

INFLUENCE OF ECONOMIC AND FINANCIAL PERFORMANCE ON TECHNOLOGICAL INNOVATIONS OF BRAZILIAN CONSTRUCTION STOCK EXCHANGE FIRMS

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ABSTRACT

The main objective of this paper is to analyze the influence of economic and financial performance on the technological innovation of stock exchange real estate Brazilian firms. Economic and financial performance and technological innovations themes are described on specific topics using many authors who analyzed the correlated themes to compose the theoretical basis. According to the objective, this study is descriptive, in relation to the procedures, it is considered as documentary and it uses a quantitative approach. To collect our data, we used innovation evidences from management reports and economic and financial results were gotten consulting Economatica® using the data published by the stock exchange real estate Brazilian firms. We used Multiple linear regression as a statistic method and we concluded that economic and financial performance variables such as: general liquidity ratio, size of the firm, and sales growth presented a statistically significant relationship with technological innovation of construction firms.

Keywords: Innovation, economic and financial performance, construction companies.

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1 INTRODUCTION

The firm innovation has been discussed since the beginning of the XX century, mentioning its nature, specific characteristics, sources and classification, as a way to understand its relationship with the economic development of entities (MARQUES, 2004). According to Gunday et al. (2011), the innovation is one of the main instruments of growing strategies to the firms which intend to expand into new markets because they have competitive advantages.

Innovation is a term used not only related to new products and processes, but also related to marketing and organizations (GUNDAY et al., 2011). Innovations in new products, processes, costs or organizational improvements allow entities to become differentiated and to stand out at the market of action by the increase of its efficiency and by the costs reduction (HASHI, STOJCIC, 2013).

In a socioeconomic context in which the competitiveness is part of day to day of the firms, the implementation of the different ways of doing things can become a basic condition to keep the products and also the firms at the market. More than making it possible for the firms to expand their live cycle, the innovations can contribute to economic and financial indicators of the most innovative firms (FLORIANI, 2009).

According to Brito, Brito and Morganti (2009) the relationship between the innovation and the performance of the firms has been discussed at the current literature and it allows us to propose the follow research question: What is the influence of the economic and financial performance on the technological innovation of stock exchange real estate Brazilian firms? As a way to solve the research question, we identify the objective of the study: To analyze the impact of economic and financial influence on technological innovations of stock exchange construction Brazilian firms.

National studies as Brito, Brito and Morganti (2009); Santos, Basso and Kimura (2010), Santos et al. (2014) analyzed the relation between innovation and performance of Brazilian firms, using data from IBGE; the degree of relationship of innovation construct with the variables that represent the performance of the firms, with information related to innovation of firms from PINTEC, from the years 2000, 2003 and 2005; and analysis of the potential relationship between innovations with PINTEC data and performance of Brazilian firms.

International studies as those from Hall and Bagchi-Sem (2002), Marques (2004); Liao and Rice (2010); Kostopoulos et al (2011); Gunday et al (2011); Horta, Camanho and Costa (2012); Wang and Wang (2012); Hashi and Stojcic (2013); Hung and Chou (2013); Klingenberg et al. (2013); Ivanov and Avasilcai (2014) verified the impact of innovation on economic and financial performance, on market strategy, on financial and organizational performance, as innovation performance of production, market and financial, on the excellence of the sector of the firms and also identified the key organizational indicators that are used to measure the process of organizational innovation.

The present study is justified because the organizational innovation has been fully discussed in scientific environments of social studies at international level due to its relevance and importance, but few studies have been done at national level. This research intends to contribute to a deeper understanding of the theme and it differs from other national studies such as those presented by Brito, Brito and Morganti (2009); Santos, Basso and Kimura (2010); Santos et al. (2014) that verified managerial innovations and its relations to the performance of the firms on technological innovations of real estate firms.

To relate economic and financial indicators with technological innovations can confirm the hypothesis of a direct relationship between those results caught by the firms and the innovative activity. The choice of construction sector was due to the size and importance of that sector in relation to the whole Brazilian GPD, as by the intensive use of workforce with low level of formal instruction.

2 THEORETICAL BASIS

At this section, with the purpose of providing theoretical support to the present study, we present the theoretical basis used at the study about innovation focusing on technologies, economic and financial performance and similar studies.

