How does market concentration influence Brazilian firms’ operational performance? an analysis of concentration moderating effect

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Abstract
This article focus on investigating the moderation role of market concentration on the relationship between operational performance and firms’ costs composition. We adopt for operational performance the Return on Invested Capital (ROIC) and the Degree of Operating Leverage (DOL) as proxy for firms’ cost behavior. As proxy for market concentration, we adopt Herfindahl-Hirschman Index (HHI) and we also include the Degree of Financial Leverage (DFL) as moderating variable to increase our robustness. The database covers non-financial firms at Brazilian market from 1996 to 2016, third quarter. Our findings indicate the existence of a moderating effect of concentration on the relationship between ROIC and DOL at Industry and Services sectors. Overall results suggest the existence of a relation between firms’ operational performance and cost behavior, indicated by a negative relationship between ROIC and DOL. Furthermore, Degree of Financial Leverage (DFL) and market concentration (HHI) exert a combined moderating role on the relationship between ROIC and DOL. At Industry and Services sectors, in the extent that market concentration moves towards a higher concentration level configuration, the moderating effect of HHI becomes more latent.

KEYWORDS: Degree of operating leverage. Return on invested capital. Market concentration. Degree of financial leverage. Moderation.

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Como a concentração do mercado influencia o desempenho operacional das empresas brasileiras? Uma análise do efeito moderador da concentração

Resumo
Este artigo concentra-se em investigar o papel de moderação da concentração do mercado na relação entre desempenho operacional e composição de custos das empresas. Adotamos para desempenho operacional o Retorno sobre Capital Investido (ROIC) e o Grau de Alavancagem Operacional (DOL) como proxy para o comportamento de custo das empresas. Como proxy da concentração de mercado, nós adotamos o Índice Herfindahl-Hirschman (HHI) e também incluímos o Grau de Alavancagem Financeira (DFL) como variável moderadora para aumentar nossa robustez. O banco de dados abrange empresas não financeiras no mercado brasileiro de 1996 a 2016, terceiro trimestre. Nossas descobertas indicam a existência de um efeito moderador de concentração no relacionamento entre ROIC e DOL nos setores de Indústria e Serviços. Os resultados gerais sugerem a existência de uma relação entre o desempenho operacional das empresas e o comportamento dos custos, indicado por uma relação negativa entre ROIC e DOL. Além disso, o grau de alavancagem financeira (DFL) e a concentração do mercado (HHI) exercem um papel moderador combinado na relação entre ROIC e DOL. Nos setores de Indústria e Serviços, na medida em que a concentração do mercado se move para uma configuração de nível de concentração mais alta, o efeito moderador do HHI se torna mais latente.

Palavras-chave: Grau de Alavancagem Operacional. Retorno sobre o capital invertido. Estrutura de mercado. Grau de Alavancagem Financeira. Moderação.

¿Cómo influye la concentración del mercado en el desempeño operativo de las empresas brasileñas? Un análisis del efecto moderador de la concentración

Resumen
Este artículo se centra en investigar el papel de moderación de la concentración del mercado en la relación entre el desempeño operativo y la composición de costos de las empresas. Adoptamos para el rendimiento operativo el Retorno del capital invertido (ROIC) y el Grado de apalancamiento operativo como proxy del comportamiento de los costos de las empresas. Como proxy de la concentración del mercado, se adoptó el Índice Herfindahl-Hirschman (HHI) y también incluimos el Grado de apalancamiento financiero (DFL) como variables moderadoras para aumentar nuestra solidez. La base de datos cubre empresas no financieras en el mercado brasileño desde 1996 hasta 2016, tercer trimestre. Nuestros hallazgos indican la existencia de un efecto moderador de concentración en la relación entre ROIC y DOL en los sectores de Industria y Servicios. Los resultados generales sugieren la existencia de una relación entre el desempeño operativo de las empresas y el comportamiento de los costos, indicado por una relación negativa entre ROIC y DOL. Además, el grado de apalancamiento financiero (DFL) y la concentración del mercado (HHI) ejercen un papel moderador combinado en la relación entre ROIC y DOL. En los sectores de Industria y Servicios, en la medida en que la concentración del mercado se mueve hacia una configuración de nivel de concentración más alta, el efecto moderador de HHI se vuelve más latente.

