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# Effects of investment opportunities on firms' financial performance: a fresh look through a dynamic panel approach and multivariate analysis

# Formação Efeitos das oportunidades de investimento no desempenho financeiro das empresas: um novo olhar através de uma abordagem dinâmica de painel e análise multivariada

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**Abstract:** The aim of this study is to investigate the effect of macroeconomic component Investment Opportunities, extracted by the multivariate PCA method, on firms' financial performance. We conducted the analysis following two stages: i) Principal Component Analysis (PCA) to circumvent the multicollinearity problem and identification of the Investment Opportunities variable; and ii) Application of the System Generalized Method of Moments (GMM-SYS) to analyze the relationship between Investment

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Opportunities and firms' financial performance (measured by current and future ROE), dealing with endogeneity. The sample comprises 160 non-financial companies, with quarterly data from 2010 to 2020. We use the PCA method exploratively to identify the first principal component as an explanatory variable in the econometric models. We extracted such component from macroeconomic variables, including GDP variation and activity indexes, confidence, and agents' expectations in Brazilian economy. Finally, we applied the GMM-SYS panel data method. The results showed that the Investment Opportunities variable has a positive and significant effect on companies' financial performance, with persistent effects in future quarters. Furthermore, we demonstrate that financial performance is highly responsive to these opportunities with significant results in all estimated models. This study makes a practical and theoretical contribution by demonstrating how economic conditions are important exogenous drivers of firm performance and competitive advantage.
**Keywords –** Consumer Confidence; Economic Activity; Future Expectations; Growth Opportunities.

**Resumo:** O objetivo deste estudo é investigar a influência do componente macroeconômico Oportunidades de Investimento, extraído pelo método multivariado de PCA, no desempenho financeiro das firmas. A análise foi realizada em duas etapas: i) Principal Componet Analysis (PCA) para contornar o problema de multicolinearidade e identificação da variável Oportunidades de Investimento; e ii) Aplicação do Método dos Momentos Generalizados Sistêmico (GMM-SYS) para analisar a relação entre as Oportunidades de Investimento e o desempenho financeiro das firmas medido pelo ROE atual e futuro, lidando com a endogeneidade. Foi utilizada uma amostra de 160 empresas não financeiras, com dados trimestrais de 2010 a 2020. Utilizou-se de forma exploratória o PCA para a identificação do primeiro componente principal como uma variável explicativa nos modelos econométricos. Esse componente foi extraído a partir de variáveis macroeconômicas, incluindo variação do PIB e índices de atividade, confiança e expectativas dos agentes na economia brasileira. Por fim, aplicou-se o método de dados em painel GMM-SYS. Os resultados apontaram que a variável Oportunidades de Investimento tem efeito positivo e significativo no desempenho financeiro das empresas, com efeitos persistentes em trimestres futuros. Ademais, ficou demonstrado que o desempenho financeiro tem alta responsividade a essas oportunidades, com resultados significativos em todos os modelos estimados. Este estudo contribui com uma demonstração de como as condições econômicas são importantes direcionadores exógenos do desempenho e da vantagem competitiva das firmas.
**Palavras-chave –** Confiança do Consumidor; Atividade Econômica; Expectativas Futuras; Oportunidades de Crescimento.

## Introduction

The strategic Some macroeconomic factors, such as the variation in the Gross Domestic Product (GDP) and other indicators of agents' expectations and economic activity, are important determinants of companies' financial performance. Due to that, empirical studies suggest that such indicators should be included in models that predicts this kind of output (Issah &Antwi, 2017) This is important because, since that relationship exists, financial managers can better understand and use that to prevent losses or take advantage from the different stages of business cycles (i.e. recession or expansion).

However, highly correlated with each other, such factors can cause multicollinearity problems if used simultaneously in regression models (Bonaime et al., 2018; Issah & Antwi, 2017). Reducing the set of variables through multivariate techniques such as Principal Component Analysis (PCA) allows the retention of significant properties from the original data. This approach also makes it possible to use them later in further econometric models in an effective and satisfactory way.

In the scientific literature, some studies have verified the effectiveness of consumer and business confidence indexes in predicting variations in the economic activity level (Easaw & Heravi, 2004; Kwan & Cotsomitis, 2006; Pošta & Pikhart, 2012; Dées & Brinca, 2013). These studies discuss how these components can impact corporate decisions and suggest that they can be employed in macro-level forecasting and firm-level empirical analysis.

The Corporate Finance and Macro Finance literature that discusses investment opportunities is still scarce (Bonaime et al., 2018; Chernavsky, 2018; Graminho, 2015; Issah & Antwi, 2017; Mello & Figueiredo, 2014). To date, no research has investigated the relationship between investment opportunities and firms' performance in the way we have. Both, through the use of Brazilian data and the methodological approach applied, we offer a new perspective on the investigated relationship. In some cases, authors only use isolated macroeconomic factors as control variables in regression analyses (Jesuka et al., 2021; Pamplona et al., 2021; Souza Júnior & Silva, 2021).

According to Boateng et al. (2014), theoretically, capital flow should be higher in countries that offer a favorable environment in terms of macroeconomic attractiveness. This attractiveness is provided

by fluctuations in macroeconomic factors, such as GDP growth, credit supply, price and volatility in the financial market, exchange rate, interest rate, and inflation. Such conditions reflect investment opportunities for firms by reducing negotiation costs and raising the demand for goods and services. Similarly, macroeconomic conditions that offer poor investment opportunities could inhibit firms from doing business. This fact could lead to a blockage in the demand for goods and services with a negative impact on firms' performance (Bonaime et al., 2018).

