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ANALYSIS OF THE INFLUENCE OF INTANGIBLE ASSETS ON THE PERFORMANCE OF BRAZILIAN COMPANIES

ANÁLISE DA INFLUÊNCIA DOS ATIVOS INTANGÍVEIS NO DESEMPENHO DAS EMPRESAS BRASILEIRAS

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ABSTRACT

Purpose – The study aims to analyze the relationship between intangible assets and the economic performance of Brazilian public companies.

Design/methodology/approach – We calculated the Degree of Intangibility (DI) to segregate companies into two groups: intangible-intensive and tangible-intensive in a sample of Brazilian public companies from 2012 to 2016. We applied the Mann-Whitney test to verify whether there were statistically significant differences between these two groups of companies concerning the Operating Margin, Return on Equity, Return on Assets, Market Value Added and Earning per Share.

Findings – The results show that intangible-intensive companies presented higher economic performance in most part of the indicators and years analyzed. In addition, we did not find significant results for Earnings per Share, although the signed rank sum mean values of intangible-intensive are higher than tangible-intensive companies in most part of the years.

Practical implications - The findings seek to contribute to discussions about the importance of intangible resources as determinants of competitive advantages and reflecting in higher economic performance, and thus increasing market value. In this sense, investments in intangible resources can be applied in adopting initiatives in markets and definition of strategic positions in companies. Finally, our study seeks also to contribute to capital markets since the relationship between intangible assets and economic performance can be useful in detecting investment opportunities.

Originality/value – Previous studies analyzed the relationship between intangible assets and economic performance with other periods and samples. We also measured different proxies for economic performance as Operating Margin, Return on Equity, Return on Assets, Market Value Added and Earnings per Share.

Keywords: intangible assets; performance; Resource-Based View; competitive advantage.

CNPQ Classification: 6.02.00.00-6

RESUMO

Objetivo – O presente estudo visa analisar a relação entre os ativos intangíveis e o desempenho econômico das companhias abertas brasileiras.

Desenho/metodologia/abordagem – Foi calculado o Grau de Intangibilidade (DI) para segregar as empresas em dois grupos: intangível-intensivas e tangível-intensivas em uma amostra de empresas listadas brasileiras de 2012 a 2016. Foi aplicado o Teste de Mann-Whitney para verificar se existem diferenças estatisticamente significativas entre esses dois grupos de empresas, considerando Margem Operacional, Retorno sobre o Patrimônio Líquido, Retorno sobre o Ativo, Valor de Mercado Adicionado e Lucro por Ação.

Resultados – Os resultados mostram que as empresas intensivas em intangíveis apresentam melhor desempenho econômico na maior parte dos indicadores e anos analisados. Além disso, não foram encontrados resultados significativos para a variável Lucro por Ação, embora os valores médios da soma dos ranks das empresas intangíveis-intensivas sejam superiores às das tangíveis-intensivas na maior parte dos anos.

Implicações práticas – Os resultados visam contribuir para as discussões sobre a importância dos recursos intangíveis como determinantes de vantagens competitivas e desempenho econômico, aumentando assim o valor de mercado das empresas. Nesse sentido, os investimentos em recursos intangíveis podem ser aplicados na adoção de iniciativas em mercados e na definição de posições estratégicas nas empresas. Por fim, o presente estudo também contribui para o mercado de capitais, uma vez que a relação entre ativos intangíveis e desempenho econômico pode ser útil para detectar oportunidades de investimento.

Originalidade/valor – Estudos anteriores analisaram a relação entre ativos intangíveis e desempenho econômico com outros períodos e outros tipos de empresas. No presente estudo, também foram consideradas diferentes proxies para desempenho econômico como Margem Operacional, Retorno sobre o Patrimônio Líquido, Retorno sobre o Ativo, Valor de Mercado Adicionado e Lucro por Ação.

Palavras-chave: ativos intangíveis; desempenho; Teoria Baseada em Recursos

1 INTRODUCTION

Over the last decades, globalization and the development of information technology have intensified competition between companies (Lev, 2001). Therefore, those intangible assets have gained prominence in this scenario, being important determinants of differentiation and contributing to obtain competitive advantages (Perez & Famá, 2006).

The tangible assets are composed of tangible resources capable of being owned or realized, such as properties, buildings, vehicles, machines and equipment (Buniatti & Prux, 2012). The intangible resources are subjective in terms of availability of goods and rights, and their value is attributed by the market (Moura & Rêgo, 2014).

According to Lev (2001), intangible assets are sources of future advantages that do not have physical or financial characteristics, generated by innovations, human competences, or singular organizational structures. Carvalho, Kayo and Martin (2010) corroborate that singular attributes are those enhancing intangible assets in generating value for companies.

In this regard, Resource-Based View (RBV) aims to explain the economic performance of companies through internal competences and capabilities (Barney, 1991). This view demonstrates that the main cause of the difference in the economic and financial performance of companies is explained by the diversity of their resources (Peteraf, 1993; Lev, 2001; Villalonga, 2004), and can be intensified by the combination of tangible and intangible resources (Lev, 2001).

Thus, companies must focus their efforts on intangible assets, that is, on singular resources, which are more difficult to replicate and imitate, in order to obtain sustainable competitive advantage (Barney, 1991). In general, companies have easy access to the market for tangible resources, while most intangibles are not traded in common markets.

This emphasizes the relevance of intangible assets as a factor of differentiation, value cre-

ation for companies (Carvalho et al., 2010) and sustainable competitive advantage (Barney, 1991; Oliveira, Schossler, Campus & Luce, 2014). In this sense, when comparing intangible-intensive companies with tangible-intensive companies, it is observed that intangible-intensive companies tend to have higher returns (Chan, Lakonishok & Sougiannis, 2001) and profitability (Almeida & Jordão, 2017).

There are several studies in the literature on the relationship between intangible assets and economic-financial performance or companies' value (Aboody & Lev, 1998; Kayo & Famá, 2004; Perez & Famá, 2006; Carvalho et al., 2010; Gonçalves, Cunha & Neves Junior, 2011; De Luca, Maia, Cardoso, Vasconcelos & Cunha, 2014; Oliveira et al., 2014; Perez & Famá, 2015; Almeida & Jordão, 2017).

Although there is an inherent complexity in accounting recognition and measurement of these assets, especially when they are internally generated (Perez & Famá, 2006), the studies in general highlight the relevance of investments in intangible assets for companies.

Oliveira et al. (2014) demonstrate that intangible resources can be great allies in improving the performance of organizations and sustainable competitive advantage. Through the analysis of 27 Brazilian public companies in the period from 2003 to 2007, the authors evidenced that companies intensive in intangible assets showed higher growth in net margin, operating margin and current liquidity.

