Foreign Direct Investment and Property Protection in Brazil
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Abstract

Transfers and spillover of technology between countries are important means of improving the economic performance of a country, and thereby its competitiveness in global markets. Foreign direct investment (FDI) where the home country has a more developed technological base than the host country serves as a channel for such transfers and spillovers, and can spur economic growth. This paper statistically tests whether the level of intellectual as well as private property protection in Brazil has an effect on the amount of FDI that flows into the country, and whether this effect is greater in investments targeting high-technology industries than low-technology industries. These hypotheses are based on previous empirical studies that suggest a positive correlation between level of property protection and FDI inflows.

This study finds that private property protection is a better determinant of FDI inflows in Brazil than intellectual property protection. Nevertheless, the relationship between private property protection and FDI is stronger in low-technology industries that in high-technology industries. Concerning intellectual property protection, it appears more strongly correlated with inflows of FDI in high-technology industries than low-technology industries. The findings imply that better enforcement of IPR legislation in Brazil could foster the technological development of the country via transfers and spillover of technology from FDI.

Recommendations for Brazil to attract more high-technology FDI are to improve the domestic IPR system by reducing the processing time for the granting of patents and ensuring more timely and predictable court rulings on IPR cases. For foreign investors, this paper draws attention to the importance of studying the local business environment at the industry level when taking decision about whether to establish their business in a new country. This paper also provides reaffirmation to the body of literature that claims that property protection has an impact on inward FDI, and that the strength of such impact is largely dependent on the local context.
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1. Introduction

In economic theory, the one statement that is largely uncontested is that resources, human, capital and natural, are limited and must be used sensibly (Barney, 1991). Through innovation and advances in technology, improved products whose production processes make more efficient use of such resources are developed. The production of high-technology products consists of high-value adding processes. This means that productivity, measured in terms of value-added, is higher in the manufacturing of high-technology products than of low-technology products, such as commodities and utilities. Therefore, differences in technology endowments across countries are partly responsible for the uneven economic performance among them. Transfers and spillover of technology between countries are important means of improving the economic performance of a country, and thereby its competitiveness in global markets. Foreign direct investment (FDI) where the source country has a more developed technological base than the host country serves as a channel for such transfers and spillovers. Thus, as FDI can foster technological advances in host economies via transfers and spillovers of technology from their home country, investigating how host countries can become more attractive FDI destinations is of great importance to their sustained economic growth.

Several country-specific characteristics influence the amount and type of FDI that flows into a country: resource availability, input prices, corporate taxes and institutional environment being the most evident of them (Dunning, 1980). One host country institutional aspect whose effects on FDI inflows have been studied extensively, and is thought to influence the type of technology that firms are willing to share with affiliates and subsidiaries, is protection of intellectual and private property (Smarzynska, 2004; Smith, 2001; Mansfield, 1994; Knack and Keefer, 1995; Tuman and Emmert, 2004; Biglaiser and DeRouen, 2006). There is agreement among these scholars that intellectual and private property protection are important locational determinants of FDI inflows. This paper set out to test this claim in the context of Brazil, and focuses on FDI inflows in high-technology industries. Brazil makes an interesting case for this study because, while its level of intellectual and
private property protection is viewed as inadequate by foreign investors (European Commission, 2008; Matias-Pereira, 2011; MarketLine 2014), it was the third country to receive the most FDI in the 2000s (Rao, 2012). This implies that, in the case of Brazil, intellectual and private property protection might not be as important in determining FDI inflows as predicted by the scholar referred to above. Conversely, FDI inflows into Brazil might be concentrated in low-technology industries, which are not very sensitive to the level of property protection. Thus, the particular context found in Brazil deserves further investigation.

This study reveals that, in line with existing theory, institutional aspects such as intellectual and private property protection influence the inflows of FDI in Brazil to some extent. Intellectual property (IP) protection was shown to be only weakly related to FDI. Nevertheless, this relationship was stronger for FDI in high-technology industries than in low-technology industries. Private property protection showed a stronger relationship to FDI than IP protection. However, low-technology industries appeared to be more affected by private property protection than high-technology industries. These findings imply that improvements in property protection in Brazil could potentially attract more FDI to the country, and even help policy-makers develop economic growth strategies that target specific industries, as the effects of host country institutional characteristics on FDI vary according to the target industry. Moreover, the findings contribute to the refinement of this field of study by enlarging the pool of evidence that shows that institutional contexts are important determinant of FDI, but also that local factors must be taken into consideration.

This paper will be structured as follows. Section 2 starts out with conceptualizations of the key terms that will be used throughout the paper. Later in section 2, the theoretical background upon which the hypotheses are built is presented, and the reader is located in the economic and institutional context of Brazil. Section 3 outlines the methodology that will guide the execution of this study, and section 4 presents the results. Section 5 discusses implications of the results for Brazil’s economic growth, and provides
recommendations directed at policy makers on how to improve the country’s system of intellectual and private property protection. Section 6 concludes the paper and provides suggestions for further research.

2. FDI, Property Protection and Economic Development: a theoretical overview

The era of contemporary accelerated globalization, which we entered in the 1960s (Scholte’s 2005) and is characterized by exponential increase in cross-border exchanges in terms of communication, travel, production, markets, capital, finance and trade has spurred similar increase in foreign direct investment. The ease with which information and communication technology spreads to all corners of the earth, and air travel becomes cheaper and more accessible, reduces the transactions costs of cross-border interactions such as trade and investment and ties countries closer together, contributing to the process of accelerating globalization. In 1996, Renato Ruggiero, WTO Director General at the time, affirmed in his speech at the UNCTAD (United Nations Conference on Trade and Development) Seminar on foreign direct investment and the multilateral trading system that “trade and investment are not merely increasingly complementary, but also increasingly inseparable as two sides of the coin of the process of globalization” (WTO, 1996, para. 1) In fact, world stock of FDI went from USD 697 billion in 1980 to 25,500 billion in 2013 (UNCTAD, 2014). Even though developed countries are the largest receivers of FDI, developing countries inward FDI has followed a similar growth rate since the late 1990s, as shown in Figure 1 below (the grouping of countries follows that of the UNCTAD. Developed countries include most of Europe (including all EU member states), North America (excluding Mexico), Australia, New Zealand and Japan. Transition economies refer mainly to Eastern Europe, and the remaining countries fall in the developing economies group).

Decisions about the destination of these dollars were definitely not taken at random. To help identify which factors affect this decision, Dunning (1980) developed a model of internationalization of the firm, the OLI-model (also called eclectic theory of internationalization). This model suggests that there are three sets of
advantages which must be in place for investment in a foreign market to pay off: ownership advantages, locational advantages and internalization advantages. One locational advantage is the host country regulatory environment and law enforcement. A key aspect of this advantage for foreign investors is the level of intellectual and private property protection offered by the host country. Studies reveal that this aspect can be a strong determinant of inward FDI (Mansfield, 1994; Smarzynska, 2004; Smith, 2001; Ali, Fiess and MacDonald, 2010; Khoury and Peng, 2011). This paper focuses on intellectual and private property protection as a factor influencing inflows of FDI in high-technology industries in Brazil, and the implications of this form of investment on economic development in the country. Nevertheless, it is worth to point out that, as the OLI-model shows, there are several other factors that influence inward FDI. Thus, the OLI-model will be presented in more detail in section 2.1.2.

This chapter starts with a brief description of the concepts of property rights, foreign direct investment and the classification of low- and high-technology industries. Thereafter, sections 2.2 and 2.3 discuss the relationship between intellectual and private property rights and FDI, respectively, including the main studies conducted in the field to date. Next, in section 2.4, some contextual background is provided to the reader in the form of an overview of the Brazilian economy, industrial policies, system of intellectual and private property protection and recent expansion in inward FDI. Section 2.5 presents a theoretical discussion of the
effects that FDI is thought to have on economic growth. Section 2.5.2 explains how all three concepts (FDI, property rights and economic growth) play out together.

2.1. Main Concepts

2.1.1. Property Rights

Barzel (1997) explains the concept of property rights as “an individual’s ability, in expected terms, to consume the good (or the services of the asset) directly, or to consume it indirectly through exchange” (p. 3). Assuming that the “individual” in this definition is an organization, property rights are a means to ensure firms that they will be able to derive profits from the assets they own. That is, property rights grant firms the security that their tangible and intangible assets are protected against misuse or misappropriation by unauthorized parties. As such, effective protection of property rights provides a crucial incentive for firms to invest in, and improve their assets, and thereby become more productive and competitive (Martínez-Piva, 2010; Knack & Keefer, 1995).

**Intellectual Property Rights**

Firms’ intangible assets consist of commercial secrets, business strategies, brands, managerial know-how, technologies, designs and production processes. These creations of the mind (WIPO, 2014) are protected from misuse by intellectual property rights (IPR) such as patents, copyrights, trademarks and industrial design, which inventors can apply for in government institutions dedicated to handling IPR. In this paper, we are mainly concerned with patents, which grant exclusive right for a “product or a process that provides a new way of doing something, or offers a new technical solution to a problem” (WIPO, 2014). That is, patents protect innovations that lead to technological advances. Conversely, copyrights, trademarks and industrial designs protect literary and artistic work: books, songs, logos, brand names and slogans, and the aesthetic aspect of a product. To get a patent, full disclosure of the technical information behind the invention is required in the
application. This information is then made available to the public after the patent has been granted, so that researchers can build on existing knowledge and continue improving technological solutions.

In order to ensure that patents are only granted to innovations that significantly improve products and consumer welfare, rather than for minor product upgrades where the cost borne by consumers as a result of the patent outweighs the benefits, some requirements are imposed on inventions for them to be eligible for patentability. These requirements are outlined in countries’ IPR laws and can vary across jurisdictions, but there are a few key conditions that are quite universal for all IPR regimes. The World Intellectual Property Organization defines them as follows: a) the invention must show an element of novelty (not known in the body of existing knowledge in its technical field); b) the invention must involve an “inventive step” or “non-obvious” (it could not be obviously deduced by a person having ordinary skill in the relevant technical field); c) the invention must be capable of being used for an industrial or business purpose; d) its subject matter must be accepted as “patentable” under law (in many countries, scientific theories, aesthetic creations, mathematical methods, plant or animal varieties, discoveries of natural substances, commercial methods, methods for medical treatment (as opposed to medical products) or computer programs are generally not patentable); e) the invention must be disclosed in an application in a manner sufficiently clear and complete to enable it to be replicated by a person with an ordinary level of skill in the relevant technical field.

Despite these general requirements, there are different opinions regarding the effect of IPR on a country’s rate of innovation and economy. A critical view of the recent development within the global IPR regimes is exposed by Dosi and Stiglitz (2014). They present Intellectual Property Rights as “part of what might be thought of as a country’s innovation system, the collection of institutions that promote innovation” (p. 4) and frame it as a social construction “designed to increase welfare, by supposedly enhancing innovation” (p. 3). Nevertheless, the authors emphasize that welfare and innovation only result from well-designed IPR regimes
that are tailored to the circumstances, history and objectives of each country. And that IPR is only one component of a country’s innovation system. Not surprisingly, the authors are critical of the process of global standardization of IP regimes initiated by the Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS; explained below), and argue that this regime is not adequate for developing countries since it hinders their ability to absorb capabilities through reverse engineering and imitative experimentation, which were important mechanisms in the industrialization of developed countries.

The less critical view of the effect of strong IPR regimes on development departs from a conceptualization of the notion that is similar to Dosi and Stiglitz’s, and also refers to the social role of IPR regimes. The Commission on International Property Rights, set up by the British government to look at how intellectual property rights might serve poor people and developing countries better, sees IPR as “an instrument of public policy which confers economic privileges on individuals or institutions solely for the purposes of contributing to the greater public good. The privilege is therefore a means to an end, not an end in itself” (CIPR, 2002, p. 6). When presented in this way, IPR seems undisputedly to be a driver of innovation and economic growth and welfare. And, to support this view, there are indeed studies that suggest that stronger intellectual property protection in a country is associated with higher propensity for multinational enterprises to license their technologies to local firms or establish production and R&D facilities in the given country (Maskus, Dougherty, and Mertha, 2005; Smith 2001), and consequently ease access to technologies that can be absorbed and imitated locally.

The two somewhat contrasting lines of though presented above concerning the adequacy of a global IPR regime and its effect on social welfare caused fierce disagreements between developed and developing countries during the negotiations of the TRIPS Agreement. This Agreement, which came into effect in 1995, marks the first time intellectual property rights entered discussions at the multilateral level. The negotiations
took place during the Uruguay Round of multilateral trade negotiations (1986-1994), which also marked the establishment of the World Trade Organization (WTO). This agreement was intended to stimulate international trade of goods and service which embodied some form of intellectual property by ensuring that they were covered by a minimum level of protection from imitation and unlicensed commercialization in almost any country where they were traded, thereby reducing exporters’ risk of losing rents in the transaction. The common international laws on intellectual property protection established by the TRIPS apply to all 160 WTO Members States, although the transition period allowed for them to implement the laws varies according to their level of development and preparedness. The Agreement covers the following areas: copyright and related rights, trademarks including service marks, geographical indications, industrial designs, patents, layout-designs (topographies) of integrated circuits, and undisclosed information including trade secrets. As always, there are exceptions to the rules. Governments can infringe the right of an intellectual property owner in case he/she abuses this right (i.e.: failure to supply the product on the market) or in the name of public interests such as protection of public health (for more detail, see wto.org).

As mentioned above, developed and developing countries held diverging positions on the area of IPR and had a hard time agreeing on the content and level of ambition of the TRIPS (Stoll, Busche and Arend, 2009). Industrialized countries, namely Western Europe, the US, Canada and Japan, favored a highly ambitious agreement that allowed long-lasting exclusive rights to the products of their multinational enterprises (MNEs) in foreign markets (Dosi and Stiglitz, 2014). Developing countries interpreted the request of these industrialized countries as unfair on two grounds. Firstly, they argued that they were being deprived of the transfer of knowledge which industrialized countries themselves benefitted from in their industrialization process. Secondly, they argued that the level of IP protection advocated by their counterparts opened way to unfair monopolistic market forces, which deliberately opposed the principles of free trade on which the WTO rests.
On a conceptual basis, the protection of intellectual property rights allows holders of these rights a temporary and monopolistic control over their invention or work, which, in principle, contradicts the notion of free competition and, likewise, the improvement of international trade rules embodied in the General Agreement. When analysed exclusively from the point of view of international trade, such protection would be tantamount to a highly unacceptable technological protectionism (Government of Brazil, 1989, p. 2).

As presented in this section, intellectual property rights can be understood in technical terms, referring to the rights granted by a State to an inventor which grants him/her exclusive ownership of the invention and of its reproduction for a previously determined period of time, allowing the inventor alone to market and profit from the invention during that period. In a less technical sense, the concept of IP also embodies social and developmental aspects because of its power to stimulate innovation by providing the security of monetary return to successful research and development, as well as its power to restrict or assist knowledge dissemination between countries, and contribute or not to closing the knowledge gap between developed and developing countries. In this paper, the term itself refers to its technical meaning, but the focus will be in the social and developmental aspects of it, which will be considered as potential implications of IPR regimes.

**Private Property Rights**

Private property rights refer to the exclusive right of any individual to own physical assets (i.e.: goods, real-estate, machinery, etc.), to determine the use of these assets, and to exchange them freely (Alchian, 2008). Protection of private property rights are meant to ensure that an asset owner can enjoy this ownership, and all of the benefits that come with it (ability to determine its use and freedom to exchange it), but also to
protect the property from theft, unauthorized use and unjustified expropriation. Protection of private property is exerted through private property laws integrated in countries’ national legislations. As will be put forth in section 2.4.5, private property laws are integrated in the Brazilian Federal Constitution.

