

The Effect of Intellectual Capital on Innovation and Performance of Companies Listed on B3 S/A

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Abstract

The research aims to investigate the effect of intellectual capital on innovation and performance of companies listed on B3 S/A. To this end, statistical results were analyzed for three hypotheses: IC positively influences performance (H1); IC positively influences innovation (H2); and innovation positively influences performance (H3). Based on the PLS-SEM method and the Robust Path Analysis technique, with the aid of the WARPPLS software (version 3.0), the data of 142 companies listed on B3 S/A, in the period from 2010 to 2020, in relation to the variables: degree of intangibility (intellectual capital); intangible (innovation); Tobon's Q, Ebitda Margin, ROE and revenue growth (performance); sector, size, age and year (control variables) were tested. The adjustment results confirm the quality and explanatory power of the model, confirming the three formulated hypotheses. Thus, the analyses demonstrate the contribution of IC to innovation, as well as to the organizational performance of companies.

Keywords: intellectual Capital, innovation, performance

1. Introduction

Intellectual capital (IC) is a relevant topic in academia and business (Jordão, 2015; Scantamburlo et al., 2019) claim expansion of discussions on the subject, mainly, by the growth and spread of multinational operations, increased global competition and internationalization of the capital market. In addition, they emphasize the growing human contribution in business activities, together with technological innovations and the strong relationship with customers and other stakeholders, providing a significant source of value for organizations.

It is understood, then, the importance of intangible assets as inducers of differentiation, motivating increased profitability and greater brand value (Nascimento & Sousa Júnior, 2019). Thus, investments in intangibles are essential for business relationships, because their capitalization is technologically feasible, providing relevance and increased financial performance and innovative activities (Turra et al., 2015). Thus, intellectual capital should be valued intangible resource in order to expand competitiveness and sustainability of firms in the market in which they operate (Silva, 2007). Survival in these markets, therefore, is conditioned by the capacity for innovation, which depends on organizational intelligence and the applicability of intangible assets, more precisely, intellectual capital (IC) (Carbone et al., 2005).

There are several conceptions about intellectual capital, but there is still no consensus about the best denomination. Researches approach the theme with different approaches, in general, aiming at understanding knowledge as an economic resource for the improvement of performance (Antunes & Martins, 2007). Stewart (1998) and Santos (2012), for example, define intellectual capital as the set of knowledge and information pertinent to the organizations, which add value to products and/or services, with reference to human intelligence contributing to the competitive advantage.

It is the employees who disseminate and share knowledge inside and outside the organizations, flowing from the

individual level to the formation of organizational knowledge (Nascimento & Sousa Júnior, 2019). Thus, generating wealth through intellect are essential to the process of creativity and innovation, given the increase in brand value through its intellectual capital (Nascimento & Sousa Júnior, 2019).

An economy based on knowledge and the implications of its use, therefore, have determined significant changes in relation to the valuation of the holders of organizational knowledge, in the perspective of exploring and extracting the maximum value from it, thus demanding a better management of this intangible asset (Santos, 2012). Engelman and Schreiber (2018), for example, demonstrate that innovation is essential to competitiveness, suggesting that knowledge management contributes to the consolidation of the innovation process. Studies have also linked innovation and business performance, with results suggestive to the expansion of research on the nature of innovation and its relationship with knowledge management (Brito et al., 2009; Forsman & Temel, 2011).

Brizolla and Turra (2015), on the same path, concluded that intellectual capital significantly influences the financial performance of the publicly traded companies investigated. The results attributed from the studies of Jordão et al. (2017) advocate that IC stimulates the innovation process, also collaborating to organizational performance and competitiveness. As well, Cassol, Artifon, and Perozin (2015) concluded that intellectual capital positively influences innovation. Carmona and Zonatto (2017) also investigated the relationship between innovation and business performance of Brazilian publicly traded firms listed on the BM&FBovespa, concluding statistically that innovation positively influences organizational performance.