Almeida and Jordão (2017) analyzed the Brazilian public companies from 2010 to 2014 and demonstrated that the more intangible-intensive the companies are, the greater the profitability indicators of Earnings Before Interest, Taxes, Depreciation and Amortization (EBITDA), gross margin and net margin. The findings also pointed out that these indicators are different between the business industries, so that there is a tendency for intangible-intensive companies to present financial performance superior to their counterparts.

Our study analyzes the relationship between intangible assets and the economic performance of Brazilian public companies from 2012 to 2016. That is, to verify whether there is a difference in the economic performance of companies intensive in intangible assets compared to companies that are intensive in tangible assets.

We calculated the Degree of Intangibility (Lev, 2001; Haji & Ghazali, 2018; Arantes, Oliveira, Junior, Ávila & Antonialli, 2020) and segregated the companies into two groups: intensive in intangible assets and intensive in tangible assets (Perez & Famá, 2006; Oliveira et al., 2014). We measured economic performance by Operating Margin (OM), Return on Equity (ROE), Return on Assets (ROA), Market Value Added (MVA) and Earnings per Share (EPS) indicators. We applied the Mann-Whitney test to verify whether there is statistical evidence that supports the hypothesis that values in one group (intangible-intensive assets) are higher than values in another group (tangible-intensive assets). It is noteworthy that this study complements Oliveira et al. (2014) with respect to the extension of the period of analysis, and also in terms of the economic performance proxies.

The results of this study demonstrated that the group of companies intensive in intangible assets performed better in most of the years analyzed, corroborating with previous literature (Carmeli & Tishler, 2004; Perez & Famá, 2006; Gonçalves et al., 2011; Oliveira et al., 2014; Perez & Famá, 2015; Almeida & Jordão, 2017).

This article aims to contribute in three ways. First, it corroborates with the discussion about the differences between the companies' book value and their market value. Intangible assets tend to contribute to the increase in market value, reflecting an increase in perceived economic value, but these effects are not always adequately captured by accounting standards. In this sense, the findings signal the importance of intangible assets in the correct assessment of the company and its performance, in line with the findings in the Brazilian (Kayo, 2002; Honorato, 2008; Oliveira et al., 2014;

Almeida & Jordão, 2017) and international context (Aboody & Lev, 1998; Carmeli, 2001; Carmeli & Tishler, 2004; Perez & Famá, 2006), and the importance of disclosing these intangible assets in the quality of accounting information for the capital market (Silva, Klotzle, Pinto & Motta, 2018 ; Moura, Ziliotto & Mazzioni, 2016).

Second, it is related to the fact that the results can contribute to discussions about the importance of intangible assets as determinants of competitive advantages (Barney, 1991; Perez & Famá, 2006), both for the adoption of initiatives in markets (marketing), and for the definition of strategic positions.

Finally, the study may contribute to investors in the capital markets, since discoveries in the field of the relationship between intangible assets and business performance can be useful in detecting investment opportunities.

This paper is divided into sections. After this introduction, the theoretical background and the development of the research hypothesis are presented, followed by the methodology, results and discussions, and finally, the final considerations and suggestions for future research.

2 METHODOLOGICAL PROCEDURES

Companies are composed of sets of resources, which are considered as main factors contributing to explain the performance of companies (Barney, 1991; Peteraf, 1993).

The interaction between the resources of a company, more specifically, the interaction between tangible and intangible assets, provides companies with economic development, greater performance, and creation of corporate value (Lev, 2001). Thus, the differences in economic performance between companies are explained by the resources and capabilities that each company has (Barney, 1991; Peteraf, 1993) in line with Resource-Based View (RBV). This view argues that the main cause of the difference in the economic and financial performance between companies can be explained by the diversity of its resources (Peteraf, 1993; Lev, 2001; Villalonga, 2004) and it can be intensified by the combination between tangible and intangible resources (Lev, 2001).

Intangible assets are gaining more and more prominence in the corporate world. Intangible assets are considered the most important assets of many of the largest and most powerful companies around the world, as the basis for market dominance and continuous business profitability (Lin & Tang, 2009).

In long term, tangible assets provide companies with little competitive advantage, as they are physical resources that are easily purchased in the market, so that competitors can purchase identical or similar assets in the short term. Intangible assets, in turn, are identified as the main source of sustainable competitive advantage, since they are not easily found in the market and, unlike physical resources, take time to be constructed (Barney, 1991; Peteraf, 1993; Perez & Famá, 2006).

These resources are considered a source of competitive advantage, valuable, rare, imperfectly imitable, and not replaceable (Barney, 1991), being the main determinants of companies' strategies and leveraging gains (Honorato, 2008).

Carmeli (2001) points out that there are different profiles of companies with high and low economic performance, so that the type of intangible resource influences the segregation of these companies, emphasizing the importance of a strategic view instead of a market view to obtain superior performance (Prahalad & Hamel, 1990).

Carmeli and Tishler (2004) complement that some intangible organizational elements are key factors to improve the performance of an organization, such as managerial capacity, human re-

sources, internal audit, work relations, organizational culture, and organizational reputation, so that the interaction between these factors can improve the organization's performance.

Intangible assets are often incorporated into tangible assets, as in the case of technology contained in equipment, or even in the workforce, such as the employees' implicit knowledge. The interaction between tangible and intangible assets highlights one of the methods of generating value in companies (Lev, 2001). It is practically impossible to decompose the intangible asset of the tangible, since the combination of the two types of resources defines the effective value of a company (Kayo & Famá, 2004). In this sense, Chander and Mehra (2011, p.94) argue that "intangible assets have become an integral part of the value creation process for any company".

The Accounting Technical Pronouncement CPC 04 (R1) addresses the accounting treatment of intangible assets, in which an intangible asset is only recognized in accounting if it is identifiable, controllable, reliably measurable, and capable of generating future economic benefits for the company.

Regarding the recognition of intangible assets generated internally, it occurs in two phases; that of research and that of development. Expenses with internal project development can be capitalized if, and only if, the company can demonstrate the characteristics of the investment described in CPC 04 (R1). Research expenses, for regulatory reasons and accounting conservatism, are discharged directly as operating expenses for the period in the Income Statement (IS) and not as capital expenditures with a view to returns in future periods.

In this regard, there is a significant difficulty in recognition and measurement by companies, especially intangible assets generated internally, since there is subjectivity in measurement and a complexity in quantifying the returns from innovation activities (Perez & Famá, 2006). This causes companies to generally recognize only intangible assets acquired from third parties (Upton, 2011).

For several authors (Lev, 2001; Reilly & Schweihs, 1998; Zanoteli, Amaral & Souza, 2015), the financial statements are far from representing the economic value of companies, which reduces the informational power and the usefulness of these statements.