The Brazilian conjuncture and the macroeconomic environment make it opportune to investigate the effect of these macroeconomic factors on Brazilian companies' performance. In this article, we analyze the period from 2010 to 2020, which is characterized by political, economic and health instability (considering the pandemic peak of COVID-19 in 2020). It is expected that disturbances may have occurred in the Gross Domestic Product (GDP) volatility over the years, as well as in the confidence and expectations of various market participants.

The macroeconomic factors analyzed in this article include the quarterly GDP variation and the Business Confidence Index (BCI), Consumer Confidence Index (CCI), and Composite Leading Indicator (CLI), all retrieved from the OECD (Organization for Economic Cooperation and Development) database. Together, such indicators seek to capture characteristics of economic attractiveness and consumption expectations in the present and future (OECD, 2021a; 2021b; 2021c). Based on Bonaime et al. (2018), we applied Principal Component Analysis (PCA) to extract a component that represents Investment Opportunities at the macroeconomic level. This approach reduces the set of variables and, therefore, solves the multicollinearity problem. Thus, we seek to answer the following question: What is the effect of Investment Opportunities, extracted from the macroeconomic environment, on Brazilian companies' performance?

This study attempts to fill a gap in the literature by analyzing the influence of the macroeconomic component Investment Opportunities on the current and future financial and economic performance of Brazilian companies listed on B3. Despite being a relationship already tested in the literature, this study differs from others by employing the PCA method. This approach offers the advantage of capturing and

examining available macroeconomic information concurrently with GDP variation information. Commonly found in the literature is the use of individual impact analysis of each pre-selected macroeconomic variable. In addition, we have controlled the endogeneity inherent in economic and financial data. It is a problem that can influence results estimated using traditional estimators.

Another contribution of this article is the proposal of using a component extracted from the macroeconomic environment to analyze the relationship between companies' performance and their investment opportunities in the economy. This component can be used as a variable concomitantly and complementarily to the market-to-book index, usually adopted as an individual control for Growth Opportunities of firms in their specificities. Thus, the use of this component can provide a more accurate view of the macro and microeconomic effects that influence corporate financial performance. This variable can capture the investment opportunity at the macroeconomic level (since it is generated from macroeconomic factors) and affects all firms jointly. Therefore, it can help in understanding the origin of firms' competitive advantage.

## Theoretical background

### Macroeconomic Factors and Financial Performance of Firms

There are several variables commonly used in literature to measure the company’s performance such as ROA (return on assets), ROI (return on investments), ROE (return on equity), EVA (economic value added), among others. The origin of firms' performance may be associated with more restrictive and idiosyncratic specific factors, such as industry factors affecting firms in the same value chain or macroeconomic, exogenous, and uncontrollable factors affecting the entire business environment (Killins, 2020; Louzada et al., 2017). Both the most peculiar and exogenous factors interact to determine firms' performance. While micro factors are under management control, which include resources and internal agents' capabilities, macro factors leave firms more susceptible to shocks that relate to economic activity, consumer price indexes, unemployment, tax regulations, and interest rates (Egbunike & Okerekeoti, 2018).

The literature presents several findings that relate macroeconomic factors to the firm's financial performance (Issah and Antwi, 2017; Egbunike and Okerekeoti, 2018; Vieira et al., 2019; Killins, 2020 Hussain et al., 2021). However, new scientific evidences reinforce the existence of simultaneity between both variables groups, or in other words, have demonstrated the accounting (financial) information influence in anticipating movements of macroeconomic indicators, such as GDP growth (Konchitchki & Patatoukas, 2014; Brito, 2017; Louzada, 2017; Silva, 2018; Sekunda, Silva & Paulo, 2020); inflation (Shivakumar & Urcan, 2017; Sekunda et al., 2020) and employment rate (Hann, Li & Ogneva, 2020; Nallareddy & Ogneva, 2017; Sekunda et al., 2020).

The literature investigating the relationship between firm performance and macroeconomic variables of moment is vast. However, little research has focused on analyzing the relationship by controlling for endogeneity problems. Such problems may be caused due to the simultaneity existing between the variables and by the dynamic nature of economic and financial data (Barros et al. 2020). For instance, Egbunike and Okerekeoti (2018) explored the interrelationship between macroeconomic factors, firm specific characteristics, and financial performance of Nigerian firms. Using a static and dynamic panel data, the results were positive and significant when analyzing the relationship between GDP growth rate and firms' financial performance.

Issah and Antwi's (2017) study in the United Kingdom also showed a significant relationship between performance and real GDP. Despite the qualitatively similar results, they relaxed the regressors exogeneity assumption by estimating just a static panel, including dependent variable lags as an explanatory variable.

Mindful of dynamic endogeneity, Vieira et al. (2019) investigated the determinants of Portuguese firms' performance with a focus on identifying which internal, external and institutional factors may influence firms' performance. Among the explanatory variables, the authors used GDP growth and the CCI to explain market and accounting performance, measured by stock returns/Tobin's Q and ROA, respectably. Through GMM modeling, the authors identified that the macroeconomic variables GDP and

CCI are positively significant for explaining the market performance as measured by Tobin's Q), but not firms' financial performance (as measured by ROA).