Palabras clave: Grado de apalancamiento operativo. Retorno sobre el capital invertido. Estructuras de mercado. Tamaño. La moderación.
INTRODUCTION

The present research investigates the moderating influence of Market Structure on the relationship between firms’ operational performance and firms’ cost behavior. As proxy for firms’ operational performance, we adopted Return on Invested Capital; for firms’ cost behavior, we adopted the Degree of Operating Leverage, following the Cost-Volume-Profit approach (CVP). In order to refine our results, we include the Degree of Financial Leverage as moderator of the Market Structure influence, for non-financial Brazilian public firms.

Nonfinancial measures are the leading indicators for financial performance, according to Banker and Mashruwala (2007), which justifies the using for evaluation performance. We adopt the Cost-Volume-Profit (CVP) approach, according to the neoclassical economic theory of markets at equilibrium (FRANÇA and LUSTOSA, 2011; LUSTOSA and FRANÇA, 2012). We follow Mandelker and Rhee (1984), Tabak and Guerra (2007), Dantas, Medeiros and Lustosa (2006) using the DOL as a metric of firm operating risk to study the Brazilian market, and Simons (1999) using ROIC as proxy for operational performance.

We found that market structure moderates the relation between DOL and ROIC when competition level decreases. However, DOL responds to operational performance when makerts tends to competition on monopoly. Market structure exert a moderating role for all sectors, except Commerce. The introduction of DFL as a moderating variable of the HHI moderating role, follows the findings of Campanella and Serino (2019) research that shows existence of correlation between firm financial leverage and key firm aspects as age, size and profitability, which indicates the importance of analyzing the DFL impact on firms’ profitability for model robustness.

Under a deterministic microeconomic analysis, firms in perfectly competitive markets are price-takers, which means that they have to operate with marginal revenue and marginal costs ratio close to one to have a positive Contribution Margin (CM) (LUSTOSA and FRANÇA, 2012). On the other hand, firms operating with high monopoly power, but not monopolistic, tend to operate outside the economic equilibrium point in a effectiveness-seeking behavior (HUNT and DUHAN, 2002). For example, such firms may operate with idle capacity to respond market demand fluctuations or use this idle capacity as an entry barrier (THOMPSON JUNIOR and FORMBY, 2002), and such behavior, despite of being strategic positioning, leads to worse operational performance. Assuming the managers to be risk-takers in order to increase firm revenues, the firm leverage over its systematic risk can be measured by DOL (GAHLON, 1981; CHUNG, 1989; DANTAS, MEDEIROS and LUSTOSA, 2006; DARRAT and MUKHERJEE, 1995; DUGAN, MINYARD and SHRIVER, 1994; FRANÇA, 2012; GRIFFIN and DUGAN, 2003; HODGIN and KIYMAZ, 2005; HUFFMAN, 1983; LUSTOSA and FRANÇA, 2012).

Recent research tackles the moderating effect of environmental dynamism on green product performance (CHAN, YEE, DAI et al., 2016), product market competition and firm performance (LIU, QU and HAMAN, 2018), the moderating role of market conditions on firms’ growth (FENG, MORGAN and REGO, 2017) and moderating role of product market competition on firms’ performance and business strategy (ZHANG, 2016). However, at Brazilian market Empirical research on operating leverage is still incipient, with few evidences of this issue in emergent market (DANTAS, MEDEIROS and LUSTOSA, 2006; FRANÇA,
Brazilian characteristic of market concentration leads to an investigation of its impact on firms’ operational performance, which can be captured through the analysis of the DOL's influence on firms' ROIC. Following prior research that suggests a moderating role of product market competition in the strategy performance link (ZHANG, 2016), we adopt the approach at the present research, which responds to the neoclassical microeconomic theory.

The CVP approach originates from the neoclassical economic theory (WICKRAMASINGHE and ALAWATTAGE, 2007) and this addresses allocation problems, since managers face the economic problem of scarcity (DOPUCH and BIRNBERG, 1969; KARNANI, 1983). The CVP premise that firms operate in a perfectly competitive or monopolistic market (KARNANI, 1983) convey the investigation of the impact of market structure on the relation between operational risk and operational returns. Then, this paper aims to analyze the moderating role of market structure on the relationship between firm’s operational performance and the degree of operating leverage.

