

Are financially sophisticated CEO's more efficient when it comes to investing?

Márcio Fernando da Silva¹

 <https://orcid.org/0000-0003-3446-3268>
Email: marciofernandorbi@gmail.com

Rodrigo Oliveira Soares²

 <https://orcid.org/0000-0003-0428-8278>
Email: rosoares@ufpr.br

¹ Universidade Federal do Rio Grande do Sul, Escola de Administração, Porto Alegre, RS, Brazil

² Universidade Federal do Paraná, Setor de Ciências Sociais Aplicadas, Departamento de Administração Geral e Aplicada, Curitiba, PR, Brazil

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ABSTRACT

This study aims to examine the relationship between the financial sophistication (FS) of the Chief Executive Officer (CEO) and the efficiency of corporate investments using empirical analysis in a sample of 189 companies listed on the B3 S.A. – Brasil, Bolsa, Balcão (B3), from 2010 to 2021. Research on the individual characteristics of managers has mainly explored aspects related to decisions on companies' financial policies. Thus, this study seeks to add a new element to the discussion by investigating how these characteristics are related to the efficient use of resources available for investment. By examining the relationship between CEO FS and investment efficiency, it contributes to the discussion in the literature on how manager characteristics affect the way in which decision makers run companies. This adds new insights to the understanding of how the financial skills and individual characteristics of managers can influence organizational performance and results. The research is relevant in presenting the relationship between CEO expertise and investment decisions in the Brazilian market, where the supply of capital tends to be low (financial constraint); consequently, investing more assertively and efficiently has an impact on the organization's results and longevity. Using a proxy that measures investment efficiency, regressions were run using the generalized method of moments (sys-GMM) and multinomial regression. The analyses suggest that CEO FS is related to investment efficiency in several ways. When FS is measured in terms of components, past experience is negatively related to deviations from the optimal level of investment. However, the international component is positively related to such deviations. In addition, a multinomial analysis showed that CEO experience helps reduce the probability of underinvestment, suggesting that an experienced CEO tends to contribute to the efficiency of company investments.

Keywords: experience, education, overinvestment, underinvestment.

Correspondence address

Márcio Fernando da Silva

Universidade Federal do Rio Grande do Sul, Escola de Administração
Rua Washington Luiz, 855 – CEP: 90010-460
Centro Histórico – Porto Alegre – RS – Brazil

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1. INTRODUCTION

Corporate management is essential for the profitability of an organization, as the complexity of the business environment requires decisions aimed at the current and future success of the organization. To this end, the skills and competencies of managers acquired throughout their careers are essential for making quality decisions (Custódio & Metzger, 2014; Michelon et al., 2021). In this sense, organizations with more qualified human capital are more likely to adopt more efficient strategies, which in turn make the business more competitive. Many studies have sought to understand the relationship between the profile of managers and the strategic decisions of firms and how this affects their performance (Custódio & Metzger, 2014; Li et al., 2021; Malmendier & Tate, 2005).

In this sense, the characteristics of managers are fundamental to understanding how the strategies outlined by companies work in one way and not in another (Hambrick, 2018). This idea forms the basis of upper echelons theory (UET), addressed by Hambrick and Mason (1984), which considers the organization as a reflection of its top managers, so that its results are influenced by the values and characteristics of the decision makers. In essence, UET assumes that the characteristics of all members of the top team shape strategic decisions; however, Hambrick's study (2018) shows that the Chief Executive Officer (CEO) has a significant impact on the group's decisions due to the power he or she holds. In other words, according to UET, the individual characteristics of the CEO influence the strategic decisions of companies.

Among the priority strategies of organizations are those that direct the available financial resources, that is, investment decisions. These are a fundamental part of the company's financial decisions, since the efficient allocation of resources tends to affect growth and productive capacity (García-Sánchez & García-Meca, 2018). The factors that determine investment are documented in the corporate finance literature, such as cash flow, growth opportunities, profitability, and leverage, as well as the problems arising from agency conflicts and information asymmetry (Jensen, 1986; Jensen & Meckling, 1976; Myers, 1977). In addition, other factors less explored in corporate investment research may influence investment decisions, such as the skills and ability of corporate management.

Recently, studies in the field of finance have sought to identify the skills of managers, as they affect the optimized use of resources and the achievement of better results in terms of firm performance and efficiency (Gupta et al., 2021). In this sense, quality management tends to make the firm efficient; more specifically, a management with

skills in areas related to investment is expected to provide investment efficiency.

To achieve investment efficiency, firms must undertake all projects with a positive net present value (NPV) and reject those with a negative NPV, with any deviation that leads to overinvestment or underinvestment classified as inefficiency (Biddle et al., 2009). In other words, investment efficiency occurs when the firm invests close to the optimal level according to its future growth opportunities (Yoshikawa, 1980). However, there is a possibility that firms may deviate from the optimal level of investment by investing too much (overinvestment) or too little (underinvestment). This can happen because decision makers miscalculate a project. The efficient allocation of resources therefore depends on the ability of managers to identify the best opportunities and convert them into profitability.

In this context, UET suggests that the behavioral factors and characteristics of CEO's have an impact on strategic decisions (Hambrick & Mason, 1984). Based on this line of reasoning, it is argued that firm investment decisions can be influenced by the characteristics of the CEO, in particular by his or her experience and education, i.e., professional experience and academic education can be drivers for the manager to invest closer to the optimal level, avoiding both underinvestment and overinvestment. For example, less experienced CEO's may ignore the information they have and copy the decisions of previous managers (herd behavior) because they are afraid of being punished by the market and shareholders for their investment decisions (Gan, 2019). This behavior can lead CEO's to overinvest or underinvest (Gan, 2019). On the other hand, experienced CEO's may be more accurate in using the company's own information to evaluate investment opportunities, even if it means going against previous managers.

In this study, it is assumed that various individual characteristics of CEO's, related to specific areas, can be linked to the investments of the companies they manage. These characteristics are grouped into a construct called financial sophistication (FS). FS refers to the set of observable attributes consisting of education (accounting, business administration, and economics; education abroad) and experience (financial industry, CEO's industry, and experience abroad). In this sense, financially sophisticated CEO's are expected to make more efficient investments for a number of reasons: (i) experience in the financial industry or in a financial position can help them to use the company's internal information and decide on a project,

and a background in finance can help them to use more accurate valuation techniques (Gan, 2019); (ii) the CEO's have more knowledge about the economic scenario and the behavior of companies in different periods, which helps to design the best strategy (Custódio & Metzger, 2014); (iii) the company can be more efficient if the manager to different degrees predicts the future demand, understands the industry trends, and thus applies the strategy that best fits the company's objectives (Gan, 2019).

For Custódio and Metzger (2014), CEO's with financial expertise are more likely to be active in managing the company's financial policies, directly influencing the result. Since investment decisions are considered an essential element with a significant impact on performance, it is argued that financially sophisticated CEO's have a greater capacity to make decisions, making investments more efficient. In light of this, this research aims to analyze the relationship between CEO FS and the efficiency of corporate investments.

