Intellectual property and industry performance in Brazil

Propriedade intelectual e desempenho da indústria do Brasil

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Abstract

Purpose: To analyze the influence of trademark registration and patent application on the economic-financial performance of publicly traded companies in the Brazilian manufacturing industry between 1995 and 2014.

Originality/value: The approach offers critical reflections for decision making by firm management and its investors. Analyses of companies' economic and financial performance in the Brazilian manufacturing industry, based on the strategy of protecting their intellectual property, especially considering the time interval analyzed, have not been identified in recent literature.

Design/methodology/approach: Manufacturing companies listed on the Brazilian stock exchange were studied. Between1995 and 2014 were considered in a sample composed of 49 companies and 746 observations. Estimates were made using panel regression models. The dependent variables are market value and return on assets. The independent variables (controlled) are trademark registrations and patent applications (intellectual property).

Findings: A positive and statistically significant relationship was observed between trademark registrations and patent applications and the firms' market value. As they are assets that reflect the company's image in the market, the protection of trademarks seems to reflect well on the perception of the company's shareholders, which impacts the market value. In the case of patents, the positive effect on market performance is related to the investor's positive expectation of the firm's application in technology, innovation, and intellectual property. No positive impact of intellectual property on the return on assets has been identified.

Keywords: technological innovation, trademarks, patents, manufacturing sector, finances

Resumo

Objetivo: Analisar a influência das estratégias de registro de marcas e de depósito de patentes sobre o desempenho econômico-financeiro de empresas de capital aberto da indústria de transformação brasileira entre os anos 1995 e 2014.

Originalidade/valor: A abordagem oferece reflexões importantes para tomada de decisões pela gestão de firmas e por seus investidores. Análises do desempenho econômico-financeiro de empresas da indústria de transformação brasileira, a partir da estratégia da proteção de sua propriedade intelectual, especialmente considerando o intervalo temporal analisado, não foram identificadas na literatura recente.

Design/metodologia/abordagem: Foram estudadas empresas da indústria de transformação com listagem na Bolsa brasileira. Consideraram-se os anos entre 1995 e 2014, numa amostra composta por 49 companhias e 746 observações. As estimativas foram feitas por meio de modelos de regressão em painel. As variáveis dependentes são o valor de mercado e o ROA. As variáveis independentes (controladas) são registros de marcas e depósitos de patentes (propriedade intelectual).

Resultados: Evidenciou-se uma relação positiva e estatisticamente significativa entre os registros de marcas e depósitos de patentes e o valor de mercado das firmas. Como são ativos que refletem a imagem da empresa no mercado, a proteção das marcas parece refletir bem sobre a percepção dos acionistas da empresa, o que repercute no valor de mercado. No caso das patentes, o efeito positivo sobre o desempenho de mercado está relacionado à expectativa positiva do investidor sobre a aplicação da firma em tecnologia, inovação e propriedade intelectual. Não foram identificados efeitos positivos da propriedade intelectual sobre o ROA.

Palavras-chave: inovação tecnológica, marcas, patentes, indústria de transformação, finanças

INTRODUCTION

In recent years, the volume of research on intellectual property and its impact on the economy and organizational performance has increased. The mechanism of intellectual property protects human creations and technological innovations, which are strategic elements of companies, especially in industries that primarily work from a technological base.

The intellectual property system protects patents, brands, copyrights, among other assets. Brazil's regulations in this area, especially from the 1990s onward, advanced disclosure and spread its importance in the science, technology, innovation systems, and the national economic sphere.

Among the various legal instruments is Law no. 9,279/1996, known as the Brazilian Industrial Property Law. Industrial property protects the technologies and trademarks used in industry, commerce, and agriculture (Russo et al., 2012), with trademark registrations and patents highlighted among these assets.

Patents protect technologies, products, or processes that meet the requirements of novelty, inventive step, and industrial application. Trademarks correspond to the registration of visually perceptible logos or signs used to distinguish and market a product or service (Nam & Barnett, 2011).

These elements seem to be necessary to strengthen national industrial activity. In this regard, the literature indicates that Brazil has suffered an intense process of deindustrialization, especially from the mid-1990s onwards (Cassiolato & Lastres, 2015; Departamento de Pesquisas e Estudos Econômicos [Depecon], 2014; Silva & Pereira, 2018), with a drop in participation of the sector in the gross domestic product (GDP) from 48%, in 1985, to 25%, in 2013, a trend also followed by the manufacturing industry (Cassiolato & Lastres, 2015; Cassiolato & Szapiro, 2015).

Until 1996, Brazil was among the 25 countries that moved the most technology globally, importing and exporting brands and patents. In the same year, 3,319 patents and 5,903 trademarks entered Brazil, and 359 patents and 2,324 trademarks exited. The country could not keep up with this movement in subsequent years, dropping off the list of the 25 most important countries (Nam & Barnett, 2011).

Investment in innovation activity is required to reverse this situation (Cassiolato & Lastres, 2015; Fujita & Jorente, 2015; Raimundo et al., 2017; Silva & Pereira, 2018). It is necessary to prioritize investments in research and development (R&D), scientific production, patent protection (Pereira & Dathein, 2015), and other industrial property assets.