Nevertheless, the right to own property is also recognized internationally through the United Nations Universal Declaration of Human Rights (UDHR), which was adopted in 1948 by all Members of the United Nations. Article 17 of the Declaration, composed of the two following sentences, entitles natural persons to enjoy their possessions without disturbances: “(1) Everyone has the right to own property alone as well as in association with others. (2) No one shall be arbitrarily deprived of his property”. Even though the UDHR is not a legally binding instrument of law, but rather a declaration (a term understood in international law as a declaration of aspiration rather than a binding commitment), it is widely recognized as one by international courts (Trindade, 2008). Firstly, because human rights inherently apply to all human beings, the Declaration is morally binding on all countries, and all countries should respect, protect and fulfil human rights. Secondly, already in its preamble, the Charter of the United Nations (international treaty adopted in 1945 establishing the United Nations, legally binding on all UN Members) states that the UN is determined “to reaffirm faith in fundamental human rights, in the dignity and worth of the human person”. And lastly, because of the repeated reference to the Declaration in court cases, making it “general law practice”, the UDHR has come to be recognized as international case law and international customary law (Trindade, 2008). In fact, in defining the use of the term declaration, the United Nations (2014) states that:

Some instruments entitled "declarations" were not originally intended to have binding force, but their provisions may have reflected customary international law or may have gained binding character as customary law at a later stage. Such was the case with the 1948 Universal Declaration of Human Rights (para. 15).
As corporations gain legal personality and the status of juridical person when registered in a jurisdiction, they are subject to the laws that govern this jurisdiction, and acquire legal rights and duties. As such, a firm is entitled to protection of its private properties under the private property laws of the jurisdiction where it is registered. Firms possess private properties such as production plants, capital goods, machinery, stock of products, office space and office supplies. These tangible assets constitute the infrastructure that enables them to conduct their operations and business practices without hindrances, which result in output, profits and value for the firm. Therefore, effective protection of private property ensures that firms can operate without the risk of their internal infrastructure being exposed to misuse or misappropriation that could affect their productivity and profits. Firms whose output embodies high-technology contents such as machinery, production designs, patented solutions, or other commercially sensitive information or trade secrets are especially vulnerable in jurisdictions where their private property is not effectively protected. The reason for this is that break-ins in their facilities, be it in production sites or offices, can lead to knowledge leakages if the trespasser gains access to unprotected documents and production designs, or high financial losses in case of destruction of property or theft. These losses arise both from the need to replace private property and technologically advanced machinery, but also from the lead time until normal operations can be restarted.

2.1.2. Foreign Direct Investment

According to the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD):

Foreign Direct investment is the category of international investment that reflects the objective of a resident entity in one economy obtaining a lasting interest in an enterprise resident in another economy. (The resident entity is the direct investor and the enterprise is the direct investment enterprise). The lasting interest implies the existence of a long-term relationship between the direct
investor and the enterprise and a significant degree of influence by the investor on the management of

The IMF also defines a direct investment enterprise as:

An incorporated or unincorporated enterprise in which a direct investor, who is resident in another
economy, owns 10 % or more of the ordinary shares or voting power (for an incorporated enterprise)
or the equivalent (for an unincorporated enterprise) (IMF, 1993, p. 86).

Although the definition of FDI presented above is accurate, full understanding of the concept requires
some contextualization. FDI actually takes different meanings in a macro- and microeconomic context. At the
macroeconomic level, or in the field of international finance, foreign direct investment is an international
transfer of capital that is listed in a country’s balance of payment, where all international monetary and
financial transactions (both debts and credit entries) that the country participated in over a period of time are
registered (Eun, Resnick and Sabherwal, 2011). Apart from foreign direct investments, a country’s balance of
payments includes its exports and imports, and purchase and sales of assets and currencies between residents
and non-residents. In this context, the most important aspect of FDI is the flow of capital and its size, as it
counts either towards a balance of payment deficit or a surplus.

At the microeconomic level, which is of more relevance to this paper, the focus is on the rationale
behind a firm’s decision to invest abroad, on the degree of control it has over the investment enterprise, and
on the implications this decision has for the investor, for its home economy and for the economy hosting the
investment (Lipsey, 2001). In this case, the industry in which the investment will take place, and even the
specific functions in which it will take place are important, as both factors affect how trade, employment,
production and flows of intellectual capital resulting from the investment will influence the home and host
economy. In other words, when firms invest in other countries, they essentially reallocate production inputs,
thereby changing the aggregate production function in both economies. Another aspect of FDI that affects both economies involved is the mode of entry chosen by the investing firm, which can be a greenfield investment, a merger or an acquisition. If a firm chooses to open a new production facility or affiliate in the host country, this is referred to as a greenfield investment. Otherwise, firms can merge with an existing firm, in which case a so-called merger takes place, meaning that both firms cease to exist legally and a new firm is established. Finally, in the case of an acquisition, a foreign firm can buy a local firm, which then ceases to exist legally and becomes part of the foreign firm.

Foreign direct investment which designating nothing but a transfer of capital from one country to another is referred to as portfolio investment, and concerns the purchase and sales of financial assets such as stocks in a publicly traded company or bonds. Whereas the purpose of greenfield investments, mergers and acquisitions is to extend businesses across borders and gain a certain degree of (or even full) control over the investment enterprise, the purpose of portfolio investments is usually to derive the most interests from the capital invested, and does not entitle the investor to any control of the assets he/she has chosen to invest in. Thus, countries with high interest rates, or where the interest rates are expected to rise are likely to be the target of portfolio investors. Unlike the other forms of FDI mentioned, portfolio investments do not influence productivity, employment or knowledge spillover in the host economy, and therefore will not be considered in this paper. Dunning (1970) explained this difference as follows:

Something other than money capital is (or may be) involved in international direct investment. This might simply be informal managerial or technical guidance; on the other hand it could incorporate the dissemination of valuable knowledge and/or entrepreneurship in the form of research and development, production technology, marketing skills, managerial expertise, and so on; none of which usually accompanies investment (p. 4).
With the aim of providing clarity around why firms choose to invest abroad, and why they choose one entry mode over another, Dunning (1980) developed the Eclectic Theory of FDI, also known as the OLI-model. The theory states that, for FDI to pay off for firms, they must benefit from at least one of three types of advantages: ownership advantages, locational advantages, and internalization advantages. Ownership advantages refer to those that are internal to the firm, independent of external conditions, and that cannot easily be exploited by competitors (e.g.: trademark, patents, production technique, entrepreneurial skills and returns to scale). Location advantages refers to characteristics of the foreign market that make out a favorable business environment (e.g.: availability of natural and human resources, cost of these resources, size of market, proximity to research institutions, infrastructure, governance and regulations). Internalization advantages imply that for a business to choose to establish a presence abroad, this option must be more profitable or less risky than alternative ways of serving a foreign market, like licensing agreements, for example.

According to the OLI-model, the set of advantages that a firm can exploit from the ones mentioned above will determine how it chooses to serve a foreign market. If a firm has developed an innovative production process (an ownership advantage), and the target country it wants to serve is rich in a natural resource that is used in this production process (locational advantage), the firm might license the use of its innovative production process to a local firm, so that production can take place closer to the natural resource needed. Nevertheless, if the firm thinks there is a risk of the secret behind its production process to leak out to local companies if it engages in such a licensing agreement, this risk associated with licensing production gives rise to an internalization advantage. That is, it becomes more advantageous for the firm to not engage in a licensing agreement, but rather to open a wholly owned production facility in the given country to be able to benefit from the local natural resources.
In this paper, the notion of foreign direct investment extends further than the technical definition from the IMF that opened this section, and encompasses also the effects that it is likely to have on the aggregate production function of the host economy, and consequently on its economic development. The corresponding effects on the home economy are not considered here since this paper limits itself to inward FDI, the type of FDI entering, rather than leaving, an economy. These effects take place because inward FDI (excluding portfolio investments) represents an increase in capital inputs in the host country at the expense of the home country, and often brings with it technologies and skills that are new to the host country. This implies that FDI can have positive implications for the economic development of the host economy, since it influences the allocation of factors of production and the efficiency with which these are used in production. The role of FDI in fostering economic development is explained by Chaudhuri and Mukhopadhyay (2014) in the following statement:

In case of the developing economies that are typically plagued by low levels of productivity leading to low levels of wages and hence low levels of savings and investment, again perpetuating the low productivity levels, an external injection in the form of foreign investment often acts as a vehicle to break away from the ‘vicious circle’. It tends to supplement national savings, facilitate access to internationally available technologies and management know-how, raise efficiency and expand output so that the inward spiral turns to a trajectory of economic growth and prosperity (p. 1).

2.1.3. High-Technology Industries

In its most basic understanding, high-technology industries are those whose output consists of sophisticated goods, which require above average research and development (R&D) expenditures at one or more stages of its production. Nevertheless, there are several other, more informative accounts of what defines high-technology industries. These can be based on determinants like high-wage jobs in the industry and knowledge intensity (INTEC, 2003), rate of innovation (Malecki, 1985), or percentage of revenue spent on R&D
(OECD, 2011). Thus, because high-technology is a multifaceted adjective in the context of industries, no single definition of the concept can be said to be universal. In order to substantiate the vague definition of high-technology industries in the first sentence of this section (2.1.3), a few of these accounts will be explained below.

The first notion mentioned, that of high-technology industries being the ones that spur high-wage jobs is most common in sub-national, national or regional technology development plans and policies (INTEC, 2003). The central argument here is that, if an economy is to be fuelled by innovation and technology (which is the basic goal of technology development plans), smart, talented and skilled individuals must be in the center of this economy. One example of this is the strategic plan for an innovation economy in the Inland Northwest region of the U.S., which states that “success in the new economy is generated by smart, educated and highly-skilled individuals, capable of incredible productivity and innovation […], the intellectual horsepower behind wealth creation and economic growth.” (INTEC, 2003, p. 5). In this case, what determines whether an industry is perceived as high-technology is the percentage of technical workers in the total workforce.

Next, some consider industries with high rates of innovation to belong under the high-technology category (Malecki, 1985). The rate of innovation measures the speed with which industries renew the science-based inputs in their operations so as to develop emerging products and processes based on non-routine, state-of-the-art knowledge. In this view, high-technology industries can be said to be those whose product life cycle is typically short, and therefore require constant innovation and product updates in order to keep up with, or sometimes induce, market demand. The electronics industry represents one such industry. In this industry, highly specialized technical skills are required in the development of production designs. These designs are then standardized and produced in large scale, by processes that do not require much technological input. Nevertheless, in this industry, the work of the specialized technical workers is by no means
done once the designs are ready and passed on to production. In order to remain competitive, they must constantly work on improving their designs, since their competitors are often doing the same thing (Malicke, 1985).

Finally, the interpretation applied by the US Department of Commerce (and the rest of North America), the OECD and the European Union rests on industry expenditure on R&D as the key determinant of the level of technology used in a given industry. As such, the statistical agencies of all the countries in these regions follow this interpretation when gathering data about national economies and industries. These statistical agencies have, on the basis of R&D expenditure by industries, placed them under the following four categories: high-technology industries, medium-high-technology industries, medium-low-technology industries, and low-technology industries.

For such categorization to be possible there had to be a common framework for identifying which industry each enterprise belongs under. This is not an easy task, considering that firms often have several branches of operations which can fall under different industries. The ISIC (International Standard Industrial Classification of All Economic Activities), compiled by the United Nations, adopted in 1948, and revised four times since, serves this function. It classifies statistical units (e.g.: firms) into industries according to their primary business, the activity from which they derive most of their revenue. In the latest revision of the ISIC (UNSTATS, 2014), adopted in 2008, it was aligned with other classification systems (e.g.: General Industrial Classification of Economic Activities within the European Communities (NACE) and the North American Industry Classification System (NAICS)), so that statistical data classified according to national or regional classification systems could be compared and analyzed at the global level.

In this paper, high-technology industries concern the ISIC industry groups which are classified as such by the OECD due to their average R&D intensity. These are shown in Table 1 below. The classification is based
on industrial activity in OECD Member countries (for full list of member countries, see OECD, n.d.) during the period 1991-1999. The industries’ average R&D intensities during this period was compared to that of the aggregate average R&D intensity across OECD Member countries to determine which category of technology they should be placed under. In this context, R&D intensities comprise two indicators: R&D expenditures divided by total value added, and R&D expenditures divided by total production costs (OECD, 2011). This interpretation sees R&D intensity as capturing the importance of technological activity in an industry or company by measuring the capital invested in the generation of new products and processes relative to total capital investment in the development and production of the product or process (Malecki, 1985).

<table>
<thead>
<tr>
<th>High-technology industries</th>
<th>Medium-high-technology industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft and spacecraft</td>
<td>Electrical machinery and apparatus, n.e.c.</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>Motor vehicles, trailers and semi-trailers</td>
</tr>
<tr>
<td>Office, accounting and computing machinery</td>
<td>Chemicals excluding pharmaceuticals</td>
</tr>
<tr>
<td>Radio, TV and communications equipment</td>
<td>Railroad equipment and transport equipment, n.e.c.</td>
</tr>
<tr>
<td>Medical, precision and optical instruments</td>
<td>Machinery and equipment, n.e.c.</td>
</tr>
<tr>
<td><strong>Medium-low-technology industries</strong></td>
<td><strong>Low-technology industries</strong></td>
</tr>
<tr>
<td>Building and repairing of ships and boats</td>
<td>Manufacturing, n.e.c.; Recycling</td>
</tr>
<tr>
<td>Rubber and plastics products</td>
<td>Wood, pulp, paper, paper products, printing and publishing</td>
</tr>
<tr>
<td>Coke, refined petroleum products and nuclear fuel</td>
<td>Food products, beverages and tobacco</td>
</tr>
<tr>
<td>Other non-metallic mineral products</td>
<td>Textiles, textile products, leather and footwear</td>
</tr>
<tr>
<td>Basic metals and fabricated metal products</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. OECD Classification of manufacturing industries into categories based on R&D intensities (OECD, 2011)

2.2. FDI and Intellectual Property Protection

In the capitalist global market where MNEs compete nowadays, they are constantly challenged by competitors and urged by consumers to improve their products. Therefore, the discovery of better, innovative technologies, including, but not limited to, modes of production, materials, substances and software that can create new, or improve existing marketable products, should be a priority for those wishing to remain competitive and profitable (Porter, 1980). However, such discoveries usually require large and risky
investments in research and development and human capital. The large investments cover the costs of the very specialized labor needed, and the costly equipment and facilities. Moreover, these investments are risky because the end result of research is unknown, and therefore not guaranteed to lead to profitable innovation.

When such investments are proven worthwhile and bring technological advances that can improve a firm’s competitive position in its target market, another risk appears: commercial exploitation of innovation by others who did not bear the investment costs. Thus, in order to protect their intangible assets, firms can apply for a patent for their inventions, industrial designs and trade secrets, which prevents their unlicensed use for a limited period (WIPO, 2013). Patents ensure that the inventor is the only one who can profit from the invention during its duration, thereby increasing the likelihood that resulting profits will outweigh investment costs and creating an incentive for firms to take the risk of investing in innovation. This section will present some theoretical arguments that shed light onto the relationship between FDI and the protection of intangible assets in the country hosting the investment.