To this end, regression analyses were carried out in which the dependent variable is a proxy from a model that estimates optimal investment as a function of several variables that determine total investment. The variable of interest is made up of CEO characteristics, tested individually and aggregated using principal component analysis (PCA). The research was carried out using data from 189 companies listed on the B3 S.A. – Brasil, Bolsa, Balcão (B3) between 2010 and 2021.

The results suggest that CEO FS is related to investment efficiency, especially for certain characteristics. When FS is measured in component form (considering PCA scores), past experience contributes to investment efficiency. However, international experience and education seem to reduce efficiency. Furthermore, multinomial analysis showed that experience reduces the probability of

underinvestment. These results show that the presence of an experienced CEO can help reduce the inefficiency of firm investments.

This study contributes to the literature in three ways. First, although previous studies have addressed this issue, they have focused on linking specific characteristics of managers to investment decisions, such as education and career experience (Gupta et al., 2021), financial experience (Custódio & Metzger, 2014; Malmendier & Tate, 2005), and financial education (Ali et al., 2022; Malmendier & Tate, 2005).

Second, research has found that the efficiency with which firms invest their resources is influenced by free cash flow (Richardson, 2006), the quality of financial reports (Biddle et al., 2009), the quality of accounting information (Ren, 2016), government intervention (Chen, Sun, Tang, & Wu, 2011), and corporate governance (Biddle et al., 2009; Chen, Chen, & Wei, 2011; Elberry & Hussainey, 2020), among others. To date, research on the individual characteristics of managers has mainly examined aspects related to corporate financial policy decision making. Thus, this study seeks to add a new element to the discussion by investigating how these characteristics are related to the efficient use of resources available for investment.

Finally, research on CEO characteristics and investment has been conducted in developed countries (Custódio & Metzger, 2014; Li et al., 2021), whose economic characteristics are more harmonized in terms of transparency and governance, and this type of study in emerging economies is less available (Gupta et al., 2021). In addition to economic characteristics, the information asymmetry and supply of credit, among other factors, make Brazil an appropriate location for the study.

2. THEORETICAL FRAMEWORK

2.1 Managers' FS

Traditional finance theories explain organizations' strategic financial decisions primarily from the perspective of financing, investment, and performance. However, there is a growing stream of studies that seek to explain companies' strategic decisions based on the personality of their managers. Hambrick (2018) states that in order to understand the strategies of organizations, it is necessary to understand their strategists. From this perspective, UET is in line with this idea, stating that both psychological aspects, such as values and cognitive bases

(knowledge/assumptions about future events, knowledge of alternatives, and knowledge of the consequences of alternatives), and observable characteristics, such as the age, education, and experience of executives, have a significant impact on business decisions (Hambrick & Mason, 1984; Michelon et al., 2021).

Studies in psychology, management, and finance show that the experiences and skills acquired throughout an individual's professional career have a lasting impact on his or her behavior (Li et al., 2021). The executive's professional experience is a factor that positively or negatively affects corporate performance (Mendes et al., 2019), since the

experience acquired by the executive has throughout his or her career contributes to the interpretation of the corporate scenario, and the choice of strategy to be adopted (conclusion of UET) is consequently reflected in the organization's results.

In addition, education influences the way an individual thinks, acts, and decides (Gupta et al., 2021). According to Mendes et al. (2019), UET is often used in studies that associate education with cognitive ability, which reflects the ability to control resources and risks. Thus, it is reasonable to assume that a manager's decisions are influenced by his or her past experience and academic background. The underlying idea is that education contributes to the ability to generate appropriate solutions for the context. For example, a manager with a good knowledge of financial theory, investment strategies, financing strategies, etc. can help the firm to rely less on internal resources to make investments (sensitivity of investments to cash flow) (Malmendier & Tate, 2005).

2.2 FS and Investment Efficiency

In the finance literature, corporate investments are driven by growth opportunities. The understanding of this aspect lies in the fact that a higher market value indicates that investors believe the firm has opportunities for expansion (Ang & Beck, 2000). In investment studies, growth opportunities are often associated with the concept of the firm's "marginal Q," which represents the relationship between the firm's market value and the replacement cost of its assets (Ang & Beck, 2000; Yoshikawa, 1980).

In this sense, the concept of efficient investment consists of implementing all projects with a positive NPV in a scenario without market frictions, borrowing at the interest rate prevailing in the economy, and returning the excess cash to investors (Biddle et al., 2009; Elberry & Hussainey, 2020). In other words, being efficient means investing at the optimal level in response to the firm's growth opportunities whenever marginal $Q > 1$. However, market frictions can cause firms to deviate from the optimal level of investment by overinvesting or underinvesting, leading to investment inefficiency (Biddle et al., 2009).

This research aims to bring new elements to the discussion on the relationship between managers' decision making and the impact on the company's financial policies. In this sense, the theoretical framework anchored in UET and previous empirical research makes it possible to hypothesize a relationship between managers' individual characteristics and investment

efficiency, specifically education and experience, i.e. the entire background of the CEO running the firm at the time. To date, a few studies have examined specific management characteristics and investment efficiency, including Li et al. (2021), who analyzed the financial experience of members of the top management team. Their results indicate that the financial experience of members reduces investment inefficiency and increases firm performance. In addition, they find a (negative) relationship between managers with financial expertise and the "WACC fallacy," i.e., managers with financial expertise tend to use specific discount rates to value projects in specific departments instead of using the same rate for the entire firm. These findings are consistent with those of Lai and Liu (2017), whose analysis was conducted on members of the senior management team.

In light of the above, the literature provides empirical evidence that managers' skills, knowledge, and experience are positively related to investment efficiency, confirming the theoretical implications of UET and suggesting that the characteristics of top managers have an impact on the firm's results. Therefore, it is argued that the experience and education in the area of finance, as expressed by the CEO's FS, can contribute to the efficient investment of the firm's capital. To this end, we hope to confirm the following hypothesis:

H₁: CEO FS is positively related to firm investment efficiency.

The problems of overinvestment and underinvestment are partly explained by agency theory (Jensen & Meckling, 1976) and asymmetric information theory (Myers & Majluf, 1984), due to conflicts of interest between managers (agents) and owners (principals). In the case of overinvestment, it can occur due to the manager's lack of expertise in evaluating projects, using appropriate techniques, or because he or she does not actively participate in the company's project evaluation policies (Custódio & Metzger, 2014; Gan, 2019). In the case of underinvestment, one of the causes may be that managers fail to properly evaluate the project due to a lack of experience or technical inability on the part of management. These problems imply a deviation from the optimal level of investment desired by shareholders, resulting in inefficiency (Biddle et al., 2009).

Gan (2019) and García-Sánchez and García-Meca (2018) examined the effect of management capacity on investment efficiency in different samples. The results of both studies indicate a positive relationship between management capacity and investment efficiency.