Furthermore, no matter how difficult it is to evaluate intangible assets developed internally, this is an essential task, as the intrinsic value of companies is more and more closely related to the value of intangible assets created by innovation, corroborating to the development of wealth and the growth of assets in the current economy (Lev, 2001; Perez & Famá, 2006, 2006; Machado & Famá, 2011).

Several studies evidence the existence of a gap in the accounting treatment regarding the recognition and measurement of intangible resources and their impact on the evaluation of companies or on their economic performance (Aboody & Lev, 1998; Kayo & Famá, 2004; Perez & Famá, 2006; Carvalho et al., 2010; Gonçalves et al., 2011; Oliveira et al., 2014).

Aboody and Lev (1998) analyzed the relevance of intangible assets and their influence on the valuation of companies. The authors demonstrated that R&D expenses are positively associated with the return of companies' shares. Furthermore, the results show that the non-capitalization of intangible assets is strongly associated with errors in earnings forecasts by analysts, and that the non-capitalization, or incorrect capitalization, of intangible assets reinforces the gap existent in the correct accounting and measurement of intangible resources.

Kayo and Famá (2004) investigated the differences in capital structure and risk in companies that are intensive in tangible assets and intensive in intangible assets. The authors analyzed Brazilian and American companies linked to the industrial and commercial industries from 1997 to 2001. They applied the ratio between the market value of the shares and the book equity as a measure of intangibility and divided the companies into two groups: (i) high degree of intangibility and

(ii) low degree of intangibility. The results showed that companies with a high degree of intangibility had a lower level of indebtedness and a higher weighted average cost of capital (WACC).

Perez and Famá (2006) analyzed the correlation between intangible assets and the superior performance of companies, measured by the variable SPREAD (subtraction of the return on capital invested by WACC). The sample was composed of non-financial public companies from NYSE and NASDAQ during 1997 to 2002. The authors calculated the degree of intangibility (DI), measured by the ratio between the total market value of the shares and equity book value, as a measure of the presence of intangible assets in companies. The result showed that companies having a higher proportion of intangible assets achieve higher gains and increase the generation of value for shareholders.

In a further study, the authors presented the strategic characteristics of intangible assets and verified if investments in intangible assets could effectively lead to superior economic performance of the companies and create greater value for its shareholders (Perez & Famá, 2015). The results demonstrated that intangible assets are relevant to economic performance of the companies and the greater portion of intangible assets leads to greater value generation for its shareholders (Perez & Famá, 2015).

Carvalho et al. (2010) demonstrated that intangibility, measured by Tobin's Q, did not present itself as a source of sustainable competitive advantage. The sample was composed of publicly traded Brazilian companies with data for the period from 1997 to 2007. The companies were divided into two groups: companies with return on assets (ROA) above the sector average, in at least four consecutive years, and other group of returns below the industry average for at least four consecutive years. The results showed that in several industries, tangible assets stood out as a source of sustainable competitive advantage, however, it is noteworthy that most of these industries were traditional, such as electricity and oil, therefore companies strongly linked to infrastructure.

Gonçalves et al. (2011) analyzed the correlation between the market-to-book index, profitability indicators, and the economic value added (EVA) of a sample of publicly traded Brazilian companies. The study sought to relate instruments used to evaluate company results with the discrepancy that exists between the book value and the market value of organizations. The sample consisted of 90 publicly traded Brazilian companies listed in the ranking of the 1,000 largest and best companies in Brazil (EXAME Magazine) for the year 2008. For this purpose, the author used the cluster statistical techniques, with the purpose of grouping the companies. Through correlation and regression techniques, the authors found evidence that the correlation between the variables and the market-to-book index is weak in each of the clusters, as well as in general.

Machado and Famá (2011) analyzed whether a greater degree of intangibility for Brazilian companies would be related to a higher level of corporate governance. The companies were separated according to the degree of intangibility and the Brazilian level of governance (Differentiated Levels of Corporate Governance - DLCG). The results showed that the companies listed on the New Market (maximum level of DLCG) presented a higher mean of intangibility. Besides that, companies without adherence to corporate governance practices showed a higher level of intangibility than the organizations belonging to Levels N1 and N2.

De Luca et al. (2014) investigated the relation between the composition of investments in intangible assets of innovative firms, with a proxy classification proposed by Brooking (1996), and corporate performance (measured by return on assets). They applied the Mann-Whitney test and multiple linear regression analysis in a sample composed of 137 firms listed on the Brazilian Stock Exchange from 2007 to 2010 and belonging to innovative sectors according to the Brazilian Innovation Index.



Among the results, De Luca et al. (2014) found a significant association between return on assets and mean investments in intellectual property assets and infrastructure assets, but not for market assets, other intangibles and total intangible assets. The category of intellectual property assets was the most representative in their sample of intensive intangible assets and potentially it can be associated as innovative firms (Kayo, 2002).

Oliveira et al. (2014) analyzed the relationship between superior corporate performance and the presence of intangible assets in public companies, from 2003 to 2007. The authors considered the relationship between the market value of the shares and their book value as an indicator of intangibility. The sample consisted of 27 public companies, which were divided into two groups: (i) high degree of intangibility and (ii) low degree of intangibility. The performance was measured by Return on investment – ROI, Operating margin – OM, Net margin – NM, Current liquidity – CL, and Beta – B. The results showed that in most of the years analyzed, the group with the highest degree of intangibility performed better in most of the analyzed variables. The study also demonstrated a possible association between the actions of the marketing area in the construction of an organization's intangible resources and the evolution of economic and financial performance.

We highlighted that our study differs from Oliveira et al. (2014) in two main aspects. First, there is a difference in the period of analysis, while this study looked at more recent years, from 2012 to 2016, Oliveira et al. (2014) point out that they chose to analyze the period until 2007, considering the years before the 2008 crisis. Second, it corresponds to the different proxies used for the economic performance of companies; while this study proposes the variables OM, ROE, ROA, MVA, and EPS, Oliveira et al. (2014) proposed the variables OM, ROI, NM, CL and B, therefore there is only the correspondence of the variable OM in both. Thus, our study may corroborate to Oliveira et al. (2014) when analyzing recent years and different variables as a proxy for the economic performance of companies.

Almeida and Jordão (2017) analyzed the relationship between the effects of intellectual capital and organizational profitability. For this purpose, they applied Mann-Whitney's "U" statistical techniques, Spearman correlation, and panel data regression in a sample of 255 Brazilian public companies from 2010 to 2014. The authors evidenced that the more intangible-intensive companies are, the greater the profitability indicators tend to be, being different between industries.