Systems of IPR differ among countries (WIPO 2013). In general, North America and Western Europe afford better protection of intellectual property (IP) than the rest of the world (Lorenzo, 2014). The fact that IP protection is uneven among countries is the reason why it is taken into consideration by foreign investors in high-technology industries seeking a destination for their investments. One would expect countries with strong IP protection to attract more foreign IPR-sensitive investment than countries perceived to have a low level of IP protection. Not surprisingly, empirical evidence shows that the degree of IP protection in a country is a significant determinant of inward FDI in technologically advanced industries (Smarzynska, 2004; Smith, 2001; Mansfield, 1994). Furthermore, once a high-technology manufacturer chooses to operate in a new market, then the type of operations established is also affected by the local level of IP protection (Smarzynska, 2004). Weak IP protection makes foreign investors more inclined to invest in sales and distribution operations rather
than in local production or R&D facilities (Smarzynska, 2004; Mansfield, 1994). This evidence from Smarzynska (2004) and Mansfield (1994) indicates that MNEs prefer to establish operations that do not require technology sharing in countries with weak IP protection.

The theories briefly referred to above (Smarzynska, 2004; Smith, 2001; Mansfield, 1994) will now be presented in a more substantiated version. The contributions to this existing body of evidence are based on data from different countries, collected over different time periods. Also, they apply different proxies for measuring the level of IP protection in the subject countries. Overall, existing research suggests that IP protection is an important consideration for investment decisions, but also that the effect that the former has on the latter is not constant across industries.

One of the first studies concerning the effects of IPR on transfer of technology through FDI was conducted in 1994 by Mansfield. He gathered data through interviews and surveys among top managers and specialist from 94 U.S. MNEs in 1991. The interviews and surveys aimed to reveal the perceived degree of influence of IP protection in firms’ decisions to engage in joint ventures, transfer of new technology to affiliate, and licensing of new technology to foreign firm. His conclusions were three-fold: a) level of IP protection has an important effect on FDI decisions concerning technology transfers, R&D, and manufacturing of components and of whole products, b) strengthening of IP laws only has a positive impact on IP-sensitive FDI once proven to be effectively enforced over time, and c) different sectors have different opinions on the importance of IP protection (Mansfield, 1994). Mansfield’s study implies that strong perceived IP protection (in terms of legislation as well as enforcement thereof) can help countries interested in attracting high-technology FDI and technology spillovers to achieve this goal. Furthermore, it implies that the effects of IP protection on technology transfer through FDI depend on the industry and business function targeted, since IP protection is more important in some industries and business functions than others. For example, foreign direct investors in
the pharmaceutical industry are more concerned with the level of IP protection in a target country than those within the transportation equipment industry. Also, investors looking for countries to establish R&D functions in are more concerned with local IP protection than those looking to open distribution outlets abroad (Mansfield, 1994).

Focusing specifically on foreign patent rights (FPRs), Smith (2001) applied the OLI-model to examine their effect on U.S. firms’ decision of how to service a foreign market. The study assumes that a firm wishing to sell its products abroad has three ways of doing so: exporting the products to the target market, establishing an affiliate, or licensing a company in the target market to produce its products. Smith’s study analyzes data from U.S. outwards bilateral exchange (exports, affiliate sales and licenses) in 50 countries in 1989, and concludes that strong FPRs increase bilateral exchange in general for all countries included, as it protects the intangible assets which make firms competitive in the global market (ownership advantage). As expected, this effect is more significant for countries which are thought to have imitative abilities, implying that strong FPRs provide the locational advantage of reducing the chances of imitation. Finally, the study also shows an internalization advantage that makes firms more likely to license production or open affiliates than to export when seeking to serve a country with strong FPRs. The implications of this study are that FPRs are found to affect all three components of Dunning’s (1980) OLI-model of internationalization of the firm (see section 2.1.2). And, more importantly, strong FPRs have a positive effect on knowledge that leaves the firm’s home country, through the opening of affiliates abroad, and an even stronger effect on knowledge that leaves the firm, through licensing agreements with other firms.

Another relevant contribution is Smarzynska’s (2004) cross-sectional study that applies FDI data from Eastern Europe and the Soviet Union in 1995. The researcher compared the effects of IP protection on FDI in four technology-intensive sectors with those in other, less technology-intensive sectors. When justifying her
choice of proxy for IP protection, Smarzynska (2004) acknowledged that actual degree of property protection depends on two dimensions: property rights laws and their enforcement. She used the index developed by Ginarte and Park (1997) to account for patent laws, and developed her own index to account for both dimensions combined. She concluded that level of IP protection and technology-intensive FDI are not only directly related, but also that in countries with low IP protection, FDI tends to be directed at distribution facilities rather than production facilities, regardless of sector. The study points out that the effects of IPR regimes on FDI are of great implications to policy formulation, especially in developing countries, since FDI is thought to bring new technologies, management skills and marketing know-how to the host country (Smarzynska, 2004).

Similar studies focusing on level of IP protection and inward FDI in Brazil are scarce. It appears that the only author who has raised the issue in a Brazilian context to date is Frischtak (1989). He recognized that the absence of strong IPR can raise concerns for innovators over losing control of their creations, but also that “there is no systematic evidence that the current IPR regime affects either the volume or composition of direct foreign investment in Brazil” (p. 2). As the macroeconomic context and the IPR system in Brazil have undergone considerable changes since the publication of Frischtak’s work (see section 2.4), it seems appropriate that the effect of the Brazilian IPR system on inward FDI be revisited. As a first step towards this goal, this paper will analyze the effect of IP protection on inwards FDI targeting high-technology industries in Brazil.

Investments in development of technology, whether domestic or foreign, are risky and expensive, but also have the potential to give rise to a strong competitive advantage for the investor. The studies presented in this section confirm that the level of protection of companies’ intangible assets afforded by jurisdictions via IPR legislation and its enforcement are important considerations for companies’ choice of jurisdiction to establish operations in. Jurisdictions where IP protection is strong tend to receive more FDI in IP-sensitive industries and
in business functions such as production and R&D, which make use of intangible assets and expose these more to imitation than distribution and sales facilities do (Mansfield, 1994; Smith, 2001; Smarzynska, 2004). Turning to such tangible assets (i.e.: distribution and sales facilities), a theoretical discussion of the effects of protection of private property on inwards FDI follows in the next section.

2.3. FDI and Private Property Protection

The relationship between FDI and private property protection seems quite straightforward when speaking of the establishment of physical property, such as production facilities, R&D facilities or offices. Any investor, or person for that matter, would want to avoid the theft, destruction or misappropriation of their private property. This section briefly explains some theoretical arguments of how host country private property protection can affect inward FDI, and presents some empirical studies that sustain these arguments (Knack and Keefer, 1995; Tuman and Emmert, 2004; Biglaiser and DeRouen, 2006).

Before entering this discussion, it is important to point out that much of the evidence that exists concerning the relationship between FDI and private property protection does not take into account the degree of technological advancement of FDI. Yet, contract enforcement is often included by researchers in the combination of factors that determine the degree of private property protection (Knack and Keefer, 1995). And, as a patent is also a contract, the inclusion of contract enforcement as a determinant of private property protection indirectly accounts for the level of IPR enforcement in the country. That is, as the level of private property protection reflects, among other factors, the strength of contract enforcement in the country, the level of private property rights also provides an indirect proxy for the level of enforcement of IPR in a given country.

Furthermore, as private property in different industries can vary extensively in value and level of technological complexity embodied, there is reason to believe that weak protection of such property causes
greater risks for companies in high-technology industries, where such property tends to be more expensive and unauthorized access to production plants and offices can reveal secrets about production processes, designs, or other intangible assets that are crucial for a firm’s competitive advantage. As such, there is a possibility that the effects of private property protection on inward FDI is also uneven across industries, depending on the value (both intangible and tangible) embodied in their physical property. Another goal of this paper is to analyze whether the perceived protection of private property rights in Brazil has a greater effect on FDI in high-technology industries than in low-technology industries. But firstly, some studies relating private property protection and inward FDI will be presented.

Concerning FDI in general (without distinguishing between FDI in high or low technology industries), private property protection affects firms’ investment decisions because, like any person or organization, foreign investors are keen to reduce the risk of their property being robbed or damaged. Firstly, physical assets can be very costly to replace in case of damage, robbery or expropriation (Tuman and Emmert, 2004; Knack & Keefer, 1995). Secondly, breaking and entering in office spaces, production sites or laboratories can grant the trespasser access to confidential commercial information such as trade secrets, documentation about internal research, strategy papers and pipeline plans. As a consequence, low private property protection can also lead to misappropriation of documented information and technology leakage. Nevertheless, companies still invest in countries with weak private property protection because, as the OLI-model shows (Dunning, 1989) (see section 2.1.2), there are many other reasons to invest abroad. For example, despite its notorious disregard for property rights, China attracted more FDI than any other BRIC (Brazil, Russia, India and China) country in the 2000s (Dahlman, 2008).

Of the studies referred to here, the first one to be published was that by Knack and Keefer (1995), two renowned research economists from the World Bank. They claim that their analysis of the impact of private
property rights on economic growth and investment is more precise than previous attempts at this, since cross-country data on the level of private property protection disaggregate from broader measures of quality of political environment and instability were scarce at the time (p. 207). Compared to studies that had used these less accurate proxies, Knack and Keefer (1995) found private property rights to have a greater positive impact on growth and investment. The researchers used data from 119 countries over the period 1974 to 1989 (for full list of countries see Levine and Renelt, 1992, p. 961, where the data was sourced from). The dimensions they used to measure private property protection concerned mainly expropriation risk, contract enforcement and rule of law. In line with convergence theory of economic development, this study takes rate of convergence to U.S.-level of income as a measure of economic growth. The paper draws three main conclusions: a) protection of private property is crucial for economic growth, b) protection of private property affects the amount of investment, and c) protection of private property affects allocation of investments and thereby also efficiency of inputs. These findings imply that the stronger private property protection is in a given country, the higher the likelihood of private investment to take place, and the higher the chance of investment to be directed at more specialized human and physical capital, which in turn leads to technological innovation and dynamic gains to the economy.

Next, Tuman and Emmert (2004) also tested a variety of host country economic and political aspects for their power to determine inflow of FDI in Latin America, but concentrated on investments coming from U.S. multinationals between 1979 and 1996. This period covers the Latin American debt crisis as well as the first years of the neoliberal reforms imposed by the Washington Consensus (see section 2.4.1). The authors apply two theoretical approaches to their analysis: the OLI-model (Dunning, 1980) (see section 2.1.2) and classical analytical theories, which take a Marxists approach to FDI decisions, implying that MNEs use FDI as a bargaining chip to force potential host countries to repress their working class and wages (O'Donnell, 1979 in Tuman and Emmert, 2004). This study (Tuman and Emmert, 2004) includes statistical tests of the effect of the
following variables on inward FDI: market size, free trade areas, workers' skills, production costs, economic reform, political risk, and human rights. The test for revolution deaths and anti-government riots, which the OLI-model links to insecurity of property rights, suggests an inverse relationship between such events and inflow of FDI from the U.S. Also, authoritarian regimes and low human rights protection, which classical analytical theories link to political stability and strong private property protection, proved to be directly related to U.S. FDI. The study concluded that market size, openness to trade, and education had important effects on FDI, but that firms also paid close attention to political instability and the security of their property. These conclusions support the argument that host country private property rights are important for an MNE’s decision to invest abroad, but also that there are a number of other important factors affecting this decision.

Along the same lines, Biglaiser and DeRouen (2006) conducted a multivariate analysis of FDI against several host country independent variables that were grouped in three categories: economic reforms, macroeconomic conditions, and good governance. Table 2 below shows the variables included in each category. The asterisk (*) marks the ones that proved significant for attracting FDI. And, among those, enforcement of property rights stood out as the most significant. These results provide guidance for countries trying to increase their attractiveness as an FDI destination; not only in terms of actions that are likely to pay off, but also those that are unlikely to pay off.

<table>
<thead>
<tr>
<th>Economic reforms</th>
<th>Macroeconomic conditions</th>
<th>Good governance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in tax law</td>
<td>Economic growth rates</td>
<td>Regime type</td>
</tr>
<tr>
<td>Trade liberalization*</td>
<td>Government consumption</td>
<td>Corruption</td>
</tr>
<tr>
<td>Privatization</td>
<td>Previous FDI inflows*</td>
<td>Societal conflicts</td>
</tr>
<tr>
<td>Removing barriers to international capital flows*</td>
<td>Per capita Gross Domestic Product</td>
<td>Credibility, stability and transparency of government</td>
</tr>
<tr>
<td>Domestic financial reform*</td>
<td>Enforcement of property rights* and</td>
<td></td>
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<td></td>
<td>of contracts</td>
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</table>

Table 2. Host country independent variables tested for their effect on FDI inflows in Biglaiser and DeRouen (2006)
Ali, Fiess and MacDonald (2010) analyzed how the degree of private property protection affects the level of FDI in different sectors. This study is based on data from 69 developing countries from 1981 to 2005. The proxy for private property protection used combines indicators of the following measures of institutional quality: expropriation risk, the risk of contract repudiation by the government, the strength and impartiality of the legal and judicial system, and observance of the law. These indicators are taken from the International Country Risk Guide (ICRG), provided by the Political Risk Services (PRS) Group. The study finds that sound institutional environment is a strong predictor of FDI. Moreover, among the institutional attributes applied (i.e.: property rights security, democracy, corruption, political instability, and social tension), property rights security is the most robust predictor of FDI. However, these results apply only for the manufacturing and service sectors. The results were not significant for the primary sector. This implies a direct positive relationship between private property protection and FDI in the manufacturing and services sectors, meaning that an increase in the former can lead to a corresponding increase in the latter.

The above mentioned studies (Knack and Keefer, 1995; Tuman and Emmert, 2004; Biglaiser and DeRouen, 2005; Ali, Fiess and MacDonald, 2010) show that there are several macroeconomic and institutional determinants of inflows of FDI. Figure 2 below gathers the determinants considered in these studies. Some of the variables were aggregated under a single heading to make the model as simple as possible. These are explained to the right of Figure 2.

All four studies provide empirical evidence that private property protection and FDI are positively related. In fact, property rights proved to be the most significant institutional determinant of FDI in two of the studies (Biglaiser and DeRouen, 2005; Ali, Fiess and MacDonald, 2010). Furthermore, not only the amount, but also the allocation and efficiency of investments are thought to be influenced by private property protection, as a reduced risk of expropriation induces firms to make more long-term, specialized, innovation-generating
investments (Knack and Keefer, 1995). The next section will narrow the scope of discussion to the Brazilian macroeconomic and institutional environment.

2.4. Brazil: Economy, Intellectual Property and Private Property

In order to equip the reader for the data analysis and discussion of implications for Brazil, this section provides a brief historical overview of the Brazilian economy and industrial policies, as well as an outline of the domestic IPR system, private property protection system and trends and composition of FDI in Brazil. This section ends with the presentation of the two hypotheses that guide this study.

2.4.1. The Brazilian Economy: brief history

Brazil’s industrial output is largely based on natural resources and other commodities, which account for more than 70% of its exports (Government of Brazil, 2014). The strong natural resource sector can be traced back to the Import Substitution Industrialization (ISI) strategy that prevailed in the country between the 1946 and 1964, period of democratic regime that succeeded Getúlio Vargas’ authoritarian regime and preceded the military dictatorship. During this period, the ISI model aimed to foster and diversify the domestic industry by imposing protectionist trade measures on goods which could be produced domestically. One crucial
measure to stimulate domestic production and economic growth was the establishment of a range of state-owned companies in sectors deemed strategic such as mining, steel and electricity. Among these companies are the Companhia Vale do Rio Doce (national mining company), Companhia Siderúrgica Nacional (national steel-maker) and Petrobrás (national oil and energy company). Although still prevalent during the military dictatorship (1964 - 1985), the ISI model was slightly modified to welcome the import of capital goods in order to advance and modernize the national industrial base, and of FDI in strategic industries. Moreover, during this second phase of the ISI, Embraer (national aviation company), and Embrapa (national agricultural research company) were founded. At this point, the ISI model had enabled the strengthening of the aforementioned companies (national oil and energy company, mining company, and steel-maker), as well as the foundation for a strong aircraft industry and advanced agricultural practices.