Although most empirical studies investigating this theme have used ROA as the dependent variable, we consider ROE to be the most appropriate measure for the objectives set out in this research for two main reasons: (1) ROE is a return measure for shareholders who, according to the International Accounting Standards Board (IASB), are the primary financial statements users; (2) it is a metric that has already suffered taxation and managers' financing decisions effects. Thus, the performance perspective to be provided to shareholders from macroeconomic effects combined in ROE, can provide relevant information to users. Therefore, ROE is considered in the literature the most important performance indicator among the others (Martins et al. 2020).

**Investment Opportunities**

Market expectations regarding the moment or scenario, along with financial report disclosures, contribute to the company's market valuation and can influence their performance (Graminho, 2015; Issah & Antwi, 2017; Vieira et al., 2019). Indexes from financial statements, including those of performance, are used for several purposes and contribute to decision-making processes, including being used to predict corporate failure (Beaver, 1966, Altman, 1968; Altman et al., 1977; Ohlson, 1982).

Usually, studies that evaluate growth or investment opportunities employ the market-to-book ratio as a proxy that compares the distance between companies' book value and their market value (Chen & Zhao, 2006). However, the market-to-book ratio may not reflect the entities' real ability to perform effectively, because market value also depends on other subjective factors, such as the various social actors' expectations. In addition, the accounting record still presents a certain degree of conservatism, as for example when recording intangible assets, goodwill, and intellectual capital. This contributes to the gap between book value and market value (Basu, 1997; Gonçalves et al., 2011; Issah & Antwi, 2017; Vieira, 2019).

By considering the recorded equity value and the market value of each company, the market-to-book index is specific to each entity therefore tends to vary among the individuals in the sample over time. This article proposes a measure for "investment opportunities" in the economy, considering market expectation aspects that affect all companies at the same time, that is, without differentiation between individuals. Therefore, given that managers consider investors' expectations when making decisions, Investment Opportunities can provide a market expectations measure in a complementary way to the market-to-book index, providing an accurate scenario view for the various investment possibilities available.

The nomenclature "Investment Opportunities" is based on studies that applied the PCA methodology for extracting a principal component from a highly correlated set of variables (Harford, 2005; Issah & Antwi, 2017; Bonaime et al., 2018; Borthwick et al., 2020). Bonaime et al. (2018) used the term "Investment Opportunities" and "Economic Conditions" interchangeably to refer to the expected profitability of firms' future investment projects based on macroeconomic attractiveness.

Based on Bonaime et al. (2018), the Investment Opportunities variable used in our analysis corresponds to the first principal component extracted from four macroeconomic variables: the variation in quarterly GDP, the BCI, the CCI, and the CLI. The BCI reflects the industrial entrepreneur’s confidence on the economy. It is based on surveys about the production evolution, orders, and inventories of finished goods in the manufacturing sector. OECD publishes this indicator monthly, and it can be used to monitor the economic activity evolution and anticipate oscillations. Its conception results in a standardized indicator that hovers around 100. Values above 100 suggest an optimistic perception of entrepreneurs regarding future business performance and numbers below 100 indicate the opposite (OECD, 2021a).

The CCI works as a trend indicator that aims to provide an indication of future developments in household consumption and savings (OECD, 2021b). It is based on surveys of consumers' perceptions of their expected financial situation, sentiment about the general economic situation, unemployment, and savings capacity. Like the BCI, the CCI above 100 indicates increased confidence of consumers regarding

the future economic situation, being more inclined to consume than to save in the next 12 months (OECD, 2021b).

Lastly, the CLI indicates early turning points in economic activity, since the phases and patterns of this indicator are likely to be followed by business cycles (OECD, 2021c). It shows the economic activity fluctuation around its long-term average trend standardized to the value of 100. Thus, fluctuations above this trend anticipate a warming economic activity, or an economic downturn, otherwise (OECD, 2021c).

For producing economic trend signals very quickly, usually in the same data collection month, the variables mentioned are widely used as antecedent economic activity indicators, which are essential tools for entrepreneurs, and governments when analyzing the conjuncture and making decisions (Graminho, 2015; Chernavsky, 2018). Therefore, we assume that confidence indexes are ahead of macroeconomic variables in time. We also assume that the confidence indexes inclusion increases the consumption and industrial production predictability, even including control variables often used in the literature (Melo & Figueiredo, 2014; Graminho, 2015). In this perspective, macroeconomic factors and agents' expectations are important determinants of firms' performance (Issah & Antwi, 2017; Vieira et al., 2019).

Mello and Figueiredo (2014) based on the evaluation of mean square errors, analyzed the univariate autoregressive model's ability to predict the level of activity in the current period (month or quarter) and in a period ahead. The analysis compared those results to similar forecasting models for these same variables but including confidence indices. The results show that including the Industrial Confidence Index (ICI) improves the univariate model's accuracy in predicting economic activity.

Graminho (2015) analyzed the predictive power of the ICI and the CCI through Granger causality test and joint parameter significance tests in simple models for forecasting total consumption in the national accounts and industrial production. Their results showed that the indexes precede the macroeconomic variables. In addition, their inclusion contributed to the consumption and industrial production predictability. With a Kalman filter they estimated a "sentiment" variable of agents based on

the portion of confidence indexes unrelated to macroeconomic variables usually used in forecasting models. They observed that including the filter in these models increased their predictive power.

