

**UNIVERSIDADE FEDERAL DE SÃO CARLOS
CENTRO DE CIÊNCIAS EXATAS E TECNOLOGIA
DEPARTAMENTO DE ENGENHARIA DE PRODUÇÃO
PROGRAMA DE PÓS-GRADUAÇÃO EM ENGENHARIA DE PRODUÇÃO**

**THE IMPACT OF FOREIGN DIRECT INVESTMENT ON REGIONAL
ECONOMY: A BRAZILIAN INVESTIGATION**

ANA CATARINA GANDRA DE CARVALHO

SÃO CARLOS – SP

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ANA CATARINA GANDRA DE CARVALHO

Dissertação de Mestrado apresentado ao
Programa de Pós-Graduação em
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Orientador: Dr. Herick Fernando
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ABSTRACT

Regional Economic research shows that foreign direct investment (FDI) directly impacts the host region's economy. This debate is even more critical in emerging economies, where FDI has significant potential to increase and modernize domestic firms' capabilities. However, the effects of FDI on the regional economy still need to be fully explored, especially in Latin American countries. This study seeks to examine the impacts of FDI on the regional economy in Brazil, one of the largest recipients of foreign investment in Latin America. To this end, this research aims to examine 1) the state of the art of the literature that assesses the impact of FDI on domestic firms through a systematic literature review; 2) the impact of FDI on domestic firms at the regional level in Brazil; 3) the effects of FDI on economic complexity at the regional level. This study employed a unique FDI intensity dataset at the regional level. The results suggest that FDI has the potential to benefit the regional economy by increasing the number of jobs in domestic firms and increasing economic complexity. However, factors such as regional absorptive capacity and the input sector must be considered. FDI entry into regions with low absorption capacity has no positive effect on economic complexity. While FDI into high-tech sectors has a negative impact on job creation in domestic firms. The findings of this study contribute to the literature on the effects of FDI on the regional economy and have important implications for public policies concerning foreign investments. This study can, and must, be used to help the development of FDI related policies in Brazil and other Latin American countries. The use of results like those presented here is critical to directing foreign investment so that host regions can benefit from this type of investment.

Keywords: foreign direct investment (FDI); regional economy; crowd-in; crowd-out; host firms; economic complexity (EC); absorptive capacity; Brazil; systematic literature review (SLR); panel data; econometrics.

RESUMO

As pesquisas na área de economia regional mostram que o Investimento Estrangeiro Direto (IED) tem um impacto direto na economia da região anfitriã. Nas economias emergentes, onde o IED tem o potencial de melhorar e modernizar as capacidades técnicas das firmas nacionais, esse tipo de debate é ainda mais importante. Entretanto, os efeitos do IED na economia regional ainda precisam ser explorados, especialmente em países da América Latina. Esse estudo busca examinar os impactos do IED na economia regional no Brasil, um dos maiores recipientes de investimentos estrangeiros da América Latina. Para tal, essa pesquisa examinará: i) o estado da arte da literatura que analisa o impacto do IED em firmas nacionais por meio de uma revisão sistemática da literatura; ii) o impacto do IED nas firmas nacionais a nível regional no Brasil; iii) o efeito do IED na complexidade econômica a nível regional. Este estudo empregou uma base de dados única, que apresenta a intensidade de IED a nível regional. Os resultados sugerem que o IED tem potencial para beneficiar a economia regional ao aumentar o número de empregos em firmas domésticas e ao aumentar a complexidade econômica. Porém, fatores como a capacidade de absorção regional e o setor de entrada do IED devem ser considerados. A entrada de IED em regiões com baixa capacidade de absorção não impacta positivamente a complexidade econômica. Enquanto a entrada de IED em setores de alta tecnologia tem um impacto negativo na criação de empregos em empresas nacionais. Os achados deste estudo contribuem para a literatura que analisa os efeitos do IED na economia regional, e apresentam implicações importantes para a elaboração de políticas públicas relacionadas a investimentos estrangeiros. Este estudo pode, e deve, ser utilizado para auxiliar o desenvolvimento de políticas relacionadas ao IED no Brasil e em outros países Latino Americanos. Os resultados aqui mostrados são fundamentais para direcionar o investimento estrangeiro de forma que a região hospedeira possa se beneficiar desse tipo de investimento.

Keywords: Investimento Estrangeiro Direto (IED); economia regional; crowd in; crowd out; firmas domésticas; capacidade de absorção; complexidade econômica; Brasil; revisão sistemática da literatura (RSL); dados em painel; econometria.

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SECTION 1. Dissertation Introduction

1.1. OVERVIEW

This section seeks to introduce the topics covered in this master's dissertation. This dissertation's structure is also presented to simplify the reader's comprehension. Additionally, this section will present the importance of FDI in Brazil and the necessity of examining how such investments affect the regional economy.

1.2. FOREIGN DIRECT INVESTMENT AND REGIONAL ECONOMY

Globalization has increased the intensity of capital flows worldwide in recent decades (Adams, 2009; Choi, 2018). Large corporations must expand their operations beyond borders to remain competitive internationally. These conditions were crucial to the expansion of foreign direct investment. Foreign Direct Investment (FDI) is quite a broad concept and can usually be described as the acquisition of a stake in a foreign company or project by a foreign investor, company, or government.

Today, FDI is viewed not only from the perspective of companies but also from the importance of this type of investment in developing the regional economy. Foreign Direct Investment (FDI), according to economists, is a crucial component of economic growth in all nations (Denisia, 2010), but particularly in emergent (Kaulihowa & Adjasi, 2018; Rjou et al., 2016) and transitional ones (Ashurov et al., 2020). In addition, FDI is viewed by many academics as a driver of modernization due to knowledge spillovers (Jude, 2016; Kim, 2015; Morales & Moreno, 2020).

The increase in global FDI inflows has drawn the attention of public policymakers, and many scholars are interested in understanding how foreign investment affects host economies. In the context of emerging countries, FDI plays an even more critical role as a potential ally in the face of poverty and inequality (Agarwal et al., 2017; Utama, 2015). So far, this study has discussed foreign investment as a driver of economic development, which can also help reduce poverty and inequality while raising income. Therefore, FDI can be also seen as an agent of socioeconomic development (Polloni-Silva, Morales, et al., 2021). Hence, one response to this vision has been the rise in FDI incentive programs in emerging countries over the past few decades (Demena & van Bergeijk, 2017).

However, recent studies indicate that the benefits of FDI for developing countries should be weighed carefully, and other factors must be considered. Indeed, among these factors are the country's economic context and the proxy used to measure poverty (Kaulihowa & Adjasi, 2018; Magombeyi & Odhiambo, 2018), institutional factors (Nguyen, 2021b; Slesman et al., 2021), FDI

entry mode (Djokoto, 2022), among others. Furthermore, Alguacil, Cuadros, and Orts (2011) state that more than single policies to attract foreign investment are needed to ensure economic development.

Assuming that FDI has the potential to benefit or harm the host economy, one of the strands that investigates these effects focuses on the effects of FDI on domestic companies' success (Kim, 2015; Ubeda & Pérez-Hernández, 2017). In this context, the crowd-in effect occurs when the presence of MNEs in a region encourages a rise in investments in local firms. On the other hand, the crowd-out effect occurs when investments in domestic companies decline due to the presence of foreign investments.

Several factors must be considered when crowd-in and crowd-out phenomena are under analysis. First, some academics show that regional characteristics have a significant impact on the effects felt by domestic firms (Kose et al., 2006; Munemo, 2017; Nguyen, 2021a; Slesman et al., 2021). According to Kose et al. (2006), the quality of local institutions and the region's political stability, for example, can mitigate crowd-out effects in the region. Furthermore, when MNEs are established in regions with highly efficient firms, the crowd-out effect is reduced (Morrissey & Udomkerdmongkol, 2012). On the other hand, domestic firms far from the technological frontier tend to suffer more severely from crowd-out effects due to increased local competition caused by the inflow of FDI (Dunning, 2015), which has the potential to diversify the regional economy.

In this regard, FDI has the potential to promote economic diversification. To sum up, when local industries supply or buy from foreign firms, they are encouraged to produce more complex and higher-quality goods (Javorcik et al., 2018) since MNEs require procedural standards from suppliers and buyers. Therefore, product and process innovation tends to spread throughout the supply chain of an MNE (Betim et al., 2018). Moreover, MNEs providing superior goods can pressure domestic firms to innovate to avoid losing market share. However, Kim (2015) states that although innovation may be necessary for domestic firms to remain competitive, there is a need for minimum absorptive capacity (AC) levels to explore the positive externalities of MNEs.

The organization learning theory states that a company must identify, assimilate, and apply knowledge (Cohen & Levinthal, 1990). Nonetheless, overlapping technological capabilities and distance can enhance a firm's ability to absorb new knowledge from other firms (Nooteboom, 2007). In this context, absorptive capacity (AC) is associated with a firm's proximity to the knowledge frontier. Many studies use the highest total factor productivity as a knowledge frontier parameter and the distance from this frontier as an AC (Girma, 2005; Jude, 2016; Morales & Moreno, 2020; Zhang et al., 2010). As a result, more productive firms are closer to this frontier and thus have a greater absorptive capacity. Firms with a high level of AC can quickly identify,

assimilate, and exploit knowledge, allowing national companies to imitate and absorb production methods, organizational and managerial techniques, and other techniques from multinational corporations. As a result, companies with higher AC levels find it easier to innovate. Moreover, regions with higher levels of AC will find it easier to absorb MNE knowledge and transform it into new products (innovating), allowing them to diversify their portfolio.

Likewise, Dam and Frenken (2020) argue that a positive relationship exists between a region's product portfolio diversity and the average income of its workers. Therefore, a greater variety of products should be beneficial to a region.

Nevertheless, diversification without increasing the complexity of local products is insufficient to ensure regional economic development. In this context, Balland and Rigby (2017) state that product diversification is critical for advancing local economic complexity because the more complex the economic activity, the greater the need for specialization in various areas of knowledge. Hence, FDI can potentially increase a region's variety and economic complexity. As a result, understanding the impact of foreign investment on economic complexity is critical for directing this type of investment to regions that will benefit the most.

In this context, the purpose of this work is to investigate the impact of FDI on the regional economy. The impact of FDI on domestic firms and regional economic complexity will be examined in particular.

Finally, this dissertation will be split into three sections. First, this study seeks to map de state of the art about FDI effects on domestic companies. The second paper seeks to test the effects of FDI on host firms in Brazil and whether FDI in distinct sectors affects domestic firms differently. Later this dissertation will analyze the impact of foreign investments on the regional economy by analyzing the impact of FDI on economic complexity and the role of the absorptive capacity as a moderator of this relationship.

1.3. RESEARCH GOALS

The primary goal of this master's dissertation is to **examine the impact of foreign direct investment (FDI) on the regional economy**, particularly in an emerging economy such as Brazil. The complexities of FDI effects have received little attention in the country, and understanding the impact of this type of investment on the regional economy is critical for developing public policies to attract and direct foreign investment. As a result, the following goals guide this dissertation:

- 1) Explore the current state of the literature on the effects of FDI on domestic firms, focusing on the crowd-in and crowd-out effects.

- 2) Determine whether FDI crowd-in or crowd-out domestic investments at the regional level.
- 3) Determine if the FDI entry sector affects crowd-in and crowd-out effects.
- 4) Examine the impact of FDI on regional economic complexity.
- 5) Measure the effect of absorptive capacity on the impact of FDI on economic complexity.

1.5. DISSERTATION PAPERS

1.5.1. PAPERS' SYNTHESIS

This section presents the paper's abstracts.

Paper 1 abstract (Section 2)

Foreign Direct Investment (FDI) is seen by policymakers as a driver for modernization, especially in emerging and transition economies. However, the literature investigating the impact of FDI on domestic firms shows contradictory results. As domestic firms play a fundamental role in the economy's steady growth, profoundly understanding the impact of FDI on those is crucial to direct these investments. This paper seeks to investigate the current state of the literature on the positive (crowd-in) and negative (crowd-out) effects of FDI on domestic firms. We employed a systematic literature review (SLR) to achieve this goal. The results of this study show that determining factors must be considered when measuring the effects of FDI on domestic firms. Among the factors are time, FDI inflow sector, FDI inflow mode, absorptive capacity, domestic firm size, and regional economy level of development.

Paper 2 abstract (Section 3)

This paper aims to empirically investigate the effects of Foreign Direct Investments (FDI) on domestic companies in Brazilian cities. To determine whether FDI benefit (crowds in) or harm (crowds out) domestic firms, a balanced dataset containing all Brazilian cities with data from 2010 to 2016 was built. The Driskoll-Kraay and Limited Information Maximum Likelihood (LIML) were employed. The results suggest that aggregated FDI crowds in domestic companies in the long run. This study also tested FDI disaggregated into sectors. While FDI medium low-tech sectors crowds in domestic firms, we discovered that FDI in high-tech sectors crowds out those firms. These results have important policy implications since direct FDI into the determined sectors has the potential to harm or benefit local companies.

Paper 3 abstract (Section 4)

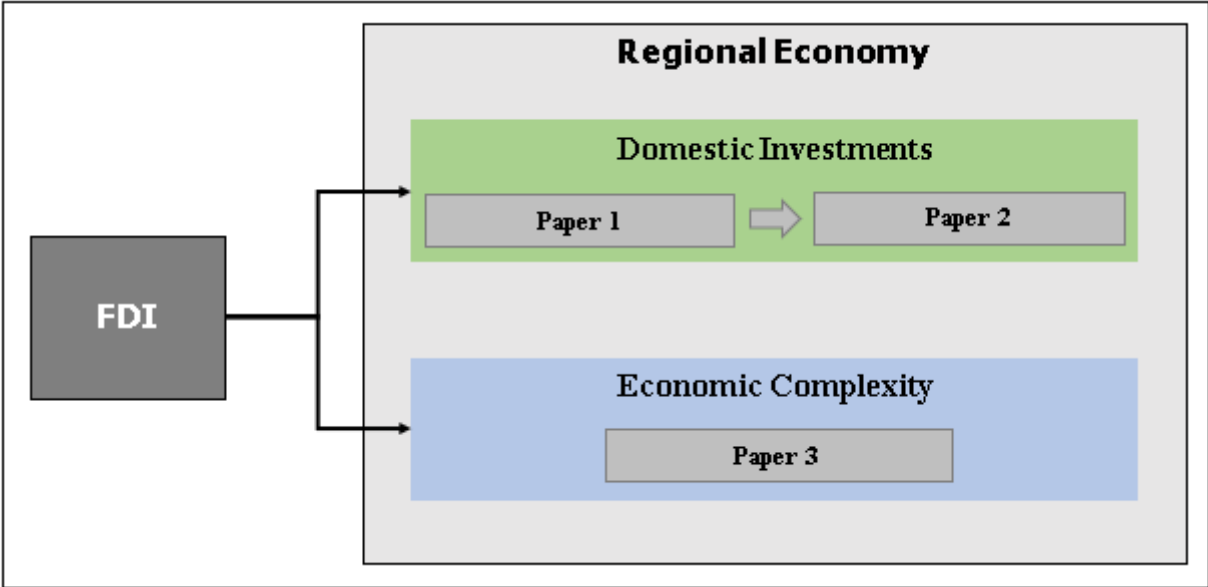
Despite the increasing amount of research on Foreign Direct Investment (FDI) and Absorptive Capacity (AC), there has yet to be an agreement on how FDI and AC affect regional-level sophistication and diversity among emerging economies. FDI can potentially increase its host country's regional economic complexity, and AC enhances this effect. Within this context, this

research aims to examine the impact of FDI and its interaction with AC on increasing economic complexity in Brazil at the municipal level. Our findings suggest that both FDI and AC positively impact regional economic complexity. Furthermore, this process is non-linear, and a minimum absorptive capacity level is required for a region to benefit from foreign investment. Our findings have important policy implications, as authorities should combine attracting foreign direct investment and developing the absorptive capacity to transform and diversify the regional structure.

1.5.2. PAPERS INTEGRATION

This topic discusses the relationship between the dissertation papers, emphasizing how all papers work together to answer the dissertation's primary goal. Figure 1 illustrates how these articles work together to explain the research goal.

Figure 1. Papers integration to achieve the research goal



This dissertation aims to explain how FDI affects the regional economy. Two specific aspects were examined to this end. First, this study tries to determine how FDI affects local businesses. A systematic literature review (Paper 1) was conducted to assess state of the art on how the presence of multinational corporations affects the increase (crowd-in) or decrease (crowd-out) of investments in domestic firms. Factors influencing this interaction were also examined in this literature review. Among the most critical factors discovered are the following:

1. It takes time for domestic firms to absorb the positive externalities brought by FDI;
2. The FDI input sector can influence the impact on companies in the region;

Identifying these factors was critical in determining which variables would be studied in the second paper of this dissertation. The second paper empirically analyzes the impact of FDI on Brazilian companies.

Paper 2 employed some of the factors identified in Paper 1. As a result, an investigation was conducted considering the time required for Brazilian companies to absorb the knowledge brought by multinationals. The findings of this article show that FDI inflows result in increased investment in domestic firms, which here was measured by the number of job posts. The second factor investigated in this paper was how the technological intensity of the FDI input sector influences the impact on host companies. Although the presence of FDI benefits domestic firms, it was discovered that when disaggregated by sector, foreign investment in high technology sectors has a negative impact (crowd-out) on the number of job posts in domestic firms. This study states that this is due to local firms' inability to absorb the positive externalities generated by high-tech multinational corporations.

In the third paper of this dissertation, absorptive capacity is also a determining factor. In this article, we examine the impact of foreign direct investment on increasing economic complexity. Economic complexity is a measure of economic sophistication that considers primarily two factors: diversity and ubiquity. As a result, more than economic diversification is required, and a region must be capable of producing non-ubiquitous goods in order to be economically complex. In this article, we discover that FDI has the potential to influence the increase in economic complexity; however, for this phenomenon to occur, the regions must exhibit minimum levels of absorptive capacity.

It is important to note that the impact of FDI is measured regionally, specifically at the municipal level in papers 2 and 3. Thus, we can determine the regional impact of FDI on domestic firm investments, the increase in economic complexity (ubiquity and diversification), and the role of absorptive capacity later in this dissertation. While the first article provides theoretical support, the second and third articles empirically examine the impact of FDI on the Brazilian regional economy. As a result, the three papers complement each other to meet the research objective that drives this study “**examine the impact of foreign direct investment (FDI) on the regional**
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SECTION 2. The impacts of FDI on domestic investments: a systematic literature review

2.1.OVERVIEW

This section presents the literature's key findings on how foreign direct investment affects the domestic economy. To determine if FDI presence promotes or decreases investments in host companies, we search for studies examining the crowd-in and crowd-out effects resulting from FDI presence in the region or country. This study seeks to achieve the first research goal presented at the end of the first section of this dissertation: "*Explore the current state of the literature on the effects of FDI on domestic firms, focusing on the crowd-in and crowd-out effects.*"

2.2.INTRODUCTION

The presence of MNEs has been viewed by policymakers as an enabler of the modernization of industries in emerging economies through knowledge spillovers (Jude, 2016; Nxazonke & van Wyk, 2020), though attracting foreign investment as an isolated policy is insufficient to ensure economic development (Alguacil et al., 2011). Furthermore, this statement should be viewed with caution, as the presence of these companies tends to increase competition in the local market (Driffield & Love, 2007; Dunning, 2015), which can reduce investments in domestic companies in the short term (Mencinger, 2003; Razin, 2003). Additionally, according to Barrios, Gorg, and Strobl (2005), an increased presence of multinationals may initially harm the development of domestic firms due to the increased competitive pressure that MNEs induce. However, in the long run, the positive effects of MNEs outweigh the adverse effects and can even foster the development of domestic firms.

The crowding-out effect refers to a decrease in domestic company investments due to the presence of MNEs. According to Jude (2019), this effect occurs when foreign competitors are technologically superior or when domestic firms have limited absorptive capacity (AC). In this context, MNEs have a significant market advantage due to their technological superiority (Agosin & Machado, 2005), which eventually leads to the replacement of domestic firms by more efficient foreign firms with lower production costs (Aitken & Harrison, 1999). Wang (2010) says that this effect is more robust in domestic firms that operate in the same industry as the MNEs.

Still, regarding the crowd-out effect, Morrissey and Udomkerdmongkol (2012) found that it tends to be less significant in more developed economies since they have more efficient domestic firms with adequate absorptive capacities to harness the spillovers. The authors also found a significant relationship between the host country's governance quality and the effects felt by the presence of MNEs. These results corroborate the findings of Kose et al. (2006), who argue that

institutional development, economic stability, and regional infrastructure can act as drivers of investments in domestic firms and, therefore, serve as mitigators of the adverse effects that can be felt with the entry of foreign capital into the region. Furthermore, Munemo (2017) asserts that adequate financial deepening is required for host countries to realize the positive spillover effects of FDI on domestic entrepreneurship.