Gan's study (2019) showed that management ability increases (decreases) capital expenditures, acquisition expenditures, and total investments when the company operates in an environment prone to underinvestment (overinvestment). In the same vein, García-Sánchez and García-Meca's study (2018) found similar results regarding managerial ability reducing underinvestment and overinvestment.

In this way, it is understood that the manager's FS can reduce the chances of underinvestment and overinvestment due to his or her lack of expertise in making optimal decisions. Thus, the following hypotheses are proposed:

H₂: CEO FS is negatively related to overinvestment.

H₃: CEO FS is negatively related to underinvestment.

3. METHOD

3.1 Data and Sample

In order to achieve the research objective, companies listed on the B3 between 2010 and 2021 were selected. This period is justified by the adoption of standardized information disclosure on the Reference Form by companies (including the personal data of executive directors), promoted by legislative changes under the S/A Law (Law No. 11,638 of December 28, 2007 and Law No. 11,941 of May 27, 2009), which became mandatory in 2010. From the initial sample of 564 companies, financial industry companies (96), investment funds (147), those with fewer than six observations in the period (123), and those with insufficient CEO data (nine) were excluded. The final sample consisted of 189 firms.

Company financial data were collected from the Refinitiv Eikon[®] database. The information on CEO FS was manually collected from sources that have information on their CVs, in the following order: (i) Company Reference Forms (FREs), under item "12. 5/6 – Composition and professional experience of senior management and the supervisory board"; (ii) websites of companies with an investor relations section; (iii) professional social media platform LinkedIn; (iv) Bloomberg database; (v) Lattes CV; (vi) Internet news and interview portals (*G1*, *O Globo*, *Veja*, *Valor*, *Exame*, and *Estadão*); (vii) Refinitiv Eikon[®] database; and, if it

was impossible to obtain information from any of the above sources, other news websites were searched on the Internet. Despite the use of all these sources for data collection, it was not possible to obtain information on all the CEO's in the sample.

3.2 Description of the Variables Used in the Study

The proxy proposed by Richardson (2006) for calculating company investment efficiency was used as the dependent variable. The principle of the model is that it takes into account the factors that affect the value of the investment, so that the difference between the expected value of the investment and the actual value is used to represent the efficiency of the investment. In addition, this model not only distinguishes between efficient and inefficient investments, but also measures the intensity of inefficiency.

For the expected investments of firm *i* at time *t*, equation 1 is constructed following Richardson (2006), based on the literature on the determinants of investment. It also shows the relationship between investment and growth opportunities, i.e. the expected level of investment as a function of the firm's growth opportunities. Deviations from the expected (optimal) level are characterized as investment inefficiency (Biddle et al., 2009):

$$Inv_{i,t+1} = \beta_0 + \beta_1 TQ_{i,t} + \beta_2 Lev_{i,t} + \beta_3 Cash + \beta_4 Age_{i,t} + \beta_5 Size_{i,t} + \beta_6 Return_{i,t} + \beta_7 Inv_{i,t} + \beta_8 \sum Year + \beta_9 \sum Sector + \varepsilon_{i,t+1} \quad \mathbf{1}$$

where *Inv* is the firm's total investment as measured by the sum of capital expenditures, research and development (R&D) expenditures, and acquisitions minus proceeds from the sale of fixed assets, *TQ* is the firm's growth opportunities as represented by Tobin's Q, *Lev* is the firm's leverage, *Cash* is the availability of cash resources,

Age is the length of time the firm has been listed, *Size* is the firm's size, and *Return* is the return on equity. Investment in the previous year (lagged), which is present in the model, is included to control for individual characteristics of the firms that are omitted from the model (Richardson, 2006).

In addition, it is assumed that total investment is reduced when it is more difficult to raise additional funds to finance new projects (Richardson, 2006), i.e. firms with financial constraints tend to reduce new investment. The effect of the firm's financial constraints is captured by leverage (*Lev*), company size (*Size*), business maturity (*Age*), and cash (*Cash*) (Biddle et al., 2009; Chen et al., 2011; Li et al., 2021; Richardson, 2006). Finally, the effects of the firm's industry (*Sector*) and year (*Year*) are added to the model to capture variations not explained by the other variables.

The absolute values of the residuals generated by the regression were used as a proxy for investment efficiency, such that the lower the value of the residual, the greater the efficiency. A positive residual indicates that the company is investing at a higher rate than expected based on its

growth opportunities, indicating overinvestment. On the other hand, a negative residual means that actual investment is lower than estimated given the growth opportunities, indicating underinvestment (Li et al., 2021; Richardson, 2006).

In order to construct the variable of interest, based on the discussion of CEO experience and education presented in the literature review, we sought to compose the FS construct. For this purpose, data were collected on the observable characteristics of CEO's, the rationale for which is established in UET, as well as in previous studies on these characteristics and company financial policies (Bortoli & Soares, 2021; Custódio et al., 2013; Custódio & Metzger, 2014; Gupta et al., 2021; Malmendier & Tate, 2005). The descriptions of all the variables that make up CEO FS are shown in Table 1.

Table 1
Description of financial sophistication

| Variable | Measurement/description |
|---|--|
| Financial education | Dummy that takes the value of 1 if the CEO has a degree in business administration, accounting, or economics at the undergraduate or postgraduate level (specialization, master's, doctorate, or post-doctorate), and 0 otherwise. |
| International education | Dummy that takes the value of 1 if the CEO has an academic education at universities outside Brazil, at the undergraduate or postgraduate level (specialization, master's, doctorate, or post-doctorate), and 0 otherwise. |
| Financial industry experience | Dummy that takes the value of 1 if the CEO has experience in companies in the financial industry and 0 otherwise. |
| Experience as a financial director | Dummy that takes the value of 1 if the CEO has experience in finance-related positions such as CFO, auditor, controller, or accountant, and 0 otherwise. |
| International experience | Dummy that takes the value of 1 if the CEO has experience in companies outside Brazil and 0 otherwise. |
| Industry experience | Number of years of experience in the same industry as the company in which he or she serves as CEO. |
| Experience as a CEO | Number of years as CEO of the current company. |
| Holds senior positions in other companies | Dummy that takes the value of 1 if the CEO holds senior positions in other companies and 0 otherwise. |

CEO = Chief Executive Officer; CFO = Chief Financial Officer.

Source: Prepared by the authors.

Next, it was necessary to transform the items related to the observable characteristics of CEO's into a smaller number of components representing the construct using the principal component analysis (PCA) technique. This results in common factors representing the behavior of the eight FS proxies shown in Table 1. The goal is to minimize problems of multicollinearity and measurement error when using the original variables.

The scores extracted from the PCA are used as proxies to represent the latent dimensions of the managers' FS in multivariate regression analyses. Each component resulting from the PCA corresponds to a dimension of FS. In addition, an index for a general proxy for FS, the financial sophistication index (FSI), was constructed by taking a weighted sum of the principal components. The results of the PCA are presented in Table 2.

