Intangibles as Innovative Drivers for Competitive Businesses

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Abstract

This paper aims to identify the impact of intangible resources as drivers of firms' performance and profitability, in the major technological firms in the world. Using information from the major technological firms for a four years economic period, a set of intellectual capital proxies were identified and regressed against the major performance and profitability indicators. The regression model embodies a set of knowledge-based resources intangible (e.g. goodwill, licenses and patents, software and R&D, and advertising expenses) and human capital proxies, aiming to identify potential disaggregated effects of intangibles those key performance indicators. Broadly, results suggest the existence of effective isolated effect for some variables, in particular for intangibles recognized in the financial reporting. Furthermore, this research also suggests that the capitalization of intangible resources can be associated with region and corresponding accounting standards used in the preparation of the financial reporting.

Keywords: intangibles, intellectual capital, technological firms, R&D, goodwill, accounting standards

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1. Introduction and scope

Intellectual capital has been the focus, over the last decades, of several researches in the knowledge-based economy, with authors attributing to intangibles resources the capacity to generate value for the firm and to achieve competitive advantage capable to enhance business performance and value creation ((Nichita, 2019; Shakina *et al.*, 2017; Lopes and Ferraz, 2016; Kianto *et al.,* 2014; Salehi *et al.,* 2014; Pal and Soriya, 2012; Schiuma *et al*. 2008; Edvinsson and Malone, 1997). Intellectual capital has been considered, in the literature, as the sum of all intangible and knowledge-related resources that an organization is able to use in its productive dynamics in the attempt to create value (Nadeem et al., 2017; Kianto *et al.,* 2014), while the management of intellectual capital is considered to be the process of extracting the value of knowledge, which can generate profit for the organization (Osinski *et al.*, 2017). From an accounting and financial point of view, several methods and tools have been introduced in the theory and practice towards the measurement and valuation of those intangible resources (Fontana et al., 2018; Osinski *et al.*, 2017; Shakina *et al.*, 2017). Furthermore, new developments have also been introduced relating intellectual capital disclosure, based on stakeholders' diversity (Fontana *et al.,* 2018; Castilla-Polo and Ruiz-Rodriguez, 2017). Thus, according to Nichita (2019: 249), "*intensive economy imposes new guidelines for recognition, measurement and reporting of intangibles to ensure to foster the quality of financial reporting and reliability of accounting information for decision-making process*". In fact, managerial decisions for intangibles not only result in a direct impact on the outperforming of companies but also generate certain signals to strategic investors (Machado and Fortunato, 2018; Shakina *et al.*, 2017).

This research aims to contribute to the literature by increasing the knowledge of intangibles and their contribution to organizational performance. It innovates by analysing the major firms in the technological sector, exploring the contextual nature of innovativeness and its relationship with business performance. These innovative driven companies can leverage the knowledge-based approaches, contributing for a framework of experimental value in the context of co-innovation relationships, as suggested by Lehtimaki *et al.* (2018).

The intangibles used in our empirical approach were selected as proxies of intellectual capital in order to conclude on its contribution to financial returns, in particular turnover, as the most direct indicator stated in the intangibles accounting standards. The specific objectives consist of (i) examining the effects of disaggregation of intangibles on performance and (ii) evaluating on what extent the characteristics of the board of directors as

a representation of human capital contribute to businesses' performance and profitability. Thus, this research tries to corroborate the assumption that intellectual capital "*contributes significantly toward firm performance, or firm performance relies on more than just physical capital*" (Nadeem *et al.*, 2017:79).

2. Theoretical background

The concept of intellectual capital has emerged in the scientific literature as "*the ability of a certain organization to transform its knowledge and intangible assets into wealth, as well as value creation*" (Osinski *et al.*, 2017: 471). In the knowledge-based economy, intellectual capital is associated to the intangible resources that cannot be properly measured and reported within the traditional accounting framework (Fontana *et al.*, 2018; Castilla-Polo and Ruiz-Rodriguez, 2017; Nadeem *et al.*, 2017; Salehi *et al.,* 2014; Pal and Soriya, 2012; Schiuma *et al*. 2008; Edvinsson and Malone, 1997). These resources are associated with knowledge, which means that they cannot be measured by traditional approaches due to the non-existence of an active market (Heiens *et al.,* 2007). Accordingly, firms have shifted their focus to intangible assets, whose nature has the ability to permit the creation of a sustainable competitive advantage (Shakina et al., 2017).

Intangibles, from an accounting approach, are expected to generate future economic benefits for the owner, which can be expected to contribute positively to the firm's turnover. Broadly, literature supports their positive and significant effect on organizational performance, considering intangible assets as the main source of competitive advantage for the firms (Bedi, 2019; Nadeem *et al.,* 2017; Sharma and Dharni, 2016; Lopes *et al.*, 2016; Lopes and Ferraz, 2016; Shakina and Molodchik, 2014; Guo *et al.*, 2012; Omil *et al.,* 2011).

Literature about intangibles is strictly linked with the corporate governance literature, as proxies of abilities and expertise. In this scope, some attributes have been emerged, namely the importance of diversity of boards, as an expression of competence, professionalism, skills, knowledge, experience, culture and management abilities, to conduct businesses towards added returns (Lehtimaki *et al.*, 2018; Lopes and Ferraz, 2016; Nath *et al.*, 2015; Wang *et al.,* 2013; Sheikh *et al.*, 2013; Mashayekhi and Bazaz, 2008). The experimental value is leveraged in the context of innovative firms, as stated by Lehtimati *et al.*, (2018:1), confirming that "*experimental value encompasses the subjective, temporal, and contextual aspects of value as well as personal relationships and projects as devices that transfer individuals' value experie3nces between individuals and organisations, and thorough time*".

Board size is an important attribute of board structure and has been widely used as a proxy for human capital, complementary to other boards' characteristics that represent the expertise and tacit knowledge of employees and management parties. Uadiale (2010) conducted a research in order to examine the impact of board structure on corporate financial returns, investigating the composition of boards of directors in Nigerian listed firms. The findings evidence that there is a strong and positive association between board diversity and financial returns, encouraging the firms to have a diversified board in order to improve corporate financial performance.

Amadieu and Viviani (2010) highlight two main methodologies used when approaching the relationship between intangibles and firms' performance. The first one regards the study of investment on intangibles and capital market financial performance measures (such as share returns, holding period returns and Tobin's Q). Alternatively, the second one investigates the relationship between intangible assets and performance measures, which can be mainly financial (return on assets (ROA), return on equity (ROE), return on investment (ROI) or nonfinancial (*e.g.* market share). This literature review will incorporate both approaches, in order to obtain a general appraisal of IC's effect on performance. Osinski *et al.* (2017) have analysed 44 methods of evaluation of intangible assets and intellectual capital. According to those authors, it was possible to identify "*which method is most appropriate for public or private sector companies; or which methods report their experience of practical application and which are theoretical models*" Osinski *et al.* (2017:481).