Present literature do not approach market structure as a moderating variable to ROIC and DOL relationship. Also, our approach fills the gap on the literature by answering to economic theory not only by adopting the CVP approach but also by considering the market structure. Our results indicate that for markets that move towards the neoclassical theory markets at equilibrium, the DOL metric tends to be more adherent. For strong oligopolistic markets, other variables may present as better metrics. Also, we show that firms competing in markets with higher competition level tend to present better overall performance when they adjust their DOL to a lower level (LUSTOSA and FRANÇA, 2012), maximizing the production factors usage.

**HYPOTHESES DEVELOPMENT**

**Return on invested capital – ROIC**

The Return on Invested Capital is an accounting metric that reflects the performance of a firm in a given period, regardless the financial flow linked to the operation (PENMAN, 2010). Prior empirical accounting-based research adopts proxies from the accounting statements to analyze the effects of managers decisions and firms’ characteristics to compare performance and indicates that firms’ specific characteristics have major impact on performance than industry characteristics. Accounting numbers allow the users to recognize the firm performance by means of return indexes, such as the Return over Assets (ROA), Return over Equity (ROE) and the Return over Invested Capital – ROIC.

The ROIC excludes the interests and taxes effects, in order to isolate the operational return of the available operational resources to the firm (CHEN and HUANG, 2006; GOLDSZMIDT, 2010; HOUGH, 2006; MISANGYI, ELMS, GRECKHAMER et al., 2006; SIMONS, 1999). Chen and Huang (2006) argues that such number better reflects the firm operational decision making and, then, it should be preferred in relation to the metrics based on total assets or the equity. Also, this configures as a relation between operational profits and operational revenues, acting as a reliable investment decision indicator.
The cost-volume-profit analysis

The CVP analysis deals with the classical economic problem about the optimal level and output mix for the firm, assuming that as long as the firm has a set of resources and, at least, one cost is fixed. The accounting cost structure analysis has the necessary characteristics to be a proxy for the economic short run model, characterized by the emphasis on costs and revenue behavior over a set of variations of mix and outputs levels (DOPUCH and BIRNBERG, 1969). The CVP analysis is a simple analytical tool for management decisions (GUIDRY, HORRIGAN and CRAYCRAFT, 1998) that provides a wide financial overview of firms' decision process (HORNGREN, FOSTER and DATAR, 1994).

The intersection between the curves of Sales Prices and Total Cost indicates the firm's accounting break-even point, measured by \( BE = \frac{FC}{CM_{unit}} \), where BE means the break-even point, which is represented in terms of volume, since the denominator has unitary volume representation; \( FC \) total fixed costs and fixes expenses; and, CM – or Contribution Margin – which is represented at unitary terms.

At this point, the revenue is equalized to costs, indicating the minimum volume of revenue not to incur in losses. In turn, the marginal revenue relates to each additional unit of production sold, with a sales price function \( MR = f(SP) \), where MR is the Marginal Revenue and SP represent the sales prices. When firms operate at full capacity, CM and sales increasing are negatively associated since it indicates the necessity of new investments, and following this argument, idle capacity may increase the profit margin of the firm by an increase in sales (JORGENSEN, SADKA and LI, 2009).

The DOL can be used as a risk metric (HUFFMAN, 1983) since that differences in production process impacts on fixed and variable costs share (LEV, 1974), answering to the firm returns as shown in prior literature (MCDANIEL, 1984; NOVY-MARX, 2011; PERCIVAL, 1974). When markets are further from competition, firm’s tends to be less efficiency-seeking and more effectiveness-seeking when competing in a strong oligopoly market (HUNT and DUHAN, 2002), which leads to greater operational leverage statistical significance and influence over operational performance when markets are near perfect competition and monopoly.

At Brazilian capital market, the relationship between returns and DOL has been studied by Tabak and Guerra (2002), Dantas, Medeiros and Lustosa (2006), Lustosa and França (2011) and França and Lustosa (2012). França and Lustosa (2012) also points that in a near competitive market that is a negative relationship between DOL and returns. Zhang (2016) Considering DOL as a metric of operational risk, as shown by Gahlon (1981), we hypothesize that:

\[ H_1 \] – There is an association between the Degree of Operation Leverage and the Return on Invested Capital.