Table 2
PCA results

| Variables | EC | | FC | | IC | |
|------------------------|--------------------|----------|--------------------|----------|--------------------|----------|
| | Loading (ρ) | Score | Loading (ρ) | Score | Loading (ρ) | Score |
| IDE | 0.8424 | 0.55705 | -0.2091 | -0.00947 | -0.0276 | 0.07932 |
| FIE | -0.1565 | 0.00014 | 0.7476 | 0.51499 | -0.1095 | -0.16772 |
| EFD | -0.0830 | 0.06205 | 0.7348 | 0.50792 | 0.0110 | -0.05989 |
| ECE | 0.8704 | 0.60001 | -0.0114 | 0.14295 | -0.1163 | -0.00735 |
| FE | 0.0080 | 0.13971 | 0.6038 | 0.40100 | 0.3571 | 0.24560 |
| IED | -0.1952 | -0.04823 | 0.0908 | -0.02827 | 0.7411 | 0.58430 |
| IEX | 0.0330 | 0.09427 | -0.0249 | -0.07385 | 0.7458 | 0.62065 |
| Eigenvalue | 1.53794 | | 1.51623 | | 1.25940 | |
| SV | 0.2197 | | 0.2166 | | 0.1799 | |
| Cumulative SV | | | 0.6212 | | | |
| KMO | | | 0.5970 | | | |
| Bartlett (p -value) | | | 0.0000 | | | |

Notes: This table shows the application of the principal component analysis (PCA) method to each variable that makes up the financial sophistication index (FSI) with its respective components. The columns show the factor loadings and the scores extracted from the factors that make up the index. The values of the loadings/correlations with their respective components are highlighted in bold. For example, EC is made up of SE and ECE. The eigenvalues and the shared variance are also shown. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's sphericity test indicate the adequacy of the extracted components.

EC = experience component; ECE = experience as a Chief Executive Officer (CEO); EFD = experience as a financial director; FC = finance component; FIE = financial industry experience; FE = financial education; IC = international component; IDE = industry experience; IED = international education; IEX = international experience; SV = shared variance (proportion of the total variance of the data that is explained by each of the components); ρ = Pearson's correlation.

Source: Prepared by the authors.

Table 2 shows the factor loadings and scores for each component of the PCA. To facilitate the interpretation of the results and the next steps in the research, the components were named according to the variables present in each one. The financial component (FC) consists of financial industry experience, as a financial director, and education in finance. The experience component (EC) is made up of industry experience and experience as a CEO. The international component (IC) consists of international experience and international education. The variable "holds senior positions in other companies" was excluded from the analysis as it did not contribute to any of the factors.

It can be seen that the correlation between the original variables that make up each factor and the factor itself is high and positive (highlighted in bold), while the other variables in each component have a low correlation. For example, in EC, the highly correlated variables are IDE and ECE; the others have a low correlation with the factor. As for the shared variance, it can be seen that the three components contribute 0.6162 of the total variables, i.e. the FS factors explain 61.62% of the variance of all seven CEO characteristics.

To continue the analysis, the value corresponding to each of the observations had to be calculated for each of

the components. The FSI was then calculated from the weighted sum of the components and their respective shared variance values according to equation 2. The FSI, like the components, is standardized to have a mean of 0 and a standard deviation of 1.

$$FSI_{i,t} = FC_{i,t} * 0.2197 + EC_{i,t} * 0.2166 + IC_{i,t} * 0.1799 \quad \boxed{2}$$

3.3 Econometric Procedures

To test the research hypotheses, regression models were estimated based on the sample and controlled for various variables that may affect this relationship according to the investment efficiency literature, as shown in equation 3,

$$Efficiency_{i,t+1} = \beta_0 + \beta_1 FinSoph_{i,t} + \sum Controls_{i,t} + \varepsilon_{i,t} \quad \boxed{3}$$

where, for each firm i in year t , *Efficiency* is the absolute value of the residuals from equation 1, *FinSoph* is the CEO's FS, *Controls* is a vector of control variables, and ε is the random error term.

For the data analysis, the panel data regression procedure was used, with estimation using the systemic generalized method of moments (sys-GMM). Although the research question could have been answered with fixed

effects analysis, variables were used that may introduce endogeneity between the estimators. Since panel data analysis assumes the exogeneity of the regressors, violating this assumption can significantly distort the inferences (Barros et al., 2020). Therefore, the first lag of the efficiency proxy variable was included as an instrumental variable in the research models, making the models dynamic.

In addition, following Biddle et al. (2009), the residuals of equation 1 were divided into quartiles, so that the lower quartile (more negative residuals) forms a proxy for underinvestment and the upper

quartile (more positive residuals) forms a proxy for overinvestment. The other quartiles were used as a reference, i.e. they represent the companies that invest closest to the optimal level. For each company, higher absolute values for the proxy indicate greater inefficiency. Similarly, more positive values indicate more severe overinvestment problems (Richardson, 2006), and more negative values indicate more severe underinvestment problems (Biddle et al., 2009; Li et al., 2021). Equation 4 aims to test the probability that firms are underinvesting or overinvesting,

$$Prob_Inefficiency_{i,t+1} = \beta_0 + \beta_1 FinSoph_{i,t} + \sum Controls_{i,t} + \varepsilon_{i,t+1} \quad 4$$

where *Prob_Inefficiency* represents categories of observations according to the criteria mentioned. Specifically, company *i* is assigned a value of 1 if it is below the 1st quartile in year *t* (underinvestment), a value of 2 if it is above the 3rd quartile in year *t* (overinvestment), and a value of 0 if it is in the intermediate quartiles in year *t*.

The procedure used for this analysis was multinomial logistic regression because the dependent variable offers three possible answers. The method predicts the probability of a company being in one of the extreme

quartiles as opposed to the intermediate ones. Thus, the variable of interest is expected to be negatively related to the probability of companies being in one of the extreme quartiles representing inefficiency.

Finally, tests were performed to identify possible problems with heteroscedasticity and serial autocorrelation and multicollinearity [variance inflation factor (VIF) test]. To reduce the impact of outliers, the variables were winsorized at the 1st and 99th percentiles. Table 3 describes all the variables used.