Import Substitution Industrialization undoubtedly had its merits in building the base for strong domestic utilities industries. Nevertheless, the way in which this was done had negative implications for Brazil’s attractiveness towards FDI. Prior to World War II, the ISI period, and the expansion of the public sector associated with it, the main players in these industries were foreign companies. The excessive intervention and regulation that was imposed on them in the form of tariffs and price controls made their business unprofitable and resulted in their nationalization, which did not always happen with appropriate compensation (Baer, 1996). In a paper published in 1987, when the drawbacks of the ISI model had come to the fore, professor of political science, Akinsanya meant that “the feeling of insecurity in these respects [the expropriation of profits and private property] is, perhaps, the major deterrent to the flow of direct foreign investment in less-developed countries” (p. 58). He mentions Brazil as an example of such a country (p. 61).

Towards the end of the military dictatorship in Brazil, the rise in interest rates of creditor countries caused by the two oil crisis (1973 and 1979) meant that countries like Brazil, who had borrowed large sums
from creditor countries to finance their industrialization, were unable to repay their debts. In 1982, these events culminated in the Latin American debt crisis, which marked the beginning of a decade of economic recession, the lost decade. This decade was characterized by high unemployment, hyper-inflation, wage-stagnation and low investments (Grinberg, 2008). Towards the end of the 1980s, it was quite clear that the country needed to revise its economic policy stance. The new approach that would be pursued going forward was thought out by English Economist, John Williamson, and presented to the U.S. Treasury Department, the World Bank and the International Monetary Fund in 1989. As these institution were not only the holders of Brazil’s debt, but also its lenders of last resort, the set of policy recommendations assembled by Williamson had to be endorsed by them. This new economic strategy was termed Washington Consensus, and proposed a neoliberal economic policy that consisted of trade liberalization, orthodox monetary and fiscal policies, deregulations, privatizations, and cuts in public spending. The complete implementation of these neoliberal policies was undertaken by the Cardoso administration (1995-2002). The subsequent government, headed by Lula (2003-2010), and the current Dilma government have since given continuation to the neoliberal model in Brazil (Saad Filho, 2010).

2.4.2. The Brazilian Economy: current state

The Brazilian economy is still characterized, first and foremost, by the inheritance of the ISI period, which, despite its flaws, built the industrial base of the economy and paved the way for further development in targeted industries, especially natural resource-based ones. In fact, all the companies that were founded during this period remain market leaders in Latin America (Musacchio and Lazzarini, 2014) and, in 2007, seven of the top twenty Brazilian multinationals in terms of foreign assets were natural resource companies. Furthermore, these seven companies owned two thirds of Brazilian assets abroad (FDC-CPII, 2007). Other commodities which are important to the country’s economy and exports are agricultural products and derivatives, textiles, and footwear. Exports of agricultural crops and natural resource-based goods accounted for 46.8% of total exports
from Brazil, in terms of share of exports in 2012 (Government of Brazil, 2014). Furthermore, the mineral and agricultural industry showed the steepest post-crisis growth of all export sectors in Brazil, growing 77% and 48% respectively between 2009 and 2011 (Canuto, Cavallari and Reis, 2013).

Turning to the more sophisticated share of the country’s manufacturing sector, the strongest industries are aircraft, automotive, machinery, electrical equipment and chemicals. The national aviation company, Embraer, was also established by the government but is now privately owned. Nevertheless, the government still offers financial incentives for R&D investments in Embraer, and holds shares and veto power in the company. It is currently the world’s third largest commercial aircraft manufacturer, following Airbus and Boeing. Brazil also has a strong automotive industry, and is the seventh largest producer of automobiles in the world. However, the industry is heavily protected through high import tariffs on vehicles and auto-parts, making it isolated from the global value chains and less productive than its foreign competitors. For example, the productivity of a worker in a Mexican automobile assembly plant is double that of a worker in a Brazilian plant (Elstrodt, Manyika, Remes, Ellen and Martins, 2014). The transportation sector combined represented 10% of exports in 2012 (Government of Brazil, 2014). Brazil’s machinery sector focuses on agricultural, mineral extraction and construction machinery, and made up 4.5% of exports in 2012 (Government of Brazil, 2014). The electrical equipment sector accounted for only 2% of exports in 2012 (Government of Brazil, 2014). The financial crisis of 2008 had a much greater impact on these three industries (transportation, machinery and electronics) than on commodities. They each lost more than 8% of export share between 2009 and 2011 (Canuto, Cavallari and Reis, 2013). In regards to chemicals, the Brazilian industry is the eighth largest in the world (in revenues) and accounts for 6.5% of exports (Government of Brazil, 2014). It produces mainly industrial chemicals, pharmaceuticals, cosmetics, fertilizers and detergents.
The industries of concern to this paper are mainly the high-technology ones. To facilitate their identification, this paper relies on the ISIC (International Standard Industrial Classification of All Economic Activities) groups of manufacturing industries defined as high-technology by the OECD (see section 2.1.3). Among Brazil’s main industries, only pharmaceuticals and aircrafts fall under the high-technology category. In the medium-high-category are the automotive industry, chemicals, machinery and electrical equipment. Still, the main domestic economic activities, production of commodities and raw materials from natural resources, belong to the medium-low and low-technology categories. Even the two high-technology sectors mentioned above can be questioned in respect to how much technology is actually developed by domestic firms in those industries. Brazilian pharmaceuticals are less technologically sophisticated than their foreign competitors, and do not fulfil the domestic demand, leading to a trade deficit in this sector (Pinto, 2011). When it comes to the aircraft industry, manufacturer Embraer imports the majority of the components for its aircrafts (Izique, 2012). The latest report on the Brazilian aerospace and defense industry, compiled by the global industry and market research group MarketLine (2014), offers another indication of the low degree of dynamic gains from this industry to the domestic economy. The report rates both forwards and backwards integration in the industry as “1” on a 5-point scale where 1 corresponds to the weakest level of integration. Figure 3 below shows the main components of Brazilian exports in 2012 (Government of Brazil, 2014).

Figure 3. Brazil exports 2012 (excluding services)
In regards to Brazil’s main industries in the medium-low and low-technology categories, namely agriculture and natural resource-based ones, Brazil occupies an important place in the global market. Roughly one third of exports from Brazil are agricultural products (e.g.: sugar, ethanol biofuel, orange juice, coffee, soybeans, beef, poultry, pork, tobacco and forest products) (Government of Brazil, 2014). As a result, Brazil is currently the world’s third largest agricultural exporter (European Commission, 2014). The country dedicates 388 million hectares to arable land, which is more than any other country and, most importantly, funds the development of innovative farming technologies especially tailored to its different climates and soils. Most of this research is conduct by state-owned Embrapa (national agricultural research company), which has developed more than 9,000 technological products for the Brazilian agricultural industry since its establishment in 1973. As for natural resource-based exports, the oil and mining industries take the lead. Brazil is the ninth largest oil producer (Government of Brazil, 2014), and sixth largest mining producer in the world (Ernst & Young, 2012). Both industries also attract large amounts of FDI, accounting for 28% of total inward FDI (BCB, 2014). Domestic investment in both industries are also high. National steel-maker Vale do Rio Doce alone is responsible for almost 5% of total domestic annual investments (ICMM, 2013) and Petrobrás is the largest corporate investor in the country (Government of Brazil, 2014). The prioritization of investments by these two companies allows them to continuously develop new technologies for improving the efficiency of their operations and quality of their products. Thus, even though the three industries mentioned above (agriculture, energy and mining) are not rated as high-technology ones by the OECD, it is worth to point out that the use of high-technology solutions in these industries in Brazil proved to be a good investment.

Brazil can be said to have a diversified industrial base, ranging from basic commodities to sophisticated aircrafts and manufactured products that fall in between the two in terms of technological complexity, such as motorized vehicles. Nevertheless, as outlined in this section, the only industries whose larger share of added value takes place domestically and, at the same time, are strong enough to compete in foreign markets are the
agricultural and natural resource-based industries. As for the former, although it is highly advanced, it does not open way for the technological advances that can be achieved in more sophisticated industries, nor does it have the potential to become part of high-value adding production chains. The latter has very limited job-creating effects. Furthermore, both of them are highly susceptible to external shocks in the global economy.

2.4.3. Industrial Policies in Brazil

The government of Brazil has taken several initiatives to move its economy towards a more knowledge-based one, with reduced dependency on commodities, a stronger and more diversified high-tech industry, and sustainable exploitation of natural resources for the production of high value-added manufactured goods, rather than for exportation as raw materials. The overview of industrial policies below starts with the first industry development plan under the Lula government, which was launched in 2004. The previous government, headed by Cardoso, did not roll out any significant industrial policy plan. Cardoso pursued a neoliberal economic agenda, focusing on reducing public debt and inflation in order to stabilize the economy, which would in turn foster industrial development (Coronel, Campos and Azevedo, 2014).

In 2004, under the government of Lula, the Industry, Technology and Foreign Trade Policy (original title: PITCE – Política Industrial Tecnológica e de Comércio Exterior) was launched. It had four main focus areas: innovation and technological development, insertion in foreign markets, industrial modernization and institutional environment, and increase in productive capacity. Specific measures included stimulating public-private partnerships (especially between research institutions and innovative enterprises), increasing private R&D spending, creating regulatory incentives (i.e.: tax rebates for R&D expenditure, access to loans and subsidies, possibility of sharing infrastructure and human resources in public and private research) and implementing technical harmonization of exports to abide by foreign standards. To ensure the availability of trained human capital, the Ministry of Science and Technology and the Ministry of Education developed a joint plan to finance and promote post doctorate-level training within the areas of priority in the PITCE. However,
the PITCE did not reach its goals. There are a few diverging views about the reason for its failure: Castilhos (2005) believes the actual formulation of the strategy, which appears to be founded on an inclusive, pro-poor interventionist model of industrial development, is in fact quite the opposite when looked at closely, making the policy inconsistent by nature. Suzigan and Furtado (2010) suggest that, given the complexity of the policy’s structure, the lack of collaboration and coordination among ministries and government institutions, and lack of sufficient training of public officials in relevant areas jeopardized the outcome of the policy. Another perception is that the PITCE focused too much on horizontal, cross-sectoral measures rather than on specific industries, meaning that the incentives, originally meant to drive diversification, innovation and global competitiveness, did not target industries where there was potential to achieve this, but rather went to already established ones which were more experienced in navigating Brazil’s complex bureaucratic system (Coronel, Campos and Azevedo, 2014). In fact, the industries targeted by the plan: semiconductors, softwares, capital goods and pharmaceuticals, were already anchored in the economy and perceived as offering prosperous opportunities for private investment (Government of Brazil, 2014).

In his second term (2007 - 2010), Lula launched a new plan in the industrial policy area, the Productive Development Policy: innovate and invest to sustain growth (original tile: PDP - Política de Desenvolvimento Produtivo: inovar e investir para sustentar o crescimento), whose main objectives were to: expand supply capacity, preserve the positive balance of payments, improve innovation capacity and, strengthen small and medium enterprises (SMEs). In order to achieve these objectives, the plan set four national goals to be reached in 2010, which did not diverge much from the goals of the PITCE. These were: to increase fixed capital investment, private R&D spending, participation of Brazilian exports in global trade and, the competitiveness of SMEs. Not surprisingly, specific measures also remained largely the same, reduction in tax burdens, easier access to credit and funds for innovation and technology, and improvement on trade regulations. However, in
the PDP, almost all industries were included, and there was an attempt to tailor the strategy according to the level of maturity and specific needs of each industry.

The PDP only achieved a fraction of the envisaged results. A study by Coronel, Campos, Azevedo and Carvalho (2011) concluded that the PDP increased production and exports in low and medium-technology industries, especially in automotive and machinery industries, but failed to achieve the same results in high-technology industries, where the possibilities for high value-added innovation are greater. In this case as well, scholars have hypothesized over the reasons for such outcome. Sarti and Hiratuka (2010) trust that there was a misfit between the overall objectives of the plan, the prioritized industries and the instruments chosen to target them as the support instruments and funds were mostly concentrated in low-technology industries. Watanabe and Villaverde (2010) maintain that the plan failed to implement novel stimulating measures, as the tax cuts and stimulus which showed results were already in place before the plan. Finally, both scholars and the media referred to the unfavorable global macroeconomic context caused by the financial crisis of 2008 and the negative effect it had on the PDP.

Subsequently, the Greater Brazil Plan (original title: Plano Brasil Maior) was developed by Dilma Rousseff’s government, and rolled out between 2011 and 2014. It focused on innovation and technological development, and outlined four priorities: a) to build and strengthen critical competencies in the national economy, b) to enhance productivity and technology density within value chains, c) to expand the domestic and external markets of Brazilian companies, and d) to ensure socially inclusive and environmentally sustainable growth. At the time of writing, the final outcome of this plan had not been assessed yet.

All three policies described above recognized the importance of IP protection in stimulating R&D investments and innovation. The PITCE policy initialized a restructuring of the Brazilian Patent and Trademark Office, which consisted of digitalizing all application processes and increasing the workforce and its skills so as
to increase the efficiency of its work and reduce the backlog of applications (INPI, 2011). This restructuring has carried through to the subsequent policies and is therefore still ongoing, but the continued average 8-year delay in processing applications suggests that there is still a long way to go (Matias-Pereira, 2011). The system of IP protection in Brazil will be discussed in detail in the next section.

2.4.4. Intellectual Property Protection in Brazil

Since IPR first entered the international trade fora with the negotiation of the TRIPS (Trade-Related Aspects of Intellectual Property Rights) agreement adopted in 1994, Brazil has been among the least enthusiastic parties over the idea of moving IP regulation to the multilateral sphere and establishing a minimum global standard for IP protection (Turk, 2010). The reason for this is, firstly, that developing countries, including Brazil, believe the TRIPS agreement affords more protection for the IP of developed countries than to theirs. And secondly, that the degree of protection of IP imposed by the TRIPS limits the knowledge dissemination that developed countries took advantage of in their earlier stages of development (Dosi and Stiglitz, 2014). Nevertheless, as a member of the WTO (World Trade Organization), Brazil’s system of IPR must be in line with the TRIPS agreement. That is, Brazil’s IP protection must comply with TRIPS commitments, be extended to all WTO members, and be non-discriminatory.