2.1 Technological innovations

The nature of the competition can be hardly influenced by technological innovations that allows the firms to access new markets, to modify the relative importance of the resources and also to face learning capabilities. For the established organizations, it can create risk and uncertainty. The impact of an innovation can make the firms to use past technologies and make it difficult to survive or to risk too early with an innovation (CLEGG; HARDY; NORD, 1998).

Competitive advantages have been acquired due to innovative initiative when the opponents are too slow in its reactions. New technologies and ways of doing the things are part of these competitive advantages. The firms can innovate using a new design for the product, new productive process, differentiated marketing approach or new training methods. Most part of the innovations are common and incremental, from old ideas that had not been implemented intensively. The innovation needs tension, challenge and adversity. Most of the innovations require frequent improvements as a way to reduce the imitation potential. The leadership must be interested in scarifying the easy life, because it is responsible to create a dynamic and challenger environment, and the firm may not put by tensions and challenges, because the competitive advantage results from frequent improvement and not from the protection of actual secrets (PORTER, 1999).

Tidd, Bessant and Pavitt (2008) mentioned that new products allow the growing of profitability by the increasing of the market share and mature products generate sales growing due to the offer of lower prices, new and custom models, product quality and also quick and efficient services. The advantages generated by innovative actions has its competitive power reduced with the imitation by the opponents. Tidd, Bessant and Pavitt (2008) presented the strategic advantages: To offer what nobody more can offer, to offer what others are not able to imitate, to offer something of difficult domain and that requires the payment of license or tax (legal protection of intellectual property), to modify the basis of the market, advantage of being the first to enter or advantage of being the fastest follower.

The difference between economic behavior of firms and nations was explained by Drucker (2008) by the entrepreneur. The author complemented that high technology cannot be able to provide competitive advantage. He mentioned that the economic entrepreneurship happens due to the systematic innovation, presented as the search of opportunities to provide the satisfaction of human desires and needs. He defines innovation as the instrument of entrepreneurs to explore the change as an opportunity. Drucker (2008, p. 39) mentioned that "there is not something called resource until the men find some form of use in the nature and then attribute economic value to it" and every modification on the potential value in available resources can be considered as an innovation.

The innovation, as considered by Tadeu and Salum (2012) is a useful strategic option to create conducive environment with stakeholders' engagement, by the culture and structure, using indicators to accomplish and develop the creativity capability of the firms. The innovation for Tadeu and Salum (2012) goes far from technological development and it is composed by products, processes, models of management and business and they define innovation as doing

something new, as an evolution process that conducts the practical application, perceived and accepted by the customers. Tidd, Bessant and Pavitt (2008) proposed that the capabilities on establishing relationships, the detection and to catch the opportunities is what moves and motivates the innovation.

Tadeu and Salum (2012) argued that the measurement of return caught with innovative processes is so important as the investment in innovation and they presented the types of innovations: Product innovation (benefits on products' characteristics that modify the customer's perceptions); process innovation (improvements in productive process due to the productivity improvement or cost reduction); innovation on the business model (modifications at the form that the product is offer to the market). Innovations can be incremental (small progress at the benefits perceived by the clients) or radical ones (those that generates a new paradigm that modifies the present business model). The innovation management needs to capture signs of modifications and be ready to explore new areas (TADEU; SALUM, 2012).

Tidd, Bessant and Pavitt (2008) also presented the types of innovations (4P's): Product, Process, Position (modification on the context that products and services are introduced); Paradigm (mental models that direct what is done by the firm). Innovation can be due to a new positioning of perception of a product or process and most of times it happens in an incremental way, and as a result cumulative efficiency benefits are bigger in a long time than those gotten from occasional radical modifications.

The relationship of the innovation with de knowledge was proposed by Tidd, Bessant and Pavitt (2008). They mentioned that the combination of the groups of knowledge into a well-succeeded innovation happens over high uncertain and the management of the innovations happens due to the capability to extract knowledge from the uncertainties and provide resources to reduce this uncertainty in an equilibrate action. They complement that innovation is not easy, but it is indispensable. The appropriation of innovation benefits is identified by nine factors that influence the capability of the firm to get market benefit of its technology. The nine factors are: secrecy, tacit knowledge accumulated, time of production and post sales service, learning curve, complementary resources, product complexity, patterns, to be the first mover to provide new products and protection of patents.

