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Abstract

According to the Resource-Based View, the nature of the resources, competences and knowledge accumulated by firms are the major causes of variation in business performance. In view of the importance attributed to intangible assets, the purpose of the present study was to investigate whether innovative firms with superior and sustained performance and firms without superior and sustained performance differ with regard to investments in intangible assets. The sample consisted of 137 firms listed on the Brazilian stock exchange from 2007 to 2010 and belonging to innovative sectors according to the Brazilian Innovation Index. Only 51 firms with profitability above the sector average during the entire study period (four years) met the criterion of superior and sustained performance. Thus, using return on assets as a proxy for performance, investments in intangibles were found to be greater in firms without superior and sustained performance, particularly with regard to the categories **intellectual property assets** (the predominant category) and **infrastructure assets**. Based on the lack of evidence for a significant correlation between corporate performance and investment in intangible assets, our initial hypothesis that a positive relation exists between the composition of investments in intangible assets and the performance of innovative firms could not be confirmed.

Key words: resource-based view; intangible assets; business performance; superior and sustained performance; innovative firms.

Introduction

Scholars have long discussed the characteristics and peculiarities of firms which display superior and sustained performance. Many theories have been put forth to identify the determining factors and basic characteristics required to measure and improve business performance. One such theory is the Resource-Based View (RBV), according to which the nature of a firm's resources and accumulated competences are the main cause of variation in performance. To Barney (1991), tangible and intangible resources, combined with competences and controlled by the firm, make it possible to create and implement efficient strategies capable of producing organizational improvements in the long run. Thus, differences in performance between organizations derive from the heterogeneity of their resources (Peteraf, 1993). Scholars such as Wernerfelt (1984), Barney (1991), Peteraf (1993), Teece, Pisano and Shuen (1997) and Penrose (2006) defend the adoption of RBV tenets to maintain long-term sustainable competitive advantage.

Seen from this perspective, resources and competences are distributed heterogeneously among the firms of a given sector as a result of differences in each firm's history and background. Each firm's uniqueness makes it difficult to replicate its resources by acquisition or substitution, creating a potential for competitive advantage (Barney, 1991) and, consequently, superior and sustained performance, at least until its competitors obtain a comparable array of resources (Brito & Vasconcelos, 2004; Carvalho, Kayo, & Martín, 2010).

Intangible assets are resources and competences which may be combined to boost corporate performance. Iudícibus, Martins, Gelbcke, and Santos (2013) point out that while tangible assets are visually identifiable and segregated items in accounting, intangible assets may not be so. Brazilian legislation (Lei n. 11.638, 2007) considers intangible assets incorporeal property destined and used for the maintenance of the firm. In 2008, during the convergence on international accounting standards, the Brazilian Accounting Pronouncements Committee published Technical Statement #4 (Comitê de Pronunciamentos Contábeis [CPC], 2008), subsequently modified by CPC #4/R1/2010 (CPC, 2010), defining intangible assets as identifiable non-monetary assets without physical substance. It should be pointed out that the adoption of international accounting standards in Brazil, starting in 2007, is reflected in the peculiar way in which intangible assets are incorporated in the structure of the balance sheet, where they are given the status of noncurrent assets, and in the way their fair value is determined, which in turn influences the way the indicators of an organization's assets are calculated.

Hoog (2008) sees intangible assets as property without physical substance, the useful life of which tends to be subjective, varying according to the rights resulting from ownership and the associated competitive advantages and profits, which may be acquired or developed internally.

To Edvinsson and Malone (1998), Stewart (1999) and Santos and Schmidt (2002), intangible assets are synonymous with intellectual capital or knowledge assets. They add value to the organization and are part of its base of knowledge and information. Thus, for the purpose of this study, the expressions knowledge management, knowledge assets, intangible assets, intangible capital, intangible resources, intellectual capital, goodwill, occult capital, invisible assets and intellectual property refer to the same type of asset, as shown by similarities between the definitions proposed by different authors (Antunes, 2006; Brooking, 1996; Carvalho & Ensslin, 2006; Edvinsson & Malone, 1998; Kaufmann & Schneider, 2004; Lev, 2001; Petty & Guthrie, 2000; Rezende, 2001; Stewart, 1999; Sveiby, 1997).

With regard to the strategic role of intellectual capital and knowledge management, Rezende (2001, p. 17) stated that "knowledge management is the process of creating value through the use of the organization's intangible assets; it is the transformation of information into knowledge, and of knowledge into business". This is the definition adopted in our study.

Regardless of the nomenclature and definitions assigned to intangible assets, in the perspective of RBV this type of asset is generally seen as the main source of competitive advantage because it is inimitable, specific, rare and valuable for the organization (Teixeira & Popadiuk, 2003). The

combination of intangible assets consequently improves business performance and competitive advantage. Thus, Kaplan and Norton (1996), Nonaka and Takeuchi (1997), Sveiby (1997), Stewart (1999) and Lev (2001), among others, believe intangible assets are the main factor responsible for the creation of competitive advantage (or disadvantage) in an organization. In other words, a considerable part of the variation in corporate wealth is attributed to intangible assets and their use.

However, results from studies on intangible assets have not always been consistent. Thus, while Villalonga (2004) and Perez and Famá (2006) concluded intangible assets significantly contributed to the superior and sustained performance of US firms, Carvalho, Kayo and Martín (2010) reported opposite effects on Brazilian firms, concluding investments in intangible assets were actually negatively associated with business performance. However, the result of the study may have been influenced by the setting in which it was conducted: the sample consisted of firms from several sectors listed on the Brazilian stock exchange (BM&FBovespa).

Peteraf (1993) defines competitive advantage as sustained, above-normal returns. To Barney and Hesterly (2007), a firm achieves competitive advantage when it creates more economic value than the competitors in its sector or product market. Silva (2009) described a line of research focused on sustained extraordinary profits based on earlier studies by Brozen (1971) and Mueller (1977), who empirically evaluated firms with persistently better results than those of their competitors, that is, with better performance over an extended period of time, and concluded that the abnormal returns observed at a given moment in time were due to some extraordinary factor impacting all firms simultaneously.

According to McGahan and Porter (2002), the persistence of abnormal returns is related to sector and company characteristics, since convergences on abnormal returns are sector and company-specific. The authors also demonstrated that business-specific effects represented by competitive position and other factors influence corporate performance.

These same issues were addressed by Bou and Satorra (2007) in a study of Spanish firms. The authors found that abnormal returns occur when, at a given moment, profit rates vary greatly between firms and sectors and are identified most prominently in organizations whose performance is well above average.

In view of this, despite difficulties in classifying Brazilian innovative firms (Oyadomari, Cardoso, Silva, & Perez, 2010), the sample of the present study consisted of potentially innovative firms included in the Brazilian Innovation Index (Índice Brasil de Inovação [IBI]). The index was developed by the State University of Campinas (Universidade Estadual de Campinas [UNICAMP]), the UNIEMP Institute and the São Paulo State Foundation for Research Aid (Fundação de Amparo à Pesquisa do Estado de São Paulo [FAPESP]), based on results from studies indicating an association between intangible assets and innovative capacity. According to the third edition of the Oslo Manual (which contains guidelines for the collection and interpretation of information on innovation, published in 2005 by the Organization for Economic Co-Operation and Development [OECD]), innovation requires considerable investments, including the acquisition of intangible assets with potential long-term return. In addition, in a study published by the Institute of Applied Economics (Instituto de Pesquisa Econômica Aplicada, a public foundation affiliated with the Department of Strategic Affairs of the Brazilian presidency), Tironi and Cruz (2008) highlighted the importance of intangible assets for corporate innovation in the era of knowledge economics and stated that higher levels of innovation require a greater predominance of intangible assets in the innovation process.

Thus, in this study we attempt to answer the question: What is the relation between the composition of investments in intangible assets of innovative firms and corporate performance?. The objective of the study was to investigate whether innovative firms with superior and sustained performance and firms without superior and sustained performance differ with regard to investments in intangible assets. In addition, the relation between investments in intangible assets and the performance of innovative firms was evaluated. Inclusion in IBI level of innovativeness was used as a proxy for innovation capacity. The following hypothesis was formulated:

Hypothesis: A positive relation exists between the composition of investments in intangible assets and the performance of innovative firms.

We adopted the classification proposed by Brooking (1996) which segregates intangible assets into market assets, human-centered assets, intellectual property assets and infrastructure assets. Over the past decade, this classification has been employed by a number of researchers (Bollen, Vergauwen, & Schnieders, 2005; Kot, 2009; Marr, Schiuma, & Neely, 2004) and in a wide range of empirical settings (Antunes, 2005; Antunes & Leite, 2008; Santos, Silva, Gallon, & De Luca, 2011). Furthermore, in view of the study objectives and the importance of collecting corporate data as objective and representative of reality as possible, we used the information on investments in intangible assets provided in the accounting statements of the sampled firms under the heading **intangible assets**, in accordance with international accounting regulations recently adopted in Brazil (CPC, 2010).