Intangibles are expected to have a positive effect on the performance of companies. Several studies have sought to identify the impact generated by innovation and intangible resources, such as intellectual property, on business economic and financial performance (Gallon et al., 2010; Kreuzberg et al., 2013; Lazzarotti et al., 2011; Lima et al., 2014; Parente et al., 2014; Perez & Famá, 2006a, 2006b; Schnorrenberger & Candido, 2014; Sprenger et al., 2017; Teh et al., 2008).

Despite recent advances, it is unusual for a study to analyze the financial performance of publicly traded Brazilian companies based on their intellectual property assets, such as patent protection and trademark registrations.

To contribute to studies on intellectual property and its economic-financial impacts within organizations, this work seeks to verify the following issue:

- To what extent did trademark registrations and patent deposits influence the performance of publicly traded Brazilian companies in the period between 1995 and 2014?

This study analyzes the influence of trademark registration and patent filing strategies on the financial performance of publicly traded companies in the Brazilian manufacturing industry between 1995 and 2014. This work presumes that intellectual property positively affects asset returns and market value (MV) as its primary hypothesis.

Companies in the food and beverage, chemical, and textile industries listed on the Brazilian Stock Exchange were studied since they showed the most intensive use of intellectual property in their activities in the years analyzed. Panel models that evaluated the impact of intellectual property on the financial performance of firms over time were estimated.

Advances were made in the literature based on the works of Sprenger et al. (2017), Mazzioni et al. (2014), and Teh et al. (2008). They analyzed the relationship between intangible assets and performance by using econometric models.

In addition to this introduction, the article reviews the literature, methodological aspects, results and discussions, and final considerations.

INTANGIBILITY, INNOVATION, AND PERFORMANCE

This section analyzes studies on the effects of intangible assets, innovation, and intellectual property on the performance of companies. In general,

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whether these assets generate a positive impact on the financial performance of firms has been investigated in the literature.

Intangible assets and performance

The Resource-Based View (RBV) can explain the relationship between intangibles and company performance (Barney & Hesterly, 2018). Companies use tangible and intangible resources to generate competitive advantage and strategic performance in the market. These assets' competitive gains and benefits occur from the value, rarity, imitation costs, and organizational structure.

Considering these characteristics, several studies have analyzed the role of intangibles on the performance of companies, such as Mazzioni et al. (2014), Sprenger et al. (2017), Schnorrenberger and Candido (2014), Lima et al. (2014), Kreuzberg et al. (2013), Gallon et al. (2010), and Parente et al. (2014).

Mazzioni et al. (2014) tried to identify the relationship of intangible assets to publicly traded companies' economic and financial performance in Brazil, Russia, India, China, and South Africa (Brics). Between 2009 and 2012, 5,028 observations were made. The authors used a panel and studied return on assets (ROA), return on equity (ROE), and asset turnover based on intangibility, sales growth, size, indebtedness, economic segment, and country of origin. They identified that the degree of intangibility influences ROA and ROE.

Sprenger et al. (2017) evaluated financial performance (ROA, ROE, profit margin, asset turnover, and earnings per share) based on the intangibility of 688 publicly traded companies in Argentina, Brazil, Chile, Colombia, Mexico, and Peru between 2008 and 2014. They noted that intensive intangible companies perform better than intensive tangible ones and that the degree of intangibility is favorable to ROA.

Schnorrenberger and Candido (2014) looked at the telecommunications sector. They found that high-tech companies invest more in intangibles than low-tech ones. Furthermore, high-tech companies are organizations that have superior MV.

Lima et al. (2014) studied through linear regressions the relationship between the degree of intangibility and economic performance in the trading sector of the São Paulo Stock, Commodities and Futures Exchange (BM&FBovespa) in the period from 2010 to 2013. They observed that there is a relationship between intangibility and economic performance.

Conversely, Kreuzberg et al. (2013) evaluated the relationship between financial indicators and the degree of intangibility of 241 publicly traded Brazilian companies. They realized that only indebtedness had significant relationships and explained the degree of intangibility. ROA, ROE, general liquidity, and current liquidity, among other measures, did not maintain meaningful relationships with business intangibility.

Gallon et al. (2010) studied the effect of innovation on micro and small companies' economic and financial performance in Santa Catarina that participated in the Juro Zero program run by the Brazilian Financier of Studies and Projects (Financiadora de Estudos e Projetos – Finep) to support innovative projects. They realized that the performance of liquidity and profitability ratios improved after Finep's financing of innovation, while the indebtedness level worsened.

In another analysis of the impact caused by Finep incentives on the economic and financial performance of firms, it was found that more innovative companies had better results. The development of new solutions was encouraged with the resources of the innovation support program, which resulted in better economic and financial indices (Braga et al., 2014; Parente et al., 2014).

Brito et al. (2009) used multiple linear regressions and analyzed companies in the Brazilian chemical sector from a different perspective. They concluded that there was no direct relationship between innovation and profitability. However, there was a positive and significant statistical relationship between innovation and net revenue growth.

Godoy (2012) considered innovation a strategic resource and created a multiple linear regression model to show the relationship between innovation and value creation. They showed how the value could change depending on different activities or types of investment in innovation.

The research developed by Gupta (2011) also corroborates these results. He studied the Brazilian chemical industry from 1996 to 2008 using fixed and random effects estimators with an unbalanced data panel. He concluded that there is a positive relationship between spending on R&D, innovation, and the MV of the companies in question. Finally, he found that an increase in expenditure on R&D by 1% generated a 0.26% increase in MV.