Despite increased competition in the local market due to MNE's activity, these companies tend to increase demand for local suppliers (Cardoso & Dornbusch, 1989). According to Markusen and Venables (1999), the crowding-in effect occurs when foreign investment stimulates backward or forward production linkages in the host country. Therefore, if the presence of multinational companies in a region in the final products sector increases the demand for intermediate products, those MNEs crowd in the local economy in sectors related to which the MNE is present (Barrios et al., 2005; Wang, 2010). This theory is discussed in Albuлесcu and Tămășilă (2014) study, which suggests that the presence of MNEs opens the door for local companies to become part of their production chain as suppliers or contractors of MNEs as these companies work together.

The crowding-in effect is felt not only in companies that are part of the MNE production chain, since the presence of MNEs can benefit local companies through knowledge and productivity spillovers (Chen et al., 2017), but it is also felt between different industries via labor mobility, despite being a rare event (Orlic et al., 2018). Moreover, the knowledge spillovers from one type of industry to another can enhance domestic firms' production of more complex products. In this regard, Javorcik, Lo Turco, and Maggioni (2018) claim that the presence of MNEs correlates with domestic firms developing more complex products.

More complex products developed by more complex industries require a deep division of knowledge and labor (Balland et al., 2020). In other words, industries need more connections with specialized professionals and companies to produce more complex products. This means that the greater the number of sectors an industry relates to, the more complex and technologically advanced the industry is. Thus, the greater is its capacity to transfer knowledge to those industries, bringing new business opportunities (Ayyagari & Kosová, 2010) and crowding-in those sectors. This means that more complex and technologically advanced industries have more significant potential to crowd in the economy than medium and low-tech industries.

Therefore, with all the elements stated before taken into consideration, the academic literature regarding foreign direct investment (FDI) is prolific. However, the interaction of this type of investment with domestic expenditure receives little attention when compared to the total number of investigations conducted within this field of knowledge (Jude, 2019). The theoretical researches available are insufficient, and empirical investigations suffer from several drawbacks,

leading to conflicting conclusions (Gondim et al., 2018). These statements motivate and justify the present investigation. Although several studies have analyzed the effects of foreign investment on domestic firms, the literature consulted points out that there is no consensus on the positive or negative externalities arising from foreign investment. Factors such as the MNEs sector, regional infrastructure and institutions, regional economic complexity, and distance of domestic firms from the technological frontier should be considered when analyzing those effects.

The present study analyzes the impacts of FDI on domestic companies in the host region (such as crowd in and crowd out) and the factors associated with those impacts. To this end, this article will perform a systematic literature review to combine, summarize, and investigate the results found in previous studies that analyzed the effects of FDI on domestic firms. The following text is divided into three sections. First, the systematic literature review procedure explains precisely what the name suggests, detailing the method and every step of the process. The results section displays the analysis of the SLR results and shows propositions to answer our research question, highlighting moderator factors of the relationship between FDI and domestic investments.

2.3.SYSTEMATIC LITERATURE REVIEW PROCEDURE

A systematic literature review (SLR) aims to summarize and critically assess the available literature on a specific subject (Hart, 1998). Thus, this methodological procedure aims to answer a question formulated by finding, describing, and evaluating the evidence of all published research on the subject linked to the question within a specific set of parameters (Eriksson, 2013). Furthermore, SLR is not just about reviewing previous studies but identifying the diversity of available literature, which may be inconclusive.

In this scenario, an SLR can be valuable for finding gaps that new research can explore or even summarizing previous results to find a pattern that can answer a research question (Ankrah & Al-Tabbaa, 2015; Thomé et al., 2016; Tranfield et al., 2003). Furthermore, the SLR method differs from a traditional review by adopting well-defined search and exclusion criteria that make it less likely to neglect potential studies relevant to research (Cronin et al., 2008). In this way, the execution of an SLR generates more concise and robust results than a traditional literature review, facilitating the interpretation of the state of the art and the extrapolation of the results to find patterns of behavior in pre-existing studies.

The main objective of this study is to determine the impacts of Foreign Direct Investments (FDI) on the regional economy, specifically on domestic companies. To this end, we explored the literature that discusses the increase (crowd-in) or decrease (crowd-out) of investments in host

companies due to multinational companies' (MNEs) presence. We used the Scopus and Web of Science databases since they comprise the most important studies in this research field. Furthermore, those databases provide the most extensive global collections of articles and publishers and have been used in several other systematic literature reviews.

To achieve the objective mentioned above, this research employed the method proposed by Tranfield, Denyer, and Smart (2003) in conducting the Systematic Review of the Literature. Although systematic literature reviews are a method initially created for health areas, this type of analysis in social and management sciences is unfeasible due to the high degree of subjectivity of the topics addressed. For this reason, Tranfield Denyer and Smart (2003) present an SLR method adapted to other areas to maintain the rigor that an SLR requires while making the method feasible for researchers outside the health area. The authors divide systematic reviews into three stages, each comprising several steps. Figure 2 shows the stages and steps where planning is the first one. Figure 2 shows the recommended stages and steps for conducting an SLR.

Figure 2. SLR stages and steps

Stage 1: Planning the review
<ul style="list-style-type: none"> • Step 1 – Identification for the need for a review • Step 2 – Development of a review protocol
Stage 2: Conducting a review
<ul style="list-style-type: none"> • Step 1 – Selection of studies and exclusion of duplicated articles • Step 2 – Reading of abstracts and application of inclusion and exclusion criteria • Step 3 – Study quality assessment • Step 4 – Data extraction and synthesis
Stage 3: Reporting
<ul style="list-style-type: none"> • Step 1 – The report and propositions

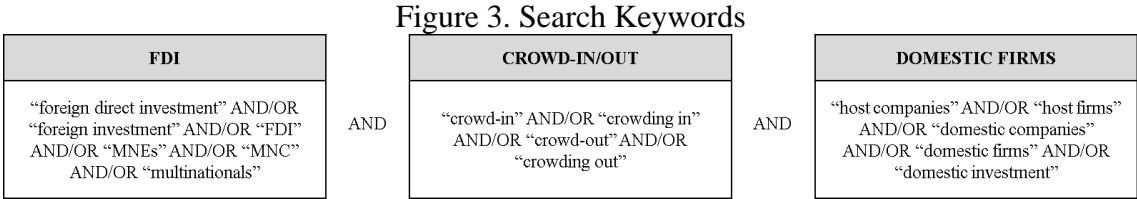
2.3.1. PLANNING THE REVIEW

In the planning stage, the authors must clarify and refine the general objectives of the research. The result of this stage was a research protocol (see appendix A) with a clear definition of the search bases, keywords, and criteria for the inclusion and exclusion of studies.

This SLR included only articles from journals indexed to internationally recognized search bases in applied social sciences, such as the Social Science Citation Index (Web of Science) and Scopus. These search bases guarantee a broader diversification of consistent studies, as they index

several databases of journals that have scientific merit (Payne et al., 2011). Furthermore, an SLR must use at least two search bases (Levy & J. Ellis, 2006; Thomé et al., 2014; Thomé et al., 2012).

We defined the keywords to begin the search. According to Cooper (2016), the definition of keywords must be specific enough so that only studies relevant to the research topic are found, but not excessively restrictive to limit the results found and eliminate investigations associated with the discussed topic. Furthermore, according to Tranfield, Denyer, and Smart (2003), the research strategy must be detailed enough to guarantee the replicability of the SLR, if necessary. This study divided the keywords into three groups: 1) FDI-related terms, 2) crowd-in or crowd-out effect-related terms, and 3) domestic company-related terms. The English language was chosen to do the research due to its coverage. Figure 3 shows the keywords division



2.3.2. CONDUCTING THE REVIEW

The second stage of an SLR consists of conducting the review, and its objective is the selection of studies, analysis, and data extraction. The first step of this stage is a selection of the studies. We adopted the StArt (State of the Art Through Systematic Review) software to manage the next steps of the SLR. The initial search included a sample of 183 articles, of which 40 were duplicates. Then, to identify the main objectives and conclusions of the studies, we read the titles and abstracts of the 143 studies. This step is essential to confirm if the selected studies fit the search criteria and if they are directly related to the analyzed topic.

The second step of the second stage consists of reading the selected studies' abstracts and applying the inclusion and exclusion criteria: (i) Studies must be written in English since the language of the principal scientific publications is English; (ii) Contains less than three pages. This systematic review sought to use only complete scientific studies, then delimitating a minimum number of pages to eliminate any expanded reports or abstracts. (iii) It is not a scientific article. This criterion was determined to discard book chapters, thesis, and journalistic texts. This type of material is classified as grey literature, and although eliminating these may cause a research bias, it is admissible as it may serve as a limiting factor for the inclusion of studies with dubious quality (Thomé et al., 2016). Moreover, finally, (iv) The article does not fit the scope of the research. This step resulted in the removal of 66 articles.

The third step of stage two requires that the authors assess the quality of the articles to identify if they present any methodological flaws or research bias. To evaluate the quality of the selected articles, it will be necessary to read all studies in their entirety and evaluate the methods and integration with the developed theory. According to Levy and Elis (2006), this step should be peer-reviewed. In addition, Tranfield, Denyer, and Smart (2003) indicate that quality checking is part of a rigorous analysis method, essential for conducting a Systematic Review. However, “one of the main ways of verifying the validity of a study is the analysis of the correspondence between theory, methods, and results” (Cooper, 2016). Table 1 shows the established quality criteria suggested by Valentine and Cooper (2008). This step resulted in the removal of four additional articles.

Table 1. Quality assessment criteria

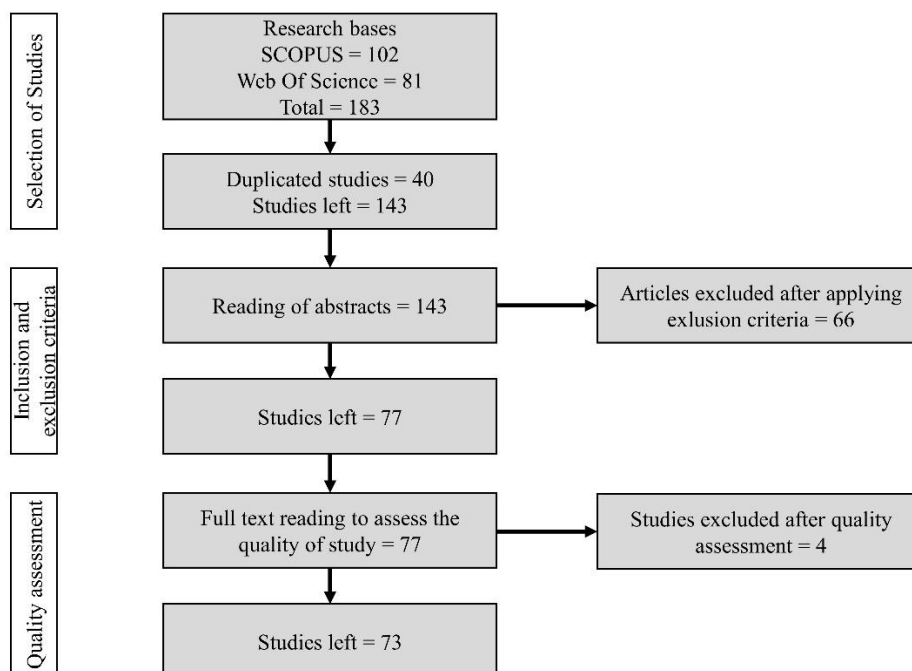
Criterion	Definition
The connection between theory and empirical model	Is there an evident relationship between the theories presented throughout the text and the empirical model?
Clarity of inference	Did the research design allow a well-defined conclusion about the analyzed phenomenon?
The possibility of generalizing the results	Is the sample used for the study significant enough to generalize the results?
Presentation of the empirical method and results	Is the presentation of results sufficiently detailed to allow replicability of the study?

Source: Adapted from Cooper and Valentine (2008)

The fourth step in conducting the review consists of extracting data from the articles. Therefore, it is necessary to read the selected articles and summarize their main methods and results. Therefore, the fourth step of stage two and the entire stage three will be presented in the following topics.

Despite the research rigidity that the SLR method offers, it is worth noting that this study has some limitations. The non-inclusion of grey literature may have excluded potential studies relevant to the summary of results. Furthermore, Tranfield, Denyer, and Smart (2003) state that research related to management areas faces difficulties in establishing exact criteria for evaluating the quality of articles, which favors the subjectivity of the analysis. The inclusion of the analysis proposed by Valentine and Cooper (2008) aims to reduce such subjectivity and facilitate the replicability of the study, an essential element for the execution of an SLR (Tranfield et al., 2003). Figure 4 shows the results from stage 2, and Appendix B shows the articles selected for the data extraction and monitoring progress.

Figure 4. Results of the second stage of SLR



The fourth step of this SLR will consist of a quantitative analysis of the studies included in the SLR in order to describe patterns like 1) publications per year, 2) journals with the most publications, 3) the journals with more citations, and 4) the key writers in the field – analyzing the aspects surrounding the variation in the number of publications along the years and also identifying key points brought by the most relevant authors and journals in the field. This topic's analysis will be presented later in the results section of this research.

2.3.3. REPORTING

This stage consisted of descriptive analysis based on the information extracted from articles which included: 1) crowd-in and crowd-out effects, 2) types of FDI, and 3) FDI in the different sectors. This phase explored the relationship between FDI and domestic investments more profoundly.

Furthermore, the subjects in the selected articles were connected to organize and highlight the main contributions of the literature on the researched theme, aiding the analysis and comprehension of the relationship between FDI and domestic firms. This topic's analysis will be presented later in the results section of this research.

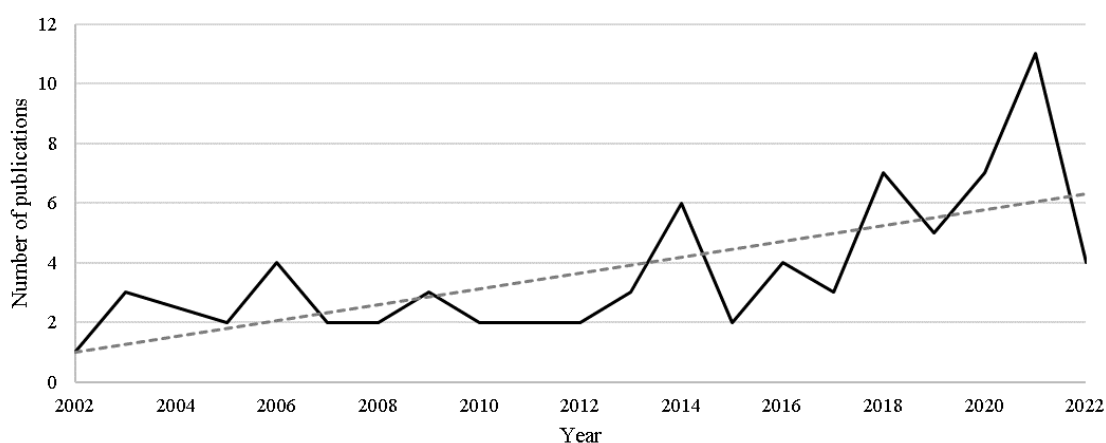
2.4.RESULTS

2.4.1.DATA EXTRACTION AND SYNTHESIS

In this session, we give a descriptive analysis of the studies we found. We also list the journals with the most publications, the journals with more citations, and the key writers in the field.

Figure 7 portrays the annual increase in the number of publications. Interest in analyzing the effects of FDI on domestic firms has grown over the last decade. The first article examined in this SLR appeared in 2002. This article was the only one captured by this SLR in 2002. It is worth noting that the authors (Mišun & Tomšík, 2002) examine a group of countries (the Czech Republic, Poland, and Hungary) during a period of economic transition (1990-2000), which demonstrates the authors' interest in investigating the effects of FDI in these countries at a critical time for domestic company formation.

Figure 5. Publications per year



We also identified the journals with the most articles on the subject. *African Development Review*, *Economic Change and Restructuring*, *Economics Bulletin*, *Economics of Transition*, *Emerging Markets Finance and Trade*, *Empirical Economics*, *International Journal of Economics and Business Research*, *Journal of Economic Studies*, and *Journal of Policy Modeling* are the new leading journals of this SLR where each of these journals has two published articles on the subject.

We also identified the primary authors on the subject in the last two decades. Table 2 displays those authors and the number of citations of those authors both in Scopus and Web of Science databases.

Table 2. Citations per author

Author	Scopus citations	WoS citations	Total citations
Samuel Adams	225	187	412
Koen De Backer	191	0	191
Manuel R. Agosin	187	0	187
Kristine Farla	62	60	122
Renata Kosová	0	94	94
David Deok-Ki Kim	64	0	64
Léonce Ndikumana	62	0	62
Denis de Crombrugg	0	60	60
Bart Verspagen	0	60	60

On the subject of this study, Samuel Adams (Adams, 2009) was the most cited author. It is worth noting that his research examines the effects of FDI on domestic investments in Sub-Saharan African countries between 1990 and 2003. Its main findings show that foreign investments initially harm domestic firms, but these effects tend to be positive in the medium and long term. This suggests that crowd-in effects may take time to manifest in developing countries. Table 3 displays the number of citations per journal.

Table 3. Journals citations

Journal	Scopus citations	WoS citations	Total citations
Journal of Policy Modelling	239	200	439
Review of Industrial Organization	191	0	191
Oxford Development Studies	187	0	187
Academy of Management Review	0	183	183
World Development	62	60	122
Review of Economics and Statistics	0	94	94
Economics of Transition	42	37	79
Economics of Transition	42	37	79
Journal of Economic Studies	67	0	67
Development Policy Review	62	0	62

The journal with the higher number of citations reviewed by this study was the “Journal of Policy Modeling.” This journal contains two published articles in this SLR, the first and most cited of which was written by Samuel Adams in 2009. The second article, published in 2020, examines the relationship between the FDI sector and domestic investment in Pakistan from 1980 to 2012 (Shah et al., 2020). A sectoral analysis of the impact of FDI on the domestic economy is required to determine which sectors the foreign investment can benefit host firms the most or, at the very least, mitigate crowd-out effects. According to the author's analysis, the crowd-in and crowd-out effects are felt differently depending on the sector in which the FDI is present.

The interest in emerging and transition regions has demonstrated the importance of analyzing those effects in regions in critical development phases of host industries. This is the case of Brazil, a country that has been in the process of deindustrialization (Silva, 2019) in recent decades and has an important task to strengthen and protect its domestic firms. The next topic will further explore the relationship between FDI and domestic investments by deepening the analysis of the papers presented so far.

2.4.2. REPORTING AND PROPOSITIONS

2.4.2.1. Crowd-in or Crowd-out?

The findings of studies on the impact of FDI on domestic firms vary greatly. Table 4 summarizes the findings of the studies examined in this literature review, splitting the results into no effect, crowd-in and(or) crowd-out.