Ettlie (2006) presents the competitive answers to new products: a) Organizations usually compete based on strong points and tend not to modify if new capabilities are required; b) The more significant an organizational movement, the more probable a significant answer would be postpone; c) New entrances typically challenge with new technologies in their products and services, but they are usually ignored by the opponents; d) When a product is announced or introduced, there is 50% of chance that the opponents answer with a new product; e) In industries with high patent protection, the firms will prefer to react to the introduction of new products with a mix of market answer and not with new products; f) New competitors are considered serious the moment they become established firms. For Ettlie (2006) it is clear that new products are resulting parts of the competitive movements of all firms, and the bigger the perception of the threat, the bigger the answer will be. But, the firms will not always perceive the movements mainly of the new entrances, as great treats, or they believe that the protection using patents will serve to protect the competitive movements.

2.2 Financial and economic Performance

According to Bortoluzzi et al. (2011) the mindset of the customers to ask for quality goods, the competition between the firms, the importance of the workers to the firm and the impact of managerial activities in the society have generated the necessity of the firms to adhere to managerial models, as a way to produce useful and relevant information about its performance, helping on decision making by the managers.

The accounting demonstration are the main data and information sources to make it possible to analyze the economic and financial performance of the firms, in which indicators are composed by historic archives and projections to the future (ASSAF NETO, 2003). The traditional indicators are: liquidity, profitability and capital structure that provide important and complementary information to the managers of the firms to decide (BORTOLUZZI et al., 2011)

Fischmann and Zilber (2009) argue that the main financial indicators to the accounting administrant are: liquidity, profitability and indebtedness. The financial and economic indicators should be considered as tools to the strategic planning and control. Trentin (2009) mentioned that the analysis of organizational performance using indicators, make it possible actions in specific situations, by demonstrating of the strengths and weaknesses of the firms.

Measuring organizational performance is important to represent a benchmarking of the organizations and to compare in relation to the opponents, to the market, globalization, technologies and managerial tendencies. Organizational performance can be measured using many diverse aspects such as: efficiency, efficacy, quality, productivity, quality of life at work, innovation and profitability (SIQUEIRA; ROSA; OLIVEIRA, 2003).

The role of measuring organizational performance on firms depends on the necessity of this practice to the organization, used as a control instrument, with the purpose of making the organizational performance better and many other applications (LIMA; PONTE, 2006).

Methods and measures available to evaluate performance are used according to the expectations of the information of the managers, like financial, economic, social or other (BRAGA; MARQUES, 2000). Teixeira and Amaro (2013) argue that the evaluation of financial performance in organizations is one of the most important perspectives to synthesize the impact of all managers' decision on the capability to create value of the firm to its users.

Kanesiro (2008) differentiates the performance indicators into two types: absolute and relatives or indexes. The absolute financial or non-financial measures are represented by the value of the profit or loses of the exercise, sales volume, and they are measured in terms of absolute values of some specific information. The relative indicators or indexes are the result of the comparison of the average or absolute indicators, as ROA, ROI, and others.

The economic and financial index, according to Matarazzo (2008) is the relation between accountings or the group of them that make it evident some aspects of the economic and financial situation of a firm, found in its economic and financial demonstrations. The evaluation of the economic and financial performance became important to the firms (BORTOLUZZI et al., 2011; ASSAF NETO, 2003; FISCHMANN and ZILBER, 2009, TRENTIN, 2009; SIQUEIRA, ROSA, OLIVEIRA, 2003; LIMA, PONTE, 2006; BRAGA, MARQUES, 2000; TEIXEIRA and AMARO, 2013; KANESIRO, 2008; MATARAZZO, 2008), because it verifies the strengths and weaknesses of the activities. Also is important, according to these authors, as the potential operations or as a way to highlight itself as a group and make higher the profitability of the firm or report lower indices of competition. In this sense, it became necessary to verify the possible operational reasons that can influence the performance, as a way to manager it in an adequate way, to preserve the assets of its users.

2.3 Correlated Studies

In this session, it will be presented studies about technological innovation related to economic and financial performance of Brazilian firms and other countries, which are necessary to confront the results of this research with those studies.

Hall and Bagchi-Sem (2002) analyzed the relation between the measures of innovation and organizational performance of Canadian firms, between 1994 and 1997. Their results provided evidences that the innovation of products presents relation with business performance of analyzed firms.