Belli (2009) studied 233 technology companies and 374 companies from the old economy (petrochemicals and textiles, among others) for a total of 607 companies that were publicly traded on the National Association of Securities Dealers Automated Quotations (Nasdaq) and the New York Stock Exchange (NYSE) from 1997 to 2008. A positive relationship

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was found between technology companies and share value. It was also found that the value is directly related to the companies' investments in R&D.

Tidd (2001) assessed the relationships between innovation and environmental contingencies, organizational configuration, and business performance and showed that innovation processes influence these last two elements.

Santos (2014) also found these analyses. Their study showed that consumer orientation (CO), product innovation capacity (PIC), and financial performance (FP) can be related to FP and that CO and PIC directly influence FP. In addition, CO affects PIC.

Santos et al. (2016) verified the effects of radical (exploration) and incremental (exploitation) types of innovation on the performance of Brazilian firms. They analyzed 76 companies between 2011 and 2012 using the Mann-Whitney and multiple linear regression tests. They found that the types of innovation (exploitation and exploration) negatively affected the results, which can be explained by the fact that the returns on the innovation take place over a longer time horizon. They also realized that profit, value creation, and performance are superior in more innovative companies.

Another approach analyzed the relationship between abnormal returns and R&D expenses in Brazilian listed companies. Using 1,597 observations from 1996 to 2016 and regressions with panel data, a negative and statistically significant relationship was identified between innovation (R&D) and abnormal returns (Oliveira et al., 2019). The authors explained that R&D expenses tend to produce returns only over more extended periods, requiring a longer time to recover these investments due to the complexity of the accounting measurement of R&D expenses.

These studies are not conclusive as some indicate positive effects of intangible resources on performance while others suggest that the impact is negative or that there is no impact. These are analyses, however they do not specifically consider the effect of intellectual property on business performance.

Specific approaches to the relationship between intellectual property and performance are presented in the following section.

Intellectual property and performance

Intellectual property (trademarks and patents) is an intangible asset that presents evidence of a firm's innovation activity. Companies that invest in intellectual property aim to develop more consolidated innovation processes

(Sweet & Maggio, 2015). Specific approaches to the influence of these assets on company performance are essential, as identified in both the national and international literature (Perez & Famá, 2006a, 2006b; Teh et al., 2008; Lazzarotti et al., 2011; Ernst, 2001; Ambrammal & Sharma, 2016; Kim et al., 2018; Paula & Rocha, 2020; Guo-Fitoussi et al., 2019).

Ambrammal and Sharma (2016) estimated the impact of spending on R&D and patenting on the performance of Indian companies. They observed that patent protection affected companies' productivity improvement, while R&D expenses did not generate positive effects on performance. This positive effect of patent protection on financial performance differed between foreign and domestic companies.

In a study in South Korea, Kim et al. (2018) analyzed whether patent protection affects the market value of companies in the renewable energy sector. The authors noted that a simple patent count is not a relevant measure to explain a firm's financial success. On the other hand, the company's market value indices, such as late citations and patent families, also related to the technology protection strategy through patents, affect a company's MV.

In a specific analysis of Latin America, Paula and Rocha (2020) analyzed the effect of internal R&D and patent applications on the performance of companies. The study found that an investment in R&D which was carried out by companies focused on patents, negatively affected performance. However, when the patenting strategy was not used, innovations positively influenced financial performance.

Guo-Fitoussi et al. (2019) studied the effect of the combination of intellectual properties on company productivity in several countries. They realized that the intellectual property protection strategy and the adoption of other intangible assets tend to optimize business profits.

Intangibility, measured based on trademarks, patents, and copyrights, was studied in 699 non-financial companies listed on the NYSE and the Nasdaq in the United States between 1997 and 2002. It was found that investment in intangibles increased economic performance, thereby expanding the value for shareholders and organizational stakeholders (Perez & Famá, 2006a, 2006b). The results suggested that tangible assets generated average profits while intangibles provided value creation.

Teh et al. (2008) also analyzed the relationship of intangible brands and patents to organizational value creation. They studied 216 companies listed on the BM&FBovespa in 2003. They found that the number of brands was positively and significantly related to market value over book value and to Tobin's Q in the companies under analysis.

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The relationship between granted patents and the economic, financial, and market performance of companies listed on the Brazilian stock exchange between 2000 and 2009 were analyzed by Lazzarotti et al. (2011). The survey indicated no relationship between patents and performance, with ROA being the financial indicator most influenced by the intellectual property (IP).

Ernst (2001) analyzed the influence of patent applications on the performance of 50 companies in the mechanical industry between 1984 and 1992. Patent applications influenced the performance of these companies between two and three years after filing.

Suh and Oh (2015) studied the Korean software industry between 1965 and 2005 and realized that software registrations affected the performance of companies. It is noteworthy that these resources are not considered trademarks or patents, but they also fall into a category of intellectual property.

Another aspect that can affect the performance of companies and the price of their shares is the creation of lawsuits based on the misuse of patents and infringement of intellectual property rights. Nam et al. (2015) observed that a company's share price increases when it announces that it will sue for illegal use of its patents. The assessed company, in turn, suffers from a loss in value.

The general results of these studies are summarized in Table 1.