The study is intended to subsidize the current discussion on intangible assets in specific business contexts (sector and region) by evaluating Brazilian firms in innovative sectors (according to the IBI), characterized as intangible asset-intensive (Kayo, 2002). The approach is itself innovative in that firms with and without superior and sustained performance are compared with regard to investments in intangible assets segregated by category (Brooking, 1996).

Review of the Literature

In this section, we outline the main aspects of superior and sustained business performance, the relation between performance and intangible assets, and the theoretical framework adopted in the study.

Superior and sustained performance and RBV

In today's globalized market, all firms are compelled to outperform their competitors. However, for some firms, positive results *per se* are not enough, especially if they do not reflect perpetual growth.

Firms and sectors are not homogeneous but are subject to many types of variation which can interfere directly with performance (Brito & Vasconcelos, 2004). Researchers of different schools have studied the question of heterogeneity in business performance, but the criteria with which to measure performance remains a matter of controversy (Carvalho *et al.*, 2010). The notion that firms are essentially heterogeneous with regard to resources and internal capacities has guided much of the research in this field (Peteraf, 1993).

Carneiro, Silva, Rocha and Dib (2007) observed that research on the determining factors of business performance has yielded conflicting or inconsistent results, possibly due to poor construct conceptualization, operationalization and measurement of business performance.

According to Neely, Gregory and Platts (1995), the evaluation of performance may literally be defined as the process of quantifying action, where measurement is the process of quantification and action leads to performance. This is the definition adopted in the present study. On the other hand, as Mintzberg (1973) pointed out, while measuring may be a process of quantification, it also stimulates action. It is only through consistency of action and decision that organizational strategies are realized.

Kimura and Suen (2003, p. 4) believe it is useful to evaluate organizational performance; however, "the complexity of the interactions between the variables that determine business performance calls for the development of special management tools for decision making". Methodical and automated analyses can help prevent rash decisions and conflicting strategies.

In order to systematically monitor how resources are allocated and converted in operational action for the attainment of the organization's goals, firms must measure their performance (Schmidt, 2002).

In fact, the measuring of performance may be seen as fundamental to the long-term maintenance and survival of the firm in the context of global business competition.

Measures of business performance should be expressed with a metrics which can be interpreted and used by stakeholders. Despite recognizing the procedure is complex and may involve different types of measures, El-Shishini (2001) and Omaki (2005) pointed out that "researches highlighted that financial measures are the most commonly used parameters" (El-Shishini, 2001, and Omaki, 2005, as cited in Carvalho *et al.*, 2010, p. 874) as they are generally believed to be the most reasonable estimates of organizational performance. However, not all scholars agree with this view.

The Resource-Based View (RBV) is based on the recognition of individual and unique resources in each firm and on the ability of such factors to explain variation in business performance (Carvalho *et al.*, 2010). The main cause of variation in organizational performance is related to the specific nature of the firm's resources and accumulated competences. RBV strategies are based on the notion that competitive advantage is derived from the organization's ability to adequately combine and exploit tangible and intangible resources (Wernerfelt, 1984). Thus, firms with superior organizational structure and management systems may obtain extraordinary profits by exploiting resources of which there is a scarcity on the market (Oening, 2010).

Several analyses and models of sustained superior performance and related factors have been published. In a seminal study on the principles of RBV, Penrose (1959) showed that corporate growth is determined by managerial competence, acquired experience and learning capacity while using internal and external resources. On the other hand, Schmalensee (1985) looked into the influence of the economic sector and market share on fluctuations in corporate profits based on data from a single fiscal year. Considering a somewhat longer period (4 years), Rumelt (1991) emphasized breaking down the components of the observed variance in corporate return rates.

Kor and Mahoney (2004) discussed a number of studies dealing with different aspects of corporate growth and performance, highlighting Penrose's study (1959) which contributed significantly to the development of RBV by providing a fundamental logical framework for understanding the causal relations between resources, capacities and competitive advantage. According to the authors (Kor & Mahoney, 2004), Penrose (1959) considered three explanatory factors regarding the relation between corporate resources, productive opportunities and growth: (a) efficient and innovative resource management, (b) causal relations between resources and the generation of productive opportunities for expansion and innovation, and (c) availability of managerial talent and techniques, the lack of which is sometimes the primary bottleneck to a firm's growth.

For the purpose of this study, superior and sustained performance was defined as long-term financial performance (Rumelt, 1991) above the average in a given sector (Schmalensee, 1985). The factors determining such performance are seen in light of RBV. In a study on RBV, Grant (1991) stressed that, by focusing on unique resources and competences, organizations can build a solid foundation on which to strengthen their identity, develop long-term strategies and define their primary source of income. Many of these resources and competences would take the form of intangible assets, as indicated by Penrose (1959).

Intangible assets and superior performance

In view of the growing interest in the subject of intangible assets, a range of different approaches have been proposed. Table 1 summarizes the main approaches to intangible assets as observed in the literature.

Table 1

Different Views of Intangible Assets

Authors	Approach to intangible assets
Kohler (1957)	A capital asset without physical substance, the value of which is defined by rights and claims to expected benefits.
Brooking (1996)	Synonymous with intellectual capital, the result of changes in IT, media and communications, providing intangible benefits and enabling firms to function.
Edvinsson and Malone (1998)	The notion of intangible assets arose in response to the growing awareness of the role of non-accounting factors in actual company value.
Hendriksen and Van Breda (1999)	Intangible assets are among the most complex issues in accounting because uncertainties about how to define them and measure their value and useful life.
Lev (2001)	Rights and claims to expected benefits without physical or financial substance originating from discoveries, organizational practices and human resources.
Hillman and Keim (2001)	Intangible assets strengthen relations with the community through socio-environmental actions, reflected in financial benefits to stockholders.
Kayo (2002)	A structured set of knowledge, practices and attitudes interacting with the organization's tangible assets to compound company value.
Schmidt and Santos (2002)	Incorporeal resources controlled by the firm from which potential future benefits may be derived.
Teixeira and Popadiuk (2003)	Intangible assets help boost corporate performance to the extent they are valuable, unique and difficult to imitate.
Perez and Famá (2006)	Permanent assets without physical substance, at the disposal of and controlled by the firm, a source of potential future benefits.
Lei n. 11.638 (2007)	Rights and claims to incorporeal property destined and used for the maintenance of the firm, including acquired goodwill.
Hoog (2008)	Incorporeal property with a frequently subjective useful economic life varying according to the rights resulting from ownership and the associated competitive advantages and profits, which may be acquired or developed internally.
International Accounting Standards 38 (n.d.), CPC (2010)	Non-monetary assets without physical substance also referred to as **goodwill**.
Surroca, Tribó and Waddock (2010)	Intangible assets consolidate the means of creating financial earnings.
Machado and Famá (2011)	Permanent non-physical assets which, together with tangible assets, are capable of producing future benefits.
Lima and Carmona (2011)	Intangible assets correspond to the difference between total value (defined by the market) and book value as stated in the balance sheet.
Teixeira, Petri and Marques (2012)	Nowadays, intangible assets comprise the values previously classified as incorporeal fixed assets.
Iudícibus et al. (2013)	Aggregated assets of future economic benefits to be controlled and exploited exclusively by a given organization.

Note. Source: Composed by the authors, based on a review of the literature.

In this study, we adopted the view that intangible (or intellectual) assets are resources without physical substance, therefore difficult to measure, at the disposal of the firm, from which future economic benefits may be derived. Examples of intangible assets include patents, franchises, brands,

goodwill, authors' rights, secret processes, licenses, developed software, data bases, public concessions, rights to exploitation or operation, portfolios of captive customers, etc. (Perez & Famá, 2006).

To Lev (2001), intangible assets have three main attributes: network externality, non-rivalry and unlimited scalability. Network externality is the influence of the initial consumption of an individual user on the total demand for a product or service. The term non-rivalry is applied to assets when its use by one person or organization does not prevent its simultaneous use by others. Unlimited scalability refers to the return on an intangible asset by increasing scale (Carvalho et al., 2010).

Many authors, such as Flamholtz (1985), Chauvin and Hirschey (1993), Megna and Klock (1993), Nonaka and Takeuchi (1997), Sveiby (1997), Kaplan and Norton (1996), Edvinsson and Malone (1998), Stewart (1999), Lev (2001), Kayo, Teh and Basso (2004), Villalonga (2004), Connolly and Hirschey (2005), Perez and Famá (2006), Ensslin and Carvalho (2007), Gallon, Lyrio and Ensslin (2008), Crisóstomo (2009), Kayo, Patrocínio and Martin (2009) and Surroca et al. (2010) have demonstrated the influence of intangible or intellectual assets on the creation of wealth and pointed out the positive relations between investment in innovation-related resources and corporate market value. Other studies focus on the representativeness of intangible assets in corporate structure, especially Colauto, Nascimento, Avelino and Bispo (2009), Carvalho et al. (2010), Ritta and Ensslin (2010), Santos, Silva, Gallon and De Luca (2012), Nascimento, Oliveira, Marques and Cunha (2012), Santos, Vasconcelos and De Luca (2013) and Vasconcelos, Santos, De Luca and Cunha (2013).