Intellectual capital leverage is traditionally linked with knowledge-based companies or innovative companies (Bedi, 2019; Carvalho et al., 2019; Lehtimaki et al., 2018; Vicente et al., 2018; Shahin et al., 2017; Li and Wang, 2014; Guo *et al.*, 2012; Omil *et al.,* 2011; Edvinsson and Malone, 1997). Thus, Bedi (2019:328) supports the evidence that "*the contextual nature of innovativeness-business performance relationship and reveal that firms operating in a dynamic environment are more likely to be beneficiated from the pursuit of innovativeness as compared to firms operating in a stable business environment*". Complimentarily, Vicente *et al.* (2018) suggests that the process of developing dynamic capabilities depends on how knowledge and information are manged and acquired by the high-tech industry.

In the 90's, Edvinsson and Malone (1997) state that the core of knowledge-economy is huge investment flows into human capital as well as information technology. In a broader research, Guo *et al.* (2012) assessed the influence of intellectual capital on the performance of 279 biotech firms listed in the US market over the period 1994-2005, discussing the

relationship between intellectual human capital, technology innovation and financial performance. Research and development (R&D) expenditures and patents were considered as part of technology innovation, whereas stock return, ROA and ROE were used as financial performance measures (Fontana *et al.*, 2018). The results evidence that human capital (measured by Chief Executive Officer's (CEO) or Vice President's compensation and their academic background) and R&D expenses, significantly contribute to positive results in financial reports, decreasing performance in terms of cash flow and return on assets. Results also evidence that R&D expenses and human capital, increase future stock returns, enhancing performance in the long term.

Li and Wang (2014) examined the effect of R&D expenses, sales training and employee benefits on Hong Kong's listed Information Technology firms' return on assets. Those researchers defend that return on assets is the most suitable indicator to measure performance, since it correlates overtime with return on equity and return on investment, with the advantage of being the most stable over time. The results evidences that only R&D expenditure and sales training have a positive relation with return on assets, with employee expenses not being significantly correlated with performance.

As research and development may be the most direct indicator to a firm's innovation proxy (Shahin et al., 2017; Omil *et al.,* 2011; Li and Wang, 2014), R&D activities are becoming increasingly important in sustaining firms' competitive advantage. In this regard, Ruiqi *et al.* (2017) examined the relationship between R&D expenditures and future performance in Chinese companies listed on the Main Board of Shanghai and Shenzhen stock exchanges. The multiple regression models' results evidence that R&D expenditures are positively related to firms' future performance measured by Future Operating Performance indicator. The authors argue that R&D expenditures are essential to leverage firms' performance through the reduction of production costs and creation of new products, which constitutes a competitive advantage in a fierce market. This research also concludes for a positive influence of state ownership on the relationship between R&D investments and future performance, defending that a connection with the government helps the improvement in the efficiency of R&D resources.

Lome *et al.* (2016) analysed 247 Norwegian manufacturers in order to evaluate the effect of a high R&D intensity on performance during a financial crisis. Using binary logistic regression, the authors found a very significant relationship between R&D intensity and subsequent growth rates through the late 2000s financial crisis. These results introduce the importance of R&D activities during a financial crisis, defending that managers should

consider it before cutting R&D spending, as it has a long-term effect and may constitute an important competitive advantage when the economy starts to recover. The literature defends that it takes time for a firm's R&D investment to translate on a firm's financial outcome (Li and Wang, 2014). This research also addresses that question, revealing a period of two years since the investment in R&D and the subsequent improved results on revenue. Thus, Lome *et al.* (2016) consolidate the importance of R&D investments for a company on the long-term, underlining the assumption that R&D intensity acts as a form of insurance against future crises, proving that companies that highly invest in R&D activities perform significantly better than the ones that do not, even during recession periods. This conclusion is consistent with Shakina and Molodchik (2014) and Nadeem *et al.* (2016) previous inferences that intangibles are especially important during market instability since they provide most of a company's competitive advantage in the knowledge economy.

Gleason and Klock (2006) investigated whether R&D capital and advertising capital were able to explain the variation of market value (represented by Tobin's Q ratio) for U.S.' chemical companies. The authors found that these measures of intangible capital, especially R&D, have an important and statistically significant role in firm valuation for this industry, particularly in firms established in the market for a longer period of time. Alongside this review, several researches commonly analyse R&D in simultaneous with advertising expenses. Furthermore, previous researches reflect the importance of R&D efforts being aligned with advertising in order to achieve a higher level of performance.

In fact, Sridhar *et al.* (2014) found that for publicly listed U.S. high technology manufacturing firms, R&D spending and advertising spending have a positive and significant impact on firm value when interrelated. A different research conducted by Mizik and Jacobson (2003) found that value creation through R&D in itself, does not enhance firm value and that it is necessary to have value appropriation through advertising in order to achieve sustained competitive advantages. They argue that value creation influences the potential magnitude of the advantage, while value appropriation influences the amount of the advantage the firm is able to capture and the persistence of that advantage in time. The first is driven by innovative activities that rely on the firm's technology capabilities, which are linked to R&D expenditures. On the other hand, value appropriation is associated with a firm's ability to differentiate its offering through advertising. The authors used stock return as a measure of long-term financial performance, influenced by the variation in accounting business performance (through return on assets). Empirically, they found that the stock market reacts favourably when a firm increases its emphasis on value appropriation, even in

the high-technology markets, where innovation and R&D are essential to companies' success (Shahin *et al.*, 2017). These results show that, although R&D can create value through innovation, its effects are only maximized when the firm uses advertising to appropriate part of the value it has created.

A research carried out by Hanssens and Joshi (2010) reinforces the importance of advertising, providing conceptual and empirical evidence of a positive relationship between advertising expenditures and the market value of firms. The authors defend that advertising has, simultaneously, a direct and indirect impact on firm value, which contributes to market capitalization. The direct impact arises from the constitution of the brand. By allowing the company to create its brand image, advertising helps guarantee firm's reputation (Tanfous, 2013). Brand awareness proved to be crucial for investors, as they tend to favour well-known and powerful brand names, which causes long-term effects on firm value. The indirect impact of advertising is due to the consequent increase in the level of sales and profits, which will ultimately be reflected in the company's turnover.