Marques (2004) studied the impact of innovation on economic and financial performance during the period of 1995 to 2001 of Portuguese manufacturing firms to identify the determinants of the innovation process. To measure economic and financial performance the study used as variables: Operational return result (ORR), return of investment (ROI), Sales growing, resources or total assets growing. As a result, the study provided evidences that innovative firms presented better economic and financial performance than those non-innovative firms did, and that the level of technological intensity of the firm was directly related with the innovation of the firm and its performance. As determinant variables on innovation process, the study verified that the investment in machines and equipment, total investment in innovation, percentage of sales resulting from new products, process innovation and intensity of exportation.

Brito, Brito and Morganti (2009) analyzed the relationship between innovation and the performance of the firms, with Brazilian firms, and using data from Pesquisa Industrial – Inovação Tecnológica from IBGE. They found that innovation variables did not explain the variability of profitability indicators of the firms, but it explained the growing tax of liquid revenues of analyzed firms.

Liao and Rice (2010) proposed and tested a relative parsimonious model that linked firm performance of the firms, innovations and engagement of market with a business model highly regular. For this, they used as innovation variables: R&D (research and development) intensity, intensity of training, intensity of technological production; and performance variables: sales growing and expected sales growing. As they verified that, the firm performance became better when the innovation is present.

Santos, Basso and Kimura (2010) investigated constructs about innovation and also evaluated the intensity of the relationship between innovation and firm performance. Information about innovation of the firms were extracted from PINTEC database, from the years 2000, 2003 and 2005 and data from firm performance were gotten from SERASA and Gazeta Mercantil. The findings of the study validated the information that latent variables previously expected were consolidated into one only variable associated to the capability to innovate.

Kostopoulos et al. (2011) studied the influence of the effect of different external knowledge on the absorptive capability, and tested the direct and indirect effects of absorptive capability on innovations and its financial advantages, from variables of innovation performance and financial performance. As results, they observed that the value of absorptive capabilities as a way to catch superior innovations and financial performance, transformed the external knowledge into related results of performance.

Gunday et al. (2011) explored the effects of the process, product and marketing innovations on the different aspects of performance of the firms, including innovative, production, marketing and financial performance, based on an empirical studied with 184 Turkish firms. As innovation variables, they used: organizational innovations, marketing innovations, process in-

novations, product innovations (each one with its respective variables); and to measure performance, they used: profits/total assets; general profitability of the firm; profits/total sales; cash flow excluding investments. And also, innovative performance of production and marketing performance. Their results provided evidences of positive effects between innovations and performance of the firms.

Horta, Camanho and Costa (2012) analyzed the tendency of results of Portuguese construction firms and they identify factors that promote excellence and innovation on the sector. Their study provided evidences that Portuguese construction industry had notable experience of improvement of performance during years of 1990, but this growing was transformed into performance slower, just on the last years. They concluded that performance of firms is highly influenced by national and economic context and that small specialized companies and big contractors tend to get better levels of performance.

Wang and Wang (2012) investigated the quantitative relationship between sharing knowledge, innovations and performance. They found that the sharing of practices of explicit and tacit knowledge facilitate the innovation and performance, meanwhile tacit knowledge sharing has more significant effects on the quality of innovation and operational performance.

Hashi and Stojic (2013) presented a study that had the objective to compare the determinants of innovation process in mature markets of European West with the transition economy that recently joined the European Union. Their results show a positive relationship between innovation's activities and productivity. Bigger firms tend to develop innovation activities and invest more in innovations, but outputs of innovations presented a negative relationship with the size of the firms. Their results also show important differences on firm's behavior on both groups of countries.

Hung and Chou (2013) proposed in their research to explore the direct and interactive effects in two dimensions of innovation (external technology acquisition and exploration of external technology) on firm performance and to examine the moderator effects of two factors (internal R&D and environmental turbulence) the relationship between the types of open innovation and organizational performance. They found that the acquisition of external technology affects positively on the performance of the firms. Both, external technology and exploration of external technology are positively related to firm's performance over high investment in R&D within turbulent marketing environment. Otherwise, technological turbulence just affects positively the relationship between external technology acquisition, but not the exploration of external technology and firm performance.