Research reinforces the relevance of intellectual capital (IC) for organizations, based on studies about the impact on profitability (Almeida & Jordão, 2016), in relation to competitive advantage (Moreira et al., 2014); on the real creation of value for shareholders (Perez & Famá 2006), as well as measurement challenges of this asset in small and medium-sized enterprises (SMEs) (Scantamburlo et al., 2019; Sperafico, Engelman, & Gonçalves, 2016), and the relationship of IC for innovation in SMEs (Jordão et al., 2017).

There is also research that aims to understand the relationship between IC and absorptive capacity (Engelman & Schreiber, 2018), with a desire for an IC management model, based on this capacity, to enhance innovation (Cassol et al., 2016); as well as the influence of IC on the profitability of assets of publicly traded companies, when there is evidencing of this asset (Freitas et al., 2018). Finally, they observe researches that aim to understand multinational realities on the theme, such as analysis in Brazilian and Chilean companies (Turra et al., 2015); and in companies from Portugal, Ireland, Italy, Greece and Spain (Dallabona, Mazzioni, & Klann, 2015). There are also studies on the positive influence of IC for innovation in incubated companies, such as Cassol, Artifon and Perozin (2015).

It is perceived, therefore, the growing interest in improving the intellectual capital as a market differential, given that the development of knowledge drives innovation and competitive advantage (Cassol, Artifon, & Perozin, 2015). Thus, it is aimed to investigate the effect of intellectual capital on innovation and performance of companies listed on B3 S/A. Specifically, it is aimed to (i) map the determinants of intellectual capital, innovation and performance; (ii) verify the effect of intellectual capital on performance; (iii) verify the effect of intellectual capital on innovation and, finally (iv) verify the effect of innovation on performance.

Antunes, Leite, and Guerra (2007) expound that studying the effects of intellectual capital on innovation and performance is essential, given that companies need to differentiate themselves in a competitive market, thus, analyzing these effects emerges as a prime factor in the companies' investment process in the decision-making and prospective course. The relationship between the research constructs also contributes to reflections on policies aimed at the economy, by presenting potential implications for economic growth, employability and access to better wages, as well as a better quality of life (Kemp et al., 2010).

2. Intangible Asset

The knowledge-based economy is characterized by complex and dynamic competitive environments, when investments in intangibles are important for organizational negotiations, and knowledge-based resources represent the true source of sustainable competitive advantage for the company (Turra et al., 2015).

The differentiator between companies, in this context, is not the machines, but the knowledge of people, known as intangible assets (Turra et al., 2015), described as the set of specific knowledge, practices and attitudes in the organization that collaborate to generate value, not having physical and financial body (Kayo, 2002). Intangible assets, then, is represented by their permanent nature, without physical existence, when available and managed by the company, are able to produce future benefits (Perez & Famá 2006). For Mantovani and Santos (2014, p. 313) these assets can be represented by "[...] brands, patents, software, copyrights and those arising from

contracts, licenses, database, customer portfolio, formulas and industrial recipes and specialized knowledge about a particular product or service”. According to Assunção (2012), there are other intangibles that are not yet recognized or measured, which also contribute to the results of an organization, such as intellectual capital, although it is not measured by accounting.

3. Intellectual Capital

Cassol et al. (2016) define that intellectual capital has been investigated with greater amplitude since 1990, especially from Sveiby, in 1989. In the sequence, understanding the theme relates knowledge with economic resource, with the junction of varied aspects, such as, for example, information, intellectual property, configuring “structural capital, human capital and customer capital, form the intellectual capital in an intangible asset, but a fundamental factor for the development of organizations” (Moreira, Violin, & Silva, 2014 p. 303). Even with advances in research, according to Table 1, the conceptions are still varied, as well as the definition of its dimensions (Antunes, 2007).