Table 1

Studies on innovation and its impacts on organizations

Authors	Resource analyzed	Observed effects
Mazzioni et al. (2014), Sprenger et al. (2017), Schnorrenberger and Candido (2014), Lima et al. (2014), and Kreuzberg et al. (2013)	Intangibility	Intangible assets affect business performance.
Gallon et al. (2010), Parente et al. (2014), Brito et al. (2009), Godoy (2012), Gupta (2011), Belli (2009), and Tidd (2001)	Innovation	Innovation impacts the financial performance of companies.
Brito et al. (2009), Santos et al. (2016), and Oliveira et al. (2019)	Innovation	There is no relationship between innovation and performance or there is a negative effect.
Perez and Famá (2006a, 2006b), Ambrammal and Sharma (2016), and Guo-Fitoussi et al. (2019)	Intellectual property	Intellectual property generates superior economic performance and increased organizational value.

Table 1 (conclusion)

Studies on innovation and its impacts on organizations

Authors	Resource analyzed	Observed effects
Teh et al. (2008)	Intellectual property	While there is no influence from patents, there is a great impact from brands on the value of companies.
Lazzarotti et al. (2011), Paula and Rocha (2020), and Kim et al. (2018)	Intellectual property	There is no positive impact from patents on business performance.

Source: Elaborated by the authors.

Considering the initial findings identified in the literature, there is no consensus on the relationship between intellectual property and company performance. While some studies have suggested a positive effect of intangibles, innovation, and intellectual property on the financial performance of companies, others find different results which indicate that there is no positive effect of these resources on performance.

Thus, it is relevant that further investigations address this research problem, which is the purpose of this study.

METHODOLOGICAL ASPECTS

Based on the initial discussion and an understanding that the effects of intellectual property on the financial performance of firms are relevant to management action and decision making, this study starts from the following hypotheses:

- H1: Intellectual property positively affects the ROA performance of companies in the BM&FBovespa manufacturing industry.
- H2: Intellectual property positively affects the value of companies in the BM&FBovespa manufacturing industry.

The practical assessment of this relationship requires a more specific and detailed approach to the subject. The study sample sought a considerable period and greater uniformity in the sectors of the analyzed companies. Regarding the first aspect, the analysis of a longer time interval is critical because there have been several changes in the country's legal innovation and intellectual property system (Lei nº 9.279, 1996; Lei nº 9.456, 1997; Lei

n° 9.609, 1998; Lei n° 9.610, 1998; Lei n° 10.973, 2004; Lei nº 11.196, 2005). In addition, the interval analyzed a period of inflation stabilization in Brazil with the implementation of the Real (Grasel, 2007). Regarding the second aspect, it is salutary to mention that the analysis took place for a specific sample group, namely the manufacturing industry, which enabled, for example, the understanding and discussion of these effects in the economic sector.

This study analyzed the influence of intellectual property deposits on asset returns and the MV of companies in the Brazilian manufacturing industry, specifically in the chemical, food, beverage, and textile industries. The timeframe corresponded to the years between 1995 and 2014. For the evaluation, four-panel econometric models were estimated.

Composition of data sample

The study analyzed Brazilian publicly traded companies and components of the manufacturing industry between 1995 and 2014. Regarding the time interval, the year 1995 was defined as the base as it is the beginning of the period of economic stability. It corresponds to the moment immediately before granting intellectual property and innovation legislation in Brazil.

During the selected period, important regulatory milestones were established, such as the Industrial Property Law (Lei nº 9.279, 1996), the Innovation Law (Lei n° 10.973, 2004), and the Lei do Bem (Lei nº 11.196, 2005). Additionally, it was the post-stabilization period of the Brazilian economy concerning inflation (Grasel, 2007), corresponding to when the country began to feel the effects of these legal and economic measures.

Concerning the sample, we chose to analyze publicly traded companies due to their legal obligation to annually disclose financial data (Braga et al., 2014). Companies in the manufacturing industry were studied because this is a sector that emphasizes technological development; thus, the activity of protecting intellectual property, which is the object of this study, is important and intense.

The sample of surveyed companies was defined based on the North American Industry Classification System (Naics 2.0) used by the Brazilian Institute of Geography and Statistics. Following Naics 2.0, 98 publicly traded companies listed on the BM&FBovespa with a classification in the manufacturing industry were identified.

However, for this study, 49 companies belonging to the subsectors of the food and beverage, chemical, and textile industries were selected. These were the three most significant subgroups of the manufacturing industry in

terms of the total number of trademark registrations and patent filing processes at the National Institute of Industrial Property (Inpi).

Some companies were not classified under the Naic 2.0 in the chemical, food and beverage, or textile industry segments despite the nature of their activities being related to these sectors, such as holding companies and other divisions of the manufacturing industry. However, these firms were also included in the study based on verifying their activity and business nature.

Fifteen companies from the food and beverage industry, 13 from the chemical industry, and 21 from the textile industry were analyzed. They represented 4,806, 3,894, and 4,002 processes of applying for trademark registrations or patent filings up to the year 2014.

The analysis considered 49 companies over 20 years. As some companies in the study went public after 1995 (the base year of the historical series), not all firms were observed over the 20 years due to incomplete financial data.

Definition of variables and data collection

The study analyzes the financial performance of Brazilian publicly traded companies listed on the stock exchange and components of the manufacturing industry based on the strategy of protecting intellectual property. For this purpose, panel models were estimated.

ROA and the companies' MV were dependent variables. Both are important indicators of financial performance. The ROA reflects the company's operating performance based on its assets, and MV reflects the perceptions of investors and stakeholders about the company. The absolute values of the variables were considered, as was the case with the number of requests for registration of trademarks and patent deposits which were also used in the model.