On Klinenbert et al. (2013) study, they questioned if ROA and ROE were useful metrics to determine the impact of isolated specific activities with JIT implementation on economic performance. Their results show that the effects of the relationship did not presented consistent relation between ROA, ROE and BEP and tax management of output of inventions. The impact of individual operational strategy is difficult to isolate of other firm's activities as the financial management. So, profitability taxes as ROA, ROE and BEP that aggregate all activities of the firm are not appropriated metrics to determine the effects of JIT/Lean Manufacturing methods on financial performance of the firm.

Santos et al. (2014) had as objective the application of exploratory factors analysis using structural equations modeling and propose constructs that can be associated to innovation phenomena. Using PINTEC data and financial information from SERASA and Gazeta Mercantil, they evaluate the potential relationship between innovations and Brazilian firm's performance. Their

found suggested that the association of innovation investment variables are connected to innovative efforts of a firm and did not significant explain the financial performance. Some observed variables can build a relevant factor associated with the innovation, but the study did not show that the latent factor of innovation had influence the financial performance of the firms.

Finally, the study of Ivanov, Avasilcai (2014) had the objective to identify the key organizational indicators used to measure the innovative process. As variables they used: non-regulated capitalization opportunities; optimization of business opportunities; development of innovative services, use of fusions and joint ventures, use of groups of R&D. As performance variables they verified percentage of not regulated products and services sales, percentage of trading sales, new services sales, percentage of customers served by fusions and joint ventures; NPV of products and services and percentage of R&D in project meeting. Their results provided evidences that the analytic board created by the exploration of key organizational indicators can be used to measure the performance of innovation process.

We evidence the theoretical worries to relate the financial and economic performance of innovative firms. Some analysis such as Hall and Bagchi-Sem (2002); Marques (2004); Gunday et al. (2011); Horta, Camanho and Costa (2012); Hashi and Stojcic (2013) analyzed firms from developed countries. Brito, Brito and Morganti (2009); Santos, Santos and Kimura (2010); Santos et al. (2014) used PINTEC-IBGE data.

In this work, we intend to contribute with the analysis of firms from developing country (Brazil) and provide some evidences about the capability of generating economic and financial results from innovations. Management reports were analyzed using many latent innovation variables as input and as outputs the economic and financial results and canonic correlation, even in a sector that is considered non-innovative such as construction.

3 METHODOLOGICAL PROCEDURES

This study was characterized as descriptive in relation to the objectives, in relation to procedures it is documental and presents quantitative approach. As a way to catch the study objective that was to analyze the influence of economic and financial development over technological innovation of stock open real estate Brazilian firms, we used observation and data description, classification and interpretation making use of precise methods and techniques (ANDRADE, 2002; TRIVIÑOS, 1987).

When we refer about the procedures, this study is classified as documental (RAUPP and BEUREN, 2004) and uses an approach to analyze, organize and provide interpretations of dispersed data. It uses a quantitative method to search and to analyze data (RICHARDSON, 1989).

Construction sector was characterized by Rosseto (1998) as intense in competition and uncertain and then, the adaptations to movements and to the marketing are necessities. So, the managerial perspective needs to shape to new paradigms to make it possible organizational survival. The author describes the sector as intense in peculiarities as great number of firms, composed by people without experience and in some cases without the use of tools as strategic planning that constantly suffer the effects of politics and economic context, and it is very sensitive to financial politics and population savings.

We analyzed a three-year period, from 2011 to 2014 for each of one of 19 firms of construction sector that composed the sample, so 57 observations for each innovation and economic and financial variables were done. Innovation data were collected from managerial report, by full reading of the document and identification of parts that make evident the use of analyzed

variables. Financial and economic data were extracted from Economatica[®]. Construction sector was selected because it is considered a traditional sector, because in more innovative sectors, for example in the pharmaceutical sector, the results tend to be strongly influenced by the innovations and seem evident the influence over the results caught from the innovations. Our intention is to verify how it happens the relations between innovation and performance of firms in a development sector of the country.

3.1 Population and Sample

The population of the study was composed by all construction and transport sectors listed on BM&FBOVESPA. The sample has 19 firms from construction segment listed at BM&FBOVESPA that had the whole information needed for the study published at mentioned source. On the Box 1 it is possible to observe the sample of this study.