Table 1. Definitions of Intellectual Capital

Authors	Definition
Stewart (1998)	Intellectual Capital constitutes the intellectual matter - knowledge, information, intellectual property, experience - that can be used to generate wealth. It is the collective mental capacity. Therefore, Intellectual Capital is admitted as the set of hidden values that add value to organizations, allowing their continuity.
Edvinsson and Malone (1998)	Intellectual Capital is a non-financial capital that represents the hidden gap between the market value and the accounting value. It is the sum of the Human Capital and the Structural Capital. Human Capital corresponds to all the individual capacity, knowledge, ability and experience of an organization's employees to perform tasks. Structural capital is the infrastructure that supports human capital, i.e. everything that remains in the company when employees go home.
Zack (1999)	Intellectual Capital is formed by the union of tacit and explicit knowledge. Tacit knowledge is the knowledge that is difficult to verify: it is developed through experience and action; it is usually shared through an interactive conversation and includes individual or routine activities, such as negotiating with customers, solving technical problems, public relations, marketing initiative, and new product development. And explicit knowledge, on the contrary, is acquired by education and involves knowledge of facts, such as experience and information stored in files, documents, electronic mail, among others.
Duffy (2000)	Intellectual Capital is the union of structural and human capital, which indicates capacity for future gains from a human point of view. It is the ability to continuously create and provide superior value to the organization.
Martin de Castro and Garcia Muiña (2003)	Intellectual Capital encompasses a set of immaterial, invisible, or intangible assets that do not appear in the balance sheets, but whose exploitation enables the creation of value.
Schmidt and Santos (2003)	Intellectual Capital consists of the knowledge acquired and transformed by people, with the aim of producing assets of greater value to the organization, such as satisfying a customer's need, developing an innovative product, good relationships with suppliers and information systems, among other intellectual assets, which together form the organizational Intellectual Capital.
Pablos (2004)	Intellectual Capital comprises all the knowledge-based resources that can create value for the organization, but are not included in its financial statements.
Gracioli (2005)	Intellectual Capital is a set of values, whether capital, an asset or a resource; all are hidden and tend to add real value to the organization.
Rodrigues et al. (2009)	Intellectual Capital is a complex phenomenon, of eclectic and multidisciplinary nature, which makes it difficult to adopt a definition and even generalizable practices for its management.
Sharabati, Jawad and Bontis (2010)	Intellectual Capital represents the wealth of ideas and the ability to innovate that will determine the future of an organization.

Source: Adapted from Vaz et al. (2015, p. 76 to 77).

Although table 1 presents variations in the definitions, it is realized that the main attribute of an asset component is the potentiality to generate future benefits to the company, and the best alternative for its measurement would be the use of methods that approximate the analysis about the expected future benefits (Moreira, Violin, & Silva, 2014).

According to Ienciu and Matis (2011), it is possible to understand intellectual capital from three dimensions: human capital (CH), relational capital (RC) and structural capital (EC). The CH, characterizes all human resources involved in a process (employees, customers, suppliers, investors, that is, the stakeholders of the

organization. In this sense, human capital consists of the knowledge inherent in the individual, the true source of value; the talents, skills and attitudes needed to generate improvements in performance, competitiveness and organizational innovation (Jordão et al., 2017). Thus, CH can be defined by the individual's capacity, knowledge, skills and experiences and integrates to these elements resources such as: creativity, competence for teamwork and interpersonal relationship skills (Edvinsson & Malone, 1998).

The relational capital (RC) or customer capital, is considered by Stewart (1998) and by Ienciu and Matis (2011) as the most valuable of the intangible assets, it represents relationships, interactions and ongoing connections with people, companies and suppliers as a function of products and services (Vaz et al., 2015).

The structural capital, finally, constitutes the physical structure of the company, since it helps the human capital to transfer the knowledge composed by the development of new technologies (Turra et al., 2015). According to Ienciu and Matis (2011), structural capital includes organizational culture, infrastructure capital, and processes. According to Edvinsson and Malone (1998), structural capital is also formed by: computer equipment, software, databases, patents, trademarks, customer relationships, and everything else of organizational capacity that supports employee productivity.

4. Innovation

Schumpeter (1961, 1988), considers innovation to be the combination of resources available in the organization capable of giving rise to something new, such as the manufacture of new or improved products, techniques and structures, inventions, discovery and inclusion of new markets and factors, including the action of the entrepreneur and his relationship with innovation. Carmona and Zonatto (2017), understand that innovation involves the creation of a new product for the market, portrays the commercialization of an invention, product or service process, organization marketing method.