Table 4. Papers and results

Paper	Crowd-in	Crowd-out	No effect
(Jude, 2019)	X	X	
(Djokoto, 2021)	X		X
(Kurtović et al., 2022)	X	X	
(Ahmad et al., 2018)		X	X
(Gondim et al., 2018)		X	
(Mišun & Tomšik, 2002)	X	X	
(Farla et al., 2016)	X		
(Shah et al., 2020)	X		X
(Choi, 2018)	X	X	
(Eregha, 2012)	X	X	
(Ang, 2009)	X		
(Lin & Chuang, 2007)	X	X	
(Ingham et al., 2020)		X	
(Ashraf & Herzer, 2014)		X	X
(Driffield & Hughes, 2003)	X	X	
(Kosova, 2010)	X	X	
(Bun, 2020)		X	X
(Tung & Thang, 2020)	X		
(Adams, 2009)	X	X	
(Chen et al., 2017)	X	X	
(Fonchamnyo et al., 2021)	X	X	
(Ameer et al., 2021)	X		X
(Rutkowski, 2006a)			X
(Slesman et al., 2021)	X	X	
(Liu et al., 2014)		X	
(Haller, 2009)		X	
(Ali & Wang, 2018)		X	
(Elheddad et al., 2021)		X	X
(Kejžar, 2011)		X	
(Chen et al., 2020)		X	
(Nguyen et al., 2021)	X	X	
(Latorre et al., 2018)	X		
(Franco & Weche Gelübcke, 2015)		X	
(Al-Sadig, 2013)	X		
(Sala & Trivín, 2014)			
(Mei, 2007)		X	
(Babatunde et al., 2018)		X	
(Ibhagui & Olawole, 2019)		X	
(Lew & Liu, 2016)	X	X	
(Adil H. Suliman, 2019)		X	
(Nguyen, 2021b)	X		
(Livanis & Lamin, 2016)		X	
(Ha et al., 2022)	X		X
(Teunen & Nubong, 2022)	X	X	
(Abraham, 2019)		X	
(Nguyen, 2021a)	X	X	
(Djokoto, 2022)	X	X	
(Yao & Salim, 2020)	X	X	X
(Konstandina & Gachino, 2020)	X		
(Ozge Bolaman & Tugba, 2020)	X	X	
(Kathuria, 2019)			X
(Tung, 2019)	X		
(Zvezdanovic Lobanova et al., 2018)	X	X	

Paper	Crowd-in	Crowd-out	No effect
(Ghebrihiwet & Motchenkova, 2017)		X	
(Chotia & Rao, 2017)		X	
(Bbale & Nnyanzi, 2016)		X	
(Munemo, 2015)	X	X	
(Gameli Djokoto et al., 2014)	X		
(Vipul et al., 2014)	X	X	
(Kokko & Thang, 2014)	X	X	
(Onaran et al., 2013)	X	X	
(Mohamed et al., 2013)	X		
(Cazzavillan & Olszewski, 2012)		X	
(Lean & Tan, 2011)	X		
(Wu et al., 2010)	X		
(Ndikumana & Verick, 2008)	X		
(Rutkowski, 2006b)	X		
(Apergis et al., 2006)	X	X	
(Pawlik, 2006)		X	
(Agosin & Machado, 2005)		X	
(Barry et al., 2005)		X	X
(De Backer & Sleuwaegen, 2003)	X	X	
(Deok-Ki Kim & Seo, 2003)			X

Table 4 shows that many authors find multiple results for crowd-in or crowd-out effects. This happens because the analyzed sample is frequently split or because the effects are examined in both the short and long term.

Several studies examine the short-term impact of FDI on domestic firms and find a crowding-out effect (Adams, 2009; Agosin & Machado, 2005; Avcı & Akin, 2020; Babatunde et al., 2018; Babu, 2019; Barry et al., 2005; Bbale & Nnyanzi, 2016; Bun, 2020; Cazzavillan & Olszewski, 2012; Chen et al., 2017; Chen et al., 2020; Choi, 2018; Chotia & Rao, 2017; De Backer & Sleuwaegen, 2003; Djokoto, 2022; Elheddad et al., 2021; Eregha, 2012; Franco & Weche Gelübcke, 2015; Ghebrihiwet & Motchenkova, 2017; Gondim et al., 2018; Haller, 2009; Ibhagui & Olawole, 2019; Ingham et al., 2020; Jude, 2019; Kejžar, 2011; Kokko & Thang, 2014; Kosová, 2010; Kurtović et al., 2022; Lew & Liu, 2016; Lin & Chuang, 2007; Liu et al., 2014; Livanis & Lamin, 2016; Mišun & Tomšík, 2002; Munemo, 2015; Nguyen et al., 2021; Nguyen, 2021a; Onaran et al., 2013; Pawlik, 2006; Sala & Trivín, 2014; Slesman et al., 2021; Suliman et al., 2019; Teunen & Nubong, 2022; Wen, 2007; Yao & Salim, 2020; Zvezdanovic Lobanova et al., 2018). However, among these authors are those that found that MNEs activities can benefit host firms in long-run (Avcı & Akin, 2020; De Backer & Sleuwaegen, 2003; Djokoto, 2022; Eregha, 2012; Jude, 2019; Kosová, 2010; Teunen & Nubong, 2022; Zvezdanovic Lobanova et al., 2018). The explanation given for why FDI, which initially harmed domestic firms, eventually began to benefit them is widely debated and supported by the spillover literature. According to the literature on spillover, it takes time for domestic firms to master the knowledge brought by multinationals.

Proposition 1: The FDI impacts on domestic firms must be analyzed in the short and long run since the effects of MNEs presence may take time.

On the other hand, studies show that FDI is initially beneficial to the regional economy (Al-Sadig, 2013; Ameer et al., 2021; Chen et al., 2017; Djokoto, 2021; Djokoto et al., 2014; Farla et al., 2016; Fonchamnyo et al., 2021; Ha et al., 2022; Konstandina & Gachino, 2020; Latorre et al., 2018; Lew & Liu, 2016; Mišun & Tomšik, 2002; Mohamed et al., 2013; Munemo, 2015; Ndikumana & Verick, 2008; Nguyen et al., 2021; Nguyen, 2021a, 2021b; Onaran et al., 2013; Shah et al., 2020; Slesman et al., 2021; Tung, 2019; Tung & Thang, 2020; Wu et al., 2010; Yao & Salim, 2020), but there is little evidence that FDI can be beneficial initially (crowd-in) but harmful in the long run (crowd-out) (Fonchamnyo et al., 2021).

In the studies examined, factors such as the size of domestic firms were also taken into account (Bun, 2020; Choi, 2018; Lin & Chuang, 2007). Lin & Chuang (2007) contend that the crowd-out effect is more prevalent in smaller firms, whereas larger firms benefit from FDI. Large firms may have the competitiveness and ability to learn and apply advanced technology from foreign firms (Choi, 2018). Bun (2020) also realizes that the impact of FDI varies according to firm size. Furthermore, the author demonstrates that the type of linkage (horizontal, backward, and forward linkages) can act as a moderator of the impact of MNEs on domestic firms, which is consistent with other studies in the field (Ha et al., 2022; Kokko & Thang, 2014).

Some studies indicated that when analyzing the impact of FDI on domestic firms, factors such as governance (Chotia & Rao, 2017; Nguyen, 2021a), government regulations (Munemo, 2015), the amount of public investment (Ameer et al., 2021), and the quality and capacity of regional institutions (Bbale & Nnyanzi, 2016; Nguyen, 2021b; Slesman et al., 2021) should be taken into account.

Furthermore, the analyzed literature extensively addressed factors such as the type of FDI and the input sector of these investments. These elements are covered in the following sections.

2.4.2.2. FDI entry mode

When we examine the literature on the effects of FDI on domestic investments, it is not uncommon for the studies to specify the FDI entry mode. After all, the entry mode of an MNE may reflect the reasons why investors choose to invest outside their home borders (Blomström et al., 2001; Canabal and White III, 2008; Meyer et al., 2009). Therefore, some of the studies included in this systematic review also address the issue of FDI type. As shown in Table 5, our sample includes studies that examine greenfield, FDI, mergers and acquisitions (M&A), outward FDI, inward FDI, Equity Joint Venture (EJV), and Wholly Foreign Funded Enterprise (WFFE).

Table 5. FDI entry mode

FDI entry mode	Crowd-in	Crowd-out	Insignificant
Greenfield	(Jude, 2019) (Nguyen et al., 2021)	(Ashraf & Herzer, 2014) (Elheddad et al., 2021)	
Mergers and Acquisitions	(Zvezdanovic Lobanova et al., 2018)	(Nguyen et al., 2021) (Zvezdanovic Lobanova et al., 2018)	(Jude, 2019) (Ashraf & Herzer, 2014)
Outward FDI	(Kurtović et al., 2022) (Gondim et al., 2018) (Ameer et al., 2021)	(Kurtović et al., 2022) (Ali & Wang, 2018)	(Ameer et al., 2021)
Inward FDI	(Driffield & Hughes, 2003) (Ameer et al., 2021)	(Lew & Liu, 2016) (Driffield & Hughes, 2003)	(Deok-Ki Kim & Seo, 2003)
Equity Joint Venture (EJV)	(Chen et al., 2017)		
Wholly Foreign Funded Enterprise (WFFE)		(Chen et al., 2017)	

According to the information in Table 4, the two most common types of FDI are greenfield, and M&A. Greenfield FDI occurs when a parent company establishes a subsidiary in a different country and builds its operations from the ground up. Concerning Mergers and Acquisitions (M&A): When two (or more) companies agree to merge into a new single company rather than remaining separate to create business synergies, this is referred to as a merger. An acquisition is the purchase of existing shares issued by another company to increase the acquiring company's ownership or control level. However, the findings of articles examining these types of FDI are inconclusive.

Jude (2019) examined the impact of two types of FDI on domestic investments, finding that while greenfield FDI resulted in long-term crowding-in, M&A had no significant effect on domestic investments (DI). These findings are consistent with Nguyen's et al. (2021) findings that greenfield investments complement domestic businesses while M&A promotes a crowding-out effect on host companies, stifling economic development. In their study, Ashraf and Herzer (2014) find exactly the opposite, demonstrating that while M&A FDI inflows do not affect domestic investments, greenfield FDI has a significant negative impact. Despite this, the author points out that the drop in DI is less significant than the capital inflow into the region.

Furthermore, Chen et al. (2017) discovered a local crowd-in effect when FDI enters a region through partnerships with local firms. They attribute this result to the positive spillovers brought by foreign investors that benefit Chinese companies because partnership formation facilitates the learning of new techniques by the host country's partners. This argument is consistent with Spencer's (2008) proposition that the more alliances an MNE forms with local partners, the greater the positive externalities. However, when FDI is entirely foreign-funded, the

country has a crowd-out effect, which the authors suspect is caused by foreign companies seeking market share in the country, displacing local competitors.

There are some theories as to why there are such disparities in M&A effects on domestic investments. According to Zvezdanovic Lobanova et al. (2018) research, cross-border mergers, and acquisitions have a negative impact in the short term, but this impact decreases over time and tends to become positive. According to Haller (2009), studies capturing the harmful effects of FDI discover that this result is due to a short-term phenomenon (crowd-out) that can be mitigated and even reversed. Haller's (2009) study also stands out by only examining domestic firms that remained active following the entry of foreign investment.

Proposition 2: The crowd-in effect is facilitated by the entry of FDI via M&A. However, this effect takes time to occur.

Other FDI types closely analyzed in our sample included inward and outward FDI. The World Bank defines inward FDI (IFDI) as all liabilities and assets transferred between resident direct investment enterprises and their direct investors. Transfers of assets and liabilities between resident and nonresident fellow enterprises are also covered if the ultimate controlling parent is a nonresident. Outward FDI (OFDI) transfers assets and liabilities between resident direct investors and their direct investment enterprises. However, it also includes transfers of assets and liabilities between resident and nonresident fellow enterprises if the ultimate controlling parent is a resident.

Concerning the outward FDI, we have contradictory results once again. The findings of Kurtovic et al. (2022) indicate that the long-run impact of OFDI varies by region. According to Gondim et al. (2018), between 1975 and 2013, OFDI caused a crowd-in effect in Brazil and Mexico. Meanwhile, Ameer et al. (2021) discovered that, in the long run, OFDI does not affect aggregated DI. However, the authors discovered that OFDI crowds in domestic private investment when they separated domestic capital formation into public and private investment. In contrast, Ali and Wang (2018) discovered that OFDI harms domestic investment in China. The authors argue that this contradictory result differs from previous studies and results from statistical techniques and control variables more appropriate for the econometric model's accuracy.

In terms of IFDI, Driffield, and Hughes (2003) discovered that, in general, this type of investment promotes DI. Nonetheless, the authors discovered that IFDI could crowd out DI if it is concentrated in areas with a large technological gap between the foreign and domestic sectors. These findings are supported by Lew and Liu (2016), who demonstrates that IFDI crowds out host companies, but absorption capacity can mitigate these effects. Moreover, to mitigate the initial negative effects of IFDI, the region requires not only ABC but also time for local companies to

absorb and apply the knowledge brought by MNEs. Thus, Ameer et al. (2021) reveal that IFDI can stimulate ID, but this relationship requires time. As a result, we make the following hypothesis:

Proposition 3: IFDI can positively stimulate DI, but this relationship requires time and minimum levels of regional ABC.

Proposition 4: The FDI entry mode is a determinant factor in the crowd-in and crowd-out effects.

2.4.2.3. Sectoral FDI

FDI intensity can vary significantly across sectors. The presence of capital can be sector-specific, and specialized domestic intermediary firms are linked to specific sectors (Galetovic, 1996). We believe that it is crucial to create financial incentives which would not only aimed at particular regions, but also particular sectors. It is necessary to attract FDI to those sectors and projects which will enable the most efficient use of the country's resources and potential and hence stimulate the development of the domestic private sector (Zvezdanovic Lobanova et al., 2018). Thus, analyzing sectoral FDI is critical for understanding the nuances of these investments' effects on the domestic economy.

Djokoto (2021) examined the effects of FDI on agriculture in 64 countries. The author classified the countries studied as emerging, transitional, or developed. As a result, the author concluded that the presence of MNEs has no discernible effect on DI in emerging and transitional economies, whereas there is a crowd-out effect in developed economies, in line with Apergis et al. (Apergis et al., 2006) findings. These results are different in the long run, where emerging economies suffer from the crowd-out effect caused by FDI inflows into agriculture, while the entry of FDI into the agriculture sector stimulates domestic companies in transition and developed economies in the long run. The crowd-out effect felt in the agriculture sector can be linked to the same effect felt in the food manufacturing sector, according to Djokoto (2022), who advises agriculture economists to investigate the crowd-out effect felt by food industries.

Proposition 5: The impact of foreign investments on domestic firms is moderated by the country's level of economic development (emerging, transition, or developed).

The crowding-out effect felt by agricultural companies in developing countries may be due to their low absorption capacity, as technologically advanced companies or companies with higher absorption capacities suffer less from the presence of FDI (Franco & Weche Gelübcke, 2015; Kosova, 2010). The agriculture sector (particularly in developing countries) is a primary sector with few technological advances, so domestic companies in these sectors are unlikely to absorb knowledge from multinationals. Furthermore, Elhaddad et al.(2021) demonstrate that FDI in

natural resource sectors stifles economic growth, which can be evidence of crowd-out. Shah (2020) also shows that FDI in primary sectors has an insignificant impact on domestic firms.

Misun and Tomsik (2002) conducted a sector-by-sector analysis of the presence of FDI and discovered that foreign investment positively affects local capital formation when it enters markets not previously explored by local firms. This can be explained by the crowd-out effect caused by increased competition in sectors already explored by local domestic firms. Although Misun and Tomsik's (2002) theory is strongly aligned with the spillover literature, Ha et al. (2022) assert that foreign investment in Vietnam motivates investments in companies in the same sector. This finding contradicts studies that show increased competition in firms in the same industry as an MNE contributes to the crowd-out effect.

In terms of increased competition, according to Ingham (2020), while FDI can crowd out more productive domestic firms, FDI entry into specific sectors (manufacturing and oil) can benefit economic development. This is explained by Choi's (2018) study, which shows that the presence of foreign companies significantly impacts the survival of domestic companies in the service sector, typically small businesses. At the same time, despite having a higher survival rate, companies in the manufacturing sector suffer from market loss due to the presence of FDI. These findings are supported by Latorre (2018), who claims that the presence of FDI in the services sector has a crowding-out effect on domestic firms in the same sector but that the presence of FDI in manufacturing benefits the country overall. According to Onaran et al. (Onaran et al., 2013), industry and services may behave differently in terms of the link between outward FDI and domestic investments. In both cases, the authors emphasize the importance of analyzing FDI inflows by sector.

Proposition 6: The effects of FDI are not uniform, and a breakdown by sector is required to explain the impacts of FDI on domestic firms thoroughly.

2.5. CONCLUSION

This study aimed to determine the impact of FDI on domestic firms. Furthermore, we wanted to know which factors influence the relationship between MNE and domestic investments. Finally, this literature review aimed to determine whether FDI is ultimately beneficial (crowd-in) or harmful (crowd-out) to local businesses. Although the outcomes of the analyzed papers vary greatly, we can see some patterns that were transformed in propositions throughout the text.

. We highlight factors such as the type of FDI, the FDI's sector, the sector in which the domestic firms operate, the host country's level of economic development, and short and long-run analysis. Based on our results, and regarding the relationship between the FDI and domestic firms,

we suggest that (1) the FDI impacts on domestic firms must be analyzed in the short and long run, (2) the crowd-in effect is facilitated by the entry of FDI via M&A, (3) the IFDI can positively stimulate DI, (4) the FDI type is a determinant factor to the crowd-in and crowd-out effects, (5) the impact of foreign investments on domestic firms is moderated by the country's level of economic development and (6) a breakdown by sector is required to explain the impacts of FDI on domestic firms thoroughly. With these findings, we hope to add to the literature on the subject and suggest factors to consider when testing the crowd-in and crowd-out effects. We propose that future studies try incorporating the factors highlighted in the propositions mentioned.

SECTION 3. Does foreign direct investment crowd in or crowd out host firms? an investigation in Brazil

3.1. OVERVIEW

This section aims to empirically test if FDI crowds in or crowds out domestic firms in Brazil. To this end, a dataset that includes all Brazilian cities from 2010 to 2016 was employed. Furthermore, this paper also tests if the FDI entry sector affects the crowd-in and/ or crowd-out effects. Therefore, this paper aims to achieve the second and third research goals presented in the first section of this dissertation. “*Determine whether FDI crowds in or crowd out domestic investments at the regional level*” and “*Determine if the FDI entry sector affects crowd-in and crowd-out effects.*”

3.2. INTRODUCTION

Capital globalization, particularly foreign direct investment (FDI), has risen dramatically in recent decades (Adams, 2009; Choi, 2018). With increased FDI, policymakers and economists have focused on the positive roles of FDI, such as the transfer of advanced technology and the creation of new jobs (Choi, 2018). More specifically, FDI can generate positive externalities that benefit domestic investment by supplying advanced technology and infrastructure such as transportation and telecommunications (Ha et al., 2022). Historically, multinational enterprises (MNEs) from developed countries have been the primary investors in charge of FDI (Gondim et al., 2018). In this context, FDI can catalyze technological diffusion from developed to emerging countries via MNEs (Borensztein et al., 1998).

MNEs' positive externalities benefit domestic investment in emerging economies, particularly in underdeveloped sectors, because domestic sectors may lack their own facilities and it is costly to put in place all of the required infrastructure (Agosin & Machado, 2005; Apergis et al., 2006). Mišun and Tomšik (2002) believe that FDI benefits are greater when directed toward sectors with the low capital formation in the host country.

However, while the entry of FDI into underdeveloped sectors appears to be beneficial, we must not overlook the fact that this type of investment entry into sectors unable to absorb its externalities can potentially harm domestic companies. Shah et al. (2020) state that FDI inflows in manufacturing and service sectors crowd in domestic firms while asserting no significant effect on the primary sector. These results are in line with Kosova's (2010) and Lew and Liu's (2016) findings. They argue that domestic firms must have minimal levels of technology to benefit from the presence of FDI. These findings are supported by research indicating that minimum absorptive

capacities are required for firms to benefit from MNEs' presence (Choi, 2018; Ingham et al., 2020; Jude, 2019).

In this case, the FDI inflows into already vastly explored sectors (increased competition) or sectors where the domestic firms do not have enough absorptive capacity to absorb knowledge from MNEs can cause the crowd-out effect. The crowd-out effect occurs when host firms experience a decrease in investments caused by the presence of FDI. At the regional level, Driffield (2003) goes further and states that the level of human capital and the type of FDI are crucial to determine the effects of FDI inflows. The author points out that regional characteristics are fundamental to explaining the motivation and, therefore, the effects of FDI in the host region.

In fact, empirical evidence varies by country and region due to differences in national/regional policies, domestic company response, the type of FDI inflow in the recipient country, and the econometric methodology used (Apergis et al., 2006; Bbale & Nnyanzi, 2016; de Mello, 1999). Wang (2009) argued that the use of aggregate FDI inflows rather than economic sectors' FDI is to blame for the ambiguous effects of FDI. Furthermore, the available theoretical research is insufficient (Jude, 2019), and empirical investigations have several deficiencies that lead to contradictory conclusions (Gondim et al., 2018).

This study aims to empirically examine the regional impact of FDI on domestic firms in Brazil, an emerging country that is a massive recipient of FDI. For this, we will examine FDI by sector in order to determine the impact of FDI on domestic firms in Brazilian municipalities. We will use a data panel that comprises all municipalities in the country between 2010 and 2016. Our research will be divided into four sections. The first will present the theoretical framework involving crowd-in and crowd-out effects, particularly in developing countries. Later, we will present our econometric methods, results, and discussion, followed by the study's conclusion and the implications of our findings for policymakers.

3.3. LITERATURE REVIEW

The recent literature on the effects of MNEs on regional economies arose from attempts to include FDI as a variable for explaining emerging economies' economic growth (Blomstrom et al., 1992; De Gregorio, 1992). At the macroeconomic level, empirical evidence suggests a positive relationship between FDI and GDP levels (Borensztein et al., 1998; Hansen & Rand, 2004; Li & Liu, 2005). To further explain this relationship, recent articles look into the link between FDI and Total Factor Productivity (TFP) (Herzer & Donaubauer, 2018; Li & Tanna, 2019; Saurav & Kuo, 2020), innovation (Grosse, 2019; Vujanović et al., 2022), domestic investments (Avcı & Akin, 2020; Babu, 2019; Tung, 2019), among others.