Three studies on the relation between intangible assets and superior and sustained performance are of particular relevance: Villalonga (2004) compared the return on assets (ROA) of each firm in a sample of US firms to the respective sector average and found intangible assets to have a significant influence on superior performance, thereby concluding intangibility was responsible for sustained performance. Likewise, Perez and Famá (2006) observed that in US firms tangible assets were only responsible for regular earnings, while new value was added by intangible assets. Conversely, in a sample of Brazilian firms, Carvalho et al. (2010) found a negative correlation between intangible resources and superior and sustained performance, thereby rejecting the initial hypothesis of their study.

Other international studies worthy of mention have contributed to consolidating the tenets of RBV. In a study on the RBV model from the early 1990s, Grant (1991) concluded that corporate resources and capacities are essential to the building of strategies capable of increasing return rates. The author believes the essence of RBV is in the perception of the relations between resources, capacities, competitive advantage and profitability in each firm. This perception is crucial to achieving competitive advantage in the long term.

In a recent study, Petkov (2011) explored conceptual issues related to the identification of intangible assets generated internally and recognized in financial statements, highlighting the need for periodical analysis of such assets for corporate sustainability. In their study on IT-related assets, Ray, Xue and Barney (2013) observed that IT capital has an effect on corporate performance to the extent that these assets expand the firm's possibilities of vertical integration and product market diversification. In addition, Ulrich and Smallwood (2005) looked at intangible assets from the perspective of human resources and found this aspect to be crucial to the creation of company value. By implementing human resources actions, a firm can create sustainable intangible values, which in turn help capitalize it on the market.

In the present study, we assumed that intangible innovation assets have a significant influence on the maintenance of superior and sustained business performance. Lee and Chen (2009) observed that, for example, investments in R&D can affect company value and were in fact associated with expectations of a significant increase and creation of value. However, according to Carvalho et al. (2010), the potential of intangible assets to create wealth for the organization depends on their specific attributes.

Recently published studies suggest that the relation between innovation and the creation of value in firms may not be uniform (Carvalho et al., 2010). Since the publication in 1962 of the Frascati Manual

(and in its wake a number of OECD-sponsored publications) and the publication in 1990 of the Oslo Manual, the notion of innovation has been informed and standardized by concepts, methodologies and the development of statistics and indicators for research on R&D in industrialized countries (OECD, 2005). The Oslo Manual (OECD, 2005) defines innovation as the implementation/commercialization of a product, process, marketing method or business practice with improved performance characteristics affecting the organization of the firm and its external relations.

For the purpose of this study, we composed a sample of Brazilian public firms from the BM&FBovespa stock exchange included in the sectors identified by the IBI as the most innovative. We adopted the classification of intangible assets proposed by Brooking (1996, p. 136) which features a specific category related to innovation, namely "intellectual property assets".

Due to the difficulty in classifying innovative Brazilian firms (Oyadomari *et al.*, 2010), we adopted the levels of innovativeness used in the 2007 edition of the IBI (developed by UNICAMP/UNIEMP/FAPESP) to compose Table 9. To Basso and Kimura (2010, p. 97), "the IBI sector classification is validated by the existence of an expressive difference in innovation effort and results between the sectors, in support of the RBV concept that individual firms are unique within their respective sector". The IBI was adopted specifically to select sectors of relevance to our study on innovative Brazilian firms because it is a well-established market indicator. As pointed out by Camargo (2008), the IBI is a tool with which firms can compare their innovative performance to that of their competitors. Since its introduction, the IBI has been used by a number of Brazilian researchers (Basso & Kimura, 2010; Inácio & Quadros, 2008; Lopes & Barbosa, 2010; Oyadomari *et al.*, 2010; Ramos, 2008).

Upon the initiative of Revista Inovação (a journal published by the Uniemp Institute), the IBI project was developed in 2005 by researchers of the UNICAMP Department of S&T Policies (Departamento de Política Científica e Tecnológica/Instituto de Geociências [DPCT/IG]), with the support of FAPESP. Designed to measure capacity for innovation, the IBI was used to establish a ranking of innovative Brazilian firms (Furtado, Quadros, Domingues, Camillo, Inácio, & Righetti, 2007).

The IBI methodology derives from well-established data collection methodologies and systems, and provides a comprehensive approach to corporate innovativeness. The main set of data used in the IBI model are retrieved from the database of Research in Technological Innovation (Pesquisa de Inovação [PINTEC]), an initiative of the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística [IBGE]) with support from the Studies and Projects Financing Agency (Financiadora de Estudos e Projetos [FINEP]), which was instrumental in showing the relevance of gathering statistical information on firms (Furtado, Quadros, Righetti, Inácio, Domingues, & Camillo, 2007). PINTEC uses the methodology of the Oslo Manual (OECD, 2005) for research on innovation and quantifies R&D in a way consistent with the Frascati Manual. To evaluate innovation capacity in the form of patents, the IBI retrieves publicly available data from the National Institute of Industrial Property (Instituto Nacional da Propriedade Industrial [INPI]) (Furtado, Quadro, Domingues *et al.*, 2007).

Due to its importance at the national level, Ramos (2008) compares the IBI (Furtado & Quadros, 2006; Quadros & Furtado, 2007) to well-established international indices, such as the UN-sponsored Technology Achievement Index (TAI) (United Nations Development Programme [UNDP], 2001), the OECD-sponsored Composite of Innovation Performance (Freundenberg, 2003) and the Japanese Overall Science and Technology Index (National Institute of Science and Technology Policy [NISTEP], 1995).

In this study, our objective was to analyze the composition of the intangible assets of a sample of Brazilian public firms belonging to sectors defined by the IBI as innovative and evaluate potential associations between asset composition and business performance, based on previous empirical studies and considering the characteristics and specificities of each category of assets.

Methodology

In order to give a detailed description of intangibility and superior and sustained business performance in a sample of Brazilian public firms and define relations between study variables, the collected information consisted of corporate financial data retrieved from the Economática® database and from explanatory notes in standard financial reports and statements posted on the website of the BM&FBovespa stock exchange.

The sample consisted of public firms traded on BM&FBovespa as of April 2010, classified by the IBI as innovative. According to Carvalho *et al.* (2010), studies on intangibility and superior and sustained performance yield more meaningful results when based on samples covering particularly innovative business sectors. Based on PINTEC data 2005 (IBGE, 2006), the IBI was highlighted in studies by Furtado and Quadros (2006), Inácio and Quadros (2006), Furtado, Quadros, Righetti *et al.* (2007), Furtado, Quadros and Domingues (2007), Quadros and Furtado (2007), Righetti and Pallone (2007), Camargo (2008) and Rocha (2009) and has been employed in several other studies, such as Inácio and Quadros (2008), Ramos (2008), Lopes and Barbosa (2010), Oyadomari, Cardoso, Silva and Perez (2010) and Basso and Kimura (2010).

Financial data and information on asset composition were available for 137 of a sample of 174 innovative Brazilian firms. Thus, the final sample included 137 firms, distributed according to the sector classification adopted by BM&FBovespa and IBI level of innovativeness: high-tech (Group 1), medium high-tech (Group 2), medium low-tech (Group 3) and low-tech (Group 4) (Table 2).

Table 2

Classification of the 137 Firms in the Sample According to Sector and IBI Level of Innovativeness

Sector	Group 1: high-tech	Group 2: medium high-tech	Group 3: medium low-tech	Group 4: low-tech	Total
Capital goods and services	13	12	-	-	**25**
Construction and transportation	-	-	3	-	**3**
Cyclical consumption	-	4	20	3	**27**
Non-cyclical consumption	-	-	1	20	**21**
Basic materials	-	10	6	18	**34**
Oil, gas and biofuels	-	4	-	-	**4**
IT	7	-	-	-	**7**
Telecommunications	-	16	-	-	**16**
Total	20	46	30	41	137

Note. Source: The authors.

For the purpose of this study, superior and sustained performance was taken to imply above-average performance over a period of four or more years (Carvalho *et al.* 2010). The study period therefore comprised four years of financial exercise (ending in 2007, 2008, 2009 and 2010). According to Rumelt (1991), four years is long enough to reflect the effects of an entire business cycle. In addition, the study period covers the adaptation of Brazilian firms to the newly introduced international accounting standards which, since the 2010 fiscal year, require firms to list intangible assets in financial statements (Macedo, Machado, Machado, & Mendonça, 2013; Santos, 2012).