A recent research, conducted by Acar and Temiz (2017), focuses on the association between banks' advertising expenses and the accounting measures of income and profitability of the Turkish banking sector. This research was the first to investigate the long-term effect of advertising on financial performance of banking sector by using Koyck's distributed lag model. The results evidence a positive effect of advertising on interest income, total operating income and return on assets. The authors not only confirmed the contribution of advertising to financial performance, as found a positive effect of advertising that extends over time. These results suggest that advertising expenses hold future economic benefits and, therefore, the authors argue they should be capitalized and then amortized rather than being recognized as a cost when it occurs. Another study that establishes advertising as an increasingly important investment for the firm is the one carried out by Assaf *et al.* (2015). This research analysed 65 Croatian and Slovenian hotels for a six-year period (2007 to 2012) in order to determine the impact of advertising spending on firm performance for the hotel industry. This investigation was conducted using the Bayesian stochastic frontier approach to measure sales performance. This method is widely used in marketing literature as it compares a company's sales performance against its optimal performance while considering competition, which results in a dynamic structure on the sale performance metric. Posteriorly, the effects of advertising were tested and resulted in a positive impact on hotel sales performance. Moreover, results suggest this impact is stronger for large hotels, which explains why advertising is sometimes less effective for some companies. Authors defend that large

companies have a lower cost of advertising per customer and are able to reach a larger number of potential clients with the same advertising expenditure, which does not happen for smaller businesses. This paper reinforces the assumption that increased advertising spending enhances performance, hence should be considered as a significant investment for the firm.

Although the contribution of R&D and advertising is mostly supported in the literature, a few studies dismiss their importance to performance. One of these studies was conducted by Heiens *et al.* (2007) who investigated the contribution of intangible assets and expenditures to shareholder value for 1657 traded manufacturing firms for a six-year period. Defending that the traditional financial measures of performance, such as ROA and ROE, are inadequate in strategically planning decisions, the researchers used market-adjusted holding period returns as the measure of corporate shareholder value. The empirical tests suggest the intangible assets other than goodwill strongly and positively affect the values of this indicator, whereas investments in advertising do not have a significant contribution to the generated long-term financial returns to investors. Additionally, goodwill and R&D expenditures presented a negative impact on this measure of performance. In fact, the more goodwill firms accumulate, the worst impact it has on holding period returns. This may be due to investors not considering the excess of the amount paid to acquire the assets adequate, or the assets not translating the benefits the firms were expecting. In regard to R&D, Heiens *et al.* (2007) defend that these results may be explained by the uncertainty of the future benefits of R&D or by the way markets tend to view the excess spending on intangibles negatively due to the risk involved. Nonetheless, the authors argue that, even though advertising and R&D expenditures negatively affect performance and therefore do not constitute a competitive advantage for the firm, their importance to competitiveness in an industry is undeniable.

A research lead by Tanfous (2013) on 252 non-financial French companies listed on Paris Stock Exchange aimed to demonstrate the aggregated effect of intangibles on value creation and examine whether the sector of the company is associated with intangible activities. The research confirmed the previous assumptions that R&D expenditures and advertising expenses contribute favourably to the value creation of companies when considered aggregately, as well as the participation and training of employees. However, the results differ between activity sectors and demonstrate that the technological sector has a lower investment on intangibles than the industrial and service sectors, although displaying the highest values in advertising expenses and motivation of human resources. This low investment diminishes the intangibles' influence on value creation and this study alerts for

the possibility of a different impact of intellectual capital among industries, with special focus on the technological one.

In this scope, for a sample of 562 companies listed on Frankfurt Stock Exchange and London Stock Exchange, Tudor *et al*. (2014) found that there is a positive and steady relationship between intangible assets and multiple performance indicators (ROA, ROCE, etc.). This relationship seems to suffer structural differences and scale effects when considering distinct sectors or the two markets as a whole. One possible explanation for this fact regards the uncertainty of the sector. It can be argued that in sectors in which intangible assets such as patents, software, trademarks, brands, in-progress R&D, among others, have an important weight in the total value of intangible assets, there is a higher degree of uncertainty and a bigger vulnerability to market conditions. In comparison, sectors in which intangible assets are protected by formal mechanisms (such as customer contracts, licensing and franchising agreements) tend to suffer less from the market's fluctuations.

In their empirical review of the major topics concerning intangible assets, Sharma and Dharni (2016) validate the previous statement regarding the effect of intangible assets on firm performance across sectors. In their research, the authors observed differences in the contribution of intangibles depending on the sector they are inserted, which they believe may be due to the difference in appropriability of intangibles. This appropriability 'may differ on account of the protection regimes available across sectors, nature of intangibles and the tendency of firm to leverage intangibles for business efficiency' (Sharma and Dharni, 2016: 63). A significant relation between intangible assets and organizational performance was found in the biotechnology, pharmaceuticals and IT industries, which have one important thing in common: all are largely R&D and knowledge intensive firms. This conclusion is congruent with a previous deduction of Shakina and Molodchik (2014), stating that an intensive development strategy, which happens when a company decides to conduct its own research and development projects rather than buying new technologies, is positively correlated with value creation. Consistently, the firms from the food and agricultural sectors were found to have a negative relation with financial performance (Sharma and Dharni, 2016).

The current research regards a sample of the major technological companies in the world, with the respective ranking being based on a composite score from equally-weighted measures of revenue, profits, assets and market value (Forbes, 2017). Thus, one can deduct that these companies are high-profitable firms. In this scope, based on the resource-based theory of the firm, Omil *et al.* (2011) evidenced that high profitability firms (HPF) are

strongly focused on their management of intangibles regarding relational factors, innovation activities, and employee productivity. This research suggests that in comparison with non-high profitability companies, HPF's management of intangibles is reflected on their business performance (measured by return on assets). Among structural factors, innovation activities represent a crucial factor for a company to become high profitable (Shahin *et al*., 2017*)*. The study also suggests that 'companies that invest time and resources in developing their business relationships will be able to obtain better business performance rates than others'.

Amadieu and Viviani (2010) explain the variation of the impact of intangibles on performance among industries. They state that the nature of the intangible resources that create competitive advantages is different from one sector to another. Hence, the efficacy of the mechanisms that ensure the appropriation of the value generated by intangible assets is also different among industries.

A different factor that is worth analysing regards the region where a company is located. Diversity has not always been observed in regard to the relation between intangible assets and performance of the firm across different countries. Nevertheless, Sharma and Dharni's (2016) review verified that the majority of studies conducted in the USA, UK, and France establish a negative relationship between the intangible assets and performance of the firm. The authors found no relationship for Israel and Taiwan, while developing countries have shown a positive association with performance, which they justify by arguing that 'firms from developing countries are still having a window of opportunity, while this window may be closing in case of developed nations' (Sharma and Dharni, 2016: 63). Other research found no relation between performance and region (Lopes *et al*., 2016) and, in an investigation on whether the IC value was perceived differently across nations, Inkinen *et al.* (2017) proved the similarity of IC elements across the examined countries, establishing that firms are starting to uniform IC management and, therefore, verify less variation at this level.