In this section, we look further into the literature that attempts to explain the effects of foreign direct investment on domestic investments (DI), specifically the crowd-in and crowd-out effects.

One of the first authors to cite the crowd-in and crowd-out effects implicitly was Dunning (1977). According to Dunning's theory of the international allocation of economic activity, MNEs may benefit, harm, or have a neutral effect on related firms. Agosin and Machado (2005) go further and explain that the crowd-in effect occurs when a monetary unit of foreign investment induces a rise in domestic investments of more than one monetary unit. However, if a monetary unit of FDI induces a decrease of more than one monetary unit of domestic investments, then we have a crowd-out effect.

According to Barrios, Gorg, and Strobl (2005), increased multinational presence may harm domestic firm development due to the increased competitive pressure that MNEs induce. This argument is consistent with Wang's (2010) finding that the crowd-out effect is stronger in domestic firms operating in the same industry as MNEs. Domestic firms may struggle to compete with MNEs due to technological and/or managerial deficiencies (Jude, 2019), and eventually, more efficient foreign firms with lower production costs will naturally replace host firms (Aitken & Harrison, 1999). However, Morrissey and Udomkerdmongkol (2012) discovered that the crowd-out effect is less significant in more developed economies where domestic firms are more efficient. This result is consistent with literature showing that technologically advanced firms with higher absorptive capacity are less likely to suffer from negative effects from MNEs (Franco & Weche Gelübcke, 2015; Kosová, 2010). Therefore, although policymakers have viewed MNE presence as an enabler of industry modernization in emerging economies (Jude, 2016; Nxazonke & van Wyk, 2020), this statement should be viewed with caution due to the crowd-out effect.

Nonetheless, many studies show that, while MNEs may have a crowding out effect in the short term, their presence can be beneficial in the long run (Avcı & Akin, 2020; Jude, 2019; Kosová, 2010; Teunen & Nubong, 2022). Teunen and Nubong (2022) state that emerging economies may take time to materialize the positive effects of FDI. Jude (2019) found that FDI crowds out DI in the short term and calls this effect “creative destruction.” The author explains that foreign investment eventually becomes beneficial and tends to crowd in as domestic firms gradually adjust and foreign affiliates develop trade links with local firms.

In this sense, we propose our first hypothesis:

Hypothesis 01: The presence of FDI crowd-in domestic firms,, but this effect is stronger in the long run.

Although several studies have examined the effects of foreign investment on domestic firms, the literature reviewed indicates no agreement on whether the foreign investment has positive or negative externalities. Furthermore, according to Gondim et al. (2018), theoretical research is insufficient, and empirical investigations have several flaws that lead to contradictory conclusions. Wang (2009) attributes those ambiguous results to aggregate FDI instead of FDI disaggregated by economic sector.

Mišun and Tomšík (2002) conducted a sector-by-sector analysis of the presence of FDI and discovered that when foreign investment enters markets not previously explored by local firms, it positively affects local capital formation. However, some studies divide FDI analysis into industry and service sectors, finding that the service sector tends to suffer more from the presence of foreign investments. (Choi, 2018; Latorre et al., 2018). Choi (2018) attributes this result to the fact that the service sector typically includes small and medium-sized businesses that struggle to compete with an MNE. As a result, when directing FDI, the efficiency of a sector and the average size of firms in that sector should be considered.

Also, the presence of FDI varies significantly across sectors, as does the presence of capital and specialized domestic intermediary firms (Galetovic, 1996). Zvezdanovic Lobanova et al. (2018) believe policymakers should attract foreign investments to strategic sectors to stimulate domestic investment growth. Thus, sectoral FDI analysis is critical for understanding the nuances of these investments' effects on the domestic economy.

It is common to classify industries based on their technological level. For example, Acca (2021) categorizes different sectors as low, medium, or high technology based on the percentage of R&D investment for each monetary value accumulated. In this sense, the higher the percentage of R&D investments, the more technologically advanced the sector.

We propose the following hypothesis based on the literature presented:

Hypothesis 02: The MNE's entry into sectors with different technological intensities modifies the impacts of FDI on the regional economy.

3.4. DATA AND METHOD

3.4.1. DATA COLLECTION AND VARIABLES CONSTRUCTION

This research aims to understand the effects of MNEs on regional economy, by analyzing the impact of FDI on domestic firms. First, this study will verify the impact of aggregated FDI on host firms of the region. Secondly, we will analyze the effects of the presence of MNEs in medium-low, medium, medium-high, and high-tech sectors. We will use the first Brazilian FDI ATLAS (FAPESP research aid 2019/19905-0), which employed the Brazilian Integrated System of Foreign

Trade (SISCOMEX). Therefore, a research team manually visited each company's website and verified if the company was Brazilian or foreign, an effort that led to approximately 158.000 checks.

To measure the intensity of FDI at the municipal level, we employed a unique exported-related FDI proxy (Moralles & Moreno, 2020; Polloni-Silva, Moralles, et al., 2021; Polloni-Silva, Silveira, et al., 2021). First, using equation 01, we calculated the FDI intensity for all municipalities in the country that have exporting companies.

$$\text{FDI Intensity} = \frac{\sum_{i=1}^k W_i}{T} \quad (01)$$

where,

MNE is the number of exporting multinational firms in the region “j”;

T is the whole regional population of exporting firms (domestic and foreign) in the region j;

W is the adjustment weight (based on its exporting value) for each firm I;

k is the total number in each region.

We will also measure the FDI intensity disaggregated sector according to each sector's technological intensity. To this end, we employed the division proposed by Acca (2021). The author divided the CNAE 2.0 (National Classification of Economic Activities) sectors into medium-low, medium, medium-high, and high technological intensity.

We developed a proxy based on the number of jobs in domestic firms to measure crowd-in/out. We used the RAIS to create this proxy (Annual Social Information List). RAIS is the country's main tool for labor statistics, counting the number of employees at the end of each year. In this case, we count the number of domestic employees in each municipality for each tested year (2010-2016). Appendix C explains how this proxy was created.

Brazil's regional development is highly uneven (Ferraz et al., 2020), and therefore is especially necessary to define appropriate instruments as control variables. We include the *GDP* (*Gross Domestic Product*) will be used to control the size of the regional economy. The *DENS* (populational density per area) will account for regional population aspects. The *ECI* (Economic complexity index) is the variable chosen to account for regional economic sophistication. The ECI is calculated using international trade data and counts both diversity and ubiquity (Hidalgo & Hausmann, 2009). Therefore, a sophisticated economy (Higher ECI) must not only produce diversified goods, but also ubiquitous goods. We employed FIRJAN (Firjan Fiscal Management Index) to account for regional institutional quality. This index considers the capacity to obtain revenue, the degree of rigidity of the budget, sufficient cash resources, the capacity to make

investments, and the cost of debt in the long term (Polloni-Silva, Moralles, et al., 2021). All variables are presented in Table 6.

Table 6. Variables and source

Variable	Description	Source
<i>Crowd-in/out</i>	Measured by the number of jobs in domestic companies	Annual Social Information List (RAIS)
	Municipal Foreign Direct Investment intensity	SISCOMEX
	Municipal Foreign Direct Investment intensity on medium-low technological intensive firms	SISCOMEX
	Municipal Foreign Direct Investment intensity on medium technological intensive firms	SISCOMEX
	Municipal Foreign Direct Investment intensity on medium-high technological intensive firms	SISCOMEX
	Municipal Foreign Direct Investment intensity on high technological intensive firms	SISCOMEX
	Gross Domestic Product per capita (Gross Domestic Product divided per population)	Brazilian Institute for Geography and Statistics (IBGE)
	Populational density (total population divided per area in km ²)	Brazilian Institute for Geography and Statistics (IBGE)
	Economic Complexity Index	DataViva
Firjan Fiscal Management Index. Index calculated to identify the challenge many municipalities face in allocating their resource.	National Treasury Secretariat	

3.4.2. ECONOMETRIC ESTIMATION

To test the impact of MNEs on regional economies and firms, equation (02) is proposed. Equation (02) estimates the effect of FDI intensity on regional domestic companies by examining whether FDI intensity variation can enhance or harm job creation in domestic firms. Equation (02) tries to answer our first hypothesis (H01).

(02)

Moreover, we will employ a disaggregated FDI proxy to estimate the impacts of MNEs of distinct technological intensity sectors, as presented in equation (03). This equation will be employed to test the hypothesis (H02).

(03)

In the equations presented above, j represents the cities in the sample, t represents the period, α is the intercept, and β are the estimated coefficients concerning our set of variables, X is the matrix of control variables, and Y is the matrix of disaggregated FDI variables (*MediumLow*, *Medium*, *MediumHigh*, and *High*). Furthermore, ε is the residual.

Regarding the choice of the econometric model, we will first determine which specification (random or fixed-effects) is better suited to each model. Later we will analyze if our sample presents heteroskedastic or homoscedastic behavior with the modified Wald test (Greene, 2002). The Wooldridge test for autocorrelation (Wooldridge, 2010) will also be employed. If our models present autocorrelation and heteroskedastic behavior, we will employ an alternative estimation method to deal with those and non-spherical disturbances: the Driscoll-Kraay approach (Driscoll & Kraay, 1998).

Furthermore, there is the issue of endogeneity. In both models, we will employ the lagged FDI since literature has shown that emerging economies may take time to fully materialize the effects of foreign investments (Avcı & Akin, 2020; Jude, 2019; Teunen & Nubong, 2022). Moreover, the literature recognizes the difficulties in finding adequate exogenous instruments and allows the use of internal instruments (such as lagged independent variables) as validation (Razzaq et al., 2021). Using lagged independent variables, we partially treat the endogeneity issue. Nevertheless, we will employ the C-statistics (Baum et al., 2003) to verify if our models present endogeneity between dependent and independent variables. In the case of endogeneity, we will employ the Limited Information Maximum Likelihood (LIML) to treat the endogen estimations. All regressions will use normalized values for all variables (min-max normalization).

3.5. RESULTS

3.5.1. MAIN RESULTS

Table 7 presents our main results regarding hypothesis 01. The variance inflation factor (VIF) was 6.63, indicating that multicollinearity was not overinflating the estimated standard errors (Field, 2010). The Hausman test shows that our model should be estimated using a fixed-effects estimation. Additionally, our sample presents heteroskedastic and autocorrelation issues across the panel. Therefore, we employ the Driscoll-Kraay technique to deal with autocorrelation and heteroscedastic. Also, DK results are robust to general forms of cross-sectional (spatial) and temporal dependence.

Table 7. Impact of one year lagged FDI on the number of domestic jobs

Variables	FE-DK
	0.00282***
	(0.000310)
	-0.0315
	(0.0984)
	0.00418*
	(0.00202)
	0.00403*
	(0.00158)
	0.000500***

	(5.71e-05)
Constant	0.00302***
	(0.000555)
Hausman	11393.17***
Mod. Wald	5.5e+05***
Wooldridge	87.635***
Endogeneity	1.901
Obs	15,078
Number of cities	2,513

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

Table 8 presents the impact of disaggregated FDI on the number of domestic jobs. As in table 2, we also had to treat endogeneity, autocorrelation, and heteroskedastic issues. However, model 04 also deals with endogeneity. Therefore, we employed LIML method with FE specification.

Table 8. Impact of disaggregated one-year lagged FDI on added value and number of domestic jobs

Variables	FE-DK (01)	FE-DK (02)	FE-DK (03)	FE-LIML (04)
	0.00209* (0.000822)			
		0.00507 (0.00283)		
			-0.000141 (0.00190)	
				-0.0109*** (0.00223)
	-0.0305 (0.0988)	-0.0300 (0.0985)	-0.0303 (0.0989)	-0.164*** (0.00369)
	0.00421* (0.00202)	0.00419* (0.00201)	0.00424* (0.00207)	-0.0112*** (0.00410)
	0.00420** (0.00154)	0.00416** (0.00155)	0.00425** (0.00144)	0.00532*** (0.000577)
	0.000500*** (5.94e-05)	0.000503*** (5.85e-05)	0.000502*** (5.95e-05)	0.000437*** (0.000124)
Constant	0.00303*** (0.000555)	0.00304*** (0.000558)	0.00306*** (0.000561)	
Hausman	11392.73***	11375.49***	11398.49***	11396.52***
Mod. Wald	5.5e+05***	5.7e+05***	5.5e+05***	6.3e+05***
Wooldridge	87.218***	88.098***	87.554***	134.708***
Endogeneity	2.024	0.117	1.963	21.130***
Obs	15,078	15,078	15,078	21.130***
Number of cities	2,513	2,513	2,513	1,927

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

The results in Table 8 can help us understand the impact of FDI in different sectors (H02). Our study divided the economic sectors by technological intensity. Our results point out that while FDI in medium-low technological-intensive sectors crowds in domestic firms, FDI in high-tech sectors crowds-out host firms. The regression coefficients yield some intriguing results as well. Although FDI can have a positive or negative impact on the number of jobs in domestic firms

depending on the sector, the positive impact of FDI in medium-low technology sectors (coefficient 0.00209) is weaker than the negative impact of FDI in high technology sectors (coefficient -0.0109***).

3.5.2. ROBUSTNESS CHECK

To further evaluate if our estimations are consistent, we test the crowd-in/out effects under an alternative specification. Table 9 shows the results with a trimmed sample, excluding the 2.5% top and bottom values of FDI.

Table 9. Impact of one year lagged FDI on the number of domestic jobs (sensitivity test)

Variables	FE-DK
	0.00213*** (0.000562)
	0.0161*** (0.00253)
	-0.00275** (0.00119)
	0.00138*** (0.000236)
	0.000364*** (3.47e-05)
Constant	
Hausman	3991.99***
Mod. Wald	8996.69***
Wooldridge	81.471***
Endogeneity	14.116***
Obs	11,695
Number of cities	2,339

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

In Table 10, we test the impact of disaggregated FDI in a trimmed sample.

Table 10. Impact of one year lagged disaggregated FDI on the number of domestic jobs (sensitivity test)

Variables	FE-DK (01)	FE-DK (02)	LIML (03)	LIML (04)
	-0.000178 (0.000177)			
		0.000552* (0.000225)		
			0.826 (2.206)	
				-0.00184*** (0.000525)
	0.0328 (0.0239)	0.0327 (0.0239)	0.00359 (0.0475)	0.0168*** (0.00250)
	-7.76e-06 (0.000516)	1.75e-06 (0.000517)	0.0275 (0.0826)	-0.00361*** (0.00119)
	0.00138*** (0.000260)	0.00138*** (0.000254)	-0.0198 (0.0565)	0.00147*** (0.000236)
	0.000387***	0.000386***	0.000283	0.000370***

Variables	FE-DK (01)	FE-DK (02)	LIML (03)	LIML (04)
	(4.27e-05)	(4.23e-05)	(0.000487)	(3.43e-05)
Constant	0.000833***	0.000828***	-56,458***	-56,430***
	(7.22e-05)	(7.05e-05)	(841.6)	(853.9)
Hausman	4019.61***	3985.95***	4006.83***	4012.69***
Mod. Wald	9192.98***	9156.08***	9144.19***	10749***
Wooldridge	81.547***	81.582***	81.199***	102.217***
Endogeneity	1.714	0.085	21.875***	6.329**
Obs	14,262	14,262	11,695	11,695
Number of cities	2,411	2,411	2,339	2,339

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

3.6. DISCUSSION

This study empirically examines the impacts of FDI on the regional economy, specifically the crowd-in and crowd-out effects. The literature on crowd-in and crowd-effect is extensive (Adams, 2009; Avcı & Akin, 2020; Djokoto, 2021; Gondim et al., 2018; Jude, 2019; Kurtović et al., 2022) but insufficient (Jude, 2019) and also presents contradictory results (Avcı & Akin, 2020; Gondim et al., 2018). Therefore, analyzing those effects is critical, especially for a major emerging economy like Brazil, one of the largest Latin American recipients of FDI. Furthermore, this study not only examines the effects of FDI on domestic firms but also by segmenting FDI by the technological level of the sector in which FDI is inserted.

The first stage of our empirical analysis reveals that MNEs positively impact job creation in domestic firms in Brazil, which is an indicator of crowd-in (H1). We argue that although FDI is an important driver of economic growth, it alone is insufficient, and to maintain steady growth, policymakers should also consider domestic investments (Avcı & Akin, 2020). Therefore, a positive impact of FDI on domestic investments is crucial to enhance economic growth. We used FDI values lagged in one year to observe positive FDI effects over time (Avcı & Akin, 2020; De Backer & Sleuwaegen, 2003; Djokoto, 2022; Jude, 2019). According to De Backer and Sleuwaegen (2003), while FDI may have a short-term crowd-out effect, policymakers should not overlook the positive long-term effects of MNE presence. These long-term benefits can mitigate or even reverse the negative impact of MNEs. One explanation is that it takes time for domestic firms to establish trade links with local firms (Jude, 2019), which eventually pays off and leads to crowd-in (increasing domestic investments).

In our model, we also use control variables. Not surprisingly, population density appears to be positively and significantly related to the number of domestic jobs. This is because higher density areas are typically more urbanized, and urbanization can boost job creation (Hoogstra & van Dijk, 2004). This theory can also help explain why the economic complexity index (ECI) has a positive relationship with domestic jobs. This result can be explained by the fact that complex

activities are usually located in large cities (Balland et al., 2020), and large urban agglomerations have a sufficient number of different pieces of knowledge to support complex economic activities. Therefore, large urban agglomerations have a higher ECI and a higher number of jobs, including domestic jobs.

Institutional quality (*FIRJAN*) also has a positive relationship with the number of jobs in domestic companies. This result is in line with those found by Tan and Tran (2017). The author found a positive relationship between local governance and firm productivity. As a result, regions with higher institutional quality may have more productive firms, which is important for improving firm capacity to absorb positive FDI externalities. Over time, those positive externalities develop to crowd in.

The second stage of our empirical analysis consisted in analyzing the effects of FDI segmented by the level of technological intensity of the sector where FDI is inserted. Although aggregated FDI causes crowd-in, this result is not homogeneous when FDI enters into different sectors (H2). FDI in medium-low-technologically intensive sectors has a crowd-in effect. However, FDI in high-tech sectors negatively impacts domestic firms' jobs. This is an unprecedented result that defies expectations based on the spillover literature. Multinational corporations in high-tech sectors are expected to have large amounts of knowledge that can be converted into positive externalities for domestic firms. In this case, however, the presence of MNEs in high-tech sectors reduced the number of jobs in domestic firms. This could happen due to Brazil's recent deindustrialization process (Cypher, 2015; Silva, 2019). With a lack of policies that stimulate domestic firms in high-tech sectors, Brazilian firms may lack the absorptive capacity to process the knowledge brought by MNEs in more advanced technology sectors. The negative effects of this type of investment (more competition with domestic firms) cannot be offset by knowledge advances brought to the region if Brazilian enterprises are not able to capture favorable FDI externalities. As a result, policymakers must be cautious regarding FDI in high-tech sectors. This type of investment must be directed in conjunction with policies that strengthen domestic companies' ability to capitalize on MNEs' positive externalities.

We also know that our proxy for crowd in and crowd out is highly sensitive to those factors since we use the number of jobs in domestic firms. However, we should not neglect that labor input, including the number of workers, is determinant for long-term economic growth.

3.7. CONCLUSION

FDI is an important driver of economic development. However, FDI attraction as an isolated policy can be insufficient to ensure steady economic growth. Therefore, considering the

effects of FDI on the regional economy, especially on domestic firms, it is required to guarantee that FDI attraction policies will be “*de facto*” beneficial to the economy in the long run. This study analyzes the impact of FDI on domestic firms by measuring how FDI intensity affects domestic jobs. Our results point out that FDI can benefit domestic firms, enhancing the number of jobs in host firms in regions where FDI is inserted. In other words, FDI crowds in domestic firms, and the increase in domestic jobs is an effect. However, FDI in high-tech sectors should be viewed with caution since it has the potential to harm the regional economy, decreasing the number of jobs in host firms.

It is worth noting that policies to attract FDI should consider regional features. Since Brazil is a country with highly uneven social, cultural, economic, and geographic characteristics, it is crucial to consider those when modeling the impact of FDI.