Only firms with profitability (as expressed by ROA) above the sector average during the entire study period (considering the sector average of each of the four years covered by the study) met the criterion of superior and sustained performance. Thus, firms with one or more years of financial performance below the sector average were not considered to have superior and sustained performance. The choice of ROA in this study is justified by the extensive applicability of this indicator in studies on corporate performance (Almeida & Santos, 2008; Bomfim, Almeida, Gouveia, Macedo, & Marques, 2011; Bortoluzzi, Lyrio, & Ensslin, 2008; Carvalho *et al.*, 2010; Roberts & Dowling, 2002). According to Silva (2009), ROA reflects the efficiency of operations based on a firm's assets in accounting. The indicator may be interpreted as the maximum financial cost incurred by a firm in its external funding operations; in other words, if the rate obtained in external funding operations exceeds the ROA, the shareholders' return is reduced (Assaf, 2009). Thus, in detriment to other possible variables, ROA was adopted as a measure of performance based on several studies discussed above. Furthermore, the choice of ROA is consistent with the study objective of evaluating the relation between superior and sustained performance and investments in intangible assets in the study period.

Initially, we collected financial data for each firm in the sample. Information on profitability was retrieved from Economática®. Subsequently, content analysis (Richardson, 2007) was applied to information on intangible asset composition extracted from the explanatory notes in each firm's accounting statements. Values representing property items (intangible assets and total assets) were converted into USD at the exchange rate in effect upon the closing of the balance sheet of each year of exercise, while earnings were converted into USD at the average exchange rate of each period, as specified in International Accounting Standard 21 (2003). The variable representing the composition of investments in intangible assets was operationalized based on the amount indicated in the financial statements as invested in intangible assets each year of the study period. It should be added that our choice of measure of investment in intangible assets, as registered in corporate accounting statements and explanatory notes, was based on several Brazilian and international studies on intangibles in which the measure was deemed appropriate and objective (Carvalho *et al.*, 2010; Connolly & Hirschey, 2005; Crisóstomo, 2009; Kayo, Patrocínio, & Martin, 2009; Megna & Klock, 1993; Perez & Famá, 2006; Villalonga, 2004).

Our analysis of the intangible asset composition was based on the classification proposed by Brooking (1996, p. 136) which features a specific category related to innovation, namely "intellectual property assets" (Table 3).

Table 3

Intangible Asset Composition, Based on Brooking (1996)

Classification	Composition
Market assets	Company potential derived from market-related intangible assets.
Human-centered assets	Company potential derived from the expertise, creativity, knowledge and problem-solving skills of individuals, considered collectively and dynamically.
Intellectual property assets	Assets that require legal protection in order to benefit organizations.
Infrastructure assets	Technologies, methodologies and processes, such as organizational culture, information systems, management methods, risk acceptance, customer databases etc.

Note. Source: Adapted from Brooking, A. (1996). *Intellectual capital: core asset for the third millennium enterprise*. Boston: Thomson Publishing Inc.

Data extracted from explanatory notes included information on intangible assets segregated by category and indicator, rather than simply registering the total monetary value, of the group. The classification used was that of Brooking (1996) (Table 4).

Table 4

Indicators of Intangible Assets Classified According to Brooking (1996)

Classification	Indicator
Market assets	Goodwill, customer portfolios, program contracts (commitment), program contracts (investments made), cost of removing property and reforestation, negative goodwill, expenditure on acquisitions and equity, brands, allowance for losses.
Human-centered assets	Acquisition of payroll.
Intellectual property assets	Concessions, exclusive agreements, acquired software, software licenses, other acquired rights, product research and development, technology, patents, completed projects.
Infrastructure assets	Expenditure on shopfitting, expenditure on ongoing projects, setup of facilities on third-party premises, sales outlets, system implementation projects, distance-learning projects, administrative services, information systems, software, preoperational expenses.
Other intangibles	Other.

Note. Source: The authors.

The classification **human-centered assets** has only one indicator, while **market assets**, **intellectual property assets** and **infrastructure assets** have 10, 9 and 10 indicators, respectively. Indicators not classifiable elsewhere in the framework are listed under the heading **other intangibles**.

The statistical techniques adopted were consistent with the study objectives and included calculating mean values and correlation coefficients and performing regression analyses in order to test for differences between innovative firms with superior and sustained performance and firms without superior and sustained performance with regard to investments in intangible assets, and to verify the existence of a relation between investments in intangible assets and corporate performance during a period of four years. Intangible assets were expressed in relative measures in the statistical analysis due to the inclusion of firms of varying size in the sample. Thus, the value of the intangible assets was divided by total company assets, and outliers were removed from the sample.

The normality of the data was initially verified with the Kolmogorov-Smirnov test. Subsequently, the data were analyzed with the Mann-Whitney test in order to compare firms with and without superior and sustained performance with regard to the composition of intangible assets throughout the 4-year study period. According to Fávero, Belfiore, Silva and Chan (2009, p. 163), Mann-Whitney is used "to test whether two samples of independent observations represent populations with equal mean values". The test detects differences or similarities between the mean values of the two samples (in this case, firms with and without superior and sustained performance).

To test the hypothesis, the level of statistical significance was set at 5% ($p<0.05$). The finding of significant differences ($p<0.05$) between firms with and without superior and sustained performance with regard to mean values of intangible assets implies the rejection of the null hypothesis.

Due to the non-normal distribution of the sample, a non-parametric test (Spearman's correlation coefficient) was used in the correlation analysis.

Also adopted in the study, regression analysis is used to investigate the relation between two or more explanatory variables presented in linear form (Fávero, Belfiore, Silva, & Chan, 2009), thereby allowing verification of the existence of a significant association between a dependent variable (in the present study, corporate performance) and one or more independent variables (in the present study, total investment in intangible assets, investments in intangible assets by category adopted in this study, and

control variables represented by size, sector and classification of innovation according to the IBI) (Cunha & Coelho, 2007).

Thus, in order to present more consistent results for the relation between intangible assets and corporate performance, we developed three regression models represented by the following equations:

$$ROA_i = \beta_0 + \beta_1 SIZE_i + \beta_2 D1\_INOV_i + \beta_3 D2\_INOV_i + \beta_4 D3\_INOV_i + \beta_5 D4\_INOV_i + \beta_6 D1\_IND_i + \beta_7 D2\_IND_i + \beta_8 D3\_IND_i + \beta_9 D4\_IND_i + \beta_{10} D5\_IND_i + \beta_{11} D6\_IND_i + \beta_{12} D7\_IND_i + \beta_{13} D8\_IND_i + \varepsilon \quad (1)$$

$$ROA_i = \beta_0 + \beta_1 MARK_i + \beta_2 INT_i + \beta_3 D2\_INFRA_i + \beta_4 D3\_OTH_i + \beta_5 SIZE_i + \beta_6 D1\_INOV_i + \beta_7 D2\_INOV_i + \beta_8 D3\_INOV_i + \beta_9 D4\_INOV_i + \beta_{10} D1\_IND_i + \beta_{11} D2\_IND_i + \beta_{12} D3\_IND_i + \beta_{13} D4\_IND_i + \beta_{14} D5\_IND_i + \beta_{15} D6\_IND_i + \beta_{16} D7\_IND_i + \beta_{17} D8\_IND_i + \varepsilon \quad (2)$$

$$ROA_i = \beta_0 + \beta_1 TOTALINT_i + \beta_2 SIZE_i + \beta_3 D1\_INOV_i + \beta_4 D2\_INOV_i + \beta_5 D3\_INOV_i + \beta_6 D4\_INOV_i + \beta_7 D1\_IND_i + \beta_8 D2\_IND_i + \beta_9 D3\_IND_i + \beta_{10} D4\_IND_i + \beta_{11} D5\_IND_i + \beta_{12} D6\_IND_i + \beta_{13} D7\_IND_i + \beta_{14} D8\_IND_i + \varepsilon \quad (3)$$

Table 5 shows the variables used in the present study.