Chernavsky (2018) sought to assess the confidence indices predictive power through joint significance tests of the lagged index parameters and the adjusted $R^2$ determination coefficient analysis. The within-sample predictive performance indicated that the industrial and consumer confidence indices and their components contribute to forecasting the industrial production and retail sales evolution. However, the contribution was shown to be very heterogeneous according to the index and component analyzed.

Nevertheless, it is debatable whether the information contained in confidence indexes could already be present in other economic indicators, causing the endogeneity problem. Naturally, confidence indexes have relationships with labor income, unemployment, and production. However, financial indicators such as interest rates and stock prices may similarly already contain information like that provided by confidence indexes (Mello & Figueiredo, 2014; Graminho, 2015; Chernavsky, 2018). Therefore, there is opportunity to apply techniques such as PCA that can retain the significant and common properties through the linear combination of a variables set that carry such expectations.

Given the arguments presented in the literature review and the previous empirical evidence, we test the following research hypotheses:

*H1: There is a positive and significant relationship between investment opportunities and the actual financial performance of Brazilian companies listed on B3.*

*H2: Investment opportunities can persistently influence the financial performance of Brazilian firms for future periods.*

## Methods

### Sample and Data Collection

We collected quarterly firm-level data from a sample of 160 publicly traded non-financial firms listed on the Brasil, Bolsa, Balcão (B3). We excluded the financial sector firms from the sample due to

differences in their regulation and financial statement structure. The sample derives from a previous filter performed in the Economatica® database, which considered a total of 309 non-financial companies, from the fourth quarter of 2010 to the third quarter of 2020 (the last date with available data at the time of collection). From this total, we excluded 149 companies since they had uncovered liabilities or did not publish financial statements at some point in the period. Macro-level data for the formation of the variable "Investment Opportunities" were extracted from the OECD database (https://data.oecd.org).

**Multivariate Analysis and Econometric Method**

To avoid multicollinearity problems in the regression analysis, we applied the multivariate method of Principal Component Analysis (PCA), reducing the dimensionality of the four proxies for Investment Opportunities by extracting their first principal component. According to Hair et al. (2009), this technique is used when one intends to summarize most of the original information in a minimum number of components. The extracted factor should both explain most of the total variance represented in the original variables set and can be used in forecasting techniques. To verify the number of components to be extracted, the "latent root" or "eigenvalue" criterion may be used, in which components with this measure greater than 1 are used.

We constructed the variable taking as guidance the studies by Bonaime et al. (2018) and Borthwick et al. (2020). For this construction, we employed macro-level variables that reflect expectations of future conditions in the economy. Each of them individually measures specific dimensions of those conditions but are typically highly correlated with each other. The variables employed were: (i) Business Confidence Index - BCI; (ii) Consumer Confidence Index - CCI; (iii) Composite Leading Indicator - CLI; and (iv) variation in Gross Domestic Product. All variables are released by the OECD. The first three indexes are released monthly. Therefore, we considered each quarter average to coincide with the periodicity of our analysis. Thus, we applied PCA with the four variables throughout the analyzed period, totaling 40

quarters. After extracting the first principal component, its representative score is created for each observation.

To verify the investment opportunities effect on firm performance, we conducted regression analyses using panel data estimations based on the system Generalized Method of Moments (GMM) (Blundell et al., 2001). This is a dynamic model for panel data as it incorporates lags and/or time differences of the input variables (Barros et al., 2020). Thus, we can mitigate problems commonly found in corporate data such as the simultaneity between the dependent and independent variables and others that lead to not meeting the assumption of regressors exogeneity (Barros et al., 2020). This method is fundamental when one seeks to estimate causal relationships from dynamic variables with financial data, such as leverage, liquidity, financial and market performance. Without its proper treatment it is unlikely that these data will generate consistent estimators even with the use of external instrumental variables (Barros et al., 2020).

System GMM can circumvent these problems and offer consistent estimations as long as its assumptions are met: Absence of multicollinearity among the regressors, checked by the VIF statistic (Wooldridge, 2019); regressors stationarity, checked by Fisher's unit root test; absence of second-order serial autocorrelation in the residuals, checked by the Arellano-Bond test; exogeneity of the instruments, checked by the Sargan-Hansen test (Arellano & Bond, 1991); the additional instruments validity (of the system GMM), checked by the Dif-Hansen test (Roodman, 2009). We presented the the diagnostic test statistics in the results section.

Roodman (2009) presents some reasons for employing the GMM modeling: ii) "short panel", i.e., T<N; ii) linear functional relationship; iii) the dependent variable is dynamic, and has feed-back from its past value; iv) the independent variables are not strictly exogenous meaning that they are correlated with past variables and with the error term; v) individual fixed effects; vi) heteroscedasticity and autocorrelation within the sample group, but not between them.

Therefore, the conditions and data structure that we used in this research justify the application of system GMM. Moreover, this methos has been used in studies with similar proposals (Killins, 2020; Hussain et al., 2021). The following subtopic presents more details about the estimated empirical model.

**Empirical Model Specification and Variables**

The dependent variable we use as a proxy for firms' financial performance is the Return on Equity (ROE). The financial performance dimension can be measured from several perspectives, resulting from managers' strategic choices and the resources selected to compete in the industry (Louzada et al., 2017; Barney & Hesterly, 2018). Most empirical studies that have investigated this theme use Return on Assets (ROA) as the dependent variable. However, we believe that ROE is the most appropriate measure for our investigation. Among the aspects previously presented, this is a metric that has already suffered the effect of taxation and managers' financing decisions (Martins et al., 2020).