Haji and Ghazali (2018) explored the extent of intangible assets and liabilities of large Malaysian companies. In one of their hypotheses, the authors tested if there is a significant positive relationship between intangible assets (price-to-book ratio) and financial performance of a firm (ROA, ROE, net income and profit margin). The findings confirmed the hypotheses in all four measures of performance.

In this context, we have the following research hypothesis:

H1: Brazilian public companies with a high degree of intangibility have higher economic performance.

Furthermore, we expect differences in economic performance between intangible-intensive and tangible-intensive companies by demonstrating that intangible-intensive companies can present higher levels of economic performance when compared to its counterparts during the period.

3 METHODOLOGY

We collected the financial information from the Economatica® database. The initial sample comprises 485 Brazilian public companies from Brasil, Bolsa, Balcão (B3) for the period of 2012 to 2016. From this, we excluded some companies: (i) belonging to the financial industry, as they present financial and operational peculiarities; (ii) with missing data; and (iii) companies with negative equity, since they could influence the results. After the exclusions, a total of 137 Brazilian public companies were obtained.

To verify whether there is a difference in the economic performance of companies that are intensive in intangible assets in comparison with companies that are intensive in tangible assets, the variable Degree of Intangibility (DI) was calculated, measured through the ratio between the market value and the book value of the company (Lev, 2001; Haji & Ghazali, 2018; Arantes et al., 2020).

The DI is a relative measure, based on the principle that the greater the degree of intangibility, the greater the participation of intangible resources in the company's resources (Perez & Famá, 2006). For the calculation of the DI, the value of the shares of each company, the volume on the last business day of each year, and the company's net equity were used. The market value was calculated by multiplying the price of the shares in circulation on the date of the last trading day of the year by the number of shares issued, based on previous studies from Lev (2001), Kayo and Famá (2004), Perez and Famá (2006), Machado and Famá (2011), Oliveira et al. (2014), Perez and Famá (2015), and Almeida and Jordão (2017).

From the DI calculation, the sample companies were allocated into two distinct groups, one group with the DI value below the median, and the other group with a DI greater than or equal to the median. Subsequently, companies that did not support themselves in each group previously defined during the analyzed period were removed, remaining a total of 62 companies.

The remaining companies were subsequently grouped again and ordered according to their average intangibility, and segregated into quartiles during the years analyzed. The companies in the first quartile represented the group of companies intensive in intangible assets (SII), while the companies in the fourth quartile represented the group of companies intensive in tangible assets (STI). Both groups were composed of 15 companies each, so that the final sample was composed of 30 Brazilian public companies from 2012 to 2016, as shown in Table 1.

Table 1 - List of the companies per group

SII	STI
Multiplus	Tecnisa
Natura	SLC Agrícola
Lojas Americanas	Sonae Sierra Brasil
Arezzo	Rodobens
Raiadrogasil	Copel
Gafisa	Coteminas
Cia Hering	Positivo
Eletropar	Celesc
BRF S.A.	Inds Romi
Engie	CR2
Marisa	Empreendimentos
CPFL Energia	Eletrobras
Estacio	Eucatex
B2W Digital	WLM
Alpargatas	Trisul
	EMAE

Source: the authors.

SII refers to the group of companies intensive in intangible assets.

STI refers to the group of companies intensive in tangible assets.

According to Assaf Neto and Lima (2014), profitability indicators aim to compare the organization's result with some other parameter of the financial report that best expresses its importance.

In order to enable the comparison between the performance of the two portfolios of companies, SII and STI, the following indicators were calculated: Return on Equity (ROE), Return on Assets (ROA), Operating Margin (OM), Market Value Added (MVA) and Earnings per Share (EPS).

ROE measures the return on equity, which is obtained by the ratio between net profit and equity (Assaf Neto & Lima, 2014). ROA reflects the ability of a company to generate profit, after subtracting all costs from the company, with the assets it owns, being obtained by the ratio between net profit and total assets (Marques, 2004).

The OM measures the effectiveness of a company to generate profit, through its sales and

in operational terms, being obtained by the ratio between operating profit and the company's net revenue (Assaf Neto & Lima, 2014).

The MVA is an indicator of extending the company's management capacity, linking it directly to the company's value (Frezatti, 2001). MVA represents the wealth generated by the company, it is the excess value represented by its intangible assets. The MVA is calculated by subtracting the company's market value and the invested capital, which comes from the difference between operating assets and operating liabilities (Assaf Neto & Lima, 2014).

Finally, the stock analysis indicators aim to assess the effects of the company's results in relation to its shares. The EPS shows the profit for the year divided by the number of shares issued (Assaf Neto & Lima, 2014).

The normality of the variables test was used to verify the proper test for comparing the two portfolios. All tests and statistics were calculated using the Statistical Package for the Social Sciences® (SPSS) software.

According to Table 2, none of the analyzed variables were normal, since all p-value statistics are less than 0.05.

Table 2 - The Normality Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Estatistic	df	Sig.	Estatistic	df	Sig.
ROE	.242	150	.000	.627	150	.000
ROA	.101	150	.001	.951	150	.000
EPS	.135	150	.000	.851	150	.000
OM	.391	150	.000	.219	150	.000
MVA	.278	150	.000	.628	150	.000
DI	.281	150	.000	.563	150	.000

Source: the authors.

ROE is the return on equity. ROA is the return on assets. EPS is the earnings per share. OM is the operating margin. MVA is the market value added. DI is the degree of intangibility.

As the variables did not show normal behavior, the Mann-Whitney non-parametric statistical test was used to compare each performance indicator for the two companies' groups (SII and STI) by sample year (2012 to 2016).

The Mann-Whitney test is indicated for comparison between two unpaired groups in order to test whether or not they belong to the same population and when the prerequisites for applying the Student t test have not been met (Siegel, 2006; Stevenson, 2001), being:

Null hypothesis (H0) - there is no difference between the performance of the SII and STI groups.

Alternative hypothesis (H1) - there is a difference between the performance of the SII and STI groups.

To calculate the Mann-Whitney U of each group of companies, bilateral analysis was used for the significance level $\alpha < 0.05$. The null hypothesis must be rejected if the observed value of U does not exceed the value provided by the K tabulated values (Siegel, 2006). We also performed a comparison between the mean values of signed rank sum for the groups SII and STI (Wagner, Motta & Dornelles, 2014).

4 RESULTS AND DISCUSSIONS

4.1 SAMPLE DESCRIPTION

Table 3 shows the descriptive statistics of the final sample, considering the period from 2012 to 2016.