Table 5

Variables

Variable	Description	Metric
ROA	Performance	Net earnings / Total assets
TOTALINT	Total intangible assets	Total investments in assets
MARK	Market assets BRL	Investments in market assets
INTEL	Intellectual property assets BRL	Investments in intellectual property assets
INFRA	Infrastructure assets BRL	Investments in infrastructure assets
OTHER	Other intangibles BRL	Investments in other intangibles
SIZE	Company size	Logarithm of asset
D1_INOV	Dummy innovation group 1	1 for firms in Group 1
D2_INOV	Dummy innovation group 2	1 for firms in Group 2
D3_INOV	Dummy innovation group 3	1 for firms in Group 3
D4_INOV	Dummy innovation group 4	1 for firms in Group 4
D1_IND	Dummy capital goods and services industry	1 for firms in capital goods and services sector
D2_IND	Dummy construction and transportation industry	1 for firms in construction and transportation sector
D3_IND	Dummy cyclical consumption industry	1 for firms in cyclical consumption sector
D4_IND	Dummy non-cyclical consumption industry	1 for firms in non-cyclical consumption sector
D5_IND	Dummy basic materials industry	1 for firms in basic materials sector
D6_IND	Dummy oil, gas and biofuels industry	1 for firms in oil, gas and biofuels sector
D7_IND	Dummy information technology industry	1 for firms in information technology sector
D8_IND	Dummy telecommunications industry	1 for firms in telecommunications sector

Note. Source: The authors.

Data analysis was performed with the software SPSS® (Statistical Package for the Social Sciences) and Stata. The results of the test of normality (Kolmogorov-Smirnov), comparison of means (Mann-Whitney), correlation (Spearman) and multiple linear regression analysis are presented and analyzed below.

Presentation and Analysis of Results

Initially, it should be pointed out that intangible assets were only taken into account when monetary values were assigned to them in the sampled accounting statements. Once a monetary value had been identified in a company's explanatory notes, information was collected regarding the composition and definition of each asset (Table 3) and the indicators of intangible assets classified according to Brooking (1996) (Table 4).

To help understand the content analysis of the explanatory notes performed in view of the study objectives, the indicators of the intangible assets in each category identified in the explanatory notes (Brooking, 1996; Table 4) are listed in Table 6 along with examples of the terminology employed by the sampled firms in their disclosure of intangible assets in explanatory notes of accounting statements covering the period 2007-2010.

Table 6

Indicators of Intangible Assets (Brooking, 1996) and Examples of the Terminology Employed by the Sampled Firms in Their Disclosure of Intangible Assets in Explanatory Notes (EN) of Accounting Statements Covering the Period 2007-2010

Category	Indicators of intangible assets, according to Brooking (1996), identified in EN	Terminology employed by the sampled firms in their disclosure of intangible assets in EN
Market assets	Goodwill resulting from expected future profitability	*Ágio na Aquisição de Companhias* - EN from 2007, Totvs S.A. (note 10, p. 17);
		Ágio em Controladas - EN from 2008, São Paulo Alpargatas S.A. (note 10, p. 6);
		Ágios na Incorporação/Aquisição - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22);
		Ágio na Aquisição de Controladas - EN from 2009, MMX Mineração e Metálicos S.A. (note 17, p. 26); NE from 2009, Weg S.A. (note 13, p. 10);
		Ágio de Aquisição - EN from 2009, Telefônica Brasil S.A. (note 13, p. 19);
		Ágio na Aquisição de Empresas - EN from 2009, Springs Global Participações S.A. (note 10, p. 15);
		Ágio na Aquisição de Participação - EN from 2010, Iochpe-Maxion S.A. (note 12, p. 67);
		Ágio Fundamentado em Rentabilidade Futura - EN from 2010, Braskem S.A. (note 15, p. 75);
		Ágio Pago em Aquisições - EN from 2010, Usinas Sid. de Minas Gerais S.A./Usiminas (note 19, p. 107);
		Ágio - EN from 2010, Forjas Taurus S.A. (note 16, p. 38); EN from 2010, Tim Participações S.A. (note 17, p. 47)

Continues

Table 6 (continued)

Category	Indicators of intangible assets, according to Brooking (1996), identified in EN	Terminology employed by the sampled firms in their disclosure of intangible assets in EN
Market assets	Customer portfolios	*Carteira de Clientes* - EN from 2008, São Paulo Alpargatas S.A. (note 10, p. 6); EN from 2009, Totvs S.A. (note 13, p. 30); EN from 2010, Telemar Participações S.A. (note 18, p. 91); *Carteira de Clientes (Rede IP)* - EN from 2009, Telefônica Brasil S.A. (note 13, p. 19)
	Program contracts (Commitment and investment made)	*Contratos com Clientes e Fornecedores* - EN from 2010, Braskem S.A. (note 15, p. 75); *Subsídios na Venda de Aparelhos e Mini Modens* - EN from 2010, Tim Participações S.A. (note 17, p. 47)
	Cost of removing property and reforestation	*Custo para Retirada de Ativos e Reflorestamento* - EN from 2009, MMX Mineração e Metálicos S.A. (note 17, p. 26)
	Goodwill resulting from operations	*Fundo de Comércio* - EN from 2010, Portobello S.A. 2010 (note 22, p. 57)
	Expenditure on acquisitions and equity	*Intangíveis Adquiridos na Combinação de Negócios* - EN from 2010, Fibria Celulose S.A. (note 19, p. 75)
	Brands	*Marcas* - EN from 2007, Bematech Ind.a e Com. de Equipamentos Eletrônicos S.A. (note 15, p. 16); EN from 2007, Totvs S.A. (note 10, p. 17); EN from 2008, São Paulo Alpargatas S.A. (note 10, p. 6); EN from 2009, Randon S.A. Implementos e Participações (note 12, p. 16); EN from 2009, Springs Global Participações S.A. (note 10, p. 15); EN from 2010, Braskem S.A. (note 15, p. 75); EN from 2010, Portobello S.A. 2010 (note 22, p. 57)
Human-centered assets	-	-
Intellectual property assets	Concessions	*Cessão de Direitos Comerciais* - EN from 2010, São Paulo Alpargatas S.A. (note 16, p. 58); *Concessão* - EN from 2010, Telemar Participações S.A. (note 18, p. 91); *Licenças de Concessão* - EN from 2010, Tim Participações S.A. (note 17, p. 47)
	Exclusive agreements	*Direitos Minerários* - EN from 2009, MMX Mineração e Metálicos S.A. (note 17, p. 26); EN from 2010, Usinas Sid. de Minas Gerais S.A. – Usiminas (note 19, p. 107); *Direito de Exploração de Jazidas* - EN from 2010, Portobello S.A. 2010 (note 22, p. 57)
	Acquired software and software licenses	*Direito de Uso* - EN from 2007, Bematech Ind. e Com. de Equipamentos Eletrônicos S.A. (note 15, p. 16); *Licença de Software* - EN from 2009, Weg S.A. (note 13, p. 10); *Direitos de Uso de Software* - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); EN from 2010, Tim Participações S.A. (note 17, p. 47); Software *Direitos de Uso* - EN from 2010, Braskem S.A. (note 15, p. 75)

Continues

Table 6 (continued)

Category	Indicators of intangible assets, according to Brooking (1996), identified in EN	Terminology employed by the sampled firms in their disclosure of intangible assets in EN
Intellectual property assets	Other acquired rights	*Direito de Exploração de Área* - EN from 2007, Totvs S.A. (note 10, p. 17); *Direitos de Uso - Adutora de Água* - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); *Direitos de Exploração de Áreas e Direitos Autorais de Produtos Desenvolvidos por Terceiros* - EN from 2009, Totvs S.A. (note 13, p. 30); *Franquias* – EN from 2009, Totvs S.A. (note 13, p. 30); *Direitos de Uso de Subestação de Energia* - EN from 2009, Randon S.A. Implementos e Participações (note 12, p. 16); *Direito de Uso de Telefone* - EN from 2010, Kepler Weber S.A. (note 19, p. 54); *Licenças de Uso* - EN from 2010, Positivo Informática S.A. (note 14, p. 40)
	Product research and development	*Desenvolvimento de Produtos* - EN from 2007, Totvs S.A. (note 10, p. 17); EN from 2009, Totvs S.A. (note 13, p. 30); EN from 2010, Kepler Weber S.A. (note 19, p. 54); *Pesquisa e Desenvolvimento* - EN from 2010, Embraer S.A. (note 18, p. 45); *Pesquisa e Desenvolvimento de Novos Produtos* - EN from 2010 do Itautec S.A. (note 15, p. 44)
	Technology	*Tecnologia* - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); *Licenças Regulatórias* - EN from 2010, Telemar Participações S.A. (note 18, p. 91)
	Patents	*Patentes* - EN from 2007, Totvs S.A. (note 10, p. 17); EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); EN from 2009, Randon S.A. Implementos e Participações (note 12, p. 16); EN from 2010, DHB Indústria e Comércio S.A. (note 15, p. 4); EN from 2010, Kepler Weber S.A. (note 19, p. 54); *Direitos e Patentes* - EN from 2008, São Paulo Alpargatas S.A. (note 10, p. 6)
	Completed projects	*Projetos Concluídos* - EN from 2010, DHB Indústria e Comércio S.A. (note 15, p. 4)
Infrastructure assets	Expenditure on ongoing projects	*Projetos em Andamento* - EN from 2010, São Paulo Alpargatas S.A. (note 16, p. 58); *Custos de Desenvolvimento* - EN from 2010, Forjas Taurus S.A. (note 16, p. 38); *Projetos de Desenvolvimento* - EN from 2010, Positivo Informática S.A. (note 14, p. 40)

