of a population, considering the effects of choice characteristics on the determinants of choice probabilities (Maddala, 1983). The model proposed by McFadden (1973) is a specific type of the random utility model, in which the goal is to estimate the probability of choice of an alternative, among those available based on the utility for the individual.

As the objective of the current dissertation is to understand the determinants for the choice of location on inward FDI in Brazil, the model suits the goal of the work and the form of the database, which contains the firm-level data of the investment decision made. Similar studies using the conditional logit model were carried out by Head and Ries (1995) and Sun et al. (2002), both analyzing the choice on investments across China's provinces.

The McFadden's model describes that an individual faces *M* alternatives, with a utility associated with a level of indirect utility associated with each of them, represented by U_i, with $i = 1, 2, 3, \dots, M$. The individual will them chose the alternative that represents the higher level of utility, $max[U_1, U_2, \dots, U_i]$.

The utility model assumed in the model has the form: $U_i = V_i(X_i) + \epsilon_i$, where X_i is the vector of attributes for the *i*th choice option, and ϵ_i is the residual value (the error of the estimation) (Maddala, 1983). Hence:

Equation 4 – Choice probabilities of the alternatives

$$P\{Y_i = 1\} = P\{U_i = max[U_1, U_2, \dots, U_i]\}$$

Source: Maddala (1983), author adaptation.

The model assumes that the residuals (ϵ_i) are identically and independent distributed with a type I extreme value distribution. Then, each ϵ_i have the cumulative distribution function given by: $F(\epsilon_i < \epsilon) = \exp(-e^{-\epsilon})$. And the probability density function $f(\epsilon_i) = \exp(-\epsilon_i - e^{-\epsilon_i})$. From these assumptions the model derives that:

Equation 5 – Conditional logit choice probability

$$P(Y_i = 1 \mid X) = \frac{\exp(V_i)}{\sum_{j=1}^{M} \exp(V_j)}$$

Source: Maddala (1983).

Assuming also that $V_i(X_i)$ is a linear function of the observatory variables, given by: $V_i = X_i\beta = x_1\beta_1 + x_2\beta_2 + \cdots + x_M\beta_M$. With these assumptions we have:

Equation 6 – Conditional logit choice probability (considering the linear utility function)

$$P(Y_i = 1 \mid X) = \frac{\exp(X_i\beta)}{\sum_{k=1}^{M} \exp(X_j\beta)}$$

Source: Train (2009), author adaptation.

Hence, the objective of the model is to estimate the β coefficient associated with each of the independent variable to determine its impact on the utility of a specific alternative.

5.3.1. Assessing the fit of the model

The likelihood ratio is a measure often used in discrete choice models, such as the conditional logit, to assess how well the model fit the data. This statistic compares how well the model performs, with its parameters estimated, in comparison with a model where all the parameters used are equal to zero, which is basically the same to not having any model at all (Train, 2009).

The principle of the maximum likelihood defines that the value of β that maximizes the likelihood function is the estimate of the model. For that the likelihood function is defined by the expression:

Equation 7 – Likelihood function

$$l(\beta) = \prod_{i=1}^{n} \pi(x_i)^{y_i}[1 - \pi(x_i)]^{1-y_i}$$

Source: Hosmer et al. (2013).

But, as it is easier to work, mathematically, with the log of the equation defined, the log-likelihood function is defined by the expression:

Equation 8 – Log-likelihood function

$$L(\beta) = \sum_{i=1}^{n} \{y_i \ln[\pi(x_i)] + (1 - y_i) \ln[1 - \pi(x_i)]\}$$

Source: Hosmer et al. (2013).

The likelihood ratio test considers a null hypothesis *H* that can be expressed as constraints of the model parameters. A common hypothesis is that several parameters are equal to zero. For test this hypothesis, is defined the constrained maximum likelihood estimate of the parameters ($\hat{\beta}^H$), which gives the highest value of likelihood under the constraints defined. And $\hat{\beta}$ is the unconstrained maximum of the likelihood function. Then is defined the ratio of likelihoods $R = l(\hat{\beta}^H)/l(\hat{\beta})$ (using Equation 7).

For the likelihood ratio test, the test statistic is defined as $-2 \log (R)$. Which the distribution is given by the chi-square distribution with the degrees of freedom given by the number of restrictions imposed in the null hypothesis. Hence, the test statistic is given by $-2[L(\hat{\beta}^H) - L(\hat{\beta})]$, using the Equation 8. If the critical value of the chi-square distribution with the appropriate degrees of freedom is exceeded the null hypothesis is rejected (Train, 2009). The *p*-value for this test is given by $P\{\chi^2 > -2[L(\hat{\beta}^H) - L(\hat{\beta})]\}$ (Hosmer et al., 2013).

Additionally, to test the hypothesis that an individual coefficient is zero, the univariable Wald test statistics is used.

Equation 9 – Wald test statistic

$$W_j = \frac{\hat{\beta}_j}{\widehat{SE}(\hat{\beta}_j)}$$

Source: Hosmer et al. (2013).

These statistics will follow the standard normal distribution. So, the two-tailed *p*-value is calculated, usually this is reported in statistical applications as $P(|z| > W)$, where z is a random variable following the standard normal distribution. The values obtained for each variable are used to assess the statistical significance of the independent variables of the model (Hosmer et al., 2013).

6. MODEL AND ANALYSIS

With the literature review of the economic theories of FDI, the empirical studies on the determinants of FDI, and econometric models. The model described in this chapter aims to understand the determinants for the allocation of FDI across the Brazilian states, and then focus on the particularities for companies of the more relevant industry sectors.

For this, the chapter is organized in the following way. First, the database used in the model is described, the dependent variable as the investment-level data provided by fDi Markets (2020), for which is also described the filters made in the database. And the independent variables that were chosen for the model, that are GDP per capita, GDP growth, population, illiteracy rate, monthly wages, unemployment rate, tax burden, infrastructure, and natural resources rents. Then the database used in the freeware *R* is described explaining the procedures used to format it correctly for the application of the model.

The second section of the chapter is the descriptive analysis of the database variables. In this section all the values of the database are analyzed focusing on the specificities for each state and how is the regional distribution of the values. Then the dependent variable is analyzed with more detail, and finally, the correlation between the independent variables is assessed. The third section of the chapter is the analysis of the results indicated in the model, that first described the results for all the period of analysis and sectors, then is made a second analysis on the sample divided into two periods, and finally is conducted an analysis for the differences on the determinants for FDI for the main industry sectors, selected by the number of FDI.

6.1. Description of the dataset

The first step to the development of the econometric model is the data collection and the pre-processing of this data. This way it can be the input for the model generating no errors and enabling the generation of consistent results.

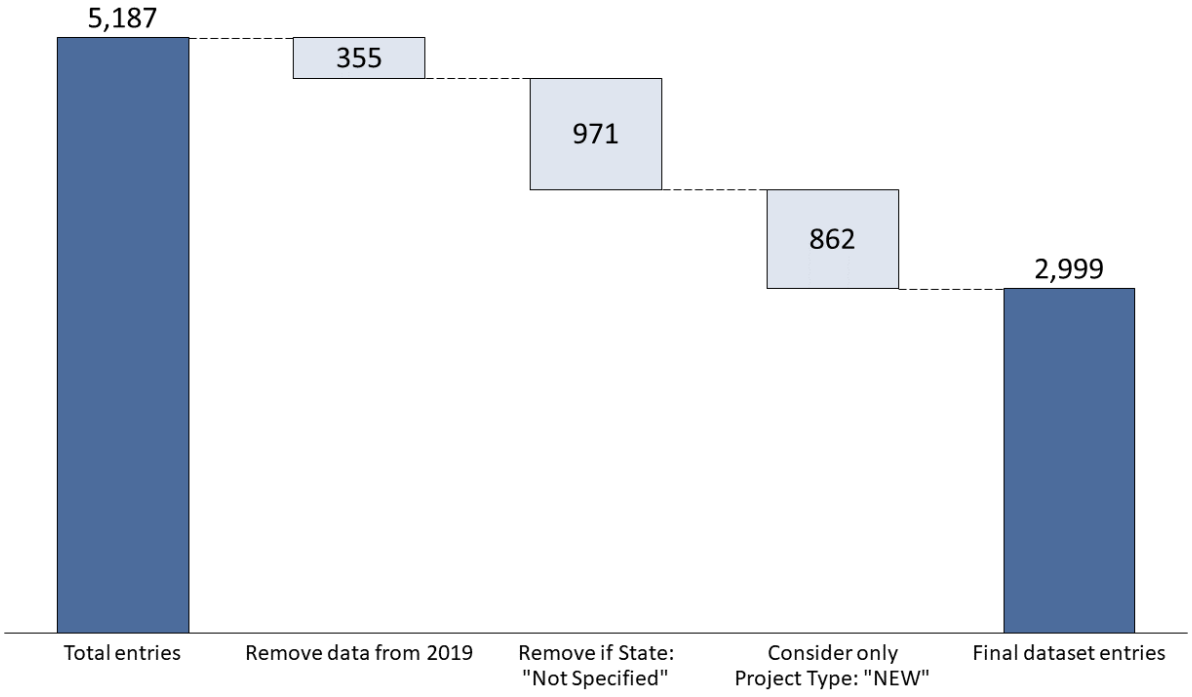
This section describes each variable that will be used in the model. First, the dependent variable, related to the foreign investments made across each state of Brazil. Then will be described the data used for the independent variables. For those, the choice to add each variable to the model is made based on the determinants reported by the literature, hence, the model can capture all the relevant determinants for the FDI inflows. A common problem faced by previous works on the theme is the difficulty to gather the data for the model, for the present work some data required some adaptations and approximations, therefore those changes are also described in this section.