For the Organization for Economic Cooperation and Development (OECD), innovation is the center of economic change and refers to the scientific, technological, organizational, financial, and commercial steps that effectively lead to or are aimed at innovations (OECD, 2005). It is characterized, therefore, by the implementation of a new or significantly improved product, a process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations. It is differentiated into four types: product, process, organizational, and marketing innovation (OECD, 2010). Organizational innovations, then, involve the creation and effectuation of new organizational methods, such as: changes in business practices, workplace organization, or the firm's external relations; marketing innovations involve the implementation of new methods of marketing and product (and service) design, including packaging, promotion and placement, as well as pricing structuring (Carmona & Zonatto, 2017); product innovations include changes in the potential of products and services, goods and services that are new in their entirety, and improvements to existing products; process innovations, finally, represent significant changes in production and distribution methods (Carmona & Zonatto, 2017).

5. Performance

Performance involves checking levels of efficiency and effectiveness, performance, using a range of indicators from traditional economic-financial indicators to social performance measures (Buchanan & Huczynski, 2004). In addition, performance evaluation is an objective way to check the health of the company and present information to managers about possible strategic change needs (Anning-Dorson, 2018).

Thus, the need to make decisions at the various corporate levels in search of the company's continuity involves information made possible by accounting, market behavior, and the company's internal performance. Thus, stakeholders use performance indicators to understand the business results (Assaf, 2008).

Regarding performance metrics, one has, as a starting point, that all organizational decisions, including those related to innovation, are preceded by investments, which will constitute assets (tangible and intangible) and will be expressed in monetary value (Besanko et al., 2006).

6. Relationship between Intellectual Capital and Performance

Investments in intangible assets are generally not recorded by corporate accounting due to the challenge of measurement, which hinders the management of this type of capital. For companies to be competitive, however, it is critical to understand the relationship between intangible assets contribute and financial performance (Chareonsuk & Chansa-Ngavej, 2008).

Llorente and Arechavala (2008) maintain that investments in intellectual capital improve the performance of organizations both in quantity and, in quality. Perez and Famá (2006, p. 7), in the same path, state that, "the

generation of wealth in companies is directly related to intangible assets, because these assets are responsible for superior economic performances and for the generation of value to shareholders". Wernke, Lembeck and Bornia (2003) also state that, due to the subjectivity of intellectual capital, its understanding is difficult, but there is no doubt that it is a relevant factor, directly influencing the value of companies in the market. Thus, the first research hypothesis to be tested was formulated:

H1: IC positively influences the performance of companies listed on B3 S/A.

6.1 Relationship between Intellectual Capital and Innovation

According to Cassol et al. (2016), innovation is expressed as a competitive differentiator, essential for competitive advantage, to expand the probability of survival, for improving the quality of products, services and processes, and for reducing costs (Jordão et al., 2017). Thus, according to Artifon and Perozin, (2015) innovation is driven by intellectual capital, it makes it crucial that knowledge is developed in the firm to produce products and services.

Intellectual capital, therefore, is an important factor as a management strategy (Omerzel & Jurdana, 2016), while its effective management provides opportunities for the development of actions more conducive to innovation (Cassol et al., 2016). Thus, companies seek to manage the intellectual capital in an innovative way, because it is about qualified people driven by creativity, adding value to the activities performed by the company (Gracioli, Godoy, Lorenzetti, & Godoy, 2012). It is understood, therefore, to be the starting point for innovation, because it values and provides credibility, in addition to determining the ability to innovate and learn (Almeida, 2008). From the above, the following hypothesis can be formulated to be tested:

H2: IC positively influences innovation in companies listed on B3 S/A.

6.2 Relationship between Innovation and Performance

Studies on innovation and performance in organizations demonstrate a direct relationship (Acs & Audretsch, 1988). For Lukes et al. (2019), investments in innovation involve costs aimed at generating an idea or behavior, relative to a product, service, device, system, policy, or program, that is new to the organization.

Innovations impact the performance of organizations, causing companies to raise their capabilities to utilize options to meet demands. Considering change in consumer trends, as the use of strategies supported on existing resources and capabilities in the company itself, innovation can provide the achievement of the goals of the present and those of the future (Farias et al., 2019).