This study used a single dataset covering all municipalities in the country over seven years. However, some limitations should be mentioned. Our proxy for measuring crowd-in and crowd-out effects is extremely sensitive to factors such as sectoral labor intensity, labor migration, and changes in the number of inhabitants. However, as our study contemplates only a short time interval, these factors should not significantly interfere with our results. We also recognize that the crowd-in and crowd-out effects also depend on other characteristics of the FDI, such as the identification of the type of connection with domestic firms, the type of FDI (Mergers and Acquisitions) or greenfield input, or even the regional absorptive capacity. However, this information is limited and could not be included in this study.

Knowing the impact of FDI on domestic companies based on the level of technology of the FDI entry sector can be strategic information for developing policies to direct this type of investment. Hence, we recommend that the analysis conducted in this study be replicated for other emerging countries.

SECTION 4. The role of regional absorptive capacity on the FDI and Economic Complexity Nexus: A Brazilian investigation

4.1. OVERVIEW

This section aims to analyze the impacts of FDI on economic complexity at the regional level. However, we expand this analysis by adding the absorptive capacity as a moderator effect of this impact. To address this, we employ a unique Brazilian database of FDI intensity at the municipal level. This section seeks to achieve the fourth and fifth research goals presented at the end of section 1 of this dissertation: “*Examine the impact of FDI on regional economic complexity*” and “*Measure the effect of absorptive capacity on the impact of FDI on economic complexity.*”

4.2. INTRODUCTION

Foreign Direct Investment (FDI) is an essential element of economic growth since FDI fills local funding gaps, provides foreign demand to buy local goods, stimulates local infrastructure to export, enhances labor skills, creates new jobs, and enables knowledge spillover effects on local firms (Blomstrom et al., 1992; Borensztein et al., 1998; de Mello, 1999; Hansen & Rand, 2004; Iamsiraroj, 2016; Kalai & Zghidi, 2019).

Nonetheless, economists are focusing the FDI-related research on the productive structure and issues of diversity and capabilities. *De facto*, understanding how a nation can produce sophisticated goods and boost its product diversity is more imperative than studying GDP growth or Total Factor Productivity (TFP) alone, as Kannen (2020) pointed out. For example, the author argues that a region's TFP may be high due to the efficient manufacturing of potato chips, but complexity indexes should be used to account for product sophistication (e.g., potato chips versus computer chips).

Economic complexity (EC) is related to the number of different activities (e.g., marketing, finance, technological development, human resources, and law) a nation has available to combine its accumulated knowledge to make products. In other words, EC is linked to the capability set of a society (Hausmann et al., 2013). Within this approach, two distinct concepts must be clarified: diversity and ubiquity. Diversity is related to the variety of products from a country's export basket, reflecting its productive structure and ability to combine knowledge (Hausmann et al., 2013; Neagu, 2019). On the other hand, ubiquity refers to the number of countries exporting a product (Hidalgo & Hausmann, 2009). A ubiquitous good can be manufactured and exported by many countries, whereas non-ubiquitous ones are rare. The later goods are classified into two types: those with a high technological content (such as airplanes and x-ray machines) and those that are scarce in nature (niobium and rough diamonds, for example). As a result, producing non-

ubiquitous goods does not guarantee that a region is economically complex. Furthermore, goods classified as non-ubiquitous due to their production difficulty (high technological content) usually necessitate the use of multiple skills and different pieces of knowledge (Balland et al., 2020; Balland & Rigby, 2017). The EC approach aims to combine knowledge to produce sophisticated (i.e., high-tech) goods. Complex products are less ubiquitous, as only a handful of countries can produce the technology competitively. Consequently, ubiquity deals with the relative scarcity of a product and the comparative advantage that a few countries have in their ability to produce it.

From the EC perspective, science and technology in innovation are essential driving forces behind a society (Hausmann et al., 2013; Moed, 2002; Sepehrdoust et al., 2019) and represent the power to create wealth and economic development through sophistication (Gala et al., 2018; Hausmann et al., 2013; Kannen, 2020). Hence, complex economies are expected to have a diverse export basket, including fewer ubiquitous products. Conversely, less sophisticated economies are expected to exhibit less diversity and have more ubiquitous products (Hidalgo & Hausmann, 2009; Neagu, 2019).

Considering that Brazil is moving along an unstable path toward sophistication, we are interested in studying how foreign investments may facilitate the development of local EC. But how does FDI contribute to developing its host's EC?

Briefly, foreign firms may share knowledge and technology with local suppliers, thus providing better inputs and facilitating product innovation. FDI may also force competition and force innovation once more (Javorcik et al., 2018; Kim, 2015). Moreover, multinational companies may invest in high-skilled workers, provide education and training, and facilitate labor mobility (Blomström et al., 2001; Sari, 2019). This interaction facilitates product innovation and both horizontal and vertical spillovers from FDI. Moreover, an agglomeration of diverse economic activities, which may occur through inward FDI, plays a significant role in product and knowledge recombination (Griffith et al., 2017; Olsson & Frey, 2001; van den Bergh, 2008). We argue that the presence of multinationals may increase the knowledge pool of a region, and these multiple channels may boost regional EC.

However, EC is (not surprisingly) a complex issue. Studying EC in emerging economies is even more complicated due to these economies' heterogeneity and regional differences (Sun et al., 2015). A few scholars argue that EC, as well as possible effects from FDI, depends on the local conditions and capabilities of the host. Here, the concept of Absorptive Capacity (AC) emerges. A good level of AC enhances the ability of a region to identify, assimilate, and exploit knowledge, allowing national companies to imitate and absorb production methods and organizational and managerial techniques from multinational companies (Apriliyanti & Alon, 2017; Ascani &

Gagliardi, 2015; Blalock & Simon, 2009; Cohen & Levinthal, 1989, 1990; Damijan et al., 2013; Girma, 2005; Görg & Greenaway, 2003; Haskel et al., 2007; Kim, 2015; Lane & Lubatkin, 1998; Li-Ming et al., 2016; Liu & Buck, 2007; Ubeda & Pérez-Hernández, 2017; Zahra et al., 2002). Local cognitive capabilities enable the exploitation of positive spillovers from FDI, as a comparative advantage is necessary for developing complex products (Ferrarini & Scaramozzino, 2016).

Hence, we argue that FDI may be beneficial when the region shows a satisfying AC level. In a sense, the lack of regional FDI data and the inclusion of AC (and other regional characteristics) may result in inadequate conclusions. Consequently, the interaction between FDI and AC should be analyzed. Unfortunately, regional FDI and AC studies are rare, mostly due to the lack of data.

Nonetheless, emerging economies are receiving significant attention within the international business literature, and a foreign presence is increasing in such regions. Moreover, despite possible challenges for FDI-driven effects, there is a trend in R&D internationalization — historically concentrated in developed countries — in less-developed economies (e.g., Brazil, China, and India) (Gala et al., 2018; Papanastassiou et al., 2020; Zhao et al., 2021). To study inward FDI in Brazil is, therefore, of great importance, especially considering Brazil's current de-industrialization, “fiscal war,” and ongoing growth issues (Arbix, 2000; Bernardi & Floyd, 2018; Cypher, 2015; Mattos et al., 2017; Nunes & Nunes, 2000; Silva, 2019). Furthermore, because FDI has the potential to spur regional innovation, it has the potential to impact the EC as well. Furthermore, studies have highlighted the potential of AC to enhance the benefits of FDI (Coulibaly et al., 2018; Morales & Moreno, 2020; Nguyen et al., 2018; Nguyen & Su, 2021). As a result, policymakers must assess the impact of FDI and AC on EC in an emerging economy, as increasing economic sophistication is critical to the creation of wealth and economic development in emerging economies (Gala et al., 2018; Hausmann et al., 2013; Kannen, 2020). Moreover, a regional approach towards this issue facilitates discovering the real effects of FDI and AC in regard to EC.

Our investigation contributes to the literature in two ways. First, we contribute by measuring the impact of FDI and AC on EC in an emerging economy, an issue still poorly addressed by the literature. Second, we employ regional-level data for FDI, which is a challenge for researchers worldwide, especially in Latin America. To our knowledge, no study has employed municipal-level data regarding FDI in Brazil, which is essential considering the country's heterogeneity. Furthermore, our findings matter for policy, as sophistication matters for economic growth. Our study sheds light on the importance of FDI along with the minimum AC level necessary for Brazilian regions to benefit from foreign investments.

4.3. LITERATURE REVIEW

4.3.1. FDI AND ECONOMIC COMPLEXITY

New economic sectors have been created since the Industrial Revolution. This event changed products, required more social actors, and transformed the productive structure of countries (Saviotti et al., 2020). This transformation is important, as a restrictive productive structure is responsible for problems regarding economic growth (Haq & Zhu, 2019), employment, and income distribution (Ali & Cantner, 2020). These issues have been investigated by the EC approach. To produce technological-intensive products, a nation needs to combine several activities, productive sectors, and its available knowledge (Hausmann et al., 2013). The combination of knowledge provides a sophisticated productive structure. Hence, EC generates wealth, as competitive advantage increases the export of high-tech products.

Despite the fact that the concept of complexity is not new in economic theory (Colander, 2002), it has reemerged as a trend in literature since Hidalgo and Hausman (2009) introduced the economic complexity index (ECI). Tacchella et al. (2013) presented ECI+ not long after, but the ECI remains the most commonly used method to measure economic sophistication, with several studies using it (Albeaik et al., 2017; Hausmann et al., 2013; Javorcik et al., 2018). ECI is calculated using data from the United Nations (Hausmann et al., 2013) and quantifies the productive structure of a country. The Index reviews the macroeconomic role of structural transformations and shows that a high index means a more complex economy (Hausmann et al., 2013; Tacchella et al., 2013). From the ECI, it is possible to infer the capabilities of a country by analyzing its export specialization profile (Hausmann et al., 2013). However, sophistication is only possible when a country has a set of advanced skills and the ability to combine them effectively (Sbardella et al., 2018).

Seeking this set of skills, nations may develop strategies aimed at opening the country for foreign investors and the variety of expertise that they bring. Thus, when considering FDI-driven effects on EC, three distinct avenues should be considered. This perspective and the role of FDI will be discussed further.

The first avenue is related to the idea of product upgrading. In sum, local firms are more likely to supply foreign enterprises, being stimulated by them to develop more complex products, given the technological superiority of foreign companies (especially those from developed countries). Within this interaction, the reverse route also occurs, as multinationals will provide local producers with better inputs, thus facilitating product innovation (Javorcik et al., 2018). Likewise, multinationals will tend to transfer technology to regional suppliers to be provided with better inputs, thus deliberately generating vertical knowledge spillovers (Aitken & Harrison, 1999;

Kim, 2015). In addition to the increase of export quality, FDI may exert an effect of demonstration and competition on local enterprises, which forces improvements in the products and services of local organizations and encourages product innovation (Lin & Lin, 2010; Xie & Xue, 2020).

Although it is more pronounced for export-oriented firms (Djulius, 2017; Ebghaei & Akkoyunlu Wigley, 2018), the second avenue is the occurrence of horizontal spillover, which occurs through two main channels. The first one is the demonstration effect that occurs through observation, as competition forces local firms to be more efficient by applying modern production methods and developing better managerial skills. The second avenue relates to labor mobility within industries (Blomström et al., 2001; Sari, 2019), which can be considered the determining factor for deepening the municipal EC resulting from the presence of multinational companies, as they will provide a more highly skilled labor pool for local firms, enabling them to offer goods and services that they were not capable of providing before. Furthermore, FDI may be positively related to investments in education and health, especially in emerging markets, as multinational enterprises partially substitute for the state in either building infrastructures or providing education (Doh et al., 2017; Lehnert et al., 2013). To exemplify this, evidence points to international enterprises providing the local workforce with professional training initiatives (Del Giudice et al., 2019).

The last avenue is the idea of knowledge recombination. Though the notion of innovation as a result of new combinations goes back to Schumpeter, recombination is now an alternative when either the organizational culture or the financial structure of organizations does not allow them to incur risks inherent in R&D projects (Guan & Yan, 2016). Thus, recombinant innovation (or modular evolution) plays a relevant role in technological progress, as the existence of diverse economic activities can incite the emergence of innovations by combining previously existing units or technologies into a previously nonexistent one with new emergent features, implying that knowledge can be built upon itself, with significant results in terms of economic growth (Griffith et al., 2017; Olsson & Frey, 2001; van den Bergh, 2008; Zhu & Li, 2017). Here, we argue that the greater variety of products can create an environment favorable to recombination processes, which deepens the regional EC. Also, Balland and Rigby (2017) state that the more complex the activity, the greater the need for specialization in different areas of knowledge.

However, in this discussion, a few critical voices point to the practical difficulties of the FDI-driven boost in ECI. Product upgrading in developing economies may be prevented by appropriability issues (Javorcik et al., 2018). In fact, many multinational companies tend to protect their technological core, as exposed by Gala, Camargo, and Freitas (2018), through network analysis and computational methods, showing that countries with higher incomes concentrate on

producing complex goods at the center of the world trade network. In contrast, lower-income countries specialize in producing non-complex goods at the network's periphery. In other words, the development and production of products with greater added value remain in the home country. Also, some authors argue that FDI may stagnate growth, as foreign investments often occur through mergers and acquisitions, creating monopolies and decreasing competition (Bos et al., 1974), or even stealing market share from local enterprises, given the reduction of relative productivity (Aitken & Harrison, 1999; Kim, 2015; Lin & Kwan, 2016), especially within the intra-industry case for emerging economies (Gerschewski, 2013).

Therefore, there is no consensus in the literature about the relationship between FDI and EC (Harding & Javorcik, 2012; Javorcik et al., 2018; Wang & Wei, 2008). For the purpose of this study, we argue that FDI provides new investments, knowledge, qualified human capital, and a transformation of the host's economic structure with the presence of multinational companies. Building on the previous literature, we propose the following hypothesis:

H1: FDI develops the regional productive structure in developing economies by having a positive effect on economic complexity.

4.3.2. REGIONAL CAPABILITY AND ABSORPTIVE CAPACITY

Regarding the lack of consensus on the effects of FDI on the economic structure of the host region: One relevant aspect of this discussion is the role of regional capability. Although the literature points to diversity as a driver of innovation through recombination within a symbiotic process (Frenken et al., 2007), there are extremely relevant moderating and catalytic variables, as propounded by Lin and Chang (2015). The relationship between technological diversity and firm performance is found to be strengthened by firms' internal and external contextual factors, such as the AC.

This concept, first introduced by (Cohen & Levinthal, 1989), represents the ability of a company to recognize the value of new information from its environment, assimilate this new information, and apply it. In other words, it is the company's capacity to exploit external knowledge internally for competitiveness (Kranz et al., 2016; Sultana & Turkina, 2020). As this process is deeply related to the company's learning capabilities, AC is a dynamic skill (Aldieri et al., 2018; Sultana & Turkina, 2020). These capabilities are a product of both prior knowledge and investments in learning and teaching (e.g., human capital and R&D). To ensure a successful transfer of technology between companies (in addition to legal proprietary issues), the recipient company needs to develop its knowledge-related skills (Sultana & Turkina, 2020). Additionally, Damijan et al. (2013) found that a higher AC results in a better performance for local companies.

For this reason, AC is one of the most influential concepts in the management literature (Aldieri et al., 2018).

We expect that regions receiving FDI show greater EC. Since knowledge transfer is definitely stronger at domestic firms located in cities with intensive inflows of FDI (Lin & Kwan, 2016; Merlevede & Purice, 2016), we suppose that these regions must also have highly qualified professionals with access to international strategic knowledge (Khordagui & Saleh, 2016; Silajdzic & Mehic, 2015). This is important because regions must absorb knowledge through skilled workers (Ferrarini & Scaramozzino, 2016; Tacchella et al., 2013) and diversify their human capabilities (Gala et al., 2018). From the EC perspective, knowledge is essential to produce a variety of technological products, which explains the differences in countries' economic performance (Cristelli et al., 2015; Rodrik, 2006; Saviotti & Frenken, 2008). For this reason, a complex region has to create human capital with high professional skills and train unskilled workers to spread knowledge during working routines (Agosin & Machado, 2005; Cristelli et al., 2015; Ferrarini & Scaramozzino, 2016; Hidalgo et al., 2007; Szulanski, 2000).

Recent studies have found that FDI is influenced by the host country's institutions and infrastructure endowment (Cai et al., 2019; Rehman et al., 2020), and even how unstable environments can affect AC (Mäkinen & Vilkkö, 2014). In this sense, regions with low AC are less capable of decoding and efficiently exploiting new knowledge, both locally produced and originating from outside. On the other hand, a higher AC allows a region to transform its productive structure, as AC can spread knowledge between local and foreign companies and across the region's economic sectors. Moreover, taking advantage of AC, a region can provide technological changes, presenting national enterprises with new organizational methods and innovation processes.

Sharing the same view as previous studies on the interaction between FDI and AC on economic growth (Durham, 2004; Khordagui & Saleh, 2016; Smith & Thomas, 2017; Sánchez-Sellero et al., 2014), we argue that this phenomenon also affects EC (Audretsch & Feldman, 1996; Bruhn et al., 2017). Combining the FDI and AC, a region can overcome its financial constraints and spread knowledge within its economic sector. In Brazil, Silveira et al. (2017) found that economic activity, wages, and productivity are positively related to FDI flows. In other words, a region must recognize the value of new information, making possible its assimilation and adaptation, which will allow its application for commercial purposes (Cohen & Levinthal, 1989; Mowery et al., 1996). Moreover, not considering AC may lead to inadequate results (e.g., a non-significant effect of FDI), as regional characteristics should be considered when investigating the local role of foreign investments.

Such discussion is commonly present in FDI-related studies using country-level data. After all, aggregate data may hinder significant effects of FDI, and also cover possible negative effects from FDI or other variables. However, some authors argue about the importance of analyze the absorptive capacity at microscales, since this factor also depends on geographic proximity between foreign invested and domestic firms (Gorodnichenko et al., 2014; Thang et al., 2016). We argue that regional-level data and local characteristics may present substantial evidence of the real effects of FDI, AC, and EC. This study will confirm (or not) the findings of previous studies (Aldieri et al., 2018; Iwamoto & Nabeshima, 2012; Javorcik et al., 2018; Kannen, 2020; Nguyen & Su, 2021) by analyzing the problem at the regional level. This is especially relevant considering the heterogeneity across Brazilian regions, as well as the different amount of foreign investment each region receives.

In this sense, we propose our second hypothesis as follows:

H2: The impact of FDI on economic complexity is moderated by the level of AC available in the region

4.3.3. THE CASE OF BRAZIL AND ANECDOTAL EVIDENCE

Several studies show a positive relationship between the presence of FDI, EC, and product diversification (Iwamoto & Nabeshima, 2012; Javorcik et al., 2018; Kannen, 2020), and previous studies suggest that this process takes time (i.e., use of lagged FDI variables) since host firms may take time to assimilate the effects of FDI. Furthermore, expanding the analysis of the impact of FDI on economic complexity is extremely important, particularly for emerging countries.

Brazil is one of the largest recipients of FDI in Latin America, and although its ECI has been increasing in recent years, some authors claim that the country is undergoing a process of de-industrialization (Cypher, 2015; Silva, 2019). Although economists disagree on the reasoning behind this issue (and this study will not further discuss it), de-industrialization may be one of the reasons for the fall of ECI rank in the last decades. For example, Brazil had the world's 26th most sophisticated economy in 2000, but by 2020, it had dropped to 60th place, according to the Atlas of Economic Complexity.

Agri-related activities have less potential to enhance the industrial and service sectors, as fewer capabilities are needed (Kannen, 2020). Even when machinery is necessary, farmers can simply import it. The country must produce tractors, fertilizers, and other complex products if EC is the goal. The potential for specialization is greater in manufacturing than in other sectors (Gala et al., 2018). Even the service sector largely depends on industry-related activities. The

development of new services depends on the industry's structural and technological composition (Guerrieri & Meliciani, 2005).

From this perspective, de-industrialization is a major issue. Concurrently, FDI did not show stable growth since the beginning of the 2000s. This is worrisome, as FDI is arguably a great source of technology and industry-intensive activities. If FDI continues to decrease, the industrial (and therefore EC) side of Brazil may worsen with time. Therefore, the presence of FDI is essential for the maintenance of industrial activity in the country, since it is a driving force for innovation.

To corroborate this idea, we use cases of multinationals and Brazilian companies and other national agents working towards innovation. For example, the Brazilian sugarcane sector was historically made up of family businesses. Since the economic liberalization, this sector has received foreign investments, increasing the market share of multinational companies (Viana & Perez, 2013) and diversifying the sector and its products, such as biofuels, bioplastics, and alternative energy (Scheiterle et al., 2018; Viana & Perez, 2013). One successful case is the joint venture between the multinational Shell Fuel SA and the national company called Cosan SA (Shell, 2019), the Raizen group.