6.1.1. Dependent variable

The dependent variable for the model is the choice of the foreign investments made across the Brazilian states. The data used for this purpose is the fDi Markets (2020) database, generated by the Financial Times. The database contains the firm-level data for greenfield FDI projects announced from 2003 and after. The database extracted for this study contains data from 2003 to 2019, and for each investment is provided: the date, the investing and parent company, the investor location (country, state, and city), the destination location (country, state, and city), the industry (by activity, sector, and sub-sector), the capital investment (estimated or not), the number of jobs creates (estimated or not), and the project type (new, expansion or co-location).

For the current study, some changes and filters were made in the database. The first filter is the removal of the investments made in 2019, maintaining the data from 2003 to 2018, due to the lack of information regarding the independent variables.

Figure 14 – Number of entries on original dataset and excluded on filters



Source: author elaboration.

The second filter is the removal of the entries that have the information on the state as "Not Specified" as it does not provide the information on the choice, required for the model. Another filter is that for the study is considered only the investments labeled as "NEW" in the "Project Type" column. So is only considered the new investments made, excluding the expansion project for an MNE already established in Brazil and co-location projects. This restriction on new investment guarantees that the dataset reflects the entries of MNEs, so the model can effectively capture the effect of determinants in this choice. The number of entries on the original dataset and excluded in each filter is presented in Figure 14.

6.1.2. Independent variables

The independent variables represent the determinants found in literature in their diverse aspects, the choice of the variables must be restricted for each one to be representative in the model and because of the availability of data. Furthermore, as part of the previous literature referenced in chapter 3 is represented by studies of diverse nations, in this model we cannot consider some variables that represent nationwide determinants, for instance, macroeconomic variables such as inflation or exchange should not be considered as it would represent the same value for every state and would not be representative for this model of choice.

The first set of variables for the model are the market size and growth. Represented by the real GDP per capita, population, and the GDP growth for each federation unit.

For the *GDP,* the data was extracted from the data generated by the IBGE (Brazilian Institute of Geography and Statistics) in its 2018's report of social and economic indicators for municipalities, the Gross Domestic Product of Municipalities 2018 (IBGE, 2020d). Using the IBGE's system called SIDRA was possible to extract the data from 2003 to 2018 consolidated by each of the 27 federation units, regarding the nominal GDP in Brazilian Reais. From the same report of IBGE, is extracted the GDP implicit deflator, it is used to obtain the GDP in real terms for each Brazilian state, using 2010 as the reference year (IBGE, 2020d).

The second variable is the *population* that was extracted from IBGE's databases which are generated by the institute. The population per federation unit was reported on the Continuous National Household Sample Survey - Quarterly Release (Pesquisa Nacional por Amostra de Domicílios Contínua - Divulgação Trimestral), which contain data on the population for each state from 2002 to 2019 (IBGE, 2020b).

Using the data on *GDP* and *population* the variable *GDP per capita* was obtained simply by dividing the values of GDP by the population for each federation unit. Also, for obtaining the *GDP growth* was calculated the yearly growth for the GDP per capita values, as the series star from 2002 this variable is calculated for 2003 to 2018.

The following aspect to be considered in the analysis is the quality of human capital evaluated by the education, according to the empirical literature the *illiteracy rate* can be used as a proxy for the estimation of levels of education in the region, and it is expected to be negative related to FDI. Hence, the data on illiteracy in Brazil, at a federation unit level, was provided until 2014 by the Institute for Applied Economic Research (Ipea), a Brazilian public institute that provides technical support to the federal government regarding public policies (Ipea, 2016).

For that, the data for the period of 2003 to 2014 was extracted from their portal, Ipeadata, regarding the illiteracy rate for individuals aged 15 or above. The series for that variable is restarted with the release for the data from 2016 to 2019, now with data generated by the IBGE and published in the National Survey by Annual Continuous Household Sample (PNADC/A) (IBGE, 2020a). As the series of data have an interruption for the year 2015, the data for this year will be interpolated using the data from the previous and following years.

Regarding the costs of labor, the literature gives a very important position to the *wages* as a measure for those costs. So, the independent variable, in this case, will be the average monthly wages per capita measure in Brazilian Reais (BRL). The data is provided by the IBGE, in the National Survey by Household Sample Quarterly Continuous (PNADC/T) and the data is labeled as the "average real income from all jobs, usually earned per month, by people aged 14 or over, employed in the reference week, with work income (BRL)" the data extracted from 2003 to 2018 (IBGE, 2020b).

Also referring to the human capital aspects, the *unemployment rate* is appointed to be relevant for the location of the investments by the literature. But in this case, the studies do not get the same results, finding either negative or positive relationships to FDI, depending on the situation. The source of data for this independent variable is the same as the *average wage* the PNADC/T (IBGE, 2020b).

The dataset represents the *unemployment rate* as the percentage of people that look for an occupation but do not find any among those in the market including individuals aged 10 or above, from 2003 to 2014. The series reported by the IBGE suffered a change in 2015 from this year the data represented individuals aged 14 or above. Furthermore, in the same year, the institute changed the concept of underutilization of the workforce, including the criterion of insufficiency in working hours. Those changes required adaptations to the *unemployment rate* (made by the IBGE) from 2015 to 2018 (IBGE, 2020b).

Among the determinants for the costs for a company in a location, the contribution of the taxes is relevant. To evaluate this criterion the proxy to be used is the *tax burden as a percentage of gross value-added* for each federation unit. For this purpose, the data was extracted from the IBGE's database, from the publication Gross Domestic Product of Municipalities 2018 (IBGE, 2020d). In order to generate the ratio purposed data on the total volume of taxes per federal unit was extracted as the taxes, excluding subsidies, on products at current prices, this way the effect of a subsidy is considered on the dataset. And for the denominator of the ratio was used the gross value added at current prices for all the industries for each federal unit from the same report (IBGE, 2020d).

Following the determinants of the cost is possible to derive the effects of *infrastructure* on the transportation costs. For this purpose, for each federation unit, the proxy for this variable is the kilometers of roads extracted from the research of the Brazilian

National Confederation of Transport (CNT), reported in the Transport 2020 CNT's Yearbook (CNT, 2020). The series extracted from the yearbook contains data on a federation unit level from 2002 to 2017, for this reason, the data for 2018 is estimated based on the total kilometers of roads from Brazil in 2018.

Finally, regarding the *natural resources*, literature diverges about the effects, but it is relevant for the location of investments given the immobility of the resources. To estimate the natural resources the variable of interest is the *total rents of oil, gas, and minerals as a percentage of GDP* for each federation unit.