Table 3
Description of the variable

| Description | Operationalization | Sign | Reference |
|------------------------------------|---|------|---|
| Dependent variables | | | |
| <i>Efficiency</i> | Absolute value of the residuals from the Richardson model (2006) | | Biddle et al., 2009; Li et al., 2021; Ren, 2016; Richardson, 2006. |
| <i>Overinvestment</i> | Residuals from the upper quartile of the sample | | Biddle et al., 2009 |
| <i>Underinvestment</i> | Residuals from the lower quartile of the sample | | |
| Variable of interest | | | |
| CEO's FS (<i>FinSoph</i>) | FSI and its main components, as well as the CEO's characteristics | - | Bortoli & Soares, 2021; Custódio et al., 2013; Custódio & Metzger, 2014. |
| Control variables | | | |
| Growth opportunities (<i>TQ</i>) | $\frac{\text{Market value of shares}}{\text{Total assets}}$ | + | Chen, Sun, Tang, & Wu, 2011; Richardson, 2006. |
| Size (<i>Size</i>) | Natural logarithm of net revenue | +/- | |
| Leverage (<i>Lev</i>) | $\frac{\text{Total liabilities}}{\text{Total assets}}$ | +/- | Biddle et al., 2009; Chen, Sun, Tang, & Wu, 2011; Li et al., 2021; Ren, 2016; Richardson, 2006. |
| Tangibility (<i>Tang</i>) | $\frac{\text{Fixed Assets}}{\text{Total assets}}$ | + | |
| Cash availability (<i>Cash</i>) | $\frac{\text{Cash and cash equivalents}}{\text{Total assets}}$ | + | Biddle et al., 2009; Richardson, 2006. |

Table 3

Cont.

| Description | Operationalization | Sign | Reference |
|----------------------------|---|------|---|
| Age (Age) | Years listed | + | Biddle et al., 2009; Chen, Sun, Tang, & Wu, 2011; Li et al., 2021; Ren, 2016; Richardson, 2006. |
| Return on assets (ROA) | $\frac{\text{EBIT}}{\text{Total assets}}$ | + | |
| Earnings management (EM) | Proxy based on the model of Kothari et al. (2005) | - | Kothari et al., 2005 |
| Corporate governance (GOV) | Dummy that takes the value of 1 for a company that is in the new market segment, level 1, or level 2, and 0 otherwise | - | Biddle et al., 2009 |

FSI = financial sophistication index; EBIT = earnings before interest and tax; FS = financial sophistication.

Source: Prepared by the authors.

4. PRESENTATION OF THE RESULTS

4.1 Descriptive Statistics

Table 4 shows the descriptive statistics for all the variables in the study.

Table 4

Descriptive statistics of the research variables

| Variables | Mean | Median | St. deviation | Minimum | Maximum | Obs. |
|--|--------|--------|---------------|---------|---------|-------|
| Panel A – FS characteristics | | | | | | |
| FSI | 0.000 | -0.014 | 1.000 | -2.065 | 3.179 | 2,126 |
| FC | 0.000 | -0.128 | 1.000 | -1.175 | 2.981 | 2,126 |
| EC | 0.000 | -0.192 | 1.000 | -1.760 | 5.003 | 2,126 |
| IC | 0.000 | -0.341 | 1.000 | -1.550 | 2.753 | 2,126 |
| Panel B – Company characteristics | | | | | | |
| Total investment (R\$ million) | -927.9 | -867.0 | 479.2 | -105.2 | 125.4 | 2,126 |
| Age | 14.32 | 12 | 10.41 | 0 | 78 | 2,126 |
| Inv | -0.057 | -0.040 | 0.084 | -0.488 | 0.127 | 2,126 |
| TQ | 4.454 | 2.128 | 6.561 | 0.041 | 36.16 | 2,126 |
| Lev | 0.726 | 0.625 | 0.513 | 0.115 | 3.365 | 2,126 |
| Cash | 0.129 | 0.104 | 0.107 | 0.001 | 0.538 | 2,126 |
| Log of net revenue (Size) | 21.17 | 21.18 | 1.93 | 16.11 | 25.69 | 2,126 |
| Return | 0.152 | 0.037 | 0.572 | -0.775 | 2.676 | 2,126 |
| Tang | 0.254 | 0.214 | 0.215 | 0.000 | 0.827 | 2,126 |
| ROA | 0.059 | 0.063 | 0.093 | -0.282 | 0.323 | 2,126 |
| EM | 0.035 | 0.028 | 0.030 | 0.000 | 0.182 | 2,126 |

Notes: This table shows the descriptive statistics for the characteristics of financial sophistication (FS) and firm characteristics. The description of the calculation of all the variables can be found in Table 3.

Age = time listed; Cash = cash availability; EC = experience component; EM = earnings management; FC = financial component; FSI = financial sophistication index; GOV = corporate governance; IC = international component; Lev = leverage; Q = Tobin's Q; Return = annual stock return. ROA = return on assets; Size = company size; Tang = tangibility.

Source: Prepared by the authors.

Panel A of Table 4 shows the descriptive statistics for the manager characteristics using the FSI and the components extracted from the PCA, while panel B shows the descriptive statistics for the firm characteristics used in the research. Among the FSI and the components, the FSI has the highest median and the international component has the lowest median. As for the maximum and minimum, the FSI has the lowest minimum value, while the professional component has the highest maximum, as well as the greatest distance between them. In terms of financial characteristics, the companies in the sample

invested an average of almost 1 billion (927.9 million) reais between 2010 and 2021. The total investment, weighted by the assets of the previous year, represents an average investment of 5% of the value of the total assets of the companies in the period. The other variables represent the controls used in the research.

In terms of individual characteristics, the sample consists of 452 different CEO's who were in charge of the 189 companies analyzed (considering that there were cases of CEO changes during the period), for the period from 2010 to 2021, as shown in Table 5.

Table 5*Chief executive officer (CEO) statistics*

| Variable | Frequency | Relative frequency (%) |
|-------------------------------------|-------------|------------------------|
| Panel A – Dummy variables | | |
| <i>FE</i> | 230 | 50.9 |
| <i>IED</i> | 146 | 32.3 |
| <i>FIE</i> | 92 | 20.3 |
| <i>EFD</i> | 93 | 20.6 |
| <i>IEX</i> | 89 | 20.0 |
| <i>HSP</i> | 194 | 42.9 |
| Total | 452 | 100.0 |
| Panel B – Variables in years | | |
| | Mean | St. deviation |
| <i>IDE</i> | 22.94 | 11.75 |
| <i>ECE</i> | 6.52 | 9.11 |

ECE = experience as a CEO; EFD = experience as a financial director; FE = financial education; FIE = financial industry experience; HSP = holds senior positions in other companies; IDE = industry experience; IED = international education; IEX = international experience.

Source: Prepared by the authors.

4.2 Multivariate Analysis

Table 6 shows the results of the panel data regression analysis, where the dependent variable is the proxy for investment efficiency.