Continues

Table 6 (continued)

Category	Indicators of intangible assets, according to Brooking (1996), identified in EN	Terminology employed by the sampled firms in their disclosure of intangible assets in EN
Infrastructure assets	Setup of facilities on third-party premises	*Solo Capitalizado* - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); *Direitos de Uso do Termo* - EN from 2010, Iochpe-Maxion S.A. (note 12, p. 67)
	Sales outlets	*Pontos Comerciais (Luvas)* - EN from 2009, Springs Global Participações S.A. (note 10, p. 15); *Bens e Instalações em Andamento* - EN from 2010, Tim Participações S.A. (note 17, p. 47)
	System implementation projects	*Projetos de Tecnologia da Informação* - EN from 2009, Weg S.A. (note 13, p. 10); *Desenvolvimento e Implantação de Sistemas* - EN from 2010, Fibria Celulose S.A. (note 19, p. 75); *Implantação de Sistemas* - EN from 2010, Forjas Taurus S.A. (note 16, p. 38); *Projetos Sistema – ERP* - EN from 2010, Positivo Informática S.A. (note 14, p. 40)
	Information systems	*Sistema de Gestão Empresarial* - EN from 2008, São Paulo Alpargatas S.A. (note 10, p. 6)
	Software	*Sistemas Aplicativos de Software* - EN from 2007, Bematech Ind. e Com. de Equipamentos Eletrônicos S.A. (note 15, p. 16) *Software e Licenças* - EN from 2009, Randon S.A. Implementos e Participações (note 12, p. 16); NE de 2010, Kepler Weber S.A. (note 19, p. 54); *Softwares* - EN from 2009, Telefônica Brasil S.A. (note 13, p. 19); EN from 2010 do Itautec S.A. (note 15, p. 44); EN from 2010, Iochpe-Maxion S.A. (note 12, p. 67) *Programas de Computador (Softwares)* – EN from 2010, Embraer S.A. (note 18, p. 45); *Sistemas de Processamento de Dados* - EN from 2010, Telemar Participações S.A. (note 18, p. 91); *Softwares Adquiridos* - EN from 2010, Usinas Sid. de Minas Gerais S.A. – Usiminas (note 19, p. 107)
Other intangibles	Other	*Outros* - EN from 2008, Unipar Carbocloro S.A. (note 14, p. 22); EN from 2009, Totvs S.A. (note 13, p. 30); EN from 2010, Usinas Sid. de Minas Gerais S.A. – Usiminas (note 19, p. 107); EN from 2010, Positivo Informática S.A. (note 14, p. 40); *Outros Ativos Intangíveis* - EN from 2010, Telemar Participações S.A. (note 18, p. 91); *Outros Ativos* - EN from 2010, Tim Participações S.A. (note 17, p. 47)

Note. Source: Data collected for the study.

As may be seen from Table 6, not all the indicators of intangible assets proposed by Brooking (1996) (Table 4) were found in the explanatory notes of the accounting statements issued by the firms in the sample. For example, no mention was made of negative goodwill and allowance for losses (market

assets), acquisition of payroll (human-centered assets) and expenditure on shopfitting, distance-learning projects, administrative services and preoperational expenses (infrastructure assets).

Some of the indicators of intangible assets (goodwill resulting from expected future profitability, brands, patents and software) were more frequently disclosed than others (such as cost of removing property and reforestation, goodwill resulting from operations, concessions, exclusive agreements, product research and development, technology, completed projects, expenditure on ongoing projects, setup of facilities on third-party premises, sales outlets, system implementation projects, and information systems).

Some of the terminology employed by the sampled firms, as displayed in Table 6, was similar to that adopted by Brooking (1996), for example with regard to customer portfolios, brands and patents. Other indicators featured a more diversified terminology, for example with regard to goodwill resulting from expected future profitability, system implementation projects, and software. In some cases, the categories of intangible assets (Brooking, 1996) displayed in Table 3 were used to classify items extracted from the content analysis of the explanatory notes (*e.g.* other acquired rights, setup of facilities on third-party premises, and information systems).

Table 7 shows total values of intangible assets as disclosed in accounting statements issued over the period 2007-2010 by innovative Brazilian firms and the proportion (%) of corporate investments in each category of assets (Brooking, 1996).

Table 7

Total Amount (USD) and Distribution of Investments in Different Categories of Intangible Assets (Brooking, 1996) in a Sample of 137 Innovative Brazilian Firms in the Period 2007-2010

Period	Total investment in intangible assets	Distribution of investment in intangible assets				
		Market assets	Human-centered assets	Intellectual property assets	Infrastructure assets	Other intangibles
2007	30127619.00	9298308.61	0	13788968.55	5710401.47	1329940.37
	100%	30.86%	0.00%	45.77%	18.95%	4.41%
2008	56497608.45	26426011.84	0	22963556.88	6898746.36	209293.37
	100%	46.77%	0.00%	40.65%	12.21%	0.37%
2009	120830923.20	60105892.90	0	50928760.70	9356754.27	439515.29
	100%	49.74%	0.00%	42.15%	7.74%	0.36%
2010	133212366.80	51872838.00	0	68082271.80	10789474.00	2467783.00
	100%	38,94%	0.00%	51.11%	8.10%	1.85%
Total	340668517.40	147703051.40	0	155763557.90	32755376.10	4446532.03

Note. Source: Data collected for the study.

As shown in Table 7, investments were predominantly made in intellectual property assets and market assets. Overall, an increase in intangible assets was observed, in both relative and absolute numbers, throughout the study period.

Table 8 shows the proportion (%) of investments in each category of intangible assets (Brooking, 1996) according to IBI level of innovativeness: high-tech (Group 1), medium high-tech (Group 2), medium low-tech (Group 3) and low-tech (Group 4).

Table 8

Distribution of Investments in Different Categories of Intangible Assets (Brooking, 1996) as Disclosed in the Accounting Statements of a Sample of 137 Innovative Brazilian Firms in the Period 2007-2010, Organized According to IBI Level of Innovativeness

IBI level of innovativeness	Period	Distribution of investments in intangible assets				
		Market assets	Human-centered Assets	Intellectual property assets	Infrastructure assets	Other intangibles
Group 1	2007	44.47%	0.00%	14.65%	40.12%	0.76%
	2008	20.81%	0.00%	57.65%	20.89%	0.65%
	2009	30.85%	0.00%	48.25%	19.43%	1.47%
	2010	52.29%	0.00%	33.90%	11.30%	2.50%
Group 2	2007	23.32%	0.00%	50.99%	20.71%	4.99%
	2008	30.75%	0.00%	52.35%	16.41%	0.49%
	2009	35.31%	0.00%	54.76%	9.70%	0.23%
	2010	11.45%	0.00%	74.79%	10.97%	2.78%
Group 3	2007	93.57%	0.00%	4.17%	2.26%	0.00%
	2008	87.65%	0.00%	5.83%	6.52%	0.01%
	2009	93.58%	0.00%	3.12%	3.30%	0.01%
	2010	61.25%	0.00%	9.78%	28.96%	0.01%
Group 4	2007	68.93%	0.00%	27.11%	1.80%	2.16%
	2008	85.71%	0.00%	13.37%	0.84%	0.08%
	2009	90.13%	0.00%	8.06%	1.06%	0.75%
	2010	88.09%	0.00%	10.81%	0.96%	0.14%

Note. Source: Data collected for the study.

It may be observed (Table 8) that investments in infrastructure assets were predominant among technology-intensive firms (Groups 1 and 2), with emphasis on investments in new stores, ongoing projects, facilities installed on third-party premises, sales outlets, implementation of systems, information systems and software. Conversely, in less technology-intensive firms (Groups 3 and 4), investments tended to concentrate on market assets, such as goodwill, brands, acquisitions and equity.

Subsequently, the numerical variables were submitted to descriptive statistical analysis according to category of intangible assets (Brooking, 1996). For this purpose, the absolute values of the intangible assets were used to ensure the analysis reflected the actual amounts invested by the firms. The results are shown in Table 9.

Table 9

Descriptive Statistics

Parameters of descriptive statistics	Market assets	Intellectual property assets	Infrastructure assets	Other intangibles	Total intangible assets
Number of observations	548	548	548	548	548
Mean	269,531.12	284,240.07	59,772.58	8,114.11	621,657.88
Median	114.00	34.50	0.00	0.00	6,104.50
Standard deviation	1,359,265.04	1,468,260.50	247,136.22	65,081.69	2,173,583.44
Coefficient of Variation (%)	5.04	5.17	4.13	8.02	3.50
Interval	21,610,615.00	16,012,390.00	3,111,134.00	1,056,859.00	21,607,999.00
Minimum	-771,805.00	0.00	-13,439.00	0.00	-14,646.00
Maximum	20,838,810.00	16,012,390.00	3,097,695.00	1,056,859.00	21,593,353.00

Note. Source: Data collected for the study.