For the Oil and Gas estimations data was collected from the Brazilian National Agency for Oil, Natural Gas, and Biofuels (ANP), released on the ANP 2020 Statistical Yearbook (tables 2.9 for oil and 2.13 for natural gas) (ANP, 2020). For those resources, the data available is the total production in squared meters in the year for each federation unit in the period from 2003 to 2019, for petroleum (World Bank, 2020d) and natural gas (World Bank, 2020c). To get to the value as a percentage of GDP the values must be expressed in BRL. For that, data from the World Bank gives the rents of oil and gas as a percentage of GDP for Brazil as a whole of all the years of interest. With this information is possible to multiply by the total GDP of Brazil and get the total value of the production of oil and natural gas of Brazil. Finally, using the production figures in volume, the value of the production of oil and natural gas is determined for each federation unit by distributing proportionally the total value of production in Brazil based on the production volume of each Brazilian state.

Analogously, the World Bank provides data for mineral resources as a percentage of GDP for Brazil, including bauxite, copper, gold, iron, lead, nickel, phosphate, tin, and zinc. And to approximate the volume of these mineral substances production of each state is used the total taxes paid in the revenue from the commercialization (World Bank, 2020b). The

Brazilian National Mining Agency (ANM) provides data regarding the tax revenue for the named Financial Compensation for the Exploration of Mineral Resources (CFEM) for each mineral substance and each federation unit (ANM, 2020). Hence, with this information is estimated the total production of minerals for each state, which is used to distribute the total rents from Brazil proportionally.

Finally, with the total rents in BRL for oil, gas, and minerals for each federation unit, the sum of these rents can be divided by the GDP of the state (IBGE, 2020d) to get the *natural resources rents as a percentage of GDP* for each state.

Table 3 – Explanatory variables indicators description and model variable

Dimension	**Proxy**	**Model Variable**
Market Size	GDP per capita in BRL of the FU (real)	gdp_cap
	Population in the FU	population
	GDP per capita real growth (%) of the FU	gdp_growth
Human Capital	Illiteracy rate: % of illiterate individuals aged 15 or above in the FU	illiteracy
	Unemployment: % of people that look for an occupation but do not find aged 10 (or 14) above in the FU	unemployment
Cost of Labor	Average monthly wage per individual in the FU (BRL)	wage
Tax Burden	Tax as a percentage of gross value-added in the FU	tax_burden
Infrastructure	Road network size in km of the FU	infrastructure
Natural Resources	Oil, natural gas, and mineral rents as % of GDP of the FU	nat_resources

Source: author elaboration

Table 3 summarizes all the explanatory variables that will be considered in the model, as the independent variables. Those variables explain six dimensions considered by the empirical literature to affect the FDI inflows.

6.1.3. Dataset structure

The final dataset is composed of two tables, one representing investments made, regarding dependent variable and its characteristics. The second table contains the information on the independent variables and the states and years of the data.

The table containing the information on the investments is composed of the ID of the investment, the destination state, the year of the investment, and the industry activity of the company.

The investment ID is a unique value associated with each of the entries of the database of investments. This variable is required for the model that will be used to reference the choice made by each investor.

The destination state will be used as a key to join the investments table with the independent variables table. Also, as the model requires information on the decisions not made, we need to include a row for every state and mark if it is the choice. For that, first is made a treatment on *Excel* where, for each row of the database, is added a column for each state and assigned the value of one if it is the state of the choice or zero otherwise.

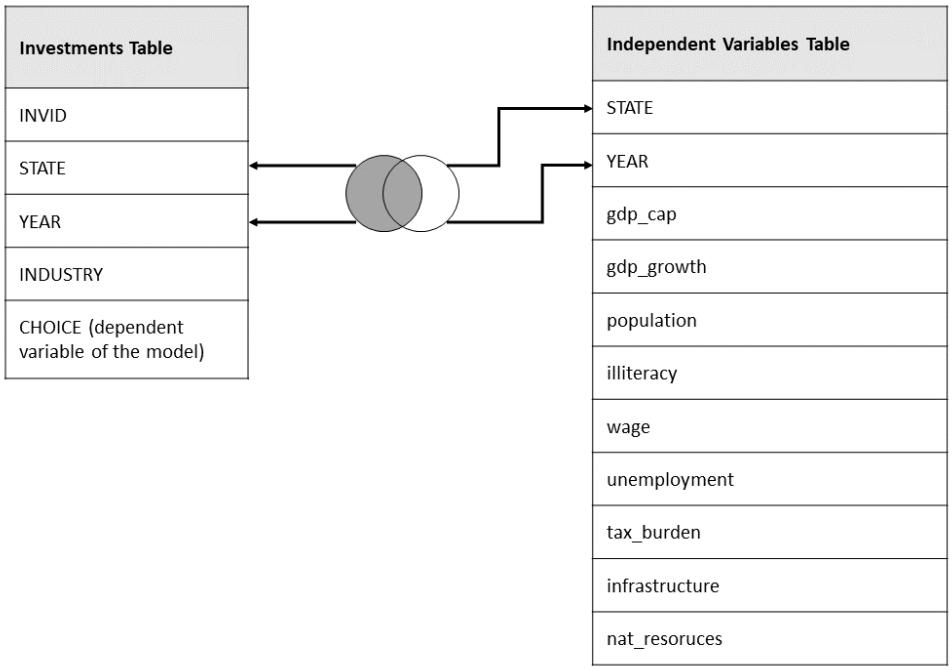
After that, the data is treated on *R*. Applying the function *gather*, from the package *tidyr*, that transposes the states columns to a single column by creating a line for each state for each investment ID, multiplying the number of rows by the number of states considered. This column is named *CHOICE* and is the dependent variable of the model.

The table with the information on the independent variables has columns containing the following information: year, state, GDP per capita (*gdp_cap*), population (*population*), GDP growth (*gdp_growth*), illiteracy rate (*illiteracy*), unemployment rate (*unemployment*), monthly wage (*wage*), tax burden as a percent of GDP (*tax_burden*), infrastructure (*infrastructure*), and natural resources rents as a percentage of the GDP

(*nat_resources*). The data on this table is standardized, i.e., rescaling of the data to have a mean of 0 and unit variance, which is made on *R* using the function *scale* that is native from the language. This process facilitates the visualization of the results, as the coefficients of the independent variables will have the same scale.

Finally, when both tables are treated, they are joined in a single table to be used in the model. Hence, is made a left outer join from the investments table to the independent variables' table using the year and the state as the reference fields, for this the *left_join* function of the package *dplyr* is employed. The Figure 15 illustrates the data model and the fields that are used in the join.

Figure 15 – Data structure



Source: author elaboration.

Hence, the final dataset is composed of the following columns: investment ID, state, year, industry activity, choice, GDP per capita, GDP growth, population, illiteracy rate, monthly wages, unemployment, tax burden, infrastructure, and natural resources. With 2999

investments and 80973 rows, given that each choice has 27 available options among the federation units.

6.2. Descriptive analysis

The distribution of FDI inflows across Brazilian federation units is significantly uneven. Among the greenfield new projects made from 2003 to 2018, the 2999 entries of the database, the state of São Paulo represents 54% of the number of investments with 1624 projects. The second most representative state is Rio de Janeiro with approximately 15% (447 projects), followed by Minas Gerais, Parana, and the Rio Grande do Sul, those five states account for 81.4% in the number of inflows in Brazil. On the other hand, the bottom five states are Roraima, with 1 project, Acre, and Sergipe, with 2 each, Rondonia with 3, and Amapa with 4 projects. In Appendix A, the information on all the federation units is provided.

Table 4 includes the descriptive statistics for the dependent and independent variables for the period of 2003 to 2018. The information on the tables shows that the discrepancy among the federation units is highly significant. Regarding the GDP per capita, the Federal District had the highest value with 56,252 BRL per capita in 2018, as Piaui had 4,791 BRL in 2003. Furthermore, the GDP growth average value is slightly above 3% with a standard deviation of 5.2%.

Regarding the population figures, the state of São Paulo has the higher value of the series with almost 46 million in 2018, while Roraima had 357 thousand population in 2003. The high variation in this figure across the states is given by a standard deviation of more than 8 million. For the illiteracy rate, the states of the Northeast region have the higher rates where the Southeast and the Federal District have the lower rates. The monthly wages higher values in the Southeast, while the lower values are from the north and Northeast regions, but the

highest value is found in the Federal District with 3987 BRL/month in 2018. Regarding the unemployment rates, the higher values are concentrated in the North region and the lower in the South region.