Table 3 - Descriptive Statistics

Variable	N	Mean	SD	Minimum	Maximum
DI	150	2,670	4,496	0,057	34,261
ROE	150	0,122	0,327	-0,602	2,006
ROA	150	0,039	0,079	-0,223	0,293
EPS	150	0,752	2,309	-11,055	13,303
OM	150	-0,045	1,332	-15,432	1,874
MVA	150	933622,12	10697732,16	-54085703,01	34549727,12

Source: the authors.

DI is the degree of intangibility. *ROE* is the return on equity. *ROA* is the return on assets. *EPS* is the earnings per share. *OM* is the operating margin. *MVA* is the market value added.

According to Table 3, average *DI* was 2.67, in which the lowest value was 0.057 and the highest was 34.26, showing that the market value is higher than the book value, given the presence of intangible resources. Both *ROE* and *ROA* showed positive average values in the period. *EPS* showed a positive average value of 2.309, reaching a maximum of 13.303 and a minimum of -11.055. Finally, the average *MVA* was also positive in the period.

Table 4 shows the descriptive statistics of the groups *STI* and *SII*.

Table 4 - Descriptive statistics segregated according to the groups

Variable	Group	N	Mean	SD	Minimum	Maximum
ROE	STI	75	0,0079	0,1042	-0,3583	0,2189
	SII	75	0,2364	0,4216	-0,6018	2,0063
ROA	STI	75	0,0042	0,0541	-0,2223	0,0831
	SII	75	0,0731	0,0846	-0,2230	0,2934
EPS	STI	75	0,5848	3,0657	-11,0552	13,3027
	SII	75	0,9199	1,1327	-3,0727	3,5885
OM	STI	75	0,0395	0,4926	-1,7084	1,8742
	SII	75	-0,1293	1,8209	-15,4318	1,1302
MVA	STI	75	-4053973,00	11500000,00	-54100000,00	605669,00
	SII	75	5921217,00	6841202,00	-1559457,00	34500000,00

Source: the authors.

STI is the group of companies intensive in tangible assets. *SII* is the group of companies intensive in intangible assets. *ROE* is the return on equity. *ROA* is the return on assets. *EPS* is the earnings per share. *OM* is the operating margin. *MVA* is the market value added.

Table 4 provides evidence that the average values of the statistics are higher in almost all indicators for the group of companies intensive in intangible assets, except for the operating margin.

Table 5 shows Spearman's correlation analysis of the variables with the DI.

Table 5 - Spearman Correlation – Intangibility Degree

Variable	N	Coef.	Sign.
ROE	150	0,5625	0,0000
ROA	150	0,4888	0,0000
EPS	150	0,2461	0,0024
OM	150	0,2823	0,0005
MVA	150	0,7952	0,0000

Source: The authors.

Spearman correlation coefficients for nonnormality variables. *ROE* is the return on equity. *ROA* is the return on assets. *EPS* is the earnings per share. *OM* is the operating margin. *MVA* is the market value added.

According to Table 5, it is observed that all variables have a positive and statistically significant association with the DI, that is, the greater the variable, the greater is the DI. This variable also showed to be more intensely associated with MVA (0.7952), demonstrating a strong correlation. On the other hand, ROE and ROA showed a moderate correlation (around 0.50). Finally, EPS and OM presented the lowest correlation.

In the next topics, the results of the comparisons between the groups (STI and SII) will be provided by applying the Mann-Whitney test for each of the indicators in each of the years analyzed.

4.2 RETURN ON EQUITY

By analyzing the ROE results (Table 6), it is possible to understand that the results were significant for all years ($\alpha < 0.05$), since in all cases, the result of the U test was lower than the critical values of U tabulated values.

Table 6 - ROE Results

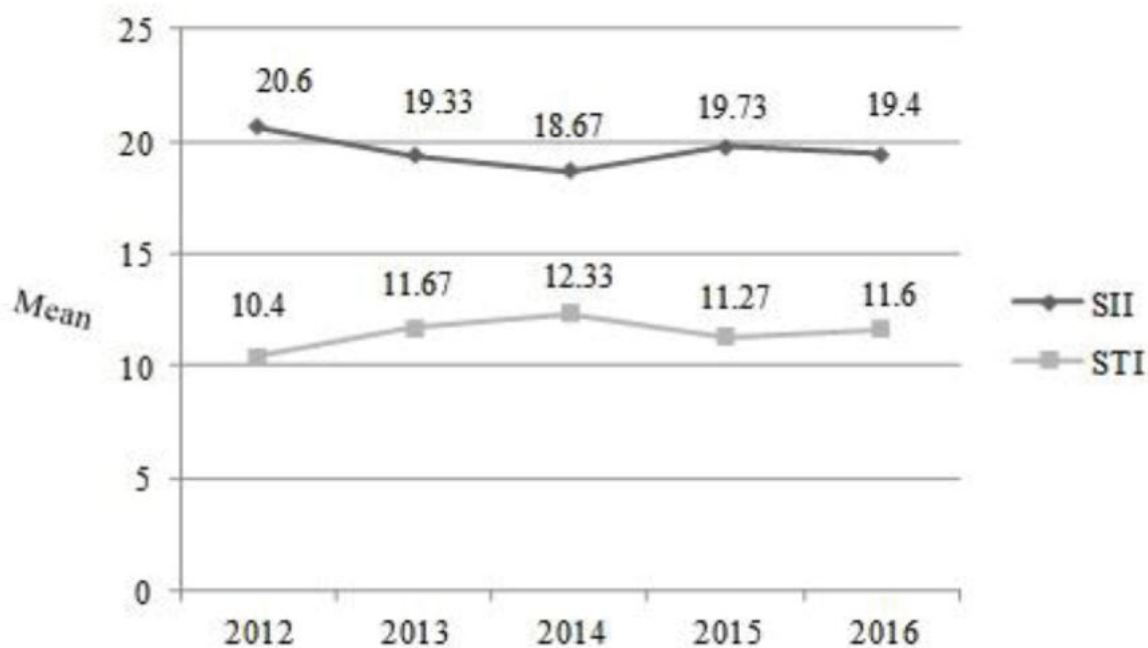
Year	Group	N	Signed rank sum mean	U	Sig. 2 Tailed
2012	SII	15	20,60	36,00	0,002
	STI	15	10,40		
2013	SII	15	19,33	55,00	0,017
	STI	15	11,67		
2014	SII	15	18,67	65,00	0,049
	STI	15	12,33		
2015	SII	15	19,73	49,00	0,008
	STI	15	11,27		
2016	SII	15	19,40	54,00	0,015
	STI	15	11,60		

Source: the authors.

SII is the group of companies intensive in intangible assets. *STI* is the group of companies intensive in tangible assets. *ROE* is the return on equity.