Table 6*Multivariate analysis results*

| Variables | Efficiency proxy (t+1) (deviations from the optimal investment level) | |
|-------------------------------|--|-------------------------------------|
| | (1) | (2) |
| <i>Efficiency_t</i> | 0.270*** (4.775) | 0.269*** (4.717) |
| <i>FSI</i> | 0.002 (0.487) | |
| <i>EC</i> | | -0.003*** (-2.622) |
| <i>FC</i> | | 0.001 (0.908) |

Table 6
Cont.

| Variables | Efficiency proxy (t+1) (deviations from the optimal investment level) | |
|---------------------|--|----------------------------------|
| | (1) | (2) |
| <i>IC</i> | | 0.004** (2.467) |
| <i>TQ</i> | 0.001 (1.393) | 0.000 (1.215) |
| <i>Lev</i> | 0.001 (0.234) | 0.000 (0.096) |
| <i>Cash</i> | 0.045** (2.055) | 0.047** (2.195) |
| <i>Size</i> | -0.003*** (-2.905) | -0.004*** (-3.591) |
| <i>Tang</i> | -0.001 (-0.144) | -0.002 (-0.288) |
| <i>ROA</i> | 0.061** (2.271) | 0.064** (2.350) |
| <i>EM</i> | 0.001 (0.034) | 0.003 (0.163) |
| <i>Age</i> | -0.000 (-1.622) | -0.000 (-1.383) |
| <i>Constant</i> | 0.075*** (3.733) | 0.090*** (4.408) |
| <i>Year dummy</i> | Yes | Yes |
| AR(1) | -5.885*** | -5.856*** |
| AR(2) | -0.217 | -0.337 |
| Sargan test | 28.11*** | 29.13*** |
| Hansen test | 6.925 | 7.373 |
| Observations | 1,733 | 1,733 |
| Number of companies | 189 | 189 |

Notes: This table presents the results using the systemic generalized method of moments (sys-GMM) procedure in two stages. The dependent variable is the proxy for investment efficiency estimated from the residuals of an ordinary least squares (OLS) linear regression, following the model proposed by Richardson (2006) (equation 1). In model 1, the variable of interest is the financial sophistication index (FSI), while in model 2, the variables of interest are the components calculated from the scores of the principal component analysis (PCA). In this analysis, the dependent variable is used in a first lag ($Efficiency_{t-1}$). The values in parentheses correspond to the z-statistics of the coefficients. Significant coefficients are in bold.

Age = time listed; AR(1) = first-order autoregression; AR(2) = second-order autoregression; Cash = cash availability; EC = experience component; EM = earnings management; FC = financial component; GOV = corporate governance. IC = international component; Lev = leverage; Q = Tobin's Q; ROA = return on assets; Size = company size; Tang = tangibility.

Significance level = *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Prepared by the authors.

As shown in Table 6, the first-order autoregression (AR(1)) and second-order autoregression (AR(2)) tests confirm that the instruments used are valid, and the Hansen test rejects the null hypothesis that the instruments are not exogenous, making the model suitable for analysis. As for the results of the coefficients, the lagged *Efficiency* variable shows significance, confirming the temporal persistence of the firms' investment efficiency.

Regarding the analysis of the coefficients, the results of model 1 show that the *FSI* is not related to investment efficiency, contrary to previous studies (Gan, 2019; García-Sánchez & García-Meca, 2018; Li et al., 2021). However, when analyzing the components that make up the *FSI* in model 2, the experience component (*EC*) has a negative and significant coefficient, indicating that CEO experience has a negative relationship with

the deviation from the optimal level of investment. The international component (*IC*) has a positive and significant coefficient, indicating that CEO's who have an international education and/or experience in companies outside Brazil are positively related to the deviation from the optimal level of investment. The financial component (*FC*) was not statistically significant.

This result shows that the CEO's experience in the industry and his or her length of time at the company seem to contribute to more efficient investments, confirming the propositions based on UET. The negative relationship between the CEO experience component (*EC*) and the proxy suggest that the knowledge acquired throughout his or her career may have contributed to the firm's efficiency, as theorized by UET (Hambrick, 2018; Hambrick & Mason, 1984).

However, contrary to expectations, the relationship between *IC* and investment efficiency may suggest that the manager has a distorted view of international markets based on his or her past experiences and subjective judgments, which may lead to a misperception of the risks and rewards of investing in a foreign market. Carpenter et al. (2003) found that members of the board of directors or senior management who have international experience exhibit risk-seeking behavior in IPOs.

In summary, it can be concluded that some CEO characteristics may contribute to the efficiency of firm investments. According to previous studies (Custódio & Metzger, 2014; Li et al., 2021; Malmendier & Tate, 2005), the expertise derived from CEO's' academic

and professional careers has an impact on the various financial policies of firms. As for the FSI, the results are not significant for the sample and context studied, although the theoretical implications raised indicate the relationship between the construct and investment efficiency. However, according to the regression results, two components that make up the index have inverse signs (negative sign for *EC* and positive sign for *IC*), which is a possible reason for the lack of statistical significance of the index. Therefore, the components of FS support H_1 , while the FSI does not.

The control variables that are significant are consistent with the literature on investment efficiency. Available cash is positively related to deviations from the optimal level of investment, suggesting that firms with more available resources are less efficient. Firm size showed a negative result, indicating that larger firms tend to invest more efficiently, which is consistent with the literature that suggests that they are more closely monitored, so managers tend to act more efficiently and in the interests of shareholders and creditors (Chen, Sun, Tang, & Wu, 2011; Richardson, 2006).

Return on assets (ROA) has a positive coefficient, indicating that higher profitability means investment further away from the optimal level, consistent with Ren (2016), who states that overinvestment is strongly dependent on firm profitability. Finally, the corporate governance, age, and earnings management variables were not statistically significant. Table 7 shows the same econometric procedure for the individual characteristics.

Table 7

Results of the multivariate analysis for the characteristics

| Variables | Efficiency proxy (t+1) (deviations from the optimal investment level) | | | | | | | |
|-------------------------------|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| <i>Efficiency_t</i> | 0.269*** (4.707) | 0.270*** (4.783) | 0.271*** (4.777) | 0.270*** (4.764) | 0.270*** (4.767) | 0.272*** (4.794) | 0.268*** (4.741) | 0.270*** (4.772) |
| <i>IDE</i> | -0.000** (-2.009) | | | | | | | |
| <i>FIE</i> | 0.004 (0.982) | | | | | | | |
| <i>EFD</i> | 0.006 (1.432) | | | | | | | |
| <i>ECE</i> | -0.000*** (-2.910) | | | | | | | |
| <i>FED</i> | 0.001 (0.175) | | | | | | | |
| <i>IED</i> | 0.009*** (2.984) | | | | | | | |

Table 7
Cont.