Regarding the ROA variable, net income was used, which refers only to the residual values transferred to shareholders, thereby capturing the effect of financial expenses caused by the financing liability and disregarding a company's other sources of financing[1].

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[1] An additional research line could explore in new studies the operating profit, which estimates the result of operations without the inclusion of financial expenses, being a suitable measure for the proposed approach (Weil et al., 2015; Martins et al., 2018).

Concerning MV, it was decided to use logarithmized absolute values to capture a trustworthy panorama of reality, as was done with intellectual property data[2].

As independent variables of the model, intellectual property information was considered, specifically each company's accumulated trademark registrations and patent deposits until 2014.

Industrial property trademark registrations were chosen to protect the visually perceptible distinctive signs identifying the company and its products. They are essential resources in a company's presentation strategy regarding the market and society.

Patents protect technologies, products, and processes that present novelty, inventive steps, and industrial applications. They are, therefore, assets that reflect a firm's innovative activity through the ownership of developed and acquired technologies.

The degree of intangibility, sales growth, size, and firms' indebtedness were used among the control variables.

Table 2 summarizes the variables, proxies, types, expected signs, and theoretical bases for use in the model.

Table 2

Variables used in panel analysis

Variables	Proxy	Type	Expected sign	Basis
Return on assets (ROA)	ROA = net income/total assets (%)	Dependent	Not applicable	Mazzioni et al. (2014) and Sprenger et al. (2017)
Market value (MV)	MV = natural logarithm of market value	Dependent	Not applicable	Lima et al. (2014)
Cumulative registers of trademarks (MARCAS)	MARCAS = Accumulated number of trademark registrations at the Inpi	Non-financial/ independent	(+)	Teh et al. (2008)
Accumulated patent deposits (PAT)	PAT = Accumulated amount of patent deposits at Inpi	Non-financial/ independent	(+)	Teh et al. (2008)

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[2] This may bring limitations, because absolute values may omit some asymmetries between companies. Thus, another line of investigation can consider the use of additional indicators to measure value, such as price/asset value, price/profit, or Tobin's Q (Famá & Barros, 2000). Despite the Q estimate, it is also recommended to account for intangible capital, as an alternative proposed by Peters and Taylor (2017).

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Table 2 (conclusion)

Variables used in panel analysis

Variables	Proxy	Type	Expected sign	Basis
Degree of intangibility (GI)	GI = Total market value of shares/book equity (%)	Financial/ control	(+)	Mazzioni et al. (2014), Sprenger et al. (2017), and Santos et al. (2016)
Sales growth (CV)	CV = (ΔSales revenues (t, t-1) / sales revenues (t-1)) (%)	Financial/ control	(+)	Mazzioni et al. (2014) and Sprenger et al. (2017)
Size (TAM)	TAM = natural logarithm of total asset value	Financial/ control	(+)	Mazzioni et al. (2014) and Sprenger et al. (2017)
Indebtedness (END)	END = total debts/equity (%)	Financial/ control	(-)	Mazzioni et al. (2014) and Sprenger et al. (2017)

Source: Elaborated by the authors.

Note: Sales variations for the specific year of 1995 presented exorbitant values due to superinflation rates up to 1994. For that reason, such values were ignored.

The data used in the study referred to financial and intellectual property indicators of publicly traded Brazilian companies listed on the Brazilian Stock Exchange and components of the manufacturing industry.

Financial data were collected from the Economatica system in March 2016. As not all companies presented financial information for the twenty years due to listing after 1995, there were some missing values.

Considering the group of companies analyzed, the period studied, and the data availability, there were 674 observations of ROA and 599 of MV. The market value, which was the only variable with absolute value throughout the series, was corrected based on the Brazilian Extended National Consumer Price Index (IPCA) as updated for 2014.

Intellectual property data were collected from the Inpi database through each company's Brazilian National Register of Legal Entities (CNPJ). There were no missing values inherent to these variables (trademarks and patents), and each one had 761 observations. The accumulated values of each company's trademark registrations and patent deposits from 2014 were calculated and used.

The collection of data inherent to the intellectual property of the studied companies did not include the subsidiaries of these companies due to the unavailability of accurate information about these companies (names or CNPJ) in the databases used.

Finally, the data inherent to the control variables were also obtained through the *Economática* database.

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Data analysis strategy

Using the Stata software, panel models were developed which consider the observation of several individuals or cross-sections over time (Fávero, 2015). More straightforward cross-sectional analyses are insufficient to verify the effect of patents on the performance of companies; therefore, it is also essential to consider the impact of time (Ernst, 2001).

The Hausman Test was used to decide the type of panel (fixed or random effects) (Gujarati & Porter, 2011). The panel presented in this study was unbalanced because, due to missing data, the number of observations was uneven for the set of variables considered (Fávero, 2015; Gujarati & Porter, 2011).

Equations 1 and 2 represent the ROA and market value control models (estimates without intellectual property variables).

- Model control for ROA:

$$ROA_{it} = \alpha + \beta_1 \cdot CV_{it} + \beta_2 \cdot TAM_{it} + \beta_3 \cdot GI_{it} + \beta_4 \cdot END_{it} + \mu_{it} \qquad (1)$$

- Model control for VM:

$$VM_{it} = \alpha + \beta_1 \cdot CV_{it} + \beta_2 \cdot TAM_{it} + \beta_3 \cdot GI_{it} + \beta_4 \cdot END_{it} + \mu_{it} \qquad (2)$$

The variables refer to ROA, MV, sales growth (CV), size (TAM), degree of intangibility (GI), and indebtedness (END). The coefficient α corresponds to the intercepts of the models, β_n to the angular coefficients of the regressors, and to error terms.