Table 4 – Descriptive statistics of the variables – period 2003 to 2018 (aggregated by year and federation unit)

Variables	Unit	Average	Standard Deviation	Minimum	Maximum
Number of FDI projects	-	6.94	21.61	-	211
GDP per capita	BRL	16,220.82	9,111.14	4,791.90	56,252.90
GDP growth	%	3.21%	5.21%	-16.07%	23.67%
Population	-	7,180,680	8,443,252	357,302	45,538,936
Illiteracy rate	%	11.37%	6.50%	2.40%	30.41%
Monthly wage	BRL	1,041.97	593.84	314.28	3,967.00
Unemployment rate	%	9.24%	2.90%	3.13%	19.60%
Tax burden	%	14.05%	3.76%	6.49%	26.53%
Infrastructure	km	63,901	65,197	1,457	280,355
Natural resources rents as % of GDP	%	2.60%	4.39%	0.00%	26.58%

Source: author elaboration.

The tax, as a percentage of the gross value added of the federation unit, have lower values in the North and the Center-West regions, and the higher values are concentrated in the Southeast with the highest values in Rio de Janeiro. The infrastructure, measured by the kilometers of road, has the highest value in Minas Gerais, and the lowest in the Federal District. This variable, given the size of the states, is higher for the states in the Southeast and South regions, and lower for the North.

Finally, for the natural resources rents as a percentage of GDP, we have relatively high values in Para, Rio de Janeiro, Espirito Santo, and Minas Gerais, while the other states show relatively low values of the ratio. Regarding oil and natural gas, the state of Rio de Janeiro

has the higher production in Brazil for both resources. For minerals, the production of Para, and Minas Gerais account for almost 86% of the total production in Brazil.

As consideration for the analysis and the development of the econometric model, the states with the number of FDI projects in the period of analysis lower or equal to 7, the 1st quartile, will be removed from the database, as they may have a negative impact on the model results. Hence, the states of Acre, Amapa, Paraiba, Piaui, Roraima, Rondonia, Sergipe, and the Tocantins will be removed from the dataset, all these states account for 32 FDI projects from 2003 to 2018.

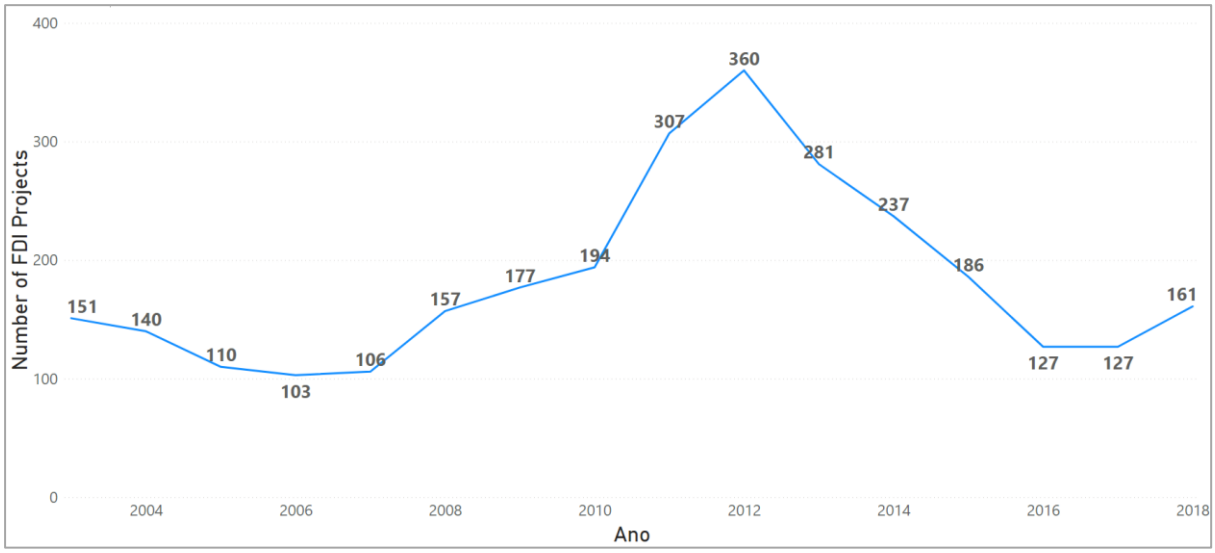
Furthermore, the Federal District will also be removed from the dataset, as the peculiarities of this Federation Unit, in terms of size and wealth are not comparable with the other states in Brazil. A first test for the model was made considering the Federal District and not. The model with the Federal District has a lower likelihood ratio test value, and the variable GDP per capita represented a negative and not significant coefficient. On the other model, the likelihood ratio had better values and a positive and significant relationship with the GDP per capita, as will be detailed in the next section. Therefore, the Federal District will also be removed from the database, accounting for 43 projects in the period of 2003 to 2018. So, the final dataset is composed of 2924 entries, removing the 76 observations from 2999 described in Figure 14.

6.2.1. Analysis of the FDI database

On the dataset considering the 2924 investment decisions is important to highlight that companies from different sectors may give more or less importance to some determinants. Hence, it is relevant to understand how the investments are distributed across the sectors, also this number of investments is relevant to understand for which sectors is possible to apply the

model and obtain statistically significant results. Furthermore, the distribution of the investments over time may play an important role in the determinants, but as Figure 16 is notable that the number of investments is not concentrated in some years. The first fact that is noticeable is a boom in the number of FDI in the early 2010s, that number came back to levels of the early 2000s in 2016, which can be related to the economic and political crisis in Brazil.

Figure 16 – Number of FDI over the period of analysis (2003 – 2018)

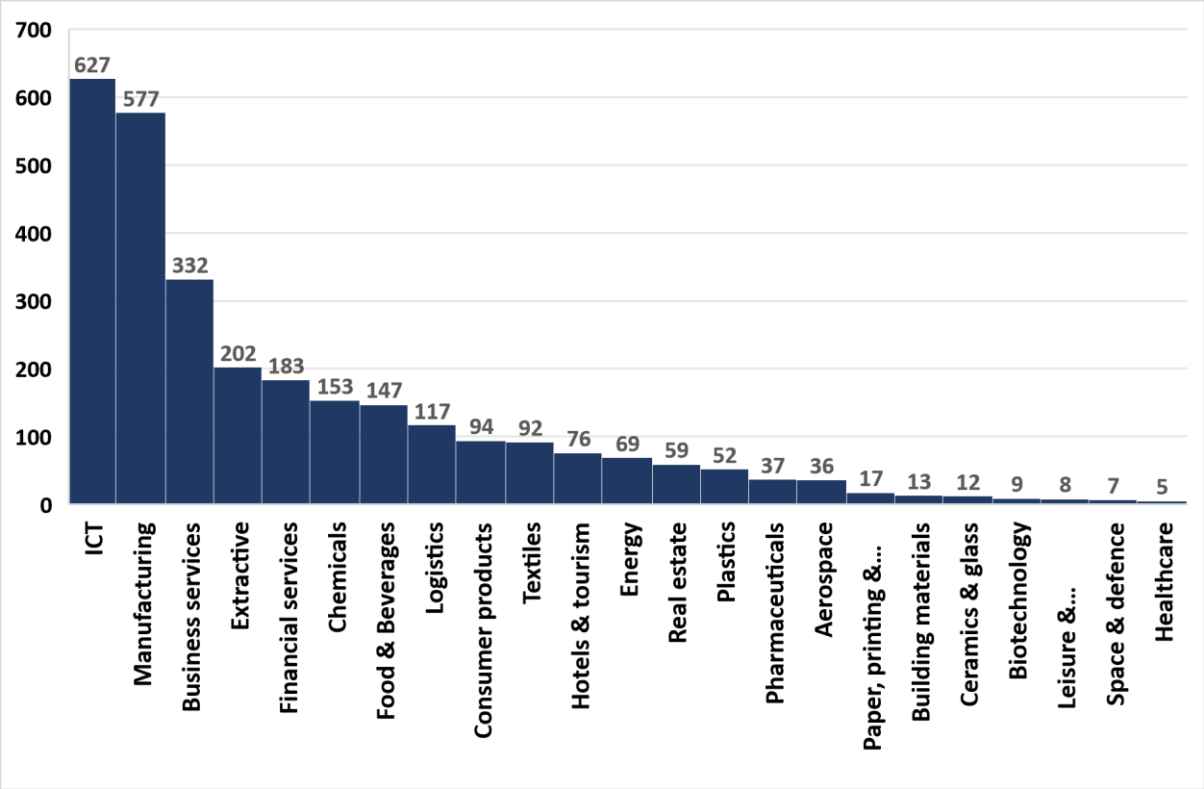


Source: (fDi Markets, 2020).