This paper will additionally assess the effect of aggregation of intangibles on performance, in light of previous studies carried out by Tanfous (2013) and Lopes and Ferraz (2016). In order to comprehend whether the combination of intangibles has a different impact on performance, these authors conducted researches contemplating two regression models, in which one was represented by the aggregation of intangibles and the other one by their disaggregation, considering intangibles separately according to their typology (goodwill, software, etc.). Their conclusions are similar. Having regressed the theoretical models, a positive and significant correlation between intangible assets and performance indicators was found, considering the first model. Conversely, the analysis of the disaggregated effects

showed the independent variables did not have a significant impact on performance. These results reflect that the integration of different intangible assets leads to more value creation than the individual contribution of each one of them (Tanfous, 2013) and that when intangibles of intellectual capital are aggregated, their synergetic effects increase the performance and profitability of businesses (Lopes and Ferraz, 2016). Nonetheless, for the technology companies, Tanfous (2013) found that the contribution of the different variables has better and more significant results when the variables are considered individually than when aggregated, suggesting the disaggregated effect may be more relevant for this sector.

A less recent, although very relevant study conducted by Chen *et al.* (2005) allowed for interesting conclusions on this topic by exploring the relation between the value creation efficiency and firms' market valuation and financial performance. This study regarding the Taiwanese listed companies used VAIC as the efficiency measure of capital employed and intellectual capital, in order to examine IC's relationship with value creation (using firms' market-to-book value ratios). Two regression models were established concerning (a) the selected aggregated measure of intellectual capital, VAIC, and (b) VAIC's major three components, each representing elements of IC, such as human capital and structural capital, as well as capital efficiency. The authors were able to conclude that firms' intellectual capital has a positive impact on market value and posteriorly examined whether IC is associated with firms' financial performance. Thus, they performed the same models using ROE, ROA, growth in net sales (GR), and net value added per employee (EP) as dependent variables. In a third model, the authors included R&D and advertising expenditures to capture additional IC. Chen *et al.* (2005) verified that VAIC is significantly positive in the financial performance models, suggesting that firms with greater IC perform better in terms of profitability and revenue growth. However, the authors also observed that the explanatory capacity of the disaggregated model was substantially greater than the one in the first model. This means that the three components of IC separately are better than the aggregated measure VAIC in explaining firm value. The authors justify this difference affirming the investors may attribute distinct value to the different components of IC. This assertion was recently assessed by Hussinki *et al.* (2017), who argue that the configuration of IC substantially impacts the subsequent financial performance of the firm. Indeed, their results show that firms which specialize in some aspects of IC tend to achieve higher levels of performance. Moreover, the model containing R&D and advertising expenses reflected an even higher explanatory power than the previous models, with R&D expenses being strongly significant to the increase of performance, while advertising shows a negative impact. Nonetheless, these results underline

the importance of intellectual capital in enhancing firm profitability and revenue growth and highlight the disaggregated effects of intellectual capital in an investor's perspective.

Hence, management of intangibles is a key source of endogenous value creation (Shakina *et al.*, 2017), granting positive signals to investors rather than create sustainable competitive advantages. Thus, to invest in a dynamic reporting process about intangibles, could easily meet all the stakeholders' expectations (Fontana *et al.*, 2018; Castilla-Polo and Ruiz-Rodriguez, 2017).

3. Methodology and methods

3.1. Objectives and data source

The main purpose of this research is to identify the impact of intangibles on performance of the top 25 major technological firms worldwide, in particular as predictors of future economic benefits, in line with international accounting standards about intangibles. The sample was selected considering Forbes' ranking 'World's 25 Biggest Tech Companies' (Forbes, 2018). The financial information used for the research was collected from companies' annual financial statements − specifically from their annual reports, corporate governance reports and proxy statements − which are publicly worldwide disseminated. The financial statements used relates to the period 2013 to 2017, however lagged one economic period for the dependent variables. Based on the 25 firms analyzed, 14 (56%) have their headquarters located in North America, 3 (12%) in Europe and 8 (32%) in Asia. Relating accounting standards, 10 (40%) firms use IFRS in their financial reporting and 15 (60%) use other accounting standards (e.g. SFAS).

3.2. Variables and theoretical framework

The selected dependent variables are TURN, ROA, ROE, ROS, and EPS, in line with literature review (Fontana *et al*., 2018; Osinski *et al.*, 2017; Nadeem *et al.*, 2016; Lome *et al.*, 2016; Pucci *et al.*, 2015; Nath *et al.*, 2015; Li and Wang, 2014; Shidhar *et al.*, 2014; Shakina and Molodchik, 2014; Wang *et al.*, 2013; Sheikh *et al.*, 2013; Amadieu and Viviani, 2010; Mashayekhi and Bazaz, 2008). Turnover is the indicator which is expected to be the most susceptible to significant effects of intangibles, as this measure directly represents the direct economic benefits obtained by firms (Hussinki *et al.,* 2017; Li and Wang, 2014; Tudor *et al.* 2014; Tanfous, 2013; Gan and Saleh, 2008). The assumption of accounting standards that intangibles are associated with future economic benefits will be supported if a positive and significant impact on these firms' turnover is verified.

Broadly, intangible resources must be capitalized (included in the statement of financial position) if they are controlled by the owner, if they are identifiable, and if future returns are expected to flow to the entity. Otherwise, their expenditure must be recognized as an expense (included in the profit and loss statement) when it is incurred, however impacting, as expected, on forthcoming revenues. The variable size of the board of directors was measured through the number of members on the board (Nath *et al.,* 2015; Wang *et al.,* 2013; Sheikh *et al.*, 2013; Uadiale, 2010; Mashayekhi and Bazaz, 2008) and was used, along with the variables board of directors' annual compensation and total number of organization's employees, as a proxy to human capital. This study introduces the variable BDAC as a proxy to human capital which intends to represent the expenses incurred with the members of the board in the period under analysis. This variable intends to quantify the value attributed to the knowledge of a firm's directors. EMP_RD was used due to the assumption that a company is better at value creation if it is more experienced and has more employees involved in R&D activities (Shakina and Molodchik, 2014), representing the intensity of labour in innovative activities.

Since the majority of the companies analyzed are from North America and European and Asian companies represent 12% and 32% of the sample, respectively, region was split into two different blocks: 1. North-American; 2. Other Regions). The purpose is to identify whether the distribution of the IC drivers depends on the region.

As control variables, total assets was used to represent the size of the company, in light of previous studies (Sardo *et al.,* 2018; Li and Wang, 2014; Omil *et al.,* 2011) and leverage as an indicator of the proportion of equity and debt the companies use to finance their assets (Pal and Soriya, 2018; Sardo *et al.,* 2018; Tanfous, 2013; Wang *et al.,* 2013).