Moreover, Siemens, originally from Germany and one of the most innovative companies in the world, has almost 110 years of history in Brazil in all types of segments. A new R&D facility was inaugurated in 2014 with a focus on improving cutting-edge technologies. The facility is located in Belo Horizonte (state of Minas Gerais) and was originally a local software development and energy solutions company (Senergy), which has now been acquired by Siemens. Additionally, Siemens has 7 “Non-routine Research, Development, and Engineering” centers around the country, employing approximately 500 highly-skilled engineers, PhDs, and other professionals (Siemens, 2014).

Furthermore, ArcelorMittal Brazil, part of the ArcelorMittal group with headquarters in Luxembourg, is investing in developing new products and industrial processes in Brazil. The group inaugurated its 12th R&D center in Tubarão (state of Espírito Santo) in 2015, and the research includes multiple industrial sectors (e.g., energy, machinery, automotive, oil, off-shore, and civil) and involves developing cleaner solutions. In Brazil, the company is also forming research-based partnerships with local universities such as the University of São Paulo (USP). In addition to research, new materials have already been developed, such as lighter and more resistant automotive steel (ArcelorMittal, 2020; Forbes, 2017).

Accordingly, we argue that FDI can enhance its host's EC through multiple channels and may be an important tool to break the current de-industrialization process. Thus, a study

considering the FDI–ECI nexus, especially including locational factors, is of pronounced importance for policymakers.

4.4. METHOD

4.4.1. DATA AND FDI MEASURE

This study will employ the ECI, proposed by Hidalgo and Hausmann (2009) in their seminal paper, as the dependent variable. This index represents the municipality's complexity based on its export basket. It combines, as previously explained, the complexity and ubiquity of goods a region produces, therefore representing the region's capacities.

Moreover, we use FDI as the main explanatory variable along with the AC, which will be explained in a separate topic. Resembling other developing economies, the Brazilian government does not account for the regional-level inward FDI. Thus, we create a regional-level FDI proxy by employing export data from the Brazilian Integrated Foreign Trade System (SISCOMEX) presented in equation (04).

$$\text{—————} \tag{04}$$

Where Foreign is the number of exporting multinational companies in the region “j,” Total is the total number of exporting companies (domestic and foreign) in the region j, and W is the adjustment weight for each company by their exported value within the region j.

Unfortunately, the Brazilian government also does not show whether a single company is either nationally or internationally based, necessitating a manual check of the registers of approximately 40,000 exporting companies. We manually checked the corporate structure of each of the 40,000 observations to identify the company's origin and thus define whether it is a domestic firm or an MNE. This fact shows the difficulty in obtaining regional FDI data, which explains the small number of municipalities in our sample, which contains 198 municipalities (see Appendix D) between 2011 and 2015. This obstacle is common in FDI studies, and scholars, such as Chen et al. (2019), are often faced with the challenge of creating FDI databases manually.

In fact, some municipalities in Brazil do not present any relevant economic activity, whereas others present a wide range of it. Thus, to both guarantee a certain degree of randomness in the choice of municipalities and allow hypotheses to be tested under appropriate conditions, it was decided to choose cities that had at least one company listed on the São Paulo Stock Exchange (Brazil). This makes our sample contain both small and large cities and also ensures the representativeness of geographic regions similar to the regional participation on Brazilian GDP. Thus, this sample holds for 51% of the Southeast, 32% of the South, 11% of the Northeast, 4% of the Midwest, and 1% of the North and the Federal District.

Finally, as our regional FDI intensity variables are export-related, our immediate concern relates to the presence of foreign firms that are not oriented toward export activities, neglecting, therefore, part of the FDI phenomenon.

However, it should be noted that the export data from SISCOMEX represent the total population of exporting companies. Thus, each single or micro export is accounted for, enabling the proposed FDI measure to capture a significant part of the regional FDI intensity. Indeed, even if a foreign company looks exclusively at the Brazilian domestic market, part of its production may end up being exported to neighbors such as Paraguay, Uruguay, Argentina, and Bolivia, making its presence within Brazilian territory accounted for by the SISCOMEX system. The case of Paraguay clearly displays the described dynamics, as it is basically a producer of commodities such as soybeans, and it ends up importing a wide variety of products from Brazil. As a result, 22% of Paraguay's imports come from Brazil, according to the Brazilian Central Bank.

Furthermore, to avoid specification problems, our models include multiple control variables. Following previous research, we use the municipality's per capita GDP (GDPPC), the ratio of GDP value added from agriculture (AGRO), the ratio of GDP value added from industry (IND), population density (DENS), the work quality measured by the number of works that requires college education (WQ), and institutional quality measured by the FIRJAN index (IFGF).

In sum, per capita GDP shows how relatively rich a region is, being one of the factors that most strongly influence economic diversification (Yalta & Yalta, 2021), and a higher per capita GDP may represent a consumer preference in favor of diversified products (Elhiraika & Mbate, 2014). Also, as EC deals mainly with industry and service-related activities, we add AGRO and IND to show how dependent on agribusiness and industry the region is, similar to Lapatinas (2019). DENS is added to deal with the region's demographic profile and the idea of spatial clustering and agglomeration facilitating the flow of ideas and innovation (Azam, 2017). We also added WQ. After all, complex economies have productive networks in manufacturing and advanced service sectors, with increasing returns to scale, which may reveal higher individual worker productivity and the need for higher work qualification and specialization (Gala et al., 2018). Finally, we needed a variable to deal with institutional quality that is different depending on the municipality

It is worth noting that all variables have been normalized between 0 and 1 (i.e., min-max normalization). This procedure preserves the original relationships between the original values while lowering the standard deviations, which can mitigate the effects of outliers in the sample. Moreover, Appendix E shows a brief description of the variables and their sources, and Appendix F shows the descriptive statistics.

4.4.2. ABSORPTIVE CAPACITY ESTIMATION

This study will employ the absorptive capacity (AC) variable as both an independent variable capable of explaining ECI and a moderator capable of influencing the interaction between the FDI and the ECI.

Some studies, such as Girma (2005), have indicated that foreign investments' effects on productivity growth depend on AC. Here, we argue that a similar relationship exists between FDI and ECI.

Girma (2005) proposed an AC measure by dividing the TFP of the previous period divided by the maximum TFP level among all regions. Denoting the maximum TFP level in Brazil at time $t-1$ by TFP_{it-1} , the AC is expressed as presented in equation (05).

$$\text{AC}_{it} = \frac{TFP_{it}}{TFP_{it-1}} \quad (05)$$

Therefore, the proposed AC calculation measures the decision unit's degree of success through the effort to generate the maximum possible amount of output from a given set of inputs. Thus, using the author's methodology to calculate the AC is justified, and not only relying on the use of proxies to replace this factor, which may become very limited.

4.4.3. ECONOMETRIC MODEL AND ESTIMATION STRATEGY

To test the previous hypotheses, we formulated the econometric model presented in equation (06), which measures the impact of the FDI moderated by AC on EC in Brazilian municipalities. We applied a one-year time lag to FDI, seeking theoretical adequacy and previous studies (Iwamoto & Nabeshima, 2012; Javorcik et al., 2018; Kannen, 2020).

(06)

Where EC_{jt} is the ECI for municipality j in time t , X is the set of control variables, FDI_{jt-1} is the one-year lagged value of FDI, AC_{jt} is the Absorptive Capacity, α_j represents the regional time-invariant characteristics, and ϵ_{jt} is the residual error. We also have used the Variance Inflation Factor (VIF) to verify possible multicollinearity issues.

Two estimation methods were employed to explore our data. Initially, we used the Feasible Generalized Least Squares (FGLS), as presented by Parks (1967), to deal with the problems of heteroskedasticity and autocorrelation. Although it is typically a random-effects estimation method, a fixed-effects Feasible Generalized Least Squares (FEGLS) has been performed by employing mean-centered (within groups) data to deal with both issues (Croissant & Millo, 2008; Wooldridge, 2010). Finally, we have added an additional fixed-effects method: the Driscoll–Kraay (DK) estimation. The DK standard errors are heteroskedasticity- and autocorrelation-consistent, in addition to being robust to spatial and temporal dependence, regardless of either the number or

the size of panels (Driscoll & Kraay, 1998). Thus, we aim to present the robustness of the linear results by employing different estimation methods.

Moreover, as pointed out by the literature, companies need a certain level of AC before they can benefit from the technologies developed by other companies. In this context, we propose to analyze the possible thresholds of FDI and AC to identify whether there is a certain point where AC and FDI will affect the EC differently or if there is, in fact, linearity between these variables.

We evaluate the possible non-linearity of the explanatory variables (FDI and AC) concerning the dependent variable (ECI) through the following model in (07).

(07)

Where $I(\cdot)$ represents the indicator function, and τ is the threshold to be estimated. In this equation, AC is the threshold variable, and FDI is the regime-dependent variable.

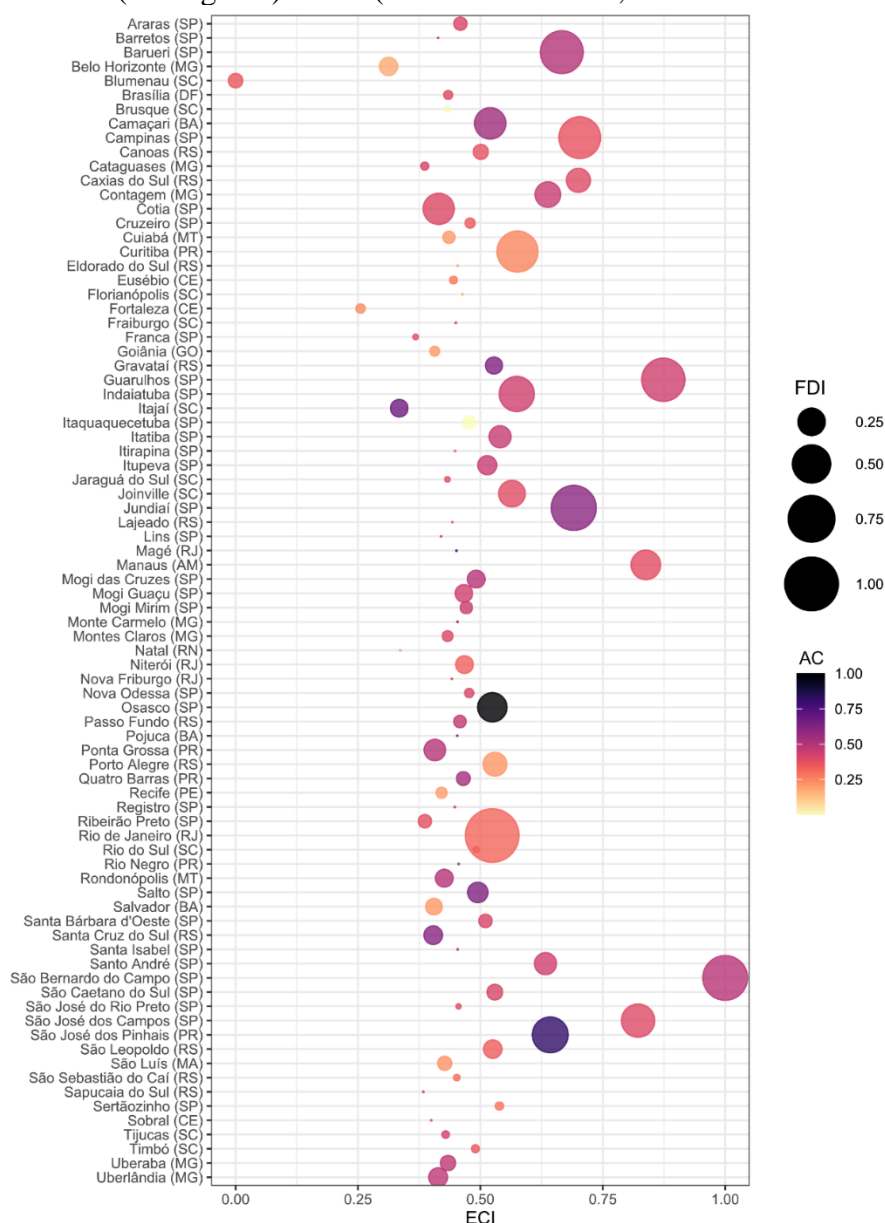
Here, a fixed-effect panel threshold model introduced by Hansen (2000) is applied. This procedure follows a set of sample quantiles (1%, 1,25%...98,75%, 99%) to estimate the threshold parameter (Girma, 2005). Then, the existence of two distinct regimes for the effects of FDI is tested () using the likelihood ratio test statistics and their bootstrapped p-values

4.5. RESULTS

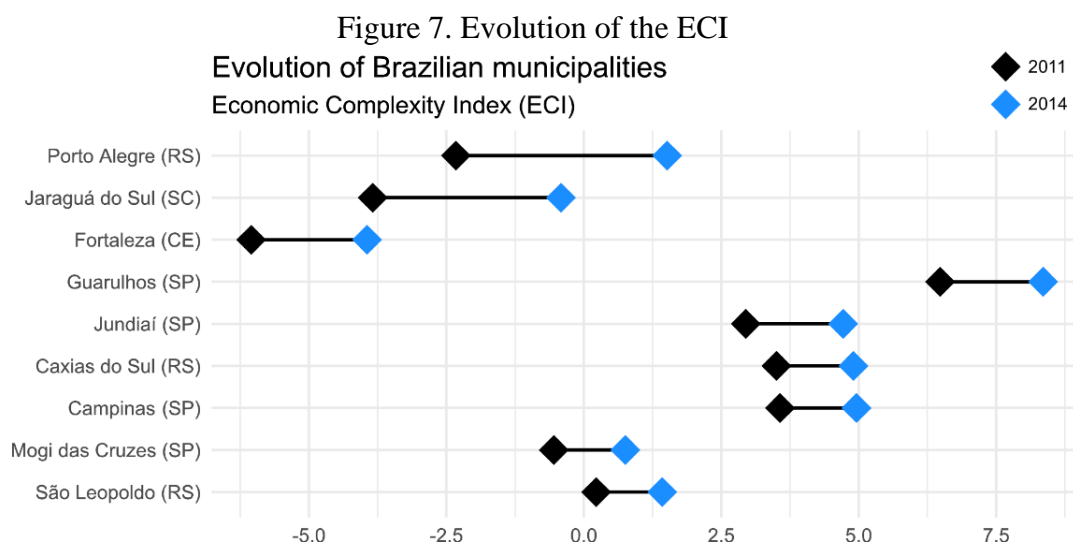
4.5.1. DESCRIPTIVE ANALYSIS

Before estimating our econometric models, a descriptive analysis was carried out. Figure 6 shows the results of an exploratory study of the data graphically. Cities with higher ECIs seem to combine a high FDI with a high AC (such as São Bernardo do Campo and Guarulhos). The opposite is also true: cities with lower ECIs have low FDIs and low AC at the same time. We can also observe that cities with high and low FDI can have similar ECIs, such as Rio de Janeiro and Osasco. The moderator activity of the AC variable can explain this. This scenario indicates that the AC may control how the FDI influences the ECI. Additionally, it is important to add that FDI and AC cannot alone explain the behavior observed for all the variables. An example of an exception to the aforementioned pattern is the existence of cities with a high ECI that, at the same time, have a low FDI and a low AC (such as Manaus).

Figure 6. Bubble plot showing the municipalities' (Y-axis) ECI (X-axis), FDI (size), and AC (color grade) levels (normalized values, 2014 data).



We also analyzed whether the period chosen was enough to capture variations in the ECI levels of the municipalities. After all, to either increase or decrease the ECI, a region needs to change its productive structure, and this process can be time-consuming. Our sample includes data from 2010 to 2014. However, we have used 2010 to calculate the MI and 2011 to create the lagged FDI variable. Therefore, our analyses employ three usable years, similar to Javorcik, Io Turco, and Maggioni (2018). Favorably, as shown in Figure 7, the municipalities presented an evolution of their productive structure during this short period, which benefits an econometric study. For example, Porto Alegre (state of Rio Grande do Sul) presented an ECI of -2.36 in 2011, which evolved to 1.51 in 2014. Guarulhos (state of São Paulo) managed to go from an ECI of 6.48 in 2011 to an ECI of 8.35 in 2014.



4.5.2. ECONOMETRIC MODELS

Table 11 presents the linear model estimates. As described previously, we employ multiple linear analyses to better comprehend the effects of our explanatory variables on ECI.

Table 11. FDI, AC and ECI linear results and interactions

Variables	(1) DK	(2) FGLS	(3) DK	(4) FGLS	(5) DK	(6) FGLS	(7) DK	(8) FGLS
<i>FDI_{t-1}</i>	0.264*	0.459***	-0.202	0.494***	0.327*	0.514***		
	(0.102)	(0.0152)	(0.145)	(0.0302)	(0.124)	(0.0233)		
<i>(FDI_{t-1})²</i>			0.721**	-0.0393				
			(0.141)	(0.0446)				
<i>AC</i>	0.213	0.133***	0.214	0.131***	0.268*	0.172***		
	(0.113)	(0.00694)	(0.110)	(0.00691)	(0.114)	(0.00661)		
<i>FDI_{t-1} x AC</i>					-0.486*	-0.291***	-0.269	0.722***
					(0.183)	(0.110)	(0.236)	(0.0873)
<i>GDPPC</i>	-0.164**	0.0264***	-0.181**	0.0176**	-0.170**	0.0317***	0.0815**	0.0918***
	(0.0346)	(0.00712)	(0.0367)	(0.00848)	(0.0470)	(0.00712)	(0.0233)	(0.0141)
<i>DENS</i>	0.0828	0.138***	0.0687	0.140***	0.0622	0.137***	-0.402	0.137***
	(0.216)	(0.0128)	-0.218	(0.0131)	(0.223)	(0.0126)	(0.295)	(0.0122)
<i>IND</i>	-0.00698	0.0300***	-0.0077	0.0317***	0.0136	0.0282***	0.114	0.0316***
	(0.0511)	(0.00343)	(0.0528)	(0.00402)	(0.0184)	(0.00335)	(0.0760)	(0.00669)
<i>AGRO</i>	0.0715**	0.00515*	0.0751**	0.00608**	0.0652**	0.00733***	0.0989**	-0.0223***
	(0.0150)	(0.00285)	(0.0158)	(0.00292)	(0.0142)	(0.00262)	(0.0242)	(0.00363)
<i>WQ</i>	0.164	0.625***	0.252*	0.618***	-0.145	0.613***	-0.191	0.799***
	(0.116)	(0.0201)	(0.0881)	(0.0200)	(0.122)	(0.0237)	(0.0925)	(0.0290)
<i>IFGF</i>	-0.00498	0.00220	-0.00540	0.00252	-0.00532	0.00289**	0.00523	0.0105***
	(0.0096)	(0.00157)	(0.0092)	(0.00164)	(0.0083)	(0.00144)	(0.0134)	(0.00196)
Constant	0.135**	0.0846***	0.148**	0.0839***	0.125**	0.0811***	0.121*	0.0955***
	(0.0313)	(0.00267)	(0.0347)	(0.00285)	(0.0252)	(0.00254)	(0.0433)	(0.00418)
Observations	719	706	719	706	719	706	719	706
Number of cities	198	185	198	185	198	185	198	185

Robust standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In Brazil, a country with very heterogeneous regions, understanding the FDI impact on increasing its industrial sophistication and consequent increase in economic complexity is fundamental for developing adequate policies to encourage and attract this type of investment. Our findings show that FDI (FDI_{t-1}) significantly and positively affects ECI. This effect is shown in

models 1, 2, 4, 5, and 6. The only exception is model 3, with a non-significant and negative coefficient. However, in model 3, the quadratic term of FDI shows a significant and positive coefficient. It can be seen that the magnitude of the coefficient that explains the impact of FDI on the ECI is higher in models estimated using the FGLS method, a model that cannot deal with spatial dependence. Therefore, we believe that the DK model may be able to deliver more coherent results.

Models 3 and 4 were employed to test a possible non-linear relation between FDI and ECI, and since both models present FDI and FDI² with opposite coefficients, we will further investigate this relation employing a threshold regression. Moreover, using a lagged value of FDI, as done by previous scholars, is appropriate, as it avoids possible endogeneity issues and accounts for the time needed to accumulate capabilities brought in by FDI, also known as the problem of simultaneity (Javorcik et al., 2018; Kannen, 2020).

Thus, the effects of FDI on the ECI levels of municipalities are positive and contradict the insignificant results found by Yalta and Yalta (2021). Our results corroborate the previous findings of Kannen (2020), Iwamoto and Nabeshima (2012) (2012), Javorcik, Io Turco, and Maggioni (2018) and Longmore, Jaupart, and Riveira Cazorla (2014). FDI seems to boost regional EC, therefore increasing the diversity and ubiquity of the municipalities' exports. These results are also in harmony with the theoretical debate on FDI and the host's development, in addition to the three distinct avenues described earlier in this paper. Here, we find support for H1.