Looking into the industry sector of the investing companies, as shown in

Figure 17. There is a high number of investments in the Information and Communication Technologies (ICT) and Manufacturing sectors, accounting for 1239 investments, which represents 42% of the investments in the dataset. Other relevant sectors are business services, the extractive industry, and financial services, accounting for 25% of the projects. The business and financial services sector have investments highly concentrated in the Southeast region with some investments in the South region as well. The extractive industry has project mainly in the southeast (Rio de Janeiro and Minas Gerais), and have a significant number of investments in Para, that can be explained due to the presence of natural resources on those states.

Figure 17 – Number of FDI projects per industry sector



Source: (fDi Markets, 2020).

All the other sectors account for 952 investment projects, approximately 32% of the database, the chemicals, food and beverages, and logistics sectors are still representative with more than a hundred investments to each. Hence, for those sectors will not be possible to run the regression model, as the level of statistical significance for the results would not be satisfactory for the interpretation of the results.

6.2.2. Independent variables correlation analysis

To assess the correlation among the independent variables is constructed the correlation matrix, as in Figure 18. The matrix is constructed using the statistical freeware R, for that is used the function *cor*, native from the language, and the function *corrplot* from the package with the same name.

Figure 18 – Correlation matrix for the independent variables

	gdp_cap	gdp_growth	population	illiteracy	wage	unemployment	tax_burden	infrastructure	nat_resouces
gdp_cap	1.00	-0.04	0.46	-0.86	0.58	-0.38	0.55	0.30	0.05
gdp_growth	-0.04	1.00	-0.07	0.06	-0.29	-0.20	0.05	0.06	0.10
population	0.46	-0.07	1.00	-0.33	0.28	0.09	0.32	0.67	-0.03
illiteracy	-0.86	0.06	-0.33	1.00	-0.63	0.31	-0.48	-0.35	-0.09
wage	0.58	-0.29	0.28	-0.63	1.00	0.01	0.12	0.21	-0.08
unemployment	-0.38	-0.20	0.09	0.31	0.01	1.00	0.03	-0.23	0.12
tax_burden	0.55	0.05	0.32	-0.48	0.12	0.03	1.00	0.12	-0.04
infrastructure	0.30	0.06	0.67	-0.35	0.21	-0.23	0.12	1.00	-0.21
nat_resouces	0.05	0.10	-0.03	-0.09	-0.08	0.12	-0.04	-0.21	1.00

Source: author elaboration.

From it is possible to derive that the GDP per capita is negative correlated with the illiteracy rate, and it is the more significant correlation observed. Also, the illiteracy rate is negative correlated with the average monthly wages, which is reasonable to derive as the higher educated workforce tends to have higher wages. The wages are also positively related to the GDP per capita, and in a lower level with the population, and negatively with the GDP growth. The unemployment rate is positively related to illiteracy and negatively to GDP per capita. Furthermore, the tax burden is positively correlated with the GDP per capita and negative with illiteracy. And the infrastructure is positively related to the population, and in a lower level with the GDP per capita.

6.3. Results

The final database contains 52632 entries regarding a total number of events equal to the 2924 greenfield inward FDI projects considered. The number of entries considers the set of choices that the investor face, hence, for each investment decision 18 entries are considered, one for each Brazilian state considered.

Using that, the model is estimated using the statistical freeware *R*, with its 4.1.0 version. For the development of the model, is used the package *survival*, which contains the function *clogit*, used to generate the conditional logistic regression. The Fixed Effects model relaxes the assumption of independence between the independent variables and the residuals from the Random Effects model, allowing the distribution of residuals to depend on the independent variables (Gardiner et al., 2009). The code used to generate the model and to treat the data is on Appendix B.

The model was tested for all the nine explanatory variables, each independent variable was removed at a time to check if the specified variable is relevant to the explanation of the variations of the dependent variable. The best model, classified using the likelihood ratio test, was the model considering all the nine explanatory variables.

In the following sections, the results obtained with the models are described. First is shown the model results for the period from 2003 to 2018, then the results from the period of 2003 to 2010 are compared with results from the period of 2011 to 2018. In addition, the model is constructed for the main sectors, to understand how the determinant change for each type of company.

Considering the whole period of analysis, the model indicates a significant relationship between the dependent variable and GDP per capita, population, and natural resources with a significance on less than 0.1% level. The illiteracy rate and infrastructure were

significant at a 5% level. The unemployment rate and the tax burden were significant at a 10% level. And the GDP growth, and wage were not significant on the usually considered statistical levels. The coefficients are detailed in Table 5.

Table 5 – Model results considering the period of 2003 to 2018

n	52632					
number of events	2924					
Likelihood ratio test	6711	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.33704	1.40079	0.09489	3.552	0.00038	***
gdp_growth	-0.02321	0.97705	0.03235	-0.718	0.47300	
population	0.71973	2.05388	0.04681	15.374	<2.0E-16	***
illiteracy	-0.2097	0.81083	0.08847	-2.37	0.01778	*
wage	-0.02799	0.9724	0.09299	-0.301	0.76342	
unemployment	0.10415	1.10977	0.05572	1.869	0.06158	.
tax_burden	0.07222	1.07489	0.0431	1.675	0.09384	.
infrastructure	-0.11808	0.88862	0.04587	-2.574	0.01004	*
nat_resouces	1.89623	6.66075	0.61875	3.065	0.00218	**
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

Source: author elaboration.

As expected, and in line with the empirical literature the market size variables of GDP per capita and population were significant and positively related to the number of FDI projects. Conversely, the GDP growth is found to not be significant in the explanation of FDI and negative related to it. In the examination of the database for the model, is found that the states with the higher growth in the GDP do not have significant numbers of FDI projects, that is the case for the state of Mato Grosso that represent high levels of GDP growth, but is not representative in the number of FDI.

The coefficient for the illiteracy rate is negative and significant, which corroborates the results found in previous literature. The result indicates that the level of education of the workforce is a significant factor in attracting foreign companies to the location. Also, the variable related to the labor costs, the monthly wages, represented a negative and not significant

relationship. The result is in line with the findings of Sun et al. (2002) for FDI across China provinces but is contrary to the result of Krifa-Schneider and Matei (2010), indicating that foreign investors in Brazil take into consideration not only the quality of the workforce but also the costs are relevant to that decision in some extent.

The unemployment shows a positive (significant at 10% level) result for the explanation of FDI. This variable had an inconclusive impact based on the previous literature. The result from the model goes in line with the assumption of Billington (1999) that foreign companies may be interested in the availability of workforce in the home country. Furthermore, the result obtained can be explained by the relation between the wages and the unemployment, as the greater is the unemployment, the higher is the pressure to lower wages, which in turn were related negatively (with no statistical significance) with the number of FDI (Blanchard, 2017).

The tax burden as a percentage of gross value added does not reflect a strong relationship with FDI, but its positive result goes in line with the analysis of the data, in which the tax burden is shown to be higher in the regions with the higher FDI. Based on the previous literature this result was not expected, as most of the studies found a positive relationship between tax exemption and foreign investment. But that result can indicate that the tax benefits in Brazil do not strongly influence the decision over the location of FDI.

The infrastructure was found as a relevant in 5% level in explaining the FDI projects, going in the opposite direction on the findings of the empirical literature. Looking at the data representing this variable and comparing it with the number of FDI projects is possible to derive that the variation of the infrastructure across the states is smaller compared to the disparity in the quantity of FDI projects, hence, the negative value in the model represents this

difference on the variations. Also, this could be explained by the sectoral distribution among the database, as the infrastructure may be less relevant to those companies' decisions.