Box 1 – Sample of firms from construction sector

CONSTRUCTION FIRMS	
Brookfield Incorporações S.A.	Joao Fortes Engenharia S.A.
Construtora Adolpho Lindenberg S.A.	Mrv Engenharia e Participacoes S.A.
Cr2 Empreendimentos Imobiliarios S.A.	Pdg Realty S.A. Empreend e Participacoes
Cyrela Brazil Realty S.A. Empreend e Part	Rodobens Negocios Imobiliarios S.A.
Direcional Engenharia S.A.	Rossi Residencial S.A.
Even Construtora e Incorporadora S.A.	Sergen Servicos Gerais de Eng S.A.
Ez Tec Empreend. e Participacoes S.A.	Tecnisa S.A.
Gafisa S.A.	Trisul S.A.
Helbor Empreendimentos S.A.	Viver Incorporadora e Construtora S.A.
Jhsf Participacoes S.A.	-

Source: Research data.

3.2 Collect and data analysis

Our data was collected using primary and secondary sources. Primary sources were composed by technological innovation indexes of product, process, position and paradigm proposed by Tidd, Bessant and Pavitt (2008) as the four types of organizational technological innovations.

PINTEC – Pesquisa de Inovação Tecnológica (Technological Innovation Research) was used as orientation to form innovation indexes and then we attributed some frequency analysis for each information followed on management report of sample firms, available at BM&FBOVESPA website. PINTEC is a conceptual basis accepted and internationally consolidated, with comparable results and traditional indicators of motivation and impact that helps on understanding of sectorial strategies (SICSÚ; MELO, 2004).

We used that information available at Management Report as secondary data to extract innovation evidences and economic and financial information of analyzed firms. We collected data using Economatica[®]. The period used to data analysis was the years 2011, 2012 and 2013. We selected this period using the last available during the realization of the research. A three-year period has chosen to make it possible to analyze the tendency curve and to verify some time effect, in which innovation produced in a specific period can reflect in results in future periods. The variables of the study are presented in box 2.

Box 2 – Variables of the study

Variable	Name of variable	Definition	Authors
Dependent 1 st model	Product	Index formed using frequency analysis.	Tidd, Bessant and Pavitt (2008); PINTEC (2005).
Dependent 2 nd model	Process	Index formed using frequency analysis.	Tidd, Bessant and Pavitt (2008); PINTEC (2005).
Dependent 3 rd model	Position	Index formed using frequency analysis.	Tidd, Bessant and Pavitt (2008); PINTEC (2005).
Dependent 4 th model	Paradigm	Index formed using frequency analysis.	Tidd, Bessant and Pavitt (2008); PINTEC (2005).
Variable	Name of variable	Definition	Authors
Independent	ROI	Return on investment	Marques (2004); Gunday et al. (2011); Horta, Camanho and Costa (2012); Kane-siro (2008)
	ROA	Return on assets	Klingenberg et al. (2013); Santos et al. (2014); Kane-siro (2008).
	ROE	Return on earnings	Klingenberg et al. (2013); Santos et al. (2014);
	Sales growing	Variation on sales growing	Marques (2004); Liao and Rice (2010);
	Cash Flow	Sum of operational cash flow, investment and financing.	Gunday et al. (2011);
	Size of the firm	Total assets	Horta, Camanho and Costa (2012); Hung and Chou (2013)
	General liquidity	Circulant assets and non-circulant assets divided by circulant passive and non-circulant passive.	Iudícibus (1998); Matarazzo (2003); Borba (2006); Silva (2008).
	Leverage	Variation on the percentage of earnings per action divided by the variation of percentage of sales.	Barros and Silveira (2008); Gitman (2004); Ferreira (2005).
	Profits per action	Total profits of the firm divided by the amount of actions.	Braga and Marques (2000) and Bortoluzzi et al. (2011).

Source: Research data.

Based on the exposed, as statistical method we apply Multiple Linear Regression to data, and we used panel data and SPSS® software. Variables of our study were composed by two groups of variables: innovation indexes and economic and financial performance, and they were distributed into four innovation indexes and as independent variables to all models, we used financial and economic performance.

The first model used product innovation index as dependent variable, the second model used process innovation index, and the third model used position index and the fourth used paradigm as dependent variable.

On the following session, we will present results of the research to catch the objective of the study: To analyze the influence of economic and financial performance on technological innovations of stock exchange construction Brazilian firms.

4 ANALYSIS AND DISCUSSION OF RESULTS

At this session, the results will be analyzed. Firstly, we will present some results from the application of random test, normality test and homoscedasticity about analyzed data to verify the normality of them. Then, we will discuss the findings from four models of linear regression as a way to catch the proposed objective of this paper.