Variables were selected and are summarized in Table 1. The time effect was also considered in the theoretical model used in the current research.

Table 1 – Variables description

VARIABLE	DESCRIPTION
$TUR_{i(t+1)}$	Logarithm of firm's turnover in Y_{N+1}
$ROA_{i(t+1)}$	Return on Assets (Net income/Total assets)
$ROE_{i(t+1)}$	Return on Equity (Net income/Shareholder's equity)
$ROS_{i(t+1)}$	Return on Sales (Operating profit/Net sales)
$EPS_{i(t+1)}$	Earnings per Share (Net income/Total capital shares)
GW_{ii}	Logarithm of goodwill recognized in non-current assets
LP_{it}	Logarithm of licenses and patents valuation recognized in non-current assets
$BTRAD_{ii}$	Logarithm of brands, trade names and trademarks recognized in non-current assets
SRD_{it}	Logarithm of software and research and development disbursements
ADV_{it}	Logarithm of advertising expenses
$BDSIZE_{it}$	Size of the board of directors (executive and non-executive members)
$BDAC_{it}$	Logarithm of board of directors' annual compensation
EMP_RD_{it}	Logarithm of number of firm's employees, directly involved in R&D activities
LEV_{it}	Ratio of total book debts to total assets
$SIZE_{it}$	Logarithm of total assets
REG_{it}	Dummy variable: 1. North America; 0. Other regions
$ASTD_{it}$	Dummy variable: 1. IFRS adoption; 0. Other accounting standards
$TIME_{it}$	Dummy variables for each economic year

TUR = Turnover; ROA = Return on Assets; ROE = Return on Equity; ROS = Return on Sales; EPS = Earnings Per Share; GW = Goodwill; LP = Licenses and Patents; BTRAD = Brands, trade names and trademarks; SRD = Software and R&D expenses; ADV = Advertising expenses; BDSIZE = Board of directors; BDAC= Board of directors' annual compensation; EMP_RD = Employees in R&D activities; LEV = Leverage; SIZE = Firm's size; REG = Region; ASTD = Accounting Standards; TIME = Time effects.

3.3. Regression theoretical model

The theoretical model used in this research is described as follows:

$$\hat{Y}_{i(t+1)} = \beta_0 + \beta_1 GW_{i,t} + \beta_2 LP_{i,t} + \beta_3 SRD_{i,t} + \beta_4 ADV_{i,t} + \beta_5 BDSIZE_{i,t} + \beta_6 BDAC_{i,t} + \beta_7 EMP\_RD_{i,t} + \beta_8 LEV_{i,t} + \beta_9 SIZE_{i,t} + \beta_{10} REG_{i,t} + \beta_{10} ASTD_{i,t} + \beta_{11} TIME_{i,t} + \varepsilon_{i,t}$$

$(i = 1, \ldots, 25;\ t = 1, \ldots, 4)$

$\hat{Y}$ = TUR; ROA; ROS; ROE; EPS

This model embodies capitalized and noncapitalized intangible resources, aiming to identify the disaggregated effects of intangibles firms' performance indicators.

Hypotheses

Hypothesis 1 (H1): *Intangible resources have a positive and significant impact on the performance of the world's major technological firms.*

Hypothesis 2 (H2): *Human capital contributes positively to the performance of the world's major technological firms.*

Hypothesis 3 (H3)*: The distribution of the intellectual capital drivers of the North-American region is convergent with the distribution of the intellectual capital drivers of the remaining regions.*

3.4. Model's reliability

The reliability of the three models was assessed through statistical inference. Primarily, it is important to verify the normal distribution of the sample and residuals. According to the Central Limit Theorem, as the sample size gets larger, its means tend to a normal distribution. This is especially true in samples whose size is bigger than 30. Considering that the sample in this study consists of 97 observations, it is assumed that it has a normal distribution. Nevertheless, this assumption was verified in each model's histogram and normal P-P plot of regression standardized residual. Regarding the independence of residuals, the Durbin-Watson test was executed, estimating values approximated to 2, proving there is no autocorrelation between the errors. The homoscedasticity of the residuals was assumed due to the fact that they present a normal distribution and the mean of the residuals is zero. From each model's scatterplot is possible to undertake that the residuals' variance is homogeneous. The assumption of the linear relation between the dependent and independent variables on β coefficients was also assessed for the models through the random distribution of the residuals. Furthermore, the models presented absence of multicollinearity, with Variance Inflation Factor (VIF) assuming values significantly inferior to 10 and tolerance inferior to 1 for each independent variable. This allows concluding that the explanatory variables are not correlated.

4. Results and discussion

4.1. Descriptive measures

Before performing a multivariate analysis, we calculated the descriptive statistics of and a conducted bivariate analysis on the dependent and independent variables in the years under analysis (Table 2 and Table 3, respectively). It is possible to verify that, firms' performance measured through turnover, each firm has registered a mean of 10.57 with 0.87 of standard deviation. Regarding the independent variables, the proxies of human capital reveal a BDAC of, in mean, 14.79 (standard deviation = 1.96) with the board size being constituted by, in mean, 10 people (standard deviation = 2) and firms having a mean of 128,011 employees (standard deviation = 145,405 people). Relating the remaining intangible assets, GW is the one with the higher mean of 8.53 (standard deviation = 1.75) followed by SRD with a mean of 8.22 (standard deviation = 1.21). The variables with lower means are BTRAD and LP, with means of 4.87 (standard deviation = 2.19) and 5.62 (standard deviation = 2), respectively.

Table 2 – Descriptive measures

Variable	N	Minimum	Maximum	Mean	Std. Deviation
TUR	97	8.975	12.362	10.5667	0.8697
ROA	97	-0.135	0.286	0.1034	0.0689
ROE	97	-0.741	1.001	0.1811	0.2093
ROS	97	-0.174	0.705	0.1871	0.1229
EPS	94	-1.310	474.000	18.921	61.304
IA	97	0.000	9.477	7.3237	1.7119
GW	97	2.950	11.122	8.5267	1.7452
LP	76	0.000	9.295	5.6923	1.8986
BTRAD	57	5.493	11.482	8.6435	1.7531
SRD	97	3.440	10.027	8.2238	1.2075
ADV	86	2.079	9.319	6.1889	1.8916
BDSIZE	97	5	15	10.0800	2.2210
BDAC	92	9.307	18.198	14.7883	1.9562
EMP_RD	96	6.342	11.516	8.0921	2.944
LEV	97	0.064	1.134	0.4627	0.2061
SIZE	97	9,262	13.393	11.0866	0.8441

As previously mentioned, Table 3 evidences the bivariate correlations for all variables except for the dependent variables to which the regression model was not globally validated (ROE, ROS, EPS).