The models with the insertion of intellectual property variables are shown. The strategy involved the individual analysis of each variable[3]. In equations 3 and 4, there are panels for estimating ROA. In equations 5 and 6, the panels are for estimating market value.

- ROA model 1 (with accumulated patents):

$$ROA_{it} = \alpha + \beta_1 \cdot CV_{it} + \beta_2 \cdot TAM_{it} + \beta_3 \cdot GI_{it} + \beta_4 \cdot END_{it} + \beta_5 \cdot PAT_{it} + \mu_{it} \qquad (3)$$

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[3] Initially, a model was also estimated considering simultaneously trademark registrations and patent application filings as explicative variables. The estimated coefficients were not significant. More detailed research of the results and other analysis strategies may be the subject of future studies on the area of research.

- ROA model 2 (with accumulated trademarks):

$$ROA_{it} = \alpha + \beta_1 . CV_{it} + \beta_2 . TAM_{it} + \beta_3 . GI_{it} + \beta_4 . END_{it} + \beta_5 . MARCAS_{it} + \mu_{it} \quad (4)$$

- MV model 1 (with accumulated patents):

$$VM_{it} = \alpha + \beta_1 . CV_{it} + \beta_2 . TAM_{it} + \beta_3 . GI_{it} + \beta_4 . END_{it} + \beta_5 . PAT_{it} + \mu_{it} \quad (5)$$

- MV model 2 (with accumulated brands):

$$VM_{it} = \alpha + \beta_1 . CV_{it} + \beta_2 . TAM_{it} + \beta_3 . GI_{it} + \beta_4 . END_{it} + \beta_5 . MARCAS_{it} + \mu_{it} \quad (6)$$

The MARCAS (trademarks) variable refers to the quantity of trademark registration processes requested by the analyzed firms. In turn, PAT corresponds to the amounts of patent filing processes. Variables accumulated over time were considered.

RESULTS AND DISCUSSION

This work analyzed 49 publicly traded companies on the Brazilian stock exchange. Of these, there were 13 companies in the chemical sector with an average of 286.4 brands (standard deviation of 832.0) and 13.2 patents (standard deviation of 34.3) per company.

Twenty-one companies in the textile sector were analyzed, with 177.6 brands (standard deviation of 328.5) and 13 patents (standard deviation of 37.0) per company. The food and beverage sector had 15 companies with an average of 317.9 brands (standard deviation 561.1) and 2.5 patents (standard deviation 3.8) per company.

The estimated models for the ROA and the MV of the studied companies are presented in the next section.

ROA estimate

Models ROA 1 and 2 (equations 3 and 4) considered, respectively, cumulative patent filings and cumulative trademark registrations in the ROA estimate. According to the Hausman Test, the results had significant p-values at the 5% level. Thus, the panels were analyzed by fixed effects. The results are shown in Table 3.

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Table 3

ROA of publicly traded industrial companies – 1995-2014

Variables	ROA control model (no intellectual property)		ROA model 1 (with accumulated patents)		ROA model 2 (with accumulated brands)	
	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects
Constant	-281.87***	-145.15***	-290.16***	-144.07***	-341.19***	-146.93***
	(58.43)	(26.94)	(59.80)	(27.48)	(64.79)	(28.28)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Degree of intangibility	0.002	0.005	0.0022	0.0047	0.002	0.0047
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
	0.571	*0.199*	*0.572*	*0.205*	*0.573*	*0.205*
Size	13.165***	6.593***	13.60***	6.52***	16.39***	6.681***
	(2.771)	(1.276)	(2.85)	(1.31)	(3.164)	(1.357)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Growth of sales	0.099***	0.099***	0.098***	0.100***	0.096***	0.099***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
	0.005	*0.005*	*0.006*	*0.005*	*0.007*	*0.005*
Indebtedness	-0.0002	-0.0005	-0.0002	-0.0005	-0.0002	-0.0005
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
	0.624	*0.334*	*0.623*	*0.341*	*0.605*	*0.340*
Trademarks	-	-	-	-	-0.0355**	-0.0003
	-	-	-	-	(0.017)	(0.005)
	-	-	-	-	*0.038*	*0.951*
Patents	-	-	-0.107	0.037	-	-
	-	-	(0.162)	(0.098)	-	-
	-	-	*0.510*	*0.706*	-	-
No. of observations	489	489	489	489	489	489
R^2 adjusted	0.0677	0.1191	0.0686	0.1210	0.0767	0.1185
Hausman test	18.63		18.99		33.46	
p-value	0.0003		0.0008		0.0000	

Source: Elaborated by the authors.

Notes: The numbers in parentheses refer to the standard deviations of the estimators. The numbers in italics are relative to the P-values of the T-tests made for each variable. Significant at 1% (***), 5% (**) and 10% (*). For the adjusted R2 values, we considered the value of R Within for the fixed effects panel model and R Overall for the random effects panel model.

ROA model 1 considered the patent filing variables and the control variables. Only size and sales growth were significant and were positively correlated with ROA. The variables of the degree of intangibility, indebtedness, and patent deposits did not show a substantial relationship with ROA.