Table 1 shows the proposed test applied to the analyzed data.

Table 1 – Random, normality and homoskedasticity tests

Assumptions	Tests	Hypotheses
Random	1 st Model <i>Durbin-Watson</i> . Statistics DW = 1,4720 p-value = 0,0146; residual autocorrelation = 0,2640	No autocorrelation of first order between residuals.
	2 nd Model <i>Durbin-Watson</i> : Statistics DW = 1,7521 Valor-p = 0,1865; residual autocorrelation = 0,1240	
	3 rd Model <i>Durbin-Watson</i> : Statistics DW = 1,4094 Valor-p = 0,0069; residual autocorrelation = 0,2953	
	4 th Model <i>Durbin-Watson</i> : Statistics DW = 2,0619 Valor-p = 0,9031; residual autocorrelation = -0,0310	
Normality	1 st Model <i>Shapiro-Wilk</i> : SW Statistics = 0,8802; Valor-p = 0,0001	The distribution of residuals is normal.
	2 nd Model <i>Shapiro-Wilk</i> : SW Statistics = 0,9582; Valor-p = 0,0575	
	3 rd Model <i>Shapiro-Wilk</i> : SW Statistics = 0,9889; Valor-p = 0,8949	
	4 th Model <i>Shapiro-Wilk</i> : SW Statistics = 0,8476; Valor-p = 0,0000	
Homocedasticity	1 ^o Model <i>Levene</i> : F Statistics = 0,0409; Valor-p = 0,8406	The variance of errors is uniform.
	2 ^o Model <i>Levene</i> : F Statistics = 1,5227; Valor-p = 0,2228	
	3 ^o Model <i>Levene</i> : F Statistics = 0,1721; Valor-p = 0,6800	
	4 ^o Modelo <i>Levene</i> : F Statistics = 0,5243; Valor-p = 0,4723	

Source: Research data.

Based on Table 1 it is possible to perceive that Durbin-Watson test attended the assumption of random on the regression procedures and evidenced that there was not autocorrelation between residuals in all analyzed models. According to Marôco (2003), the Durbin-Watson value must be near to 2.

Normality of data was verified by Shapiro-Wilk (S-W) test, that compares the “distribution of accumulated frequency of a group of observed values of the sample with a theoretical or expected distribution” (FÁVERO et al. 2009, p.112). Our analysis provided evidences that the distribution of residuals is normal and do not have problems of data normality. Finally, according to Marôco (2003) Levene’s test verifies the assumption of data homoscedasticity, in which on the fourth analyzed models the variance of the data was uniform.

After running these verifications, four multiple linear regressions were generated, using as independent variables those related to financial and economic performance, and as dependent variable, we used product innovation at first model, process innovation on the second model, position of innovation on third and paradigm on the fourth model. The results of linear regressions are presented on Table 2.

Table 2 – Result of multiple linear regression

Variable	Indexes of divulgation of intellectual capital			
	Product	Process	Position	Paradigm
General Liquidity	-1,962 (0,092)***	0,283 (0,720)	0,590 (0,784)	-1,790 (0,560)
Size	-0,007 (0,989)	0,525 (0,133)	2,026 (0,036)**	1,638 (0,226)
Cash Flow	0,000 (0,404)	0,000 (0,147)	0,000 (0,492)	0,000 (0,541)
ROA	0,265 (0,397)	-0,031 (0,885)	0,178 (0,761)	0,831 (0,321)
ROE	-0,052 (0,244)	0,016 (0,608)	-0,005 (0,954)	-0,011 (0,927)
ROI	-3,266 (0,606)	-3,980 (0,363)	-18,188 (0,131)	-20,040 (0,240)
Leverage	0,010 (0,951)	-0,058 (0,600)	-0,037 (0,901)	-0,197 (0,647)
EPA	-0,087 (0,731)	0,150 (0,391)	0,148 (0,755)	-0,418 (0,538)
Sales Growing	-1,702 (0,499)	-4,588 (0,011)	-9,627 (0,046)**	-11,227 (0,100)
Year 2013	-	-	-	-
Year 2012	-2,816 (0,199)	-3,235 (0,035)**	-19,494 (0,000)*	-9,549 (0,106)
Year 2011	-1,279 (0,548)	-0,140 (0,924)	-9,553 (0,020)**	-6,964 (0,225)
R²	0,155	0,334	0,466	0,194

(*) Significant at 1% level, (**) Significant at 5% level and (***) Significant at 10% level. Absolute value of t-statistic in parenthesis.