| Variables | Efficiency proxy (t+1) (deviations from the optimal investment level) | | | | | | | |
|------------------------|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| <i>IEX</i> | | | | | | | 0.008* | |
| | | | | | | | (1.717) | |
| <i>HSP</i> | | | | | | | | -0.002 (-0.892) |
| <i>TQ</i> | 0.001 (1.303) | 0.001 (1.406) | 0.001 (1.395) | 0.001 (1.304) | 0.001 (1.382) | 0.000 (1.226) | 0.001 (1.396) | 0.001 (1.400) |
| <i>Lev</i> | 0.000 (0.064) | 0.001 (0.252) | 0.001 (0.233) | 0.001 (0.219) | 0.001 (0.216) | 0.001 (0.227) | 0.001 (0.245) | 0.001 (0.199) |
| <i>Cash</i> | 0.048** (2.213) | 0.046** (2.128) | 0.046** (2.137) | 0.049** (2.309) | 0.046** (2.112) | 0.046** (2.118) | 0.042* (1.923) | 0.044** (2.048) |
| <i>Size</i> | -0.003*** (-3.054) | -0.003*** (-2.949) | -0.003*** (-2.967) | -0.003*** (-3.459) | -0.003*** (-2.907) | -0.003*** (-3.240) | -0.003*** (-3.095) | -0.003*** (-2.888) |
| <i>Tang</i> | -0.000 (-0.056) | -0.000 (-0.070) | -0.001 (-0.124) | -0.001 (-0.173) | -0.001 (-0.128) | -0.001 (-0.153) | -0.002 (-0.219) | -0.001 (-0.089) |
| <i>ROA</i> | 0.062** (2.279) | 0.062** (2.275) | 0.061** (2.254) | 0.063** (2.361) | 0.061** (2.271) | 0.063** (2.306) | 0.062** (2.294) | 0.061** (2.263) |
| <i>EM</i> | 0.003 (0.170) | 0.001 (0.043) | -0.000 (-0.008) | -0.000 (-0.000) | 0.001 (0.044) | 0.003 (0.130) | 0.000 (0.015) | 0.000 (0.008) |
| <i>Age</i> | -0.000 (-1.340) | -0.000 (-1.428) | -0.000 (-1.477) | -0.000 (-1.336) | -0.000 (-1.587) | -0.000 (-1.459) | -0.000* (-1.734) | -0.000 (-1.507) |
| <i>Constant</i> | 0.083*** (4.036) | 0.074*** (3.712) | 0.075*** (3.751) | 0.086*** (4.389) | 0.075*** (3.741) | 0.080*** (3.978) | 0.079*** (3.896) | 0.075*** (3.768) |
| <i>Year dummy</i> | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| <i>AR(1)</i> | -5.879*** | -5.905*** | -5.884*** | -5.905*** | -5.890*** | -5.861*** | -5.890*** | -5.895*** |
| <i>AR(2)</i> | -0.187 | -0.194 | -0.219 | -0.290 | -0.212 | -0.287 | -0.293 | -0.202 |
| <i>Sargan test</i> | 29.35*** | 28.19*** | 28.23*** | 28.07*** | 28.21*** | 28.28*** | 28.19*** | 28.44*** |
| <i>Hansen test</i> | 7.368 | 6.948 | 6.959 | 6.999 | 6.960 | 7.177 | 6.914 | 7.049 |
| <i>Observations</i> | 1,733 | 1,733 | 1,733 | 1,733 | 1,733 | 1,733 | 1,733 | 1,733 |
| <i>N. of companies</i> | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 |

Notes: This table presents the results using the systemic generalized method of moments (sys-GMM) procedure in two stages. The dependent variable is the proxy for investment efficiency estimated from the residuals of an ordinary least squares (OLS) linear regression, following the model proposed by Richardson (2006) (equation 1). In this analysis, the dependent variable is used in a first lag ($Efficiency_{t-1}$). The table shows the analysis for each of the individual characteristics of the Chief Executive Officers (CEO's) as the variable of interest. The values in parentheses correspond to the z-statistics of the coefficients. Significant coefficients are in bold.

Age = time listed; AR(1) = first-order autoregression; AR(2) = second-order autoregression; Cash = available cash; ECE = experience as a CEO; EDF = experience as a financial director; EM = earnings management; FIE = financial industry experience; FED = financial education; GOV = corporate governance; HSP = holds senior positions in other companies; IDE = industry experience; IED = international education; IEX = international experience; Lev = leverage; Q = Tobin's Q; ROA = return on assets; Size = company size; Tang = tangibility.

Significance level = *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Prepared by the authors.

Table 7 shows that the *IDE* and *ECE* variables have negative signs, while the *IED* and *IEX* variables have positive signs, confirming the previous analysis carried out with the results of the PCA, i.e. the characteristics that make up FS and show a significant relationship are consistent with the procedures used.

In general, the results obtained were expected given the literature on the impact of managers' individual characteristics on investment decisions (Custódio & Metzger, 2014; Hambrick, 2018; Hambrick & Mason, 1984; Malmendier & Tate, 2005). Although few studies have correlated education and experience with investment efficiency, they have shown a relationship in the same direction as that found in the analyses of this study (Ali et al., 2022; Peng & Chiu, 2022). In this study,

these findings are maintained for the analysis of the experience and international components, confirming H_1 : CEO financial sophistication is positively related to firm investment efficiency. As for the FSI, the results do not confirm this hypothesis, since it was not significant in the models.

4.3 Overinvestment and Underinvestment Analyses

Table 8 shows the multinomial logistic regression analysis for three categories of the sample: companies that underinvested, those that overinvested, and the benchmark companies.

Table 8
Inefficiency analysis using multinomial logistic regression

| Variables | Underinvestment | | Overinvestment | |
|-------------|---------------------|------------------------------------|-----------------------|-----------------------|
| | (1) | (2) | (3) | (4) |
| <i>FSI</i> | -0.201 (-0.942) | | -0.060 (-0.305) | |
| <i>EC</i> | | -0.175** (-2.249) | | -0.065 (-0.884) |
| <i>FC</i> | | -0.010 (-0.149) | | -0.036 (-0.544) |
| <i>IC</i> | | 0.064 (0.762) | | 0.081 (1.187) |
| <i>TQ</i> | 0.021 (1.109) | 0.018 (0.996) | 0.058*** (3.316) | 0.056*** (3.195) |
| <i>Lev</i> | -0.051 (-0.313) | -0.060 (-0.374) | -0.635*** (-3.488) | -0.636*** (-3.492) |
| <i>Cash</i> | 2.369*** (2.801) | 2.479*** (2.916) | 2.884*** (4.498) | 2.917*** (4.547) |
| <i>Size</i> | 0.036 (0.608) | 0.017 (0.286) | -0.067 (-1.190) | -0.078 (-1.369) |
| <i>Tang</i> | 0.576 (1.435) | 0.557 (1.398) | -0.997** (-2.034) | -1.005** (-2.040) |
| <i>ROA</i> | 2.708*** (3.205) | 2.894*** (3.378) | -0.684 (-0.734) | -0.586 (-0.625) |
| <i>EM</i> | 1.643 (1.527) | 1.628 (1.507) | 2.617*** (2.612) | 2.638*** (2.609) |
| <i>Age</i> | -0.004 (-0.450) | -0.003 (-0.328) | -0.024*** (-3.073) | -0.025*** (-3.088) |
| <i>GOV</i> | 0.082 (0.352) | 0.064 (0.281) | -0.043 (-0.203) | -0.058 (-0.276) |
| Constant | -2.286* (-1.832) | -1.903 (-1.554) | 1.169 (1.013) | 1.376 (1.179) |

Table 8
Cont.

| Variables | Underinvestment | | Overinvestment | |
|-----------------------|-----------------|----------|----------------|----------|
| | (1) | (2) | (3) | (4) |
| Year control | Yes | Yes | Yes | Yes |
| Sector control | Yes | Yes | Yes | Yes |
| Pseudo R ² | 0.055 | 0.057 | 0.055 | 0.057 |
| LR | 249.4*** | 251.3*** | 249.4*** | 251.3*** |
| Observations | 1,926 | 1,926 | 1,926 | 1,926 |
| No. of companies | 189 | 189 | 189 | 189 |

Notes: This table presents the results of the multinomial logistic regression. The dependent variable is categorical and equals 1 if the firm is below the 1st quartile (underinvestment) of the sample, 2 if the firm is above the 3rd quartile of the sample (overinvestment), and 0 otherwise. In models 1 and 3, the variable of interest is the financial sophistication index (FSI), while in models 2 and 4, the variables of interest are the components calculated from the scores of the principal component analysis. The standard errors were calculated using the data grouped by firm and are robust to all forms of heteroscedasticity and autocorrelation of the residuals. The values in parentheses correspond to the t-statistics of the coefficients. Significant coefficients are in bold.