Table 6 shows that the groups SII and STI are statistically different in terms of ROE in all years. To characterize these differences, Figure 1 shows the average result for each group of companies.

Figure 1 - ROE Signed rank sum mean



SII is the group of companies intensive in intangible assets. *STI* is the group of companies intensive in tangible assets. *ROE* is the return on equity.

Figure 1 shows that the average result of the SII group was higher throughout the period, corroborating with the results of the Mann-Whitney statistic.

4.3 RETURN ON ASSETS

Table 7 shows that in 60 % of the years, the SII group obtained the U value below the critical values of the K tabulated values. However, the results for 2013 and 2014 were not significant.

Table 7 - ROA Results

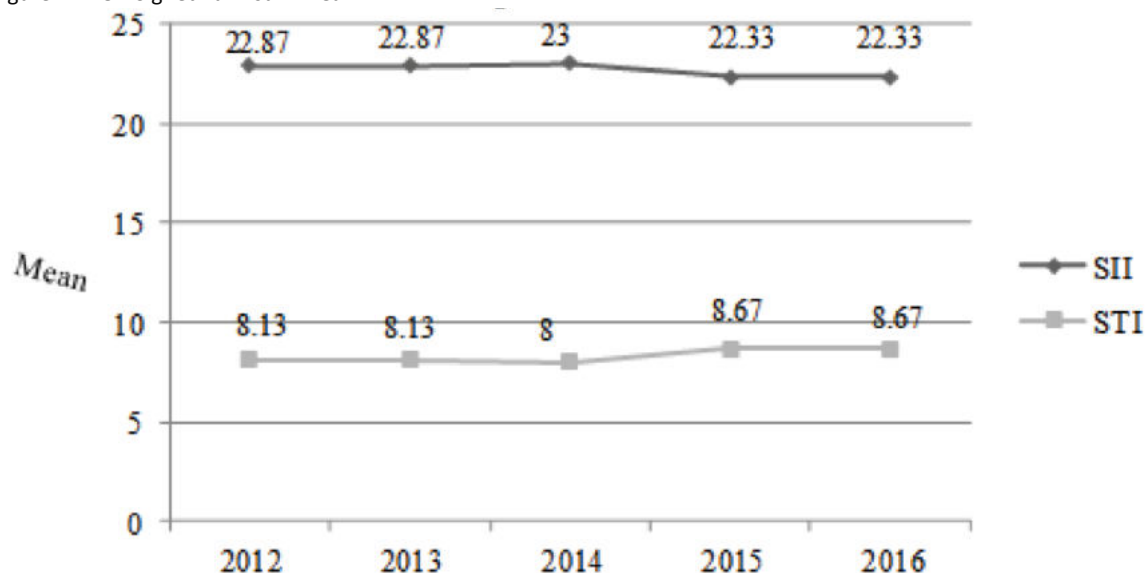
Year	Group	N	Signed rank sum mean	U	Sig. 2 Tailed
2012	SII	15	20,40	39,00	0,002
	STI	15	10,60		
2013	SII	15	18,53	67,00	0,059
	STI	15	12,47		
2014	SII	15	18,13	73,00	0,101
	STI	15	12,87		
2015	SII	15	19,27	56,00	0,019
	STI	15	11,73		
2016	SII	15	19,13	58,00	0,024
	STI	15	11,87		

Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. ROA is the return on assets.

Thus, the SII group presents significant differences between 2012, 2015 and 2016. Figure 2 shows these companies had a mean signed rank sum higher than the STI group in all years in the ROA indicator. The smallest difference between the groups was found in 2013 and 2014, as expected. The biggest performance of SII companies was obtained in 2012.

Figure 2 - ROA Signed rank sum mean



Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. ROA is the return on assets.

4.4 OPERATING MARGIN

Table 8 shows the results of the Mann-Whitney test for the OM indicator.

Table 8 - OM Results

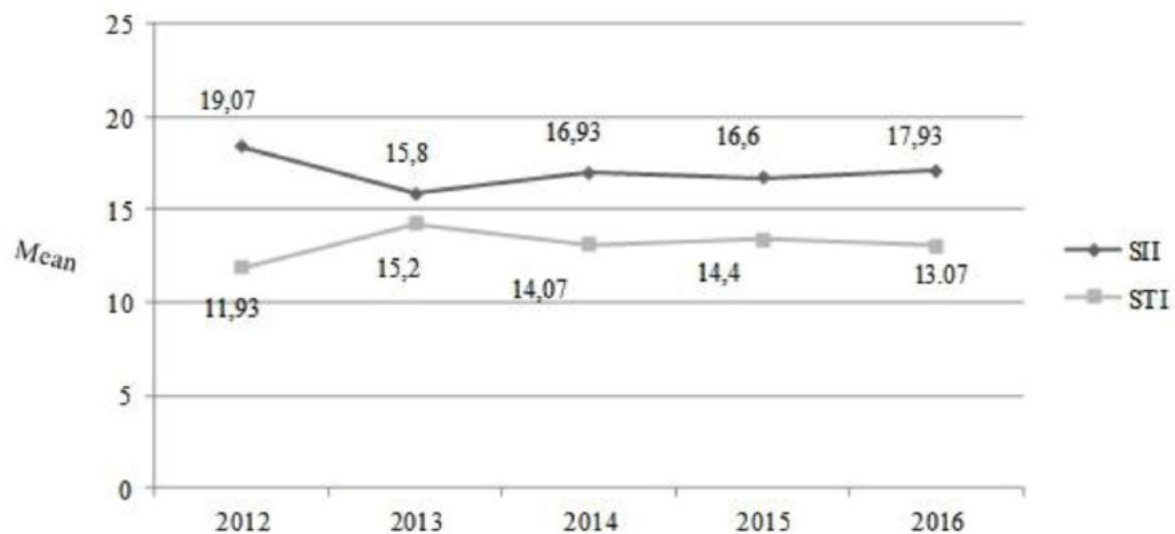
Year	Group	N	Signed rank sum mean	U	Sig. 2 T ailed
2012	SII	15	19,07	59	0,026
	STI	15	11,93		
2013	SII	15	15,8	108	0,852
	STI	15	15,2		
2014	SII	15	16,93	91	0,373
	STI	15	14,07		
2015	SII	15	16,6	96	0,494
	STI	15	14,4		
2016	SII	15	17,93	76	0,130
	STI	15	13,07		

Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. OM is the operating margin.

The above results point out only to the significance in 2012. Therefore, in all other years the results were not significant, not indicating that the SII group presents significant differences in the OM when compared to the STI group. Figure 3 supports these results.

Figure 3 - OM Signed rank sum mean



Source: the authors.

STI is the group of companies intensive in tangible assets. *SII* is the group of companies intensive in intangible assets. *OM* is the operating margin.