The TRIPS agreement makes reference to, and incorporates, other pre-existing IP protection treaties into the multilateral trading system, extending their application to all WTO members. Under the TRIPS, WTO members are obliged to comply with the Paris Convention on industrial property, the Berne Convention on copyright, and certain provisions of the International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations (Rome Convention) and of the Treaty on Intellectual Property in Respect of Integrated Circuits (IPIC Treaty) (WTO, 2014). Thus Brazil’s de jure protection of IP is similar to that afforded by other WTO members, including developed countries.
In its national legislation, Brazil divides IP into two categories: copyright and industrial property (i.e.: patents, utility models, trademarks and industrial designs). Relevant to this paper is the second category: industrial property, which protects knowledge-based assets used in high-technology sectors. The government body in charge of industrial property registration and protection is the Brazilian Patent and Trademark Office, which operates under the National Institute of Industrial Property (INPI - Instituto Nacional da Propriedade Industrial). Enforcement mechanisms include arbitration, civil action and criminal action. The first option requires both parties to agree to it and is therefore uncommon in IP cases. The second option, civil proceedings, must be filed before federal courts and consist of nullity actions, such as the granting of an IP right or the cancellation of a third party IP right, recovery of damages or destruction of seized products. The third option, criminal proceedings, must be filed before state courts and consist of infringement actions that can lead to imprisonment (between one month and one year) or fines. A plaintiff can make use of both civil and criminal litigation for a given case (Bhering, 2013).

Despite these enforcement mechanisms, in 2004 the Brazilian Ministry of Justice saw the need to create the National Council for Combating Piracy and Intellectual Property Crimes (CNCP), which developed the National Plan for Combating Piracy. The Plan consists of short, medium and long-term measures involving all government departments that have a role in IP protection, as well as the private sector. Specific initiatives of the Plan include: strengthening border control, public awareness campaigns, combined public-private pricing strategy to make original products more affordable, and updating IP legislation to facilitate its interpretation and reduce judicial burdens (CNCP, 2007/2008).

Nevertheless, advances in IP protection in Brazil remain unsatisfactory in the eyes of developed countries. This is illustrated by the results of the fifth EU-Brazil IP Dialogue, held in September 2012 (European Commission, 2013), as well as by the fact that Brazil remains in the U.S. Trade Representative Special 301
Report's Watch List of countries that have serious IPR deficiencies (USTR, 2013). In these documents, the U.S. and the EU respectively express concerns for the inefficiency of the Brazilian National Institute of Industrial Property and judicial courts. These concerns are not unfounded, given the average eight years it takes to processing a patent application (Matias-Pereira, 2011). Judicial courts can take even longer to render a final decision on an IP infringement case (European Commission, 2014). Furthermore, although seizures of counterfeit products have increased since the launch of the Plan for Combating Piracy (CNCP, 2009/2010), a survey conducted by the European Commission among foreign firms who operate and possess registered IP in Brazil showed that such seizures are “generally not adequately followed by the launch of criminal proceedings and thus become a mere cost of doing business for the infringers” (European Commission, 2008, p. 4).

Both national and foreign investors view the level of IP protection in Brazil as a major constrain to businesses in all sectors (European Commission, 2008; Matias-Pereira, 2011; MarketLine 2014). A survey conducted by Matias-Pereira (2011) among 33 managers working in Brazil in different sectors confirmed that “lack of proper IP protection in Brazil is considerably harmful for the competitiveness of the Brazilian industry”, as it “impedes, or imposes difficulties on, covering the costs of research and development” (p. 583, both passages translated from Portuguese to English by the author). A market environment analysis of Brazil conducted by research company MarketLine (2014) identified four main challenges in the countries legal sphere: a) complicated tax system, b) concerns over IP protection, c) trade and industrial policies not focused on competition and productivity growth, and d) judicial delays. These challenges, b) and c) in particular, further emphasize the extent of the problem.

In this paper, the degree of intellectual property protection in Brazil will be measured by the IPR indicator compiled annually by the Swiss-based Institute of Management Development (see section 3.3). The indicator ranges from 0-10, “10” being the highest level of protection. In 2012, the most recent year included in
this analysis, Brazil’s indicator was 4.5, while the average indicators for the 3 biggest economies in the European Union (Germany, France and the United Kingdom), and for Canada and the United States were both above 8 (see Appendix 1 for full list of indicators).

2.4.5. Private Property Protection in Brazil

In the Brazilian law, private property rights are dealt with in article 5 of the Federal Constitution of 1988. The law affirms the right to own property but also imposes a social duty on the use of property. Thus, expropriation with the intent of furthering public interests and welfare is recognized by law, but must be matched with financial compensation. Likewise, in the case of imminent public danger, competent officials can make use of private property, given that any damages are subsequently covered. Urban property is referred to in articles 182 and 183 of the Constitution, and also grants the public sector the right to expropriate in exchange of financial compensation for the sake of urban planning and proper development of social functions aimed at safeguarding the wellbeing of citizens. Expropriation laws are common in other countries as well, including developed countries (OECD, n.d.).

Private property rights legislation in Brazil extends to foreign individuals and enterprises, allowing them to purchase property and establish, own and dispose of business enterprises. According to De Soto (2000) however, what is important for firms is not necessarily the private property legislations, but the effective enforcement thereof. The judicial system in Brazil, in charge of enforcing the law, is perceived by investors to be inefficient and prone to corruption (World Bank, 2009). This inefficiency is associated with insufficient capital resources and unskilled human resources, and is making the backlog of cases, especially in the area of property rights, a pressing issue. As for corruption, courts are also thought to be among the public institutions most exposed to political influence and intimidation (Roberts, Schreiber and Scissors, 2012). As such, it can be expected that the level of private property protection in Brazil discourages foreign investors. A survey conducted by the World Bank (2009) showed that close to half of the medium and small-sized enterprises see
the domestic court system as a hindrance for their business. Furthermore, as mentioned in section 2.4.4, the market environment analysis of Brazil conducted by MarketLine (2014) identified judicial delays as one of the four main challenges in the country’s legal sphere.

Similarly to IP protection, the degree of private property protection in Brazil will be measured by the private property protection indicator compiled annually by the Swiss-based Institute of Management Development (see section 3.3). The indicator ranges from 0-10, “10” being the highest level of protection. In 2012, the most recent year included in this analysis, Brazil’s indicator was 4.6, while the average indicators for the 3 biggest economies in the European Union (Germany, France and the United Kingdom), and for Canada and the United States were both above 8 (see Appendix 1 for full list of indicators).

2.4.6. Foreign Direct Investment in Brazil

Brazil’s FDI inflows have experienced sharp growth since the 1990s. Figures 4 and 5 below show this growth measured both as percentage of world FDI inflows and total net inflows of FDI, respectively. Apart from the effects of globalization mentioned in the beginning of section 2, one potential explanation for this growth is the macroeconomic policy reform initiated by president Cardoso (1995 – 2002). It consisted mainly of abandoning the nationalist ISI model in favor of macroeconomic liberalization, internationalization of the Brazilian economy, and privatization (Shikida, 2005), and consequently gave way to increased foreign investments into the country. This liberal macroeconomic stance was continued by the following governments

![Figure 4. Inflows of FDI to Brazil (% of world inflows)](image1)

![Figure 5. Inflows of FDI to Brazil (US$ million)](image2)
of Lula and Dilma, to some extent. Evidently, the fact that the country’s economy grew at a faster rate than most others in the past decade (World Bank, 2014), and is currently the sixth biggest in the world (Financial Times, 2012) also plays a part in securing foreign investors’ interest.

In 2013, the largest investor in Brazil was the Netherlands, which accounted for more than 20% of all FDI inflows. As a region, Europe was at the top the list, bringing in 46% of all inflows in 2013. Other major European investors were Luxembourg, Switzerland and Spain (15%, 5% and 4%, respectively). Outside Europe, the largest investors were the U.S., Mexico, Chile and Japan (14%, 8%, 5% and 5%, respectively) (ECLAC, 2014). In terms of sector distribution, services received 41% of inward FDI in 2013. Manufacturing came in second, with 33% of FDI, and natural resources accounted for the last 26%. In the former sector, the automobile industry can be highlighted, as inward FDI in this industry doubled in 2013 compared to the average of the past five years. In the latter sector, the oil industry took the largest share of FDI (ECLAC, 2014). As for the mode of entry of FDI, 45% took the form of greenfield investments and 16% came from mergers and acquisitions. This implies that the remaining 39% account for reinvested earnings and intra-company loans, which are the two components of FDI apart from equity capital (see section 3.3).

The reason why the countries of origin and target industry of FDI were specified above is that they carry implications for the effects of FDI in the host country (Lipsey and Sjöholm, 2005). FDI from countries that have a different set of capabilities or more advanced technologies than the host country enables the transfer of these assets via spillover effects (see section 2.2), which, if absorbed by the host economy, increase local productivity. As such, one crucial factor for FDI to positively affect the host economy is that it is directed at technology-intensive sector, where the potential for knowledge transfers is higher. Thus, the country of origin is not in itself a determinant of whether FDI will yield positive results, but at least it indicates if there is a potential for the investment to create positive spillovers.
Although inward FDI in high-technology industries provides more opportunities for economic growth than FDI in low-technology industries (ECLAC, 2014), there is another vital pre-condition for spillovers and growth to take place. The foreign firm must establish relations with local firms, so as to create channels for knowledge flows. This can happen between firm and supplier, i.e.: backward linkages, and between firm and buyer, i.e.: forward linkages. Additionally, it can happen horizontally among competing firms via demonstration effects (see section 2.2). For example, even though the mining and oil industries can require high-technology solutions depending on how hard the reserves are to access, investment in these industries create very few jobs and very limited linkages to the economy since they are typically exported as raw materials rather than integrated in domestic production chains. It is estimated that for every US$ 1 million invested, only one job is created in extractive activities, while the same investment creates two jobs in natural resource-intensive manufacturing (ECLAC, 2014, p. 14). In Brazil, as much as 26% of inward FDI went to natural resource-based industries in 2013 (ECLAC, 2014, p. 26).

Despite the fact that Brazil has attracted record levels of FDI inflows, this alone does not spur economic growth in the country. As discussed above, the benefits derived from FDI largely depend on the industry it targets, with high-technology industries showing the strongest potential to give rise to such benefits. The arguments in sections 2.2 and 2.3 suggest that investors in high-technology industries are more inclined to establish subsidiaries in countries with strong property rights systems (Mansfield, 1994; Smarzynska, 2004; Knack and Keefer, 1995). It has also been demonstrated here that property protection in Brazil is perceived as weak by foreign investors (see sections 2.4.4 and 2.4.5). Thus, if the theories that high-technology FDI and intellectual and private property rights are positively related hold true for Brazil, inflow of FDI in Brazil should be concentrated in industries that do not rely on advanced technologies. Otherwise, one can conclude that these theories do not hold true for Brazil or that the country has other qualities which are equally or more
attractive for high-technology FDI than property protection. To test which of these propositions might be the case, the following two hypotheses are posed.

2.4.7. Hypotheses

FDI in Brazil increased exponentially between 2002 and 2012. Therefore, it would be naive to think that the low level of intellectual and private property protection in the country (as argued in sections 2.4.4 and 2.4.5, and measured qualitatively by the World Competitiveness Yearbook indicators presented in section 3.3) have had a strong negative impact on FDI inflows across industries. But, as inward FDI in high-technology sectors is thought to be the most affected by the level of intellectual and private property protection (see sections 2.2 and 2.3), the following hypotheses are posed:

**Hypothesis 1:** The level of intellectual property protection in Brazil attracts more FDI inflows in high-technology industries than in low-technology industries.

**Hypothesis 2:** The level of private property protection in Brazil attracts more FDI inflows in high-technology industries than in low-technology industries.

In the next section, some of the potential implications for economic growth that FDI inflows can bring to the host country are discussed. The theoretical arguments presented below will inform the implications of results, which are discussed in section 5.

2.5. FDI and Economic Growth

So far, this theoretical overview has indicated that strong intellectual and private property protection attract foreign investments. However, this evidence only becomes relevant if there are benefits for the host country associated with FDI inflows. Thus, this section looks at the relationship between FDI and host country economic growth, which has proven to be a much contested one. As far as this research is concerned, there exists no evidence of a universal relationship between FDI and economic growth. This relationship is
intrinsically dependent on the industry and country in which FDI takes place (Lipsey and Sjöholm, 2005). As such, this section, apart from presenting the theoretical background concerning this relationship, also points out arguments that can be challenged when taking contextual aspects, such as level of technological advancement of investment, into account.

According to Brazil’s industrial and growth policies presented in section 2.4.3, policy-makers agree that the growth and income generation in Brazil must move to more technologically advanced industries in order to become sustainable. The average GDP growth rate in the 2000-2010 period was approximately 3.5%, which was higher than in most of the developed world (World Bank, 2014). This relatively high growth rate experienced in Brazil in the 2000s, was spurred mainly by low-technology industries such as agriculture, mineral extraction, and oil and oil derivatives, which do not generate long-term sustainable growth because of their low job-creating potential, and vulnerability towards external shocks and exchange rate fluctuations (ECLAC, 2014). Not only does technological improvement and innovation lead to more sustained growth than extractive and commodity-based growth, but productivity levels in technologically advanced sectors are also higher, as they make use of more skilled human capital and more sophisticated physical capital, thereby adding more value to their final products. Already in 1988, Lucas suggested that neoclassical theory of growth and international trade, based on comparative advantage of countries and specialization in a limited range of industries, would benefit from the introduction of innovation and diversification of production in the economy as a source of growth due to their positive effects on learning and human capital development. Lucas justified this by affirming that “learning potentials on any particular goods decline with the amount produced” (1988, p. 41). To exemplify this shortcoming of the neoclassical theory of growth, he mentions the high growth rates experienced by Taiwan, Korea, Hong Kong and Singapore in the 1980s, which were fostered by high levels of exports of goods not previously produced in these countries.
Additionally, an increase in productivity at the firm level is likely to spill over to other firms, both intra- and inter-industry, and eventually impact the macroeconomic environment, the productivity level of the country, and finally, its rate of economic growth. At the horizontal, intra-industry level, the spillover effects on productivity can be attributed to the strengthened competition caused by a competitor becoming more efficient and forcing other firms in the same industry to raise their productivity or lose market share. At the vertical level, a raise in productivity of a supplier reduces the prices of the input it provides to its buyers, reducing their fixed costs and raising their profitability, which in turn allows them to invest in human and physical capital and become more productive themselves. The more complex value chains are, that is, the more linkages there are in the form of supplier-buyer relationships, the more opportunities there are to increase the productivity level along the entire value chain and raise the value-added content of the final product. In high-technology sectors, not only are there more linkages in their value chains as compared to low-technology industries, but the potential increases in productivity and value-added in each linkage is higher than in low-technology sectors. This is because, apart from being less price-sensitive than commodities, and more resilient to economic shocks (ECLAC, 2014), high-technology products require higher investments in their production process, and therefore also lead to higher return on investment in the form of value added. When the products in question are exports, and compete in the global market, these dynamics happen on a global scale, which is why exporting firms are generally assumed to be highly efficient and productive. These positive spillovers in productivity make a strong case for countries to get integrated in the international trade sphere and in global production chains.

2.5.1. Effects of FDI on Economic Growth

The relationship between foreign direct investment and economic growth is much contested (Moran, Graham, Blomström, 2005). According to Moran, Graham and Blomström (2005), this relationship can be framed in the following three main arguments. Along the lines of the Washington Consensus (see section
2.4.1), some believe that full-fledged market openness, including free flow of capital, is the best way to run an economy. Another theoretical stream rests on the assumption that, although investment promotes economic growth, it does not need to come from abroad to do so. Yet another view is that conditions (i.e.: performance requirements, local content, forced technology transfer) must be imposed on foreign investors to ensure they contribute to the economic growth in the host country. This section offers a theoretical discussion of the relationship between FDI and economic growth, focusing first on negative arguments, and then on positive arguments within each of these three views (Moran, Graham and Blomström, 2005). Other aspects that come to light when high-technology FDI substitutes all-encompassing FDI in the arguments are also included.