For Miranda et al. (2015) and Brito et al. (2009) innovation is a key element in the competitiveness of companies, while the innovative capacity has a positive reflection on business performance, resonating in the recognition of the growing number of companies mobilized in the search for knowledge, experience and technological capacity to develop innovative products, services and/or processes. Mansfield (1962), for example, in a research on the steel and oil industries, states that innovative organizations showed higher sales growth, with rates twice as high when compared to non-innovative ones.

Chaney, Devinney, and Winer (1991) also point out that empirical evaluations show a relationship between indicators associated with innovation, such as spending on R&D and the performance of companies. Tidd (2001) evaluates that, conceptually, there is consensus on the relationship between innovation and competitiveness and, consequently, the performance of companies, while the impact on competitiveness varies according to the depth of innovation.

Given this context, Besanko et al. (2018) explain that companies must find a level of innovation that maximizes their profits, since competitive advantage originates in the ability to exploit the opportunities instituted by the market, through the introduction of new products and/or services. Thus, innovation represents one of the main paths to competitiveness and economic growth for firms (Cassol, Artifon, & Perozin, 2015), which leads to the following hypothesis:

H3: Innovation positively influences the performance of companies listed on B3 S/A.

It is therefore considered that there are relationships between Intellectual Capital, and of company performance (Antunes & Martins, 2007; Moreira et al., 2014), as well as influence on innovation (Cassol, Artifon, & Perozin, 2015; Engelman & Schreiber, 2018; Cassol et al., 2016; Jordão et al., 2017; Sperafico, Engelman, & Gonçalves, 2016). Intellectual capital, thus, positively influences innovation and company performance, which aims to measure whether this asset can actually be responsible for greater value creation to its shareholders.

Verifying that the IC positively influences the performance of companies. Thus, the results can evidence that the IC stimulates the innovation process, also collaborating to the performance and organizational competitiveness

(Almeida & Jordão, 2016; Dallabona, Mazzioni & Klann, 2015; Brandt, Machaiewski, & Geib, 2018; Freitas Rêgo et al., 2018; Perez & Famá 2006; Turra et al., 2015).

7. Methodology

The research is of an exploratory nature, since it sought to obtain knowledge about the effects of intellectual capital on innovation and on the performance of companies. According to Gil (2002), this research aims to provide greater familiarity with the theme, so as to make it more explicit or to establish hypotheses, for the improvement of ideas or new discoveries. As for the approach, the research is characterized as quantitative, which, according to Oliveira (1997), comprises the use of statistical techniques to verify the relationship between variables.

The study has as target population companies listed on the Stock Exchange B3 S/A in the Brazilian stock market, during the years 2010 to 2020, with the exception of companies in the financial sector, for having accounting standards different from the other listed companies, thus requiring a unique financial and economic analysis for this sector, in addition to companies with negative net income results or with low trading volume in the market. Thus, the final sample consisted of 142 companies listed on the B3 S/A.

The secondary data was extracted from Comdinheiro's database, through paid contractual access, in the "light" modality. Initially, a survey of the formative indicators of each construct of the theoretical model was carried out with the support of empirical studies. Next, it was chosen, due to the availability of access, to equate the variables that comprise the data analysis of the study.

Table 2. Research variables

Constructos	Variables	Authors
Intellectual Capital	Degree of Intangibility	Dallabona, Mazzioni and Klann (2015) Perez and Famá (2006).
Innovation	Intangible Q de Tobin	Lukes et al. (2019).
Performance	Ebitda ROE Revenue Growth	Turra et al.(2015), Farias et al. (2019), Lukes et al. (2019).
Control Variables	Sector, size, age and year	Farias et al. (2019); Lukes et al. (2019).

Source: Prepared by the authors (2021).

In the data analysis phase, initially, the existence of missing data (missing values) is evaluated. To this end, it is considered accepted missing values up to 5% of the total sample, and, in case of existence, the treatment of adjustment by the mean was performed (Hair Jr. et al., 2014). About the multivariate outliers, through the analysis of the standardized values, the existence of extreme cases (-4 to 4) was not noted.