Regarding AC, the results also point to a positive and significant effect of a region's AC on its ECI level. This is shown in models 2, 4, 5, and 6. Therefore, our results suggest that a region's AC is of great importance to transforming its productive regional structure and presenting a diversified and competitive export basket. This is in line with the theoretical debate on FDI needing to use the host's previous capabilities to develop new products and increase sophistication. Also, this positive and significant effect is in line with previous studies. After all, scholars have found significant coefficients for R&D employment, human capital, and years of schooling (Azam, 2017; Javorcik et al., 2018), which can be considered as proxies for AC.

Nevertheless, we argue that the interaction between FDI and AC should be considered to understand these variables' impacts on ECI fully. Although a non-linear analysis should be performed to evade linear assumptions, we have added the interaction between FDI and AC to our linear models. A significant effect, if found, demonstrates that both variables should be analyzed simultaneously and that studies considering only FDI-related effects may be incomplete. Table 1 shows the significant effects of this interaction in models 5, 6, and 8. However, in models 5 and 6,

the interaction variable presented a negative coefficient. This may occur because in those models, we have two variables highly correlated (FDI_{t-1} and $FDI_{t-1} \times AC$).

On the other hand, there is a significant and positive effect of $FDI_{t-1} \times AC$ in model 8, where the variable FDI_{t-1} was not presented. A higher level of FDI combined with higher AC levels is a significant predictor of ECI increases. The coefficient in model 8 is higher than the coefficient in models that do not combine FDI and AC, showing that the combined variables have a higher impact on EC than FDI alone. Therefore, enhance human capital, education is crucial for regions to absorb positive externalities from FDI, and consequently enhance the impact of FDI on increasing EC. Here, though, the threshold analysis (see Table 12) should be considered before further discussing these findings.

Regarding the control variables, our models show multiple non-significant coefficients. Other studies have found it challenging to find good control variables for ECI and other diversification indexes. Nevertheless, Table 1 reveals some interesting findings. For instance, GDP per capita ($GDPPC$) is positive in all models. Indeed, rich regions can consume more sophisticated products and have better human capital, which is in line with previous studies (Hartmann, 2018; Hidalgo & Hausmann, 2009).

Additionally, our findings show a positive effect of population density ($DENS$) on ECI. Big cities tend to have a higher population density (Ahlfeldt & Pietrostefani, 2019). Therefore, our results align with those of Balland et al. (2020). According to the authors, complex activities are concentrated in large cities. Several factors can explain this, including the attraction of highly qualified professionals by high-wage, high-rent cities. This also explains the positive and significant relation between the number of works that require college education (WQ) and ECI (see models 2, 3, 4, 6 and 8).

IND is positively associated with ECI in all FGLS models, which is no surprise since some industries are often complex and require connections with several sectors to function (Neffke et al., 2011). Therefore, regions with a larger share of industrial activities tend to have higher economic complexity levels. However, $AGRO$ also has a positive and significant effect on ECI ; this was not an expected result since agriculture and livestock industries tend to develop more straightforward activities that require fewer connections with other sectors to be functional. Therefore, we suggest exploring the relationship between agribusiness and economic complexity more profoundly.

Moreover, the number of works requiring a college education (WQ) positively and significantly affects ECI (see models 2, 3, 4, 6, and 8). One factor influencing the transformation of simple to more complex industries is the accumulation of capabilities, for which human capital

is indispensable. In this context, education and jobs that require higher educational levels help the region to produce more complex products, thus boosting regional economic complexity (Hausmann et al., 2013).

Finally, the local institution quality (IFGF) only has a significant effect on models where we consider the variable $FDI_{t-1} \times AC$. This means that the quality of local governance (i.e., IFGF) can positively influence the economic complexity index. The literature (Tan & Tran, 2017) points out that the quality of governance has a positive relationship with the productivity indexes of local firms, which means that companies present in this region find it easier to remain competitive and improve their production processes. This accumulation of capabilities, as mentioned, is beneficial for the evolution of the local economy. However, this result is only valid when considering the moderation between the FDI and the absorptive capacity.

Table 12. FDI, AC and ECI threshold regression results

Variables	Threshold
$FDI_{t-3} \times hq_{t-3} \times \ddot{O}_{t-3} +$	0.111 (0.0991)
$FDI_{t-3} \times hq_{t-3} \times @_{t-3} \times c_{p f} \times \epsilon$	0.324*** (0.102)
$FDI_{t-3} \times hq_{t-3} \times @_{t-4} +$	0.151* (0.0848)
<i>GDPPC</i>	-0.0461 (0.0438)
<i>DENS</i>	-0.135 (0.294)
<i>IND</i>	0.0766** (0.0321)
<i>AGRO</i>	0.0529** (0.0243)
<i>WQ</i>	0.216* (0.111)
<i>IFGF</i>	0.00419 (0.0106)
Constant	0.109*** (0.0326)
Threshold (β)	0.6391***
Threshold (γ)	0.6563***
Observations	810
F-statistic	0.0000
Number of cities	162

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

The threshold regression shows an interesting finding. As hinted by the significant interaction term ($FDIt-1 \times AC$) in Table 12, the effect of FDI on ECI is non-linear and dependent upon the region's AC. Considering our sample, the effect of FDI is positive if the municipality presents an AC level either equal to or higher than 0.6391 (normalized value). Otherwise, there is no effect of FDI on ECI.

It is worth noting that the average effect of FDI on ECI is positive, as presented in Table 1, but only when the region presents medium or high levels of AC. Furthermore, it does show that non-linearity exists in this process and that in regions with particularly low levels of AC FDI does not affect the region route towards sophistication.

Moreover, previous scholars have shown that FDI from different sectors has distinct effects. Kannen (2020), for example, found no significant effects of primary-sector FDI on both ECI and diversification. Our findings suggest that FDI (aggregated) is positive when the host presents a minimum AC level, and, therefore, we find support for H2.

This demonstrates that in order to attract FDI, public policymakers should pay attention to the indicators that comprise the local AC. Whereas a minimum level of AC capacity is required for the regional economy to benefit from FDI presence. As a result, indicators such as average level of education and productivity of local firms, among others, must be monitored in order to determine which regions should receive FDI. Nonetheless, the reader should consider the limited amount of information our sample can deliver, and these results should be revisited in the future.

4.5.3. SENSITIVITY TEST

Analyzing local data allows us to evaluate a micro-regional phenomenon, despite the difficulty of finding available data. In this sense, a smaller number of observations might affect sample reliability, which requires robustness and sensitivity testing.

Hence, we perform a sensitivity test. The goal is to check whether our sample is reliable and whether outliers damage the findings. We have trimmed our sample (2.5% and 97.5%) according to the ECI and lagged FDI levels simultaneously. Table 13 shows that our sample is reliable, and similar results are found, especially for FDI alone and its interaction with AC. Here, we notice that the trimmed estimation presents difficulties in finding significance for AC in some models. Nevertheless, we argue that significant and positive results have still been found and that our sample's limited size should be considered.

Table 13. FDI, AC and ECI sensitivity test

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	DK	FGLS	DK	FGLS	DK	FGLS	DK	FGLS
<i>FDIt-1</i>	0.0424	0.298***	0.0797	0.652***	0.128	0.402***		

	(0.117)	(0.0327)	(0.0961)	(0.0506)	(0.123)	(0.0362)		
<i>(FDIt-1)</i> ²			-0.102	-1.144***				
			(0.398)	(0.155)				
AC	0.239*	0.158***	0.240*	0.154***	0.261*	0.170***		
	(0.0946)	(0.0103)	(0.0934)	(0.0121)	(0.0994)	(0.00855)		
<i>FDIt-1 x AC</i>					-0.76***	-0.577***	-0.647***	0.651***
					(0.118)	(0.0733)	(0.0566)	(0.0462)
<i>GDPPC</i>	-0.168**	0.0222***	-0.167**	0.00840	-0.138**	0.0293***	-0.028***	0.0631***
	(0.0316)	(0.00590)	(0.0342)	(0.00750)	(0.0265)	(0.00430)	(0.00424)	(0.00622)
<i>DENS</i>	0.0361	0.131***	0.0356	0.125***	0.0776	0.136***	-0.278	0.137***
	(0.176)	(0.0140)	(0.176)	(0.0136)	(0.185)	(0.0139)	(0.205)	(0.0129)
<i>IND</i>	0.00588	0.0512***	0.00552	0.0321***	0.0654	0.0509***	0.176	0.0805***
	(0.0729)	(0.00336)	(0.0729)	(0.00436)	(0.0483)	(0.00292)	(0.0862)	(0.00343)
<i>AGRO</i>	0.0742**	0.0150***	0.0741**	0.0157***	0.0726**	0.0174***	0.103**	0.0171***
	(0.0187)	(0.00247)	(0.0186)	(0.00276)	(0.0158)	(0.00213)	(0.0233)	(0.00253)
<i>WQ</i>	2.582	2.402***	2.624	2.372***	0.0618	2.229***	-2.259	4.050***
	(3.501)	(0.398)	(3.435)	(0.367)	(3.270)	(0.383)	(3.472)	(0.372)
<i>IFGF</i>	-0.0127	-0.0075***	-0.0129	-0.010***	-0.0116	-0.0078***	-0.00174	-0.0092***
	(0.00874)	(0.00178)	(0.00925)	(0.00175)	(0.00628)	(0.00167)	(0.0108)	(0.00216)
Constant	0.123**	0.0724***	0.122**	0.0838***	0.0943**	0.0706***	0.0741	0.0664***
	(0.0299)	(0.00299)	(0.0296)	(0.00332)	(0.0260)	(0.00271)	(0.0379)	(0.00270)
Observations	689	675	689	675	689	675	689	675
Number of cities	192	178	192	178	192	178	192	178

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.6. FINAL REMARKS AND POLITICAL IMPLICATIONS

EC is indicative of the number of different activities and knowledge a region can combine to create new products and technologies. It represents the capabilities a region possess. Therefore, diversity and ubiquity of a region's exports represent economic sophistication. As EC is closely related to competitiveness and economic growth, it can be considered as a driving force behind a society (Hausmann et al., 2013; Sepehrdoust et al., 2019). We have attempted to better understand regional complexity levels and how FDI and AC may facilitate the path toward sophistication.

Our findings show that both FDI and AC are important for a region to boost its complexity levels. As discussed earlier, FDI forces competition, brings high-skilled workers, provides education, facilitates labor mobility, and, with the interaction with other companies, generates knowledge spillovers and recombination. The results of this study are in agreement with these findings of the literature and diverge from those arguing that FDI is inefficient in regards to sophistication and knowledge diffusion. Concurrently, AC represents the ability to identify,

assimilate, and exploit knowledge. As expected, a high level of AC in a given region facilitates exploiting the benefits of FDI.

Our findings suggest that the Brazilian government should prioritize areas where Brazil knows how to improve its productive structure (e.g., the sugarcane sector) when developing FDI strategies. As a result, available knowledge combined with foreign investment can improve a diverse structure while also providing technological and valuable goods. Although the presence of minimum levels of AC is considered necessary to disseminate knowledge from the presence of MNEs, increasing the FDI intensity in sectors that can provide technology to develop a new set of non-ubiquitous goods should also be prioritized. It is critical to develop FDI attraction strategies that are aligned with the country's structural needs to strike a balance between sectors that already have the structure to benefit from MNE spillovers and sectors that can improve the country's export basket by bringing new technology and techniques.

Furthermore, the current Brazilian industrial sector could benefit from new foreign investments and multinationals within the country to increase regional complexity and, thus, increase the competitiveness of the region's export basket. Brazil is currently facing a de-industrialization process, and this phenomenon is harming the country's growth (Cypher, 2015; Silva, 2019). Although Brazil can still benefit from a strong and competitive primary sector, and even use its available knowledge, these activities will either only increase complexity or support technological innovations to a certain extent (Kannen, 2020). These findings can also be extrapolated to other emerging countries whose economies rely heavily on primary activities (e.g., South Africa). Simple activity development and a lack of coherent industrial policies prevent these countries from accessing the endogenous activities required to compete in the international market in the production of complex products (Hartmann et al., 2021), which typically have a higher economic return and added value.

Our study also shows that multinational companies can benefit the Brazilian industry sector, but foreign investors may lose confidence in the country due to its economic and political volatility (Gallas & Palumbo, 2019). Thus, Brazil is at risk of losing the FDI “tournament” to other emerging economies. We argue that policymakers should work toward changing this perspective.

Nonetheless, this discussion should be revisited by future scholars, and new research should consider the limitations of this study. Firstly, the number of municipalities is relatively small, given the considerable effort required to measure FDI at a municipal-level. In fact, for each municipality, all exporting companies have their origin checked manually. Another limitation is the non-contiguity of the municipalities of the sample. We suggest that future studies verify the spatial regional EC dependency neighboring the FDI host region. Moreover, we have used a time

lag approach as an instrumental variable, as Brazil does not have an available database. Although this procedure is widely accepted in the literature, we suggest that future studies measure this impact using other techniques to test endogeneity, such as that developed by Javorcik, Io Turco, and Maggioni (2018).

Finally, we recommend that new studies replicate this analysis using other developing countries, analyzing more regions and the importance of FDI and AC on EC. Our findings suggest that the FDI–ECI nexus is incomplete when AC is ignored, which has been the case in many studies so far.

SECTION 5. Conclusion

This study, comprising three papers, assumes that the presence of foreign investment has the potential to affect the economy of the host region. This premise was fundamental to elaborate the main objective of this dissertation: "*examine the impact of foreign direct investment (FDI) on the regional economy.*" In this way, the three articles that encompass this dissertation attempt, both separately and collectively, to analyze the impact of FDI on various aspects of the regional economy.

In this regard, the *first paper* of this dissertation involved conducting a Systematic Literature Review, which revealed that FDI has the potential to benefit and/or harm domestic firms (crowd in and/or out). However, it was discovered that the literature attempting to determine the impact of FDI on host firms is contradictory. The argument proposed to explain these disparities is that several factors influence the impact of FDI on domestic firms. This SLR also helped to identify these factors.

These factors were taken into account when conducting the *second paper* of this study, which sought to determine the impact of FDI on domestic firms at the regional level. It was found in this article that FDI, in general, benefits domestic firms (Crowd in). However, when FDI is decomposed by technology intensity level, we find that FDI in high-tech sectors harms local businesses. This study presents the argument that FDI in high-tech sectors can crowd out domestic firms due to their inability to absorb the positive externalities associated with foreign capital.

The *third paper* in this dissertation attempted to investigate the impact of foreign direct investment on regional economic complexity (EC). Furthermore, regional absorptive capacity (AC) was investigated as a moderator of the impact of FDI on the EC. This paper discovered that FDI positively impacts EC, but the effect is not linear. Minimum levels of regional AC are required for the region to benefit from the positive externalities of FDI, thereby increasing its EC.

All of the papers in this dissertation demonstrate that FDI has a direct impact on the regional economy. However, the former's impact on the latter is influenced by other factors. This study focused on two factors: local characteristics (e.g., AC) and the sector of foreign capital entry. This study shows that FDI has the potential to benefit the regional economy, but it must be evaluated in conjunction with other factors. Article 2 demonstrates that the presence of FDI in certain sectors can harm domestic firms, while Article 3 demonstrates that this investment in regions with low absorption capacity is ineffective in stimulating EC. As a result, when attracting and directing FDI, policymakers should consider the abovementioned factors to ensure that the investment positively impacts the regional economy.

SECTION 6. References

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APPENDIX A

SYSTEMATIC REVIEW PROTOCOL

Objective: Investigate the crowding-in and crowding-out effects of FDI on domestic firms. And determine the factors that influence these effects.

Formulation of the research questions:

- Does FDI crowd-in or crowd-out domestic firms?
- What are the main indicators of crowd-in and crowd-out?
- What host-regional factors and characteristics influence crowd-in and crowd-out effects?

Strategies for searching and selecting primary studies:

The resources and strategies for research and study selection were defined and chosen based on three fundamental items.

- Search sources: Scopus and Web of Science (WoS);
- Keywords: (“Foreign Direct Investment” OR “Foreign Investment” OR “FDI” OR “MNEs” OR “MNC” OR “Multinationals”) AND (“Crowd-in” OR “Crowding in” OR “Crowd-out” OR “Crowding out” or “crowding-in” or “crowding-out”) AND (“host companies” OR “host firms” OR “domestic companies” OR “domestic firms” OR “domestic investment”)
- Date of publication: There are no restrictions on the earliest or latest dates that an article may be published.

Criteria and procedures for selection of studies:

- Inclusion criteria
 - (I) Studies must be written in English;
 - (E) Contains less than three pages;
 - (E) It is not a scientific article;
 - (E) The article does not fit the scope of the research.

Selection process of studies

- Preliminary selection of studies
 - Articles will be selected by reading the abstracts, title and keywords. In this phase the articles will also be reviewed according to the inclusion and exclusion criteria.
- Studies quality assessment:
 - Assess the quality of the articles selected in preliminary stage.

APPENDIX B

ID	Title	Authors	Year of publication	Journal
1	Inward FDI, concentration, and profitability in the CEECs: Were the domestic firms crowded out or strengthened?	Aleksander Rutkowski	2006	Transnational Corporations
2	Linkages between Foreign Direct Investment, Domestic Investment and Economic Growth in Malaysia	Hooi Hooi Lean Bee Wah Tan	2011	Journal of Economic Cooperation and Development
3	Impact of Foreign Direct Investment & Domestic Investment on Economic Growth of Malaysia	Masoud Rashid Mohamed Keshminder Singh Jit Singh Chung-Yee Liew	2013	Malaysian Journal of Economic Studies
4	Foreign Direct Investment, Business Start-up Regulations, and Entrepreneurship in Africa	Jonathan Munemo	2015	Economics Bulletin
5	How do Liberalization, Institutions and Human Capital Development affect the Nexus between Domestic Private Investment and Foreign Direct Investment? Evidence from Sub-Saharan Africa	John Mayanja Bbale John Bosco Nyanzi	2016	Global Economy Journal
6	Institutions as a mediator of the effect of cross-border mergers & acquisitions on domestic investment	Jelena Zvezdanović Lobanova Davorin Kračun Alenka Kavkler	2018	Prague Economic Papers
7	Does foreign direct investment really support private investment in an emerging economy? Empirical evidence in Vietnam	Le Thanh Tung	2019	Montenegrin Journal of Economics
8	The interaction between foreign direct investment and domestic investment: Is there crowding out effect?	Ozge Bolaman Avci Tugba Akin	2020	Journal of Eastern European and Central Asian Research
9	Crowds in or crowds out? The effect of foreign direct investment on domestic investment in Chinese cities	Yao Yao Ruhul Salim	2020	Empirical Economics
10	Level of development, foreign direct investment and domestic investment in food manufacturing	Justice Gameli Djokoto	2022	F1000Research

ID	Title	Authors	Year of publication	Journal
11	FDI Inflows-Domestic Investment Relationship in Developing Countries: Does the Governance Environment Matter?	Van Bon Nguyen	2021	Southeast Asian Journal of Economics
12	Foreign direct investment-domestic investment nexus: Evidence from india	Abraham Babu	2021	Contemporary Economics
13	An empirical analysis of the growth impact of foreign direct investment in the South African economy	Carl Julien Teunen Gabila Nubong	2022	International Journal of Economics and Finance Studies
14	Does foreign investment crowd in domestic investment? Evidence from Vietnam	Van Ha Mark J. Holmes Tuyen Quang Tran	2022	International Economics
15	Private Capital inflow and Growth in Former Soviet-bloc Countries: Roles of Stock Market and Demand-side Macroeconomic Policy	Adil H. Suliman Mohammed Zakauallah Shariff Humoud AlMutairi Khaled ElMawazini	2019	The European Journal of Comparative Economics
16	FDI and economic growth in the GCC: Does the oil sector matter?	Mohamed Elheddad Mohga Bassim Rizwan Ahmed	2021	Economics and Business Letters
17	Impact of FDI on Private Investment in the Asian and African Developing Countries: A Panel-Data Approach	Le Thanh Thung Pham Nang Thang	2020	Journal of Asian finance economics and business
18	Foreign Direct Investment and Financial Constraints: Firm-Level Evidence from Cambodia, Lao PDR, and Myanmar	Bopith Bun	2021	Journal of Economic Integration
19	Do Foreign Firms crowd out Domestic Firms? Evidence from the Czech Republic	Renata Kosová	2010	Review of Economics and Statistics
20	The Crowding-in and Crowding-out Effects of FDI on Domestic Investment in the Yangtze Delta Region	Guoxin Wu Yu Sun Zhuning Li	2010	Transnational Corporations Review
21	Foreign direct investment in central Europe: Does it crowd in or out domestic investment?	Jan Misun Vladimír Tomsik	2002	Politická Ekonomie