4.2. Pearson correlations

Table 3 evidences that all independent variables, except GW (r=0.092; p=0.371) are significant and positively correlated with TUR. However, all independent variables are negatively correlated with ROA. Corroborating the researches carried out by Sridhar *et al.* (2014) and Mizik and Jacobson (2003), a positive relationship was found between SRD and ADV (r = 0.447; p < 0.001). SRD and ADV have a positive and strong correlation with the firms' size (r = 0.703; p < 0.001 and r = 0.557; p < 0.001, respectively), suggesting that larger companies expend more in R&D and advertising. BDAC is positively correlated with the firm's size (r = 0.394; p < 0.001), indicating that larger companies offer a higher annual compensation to their directors. Moreover, and as expected, the size of the firm is positively related to turnover (r = 0.850; p < 0.001) and ROA (r = -0.280; p =0.001), reflecting the scale effects (Fontana *et al*., 2018; Osinski *et al.*, 2017; Nadeem *et al.*, 2016; Pucci *et al.*, 2015; Li and Wang, 2014; Shidhar *et al.*, 2014; Wang *et al.*, 2013; Sheikh *et al.*, 2013; Amadieu and Viviani, 2010).

Table 3 – Main Pearson correlation coefficients

VAR.	TUR	ROA	GW	LP	SRD	ADV	BDSIZE	BDAC	EMP	LEV	SIZE
TUR	1										
ROA	-0.248**	1									
	0.014										
GW	0.092	-0.338***	1								
	0,371	0.001									
LP	0.389***	-0.215*	0.526***	1							
	0.001	0.062	0.000								
SRD	0.562***	-0.476***	0.513***	0.587***	1						
	0.000	0.000	0.000	0.000							
ADV	0.521***	-0.114	0.224**	0.484***	0.447***	1					
	0.000	0.295	0.038	0.000	0.000						
BDSIZE	0.171*	-0.142	0.387***	0.029	0.096	-0.134	1				
	0.094	0.166	0.000	0.807	0.350	0.219					
BDAC	0.246**	-0.224**	0.364***	0.442***	0.541***	0.416***	0.088	1			
	0.018	0.032	0.000	0.000	0.000	0.000	0.405				
EMP	0.387***	-0.067	-0.213**	-0.127	-0.142	0.281*	0.218	-0.123*	1		
	0.000	0.364	0.042	0.219	0.219	0.076	0.284	0.071			
LEV	0.290***	-0.456***	0.186*	-0.142	0.108	0.035	0.274***	0.035	0.262***	1	
	0.004	0.000	0.069	0.220	0.292	0.751	0.007	0.744	0.010		
SIZE	0.850***	-0.280***	0.329**	0.686***	0.703***	0.557***	0.142	0.394***	0.123	0.152	1
	0.000	0.006	0.001	0.000	0.000	0.000	0.165	0.000	0.231	0.137	

Notes: ***p<0.01; **p<0.05; *p<0.1

The theoretical model, representing the disaggregated effects of intangibles, was globally validated for TUR (adjusted R^2 = 96.1%; F = 47.775; p < 0.001) and for ROA (adjusted R^2 = 55.7%; F = 7.690; p < 0.001), as illustrated by Table 4 and Table 5. It was not validated for the other profitability and performance measures, namely ROE, ROS, and EPS.

Table 4 – Regression Model (TUR)

Variable	Coefficient	SE	t-statistic	Sig.
C	0.575	0.705	0.818	0.418
GW_{it}	-0.110	0.024	-0.458	<0.001***
LP_{it}	-0.129	0.033	-0.936	<0.001***
SRD_{it}	0.229	0.047	4.909	<0.001***
ADV_{it}	0.069	0.025	2,788	0.007***
$BDSIZE_{it}$	0.066	0.019	3.445	0.001***
$BDAC_{it}$	-0.021	0.019	-0.114	0.271
EMP_RD_{it}	0.025	0.017	4.418	<0.001***
LEV_{it}	0.162	0.181	0.894	0.376
$SIZE_{it}$	0.784	0.085	9.269	<0.001***
Time Effects			*YES*	
Region Effects			*YES*	
Accounting Standards Effects			*YES*	
R^2	0.961	Mean dependent variable		3.026
Adjusted R^2	0.924	F-statistic		47.775
SE of regression	0.2517	Prob. (F-statistic)		<0.001***
		Durbin-Watson		2.034

Notes: ***p<0.01; **p<0.05; *p<0.1

TUR = Turnover; GW = Goodwill; LP = Licenses and Patents; BTRAD = Brands, trade names and trademarks; SRD = Software and R&D expenses; ADV = Advertising expenses; BDSIZE = Board of directors; BDAC= Board of directors' annual compensation; EMP_RD = Employees in R&D activities; LEV = Leverage; SIZE = Firm's size.

As illustrated in Table 4, GW and LP (capitalized intangibles, recognized in the statement of the financial position) have a negative and statistically significant impact on TUR (β = -0.110; t = -0.458; p < 0.001; β = -0.129; t = -0.936; p < 0.001, respectively) while SRD and ADV (non-capitalized intangibles, recognized in the profit and loss statement) evidences a positive and statistically significant impact on ROA (β = 0.229; t = 4.909; p < 0.001; β = 0.069; t = 2.788; p = 0.007, respectively). Thus, intangibles seem to have a mixed effect on TURN, depending on its capitalization and recognition in the statement of the

financial position. According to international accounting standards, internally generated goodwill is an aggregated amount of all the intangibles that cannot be identified nor separately measured in order to be recognized in the financial statements. Its negative contribution to TURN is congruent with the findings of Heiens *et al.* (2007), who argue that the more goodwill firms accumulate, the worst impact it has on future expected returns. The authors defend that it may be due to the assets not translating the economic benefits the firms were expecting.

The negative or null impact of other intangible assets on TURN is not the most accepted premise in the literature. In fact, these results are not consistent with the commonly positive effect of intangibles on performance, in particular on turnover (Fontana *et al.*, 2018; Osinski *et al.*, 2017; Shakina and Molodchik, 2014; Tudor *et al.,* 2014; Tanfous, 2013; Omil *et al.,* 2011; Heiens *et al.,* 2007), although corroborating the findings of Pucci *et al.* (2015) who found no positive impact of IC measured by intangible assets on turnover.

The model also incorporates some human capital proxies (BDSIZE, BDAC, and EMP_RD). BDSIZE and EMP_RD evidences a positive and statistically significant impact ($\beta = 0.066$; $t = 3.445$; $p = 0.001$; $\beta = 0.025$; $t = 4.418$; $p < 0.001$, respectively) on turnover. Thus, based on the assumption that intellectual drivers have a positive and significant impact, the evidences induce to conclude that H1 is partially not rejected, except for BDAC ($\beta = -0.021$; $t = -0.114$; $p = 0.271$). The negative effect of GW and LP opposes to the observations of Tanfous (2013), who argue that the aggregated measures of intangibles contribute to a better financial performance.