For analysis purposes, the PLS-SEM technique was selected, which according to Nascimento and Macedo (2016), based on the definition of Nitzl (2014), is the most appropriate for modeling complex relationships with multiple relationships of dependence and independence among the latent constructs (including mediation and moderation relationships), because it allows the estimation of equations that enable the simultaneous analysis of these relationships (Smith, 2014), in addition to assessing the quality of the data based on the characteristics of the measurement model (Hair Jr. et al., 2014).

For greater robustness of the results, aligned with the study of Nascimento et al. (2018), the Robust Path Analysis technique was used to analyze the multiple relationships of dependence and independence (in addition to mediating and moderating relationships), as well as the possibility of operationalizing with up to one proxy for each construct to the detriment of the set of formative indicators. To this end, we used the Warp3 algorithm, which, due to its non-linear functions, enables non-linear transformations in construct scores, adjusting the data to be used in this research (Kock, 2015).

In order to operationalize the multivariate technique chosen, the WARPPLS software (version 3.0) (Kock, 2012) was used, as it is the most appropriate for the treatment of the data selected and collected for this research and, above all, because it is freely available for academics and researchers.

8. Search Results

After the descriptive analysis, as well as the existence of the necessary conditions for the use of the Robust Path

Analysis technique, it is reported, in Figure 1, the results of the proposed structural model. Initially, it was verified that there was no high level of correlation between the variables investigated. In this aspect, the average value of the correlation coefficient of 0.064, substantiated by the vertical and horizontal collinearity analysis, allowed us to conclude that there were no collinearity problems among the indicators.

Subsequently, it can be seen that the model presents an excellent level of adjustment, in view of the reported values: (i) for the indicators of global predictive and explanatory capacity: (APC) = 0.175 ($P < 0.001$); (ARS) = 0.336 ($P < 0.001$); (AARS) = 0.335 ($P < 0.001$); and (GoF) = 0.547; (ii) adequacy of the predicted directions for the model's causal relationships arising from the estimation of the non-linear coefficients- NLBCDR = 0.871; (iii) absence of multicollinearity problems: (AVIF) = 1.174; (AFVIF) = 1.387; (iv) absence of Simpson's paradox (SPR) = 1.00; (RSCR) = 1; and, (v) of statistical suppression cases (SSR) = 1.000. Thus, it is concluded that the proposed structural model was estimated free from the systematic influence of biases (Kock, 2015).

Analyzing the results obtained, according to Figure 1, it is concluded that, regardless of size, sector, age, and year, the structural model investigated explains 64% the variance of the endogenous construct performance, further noted, given the sizes and significance of the path coefficients of the external model, that innovation presents a greater direct effect on performance ($\beta = 0.76$ $p < 0.001$), followed by intellectual capital ($\beta = 0.15$; $p < 0.001$). Figure 1 consolidates the reporting of the three hypotheses outlined in the research, with their respective types of relationships predicted, into the proposed structural model.

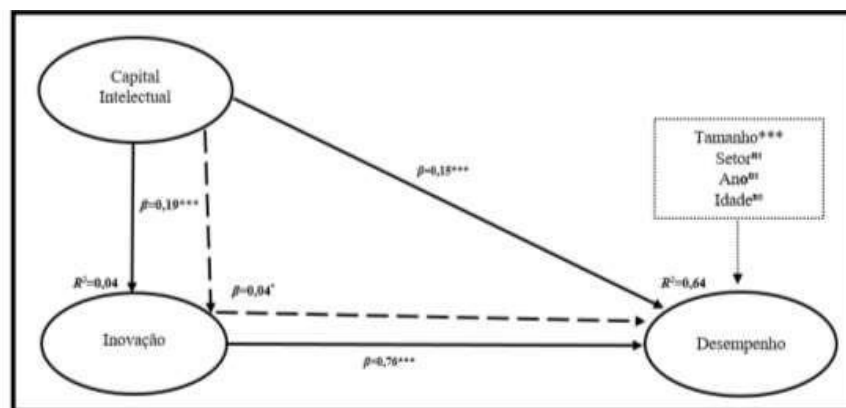


Figure 1. Results of the structural model for the full sample

Source: PLS software output.