In GMM modeling, the lagged dependent variable inclusion is necessary to deal with dynamic behavior. Barros et al. (2020) point out that this term omission can generate biased parameters when it is a dynamic variable due to its recursive behavior. Equation 1 represents our empirical model specification:

$$ROE_{i,t+l} = \beta ROE_{i,t+l-1} + \delta' FIRM_{i,t} + \lambda INVOP_t + d' INDUSTRY_s + \eta_i + \nu_{i,t} \quad (1)$$

where $i$ = 1, ... , N companies from the selected sample; $t$ = 1, ... , T analyzed quarters; $s = 1, \dots$ , T industries from the selected companies; $l \in \{0, 1, 2, 3, 4\}$ represents the quarter lead between the dependent variable and to the others, since this effect will be verified at the same level ($l$ = 0) and on financial performance in four future quarters. $\beta$ is the estimated parameter of the lagged term for the dependent variable ROE. $\lambda$ is the estimated parameter for the explanatory variable Investment Opportunities. $\delta$ is a vector composed of parameters estimated for the control variables of firm's characteristics.$d$ is a vector composed of dummies for industry fixed effects. Finally, $\eta_i$ and $\nu_{i,t}$ are

parameters of the composed error term. $\eta_i$ captures the unobserved individual heterogeneity, and $\nu_{i,t}$ is the idiosyncratic error.

Previous studies investigating the determinants of firms' financial performance adopted the control variables inserted in our models (Egbunike & Okerekeoti, 2018; Hussain et al., 2021; Issah & Antwi, 2017; Killins, 2020). Table 1 shows the descriptions of the independent variables employed in our empirical model.

**Table 1.**
Variables inserted in the empirical models

| Explanatory Variables | Meaning | Description | Previous Studies |
|---|---|---|---|
| $SIZE$ | Firm Size | Natural logarithm of net operating revenue*. | Egbunike and Okerekeoti, (2018); Hussain et al. (2021); Issah and Antwi, (2017); Killins, (2020); Vieira et al. (2019). |
| $GROW$ | Firm Growth | Variation of net operating revenue in period t compared to t-1. | |
| $LEV$ | Firm Leverage | Ratio of debt to total assets. | |
| $LIQ$ | Firm Liquidity | Difference between current financial assets and current financial liabilities divided by total assets. | |
| $DIV$ | Dividends | Dummy that receives the value 1 if the company pays dividends in the period or 0 otherwise. | |
| $INVOP$ | Investment Opportunities | First principal component extracted from the linear combination of four indices: Business Confidence Index-BCI; Consumer Confidence Index - CCI; Composite Leading Indicator – CLI; and GDP variation in the quarter in comparison with the quarter of the previous year. | |
| $IND$ | Industry Fixed Effects | Dummies for economic sector. | |

*Note:* * We used the natural logarithm of net operating revenue as a proxy for firm size, since total assets did not meet the stationarity assumption in Fisher's unit root test, necessary in the application of GMM (tests results are in appendix A). The firm-level control variables were Winsorized at the 1st and 99th percentiles, with the Dividends variable exception.
Source: Elaborated by the authors.

Control variables are the dimensions used in previous empirical studies to control the variable of interest effects on financial performance. Some of the most common dimensions that explain performance are firm size, growth, leverage, liquidity, and dividends (Egbunike & Okerekeoti, 2018; Hussain et al., 2021; Issah & Antwi, 2017; Killins, 2020; Vieira et al., 2019). We used some less conventional measures in some cases, compared to those used in previous studies. In the liquidity dimension, for instance, instead of using the traditional "Current Liquidity Index", we decided to use the measure known as "Treasury Balance" in the Dynamic (Fleuriet) Model (Brasil & Fleuriet, 2003; Fleuriet & Zeidan, 2015; Amorim, et

al. 2021). The reason is that it can be understood as the true financial slack of the company, in case the most liquid assets are larger than the most onerous short-term liabilities, or otherwise in case the company cannot cover short-term debt with such current financial assets.

## Results and discussion

### Summary Statistics

Table 2 shows the summary statistics of the variables included in the analysis. The company's average ROE in the analyzed period was 2.4% per quarter, close to the median, indicating a symmetrical distribution. These companies had an average revenue of R$ 2.52 billion in the period (in real values of the last quarter analyzed), with a growth average of 3.4% per quarter. The mean leverage level was 27.7% in relation to total assets and the maximum level reached was 68.7%. The Treasury Balance, chosen as a proxy for liquidity, indicated that the companies had some financial slack on average in the period, as it represented 4.6% of total assets. On the other hand, the minimum negative value at -25.6% indicates a situation in which the company's net working capital is not able to supply its operational needs in the short term. It is also an indication of financial constraints, if not seasonal.