Age = time listed; Cash = cash availability; EC = experience component; EM = earnings management; FC = financial component; GOV = corporate governance; IC = international component; Lev = leverage; LR = likelihood ratio; Q = Tobin's Q; ROA = return on assets; Size = company size; Tang = tangibility.

Significance level = *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: Prepared by the authors.

Among the components, only EC had a negative and significant sign (model 2), suggesting that CEO's with more professional experience are less likely to underinvest. This result corroborates that obtained in the linear regression analysis, where the EC variable maintains a negative sign with the proxy representing deviations from optimal investment, and provides support for H₃. The final analysis adds the probability component to the interpretation, such that EC not only increases investment efficiency, but also reduces the probability of underinvestment. Consistent with Gan (2019), it can be inferred from this result that prior experience and time in the same firm help the CEO anticipate future changes and identify more profitable investment opportunities, which are then translated into more efficient investments.

In general, this result highlights the importance of experience in mitigating underinvestment and bringing investment closer to the optimal level. In addition, according to the linear regression analysis and the probability analysis, it can be inferred that the experienced CEO contributes significantly, which is consistent with the study by Li et al. (2021), which found that members of the company's top team reduce underinvestment.

As for the controls, the Tobin's Q variable showed a positive sign in relation to overinvestment, suggesting that greater investment opportunities increase the likelihood that these firms will overinvest. This is in line with Jensen

(1986), where firms with greater investment opportunities tend to overinvest, i.e., invest more financial resources than necessary to take advantage of the available opportunities. Leverage, on the other hand, showed a negative and significant sign for overinvestment, in line with the literature in which debt is a mechanism to mitigate overinvestment (Jensen, 1986).

Available cash had a positive and significant sign in all models, indicating that firms with more available cash are more likely to underinvest and overinvest. Indeed, the availability of more cash resources can lead to overinvestment (Jensen, 1986; Ren, 2016; Richardson, 2006). Perhaps what is surprising about the result is that cash resources increase the likelihood of underinvestment. If a firm tends to be bolder when it has available cash and overinvests, it is not plausible that it is missing investment opportunities. However, the analysis may be capturing a dual causality in this relationship, i.e., firms may not invest their resources for various reasons, thereby exacerbating the amount of cash resources.

As for tangibility, it showed a negative and significant sign when analyzed with overinvestment, indicating that greater fixed assets reduce the likelihood of the firm overinvesting. Although the theory postulates that firms with greater fixed assets tend to have more investment expenditures (Biddle et al., 2009), the result indicates that tangibility alleviates the problem of overinvestment, contrary to previous findings (Biddle et al., 2009; Li

et al., 2021). Firm profitability, represented by ROA, has a positive and significant sign for underinvestment, suggesting that profitability is a factor that increases the likelihood of the firm underinvesting.

The earnings management proxy has a positive and significant sign for overinvestment, suggesting that firms that engage in more earnings management are more prone to overinvestment, as found in other research (Biddle et al., 2009; Ren, 2016). This may indicate that managers use earnings management to pursue

investment projects with negative NPVs in line with their interests.

Finally, firm age showed a negative sign for overinvestment, suggesting that firms with more time on the stock exchange are less likely to overinvest. This result is also consistent with the theory that firms with more time on the stock exchange tend to be in the mature or declining stage of the business life cycle, suggesting a reduction in new investment (Chen et al., 2011; Elberry & Hussainey, 2020; Li et al., 2021).

5. CONCLUSION

This study examined the relationship between CEO FS and corporate investment efficiency using empirical analysis in a sample of companies listed on the B3. The evidence suggests that CEO FS is related to investment efficiency in several ways. The experience component (industry and CEO experience) is negatively related to deviations from the optimal investment level, while the international component (international education and experience) is positively related to such deviations. The analyses of the individual characteristics confirmed the results obtained with the index and the components. The financial component and the FSI were not statistically significant.

Regarding the analysis of underinvestment and overinvestment, the experience component decreased the probability of the firm underinvesting. Among the proposed hypotheses, the results provided support for H₁, in which more financially sophisticated CEO's contribute to more efficient investments. In addition, they appear to reduce the likelihood that the firms they lead will underinvest, supporting hypothesis H₃.

From this perspective, this study fits perfectly with the theoretical implications of UET, which emphasizes the crucial influence of managers' background, experience, and knowledge on business decisions (Hambrick & Mason, 1984). Based on the results found, it can be concluded that professional and international experience have a significant impact on the efficiency of firms' investments, confirming various studies in this area (Custódio & Metzger, 2014; Gan, 2019; Li et al., 2021; Peng & Chiu, 2022). These findings highlight the importance of considering these factors when assessing organizational success and performance.

Therefore, this study contributes to the discussion in the finance literature by providing evidence on the relationship between manager characteristics and firms' financial policies. In addition, the findings complement the study by Li et al. (2021) and reinforce the importance of CEO experience and education in investment decisions. Although the financial component has no explanatory power in the analysis, the other CEO characteristics may be crucial for investment efficiency. This is consistent with the findings of the study by García-Sánchez and García-Meca (2018), which highlights how managerial skills can reduce deviations from the ideal level of investment and reduce the likelihood of underinvestment. In the context of a country with significant financial constraints, decisions to invest available resources are extremely important. The CEO's ability to make strategic and efficient decisions can be critical in overcoming financial challenges and maximizing the use of available resources.

The main limitations of the research are related to the proxies used, since in order to measure efficiency, the researchers are at a disadvantage because they do not have access to the information that people in the company have about corporate investment activities. In addition, with respect to the FS proxy, the experience and education of the CEO are limited to the availability of information they provide to the databases, thus limiting the sample. Future research should seek to identify other characteristics of managers that have an impact on the efficiency of corporate investments, such as age, gender, ownership of company stock, among others, which are supported by UET as well as other theories. In addition, there is room to extend this relationship to other financial policies of the firm, such as financing decisions and corporate performance.

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