Note. Average path coefficient (APC) = 0.175 ($P < 0.001$); Average R-squared (ARS) = 0.336 ($P < 0.001$); Average adjusted R-squared (AARS) = 0.335 ($P < 0.001$); Average block VIF (AVIF) = 1.174, acceptable if ≤ 5 , ideally ≤ 3.3 ; Average full collinearity VIF (AFVIF) = 1.387, acceptable if ≤ 5 , ideally ≤ 3.3 ; Tenenhaus GoF (GoF) = 0.547, small ≥ 0.1 , medium ≥ 0.25 , large ≥ 0.36 ; Sympton's paradox ratio (SPR) = 1.00, acceptable if ≥ 0.7 , ideally = 1; R-squared contribution ratio (RSCR) = 1, acceptable if ≥ 0.9 , ideally = 1; Statistical suppression ratio (SSR) = 1.000, acceptable if ≥ 0.7 ; Nonlinear bivariate causality direction ratio (NLBCDR) = 0.871, acceptable if ≥ 0.7 . Estimation: Outer model analysis algorithm: Factor-Based PLS Type CFM1; Default inner model analysis algorithm: Warp3; Resampling method used in the analysis: Stable3.

According to Figure 1, it is observed that greater investment in intellectual capital entails higher performance levels ($\beta = 0.15$; $p < 0.001$), thus corroborating H1. Thus, evidence is noted that the more firms invest in intellectual capital, the more firms tend to show better performance indices (Chareonsuk & Chansa-Ngavej, 2008; Llorente & Arechavala, 2008; Perez & Fam á 2006).

Intellectual capital also relates positively to innovation ($\beta = 0.19$; $p < 0.001$), signaling that the more investments in intellectual capital, the higher the firm's innovation rates, thus corroborating H2. Signaling that intellectual capital positively impacts innovation. That is, investments in innovation increase proportionally by means of investments in intellectual capital (Artifon & Perozin, 2015; Cassol et al., 2016; Jord ão et al., 2017).

Regarding the relationship between the constructs - innovation and performance - it is noted that they are positively related ($\beta = 0.76$; $p < 0.001$), indicating that in organizations with high evidence of innovation, performance tends to be better, which allows corroborating H3. Justifying that the innovative capacity has a positive reflection on business performance (Acs & Audretsch, 1988; Miranda et al., 2015; Brito et al., 2009; Cassol, Artifon, & Perozin, 2015).

Regarding the assessment of the predictive validity of each latent construct, the following Stone-Geisser Q2

coefficients were obtained ($Q2 > 0$), via the Blindfolding procedure: of 0.038 and 0.502 for ‘Innovation’ and ‘Performance’, respectively, therefore, presenting satisfactory levels of predictive validity.

When analyzing the total impact (direct and indirect effect) on ‘performance’, a relationship with greater magnitude was noted with ‘innovation’, both directly ($\beta = 0.76$; $p < 0.001$), and in the partial mediation between the relationship of ‘IC’ and ‘performance’ ($\beta = 0.04$; $p < 0.10$), and in the direct effect by ‘IC’ ($\beta = 0.15$; $p < 0.10$), signaling that investments in innovation, as well as in IC, corroborate in the instrumental end logic (performance), of these companies in the study. For sure, the exploratory perspective of this study is confirmed, as well as reaffirms the proposed theoretical alignment. Once the data discussion is concluded, Table 2 summarizes the results of the hypotheses investigated:

Table 2. Summary of the results of the research hypotheses

Hypothesis	Relationship	Expected Signal	Result	Status
H1	Intellectual Capital Performance Financial	+	0,16***	Supported
H2	Intellectual Capital Innovation	+	0,19***	Supported
H3	Innovation Performance	+	0,76 ***	Supported

Source: Prepared by the authors (2021)

Note. **, *** Statistically significant at the 0.05 and 0.001 level respectively.

9. Discussion of Results

Initially, the results revealed that the measurement proposal developed and applied, through the selection of indicators, was able to gauge the IC contribution to innovation as for the organizational performance of the companies listed on B3 S/A.

As observed in Table 1, hypothesis H1, which tested the positive contribution of IC in the performance of companies listed on the B3 S/A, in the period from 2010 to 2020, was fully validated. In this sense, the impact of IC on corporate performance was verified, indicating that the more they invest in intangible assets, the higher their performance indicators tend to be, both in the short and long term perspective. It is estimated that the generation of wealth in companies is closely related to intangible assets, since these assets are responsible for superior economic performance and the generation of value for shareholders.