ROA model 2 estimated the ROA from brand registrations and control variables. The degree of intangibility and indebtedness did not present significant coefficients. Size, sales growth, and brand registrations were statistically significant. Size and sales growth were positively correlated with ROA. Trademark registrations were negatively correlated with ROA, and 10% increase in the cumulative amount of trademark registrations generated a reduction in the ROA of 0.35%.

Based on the estimated models, the registration of trademarks by companies in the Brazilian manufacturing industry has generated a reduction in ROA. This effect is contrary to expectations. As in previous analyses, such as those by Mazzioni et al. (2014) and Sprenger et al. (2017), a positive effect of intangible resources (such as brands) on the performance of companies was identified.

There were no significant results concerning patents, indicating that they do not affect ROA. Similar results were identified by Teh et al. (2008). They explained that the insignificant relationships arising from these assets were caused by small investments in intellectual property in Brazilian companies, which is reflected in the small number of deposits made. Consequently, there were also few repercussions from patents on operational performance[4].

Another possible explanation is that the patent protection processes in these companies are intended to defend the strategic position of the firms without composing the production itself. Furthermore, expenses for investments in innovation (and, consequently, intellectual property) tend to produce returns only in the long term as they require more time to recover the assets (Oliveira et al., 2019).

Therefore, hypothesis H1 is not confirmed, as the results suggest that there was no positive impact of intellectual property on the ROA of the companies studied. The effects of intellectual property on market performance are analyzed in the next section.

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[4] In this situation, another line of research might be to analyze the effects on operating profit, in order to check whether the effects found hold true.

Market value estimate

MV models 1 and 2 (equations 5 and 6) considered, respectively, patent filings and trademark registrations in estimating MV. Hausman statistics showed insignificant P-values at the 5% level in both models. Therefore, we opted for the analysis of random effects panels. The results are shown in Table 4.

Table 4

Market value of publicly traded industrial companies – 1995-2014

Variables	MV control model (no intellectual property)		MV model 1 (with accumulated patents)		MV model 2 (with accumulated brands)	
	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects
Constant	-2.34	-2.83**	-1.59	-2.37**	0.6414	-1.66
	(1.89)	(1.18)	(1.934)	(1.192)	(2.08)	(1.203)
	0.216	*0.017*	*0.410*	*0.047*	*0.759*	*0.167*
Degree of intangibility	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
	0.004	*0.002*	*0.004*	*0.002*	*0.003*	*0.002*
Size	1.058***	1.082***	1.019***	1.056***	0.896***	1.017***
	(0.089)	(0.055)	(0.092)	(0.056)	(0.1018)	(0.058)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Sales growth	0.0007	0.0008	0.0007	0.0008	0.0007	0.0008
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
	0.285	*0.257*	*0.273*	*0.230*	*0.264*	*0.222*
Indebtedness	-0.00006***	-0.00006***	-0.00006***	-0.00006***	-0.00006***	-0.00006***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Trademarks	-	-	-	-	0.0018***	0.0008***
	-	-	-	-	(0.00054)	(0.0002)
	-	-	-	-	*0.001*	*0.001*

(continue)

Table 4 (conclusion)

Market value of publicly traded industrial companies – 1995-2014

Variables	MV control model (no intellectual property)		MV model 1 (with accumulated patents)		MV model 2 (with accumulated brands)	
	Fixed effects	Random effects	Fixed effects	Random effects	Fixed effects	Random effects
Patents	-	-	0.0097*	0.0090**	-	-
	-	-	(0.0052)	(0.004)	-	-
	-	-	*0.064*	*0.024*	-	-
No. of observations	491	491	491	491	491	491
R^2 adjusted	0.2667	0.7968	0.2724	0.7994	0.2840	0.8044
Hausman test	1.92		1.91		7.78	
P-value	0.5892		0.7517		0.0999	

Source: Elaborated by the authors.

Notes: The numbers in parentheses refer to the standard deviations of the estimators. The numbers in italics are relative to the P-values of the T-tests made for each variable. Significant at 1% (***), 5% (**), and 10% (*). For the adjusted R^2 values, we considered the value of R Within for the fixed effects panel model and R Overall for the random effects panel model.

The MV model 1 considered the control variables and patents filed by companies. Except for sales growth, all variables were statistically significant. Among the control variables, only debt was negatively related to MV.

Based on the estimate, a 10% increase in accumulated patent filings generated a 0.09% increase in a firm's market value. This result suggests an increase in the value of companies in the manufacturing industry that choose to invest in patent protection.

The MV model 2 used the control variables and the accumulated trademark registrations as estimators and showed significance for the variable's degree of intangibility, size, trademark registrations, and indebtedness. Only indebtedness was negatively correlated with MV.

The estimate indicated that a10% increase in the number of trademark registrations generated a 0.008% increase in value. Therefore, the result suggests that companies' brand protection strategies positively affect market value.

As brands are assets that reflect the company's image in the market, they reflect well on the perception of shareholders and other stakeholders. In this way, they contribute to expanding a firm's market value.

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The positive effect of patents on value is also related to positive investor perceptions of companies that invest in technology, innovation, and intellectual property protection. The protection of these assets is an essential strategic action and can influence a company's medium- and long-term competitiveness and, consequently, the financial results presented.

Based on these results, it is possible to affirm that intellectual property positively affects the market performance of companies in the Brazilian manufacturing industry. Therefore, H2 is confirmed.