**Table 2.**
Summary Statistics

| Variables | N. Observations | Mean | Median | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|---|
| ROE | 6400 | 0.024 | 0.024 | 0.055 | -0.201 | 0.236 |
| SIZE | 6400 | 2.52bi | 6.51bi | 6.12bi | 0.00 | 44.00bi |
| GROW | 6400 | 0.034 | 0.004 | 0.284 | -0.670 | 1.628 |
| LEV | 6400 | 0.277 | 0.289 | 0.170 | 0.000 | 0.687 |
| LIQ | 6400 | 0.046 | 0.032 | 0.126 | -0.256 | 0.492 |
| DIV | 6400 | 0.531 | 1.000 | 0.499 | 0.000 | 1.000 |
| BCI | 6400 | 99.513 | 99.557 | 1.792 | 95.622 | 102.620 |
| CCI | 6400 | 100.492 | 100.344 | 2.176 | 96.421 | 103.995 |
| CLI | 6400 | 100.048 | 100.554 | 2.226 | 95.833 | 103.169 |
| GDP | 6400 | 0.005 | 0.012 | 0.033 | -0.106 | 0.057 |
| INVOP | 6400 | 0.000 | 0.633 | 1.792 | -4.524 | 2.801 |

*Note:* We have also listed the disaggregated Investment Opportunities variables, inserted in the PCA.

The macroeconomic variables BCI, CCI and CLI are standardized. Such variables are interpreted from short-term movements around their mean, which indicate agents' confidence or disbelief about future expectations of economic activity. For example, the minimum values of the BCI and CLI indices were driven by COVID-19 in 2020. The CCI index, on the other hand, responded negatively with greater intensity (96.421) in the last quarter of 2015 a period marked by political instability and a presidential impeachment.

GDP had an average growth over the same quarter of the previous period about 0.5%. However, the biggest drop was sharper compared to the biggest rise in this period. From the linear combination between these macroeconomic variables in the PCA, it was possible to assign a score to each observation (derived from the correlation matrix). Thus, the generated score represents a standardized coefficient in terms of standard deviation units in relation to a zero mean.

Table 3 presents the correlations between the variables analyzed indicating the preliminary relationship between them. From this, we verified a potential multicollinearity. This characteristic was already expected and makes the PCA application propitious (Hair et al., 2009), but it must be avoided among the predictor variables in the regression model.

**Table 3.**
Correlation Matrix

| | ROE | SIZE | GROW | LEV | LIQ | DIV | BCI | CCI | CLI | GDP |
|---|---|---|---|---|---|---|---|---|---|---|
| SIZE | -0.007 | | | | | | | | | |
| GROW | **0.136** | 0.006 | | | | | | | | |
| LEV | **-0.021** | **0.148** | **-0.022** | | | | | | | |
| LIQ | **0.134** | -0.015 | **0.026** | **-0.334** | | | | | | |
| DIV | **0.161** | **0.151** | -0.004 | **0.044** | **0.073** | | | | | |
| BCI | **0.114** | -0.001 | **0.048** | **-0.052** | 0.019 | 0.014 | | | | |
| CCI | **0.116** | -0.001 | **0.025** | **-0.049** | 0.007 | **0.034** | **0.894** | | | |
| CLI | **0.069** | 0.002 | **0.077** | **-0.038** | 0.020 | -0.002 | **0.764** | **0.513** | | |
| GDP | **0.105** | -0.003 | **0.028** | **-0.054** | 0.001 | **0.027** | **0893** | **0.827** | **0.662** | |
| INVOP | **0.112** | -0.001 | **0.048** | **-0.054** | 0.013 | **0.021** | **0.982** | **0.900** | **0.799** | **0.938** |

*Note:* Highlighted in bold for correlations significant at 10% and underlined for correlations between macroeconomic level variables.

The correlation between ROE and macroeconomic variables is positive. With emphasis on the macroeconomic variables, we verify that the correlations between them are strong. To verify the multicollinearity, first, we estimate a regression by OLS estimator with the disaggregated variables. Then, we found an average Variance Inflation Factor (VIF) much higher than 10, above the tolerance levels normally accepted for this statistic (Johnston et al., 2018; Wooldridge, 2019). However, in the models presented in the next section, we employ only the INVOP variable, reducing the average VIF to 1.17. Thus, we note that PCA can mitigate or solve the multicollinearity problem.

### 4.2 Principal Component Analysis (PCA) Results

Table 4 shows the PCA results. By the Kaiser criteria (eigenvalue > 1), only the first component should be considered. This component explains most of the total variance of the included variables, with a proportion of 82.67%.

**Table 4.**
Eigenvalues and Proportion of Total Variance Explained

| Component | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| 1 | 3.3067 | 2.8068 | 0.8267 | 0.8267 |
| 2 | 0.4998 | 0.3473 | 0.1250 | 0.9516 |
| 3 | 0.1525 | 0.1117 | 0.0381 | 0.9898 |
| 4 | 0.0408 | - | 0.0102 | 1.0000 |

Table 5 shows the eigenvectors of each component. The eigenvector represents each variable importance for the extracted component and its sign indicates the direction in which they are related. In this sense, the PCA condensed information from four original variables (already indicated in the literature) and facilitated the use of a single component with least information loss.

**Table 5.**
Eigenvectors and Principal Components

| Variable | Comp. 1 | Comp. 2 | Comp. 3 | Comp. 4 |
|---|---|---|---|---|
| BCI | 0.5405 | -0.0358 | 0.2037 | -0.8156 |
| CCI | 0.4960 | -0.5280 | 0.4983 | 0.4763 |
| CLI | 0.4423 | 0.8317 | 0.1581 | 0.2961 |
| GDP | 0.5160 | -0.1678 | -0.8278 | 0.1426 |

Table 5 shows that all variables have positive relationship with the first component. We restricted the adoption of PCA to the identification and extraction of the first principal component in order to create the Investment Opportunities variable. In the next section, we present the GMM model results.