One can also highlight the positive and significant effect on innovation. For sure, innovation includes from effects on sales and market share to changes in productivity and efficiency (OECD, 2005), which according to Artifon and Perozin (2015), it is crucial that knowledge is developed in the company in order to boost it. In this sense, companies can develop actions towards the production, adoption, assimilation and application of something new with added value in social and economic areas, as well as the improvement of services, products and management methods (Kianto, Sáenz, & Aramburu, 2017). It appears as a result of this process, the innovative performance (DI), which, according to Alegre and Chiva (2013), represents the innovative behavior of organizations facing the innovations that they manage to improve/develop (Chen et al., 2015).

According to Nascimento and Sousa Junior (2019), organizations that aim for success rely on intangible assets and resources to generate value to customers, mainly through intellectual capital and knowledge management. Intellectual capital is used as a generator of wealth, in which aspects such as knowledge and information are essential to the process of innovation and creativity in organizations. And as Rezende (2002, p. 78) states, “the main focus generator of wealth is no longer Manuel labor, but intellectual labor.” As per the results of the study, according to H3, the positive, significant and major effect relationship between innovation and performance could be noted. This result corroborates the vision of Miranda et al. (2015) where they expose that innovation, is a key element in the competitiveness of companies, having the innovative capacity as a positive reflection on business performance, this being verified by having the recognition of the growing number of companies mobilized in the search for knowledge, experience and technological capacity to develop innovative products, services and/or processes.

10. Final Considerations

The market environment, of growing competition among Brazilian companies, is increasingly complex and multifaceted. While organizations diversify the supply of products and services, consumers constitute specific niches, which require, most of the time, the conception of customized solutions, without additional costs.

In the present study, we sought to analyze the possible effects of intellectual capital on innovation and

performance of companies listed on the Brazilian stock market, B3 S/A. Based on the analysis of 142 companies listed on the stock exchange B3 S/A of the Brazilian stock market, during the years 2010 to 2020, with the exception of companies in the financial sector. The three hypotheses of the research were confirmed and the results showed that IC stimulates the innovation process, also collaborating to organizational performance.

The first specific objective was to map the determinants of intellectual capital, innovation, and performance of companies listed on B3 S/A. For intellectual capital the indicator used was degree of intangibility (GL); for innovation was its intangible assets; and for performance, the variables: Tobin's Q; Ebitda Margin; ROE; and Revenue Growth.

In compliance with the second proposed objective, to verify the effect of intellectual capital on the performance of companies listed on B3 S/A, the results obtained signaled a significant positive relationship. Thus, indications are noted that the more companies invest in intellectual capital, the more companies tend to present better performance indexes. In relation to the third specific objective, to verify the effect of intellectual capital on the innovation of companies listed on B3 S/A, it is observed that intellectual capital is also positively related to innovation, signaling that the more investments in intellectual capital, the higher the company's innovation rates, thus corroborating that intellectual capital positively impacts innovation.

As for the fourth specific objective presented, whose intent was to verify the effect of innovation on the performance of companies listed on B3S/A, a positive relationship between the constructs was evidenced, signaling that, in organizations with high signs of innovation, the performance tends to be better.

One can state that this research has reached the objectives it set out to achieve, demonstrating the importance of the effects of intangible assets, in this case IC, both in innovation and in the generation of value of companies listed on the B3 S/A, which provides companies with the opportunity to reinforce strategic decisions in favor of this intangible asset, to expand their possibilities of investments and competitive visibility in the perspective of the stock market. The face is also corroborated by the increasingly demanding posture of customers, demanding innovative processes to solve their consumerist desires/needs.

As a limitation of this work, it is presented that the research was developed only with some variables of each construct. For future research we suggest the expansion of the scope of variables. Furthermore, given the significance of the size control variable in the structural model, it is believed that the technique of multi-group analysis can broaden the understanding of particulars that lead to other reflections on the model proposed in this study. Also, the application of the model in other stock market contexts.

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