**Negative Effects of FDI on Economic Growth**

The first view mentioned above is grounded in Adam Smith’s free market capitalism, which assumes that an economy driven strictly by supply and demand forces, with no intervention from the government, is in society’s best interest. This is so because Smith assumes individuals always act in their own self-interest, and are naturally directed to the economic activity which they can derive the most profits from, which in turn maximizes the overall revenue of society. In contemporary economics, Smith’s theory implies that the free flow of goods, capital and labor maximizes productivity and benefits all. However, criticism of this radical liberal ideology is widespread (Stiglitz, 1998; Naim, 1999). Concerning the free movement of capital, and hence FDI, the most prominent critique is that complete market openness in host countries exposes them to unsustainable exploitation of their human (Davies and Vadlamannati, 2013) and natural resources by MNEs (ECLAC, 2013). However, the risk of such exploitation is significantly reduced in high-technology FDI as compared to low-technology FDI, since the former is generally more capital and skilled-labor-intense and the latter is more natural-resource and low-skilled-labor-intense (Helg and Tajoli, 2005).

Secondly, the view that FDI is no different than domestic investment when it comes to its ability to foster economic growth deserves further attention when the high-technology condition is imposed on
investment. Of course it can be argued that FDI and domestic investment that are both subject to this condition could still be said to have equal potential of fostering economic growth. However, the pool of technology and know-how which can be attracted to the country via FDI is larger and more diversified than the host country’s own pool of knowledge and technology (Liu and Wang, 2003). Thus, this argument only holds true if it is assumed that the host and the home country of FDI possess the same technological and educational base and are therefore capable of tapping into the same potential.

The last of the views presented also indicates skepticism towards the idea that free flows of FDI contribute to economic growth. According to this perspective, in order to foster sustainable economic growth in host countries, investors must live up to requirements imposed by the host government. The underlying reasoning behind this perspective is that the effects of FDI that are seen as negative to the host country’s economy (i.e.: greater competition for domestic firms, loosing skilled labour to MNEs, environmental pollution, lowering labor standards) will only be outweighed by positive effects (i.e.: job creation, inflow of skilled labor, transfer of managerial and tacit skills, technology transfer and leakage, forward and backward linkages, increased productivity) if requirements are imposed on the investor. However, high-technology FDI offers much more potential to generate positive externalities than FDI in low-technology industries (Sun, 2002; Gallagher and Zarsky, 2007), and is therefore more likely to outweigh the negative externalities that might arise.

Although the perception that the more competitive environment created by the entry of foreign-owned firms crowds out domestic investments is supported by empirical evidence (Backer and Sleuwaegenvol, 2003), classic economic theory (Mill, 1848) suggests that, unless the local industry is in an early stage of infancy, protecting it from competition leads to higher prices, less choices and lower material welfare for consumers, and lower productivity and innovation for industry. In fact, Backer and Sleuwaegenvol (2003)
revealed that “the importance of positive long-term structural effects – learning, demonstration, networking and linkage effects – between foreign and domestic firms can moderate or even reverse crowding out effects” (pp. 16-17). Similarly, Markusen and Venables (1999) found that the positive effects of FDI on the development of the local industry through backward linkages can even result in the MNE being outcompeted by the local industry in time. Also, the short-term crowding out effect actually leads to the movement of entrepreneurial skills and other human resources from domestic firms to MNEs, where they gain access to foreign firms’ knowledge base and can benefit from employee training, which ultimately contributes to a more skilled local labor force. In a discussion of potential ways in which FDI can crowd in investments locally, Gallagher and Zarsky (2007) point out that FDI into industries which are relatively underdeveloped in the host economy is more likely to crowd in investments, since it brings technologies, skills, and forward and backward linkages opportunities which were previously unavailable. As presented in section 2.4.2, the Brazilian high-technology industry consists mainly of the aircraft and pharmaceutical sectors, and still, they are placed in the lower end of the spectrum in technological sophistication within these industries. Thus, the chances of any high-technology FDI to Brazil to go to a relatively underdeveloped sector and crowd in investments are high.

The discussion above demonstrates that the most common skeptical arguments over the potential of FDI to contribute to economic growth can be reverted when a) it is directed at knowledge-based output, so as to reduce the possibility of unsustainable natural resource exploitation and abuse of low-skilled labor force, b) the home country has a knowledge base that differs from that of the host country, and c) it can respond to the needs and opportunities of the host country economy.

*Positive Effects of FDI on Economic Growth*

Foreign direct investment brings both direct and indirect benefits to the economy of the host country. This justifies why many governments actively seek to attract FDI by offering incentives like corporate tax concessions, subsidies, loan guarantees and exemptions from import duties, among other initiatives. Some of
the benefits of FDI are job creation, inflow of skilled labor, transfer of managerial and tacit skills to local human resources, technology transfer and leakage, forward and backward linkages in production chains (Liu and Wang, 2003; Smarzynska and Spatareanu, 2005; Markusen and Venables, 1999), increased supplier productivity (Blalock and Gertler, 2005), market presence (Markusen and Venables, 1999), and profitability (Görg and Strobl, 2005). This section explains the dynamics behind these benefits and presents some empirical evidence.

The first benefit listed, job creation, is mainly brought about by the type of FDI referred to as greenfield investments, that is, the acquisition of new operational facilities such as offices and production plants. In this case, the MNE needs to hire new employees to work in these facilities. But, it also has to send a team of skilled employees to start the operations. Such inflow of skilled labor is of course also facilitated by FDI in the form of mergers and acquisitions. In fact, even if the investment consists of a merger or acquisition, the movement of employees between home and host countries is facilitated as it becomes an intra-firm transaction, which would not be the case if the local firm had not been merged with, or acquired by, a foreign firm. As for the transfer of technology, managerial and tacit skills to locals, the process is similar. These assets are transferred to the affiliate or branch in the host country via employees from the parent company, employee training at the new subsidiary, and access to the MNE’s strategy documents, productions models and intellectual properties (Liu and Wang, 2003). Also, employees who get training, learnings and experience in foreign-owned companies can move freely in the labor market and disseminate their acquired knowledge. According to Smarzynska and Spatareanu (2005), movement of labor, along with learning by watching (i.e.: “opportunity for host country companies to observe and imitate best practices and production techniques”, p. 5), are the two main channels through which technology leakage and knowledge spillovers take place. Another channel is identified by Wang and Blomstrom (1992), who claim that technology leakages result from interactions between the foreign subsidiary and a local firm in the form of buyer/supplier relationships or partnerships.
Forward and backward linkages refer to the transactions that take place between a company and its customers (forward linkages), and a company and its suppliers (backward linkages). In their most basic understanding, these transactions consist of traditional business transactions such as the purchase of input material to be processed, and the selling of the processed product to customers, be they end consumers or other businesses. Nevertheless, they often involve gains other than monetary profit for one firm and acquired input for the other. These interactions also lead to information flow between companies, and often also create a mutually beneficial relationship where the purchasing firm can help its suppliers raise their productivity level (Lipsey and Sjöholm, 2005) and the quality of their products to a standard that affords them a more competitive position in the market (Smarzynska and Spatareanu, 2005). The increase in productivity and market competition also reduces input prices and increases the output of suppliers, consequently increasing their market presence and profitability (Blalock and Gertler, 2005; Görg and Strobl, 2005). Sometimes these spillover effects in local firms are so strong that they actually take over the market position of the MNEs and start exporting themselves (Markusen and Venables, 1999).

The contrasting empirical evidence presented above over the effects of FDI on economic development led Lipsey and Sjöholm to conclude that “if country and industry differences are important to the impact of inward FDI on host countries, the main lesson might be that the search for universal relationships is futile” (2005, p. 40). Thus, there seems to be consensus among scholars that the effects of FDI on economic development are contingent upon local conditions (i.e.: state of the industry, regulatory environment, indigenous human resources, local infrastructure, private sector sophistication) (Lipsey and Sjöholm, 2005; Ullah and Inaba, 2014; Lin & Saggi, 2005). This means that the advancement of knowledge in this field is more likely to occur through narrowly defined case studies that take such conditions into account. This paper thus limits itself to one country: Brazil; one fraction of the industrial sector: high-technology industries; and one local condition: property rights protection.
2.5.2. FDI, Property Protection and Economic Growth in Brazil

Since the turn of the millennium, Brazil has shown significant economic growth (3.5% average annual GDP growth (World Bank, 2014)). However, this growth has been financed mainly by natural resource-based industries, mining and agriculture; none of which contribute much to sustainable, long-term growth. For this reason, if Brazil is to sustain its economic growth and raise its productivity levels, it needs to build a foundation for growth by providing more opportunities for its population to engage in high value-added economic activity. That is, the economy has to become more diversified and focus on sectors where backward and forward linkages can be created and several types and levels of skills can be employed in the production of goods that are more resilient towards shocks in the global economy (Dahlman, 2008).

Sufficient research has been presented here (Moran, Graham, Blomström, 2005) to suggest that inward FDI in targeted industries (e.g.: non-extractive high technology industries) can promote the local development of such industries, create more complex value chains, and produce exports to which more value can be added domestically. Likewise, studies that indicate that weak intellectual and private property rights protection can pose strong impediments for attracting such investment have also been presented here (Mansfield, 1994; Smarzynska, 2004; Knack and Keefer, 1995). Looking at these findings together suggests that the low level of intellectual and private property protection, through its effect on inward FDI in high-technology industries, might be a hinder to the long-term sustainable economic growth of the country. These potential implications will be discussed in section 5. Yet, prior to that, section 3 and 4 will present the methods applied and results of the quantitative tests of the hypotheses, respectively.

3. Methodology

This section will explain and justify the methodological processes applied in this research. Firstly, the overarching paradigm and beliefs that frame all stages of the research will be presented: the positivist research
philosophy. Thereafter, the specific design that this research follows, including the choice of method and data collection strategy, will be depicted. Finally, the analysis techniques will be described.

3.1. Research Philosophy

The philosophical grounds of this research are best described as positivist. The subjects of analysis are real, tangible, observable phenomena (i.e.: FDI and property rights), which are measured quantitatively and analyzed from an external, objective point of view. For this project, the fact that the researcher has not been involved in the collection and recording of the data used contributes to the objectivity of the results, as it eliminates the likelihood of researcher bias, or of the researcher altering the substance of the data. The manipulation of the data will also be kept in the positivist paradigm, and will be done by statistical correlation analysis. As such, the aim of choosing this research philosophy is to avoid that the values or beliefs of the researcher have any influence on the findings.

Although the indicators of intellectual and private property protection used in this study are based on both qualitative and quantitative data, the methods applied by the Institute for Management Development for compiling these indicators are trusted to have minimized subjectivity and bias embodied in them (the indicators are presented in section 3.3). This is not a concern for the inflows of FDI, as they are expressed by raw qualitative data alone.

3.2. Research Design

The foremost objective of this research is to statistically test the two hypotheses stated in the theoretical overview (section 2.4.7), and identify potential practical implications of the findings. The formulation of these hypotheses is entirely based on previous exploratory research, which has given rise to the theoretical background presented in section 2. As such, the hypotheses are meant to test, in a deductive manner, whether the relationships between FDI and intellectual property protection, and FDI and private property protection presented in section 2.2 and 2.3, respectively, remain valid in the context of Brazil.
This is a confirmatory study whose purpose is to test the relationship between foreign direct investment and host country protection of assets, both tangible and intangible. To fulfill this purpose, this research relies on secondary quantitative data from organizational and administrative archives, which are detailed in section 3.3 below. The use of archival data enables the researcher to track data from the past and perform a longitudinal analysis, despite the researcher’s time constrains. This allows the study of the changes that have taken place over time in each variable, and also whether changes in one variable have had any effect on changes in the other variables over time. For this purpose, bivariate statistical correlation analysis is the data analysis technique employed. The correlations between FDI and intellectual property protection are conducted separately from those between FDI and private property protection, so that the effect of each on FDI can be analyzed independently.

3.3. Data

This study analyzes and manipulates three sets of qualitative data (FDI, IP protection and private property protection), each representing one variable of the study. As it is a longitudinal study, the sets consist of annual recordings of all three variables during the period of 2002 until 2012. This period was chosen firstly because it represents a change of industrial and innovation policies in Brazil, from a more liberal approach based on market forces under Cardoso to a more interventionist approach introduced by Lula (see section 2.4). Secondly, annual observations of the data are only available for this time span. In terms of geographical scope, all data pertains to Brazil, since the objective is to apply universal theories to the Brazilian context. The analysis is undertaken at the macroeconomic level, with the intention of observing country-wide, cross-industry patterns in the interaction between FDI, intellectual property protection, and private property protection.

The first variable is inflows of foreign direct investments into Brazil. When measuring FDI, the OECD recommends that countries break the total amount into three categories: FDI income or stocks, FDI flows, and FDI positions (IMF and OECD, 2003). Each category is further broken down into three main elements: equity
Capital, reinvested earning, and intercompany loans (IMF and OECD, 2003). The data applied here consists of annual inward flows of FDI in US$ million, but does not include the element of intercompany loans. This is because intercompany loans refer to banking transactions between a foreign affiliate and a parent company, and do not necessarily imply an expansion of the foreign affiliates business. As such, including this element would mean including investments that do not represent a long-lasting interest to expand operations locally, and would therefore be misleading for the purposes of this paper. FDI in the tertiary sector, i.e.: the services sector, is also excluded from the data, since it does not embody technological knowledge in the same way that the primary and secondary sectors do. The degree of sophistication, or knowledge required for the performance of different services is an inherent characteristic of the service provider, and is not at risk of being imitated or misappropriated in the same way as tangible and intangible assets embodied in capital goods, machinery and manufactured products. That is, data used here for FDI in Brazil represents annual inward flows of equity capital and reinvested earnings from a direct investor in a direct investment enterprise in Brazil in the primary or secondary sector, from 2002 to 2012, measured in US$ million.

Furthermore, this data is segmented according to the industrial activity that the investment targets. This segmentation follows the Brazilian National Classification of Economic Activity (CNAE – Classificação Nacional de Atividades Econômicas) (Secretaria da Receita Federal, n.d.), which is analogous to the International Standard Industrial Classification of All Economic Activities (ISIC) developed by the United Nations Statistics Division. In order to test the hypotheses posed, a distinction had to be made between the amount of FDI inflows received by industries of different levels of technological sophistication. Therefore, four groups of industries were formed, based on OECD’s classification of technological level of industries (see Table 1). The first group, total FDI (abbreviated TotFDI) includes all FDI inflows that are subject to this paper: equity capital and reinvested earning in the primary and secondary sectors. FDI in high-tech industries (FDIHT) includes inflows of FDI in Brazil in industries classified as high-technology by the OECD. FDI in mid- and low-technology
industries (FDIMLT) includes FDI inflows subject to this paper that are not included in FDIHT. FDI in low-tech industries (FDILT) includes inflows of FDI in Brazil in those industries classified as low-technology by the OECD.

The data was collected by the Brazilian Central Bank through the Annual Census on Foreign Capital conducted since 1996 (annually since 2001), and is available on the Bank’s website (bcb.gov.br) or in Appendix 2.

As for the second and third variables, intellectual property protection and private property protection, two sets of observations ranging from 2002 to 2012 are applied here. The former measures perceived enforcement of patent and copyright protection, and the latter measures perceived protection of private and real property and personal security. They are measured on a scale of 0 to 10, where “10” indicates the best perceived level of protection. The indicators are compiled annually by the Institute for Management Development (IMD) for the preparation of the World Competitiveness Yearbook (WCY), and are based on an annual survey conducted among approximately four thousand business executives in top or middle management positions who are asked to assess the business environment in the country where they live and work. As the WCY includes 60 countries, not all four thousands respondents assessed Brazil. Unfortunately, the precise number of respondents per country is not publicly available. Through their website (imd.org), IMD offers access to each country’s competitiveness ranking but not to the underlying data and indicators used to compile the ranking. However, the data is used by the World Bank to compile the Worldwide Governance Indicators (WGI), and can therefore be accessed and downloaded through the WGI’s website (World Bank, 2014). The dataset is also available in Appendix 1.