Source: Research data.

According to Table 2, financial and economic performance variables such as: General liquidity, size of the firm, and sales growing presented significant relationship with the technological indexes of real estate firms.

Model 1, relates the economic and financial performance with the product innovation index, presented $R^2=0,155$ and level of significance $<10\%$ between general liquidity and product innovation. We observed a negative correlation and statistically significantly between product innovation indexes and the general liquidity index of construction firms. Model 2, presented $R^2 = 0,334$ and provided evidences that economic and financial performance was not statistically significant to express the relationship between process of innovations. We also observed that in 2012, the firms of the sample reduced process innovation investment.

In relation to model 3 we perceived that the size of the firm and the sales growing presented statistically significant relationship (5%) with position innovation index of the firms. Model 3 also presented $R^2=0,466$ and we verified that the bigger the size of the firm, the greater the position index and the biggest the growing of sales, the smaller is the position innovation index of analyzed firms.

We also verified that at the years 2012 and 2011 there was a reduction of position innovation at significance level of 1% and 5% respectively. In relation to model 4, which relates economic and financial indexes with paradigm innovation we verified no significant relationship between variables.

Based on the above, we observed that the greater the general liquidity, the smaller is

the product innovation index. The bigger the firm, the greater the position index, and the biggest the sales growth, the greater the position index of the construction Brazilian firms.

Most of the studies correlated to this research, verified the influence of the innovations over economic and financial performance of the firms. Our objective was to analyze the influence of economic and financial performance on technological innovations of construction firms, our findings are similar to those found by Hashi and Stojcic (2013) when they verify that bigger firms are more propense to develop innovation activities and they invest more in innovations. This study also provides some contributions aligned to the Hall and Bagchi-Sem (2002); Gunday et al., (2022) when they verify the relationship between organizational innovations and performance of firms.

5 FINAL CONSIDERATIONS

The influence of economic and financial performance over technological innovation of stock exchange construction Brazilian firms was studied at this paper to overcome the proposed research objective. After the verification of random, normality and homoscedaskcity criteria, we noticed that: residuals did not present correlation of the first order; the distribution between the residuals is normal and the variance of errors is uniform.

Aligned to Hall and Bagchi-Sem (2002), Marques (2004), Liao and Rice (2010), Santos, Basso and Kimura (2010), which results showed that the innovation presented relation to performance of business, we verify that some economic and financial variables such as: general liquidity, size of the firm, sales growing have a positive and statistically significant with technological innovation indexes of construction Brazilian firms.

We also observed that the greater the general liquidity indexes the smaller the innovation of product index. This fact evidences that firms which present financial stability have small necessity to invest in product innovation, possibly due to the fact of having in its portfolio consolidated products on the market. The greater the size of the firm, the greater the position index and consequently the better the positioning of market of the firm in relation to the portfolio of firm innovations. In addition, the greater the position index of analyzed construction firms, the smaller the sales growing. In this case the firms are already positioned at market and reinforce of positioning requires many actions that did not reflect on economic and financial performance. So, we observed that the performance of construction firms, mainly related to its general liquidity, its asset's size and growth of sales interfere on the propensity of the firms to innovate in a direct or in inverse forms, and it indicates that the innovations can generate economic and financial positive or negative results. The investment in innovations may not be reflected directly in profits in a small period.

Firms with general liquidity and expansion in sales growing, as analyzed at this paper, make smaller investment in innovations. Firms with big structure of assets, according to its total assets, tend to invest more in innovations. As exposed, we perceived that when the construction firms analyzed presented great values of liquidity and sales, that affect the firm results, make the expenses with innovation small, this fact not observed when the firm has its assets in expansion.

As limitations of the present study, we present: the direction of analysis to a specific sector and the quantity of firms that compose the construction sector and the period of analysis limited to three years due to the necessity to analyze all management reports to get data of the variables of sample firms.

Our paper contributes by highlighting the evidences of the relations between innovations and economic and financial results caught by traditional sectors, as considered the construction.

For future studies, it is possible to reply the study of the innovation and the economic and financial results for all the stock exchange firms, separated by sectors that could contribute on the verification of the behavior of innovation of distinct segment.

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