Similar results were found in the works of Perez and Famá (2006a, 2006b), Teh et al. (2008), Lazzarotti et al. (2011), Ernst (2001), and Suh and Oh (2015). They identified the positive effects of intellectual property assets on company performance.

Considering that intellectual property is an intangible resource, the results of this research also confirm the findings of Mazzioni et al. (2014), Sprenger et al. (2017), Schnorrenberger and Candido (2014), Lima et al. (2014), and Kreuzberg et al. (2013), according to which there is a positive influence of intangible resources on business financial performance.

A comparison of the performance of ROA and market value from intellectual property shows that investments in trademark and patent protection over the years had more repercussions on value than on return on a company's industry assets. The evidence then suggests that intellectual property assets impact the company's market value to the detriment of the effects on the operational aspect itself. In other words, more effects occur on investor perception than on operating results.

Some possible points that help to understand these findings may be related to the low level of investment by Brazilian companies in R&D, in addition to the fact that the country's economy is not very focused on high technology (Gomes & Diegues, 2019), thus failing to keep up with the technological evolution implemented in first world countries. The deindustrialization process that Brazil has faced in recent years (Cassiolato & Lastres, 2015; Depecon, 2014; Silva & Pereira, 2018) is related to the insufficiency of the country's technological modernization process.

Therefore, the reversal of this scenario demands planning and investment in innovation policies aimed at scientific and technological development, both in the public and private spheres. Furthermore, this effort must be directed toward developing technical-scientific and technical vocations aligned with the national industry.

It should also be noted that with the intensification of regulation of the intellectual property and innovation system in Brazil (Lei nº 9.279, 1996;

Lei n° 9.609, 1998; Lei n° 9.610, 1998; Lei n° 10.973, 2004; Lei nº 11.196, 2005; Lei n° 13.243, 2016) from the 1990s onwards, these mechanisms have become more widespread in Brazilian society, which also contributes to the perceptions of the investor market.

As a business strategy, it is also relevant that Brazilian industry firms invest in protecting their intellectual property since this path has repercussions in a value reserve linked to the positive perception of investors regarding innovation and protection actions for essential technologies and assets for the company.

FINAL CONSIDERATIONS

This work investigated the influence of trademark registrations and patent filings on the financial performance of publicly traded Brazilian companies in the manufacturing industry between 1995 and 2014. For this purpose, the food and beverage, chemical, and textiles industries listed on BM& FBovespa were studied. The hypotheses that intellectual property would positively affect the ROA and MV were investigated.

It is noteworthy that the research considered all companies in the chemical, food and beverage, and textile industries listed on the Brazilian stock exchange. The timeframe allowed us to verify the relationship studied over 20 years, an approach that was not identified in the previous literature.

It was discovered that trademark registrations impact ROA, but it is negative and thus contrary to expectations. Patents do not affect ROA, with statistically non-significant results. Therefore, it was not possible to confirm H1. The results may be related to the technological profile of the national industry, which is not focused on high technology and, therefore, does not reflect the effect of intellectual property on the operational aspect of companies (ROA).

When considering market value, which represents investors' perceptions about the company, the results are as expected. In this case, it was possible to confirm H2. Trademark registrations and patent filings on market performance are significant and positive. These results are related to investors' positive perceptions of a company's innovation and intellectual property protection strategy, which are considered essential activities that interfere with organizational competitiveness in the medium and long term.

Thus, this article suggests the positive effect of intellectual property on the market performance of companies in the Brazilian manufacturing industry

over 20 years (1995 to 2014). We thus advance the findings of Mazzioni et al. (2014), Sprenger et al. (2017), Schnorrenberger and Candido (2014), Lima et al. (2014), Kreuzberg et al. (2013), Gallon et al. (2010), Parente et al. (2014), Perez and Famá (2006a, 2006b), Teh et al. (2008), Lazzarotti et al. (2011), and Ernst (2001). Their work discussed the relationship between intangibles and intellectual property and business performance.

This study's results have some limitations that can be investigated in future works. The first point is that the amounts invested in a company's innovation processes were not considered as these data are not made available by the databases used. A second point refers to not considering the remaining protection period for each registered trademark or patent filed. A third point concerns the possibility of investigating the effects of intellectual property on performance considering the operating profit variable, which would be closer to the company's core activity. A fourth point refers to the possibility of evaluating the effects of intellectual property on the perception of investors considering a relative variable, such as earnings per share, which would mitigate the impact of company size on absolute market value.

Additionally, as a derivation of future research, it is essential to investigate the relationship between performance and intellectual property by analyzing other economic sectors that present intensive use of the intellectual property. For this investigation, different econometric methods can be used, inserting other factors or variables in the regression models that have the possibility of impacting business finances, such as the amounts invested in innovation.

Despite the possibilities for broadening the approach to the subject, this study reveals relevant aspects of intellectual property's effect on companies' performance. Evidence on operational performance has not been conclusive, thereby requiring further investigation. But the results reveal the importance of a company's investments in trademarks and patents to increase the company's MV.

Given the evidence, it is relevant that business organizations, especially those in industries, plan their strategies to protect intellectual property assets. Furthermore, it is essential to publicize these actions in the market, especially for a firm's shareholders. It is also fundamental to plan public policies that contribute to scientific and technological development and strengthen the culture of intellectual property protection in Brazil.

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