In fact, SRD is the most significant variable to explain TUR. This positive effect reinforces the importance of R&D to performance, being particularly relevant in dynamic environments such as the technological sector. Broadly, "*the contextual nature of innovativeness-business performance relationship supports that firms operating in a dynamic environment are more likely to be benefited from the pursuit of innovativeness as compared to firms operating in a stable business environment*" (Bedi, 2019:328). R&D reflects the innovative activities of the company, which rely on its technology capabilities and are essential to succeed in the technological market. The role of innovation represented by R&D expenses is highly accepted in the literature, with authors defending its positive effect on present and future performance (Lehtimaki *et al.*, 2018; Vicente *et al.*, 2018; Ruiqi *et al.*, 2017; Shahin *et al.*, 2017*;* Lome *et al.*, 2016; Li and Wang, 2014; Guo *et al*., 2012; Omil *et al.*, 2011; Chen *et al.*, 2005) and their contribution to firm value and value creation (Shakina

et al., 2017; Shakina and Molodchik, 2014; Sridhar *et al.,* 2014; Tanfous, 2013; Gleason and Klock, 2006).

Corroborating the researches carried out by Sridhar *et al.* (2014) and by Mizik and Jacobson (2003), a positive relationship was found between SRD and ADV ($r = 0.447$; $p < 0.001$). This correlation enhances the relevance of ADV being aligned with SRD in order to leverage the effect of R&D in the creation of competitive advantage for the firm. As empirically illustrated, ADV contributes significantly to the increase of turnover, which some authors justify by stressing the powerful effect it has on guaranteeing the firms' reputation of well-known and major brands − which is the case in the technological sector − enhancing sales and profits and causing a long-term effect on firm value (Lehtimaki *et al.*, 2018; Tanfous, 2013; Hanssens and Joshi, 2010). Furthermore, SRD and ADV have a positive and strong correlation with the companies' size ($r = 0.703$; $p < 0.001$ and $r = 0.557$; $p < 0.001$, respectively), suggesting that larger companies tend to expend more in R&D and advertising.

As expected, SIZE is positive and significantly correlated with TUR ($\beta = 0.784$; $t = 0.085$; $p = 9.269$), reflecting the scale effects. Furthermore, variables REG, ASTD, and TIME did not evidence any significant impact on the prediction of TUR. These results corroborate the literature by proving that companies with a higher level of assets tend to generate a higher level of turnover, revealing scale effects effects (Fontana *et al*., 2018; Osinski *et al.*, 2017; Nadeem *et al.*, 2016; Pucci *et al.*, 2015; Li and Wang, 2014; Shidhar *et al.*, 2014; Wang *et al.*, 2013; Sheikh *et al.*, 2013; Amadieu and Viviani, 2010). Furthermore, LEV has a positive effect on TUR ($\beta = 0.162$; $t = 0.894$; $p = 0.376$), however not statistically significant.

Table 5 – Regression Model (ROA)

Variable	Coefficient	SE	t-statistic	Sig.
C	0.442	0.118	3.748	<0.000***
GW_{it}	-0.005	0.004	-1.298	0.200
LP_{it}	-0.007	0.006	-1.200	0.235
SRD_{it}	-0.017	0.008	-2.227	0.030**
ADV_{it}	0.008	0.004	1.878	0.066*
$BDSIZE_{it}$	0.005	0.003	1.454	0.152
$BDAC_{it}$	0.002	0.003	0.609	0.545
EMP_RD_{it}	0.003	0.001	0.807	0.423
LEV_{it}	-0.143	0.030	-4.760	<0.001***
$SIZE_{it}$	0.015	0.008	1.027	<0.001***
Region Effects			*YES*	
Time Effects			*YES*	
Accounting Standards Effects			*YES*	
R^2	0.746	Mean dependent variable		0.015
Adjusted R^2	0.557	F-statistic		7.690
SE of regression	0.0443	Prob. (F-statistic)		<0.001***
		Durbin-Watson		1.926

Notes: ***p<0.01; **p<0.05; *p<0.1

ROA = Return on Assets; GW = Goodwill; LP = Licenses and Patents; BTRAD = Brands, trade names and trademarks; SRD = Software and R&D expenses; ADV = Advertising expenses; BDSIZE = Board of directors; BDAC= Board of directors' annual compensation; EMP = Employees; LEV = Leverage; SIZE = Firm's size.

Regarding the key performance indicator ROA, none of the capitalized intangibles (GW and LP) are statistically significant to explain the dependent variable. These results contradict the outcomes achieved by Nadeem *et al.* (2016), Pucci *et al.* (2015), Tudor *et al.* (2014) and by Pal and Soriya (2012), who defend the positive association between intangible assets and ROA.

Regarding the human capital proxies, EMP_RD has a positive impact on ROA (β = 0.003; t = 0.807; p = 0.423), however not statistically significant. This result is a signal that firms with higher intensity of labour achieve better results (Shakina et al., 2017; Shakina and Molodchik, 2014), however ROA is driven by multiple and mix factors, not embodied in a single variable. These evidences do not confirm our hypothesis H2.

Although BDSIZE is not significant to measure ROA, the positive effect on the dependent variable is similar to results found on previous papers (Pal and Soriya, 2012) and

indicates that large boards of directors are more likely to enhance corporate performance measured through ROA. However, these evidences are not aligned with the outcomes provided by Sheikh *et al.* (2013), Nath *et al.* (2015) and Mashayekhi and Bazaz (2008), regarding the association between those two variables.

This research introduces the original variable BDAC as a proxy to human capital which intends to represent the expenses incurred with the members of the board, expecting to quantify the value attributed to the knowledge of a firm's directors. Nonetheless, BDAC was not statistically significant in the prediction of the main dependent variable TUR (rejection of H2) although being positively correlated with it ($r = 0.246$; $p = 0.018$). BDAC fails to represent the importance of board of directors' knowledge and skills to financial profitability and performance. Nonetheless, the positive and significant results regarding BDSIZE corroborate the assumption that an effective board composition is valuable for enhancing firm performance. None of the human capital proxies utilized in this research had a significant impact in the prediction of ROA.