In Figure 3, it can be seen that the group of SII companies obtained a higher average in all the years analyzed when compared to the STI group, however these differences are not significant. The differences were significant only in 2012, as pointed out in the Mann-Whitney test, in which the mean SII was 19.07 and the STI was 11.93.

4.5 MARKET VALUE ADDED

Table 9 shows MVA results were significant for all years, since each U test was lower than the critical values of the K tabulated values.

Table 9 - MVA Results

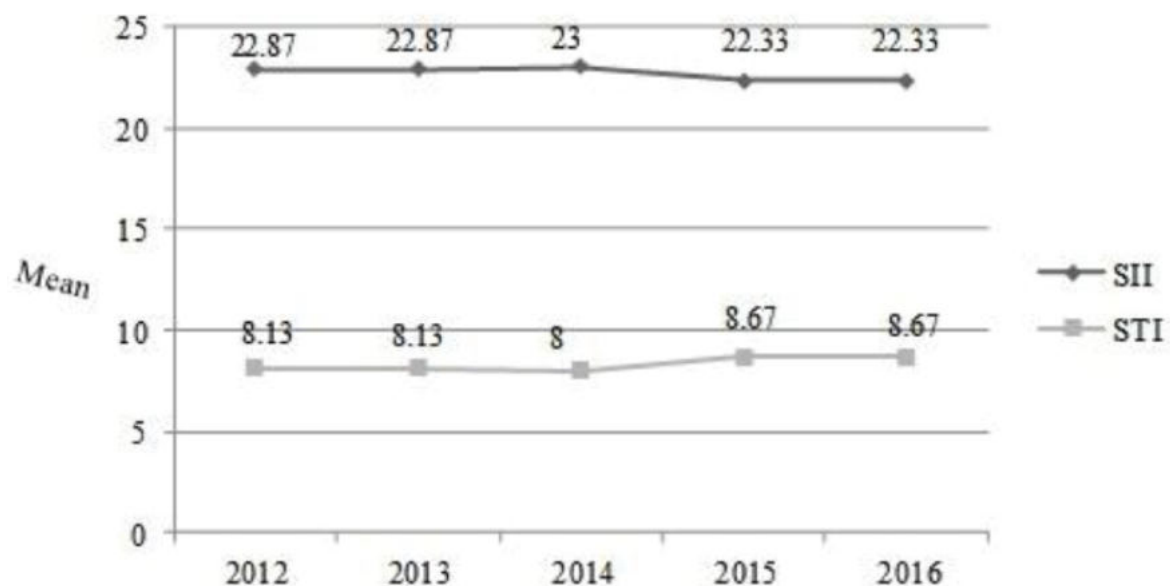
Year	Group	N	Signed rank sum mean	U	Sig. 2 Tailed
2012	SII	15	22,87	2,00	0,000
	STI	15	8,13		
2013	SII	15	22,87	2,00	0,000
	STI	15	8,13		
2014	SII	15	23,00	0,00	0,000
	STI	15	8,00		
2015	SII	15	22,33	10,00	0,000
	STI	15	8,67		
2016	SII	15	22,33	10,00	0,000
	STI	15	8,67		

Source: the authors.

STI is the group of companies intensive in tangible assets. *SII* is the group of companies intensive in intangible assets. *MVA* is the market value added.

The portfolio made up of *SII* companies showed an average performance superior to the portfolio of *STI* companies during the entire sample period, as can be seen in the Figure 4.

Figure 4 - MVA Signed rank sum mean



Source: the authors.

STI is the group of companies intensive in tangible assets. *SII* is the group of companies intensive in intangible assets. *MVA* is the market value added.

4.6 EARNINGS PER SHARE

Table 10 shows the results of EPS indicator.

Table 10 - EPS Results

Year	Group	N	Signed rank sum mean	U	Sig. 2 Tailed
2012	SII	15	17,87	77,00	0,141
	STI	15	13,13		
2013	SII	15	14,73	101,00	0,633
	STI	15	16,27		
2014	SII	15	15,87	107,00	0,820
	STI	15	15,13		
2015	SII	15	16,53	97,00	0,520
	STI	15	14,47		
2016	SII	15	17,27	86,00	0,272
	STI	15	13,73		

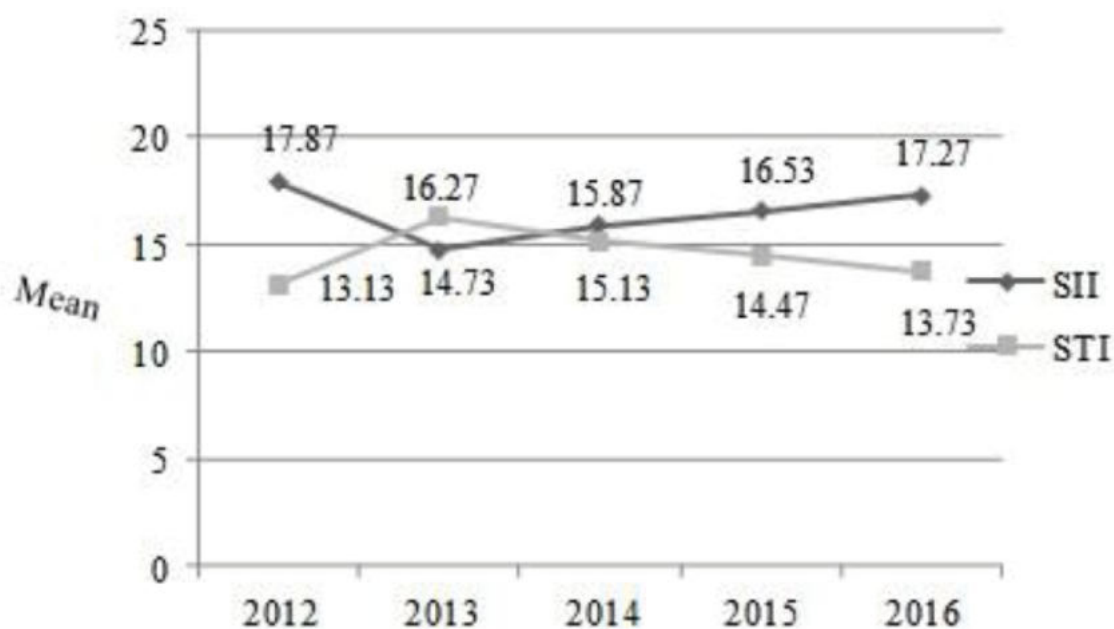
Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. EPS is the earnings per share.

Table 10 shows that none of the results were significant in the years, since the U calculated value exceeds the critical values in the K tabulated values throughout the period.