All the data used is of secondary nature, and has been retrieved from either government (Government of Brazil) or organizational archives (Institute for Management Development). As these archives provide all the necessary data for testing the proposed hypotheses, there was no need to seek sources of primary data.
Figure 6 below summarized the research processed described in this chapter.

Figure 6. Research process model

4. Data Analysis

In order to test hypotheses 1 and 2 (“the level of intellectual property protection in Brazil attracts more FDI inflows in high-technology industries than in low-technology industries” and “the level of private property protection in Brazil attracts more FDI inflows in high-technology industries than low-technology industries”), statistical correlations have been conducted to determine the degree to which a variation in the level of intellectual or private property protection in Brazil correlates to the variation in FDI inflows to Brazil in specific groups of industries. A correlation analysis indicates the degree to which two variables are related, that is, it helps describe how two variables vary together. A correlation analysis does not imply any causality between one variable and the other; it only implies how much one variable tends to change as a result of a change in the other, in a symmetrical way. For this reason, which of the variable is the X and which is the Y is indifferent in a correlation (GraphPad Statistics Guide, n.d.). The variables used for measuring the level of intellectual and private property protection are the World Competitiveness Yearbook indicators (WCY) (see section 3.3). The former, intellectual property, refers to an entity’s intangible asset (e.g.: know-how, patents, trademarks, designs, trade secrets), while the latter, private property, refers to the tangible assets (e.g.: physical capital in the form of capital goods, machinery, production sites, offices, office supplies). The other variable in the
correlations, inflows of FDI, are registered by the Brazilian Central Bank and can be downloaded from their website (bcb.gov.br).

The correlation coefficients \((r)\) and the coefficients of determination \((r^2)\) will be trusted to test our hypotheses. The \(r\)-value, or correlation coefficient, indicates the degree and the direction of the correlation. Its nominal value indicates the degree to which a change in one variable is matched by a change in the other, that is, the strength of their covariance. It ranges from minus one to one. A negative \(r\)-value indicates an inverse correlation between the variables. An \(r\)-value of zero indicates that there is no correlation between the variables. Figure 7 below shows the strength of the relationship between variables that the \(r\)-value is usually perceived to indicate. (Lind, Marchal and Wathen, 2008).

![Figure 7. Strength of correlation indicated by the correlation coefficient \((r)\)](image)

The \(r^2\)-value, or coefficient of determination, indicates how much of the variance in one variable can be explained by the variance in the other (and vice versa). It ranges from zero to one, and corresponds to the percentage of variance that the two variables have in common. For example, if \(r^2 = 0.61\), then 61% of the variation in one variable can be explained by the variation in the other variable. The results from the correlations conducted here between the different FDI variables on the one hand, and intellectual property and private property protection on the other, are shown in Table 3 below. Sections 4.1 and 4.2 will discuss these results and present charts of these correlations.

<table>
<thead>
<tr>
<th></th>
<th>TotFDI</th>
<th>FDIHT</th>
<th>FDIMLT</th>
<th>FDILT</th>
</tr>
</thead>
<tbody>
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<td>Intellectual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>property</td>
<td>(r)</td>
<td>-0.070</td>
<td>0.276</td>
<td>-0.090</td>
</tr>
<tr>
<td></td>
<td>(r^2)</td>
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<td>0.076</td>
<td>0.007</td>
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<tr>
<td>Private</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>property</td>
<td>(r)</td>
<td>0.663</td>
<td>0.660</td>
<td>0.651</td>
</tr>
<tr>
<td></td>
<td>(r^2)</td>
<td>0.440</td>
<td>0.435</td>
<td>0.424</td>
</tr>
</tbody>
</table>

*Table 3. Correlations results*
4.1. FDI and Intellectual Property Protection

4.1.1. Total FDI and Intellectual Property Protection

The correlation coefficient between total inflow of FDI in Brazil (excluding the services sector) and the intellectual property protection indicator from the World Competitiveness Yearbook over the period 2002-2012 showed an inverse variance of a very low magnitude ($r = -0.070$). According to the coefficient of determination ($r^2$), the degree of variance in total FDI that can be explained by the IP protection indicator is not more than 0.5%. That is, the statistical test indicates that 0.5% of an increase in one of these variables can be explained by a decrease in the other, as $r$ is negative and $r^2 = 0.005$. As seen in Chart 1 below, the scattered points that show the level of property protection and corresponding inflow of FDI into Brazil for each year between 2002 and 2012 appear to be closer to a straight horizontal line, which indicates that the rise in X (FDI) does not provoke a significant rise or decline in Y (IPR indicator). As a correlation is a symmetrical test, exchanging the X and Y variables would not change the results. In fact, the correlation coefficient is too close to zero to be assumed to indicate any relationship between the two variables at all.

Based on the studies by Mansfield (1994) and Smarzynska (2004), the lack of relationship between IPR and inflows of FDI in the primary and secondary sector of the Brazilian economy might indicate that operations established by these investments have been primarily within low-technology industries whose investment decisions are less affected by the degree of IP protection in the host country. This implies that R&D investments as a share of value added and production costs of most MNEs investing in Brazil are lower than they are for an MNE in a high-technology industry and, hence, that the process of developing their intellectual property is cheaper than it is for a high-technology MNE. As such, the economic risk associated with misappropriation of their IPR is also lower, and might not be a determining factor in investment decisions.
4.1.2. FDI in High-Technology Industries and Intellectual Property Protection

The correlation coefficient between FDI in high-technology industries and IPR ($r = 0.276$) indicates a weak positive linear relationship between the two variables. Still, it is stronger than the relationship between total FDI and IPR demonstrated above. The scattered points in Chart 2 below show that $X$ (FDI in high-tech industries) and $Y$ (IPR indicator) do not appear to be strongly correlated. The coefficient of determination ($r^2 = 0.076$) tells us that 7.6% of the variation in FDI in high-technology industries can be explained by the variation in the IPR indicator (or vice versa). The industries included here are those defined as high-tech by the OECD and that received FDI in Brazil between 2002 and 2012 (i.e.: pharmaceuticals, optical instruments, office, accounting and computing machinery, electronics and communication equipment).

The correlation between FDI inflows in high-technology industries and IPR is stronger than the correlation between total FDI and IPR. In line with hypothesis 1, this indicates that the positive effect of IPR protection on inflows of FDI in high-technology industries in Brazil is stronger than its effect on inflows of FDI in industries in the primary and secondary sectors in general. Nevertheless, this correlation is still quite weak. The theoretical arguments presented in section 2.2 (Mansfield, 1994; Smarzynska, 2004; Smith 2001) suggest that, since IPR does not seem to affect these investments much, they could have taken place in distribution and sales operations rather than R&D and production operations. These authors agree that investments in
distribution and sales facilities are thought to be less exposed to misappropriation of IPR, even in high-technology industries.

Chart 2. Linear correlation: FDI inflows in high-tech industries and intellectual property protection in Brazil

4.1.3. FDI in Mid- and Low-Technology Industries and Intellectual Property Protection

The covariance between inflows of FDI in mid- and low-technology industries in the primary and secondary sectors and IPR in Brazil, as expressed by the correlation coefficient ($r = -0.090$), is very weak and negative. The coefficient of determination ($r^2 = 0.007$) tells us that only 0.7% of the variation in one variable can be explained by the variation in the other. Chart 3 below exposes this lack of correlation between the two variables.

These statistical results, the $r$-value and $r^2$-value, are very close to the ones obtained from the correlation analysis between total FDI and IPR, which is to be expected since mid- and low-technology FDI constitutes on average 95% of total FDI for the entire period between 2002 and 2012 (BCB, 2014). The results confirm previous empirical studies (Mansfield, 1994; Smarzynska, 2004; Smith, 2001) that show that host country IP protection has a weaker impact on inflows of FDI in industries outside the high-technology scope, as compared to FDI in high-technology industries. These findings also afford evidence to confirm hypothesis 1.
4.1.4. FDI in Low-Technology Industries and Intellectual Property Protection

The linear relationship between FDI inflows in low-technology industries in Brazil (wood, pulp, paper, paper products, printing and publishing, food products, beverages, tobacco, textiles and textile products) and perceived level of IPR protection (as measured by the WCY) is weak and negative, as revealed by the correlation coefficient ($r = -0.205$). Here, again, the points in Chart 4 do not show an explicit positive or negative linear relationship, but rather the lack of a relationship between X and Y. The coefficient of determination ($r^2 = 0.042$) indicates that the two variables share 4.2% of their covariance. Chart 4 shows the scatter points from which these coefficients were calculated.

Even though both coefficients here show a stronger correlation between IPR and FDI inflows in low-technology industries than between IPR and total inflows of FDI, it remains a weak and inverse correlation. As such, it remains in line with Mansfield (1994), Smarzynska (2004) and Smith (2001) findings. In absolute values, the correlation coefficient here is very close to that between high-tech FDI and IPR, but because the relationship is inverse in this case, one variable actually increases while the other decreases. Judging from the type of industries included in this category, the explanation of the development of FDI inflows here is unlikely to be IPR related, but rather related to commodity prices and human and natural-resource availability.
The correlations between Brazil’s level of IP protection and FDI inflows in different industries presented here show that the results were more significant (r-values further away from zero) for industries in high-technology sectors and for industries in low technology sectors, although each on opposite ends of the spectrum. The first being positively correlated to IPR and the second being negatively correlated to IPR. The two other groups of industries tested against IPR: total FDI inflows in primary and secondary sector, and FDI in all industries excluding high-technology, revealed almost no relationship between the variables (r-values very close to zero). Thus, although none of the r-values obtained indicate a strong relationship between variables, the fact that FDI inflows in industries likely to be IP-sensitive (high-technology industries) show the strongest positive correlation, and that FDI inflows in the remaining industries are either not affected at all, or negatively affected by IP protection confirms hypothesis 1. Hence, the findings of this section reinforce the theories of Mansfield (1994), Smarzynska (2004), and Smith (2001). Next, hypothesis 2, the correlation between private property rights and FDI inflows in Brazil, is tested.

Hypothesis 1 confirmed: The level of intellectual property protection in Brazil attracts more FDI inflows in high-technology industries than in low-technology industries.
4.2. FDI and Private Property Protection

In this section, the correlation results between FDI and private property protection are discussed jointly, except for that between private property protection and low-technology FDI inflows. This is because the other three correlations (private property and total FDI, private property and high-technology FDI, and private property and non-high-technology FDI), showed very similar r and \( r^2 \)-values. Hence, the interpretation of these results is also very similar, and presenting them together will not compromise the accuracy of the interpretation.

4.2.1. Total FDI, FDI in High-, and in Non-High-Technology Industries and Private Property Protection

The relationship between private property protection and total FDI, FDI in high-technology industries, and FDI in non-high-technology industries all proved to be positive and of moderate strength. All three correlations coefficients only vary at the second decimal digit. The r-values of these correlations are, respectively, \( r = 0.663 \), \( r = 0.660 \), and \( r = 0.651 \). The level of private property rights in Brazil seems to have a moderate positive influence on FDI inflows (0.5 < \( r < 0.8 \); see Figure 7). The coefficients of determination tell us that the variations that private property protection has in common with any of the three FDI variables is approximately 43%. The coefficients of determination are, respectively, \( r^2 = 0.440 \), \( r^2 = 0.435 \), \( r^2 = 0.424 \). As the charts representing the three linear relationships mentioned here are also very similar, and do not enrich the analysis of the results, they are not included here, but can be found in Appendix 3.

The fact that private property protection alone seems to explain 43% of the variation in FDI in Brazil, even though it is only one of many determinants of FDI inflows (as demonstrated by the OLI model; see section 2.1.2), supports the empirical evidence that points to private property protection as a highly significant host country institutional determinant of FDI inflows (Knack and Keefer, 1995; Tuman and Emmert, 2004; Biglaiser and DeRouen, 2005; Ali, Fiess and MacDonald, 2010). When considering Brazil’s institutional environment, one potential explanation for the results presented here could be the legacy left by the risk of nationalization and
expropriations that is linked to the period of Import Substitution Industrialization in Brazil, which lasted from the late 1940s until the late 1980s (see section 2.4.1). That is, since expropriations and nationalizations were, at that time, a main concern among investors, being more attentive to property rights protection and responsive in case of improvements might be more ingrained in the investment culture. Furthermore, institutional changes and reforms declared or put in place by local governments have been shown to only affect the level of investment once these have been effectively implemented and proven to actually deliver on their intended improvements (Montero, 2008). As such, the fact that the neo-liberal macroeconomic stance replaced ISI more than 20 years ago, and that changing governments have given continuation to this ideology and refrained from expropriations and other forms of breach of private property protection provides a sense of credibility, long-term stability and foreseeability in the institutional and macroeconomic environment that can also stimulate responsiveness of investors to such improvements (Montero, 2008).

4.2.2. FDI in Low-Technology Industries and Private Property Protection

The correlation between low-technology industries and private property rights in Brazil was the only one that showed a strong relationship between the variables. The correlation coefficient ($r$) of 0.868 reflects the fact that the level of private property protection is a major determinant of FDI inflows in low-technology industries in Brazil. The coefficient of determination ($r^2 = 0.753$) implies that 75% of the change in FDI inflows in low-technology industries can be explained by the change in the level of private property protection in Brazil. Chart 5 below graphically represents this linear relationship.

Among the industries included under low-technology FDI inflows are agriculture and food processing, which account for 68% of these inflows, on an annual average (BCB, 2014). According to Knack and Keefer (1995), improvements in private property protection are positively related to industry specialization, as the risks associated with concentrating investments in one industry, and acquiring capital goods and machinery tailored to this one specific industry, as required for specialization, are reduced. Based on this finding, the
strong correlation between low-technology industries and private property rights in Brazil can potentially be explained by the fact that much specialization in Brazil has taken place in low-technology industries such as the agriculture and food processing. The strong covariance between private property protection and low-technology FDI inflows suggests that, since FDI in agriculture and food industry in Brazil represents a specialized investment, and consequently a more risky investment, the investor is prone to be more responsive to private property protection, as this affords the investor a measure of the institutional risk involved.

The statistical correlations between private property protection and the four FDI variables (total FDI, FDI in high-technology industries, FDI in non-high-technology industries, and FDI in low technology industries), support the theoretical argument that property protection is a significant determinant of FDI inflows (Knack and Keefer, 1995; Tuman and Emmert, 2004; Biglaiser and DeRouen, 2005; Ali, Fiess and MacDonald, 2010). Furthermore, the correlations presented here, together with the ones discussed in section 4.1, show that, in Brazil, private property protection is a better determinant of FDI inflows than intellectual property protection. One potential reason behind this is that the intended shift towards a capitalist neo-liberal economic paradigm, which has property rights as a fundamental principle (Friedman, 1968), actually managed to move from plan to action, and was swiftly implemented in the 1990s. Additionally, subsequent governments maintained this neo-
liberal macroeconomic approach, and managed to improve investors’ trust in the institutional environment and property rights protection. However, although private property protection has been shown here to be at least moderately positively related to FDI inflows, this relationship is stronger when looking at private property rights and low-technology industries alone. We can therefore conclude that hypothesis 2 is untrue, and must be rejected.