For the natural resources rents as a percentage of GDP, the model indicates a strong positive relationship, at a 0.1% significance level. The result is expected based on the analysis of the data and with the literature. The positive relationship can be explained by the fact that the states of Rio de Janeiro and Minas Gerais, which have high participation in natural resources on their market, also have high numbers of inflows in the period, being the second and third with a greater number of investments, just behind São Paulo. But also, the previous literature found significant relationships of natural resources and foreign investment in Latin America as a whole, and the state of Para that accounts for almost half of the mineral production in Brazil, received a high amount of investments in comparison with the states from the North region, and checking the database the majority of them are from the extractive industry.

6.3.1. Evaluation of different periods

To assess the shifts in the determinants over time, the model was applied to the database split into two periods. The results are described in Table 6 and Table 7. The first period is 2003 to 2010, containing 1138 investment decisions for a database of 20484 entries regarding all the available choices. The second period is from 2011 to 2018, with 1786 investment projects and a database of 32148 observations.

The results for the first period identify statistical significance, at least at a 10% level, for the population, natural resources, tax burden, and illiteracy rate. The choice variable responded positively to the population, and the natural resources, but negatively to the illiteracy and infrastructure. Furthermore, the relationship of the investment decisions with the GDP per

capita, wages, and unemployment was positive but not statistically significant. And the relationship between infrastructure and GDP growth is negative but also not significant.

Table 6 – Model results considering the period of 2003 to 2010

n	20484					
number of events	1138					
Likelihood ratio test	2277	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.11097	1.11736	0.22452	0.494	0.62114	
gdp_growth	-0.01726	0.98288	0.03851	-0.448	0.65396	
population	0.70641	2.02671	0.08819	8.01	1.15E-15	***
illiteracy	-0.21193	0.80902	0.1242	-1.706	0.08794	.
wage	0.1785	1.19542	0.37867	0.471	0.63736	
unemployment	0.07222	1.07489	0.09654	0.748	0.45443	
tax_burden	0.16209	1.17597	0.07495	2.163	0.03056	*
infrastructure	-0.04188	0.95898	0.07545	-0.555	0.57884	
nat_resouces	2.56401	12.98783	0.9013	2.845	0.00444	**
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

Source: author elaboration.

The model results for the second period indicate that the choice of the FDI location is positively related to the GDP per capita, population, and unemployment rate, at a statistical significance level of at least 5%. While its negatively affected by illiteracy and wages, and with no statistical significance with the GDP growth, tax burden, and natural resources.

Table 7 – Model results considering the period of 2011 to 2018

n	32148					
number of events	1786					
Likelihood ratio test	4467	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.556351	1.744296	0.12731	4.37	0.0000124	***
gdp_growth	-0.009047	0.990994	0.055306	-0.164	0.870061	
population	0.703613	2.021042	0.062042	11.341	<2E-16	***
illiteracy	-0.442788	0.642243	0.148154	-2.989	0.002802	**
wage	-0.274998	0.759574	0.111485	-2.467	0.013638	*
unemployment	0.297659	1.346702	0.080983	3.676	0.000237	***
tax_burden	-0.079903	0.923205	0.062955	-1.269	0.204366	
infrastructure	-0.155123	0.85631	0.064042	-2.422	0.015426	*
nat_resouces	-0.103542	0.901638	0.934643	-0.111	0.911789	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1						

Source: author elaboration.

The main differences from the results from the two periods are the change of the sign for the wages, from positive in the first period to negative in the second one, and the increase in statistical significance for this variable. And the change in the sign of the natural resources, also from positive to negative, in the second period with no relevant significance on the coefficient obtained. The change in the wages reflect the higher importance that the investors may be paying to the wages levels, but as the elasticity over wages, levels depend on the sector of investing company the results of the next sections help to understand the effect of the wages across the sectors that compose the database. For the natural resources, a possible cause for the reduced importance is the decrease in the price levels of natural resources compared to the GDP of the countries, as the data from the World Bank the natural resources represented 4.8% of the world's GDP in 2011 but this number fell to 2.4% in 2018. Hence, this reduction indicates a decrease in relative prices of natural resources reducing the FDI in the extractive industry (World Bank, 2020e).

6.3.2. Information and Communication Technology industry

To examine how the importance of the determinants changes depending on the sector of the investing country the model was tested filtering for the more representative sectors, in terms of the number of FDI. The sector with the highest number of investments over the period from 2003 to 2018 in Information and Communication Technology (ICT) with 627 investments choices, hence, the regression shows results with the desired levels of statistical significance.

The results obtained, shown in Table 8, indicate that the investments of this industry activity are positively impacted by the population and the unemployment, and negatively by illiteracy. With no statistical significance, the GDP per capita and wages exhibited a positive relation, and GDP growth, tax burden, infrastructure, and natural resources a negative impact. The main differences from the complete model are that GDP per capita, tax burden, infrastructure, and natural resources are no longer relevant to the explanation of the investments in this sector. As well as the change in the sign for the wages, tax burden, and natural resources (from positive to negative).

Table 8 – Model results for the ICT industry FDI (2003 to 2018)

n	11286					
number of events	627					
Likelihood ratio test	2013	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.27718	1.3194	0.26674	1.039	0.29874	
gdp_growth	-0.06508	0.937	0.08661	-0.751	0.45245	
population	0.72599	2.06677	0.13566	5.352	8.72E-08	***
illiteracy	-0.75165	0.47159	0.28517	-2.636	0.00839	**
wage	0.26932	1.30908	0.25119	1.072	0.28364	
unemployment	0.46666	1.59466	0.1636	2.852	0.00434	**
tax_burden	-0.0226	0.97766	0.1193	-0.189	0.84978	
infrastructure	-0.12303	0.88424	0.1298	-0.948	0.3432	
nat_resouces	-1.53026	0.21648	1.69407	-0.903	0.36636	
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

Source: author elaboration.

These results indicate that the companies in this sector value the quality of the workforce, in a stronger manner than other sectors, as can be indicated by the illiteracy significance and the change in the signal of the wages variables. Also, they do not necessarily get a high influence of the market size, as the services provided do not require a physical location, with companies such as IBM, and Google. Hence, the GDP per capita does not play an important role in explaining the investments.

6.3.3. Manufacturing industry

The second most relevant sector in the number of FDI in Brazil is the manufacturing industry. This section of the database is composed of 577 investments, from different types of manufacturers, such as automotive components and OEM, electronic components, engines, industrial equipment, and medical devices.

The results, shown in Table 9Table 9, indicate that population, unemployment, and the tax burden have a positive effect in the explanation of the choice of FDI location, with a statistical significance in a 10% level at least. On the other hand, illiteracy and wages levels have a negative effect. The variables not found to be representative in the explanation are GDP per capita, GDP growth, infrastructure, and natural resources.

Table 9 – Model results for the manufacturing industry FDI (2003 to 2018)

n	10386					
number of events	577					
Likelihood ratio test	1179	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.02982	1.03027	0.21379	0.139	0.8891	
gdp_growth	-0.10022	0.90464	0.06914	-1.45	0.1472	
population	0.64878	1.9132	0.10325	6.284	3.31E-10	***
illiteracy	-0.89068	0.41038	0.20745	-4.294	1.75838E-05	***
wage	-0.37268	0.68889	0.20446	-1.823	0.0683	.
unemployment	0.22862	1.25687	0.12392	1.845	0.065	.
tax_burden	0.17993	1.19714	0.09464	1.901	0.0573	.
infrastructure	-0.07339	0.92924	0.09675	-0.759	0.4481	
nat_resouces	-0.14469	0.86529	1.36478	-0.106	0.9156	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1						

Source: author elaboration.

Comparing those results with the ones of the ICT sector, the wages represent a change in the signal and become relevant statistically, and the tax burden is statistically significant at a 10% level. The results show that the workforce quality is a highly important factor for the companies in this sector, but those differences show that those companies are willing to pay lower wages, reducing its costs of labor, but still require good education level, shown by the negative relationship with illiteracy rate. Furthermore, the positive and significant relationship with the tax burden is counterintuitive at first glance, but it can show that the benefits of lower taxes do not compensate other factors that are relevant in the choice, as this variable is positively correlated to the population and negative with the illiteracy for instance.