In Figure 5, it is possible to observe the mean of the signed rank sum of the EPS indicator for each of the groups.

Figure 5 - EPS Signed rank sum mean



Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. EPS is the earnings per share.

By analyzing the means of the signed rank sum of the EPS indicator, it is possible to observe that in 80% of the years, the SII group presented higher values than their counterparts. Less intangi-

bility's companies, however, showed better mean results only in 2013.

4.7 GENERAL COMPARISON OF GROUPS

Table 11 presents a general comparison of the previous results.

Table 11 - Comparison of the results

Indicator	Group	ROE	ROA	OM	MVA	EPS
Signed Rank Sum Mean Superiority between groups	SII	100%	100%	100%	100%	80%
	STI	0%	0%	0%	0%	20%
General Signed Rank Sum Mean	SII	19,55	19,09	17,27	22,68	16,45
	STI	11,45	11,91	13,73	8,32	14,55

Source: the authors.

STI is the group of companies intensive in tangible assets. SII is the group of companies intensive in intangible assets. ROE is the return on equity. ROA is the return on assets. OM is the operating margin. MVA is the market value added. EPS is the earnings per share.

Table 11 shows, in general, that the SII group demonstrated superior performance since the mean of the signed rank sum is higher for the SII group compared to the STI group. EPS was the single variable not presenting superior values of signed rank sum for all years. These values are higher in 80% of the years, except in 2013.

ROE and MVA presented signed rank sum mean superior for the group SII during the period and these means are statistically significant in all years. Regarding ROA, we previous found superior performance for the SII group and it is statistically significant in most part of the years.

We also found higher values of signed rank sum means of Operating Margin for the group SII in all years, but being significant only in one year analyzed. Despite EPS has presented superior performance for the group SII in most part of the years (80%), the signed rank sum means were not significant in each year analyzed.

Considering that most part of our variables presented superior performance for SII companies during the period, these findings demonstrate that the presence of intangible assets play a role in obtaining firms' competitive advantages, being consistent with Perez and Famá (2006).

Perez and Famá (2006) observed that the group of SII companies has an average Spread greater than the group of STI companies in US context from 1997 to 2002. Consequently, the authors conclude that intangible assets are relevant to companies' economic performance since companies with greater portion of intangible assets generate more value to shareholders when compared to tangible-intensive companies.

In a similar research for Brazilian companies, Oliveira et al. (2014) found that SII group have better economic performance during the period of 2003 to 2007 for Operating Margin, Net Margin and Current Liquidity. On the other hand, they did not find significant results for ROI and Beta among the years.

Therefore, our results suggest that intangible assets can effectively differentiate companies and create value, stimulating their growth through new investments and contributing positively to the generation of shareholder wealth, improving the business performance and/or generating sustainable competitive advantage (Barney, 1991; Peteraf, 1993; Kayo, 2002; Perez & Famá, 2006; Honorato, 2008; Oliveira et al., 2014; Perez & Famá, 2015; Almeida & Jordão, 2017), in accordance with the Resource-Based View (Barney 1991; Villalonga, 2004).

5 FINAL CONSIDERATIONS

Our study analyzed the relationship between intangible assets and the economic performance of Brazilian public companies from 2012 to 2016. For this purpose, we calculated the Degree of Intangibility (DI) and segregated the companies into two groups: intensive in intangible assets (SII) and intensive in tangible assets (STI). The economic performance was measured by Operating Margin (OM), Return on Equity (ROE), Return on Assets (ROA), Market Value Added (MVA) and Earnings per Share (EPS) indicators.

The results showed that MVA and ROE were statistically higher in all years for companies intensive in intangible assets. ROA presented similar results, except in 2013 and 2014, when the SII companies did not present a statistically significant difference in relation to STI ones, although they presented a higher performance. In addition, the results showed that SII companies presented higher OM during the period, but statistically significance only in 2012. On the other hand, EPS for SII companies did not prove to be statistically different when compared to STI companies.

The general comparison of the results shows, on average, that the performance of the SII group was superior in most of the period and variables. In addition, the mean of the signed rank sum for each of the indicators was higher for these companies in all the years, corroborating with previous studies on the influence of intangible assets on the performance of Brazilian companies (Kayo, 2002; Perez & Famá, 2006; Honorato, 2008; Oliveira et al., 2014; Perez & Famá, 2015; Almeida & Jordão, 2017).

In this sense, our study seeks to corroborate with the discussion about the differences between the book and the market values. The results evidence that intangible assets can contribute to the increase in the perceived economic value of the company. Thus, our findings signal the importance of these assets in the correct valuation of the company and its performance, providing support to Resource-Based View (RBV).

The findings also seek to contribute to the debate about the accounting treatment of intangible assets, since the effects of intangible assets are not always booked by the Accounting Standards. Perez and Famá (2015) highlight that the difficulties in identifying and measuring intangible resources, in addition to the lack of accurate managerial information on the performance of these assets. This is because traditional accounting is still structured for an industrial era, allocating raw material and labor expenses to the costs of products, processes or activities, but considering as expenses the training, acquisition of new customers and research expenditures.

We highlight that the study presents some limitations: the variable to capture intangibility can portray other elements, since the share price can be affected by numerous factors, as well as by the very characteristic of the Brazilian stock market, which is characterized due to high volatility (Carvalho et al., 2010). Thus, to minimize the potential influences on the share price, we applied more comprehensive periods (Oliveira et al., 2014).

In addition, although the intangibility variable may not fully identify the portion of intangible assets that an organization has, since there is subjectivity in measuring values and difficulty in

quantifying the returns from innovation activities (Perez & Famá, 2006), it has been widely used in both national and international studies.

Finally, future studies could analyze other periods and variables to compare the performance of companies that are intensive in intangible assets to companies that are intensive in tangible assets, as well as to compare the results with similar markets in Latin America. Other studies could focus on variable dimensions with non-financial measures, focusing on strategies of organizations and their customers.

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Contribution of authors.

Every author should account for at least one component of the work. Paper approved for publication need to specify the contribution of every single author.

Contribution	[Author 1]	[Author 2]	[Author 3]	[Author 4]
1. Definition of research problem	√			√
2. Development of hypotheses or research questions (empirical studies)	√	√	√	
3. Development of theoretical propositions (theoretical work)	√	√	√	
4. Theoretical foundation / Literature review				
5. Definition of methodological procedures	√			√
6. Data collection	√			
7. Statistical analysis	√	√	√	
8. Analysis and interpretation of data		√	√	√
9. Critical revision of the manuscript		√	√	√
10. Manuscript writing	√	√	√	√
11. Other (please specify)				

Conflict of Interest

The authors have stated that there is no conflict of interest.

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