The number of observations (n=548) corresponds to the number of firms in the sample (n=137) multiplied by the number of years (n=4) in the study period. The coefficient of variation is greatest for the category **other intangibles**, which includes less-relevant or difficult-to-categorize assets of the public firms analyzed. Investments in infrastructure assets were the most homogeneous of the categories (Table 9). The category **human-centered assets** was not included in Table 6 as none of the sampled firms disclosed information on this resource, probably because human-centered assets — defined by Brooking (1996) as benefits to organizations from the expertise, creativity, knowledge and problem-solving skills of individuals, considered collectively and dynamically — can be very difficult to quantify, despite the claim by Pacheco (2005) that human capital, represented by the set of skills and knowledge available to an organization, can be measured and disclosed.

The highest mean values were observed for intellectual property assets, closely followed by market assets, indicating a preference in our sample of innovative firms for investment in these two categories of intangible assets.

Table 10 shows the number of firms with and without superior and sustained performance, according to sector and IBI level of innovativeness.

Table 10

Classification of 137 Innovative Firms According to Sector, IBI Level of Innovativeness and Presence ("Yes") or Absence ("No") of Superior and Sustained Performance

Sector	Group 1: high-tech		Group 2: medium high-tech		Group 3: medium low-tech		Group 4: low-tech		Total	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Capital goods and services	9	4	8	4	-	-	-	-	17	8
Construction and transportation	-	-	-	-	2	1	-	-	2	1
Cyclical consumption	-	-	1	3	8	12	1	2	10	17

Continues

Table 10 (continued)

Sector	Group 1: high-tech		Group 2: medium high-tech		Group 3: medium low-tech		Group 4: low-tech		Total	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Non-cyclical consumption	-	-	-	-	-	1	12	8	12	9
Basic materials	-	-	10	0	6	-	10	8	26	8
Oil, gas and biofuels	-	-	2	2	-	-	-	-	2	2
IT	4	3	-	-	-	-	-	-	4	3
Telecommunications	-	-	13	3	-	-	-	-	13	3
Total	13	7	34	12	16	14	23	18	86	51

Note. Source: Data collected for the study.

Based on disclosed ROA values, 51 (37%) versus 86 (63%) of the 137 firms in our sample displayed superior and sustained performance. Of these, as many as 17 (~33%) belonged to the **cyclical consumption** sector.

Subsequently, the collected data were submitted to the Kolmogorov-Smirnov test for normality and a test for equality of means. The results are shown in Table 11.

Table 11

Result of Kolmogorov-Smirnov Test for Normality

Variable	p-value	Reject H_0?
Market assets	0.000***	Yes
Intellectual property assets	0.000***	Yes
Infrastructure assets	0.000***	Yes
Other intangibles	0.000***	Yes
Total	0.000***	Yes

Note. Source: Data collected for the study.
† = $p<0.10$; * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$

As shown in Table 11, the null hypothesis was rejected for all variables. Since the distribution was non-normal in all cases ($p<0.05$), a test for nonparametric variables (Mann-Whitney) was employed. The results are shown in Table 12.

Table 12

Result of the Mann-Whitney Test

Variable	*p*-value	Reject H_0?
Market assets	0.286	No
Intellectual property assets	0.006***	Yes
Infrastructure assets	0.009***	Yes
Other intangibles	0.434	No
Total	0.481	No

Note. Source: Data collected for the study.
† = p<0.10; * = p<0.05; ** = p<0.01; *** = p<0.001

Table 12 shows that, when comparing firms with and without superior and sustained performance, the null hypothesis could not be rejected, indicating statistical similarity between the mean values of the intangible assets in the categories **market assets**, **other intangibles** and **total intangible assets** ($p>0.05$).

On the other hand, with regard to the categories **intellectual property assets** and **infrastructure assets**, the null hypothesis was rejected ($p<0.05$) and the alternative hypothesis confirmed, indicating a significant difference between firms with and without superior and sustained performance.

Thus, firms with superior and sustained performance displayed significantly higher mean values in the categories **intellectual property assets** and **infrastructure assets**. According to Besanko, Dranove, Shanley and Schaefer (2006), financial earnings above the sector average confer a competitive advantage for a firm in a given market.

To our knowledge, no previous study has compared innovative firms with and without superior and sustained performance with regard to intangible assets segregated by category. Several authors (Carvalho *et al.*, 2010; Kayo, 2002; Megna & Klock, 1993; Perez & Famá, 2006; Villalonga, 2004) have studied intangibility in general as a determinant of business performance and found investments in intangibles to be more prevalent in firms with superior and sustained performance.

The results of the test of correlation between investments in intangible assets (in BRL) and corporate performance (ROA) are shown in Table 13.

Table 13

Correlation Matrix

	Performance	Total intangible assets	Market assets	Intellectual property assets	Infrastructure assets	Other intangibles
Performance	1					
Total intangible assets	0.033	1.000				
Market assets BRL	0.079	0.480***	1.000			
Intellectual property assets BRL	0.138**	0.422***	0.481***	1.000		

Continues

Table 13 (continued)

	Performance	Total intangible assets	Market assets	Intellectual property assets	Infrastructure assets	Other intangibles
Infrastructure assets BRL	0.063	0.320***	0.327***	0.376***	1.000	
Other intangibles BRL	0.082	0.842***	0.675***	0.611***	0.431***	1.000

Note. Source: Data collected for the study.
*** Correlation significant at 0.01; ** Correlation significant at 0.05; * Correlation significant at 0.10.

As shown in Table 13, a non-significant correlation was observed between total investments in intangible assets and corporate performance. More specifically, performance was positively and significantly correlated with investments in intellectual property assets. However, the correlation between performance and intellectual property was weak (coefficients from 0.1 to 0.3).

In addition, using corporate performance (ROA) as dependent variable, regression models were developed to analyze the relation between the study variables. In the first regression model, the independent variables were the control variables **company size**, **dummy sector** and **dummy innovation group** (according to the IBI). In the second regression model, the independent variables included the same control variables and the variables representing categories of investment in intangible assets (according to Brooking, 1996). Finally, in the third regression model, the independent variables were the same control variables and **total investment in intangible assets**. Robust regressions were performed to prevent homoscedasticity. Variance inflation factor (VIF) analysis was used to rule out multicollinearity. The analysis yielded acceptable results (multicollinearity between 1 and 10), with VIF values below 4 in all cases.

The results of the robust regression analyzed with the ordinary least squares method are displayed in Table 14. The variables D7_IND and D3_INOV were excluded due to exact collinearity.

Table 14

Regression Models

	Coefficients Regression 1	Coefficients Regression 2	Coefficients Regression 3
Constant	-33.64***	-33.70***	-33.45***
Total intangible assets	-	-	-0.8487
Market assets	-	-0.3960	-
Intellectual property assets	-	0.1858	-
Infrastructure assets	-	-2.8000	-
Other intangibles	-	1.8403	-
Size	6.8430***	6.8019***	6.8210***
Capital goods and services	-1.6867	-1.3269	-1.6828
Construction and transportation	2.5678	2.8413	2.4999
Cyclical consumption	-11.7863*	-11.4870*	-11.8304*
Non-cyclical consumption	-5.7437	-5.4291	-5.7394

Continues

Table 14 (continued)

	Coefficients Regression 1	Coefficients Regression 2	Coefficients Regression 3
Basic materials	-4,6355	-4.3019	-4.6399
Oil, gas and biofuels	-16.7836***	-16.4008***	-16.7091***
Telecommunications	-9.8659*	-9.4824*	-9.7045*
Innovation 1	-0.2531	0.0699	-0.1790
Innovation 2	-1.2719	-1.3222	-1.2986
Innovation 4	-1.2719	-0.9526	-0.9331
F Test	$F = 4.07$ Sig. = 0.000	$F = 3.88$ Sig. = 0.000	$F = 3.82$ Sig. = 0.000
R²	0.1015	0.1020	0.1016

Note. Source: Data collected for the study.
*** Correlation significant at 0.01; ** Correlation significant at 0.05; * Correlation significant at 0.10.

As shown in Table 14, corporate performance was not significantly correlated with any of the indicators of investment in intangible assets. However, performance was positively correlated with **company size** and negatively correlated with **oil, gas and biofuels** and, at the 10% level of significance, **cyclical consumption**, as indicated by the sign of the coefficient. Thus, firms in these sectors were less likely to perform well.

The F test showed the three models to be significant, and R² was 10.15%, 10.20% and 10.16%, respectively, indicating the power of the models to explain the relation between the dependent and independent variables in each case.