**Investment Opportunities Effects on Financial Performance**

We adopted a significance from level of 10% for the regression results analysis and interpretation. Before proceeding with the analyses, we emphasize that we applied tests to verify the GMM model consistency. The AR(1) and AR(2) Arellano and Bond tests (1991) identified first order autocorrelation negative and significant at 1% and a second order autocorrelation not significant, as expected. In Hansen's test, the null hypothesis of the instruments' exogeneity was not rejected, validating the assumption. In the Dif-Hansen test, the null hypothesis of the validity of the subset of system GMM instruments was not rejected, indicating the estimator suitability. The tests results are shown in Table 6, with the diagnostic test statistics.

The model results are presented in Table 6. We estimated five models considering the explanatory variables effects on performance in the same quarter and in four subsequent quarters. We find that the variable INVOP has a positive, significant, and persistent effect on financial performance, as expected. This suggests that the current economic conditions, reflected in GDP growth, business confidence, consumer confidence, and future expectations of agents simultaneously affect the current financial performance and in future periods. Moreover, we emphasize that the significance of 1% in all coefficients estimated for this variable would allow us to be more rigorous in choosing the significance level for the results interpretation, considering this variable of interest. This consistency confirms the importance of economic conditions as predictors of firms' performance. The results are also consistent with previous evidence in the literature (Issah & Antwi, 2017; Killins, 2020; Vieira et al., 2019).

Therefore, we did not find evidence to refute hypotheses H1 (There is a positive and significant relationship between investment opportunities and the current financial performance of Brazilian companies listed on B3) and H2 (Investment opportunities can persistently influence Brazilian firms' financial performance for future periods). We also observed that the dependent variable first lag had a positive and significant effect only in the second estimation. Including this first lag in the other estimates had no significant effect. Nevertheless, its inclusion is necessary in the dynamic panel estimations. It implies a persistent positive effect of financial performance on itself in the future quarter.

**Table 6.**
Investment Opportunities and Financial Performance

| | $ROE_{i,t+0}$ | $ROE_{i,t+1}$ | $ROE_{i,t+2}$ | $ROE_{i,t+3}$ | $ROE_{i,t+4}$ |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| $ROE_{i,t+l-1}$ | 0.0413 | 0.0545** | 0.0416 | 0.0342 | 0.0314 |
| | (0.0256) | (0.0261) | (0.0263) | (0.0262) | (0.0251) |
| SIZE | 0.0015** | 0.0010* | 0.0010* | 0.0012** | 0.0014** |
| | (0.0007) | (0.0006) | (0.0005) | (0.0006) | (0.0006) |
| GROW | 0.0281*** | -0.0087*** | 0.0015 | -0.0131*** | 0.0062* |
| | (0.0049) | (0.0032) | (0.0037) | (0.0032) | (0.0034) |
| LEV | -0.0163 | 0.0014 | -0.0056 | -0.0083 | -0.0126 |
| | (0.0135) | (0.0139) | (0.0136) | (0.0144) | (0.0128) |
| LIQ | 0.0497*** | 0.0305** | 0.0247* | 0.0266** | 0.0290** |
| | (0.0135) | (0.0121) | (0.0131) | (0.0123) | (0.0119) |
| DIV | 0.0051*** | 0.0049*** | 0.0051*** | 0.0031* | 0.0044*** |
| | (0.0016) | (0.0017) | (0.0017) | (0.0017) | (0.0015) |
| INVOP | 0.0022*** | 0.0011*** | 0.0026*** | 0.0033*** | 0.0022*** |
| | (0.0004) | (0.0004) | (0.0005) | (0.0005) | (0.0005) |
| Constant | 0.0055 | 0.0078 | 0.0108 | 0.0116 | 0.0075 |
| | (0.0102) | (0.0089) | (0.0084) | (0.0089) | (0.0086) |
| Wald $\chi^2$ | 1107.66*** | 243423.37*** | 2986.91*** | 505.25*** | 454.39*** |
| AR(1) | -6.06*** | -6.01*** | -5.84*** | -5.78*** | -5.79*** |
| AR(2) | 1.13 | 1.14 | 1.12 | 1.00 | 0.99 |
| Hansen | 44.56 | 47.27 | 45.53 | 43.94 | 41.37 |
| Dif-Hansen | 18.11 | 19.71 | 16.13 | 18.74 | 17.00 |
| Obs | 6240 | 6240 | 6080 | 5920 | 5760 |
| Groups | 160 | 160 | 160 | 160 | 160 |
| Instruments | 53 | 52 | 51 | 50 | 49 |

*Notes:* Standard errors is in parentheses. ***, ** and * indicate significance level at 1%, 5%, and 10%, respectively. ROE variable at t was assumed to be the base instrument of GMM. The remaining regressors were assumed to be sequentially exogenous instruments. Variable's definition is in Table 1. AR(1) is the Arellano and Bond autocorrelation test of order 1. AR(2) is the Arellano and Bond rank 2 autocorrelation test. Hansen is the Hansen's test to check the instruments exogeneity

assumption. Dif-Hansen is the Hansen's Difference Test for checking the validity of the subset of instruments in the GMM. All models have industry dummies.