As previously mentioned, SRD and ADV were introduced in this scope in order to capture additional IC, expensed in the profit and loss statement (non-capitalized intangibles). In this scope, H1 is partially rejected for ROA, since SRD presented a negative impact on this variable ($\beta = -0.017$; $t = -2.227$; $p = 0.030$) and ADV evidences a positive and statistically significant impact for a 10% significance level ($\beta = 0.008$; $t = 1.878$; $p = 0.066$). Contrarily to expected, these results are not compatible with the ones obtained by Li and Wang (2014) and Chen *et al.* (2005), who found a positive and strong impact of R&D expenses on return on assets, although being consistent with the study of Guo *et al.* (2012), which revealed a decrease of performance in terms of ROA caused by R&D expenses. The impact of ADV corresponds to the one assessed by Acar and Temiz (2017), who strongly defend the positive contribution of advertising to return on assets. However, as expected, the variable SIZE contributes positive and significantly to the prediction of ROA in the model regressed ($\beta = 0.015$; $t = 1.027$; $p < 0.001$). Relating LEV, the impact on ROA is exactly the contrary of the result achieved for TUR, as LEV evidences a negative influence on this measure of performance ($\beta = -0.143$; $t = -4.760$; $p < 0.001$).

4.3. Region and accounting standards effects

Complimentarily, t-test for equality of means was performed for the two groups of regions under analysis (North America vs. Other regions). Similar approach has been followed for the accounting standards used in the preparation of the financial reporting (IFRS

adoption vs. Other accounting standards). The null hypothesis assumes that the distribution of the intellectual capital drivers of the North-American region is convergent between regions and between accounting standards adoption.

Analysing the outputs, there is statistical evidence to reject H_0 for the variables TUR, GW, LP, SRD, BDSIZE, and control variables SIZE and LEV, proving that these variables evidence multivariate distributions depending on the region (hypothesis H3). In fact, these variables display significantly higher means when considering the North-American region.

From the variables that rejected the null hypothesis, it is possible to observe that TUR has a higher mean in the North-American companies than in the European and Asian ones. Furthermore, all the intangible assets disclosed in firms' financial position, with the exception of BTRAD, reflect a higher mean for North-America in comparison with the non-American region. Relating the human capital proxies, BDSIZE is the only independent variable whose distribution is significantly different between regions, with North-American companies having, in mean, 11 directors on the firm's boards and the remaining firms having, in mean, 9 people in the board. SRD also evidences a higher mean in the case of North-American companies versus the remaining regions, which can reflect a higher investment in research and development in the U.S. firms.

For the capitalized intangibles recognized in the statement of financial position (GW and LP), null hypothesis is rejected, which evidences that the distribution of variables between those regions are not convergent ($t = 7.766$; $df=95$; $p< 0.001$ and ($t = 2.715$; $df=75$; $p= 0.008$). Null hypothesis cannot be rejected for BTRAD ($t = 1.449$; $df=51$; $p= 0.153$. This is also confirmed when comparison is made based on the accounting standards used in the preparation of those financial statements (major Non-American firms use IFRS and North-American firms use US accounting standards). Relating non-capitalized intangibles, null hypothesis is also rejected for SRD ($t = 4.922$; $df=95$; $p< 0.001$) and cannot be rejected for ADV ($t = 0.640$; $df=84$; $p= 0.524$). Relating human capital proxies (BDSIZE, BDAC, and EMP_RD), null hypothesis is rejected for BDSIZE ($t = 5.825$; $df=95$; $p< 0.001$). These new outcomes will certainly support further developments, considered the region dispersion in which firms' headquarters are located, and also considering the accounting standards used in the preparation of the financial reporting.

5. Concluding remarks

The general purpose of this research was to identify the impact of intangibles on the performance of the main technological companies in the world, in order to conclude on the

contribution of intellectual capital to performance, in particular turnover as the most direct accounting outcome. The specific objectives consisted of (i) investigating the effect of intangibles disclosed in firms' financial position on performance; (ii) examining the effects of disaggregation of intangibles on firms' performance and (iii) evaluating on what extent the characteristics of the board of directors as a proxy of human capital contribute to obtain future economic benefits. Furthermore, it was determined whether the distribution of the intellectual capital drivers does depend on the region and on the international accounting standards used in the preparation of the financial reporting.

Through a bivariate analysis, it was possible to conclude that the variable TUR is positive and significantly associated with the intangible assets IA and LP, as well as with all the human capital proxies, BDSIZE, BDAC and EMP. In fact, TUR evidences a high positive correlation with the intangible resources SRD and ADV and a strong positive correlation with the size and leverage of the companies. Contrarily, all the intangibles in this research evidence a negative correlation with ROA. This negative association is also observed in the relationship between ROA and the control variables, SIZE and LEV. The variable SIZE is positively correlated with all the independent variables, reflecting the scale effects.

Multiple linear regression models were realized in order to determine which intangibles have a higher impact on the performance of the world's larger technological firms. TUR is used as the main indicator of economic future benefits, in line with the international accounting standards about intangibles, complemented with the variable ROA. The regression model used embodies intangible assets recognized in the statement of the financial position along with intangible resources expensed in the profit and loss statement (software and R&D expenses and advertising expenses) and human capital, aiming to identify the disaggregated effects of intangibles on key performance indicators. In this model, GW and LP evidence a significant, although negative, impact on TUR, reflecting isolated effects Similarly, the human capital proxy BDSIZE becomes relevant to estimate TUR, suggesting that when considered alongside disaggregated measures of intangibility, the size of board of directors becomes important to enhance expected future benefits. ROA was found to be negatively correlated with every independent variable in this study. This evidence does not correspond to the ones obtained by Omil *et al.* (2011), who verified that high-profitable firms are strongly focused on managing their intangibles, which leads to a greater impact and increase on return on assets. In fact, for the estimation of this indicator of performance, intangibles appear to be irrelevant or negatively associated, which contradicts the positive

impact found by Bedi (2019), Shakina et al. (2017), Nadeem *et al.* (2016), Pucci *et al.* (2015), Tudor *et al.* (2014) and Pal and Soriya (2012).

This paper also assesses whether the distribution of the intangibles (intellectual capital drivers) depends on the region of the company by splitting the sample into two groups and comparing the means of the North-American region with the remaining regions. Results suggest that the distribution of intellectual capital is different among regions for the variables IA, GW, LP, BDSIZE and SRD, as well as for the indicator TUR and control variables. These variables present higher means for the North-American region, which indicates that U.S. companies have higher levels of IA, GW and LP, their boards are generally constituted by more members and they tend to invest more in R&D activities. North American companies also present a higher mean regarding the size and turnover of the business, implying that those firms are larger than European and Asian ones, and have higher levels of economic returns. Furthermore, this research also suggests that the capitalization of intangible resources can be associated with the accounting standards used in the preparation of the financial statements. This evidence can serve as a starting step for further developments on the topic.

Regarding suggestions for future research, it would be interesting to explore other variables as intangibles and human capital proxies in order to determine if it would originate different results for this sample. Moreover, the study would benefit from an analysis over a longer period and for a larger sample, in order to conclude on the impact of intellectual capital on future economic returns, as stated in the international accounting standards about intangibles.

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