The first model (control variables only) revealed a correlation between corporate performance and **company size**, **oil, gas and biofuels**, **cyclical consumption** and **telecommunications**. The correlation was positive for **company size** and negative for the remaining three variables.

The second regression (control variables + categories of investment in intangible assets according to Brooking, 1996) yielded similar results. Had the correlation between corporate performance and investment in intangible assets been significant, it would have been negative for investment in market assets and infrastructure and positive for investment in intellectual property and other intangibles, as indicated by the sign of the coefficient. In other words, investment in market assets and infrastructure assets had a negative influence on corporate performance, whereas investment in intellectual property assets and other intangibles, if significant, would have a positive influence on performance. Hence, not all the investments classified by Brooking (1996) were associated with improved performance.

The third regression (control variables + total investment in intangible assets) yielded similar results; *i.e.* no significant correlation between corporate performance and investment in intangible assets. However, had the correlation been significant, it would have been negative, as indicated by the sign of the coefficient. From Table 14 it may be inferred that had the total amount of investments in intangible assets been significant, it would have had a negative effect on corporate performance (the coefficient is negative). It would seem the coefficient was influenced by **infrastructure assets**, which yielded a high coefficient in the second regression, corresponding to a considerable negative effect on performance. For some of the control variables, no statistical significance was observed in any of the three regressions (capital goods and services, non-cyclical consumption, basic materials and construction and transportation). Construction and transportation was the only of these sectors which was associated with improved performance. Firms belonging to Innovation Groups 2 and 4 experienced loss of performance, indicating that inclusion in an innovative segment is not synonymous with better performance. Firms belonging to Innovation Group 1 displayed negative coefficients in the first and

third regression only; when analyzed together with the variables of the amounts invested in each category of intangible assets, the coefficient was positive and, had it been significant, it would have contributed positively to corporate performance.

Based on the lack of evidence for a significant correlation between corporate performance and investment in intangible assets, our initial hypothesis that a positive relation exists between the composition of investments in intangible assets and the performance of innovative firms could not be confirmed. In addition, as shown by the test for equality of means, firms with and without superior and sustained performance only differed with regard to investment in intellectual property assets and infrastructure assets (investments were greater in firms without superior and sustained performance).

This contradicts the premises of RBV with regard to the dependence of these variables. However, it should be pointed out that, while investments in intangible assets *per se* could not be shown to influence corporate performance, other factors in synergy with such investments may explain the firms' superior and sustained performance.

Using ROA as a proxy for performance, we found that innovative firms with and without superior and sustained performance differed only with regard to the categories **intellectual property assets** and **infrastructure assets**, with higher mean values in the group of firms without superior and sustained performance. This finding calls into question the assumption of RBV and the claim of Villalonga (2004) and Perez and Famá (2006) that intangibility *per se* is a determining factor of superior and sustained performance.

However, the studies backing this claim were contextualized in a highly developed market (the US) subject to a legal system based on common law, whereas the present study was based on a sample of firms operating in an emerging economy (Brazil) subject to civil law and characterized by an unstable capital market and unsatisfactory implementation of corporate governance practices (Lopes & Walker, 2008).

The results of an additional analysis revealed differences between mean values, indicating a relation between performance and investments in intellectual property assets and infrastructure assets. The results of the test for equality of means, showing that firms without superior and sustained performance invested more in intellectual property assets and infrastructure assets, are partly in agreement with Carvalho *et al.* (2010) who reported a negative relation between intangible assets and superior and sustained performance; in other words, in that study greater investments in intangible assets were negatively associated with corporate performance.

However, the findings of the present study contradict the results published by Ulrich and Smallwood (2005) who concluded, in light of RBV, that the possession of unique resources, especially intellectual property assets, improve corporate performance. Likewise, Ray *et al.* (2013) observed a relation between performance and IT-related infrastructure.

In their comparison of intangible asset-intensive versus tangible asset-intensive firms, Perez and Famá (2006) used stock market value, return on investment, economic value added and earnings spread as proxies for business performance. The authors concluded higher levels of intangibility were correlated with better performance. The present findings do not support this view since innovative firms without superior and sustained performance displayed greater mean values in the categories **intellectual property assets** and **infrastructure assets** (Table 8).

When seen in the light of the study of Roberts and Dowling (2002), the purpose of which was to analyze the relation between intangible assets and corporate reputation and superior and sustained performance, intangible assets may be considered inimitable, rare and valuable to the firm (Teixeira & Popadiuk, 2003). In addition, because of their uniqueness, intangible assets can make a company stand out on the market, contribute to organizational management (Oening, 2010) and help achieve superior and sustained performance. Thus, corporate reputation becomes a strategic tool with which to outperform the competition and achieve sector leadership (Castro, 2009).

In summary, in our sample of 137 innovative firms, investments in the categories **intellectual property assets** (the predominant category) and **infrastructure assets** — but not in the categories **market assets**, **other intangibles** and **total intangible assets** — were significantly greater in firms without superior and sustained performance.

Conclusion

Due to the effects of globalism, firms now need to be more effectively managed to remain competitive on the market and produce satisfactory results. Thus, above-average performance has become a priority for competitive firms. In general, scholars have extolled innovation as a highly influential factor in the maintenance of superior and sustained business performance. Investments in intangible assets are believed to determine growth and future creation of value for the organization.

In view of the importance attributed to intangible assets, the purpose of the present study was to investigate whether innovative firms with superior and sustained performance and firms without superior and sustained performance differ with regard to investments in intangible assets. In addition, we observed the existence of a relation between investments in intangible assets and the performance of innovative firms.

In our literature review, we found several studies identifying intangibility as a determining factor of business performance, but to our knowledge no previous study has evaluated the association between performance and intangible assets segregated by category.

The 137 firms in our sample — identified by the Brazilian Index of Innovation (IBI) as the most innovative in the country — were listed on BM&FBovespa throughout the four-year study period. When assets were segregated according to Brooking's classification (1996), a significant association was observed between superior and sustained performance and mean investments in the categories **intellectual property assets** and **infrastructure assets**, but not for the categories **market assets**, **other intangibles** and **total intangible assets**.

The category **intellectual property assets** was the most representative in this sample of intangible asset-intensive (Kayo, 2002) and potentially innovative firms.

The performance of the innovative firms in our sample was positively correlated with investments in intellectual property assets, matching the findings of a number of RBV-based studies on assets in general (Megna & Klock, 1993; Perez & Famá, 2006; Villalonga, 2004) and specific types of assets (Ray, Xue, & Barney, 2013; Ulrich & Smallwood, 2005).

The fact that firms without superior and sustained performance displayed higher indicators of intangible assets does not imply that investment in intangible assets influences performance. In fact, overall, the sampled firms are investing increasing amounts in intangible assets, possibly under the influence of emerging markets practices.

We believe the intended purpose of the study was accomplished in that our findings confirm the importance of intangible assets to the maintenance of superior and sustained performance in innovative Brazilian firms. Clearly, the factors associated with corporate strategy constitute a highly relevant subject in need of continual analysis and investigation. It should be kept in mind that a firm's resources, capacities and targeted market are directly dependent on management practices and should be the object of running evaluations to secure the feedback required for adequate decision making.

However, caution is necessary when extrapolating our results: our sample was limited to a specific number of public firms traded on BM&FBovespa and listed on the IBI ranking of innovative sectors, with unique characteristics and substantial investments in intangible assets. In addition, financial information was limited to information disclosed in accounting statements, and the definition of superior

performance was based on only one proxy (ROA), which reflects corporate performance in terms of returns on a given asset, without taking into account aspects of the external market. Likewise, the choice of certain variables rather than others for the analysis may have influenced the results.

No less important is the fact that the period covered by the study coincides with important global economic events, especially the world financial crisis of 2008-2009, which is considered a watershed in capitalist economies, with inevitable impacts on corporate performance.

It should also be kept in mind that our results were based on the amounts disclosed in the intangible assets section of the accounting statements published by the firms in the sample. In light of the economic concept of intangible assets, some of the classifications of intangible assets used by the firms may appear inconsistent. Hence, the use of a different measure of investment in intangible assets could potentially have yielded different results. This observation suggests the need for further studies contemplating alternative measures.

Despite the rigorous application of methodology and the relevance of our findings, caution should be exercised with regard to the generalizability of our conclusions due to the unique characteristics of our sample and the metrics employed to quantify intangible assets and performance. Thus, we suggest conducting further studies based on larger samples and using additional information sources and performance measures. In addition, in future studies other statistical methods might be employed to identify associations between specific types of intangible assets and superior and sustained performance. In qualitative terms, the subject could be further explored in light of knowledge management informed by the approach of learning and knowledge creation and innovation projects. Finally, it would useful and potentially enlightening to probe the subject of intangibility from other measuring perspectives.

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