6.3.4. Business services industry

For the business services sector, 332 greenfield investments were made from 2003 to 2018, being the third most representative industry. These investments represent the

companies that generally offer intangible services to other companies, such as marketing solutions, consultancy services, accountancy services, and legal services.

The results (as in Table 10Table 10) show a positive and significant relationship of the choice of location to the GDP per capita and the population, at a 1% statistical significance level at least. And negative relation to illiteracy and tax burden, at least with 5% level. The not statistically significant results were found for GDP growth, wages, unemployment, and infrastructure with negative signal, and natural resources with a positive signal.

Table 10 – Model results for the business services industry FDI (2003 to 2018)

n	5976					
number of events	332					
Likelihood ratio test	1188	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	1.10875	3.03057	0.39622	2.798	0.00514	**
gdp_growth	-0.06602	0.93611	0.14591	-0.452	0.65094	
population	0.95161	2.58988	0.20176	4.716	0.0000024	***
illiteracy	-1.15898	0.31381	0.63862	-1.815	0.06955	.
wage	-0.44292	0.64216	0.42459	-1.043	0.29686	
unemployment	-0.02806	0.97233	0.29141	-0.096	0.92328	
tax_burden	-0.61247	0.54201	0.20764	-2.95	0.00318	**
infrastructure	-0.30256	0.73892	0.21156	-1.43	0.15267	
nat_resouces	3.566	35.37478	2.88023	1.238	0.21568	
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

Source: author elaboration.

The positive relationship with the GDP per capita and the population indicates the relevance that the market size has to the companies in this sector. As this sector provides services to other businesses the location with the bigger market can represent the greater potential of profits for the company, being a strong determinant for the location. Furthermore, the labor quality shows high importance for the location as illiteracy is a factor that is negatively related to the number of inflows. The more significant particularity of this sector is the relationship with the tax burden, all the previous models showed a positive coefficient of this

variable, but negative in this case. This is indicative of the sensitivity of the investment to the taxes, the results are in line with the study of Stöwhase (2005) found that the response of the tertiary sector to the taxation is substantially higher than in the other sectors.

6.3.5. Extractive industry

The sector with the fourth largest number of FDI for the period studied is the extractive industry. The database for this sector includes companies that works with the extraction and processing coal, gas, oil, metallic and non-metallic minerals, rubber, and wood. The sector accounts for 202 investment projects (with 3636 entries on the database), and it is the last sector that will be evaluated as the number of investments become unable to provide statistically significative results to be analyzed.

Table 11 – Model results for the extractive industry FDI (2003 to 2018)

n	3636					
number of events	202					
Likelihood ratio test	214.1	on 9 df	p=<2e-16			
CHOICE	coef	exp(coef)	se(coef)	z	Pr(>|z|)	
gdp_cap	0.03946	1.04025	0.29909	0.132	0.895	
gdp_growth	0.05774	1.05944	0.08978	0.643	0.5201	
population	0.40527	1.4997	0.13296	3.048	0.0023	**
illiteracy	-0.08569	0.91788	0.22792	-0.376	0.707	
wage	0.57563	1.77825	0.40135	1.434	0.1515	
unemployment	0.10657	1.11245	0.16659	0.64	0.5224	
tax_burden	0.11296	1.11958	0.13096	0.862	0.3884	
infrastructure	0.06793	1.07029	0.12735	0.533	0.5937	
nat_resouces	9.45229	12737.26257	1.62204	5.827	5.63E-09	***
Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

Source: author elaboration.

The model for this sector indicates (as the results in Table 11) that the choice of the location of FDI is positive affected by the population and the natural resources presence, with a significance at a 1% level at least. Over the not significative results, GDP per capita, GDP

growth, wages, unemployment rate, tax burden, and infrastructure were all positive related to FDI. And the illiteracy rate was negative related to it.

The natural resources signal was expected as it is the main input for the companies in the sector. And the population positively related to FDI indicates the relevance of the market size. That can be explained by the advantages of the proximity to the markets and its impact on the costs. As lower is the distance to the location of processing of the natural resource extracted, the lower are the transportation costs, which can be significant for some types of resources (Sigam & Garcia, 2012).

Looking at the infrastructure signal, despite its significant only at a 60% level, is possible to assume that the infrastructure is an important factor for the companies in this sector. Also, the exports of natural resources are relevant for Brazil, representing more than 25% of total exports of the country, according to the data provided in the *Comex Stat* online portal (Brazilian Ministry of Economy, 2021). As those exports are transported by sea, the internal infrastructure becomes more relevant, and it is the case for the mineral resources found mainly in the interior of the country.

Finally, on Table 12 the results from the models are summarized, with the coefficients obtained in the conditional logit model, the standard errors observed, and the statistical significance of the variables.

Table 12 – Summary of the models

Model	All the period	From 2003 to 2010	From 2011 to 2018	ICT industry	Manufacturing industry	Business services industry	Extractive industry
gdp_cap	0.337 ***	0.111	0.556 ***	0.277	0.03	1.109 **	0.039
	(0.095)	(0.225)	(0.127)	(0.267)	(0.214)	(0.396)	(0.299)
gdp_growth	-0.023	-0.017	-0.009	-0.065	-0.1	-0.066	0.058
	(0.032)	(0.039)	(0.055)	(0.087)	(0.069)	(0.146)	(0.09)
population	0.72 ***	0.706 ***	0.704 ***	0.726 ***	0.649 ***	0.952 ***	0.405 **
	(0.047)	(0.088)	(0.062)	(0.136)	(0.103)	(0.202)	(0.133)
illiteracy	-0.21 *	-0.212 .	-0.443 **	-0.752 **	-0.891 ***	-1.159 .	-0.086
	(0.088)	(0.124)	(0.148)	(0.285)	(0.207)	(0.639)	(0.228)
wage	-0.028	0.179	-0.275 *	0.269	-0.373 .	-0.443	0.576
	(0.093)	(0.379)	(0.111)	(0.251)	(0.204)	(0.425)	(0.401)
unemployment	0.104 .	0.072	0.298 ***	0.467 **	0.229 .	-0.028	0.107
	(0.056)	(0.097)	(0.081)	(0.164)	(0.124)	(0.291)	(0.167)
tax_burden	0.072 .	0.162 *	-0.08	-0.023	0.18 .	-0.612 **	0.113
	(0.043)	(0.075)	(0.063)	(0.119)	(0.095)	(0.208)	(0.131)
infrastructure	-0.118 *	-0.042	-0.155 *	-0.123	-0.073	-0.303	0.068
	(0.046)	(0.075)	(0.064)	(0.13)	(0.097)	(0.212)	(0.127)
nat_resouces	1.896 **	2.56 **	-0.104	-1.53	-0.145	3.566	9.452 ***
	(0.619)	(0.901)	(0.935)	(1.694)	(1.365)	(2.88)	(1.622)
n	52632	20484	32148	11286	10386	5976	3636
observations	2924	1138	1786	627	577	332	202
Likelihood ratio test (9 d.f.)	6711	2277	4467	2013	1179	1188	214.1
$p > \chi^2(9)$	<2e-16	<2e-16	<2e-16	<2e-16	<2e-16	<2e-16	<2e-16

Note: (1) conditional logit estimates and standard errors in parentheses; (2) Significance codes represent: "***" $p < 0.1\%$, "**" $p < 1\%$, "*" $p < 5\%$, "." $p < 10\%$.

Source: author elaboration.

The conclusions derived from the analysis of the results from the models, that were described in this section, are synthesized in the next chapter.

7. CONCLUSIONS

This work studies the determinants for the location of FDI across Brazilian regions using firm-level data. This analysis highlighted the differences in those determinants for companies from different sectors of the economy. For this purpose, firstly, the definitions and the main economic theories for the FDI were studies and summarized in chapter two of this dissertation. In the sequence, the process of Brazilian industrialization is reviewed, giving a special focus to the role of FDI in the development of the Brazilian industry and the recent trends observed, which were linked to the governmental policies that shaped the environment for foreign investment in the country.

Following the methodology proposed in the introduction, was made a literature review of the econometric model used to assess the relationship of the number of FDI with the explanatory variables. To understand which variables would be relevant for the model, the empirical literature on the determinants for FDI was revised, looking at works studying FDI across countries or states within a country. This research was valuable for the understanding of how the effect of main dimensions, such as market size and education, can be captured with the assignment of the independent variables for the model.