**Hypothesis 2 rejected:** The level of private property protection in Brazil attracts more FDI inflows in high-technology industries than in low-technology industries.

5. **Implications**

The analysis conducted in the section above concludes that (a) IPR is more strongly correlated with inflows of high-technology FDI than non-high-technology FDI, and (b) although the level of private property protection is indeed positively correlated with the amount of FDI inflows in Brazil, this relationship is stronger in low-technology industries that in high-technology industries. In order to evaluate the implications of these findings for the country, it is useful to think of the economic context in Brazil and the industrial policies pursued by Lula and Dilma (see section 2.4). Both governments have attempted to move the Brazilian economy from commodity and natural resource-based to knowledge-based.

5.1. **FDI and Intellectual Property Protection**

The finding that IPR and inflows of FDI in high-technology industries in Brazil are correlated, although to a weak degree, implies that the perceived level of enforcement of IPR legislation can be a contributing factor to the insufficient advances in technology and innovation in Brazil. That is, the transfers and spillovers of technology that could have resulted from high-technology FDI inflows are, to some extent, foregone due to insufficient IP protection. Technology transfers from abroad play an important role in strengthening the technological base of developing countries such as Brazil, which are typically still in the process of laying down the grounds to allow them to, in the future, advance their own national technologies (Castilhos, 2005). This
process involves the establishment of trusted government institutions, high-quality educational institutions, infrastructure, and improved conditions for entrepreneurial activity (e.g.: access to credit and regulatory burden of registering a company) (Troyjo, 2014). In other words, since this groundwork has not been fully completed in Brazil, and its capacity to diversify and further develop its high-technology industries is lower than in developed economies, failure to take full advantage of the opportunities to import and absorb technologies from abroad can be a significant hindrance to the advancement of the country’s knowledge-based economy. The importance of ensuring the attractiveness of Brazil as a destination for FDI in the right industries should therefore not be underestimated.

As mentioned in section 2.5, there is no evidence of a universal relationship between FDI and economic growth, but studies show that inflows of FDI in targeted industries in countries which are equipped to derive the benefits from these investment (i.e.: where basic infrastructure, institutional environment and level of training of locals does not hamper technology transfers) do in fact promote sustainable economic growth (Liu & Wang, 2003; Sun, 2002; Gallagher and Zarsky, 2007). In order to reinforce and cross check these implications, this section will present other authors and reports that have previously exposed concerns with the effects of the lack of technological advances in Brazil and the unsuitable regulatory environment on the country’s long-term economic growth. Recommendations to policy makers and government authorities as for how these issues can be approached will also be presented.

In the latest report on FDI published by the Economic Commission for Latin America and the Caribbean (2013), a regional agency of the United Nations, it was emphasized that FDI inflows to Latin America were highly concentrated in low-technology and natural-resource-intensive industries. Such inflows do not create opportunities for high-value-added local production nor do they advance the insertion of the host countries in foreign markets. This is because their potential to create backward and forward linkages and develop
production chains where there is room for the involvement of the local labor force is very low (Castilhos, 2005). That is, the inflows of FDI in Latin America have very little effect on job creation because of the type of industries they target, which implies that knowledge transfers through movement of labor, one of the main channels for knowledge transfer from FDI (Smarzynska and Spatareanu, 2005), are left unrealized.

Specifically for the case of Brazil, it has been argued both by the academic (Furtado, 2011; Castilhos, 2005) and the business community (Ernst & Young, 2012; MarketLine, 2014) that the limited knowledge transfers from abroad, and the weak domestic technological and scientific base are hindrances to the economic development of the country. In 2011, Brazil spent 1.21% of GDP in R&D, while China spent 1.84%, and the OECD average was 2.24% (World Bank, 2015). The number of triadic patent families (patents filed at three of the major patent offices: the European Patent Office (EPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO) to protect the same invention) granted to Brazilian inventions that same year was 36, while China was granted 968, and the average for OECD countries was 1,233 (OECD, 2014). Furthermore, a study of the effect of technological advances on the labor market in Brazil has shown that demand for skilled labor in Brazil is primarily induced by technology transfer, rather than national R&D investments (Menezes-Filho and Rodrigues Jr., 2003). Again, this implies that, until Brazil does not achieve higher levels of domestic R&D, fostering an environment that attracts technology transfers is the next best option to begin laying the path for a knowledge-based economy. It has also been shown that MNEs, who are the biggest creators and disseminators of technology and consequently owners of IPR (Dahlman, 2008), view IP protection as an important determinant of location in their foreign investments decision (Adams, 2010). This is particularly true for large, middle-income, developing countries, since their indigenous human and capital resources have reached the point where they are often capable of imitating but not developing high-technology products (Fink and Maskus, 2005). In sum, one promising opportunity for Brazil to come closer to a knowledge-based economy in the near future is to import technological advances from abroad via foreign
direct investment from MNEs in industries other than natural-resources and commodities. However, for this to happen, it seems that Brazil must enhance enforcement of national IPR legislation and reverse its international notoriety and domestic public debate around the topic.

The government of Brazil has actually already tried to address the problem of breaches of IPR in the country with the creation of the National Council for Combating Piracy and Intellectual Property Crimes in 2004 (see section 2.4.4). However, the work of the Council is much more focused on remedying measures and on the impairment of the circulation of counterfeit goods via border controls and apprehensions than on preventive measures. According to recently conducted surveys (Matias-Pereira, 2011; MarketLine, 2014), the main concerns of MNEs in the area of IP protection in Brazil are the inefficiencies of the National Institute of Industrial Property (INPI; the patent processing agency) and of the judicial system, which are presumably caused by lack of sufficient funding and staff/judges who lack specialized legal training in the field of IPR. Thus, it seems like the first steps towards improving enforcement of IPR in Brazil are to ensure: a) patents are actually granted in due time, and b) faster and more predictable court rulings on IPR cases.

In order to secure inflows of FDI that bring new technologies to the country in diversified industries, Brazil should prioritize the establishment of a stronger, more credible and reliable domestic system of IP protection. Brazil should focus on increasing the number of patent examiners in INPI so that the backlog of applications (estimated at 200,000 applications (Blasi, 2014)), and their processing time, can be reduced and kept at a low level. Furthermore, strikes by the over-chargded workforce of the INPI in the quest for better working conditions and better pay are common, and evidently reduce the efficiency of the agency (Blasi, 2014). The INPI also needs to invest in specialized training for its current and future examiners. This includes: a) legal training in the field of IPR and in the requirements for the granting of a patent, and b) specialized technical training in specific industries to allow examiners to determine the degree of innovation of the invention and its
commercial applicability in a faster and more reliable way than generalist examiners are able to. Thus, investing in more examiners, and ensuring they are adequately equipped to perform their job in the most efficient way should be a first priority for the INPI.

Once a patent has been granted, mechanisms must also be in place to secure that the protection granted is actually enforced by the judicial system. As with patent applications, the number of pending court cases in Brazil is also increasing at a rapid pace. In fact, the judiciary is only capable of handling about half of the cases filed in a given year (Cunha, 2008). IPR cases are deal with at State or Federal Courts, which take about four years to render a decision. If the defendant appeals the decision, which happens in nearly all cases, this time is of course prolonged (New Zealand MFA, 2010). For IP cases, the outlook is even worse, as there is only one State and one Federal Court specialized in IP, respectively in São Paolo and Rio de Janeiro. Thus, the same recommendations as for the INPI can be given for the improvement of the judiciary system: increase the number of staff and specialized IP courts.

At the top level, the government of Brazil needs to change its standing in regards to the developmental effects of IPR in order to become a more cooperative partner in negotiations over this topic in the multilateral trade sphere. The number of parties involved in such negotiations necessarily calls for flexibility and compromise among the WTO members. Also, Brazil’s notorious skepticism towards global IPR standards in the WTO influences how MNEs perceive the willingness of Brazil to improve national IPR enforcement. Brazil’s international reputation as one of the main opponents of global IPR standards in the multinational trade system reduced MNEs’ confidence in its national system of IP protection. Still, as demonstrated by Montero (2008), the words of heads of government in Latin America do not enjoy much credibility in the eyes of investors, and must be sustained by deeds and long-lasting changes. The latest examples of this lack of credibility can be seen in the public protests that took the streets of all major Brazilian cities in June 2013, and
the latest corruption scandals involving Petrobrás and several high-level government officials (euronews, 2015). Therefore, public verbalization of a renewed commitment to IPR will not suffice, and must be paired with actions to strengthen the IPR system, both in terms of granting IP rights and enforcing them.

Nevertheless, it is crucial to point out that strengthening the IPR system is but one piece in a complicated puzzle of public initiatives needed for the economy to become more knowledge-based (i.e.: improvement of the national infrastructure and capital availability, better access to high quality education and training, increased productivity, lowered trade barriers). High-technology FDI is just one route to the expansion of the domestic technological base, and IPR is just one locational advantage that influences MNEs’ internationalization strategies. Still, I chose to focus on FDI as a route for technological advancement for two reasons: a) importing knowledge through technology transfers and spillovers is a faster and cheaper way of advancing the domestic knowledge base than developing it domestically, and also helps induce national technological development, and b) to ensure that, when interpreting the effects of FDI inflows on sustainable economic growth, the type of industry targeted is taken into account, since these effects are uneven across industries. And on IPR as a locational advantage for FDI because it is given more importance in high-technology industries than in low-technology industries, making it a differentiating aspect in internationalization strategies of these two groups of industries.

5.2. FDI and Private Property Protection

Based on the correlations results (see Table 3), the findings of this paper support the theories which predict that host country private property protection is a determinant of inflows of FDI (Knack and Keefer, 1995; Tuman and Emmert, 2004 Biglaiser and DeRouen, 2006). Still, hypothesis 2, which concerns FDI and private property rights, although based on theoretical arguments, was meant to explore whether this relationship was more significant in high-technology industries than in low-technology industries. The reason for making this distinction between industries in this analysis is that the economic growth effects of FDI inflows
can vary significantly depending on the industry that receives it (Lipsey and Sjöholm, 2005). Thus, even though hypothesis 2 proved to be untrue and did not provide enough evidence to assume that an improvement in private property protection in Brazil would have a stronger positive effect on FDI in high-technology industries than in low-technology industries, it does not mean that the theories above (Knack and Keefer, 1995; Tuman and Emmert, 2004 Biglaiser and DeRouen, 2006) are not applicable to the Brazilian context.

It was clear from the data analysis that FDI and private property protection were more strongly correlated than FDI and IPR. All correlations between FDI and private property rights indicated a moderate positive covariance between the variables, while the correlations between FDI and IPR were either weak or insignificant. This implies that private property is a better determinant of inflows of FDI than IPR is. Nevertheless, the data also showed that low-technology FDI and private property rights were in fact more strongly correlated than FDI in any other group of industry and private property rights, including high-technology FDI. As inflows of FDI in Brazil have been highly concentrated in low-technology industries, it can be stated that the level of private property rights in the country has not posed an impediment to FDI inflows. The results obtained here do not indicate that the level of private property protection in Brazil has had any negative repercussion for the inflows of high-technology FDI either. However, one crucial factor that differentiates Brazil’s perceived level of private property protection from its perceived level of intellectual property protection is that the former is ingrained in the capitalist economic paradigm that was implemented in Brazil in the beginning of the 1990s and is now deeply institutionalized and trusted by the public and investors, while the latter, although formerly covered by law, is yet to be viewed as reliable and foreseeable. What can be drawn from this is that a change of public perception of the level of intellectual property protection in Brazil is unlikely to come as an immediate response to improvements in the patent application process and enforcement, but rather after these improvements have been institutionalized and a new pattern for handling IPR cases and patent applications has been shaped. This brings a sense of urgency to the implementation of
these recommendations, since it will take time before their effect can be reflected in society and investor decisions.

6. Conclusion

This paper analyzed whether the degree of intellectual and private property protection in Brazil has had any effect on the nature of incoming FDI between 2002 and 2012, and thereby also on its potential to generate long-term, knowledge-based growth. This potential is higher for FDI in high-technology industries where the need for skilled human capital and research and development activities is also high, and the host country can benefit from knowledge transfers and spillovers. However, these industries are also more sensitive to the level of intellectual and private property protection in the countries where they operate, since their intangible and tangible assets are more costly to develop or acquire than the intangible and tangible assets used in low-technology industries.

From the statistical tests conducted in this study, it can be concluded that both intellectual and private property rights have an effect on the amount of inward FDI in Brazil, and that the strength of this effect varies across industries. The level of intellectual property protection in Brazil appears to affect inflows of FDI in high-technology industries more than inflows of FDI in low-technology industries. This indicates that host country IP protection is likely to carry more weight in decisions over establishing business facilities in a new market for firms that operate in high-technology industries than for those in low-technology industries. These findings are in line with those of Mansfield (1994), Smarzynska (2004) and Smith (2011), presented in section 2.2.

Concerning the level of private property protection in Brazil, it appears to have a stronger effect on FDI than intellectual property rights does. This indicates that foreign investors see the level of private property protection in a potential FDI destination as an important determining factor for the final investment decision, as previously argued by Knack and Keefer (1995), Tuman and Emmert (2004) and Biglaiser & DeRouen (2006). It
was also shown that, although recognized by all investors, the importance of private property protection for attracting FDI also varies depending on the target industry. FDI in low-technology industries actually seems to be more responsive to improvement in the level of private property protection than FDI in high-technology industries. This outcome could be explained the fact that much low-technology FDI into Brazil is concentrated on industries which, although belonging to the low-technology category, have reached a high level of specialization and therefore call for high investment in capital goods and machinery to enhance their productivity (e.g.: oil and derivatives, extractive industries and agriculture).

The evidence generated by this study serves to inform policy-makers and technocrats that improvement in intellectual and private property protection can help advance the technological level of Brazil’s industrial base and increase the value added to its output, and thereby also increase the country’s productivity and sustainable economic growth. While it cannot be concluded that improvements in private property protection in Brazil can induce FDI in high-technology sectors specifically, it is clearly an important factor for attracting FDI in general and should be monitored and improved by government authorities. On the other hand, strengthening IP protection can actually contribute to attracting FDI that is better tailored to meet Brazil’s economic growth needs. It is therefore recommended that policy-makers focus their efforts on improving IP protection in Brazil by dedicating more financial resources to this area as well as ensuring adequate training for examiners of patent applications and courts in charge of enforcing IP law. For foreign investors, the findings of this paper draw attention to the importance of studying the local business environment at the industry level when taking decision about whether to establish their business in a new country. Country-wide growth rates and country-level business environment do not always carry through to particular industry in the given country, and can therefore be misleading for investors. Also, the evidence generated by this paper provides reaffirmation to the body of literature that claims that property protection
has an impact on inward FDI, as well as to the argument that the level of impact is largely dependent on the local context (presented in section 2).

For further research, several other aspects of this topic remain to be investigated. For instance, bringing this analysis to the industry level and looking at the effect of property protection in FDI within a specific industry could help policy-makers develop concrete policy plans to attract specific types of FDI. Furthermore, another useful means of strengthening the technological base of one country via technology transfers and spillovers from another country is through licensing agreements between a foreign and a local firm, where the former allows the later to make use of its production processes, to produce and commercialize its products. Since licensing agreements fall outside of the scope of FDI, and their spillover effects are not captured here, studies addressing these effects could also enrich the discussions in this paper. In terms of methods, the next step in identifying whether there is not only a correlation between property rights and FDI, but also a causal relationship between them, would be to conduct regression analysis between the different variables.
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8. Appendices
(in separate file)