ID	Title	Authors	Year of publication	Journal
22	Foreign Investment, Domestic Investment and Economic Growth in China: Does Foreign Investment Crowd in or Crowd out Domestic Investment?	Najid Ahmad	2018	Economics Bulletin
		Mouna Hdia		
		Hong-Zhou Li		
		Jianlin Wang		
		Xian-Liang Tian		
23	Does outward foreign direct investment crowd in or crowd out domestic investment in central, east and southeast Europe countries? An asymmetric approach	Safet Kurtović	2021	Economic Change and Restructuring
		Nehat Maxhuni		
		Blerim Halili		
		Bujar Krasniqi		
24	Does FDI inflow crowd out domestic investment in Korea?	David Deok-Ki Kim	2003	Journal of Economic Studies
		Jung-Soo Seo		
25	Does foreign direct investment crowd out domestic entrepreneurship?	Koen De Backer	2003	Review of Industrial Organization
		Leo Sleuwaegen		
26	Foreign direct investment and wages in domestic firms in Ireland: Productivity spillovers versus labour-market crowding out	Frank Barry	2005	International Journal of the Economics of Business
		Holger Gorg		
		Eric Strobl		
27	Foreign investment in developing countries: Does it crowd in domestic investment?	Manuel R. Agosin	2005	Oxford Development Studies
		Roberto Machado		
28	Foreign ownership and productivity in polish industry: The case of polish manufacturing, 1993-2002	Konrad Pawlik	2006	Eastern European Economics
29	Dynamic linkages between FDI inflows and domestic investment: A panel cointegration approach	Nicholas Apergis	2006	Atlantic Economic Journal
		Costantinos P. Katrakilidis		
		Nikolaos M. Tabakis		
30	The linkages between FDI and domestic investment: Unravelling the developmental impact of foreign investment in sub-Saharan Africa	Léonce Ndikumana	2008	Development Policy Review
		Sher Verick		
31		Guido Cazzavillan	2012	Research in Economics

ID	Title	Authors	Year of publication	Journal
	Interaction between foreign financial services and foreign direct investment in Transition Economies: An empirical analysis with focus on the manufacturing sector	Krzysztof Olszewski		
32	FDI and domestic investment in Germany: Crowding in or out?	Özlem Onaran Engelbert Stockhammer Klara Zwickl	2013	International Review of Applied Economics
33	Foreign direct investment and the survival of domestic private firms in Vietnam	Ari Kokko Tran Toan Thang	2014	Asian Development Review
34	Dynamic linkages between foreign direct investment and domestic investment: Evidence from emerging market economies	Vipul Jain Arun Kumar Gopaldaswamy Debashis Acharya	2014	International Journal of Economics and Business Research
35	Domestic and foreign direct investment in Ghanaian agriculture	Justice Gameli Djokoto Francis Yao Srofenyoh Kobla Gidiglo	2014	Agricultural Finance Review
36	Examining the impact of public investment and private investment on economic growth: Empirical evidence from BRICS nations	Varun Chotia N.V. Muralidhar Rao	2017	International Journal of Economics and Business Research
37	Relationship between FDI, foreign ownership restrictions, and technology transfer in the resources sector: A derivation approach	Nahom Ghebrihiwet Evgenia Motchenkova	2017	Resources Policy
38	Growth and Investment: Testing for the Relationship for South Asian Countries	Vinish Kathuria	2019	Millennial Asia
39	International technology transfer: evidence on foreign direct investment in Albania	Mamica Skenderi Konstandina Geoffrey Gatharia Gachino	2020	Journal of Economic Studies
40	Knowledge, Proximity and R&D Exodus	Exodus Grigorios Livanis Anna Lamin	2016	Research Policy

ID	Title	Authors	Year of publication	Journal
41	The relationship between FDI inflows and private investment in Vietnam: Does institutional environment matter?	Van Bon Nguyen	2021	International Journal of Finance and Economics
42	The contribution of inward FDI to Chinese regional innovation: the moderating effect of absorptive capacity on knowledge spillover	Yong Kyu Lew	2016	European Journal of International Management
		Yingxue Liu		
43	Capital flows and domestic investment: new evidence from OPEC countries	Oyakhilome Ibhagui	2019	Journal of Financial Economic Policy
		Kolawole Olawole		
44	Opportunities and challenges of foreign direct investment utilisation and its impact on construction sector in developing countries	Solomon Olusola Babatunde	2018	Journal of Financial Management of Property and Construction
		Oluwaseyi Alabi Awodele		
		Onaopepo Adeniyi		
45	Foreign direct investment, regional market conditions and regional development - A panel study on China	Mei Wen	2007	Economics of Transition
46	Openness, Investment and Growth in Sub-Saharan Africa	Hector Sala	2014	Journal of African Economies
		Pedro Trivín		
47	The effects of foreign direct investment on private domestic investment: evidence from developing countries	Ali Al-Sadig	2013	Empirical Economics
48	The Death of German Firms: What Role for Foreign Direct Investment?	Chiara Franco	2015	World Economy
		John P. Weche Gelübcke		
49	A general equilibrium analysis of FDI growth in Chinese services sectors	María C. Latorre	2018	China Economic Review
		Hidemichi Yonezawa		
		Jing Zhou		
50	FDI, exports and export spillover in Taiwan's electronics industry	Naiwei Chen	2022	Journal of the Asia Pacific Economy
		Ho-Chyuan Chen		
		Rong-Siou Lin		
51	Investment liberalisation and firm selection process: A welfare analysis from a host-country perspective	Katja Zajc Kejzar	2011	Journal of International Trade and Economic Development
52		Usman Ali	2018	Global Economic Review

ID	Title	Authors	Year of publication	Journal
	Does Outbound Foreign Direct Investment Crowd Out Domestic Investment in China? Evidence from Time Series Analysis	Jian-Jun Wang		
53	The impact of multinational entry on domestic market structure and investment	Stefanie A. Haller	2009	International Review of Economics and Finance
54	FDI and Economic Development: Evidence from China's Regional Growth	Xiangbo Liu	2014	Emerging Markets Finance and Trade
		Yu Luo		
		Zhigang Qiu		
		Ru Zhang		
55	Foreign direct investment and entrepreneurship: Does the role of institutions matter?	Ly Slesman	2021	International Business Review
		Yazid Abdullahi Abubakar		
		Jay Mitra		
56	Inward FDI and financial constraints in central and east European countries	Aleksander Rutkowski	2006	Emerging Markets Finance and Trade
57	Outflow FDI and Domestic Investment: Aggregated and Disaggregated Analysis	Waqar Ameer	2021	Sustainability
		Helian Xu		
		Kazi Sohag		
		Syed Hasanat Shah		
58	Revisiting the nexus between domestic investment, foreign direct investment and external debt in SSA countries: PMG-ARDL approach	Dobdinga Cletus Fonchamnyo	2021	African Development Review
		Gildas Dohba Dinga		
		Vahsegmi Carolle Ngum		
59	Does foreign direct investment crowd in or crowd out private domestic investment in China? The effect of entry mode	George S. Chen	2017	Economic Modelling
		Yao Yao		
		Julien Malizard		
60	Foreign Direct investment, domestic investment, and economic growth in Sub-Saharan Africa	Samuel Adams	2009	Journal of Policy Modeling
61	Foreign and domestic investment: Regional development or crowding out?	Nigel Driffield	2003	Regional Studies
		Dylan Hughes		

ID	Title	Authors	Year of publication	Journal
62	The effects of greenfield investment and M&As on domestic investment in developing countries	Ayesha Ashraf	2014	Applied Economics Letters
		Dierk Herzer		
63	Aggregate and heterogeneous sectoral growth effects of foreign direct investment in Egypt	Hilary Ingham	2020	Review of Development Economics
		Robert Read		
		Shimaa Elkomy		
64	FDI and domestic investment in Taiwan: An endogenous switching model	Hui-Lin Lin	2007	Developing Economies
		Wen-Bin Chuang		
65	Do public investment and FDI crowd in or crowd out private domestic investment in Malaysia?	James B. Ang	2009	Applied Economics
66	The Dynamic Linkages between Foreign Direct Investment and Domestic Investment in ECOWAS Countries: A Panel Cointegration Analysis	P.B. Eregha	2012	African Development Review
67	Does FDI crowd out domestic firms? Micro-level evidence from the Republic of Korea	Hyelin Choi	2018	Journal of Korea Trade
68	Sectoral FDI inflows and domestic investments in Pakistan	Syed Hasanat Shah	2020	Journal of Policy Modeling
		Hafsa Hasnat		
		Simon Cottrell		
		Mohsin Hasnain Ahmad		
69	Institutions, Foreign Direct Investment, and Domestic Investment: Crowding Out or Crowding In?	Kristine Farla	2016	World Development
		Denis de Crombrughe		
		Bart Verspagen		
70	Effects of Outward Foreign Direct Investment on Domestic Investment: The Cases of Brazil and China	Igor Gondim	2018	Journal of International Development
		Mario Henrique Ogasavara		
		Gilmar Masiero		
71	Foreign direct investment into agriculture: does it crowd-out domestic investment?	Justice Gameli Djokoto	2021	Agrekon
72	Does FDI crowd out domestic investment in transition countries?	Cristina Jude	2019	Economics of Transition

ID	Title	Authors	Year of publication	Journal
73	The dynamic relationship between greenfield investments, cross-border M&As, domestic investment and economic growth in Vietnam	Hieu Thanh Nguyen Hiep Ngoc Luu Ngoc Ha Do	2021	Economic Change and Restructuring

APPENDIX C

NUMBER OF JOB POSTS ON DOMESTIC COMPANIES

The RAIS was the main data source to calculate the number of jobs on domestic companies. However, this information was not explicitly stated in the database. It is critical to understand that the RAIS provides the number of enrollments (one enrollment is equivalent to one job) on December 31 of each year. As a result, we have an annual job overview. These enrollments can be broken down in a variety of ways. We use two disaggregation in the case of this proxy. One spatial (jobs by city) and one company type. Then, we split jobs into three categories based on the type of company: government jobs, multinational corporation jobs, and jobs on domestic firms. The table below shows type of company and the categories.

Name (in portuguese)	Name (in English)	Type
Poder Executivo Federal	Federal Executive Power	government
Poder Executivo Estadual ou Distrito Federal	State Executive Branch or Federal District	government
Poder Executivo Municipal	Municipal Executive Branch	government
Poder Legislativo Federal	Federal Legislative Branch	government
Poder Legislativo Estadual ou Distrito Federal	State Legislative Branch or Federal District	government
Poder Legislativo Municipal	Municipal Legislative Branch	government
Poder Judiciário Federal	Federal Judiciary	government
Poder Judiciário Estadual	State Judiciary	government
Autarquia Federal	Federal Autarchy	government
Autarquia Estadual ou Distrito Federal	State Authority or Federal District	government
Autarquia Municipal	Municipal Authority	government
Fundação Federal	Federal Foundation	government
Fundação Estadual ou Distrito Federal	State Foundation or Federal District	government
Fundação Municipal	Municipal Foundation	government
Órgão Público Autônomo Federal	Federal Autonomous Public Agency	government
Órgão Público Autônomo Estadual ou Distrito Federal	State or Federal District Autonomous Public Agency	government
Órgão Autônomo Municipal	Municipal Autonomous Agency	government
Fundo Público	Public Fund	government
Associação Pública	Public Association	government
Consórcio Público de Direito Privado	Public Private Law Consortium	government
Município	County	government
Fundação Pública de Direito Privado Federal	Public Foundation of Federal Private Law	government
Fundação Pública de Direito Privado Estadual ou do Distrito Federal	State or Federal District Public Foundation of Private Law	government
Fundação Pública de Direito Privado Municipal	Public Foundation of Municipal Private Law	government
Empresa Pública	Public company	government
Sociedade Mista	joint venture	domestic firm
SA Aberta	Open SA	domestic firm
SA Fechada	SA Closed	domestic firm
Sociedade QT Ltda	Company QT Ltd	domestic firm

Name (in portuguese)	Name (in English)	Type
Sociedade Empresarial Nome Coletivo - A partir Rais2008	Corporate Name Collective Society - From Rais2008	domestic firm
Sociedade Comandita Simples	Simple Command Society	domestic firm
Sociedade Comandita por Ações	Limited Company for Shares	domestic firm
Sociedade Capital Indústria	Society Capital Industry	domestic firm
Sociedade em Conta de Participação	Society in Participation Account	domestic firm
Firma Mercantil Individual	Sole Trader	domestic firm
Cooperativa	cooperative	domestic firm
Consórcio Empresas	Consortium Companies	domestic firm
Grupo Sociedade	Society Group	domestic firm
Filial, Sucursal ou Agência de Emprego sediada Exterior	Branch, Branch or Employment Agency headquartered Abroad	multinational corporation
Filial, empresa binacional, Argentino-Brasileira	Branch, binational company, Argentine-Brazilian	multinational corporation
Empresa Domiciliada no Exterior	Company Domiciled Abroad	multinational corporation
Fundo Investimento	Investment Fund	domestic firm
Sociedade Simples Pura	Pure Simple Society	domestic firm
Sociedade Simples Ltda	Sociedade Simples Ltda	domestic firm
Sociedade Simples Nome Coletivo	Simple Society Collective Name	domestic firm
Sociedade Simples Comandita Simples	Simple Society Command Simple	domestic firm
Empresa Binacional	Binational Company	multinational corporation
Consórcio de Empregadores	Consortium of Employers	domestic firm
Consórcio Simples	Simple Consortium	domestic firm
Empresa Individual de Responsabilidade Ltda (De Natureza Empresária)	Individual Company of Responsibility Ltd (Of a Business Nature)	domestic firm
Empresa Individual de Responsabilidade Ltda (De Natureza Simples)	Individual Company of Responsibility Ltd (Of a Simple Nature)	domestic firm
Sociedade Unipessoal de Advocacia	Sole Proprietorship Society	domestic firm
Cooperativas de Consumo	Consumer Cooperatives	domestic firm
Cartório	Registry	domestic firm
Organização Social	Social Organization	domestic firm
Outros Fundação Privada	Other Private Foundation	domestic firm
Serviço Social Autônomo	Autonomous Social Service	domestic firm
Condomínio Edifícios	Condominium Buildings	domestic firm
Comissão Conciliação Prévia	Prior Conciliation Commission	domestic firm
Entidade Mediação e Arbitragem	Entity Mediation and Arbitration	domestic firm
Entidade Social 07 - Até RAIS2007	Social Entity 07 - Until RAIS2007	domestic firm
Filial Fundação Estrangeira	Foreign Foundation Branch	multinational corporation
Fundação Domiciliada no Exterior	Foundation Domiciled Abroad	multinational corporation
Organização Religiosa	Religious Organization	domestic firm
Comunidade Indígena	Indigenous Community	domestic firm
Fundo Privado	Private Fund	domestic firm
Partido Politico	Political party	domestic firm
Frente Plebiscitária ou Referendária	Plebiscitary or Referendary Front	domestic firm

Name (in portuguese)	Name (in English)	Type
Organização Social (OS)	Social Organization (OS)	domestic firm
Demais Condomínios	Other Condos	domestic firm
Outras Organizações - Associação Privada	Other Organizations - Private Association	domestic firm
Empresa Individual Imobiliária	Individual Real Estate Company	domestic firm
Segurado Especial	Special Insured	domestic firm
Contribuinte Individual 07 - Até RAIS2007	Individual Taxpayer 07 - Until RAIS2007	domestic firm
Candidato Cargo Político Eletivo	Elective Political Position Candidate	domestic firm
Leiloeiro	Auctioneer	domestic firm
Produtor Rural (Pessoa Física)	Rural Producer (Individual)	domestic firm
Organização Internacional	International Organization	multinational corporation
Representação Diplomática Estrangeira	Foreign Diplomatic Representation	multinational corporation
Outras Instituições Extraterritoriais	Other Extraterritorial Institutions	multinational corporation
Comissão Polinacional	Polynational Commission	multinational corporation
Empregador Doméstico	Domestic Employer	domestic firm
Construção Civil Pessoa Física	Civil Construction Individuals	domestic firm
Sociedade Civil	Civil society	domestic firm
Outras Formas de Organização Empresarial	Other Forms of Business Organization	domestic firm

Therefore, all jobs in companies classified as “domestic firm” is counted as a job on domestic firm. Finally, we sum the number of domestic jobs, *per county* and *per year*.

APPENDIX D

Araras (SP)	Itaquaquecetuba (SP)	Ribeirão Preto (SP)
Barretos (SP)	Itatiba (SP)	Rio de Janeiro (RJ)
Barueri (SP)	Itirapina (SP)	Rio do Sul (SC)
Belo Horizonte (MG)	Itupeva (SP)	Rio Negro (PR)
Blumenau (SC)	Jaraguá do Sul (SC)	Rondonópolis (MT)
Brasília (DF)	Joinville (SC)	Salto (SP)
Brusque (SC)	Jundiaí (SP)	Salvador (BA)
Camaçari (BA)	Lajeado (RS)	Santa Bárbara d'Oeste (SP)
Campinas (SP)	Lins (SP)	Santa Cruz do Sul (RS)
Canoas (RS)	Magé (RJ)	Santa Isabel (SP)
Cataguases (MG)	Manaus (AM)	Santo André (SP)
Caxias do Sul (RS)	Mogi das Cruzes (SP)	São Bernardo do Campo (SP)
Contagem (MG)	Mogi Guaçu (SP)	São Caetano do Sul (SP)
Cotia (SP)	Mogi Mirim (SP)	São José do Rio Preto (SP)
Cruzeiro (SP)	Monte Carmelo (MG)	São José dos Campos (SP)
Cuiabá (MT)	Montes Claros (MG)	São José dos Pinhais (PR)
Curitiba (PR)	Natal (RN)	São Leopoldo (RS)
Eldorado do Sul (RS)	Niterói (RJ)	São Luís (MA)
Eusébio (CE)	Nova Friburgo (RJ)	São Sebastião do Caí (RS)
Florianópolis (SC)	Nova Odessa (SP)	Sapucaia do Sul (RS)
Fortaleza (CE)	Osasco (SP)	Sertãozinho (SP)
Fraiburgo (SC)	Passo Fundo (RS)	Sobral (CE)
Franca (SP)	Pojuca (BA)	Tijucas (SC)
Goiânia (GO)	Ponta Grossa (PR)	Timbó (SC)
Gravataí (RS)	Porto Alegre (RS)	Uberaba (MG)
Guarulhos (SP)	Quatro Barras (PR)	Uberlândia (MG)
Indaiatuba (SP)	Recife (PE)	
Itajaí (SC)	Registro (SP)	

State initials in parentheses.

APPENDIX E

Table E ó Description of the main variables and sources

Variable	Description	Source
Economic Complexity Index (<i>ECI</i>)	An index that calculates the level of complexity of municipalities based on the export of goods produced locally.	Dataviva
Foreign Direct Investment (<i>FDI</i>)	Variable calculated based on information from exporting companies in Brazilian municipalities, according to Equation 01.	Hand-collected database using companies registered on SISCOMEX.
Absorptive Capacity (<i>AC</i>)	The absorptive capacity was measured through the Malmquist Index, according to Girma's method.	Brazilian Institute of Geography and Statistics (IBGE)
Per capita GDP (<i>GDPPC</i>)	Brazilian Reais (BRL) per inhabitant.	IBGE
Value-added from agriculture (<i>AGRO</i>)	Ratio (% of GDP).	IBGE
Value-added from industry (<i>IND</i>)	Ratio (% of GDP).	IBGE
Population Density (<i>DENS</i>)	Inhabitants per square kilometer.	IBGE
Work Qualification (<i>WQ</i>)	Number of formal jobs that need college education	SEADE
Local institution quality proxy (<i>IFGF</i>)	Firjan Index of fiscal management	FIRJAN

APPENDIX F

Table F - Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
<i>ECI</i>	0.73	2.26	-3.75	24.03
<i>FDI</i>	50.54	129.36	0.00	1059.64
<i>AC</i>	0.12	0.08	0.01	0.78
<i>GDPPC</i>	28.64	20.58	5.64	205.40
<i>AGRO</i>	4.11	5.62	0.00	36.48
<i>IND</i>	27.38	10.18	0.00	61.35
<i>DENS</i>	920.96	2128.60	16.75	13328.55
<i>WQ</i>	12904	98709	85	1520618
<i>IFGF</i>	0.60	0.13	0.23	0.93

Real values (non-normalized data)