The following chapter looked at the data collected for the model, explaining the sources for the data, the assumptions that were required to conduct the analysis, and the structure of the dataset for the model. Then the exploratory data analysis gave the understanding of the dataset and the details involved, such as the regional distribution of each variable and the relations between them, which helped in the analysis of the outputs given by the application of the model. In the sequence, the model was applied to the dataset and the results were analyzed, leveraging the knowledge from the previous stages.

The results for the whole period of the analysis show that the market size is a relevant factor in the explanation of the number of FDI, with positive and significant results for the GDP per capita and the population. The quality of the workforce in the destination state plays a significant role in the choice of the location, as the illiteracy rate indicated a negative relationship to FDI. The availability of the workforce, measured by the unemployment was also relevant and positive, which can be related to the results for wages that were negative and not significant, showing that this variable can be less relevant in the decision, prioritizing the quality of labor over the costs.

The results for the tax burden and infrastructure were not expected based on previous literature, with a positive and negative signal, respectively. This indicates that the tax benefits may not be relevant for most of the industry sectors, and the importance of the infrastructure may also be different among the sectors. Finally, the results for the presence of the natural resources show that it is relevant to the choice and goes in line with the findings of studies in Latin America.

The results provide evidence that the importance of the determinants of FDI shifts over time. The analysis for the period from 2003 to 2010, in comparison to the period of 2011 to 2018, indicated an increase in the importance of the market size, with the significance of the GDP per capita in the latest period. The importance of the quality of the workforce was stable, but the level of wages became relevant and negative related to FDI. Another shift was the tax burden, which became a negative factor but not significant, but showing that the tax could be a driver for some sectors. And for the natural resources, is identified a negative and not relevant relation in the second period, indicating that the decrease in the relative prices of those goods hindered the foreign investment for the extractive industry.

Looking for the specific sector of the investing companies, the ICT sector results indicate that the quality of the workforce is highly important for those companies. The same is observed for the manufacturing industry, but in this sector the labor costs also play an important role, being negatively related to investment decisions. For the business services sector, the market size was important, as wells as the quality of labor, and the tax burden was negatively and significantly related to FDI, indicating the importance of the taxes in this industry. The only sector for which the natural resources were significant and positively related was the extractive industry, for which the other variables do not represent important relationships, which is reasonable given the characteristics of the sector.

It would be interesting to enhance the results of this study with the enlargement of the database, adding more years to the period of analysis, that seems to be hindered by the structural break given by the Covid-19 pandemic, or to include more variables to the model. In this second part, the inclusion of the agglomeration analysis could give more information to analyze the empirical evidence of the Uppsala model, and the inclusion of more detail to some variables, such as the infrastructure that only includes the roads, which are not equally important among the sectors. Besides that, the enlargement of the investments database could provide better statistical confidence for the sector-specific analyses and give the possibility of assessing the determinants for more sectors.

Finally, the main contributions of the studies on the theme can be divided into two parts. The research itself, over the Brazilian scenario, and mainly the studies over the allocation of FDI within the borders of Brazil. As the literature on the topic is very limited but is important as there is notable heterogeneity among the federation units. And the second contribution is the input for policymaking. Considering that the current work provides preliminary results which indicate the importance of the education levels in a region as a significant determinant for FDI. Which shows that to attract foreign investments to certain location the promotion of the quality

in the workforce should be an important concern of policymakers and that tax benefits may not be adequate to attract FDI depending on the sector of the investing company. So, further studies on the allocation of FDI across Brazilian states would be relevant as the results of the current work provide a preliminary assessment of the determinants of FDI in Brazil.

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APPENDIX A – Number of FDI on the destination states

Destination State	Code	Number of FDI (2003 - 2018)	Percentage of total FDI
Acre	AC	2	0.1%
Alagoas	AL	8	0.3%
Amazonas	AM	59	2.0%
Amapa	AP	4	0.1%
Bahia	BA	89	3.0%
Ceara	CE	40	1.3%
Federal District	DF	43	1.4%
Espirito Santo	ES	24	0.8%
Goias	GO	28	0.9%
Maranhao	MA	13	0.4%
Minas Gerais	MG	142	4.7%
Mato Grosso do Sul	MS	14	0.5%
Mato Grosso	MT	24	0.8%
Para	PA	23	0.8%
Paraiba	PB	7	0.2%
Pernambuco	PE	75	2.5%
Piaui	PI	6	0.2%
Parana	PR	116	3.9%
Rio de Janeiro	RJ	447	14.9%
Rio Grande do Norte	RN	27	0.9%
Rondonia	RO	3	0.1%
Roraima	RR	1	0.0%
Rio Grande do Sul	RS	112	3.7%
Santa Catarina	SC	59	2.0%
Sergipe	SE	2	0.1%
Sao Paulo	SP	1624	54.2%
Tocantins	TO	7	0.2%
Total	-	2999	100.0%

APPENDIX B – R code used in the model

```
library(survival) # conditional logit model function
library(dplyr) # for filters
library(ggplot2) # plotting results
library(readr) # read the csv files
library(tidyr) # manipulation of data from wide to long
library(corrplot) #plot correlation matrix

#Read the file for the independent variable, the choice of the location
inflows_wide <- read_csv("<PATH>/inflows_wide.csv")

# Transforms the format from wide to long using tidyr package
inflows_long <- gather(inflows_wide, STATE, CHOICE, AC:TO, factor_key=TRUE)

# Filter outliers
inflows_long <- inflows_long %>% filter(!CODE %in% c("AC", "AP", "PB", "PI", "RO",
"RR", "SE", "TO", "DF"))

# Read the file for the dependent variables
states <- read_csv("<PATH>/states_data.csv")

# Filter outliers
states <- states %>% filter(!STATE %in% c("AC", "AP", "PB", "PI", "RO", "RR", "SE", "TO",
"DF"))

# Correlation matrix plot

states_values <- subset(states, select = -c(ST_YEAR, STATE, YEAR, gdp_real))
cor_states <- cor(states_values)
corrplot(cor_states, method = "number")

# Standadization of the data
states[4:12] <- as.data.frame(scale(states[4:12]))
```

```
states_normalized <- states

# Join of the tables
data <- left_join(inflows_long, states_normalized, by = c('STATE', 'YEAR'))

model = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data)

# Model: 2011 to 2018
inflows_long_2 <- inflows_long %>% filter(YEAR > 2010)

data_2 <- left_join(inflows_long_2, states_normalized, by = c('STATE', 'YEAR'))

model_2 = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_2)

# Model: 2003 to 2010
inflows_long_1 <- inflows_long %>% filter(YEAR < 2011)

data_1 <- left_join(inflows_long_1, states_normalized, by = c('STATE', 'YEAR'))

model_1 = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_1)

# Model for ICT
inflows_long_ICT <- inflows_long %>% filter(GROUP_SECTOR == "ICT")

data_ICT <- left_join(inflows_long_ICT, states_normalized, by = c('STATE', 'YEAR'))

model_ICT = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_ICT)
```

```
# Model for manufacturing
inflows_long_MAN <- inflows_long %>% filter(GROUP_SECTOR == "Manufacturing")

data_MAN <- left_join(inflows_long_MAN, states_normalized, by = c('STATE', 'YEAR'))

model_MAN = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_MAN)

# Model for Business Services
inflows_long_BS <- inflows_long %>% filter(GROUP_SECTOR == "Business services")

data_BS <- left_join(inflows_long_BS, states_normalized, by = c('STATE', 'YEAR'))

model_BS = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_BS)

# Model for the extractive industry
inflows_long_EI <- inflows_long %>% filter(GROUP_SECTOR == "Extractive")

data_EI <- left_join(inflows_long_EI, states_normalized, by = c('STATE', 'YEAR'))

model_EI = clogit(CHOICE ~ gdp_cap +  gdp_growth + population + illiteracy + wage + unemployment +  tax_burden + infrastructure + nat_resouces +  strata(INVID), data = data_EI)

#Print results
summary(model)
summary(model_1)
summary(model_2)
summary(model_ICT)
summary(model_MAN)
summary(model_BS)
summary(model_EI)
```