Regarding the firm characteristics used as a control in the regression, we found that Size had a positive, significant, and persistent effect on ROE. This result is consistent with the Egbunike and Okerekeoti (2018) and Killins (2020) findings. Size can provide opportunities for scale operations and provide gains derived from operating and financial leverage (in this case captured by ROE). Growth also showed a significant effect (Killins, 2020) however with alternating sign across future quarters, except for model 3 which had no significant estimated coefficient for this variable. Such a result may occurs since increased sales may lead to higher working capital investment needs, causing this impact to have a negative short-term effect on financial performance.

We notice that the Liquidity dimension, measured by the Treasury Balance, has a positive, significant, and persistent effect in all estimations. This implies that firms with excess net working capital, besides having lower risk of financial distress, may be more profitable. Such results are also consistent with the Egbunike and Okerekeoti (2018) and Killins (2020) findings. We also found that Dividend payments have a positive effect on financial performance. In this context, such result is in line with the hypothesis that dividend payment is a way of transmitting information (signaling) about the firm's future profitability capacity (Araújo et al., 2011).

## Concluding remarks

This study verified the effect of investment opportunities provided by the country's macroeconomic environment on companies' financial performance. The sample comprised companies listed on the Brazilian stock market from 2010 to 2020. In a first step, these opportunities were captured using the Principal Components Analysis technique, through a linear combination between macroeconomic factors that reflect the level of economic activity, consumer confidence and future expectations. Through this technique, it is possible to retain common and significant properties among

these variables, which can address the current macroeconomic conditions. We found that the adoption of the new component extracted through PCA can reduce the multicollinearity in the regression models

Regression analysis using economic and financial variables through traditional estimators such as Fixed Effects, Random Effects and Ordinary Least Squares is subject to the endogeneity problem among regressors. Thus, to verify the effect of Investment Opportunities on financial performance, we used the systems GMM estimator. This estimator can circumvent these problems. We found that Investment Opportunities at the macroeconomic level have a significant, positive, and persistent effect on firms' financial performance in all models analyzed.

The research hypotheses raised in this study were not rejected. Therefore, current economic conditions, favorable or not, are important drivers of firm performance. The Investment Opportunities variable has persistent effect in all our models, indicating that this component may be more appropriate to explain the allocation of firms' resources derived from managers' reaction to the economic environment. This seems evident, but not all studies that use economic factors as control variables find significant results.This study brings methodological, scientific, and practical contributions. Initially, we propose the use of PCA to retain significant properties of macroeconomic variables, with the least loss of information, to analyze firm performance. As these variables are usually highly correlated, we attempt to controlling multicollinearity in the models.

In addition, the component extracted through PCA is a variable at the macroeconomic level and of common impact to all companies concomitantly. Through an alternative approach to the adoption of the market-to-book index (commonly used as an individual control for firms' Growth Opportunities in their specificities), we sought to provide to the various information users a holistic view of the macro and microeconomic effects that influence the firms economic and financial performance. Thus, this article contributes to the understanding the origin of companies' competitive advantage, since performance, if above industry average, can be a precedent of such advantage.

The direct implications of this study suggest that the use of techniques such as PCA can ensure greater reliability to the estimated results. We speculate that given the complexity of analyses involving

exogenous and endogenous variables to firms, the use of macroeconomic variables in isolation may not present results consistent with reality for two main reasons: i) the use of a few macroeconomic indicators may not present all or most of the relevant macro characteristics for the analysis. Although strongly correlated, each factor may contain unique properties of the macro context; ii) analyses that ignore potential endogeneity problems, both in macroeconomic indicators and in accounting and financial data, may compromise companies' fundraising and the obtention of resources, since the results will be biased (Barros et al., 2020).

Future studies can overcome some limitations of this article. Our analyses do not consider other accounting indicators of a firm's performance as ROA. Therefore, future studies can adopt this indicator and even those of market performance. Furthermore, our findings are limited to the macroeconomic indices we selected for the PCA. Hence, future studies can adopt other indices for the principal component construction, considering that PCA does not limit a number of variables and retains the relevant information of all together. Furthermore, we encourage the use of the developed component in new studies that employ econometric models to investigate the determinants of corporate decisions.

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## APPENDIX A

To test whether the panels are stationary, we run the Fisher-type unit-root test. It is based on Phillips-Perron tests, for all regressors included in the empirical models. Table A1, shows the tests' results:

**Table A1.**
Results of unit-root tests for the regressors

| Variables | Phillips-Perron | |
|---|---|---|
| | $\chi^2$ | p-value |
| SIZE1 | 306.30 | 0.6996 |
| SIZE2 | 1,725.54 | 0.0000 |
| GROW | 7,851.66 | 0.0000 |
| LEV | 406.29 | 0.0008 |
| LIQ | 989.56 | 0.0000 |
| DIV | 5,279.53 | 0.0000 |

*Note:* SIZE1 is the natural logarithm of total assets. SIZE2 is the natural logarithm of net operating revenue. Ho: all panels contain unit roots; Ha: at least one panel is stationary.

Since INVOP is a time series, and not a panel, we have applied the Augmented Dickey-Fuller test. Table A2 shows the results.

**Table A2.**
Results of unit-root tests for of INVOP

| Variables | A. Dickey-Fuller | |
|---|---|---|
| | Z(t) | p-value |
| INVOP | -1.306 | 0.0361 |

*Note:* Ho: the time series contain unit root; Ha: the time series is stationary.

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