Market structure

The economic theory of the firm analyze the relation between a single firm and its industry, and this states the output result to be the outcome of the market forces, considering market price (ALDRICH and PFEFFER, 1976). Differences in market-structure impact on price and
production decisions of competing firms on their industries (MAS-COLELL, WHINSTON and GREEN, 1995; THOMPSON JUNIOR and FORMBY, 2002). Under this concept, Besanko, Dranove, Shanley et al. (2006) argues that the firm relies on its conduct to consider the market competitiveness. Moreover, at perfectly competition, accounting numbers and economic theory are able to converge (BEAVER and DEMSKI, 1979), since there are no opportunity costs and we can identify that firms as price-takers and consider the ratio \( MR/MC \) to be equal to 1 (FRANÇA, 2012). Under a management perspective, firms compete for shares and resources with their peers leading to product market interactions that have significant impact on firm policies (ZHANG, 2016).

Competition level and market-share are both broadly studied due to its relevance for the firm management decisions and profitability generation capability (RHOADES, 1993; SCHERER, 1965; SHEPHERD, 1972). In addition, (HALL, 2004) shows that changes in economic conditions imposes significant limitation to firms so that the competition plays a moderating effect between nonfinancial indicators and financial performance (BANKER and MASHRUWALA, 2007). Banker and Mashruwala (2007) also show that nonfinancial performance measures make sense in higher competitive markets, since the market structure empowers consumers and employees to choose between different firms.

Prior research also indicates competition as prominent factor on firm-decisions making indicates that firms from United States under strong competitive pressure from the product market rely less on banking finance (BOUBAKER, SAFFAR and SASSI, 2018); and that intense competition leads firms to lower levels of voluntary disclosure (LIN and WEI, 2014). Zhang (2016) shows a moderating role of product market competition in the strategy-performance link. We follow Besanko, Dranove, Shanley et al. (2006) usage of the HHI as a measure to market competition level.

**Degree of Financial Leverage**

Mandelker and Rhee (1984) research points toward the existence of a positive relationship between the degree of financial leverage and systematic risk. Financial risks are linked with a company selection of its financial structure and financial leverage increases the likelihood of firm's inability to service the debts, and a good financial policy aims to harmonize the degree of risk faced by shareholders, the impact of borrowing and the return equity (BARAKAT, 2014). Campanella and Serino (CAMPANELLA and SERINO, 2019) research that shows existence of correlation between firm financial leverage and key firm aspects as age, size and profitability.

Recent research indicates that financial leverage plays a big role in maximization shareholders' but has different impacts on the value of the firm country to country because of different tax laws and different tax brackets (OBRADOVICH and GILL, 2013). Other studies evidence a positive effect of leverage and firm value (GUPTA, KUMAR and VERMA, 2016; RUSSELL, BRIGGEMAN and FEATHERSTONE, 2017; ZEB and RASHID, 2016) and also between systematic risk and degree of financial leverage (HUFFMAN, 1983). In the same way as expected for DOL, to DFL we expect to find statistical significance and influence over operational performance when markets are near perfect competition and monopoly and considering that market structure impacts on firms’ costs behavior and industry returns. Then, we hypothesize that:
**H2** – There is an association between the Degree of Financial Leverage and the Return on Invested Capital

**H3** – Market competition level exert a moderating effect on the relationship between Degree of Operating Leverage and Return on Invested Capital.

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**Size**

Consider the impact of Size on firms’ performance led to diverse evidences. Literature shows that size plays a major variable for firm’s performance and for the study of performance at industry context, in both microeconomic theory and industrial organizational (PORTER, 1979; BESANKO, DRANOVE, SHANLEY et al., 2006), with firms inserted in a causality chain where firm’s size influences its performance (THOMPSON and FORMBY, 1996). However, under an operational perspective, Size may play different roles.

Fiegenbaum and Karnani (1991) point the necessity of big firms to operate with intense exploration of economies of scale. Also, the study emphasizes a trade-off between size and volume flexibility, where small firms have the advantage of flexibility on sales volume compared to the biggest firms. Since the smaller firms do not incurs in economies of scale, managers are encouraged to perceive better performance by other means.

Marcus (1969) findings indicate an erratic relationship between firm size and profitability within an industry, with some firms showing a positive relationship and others showing a negative relationship. Due to prior literature, we believe that size acts as a moderator of the moderating role of market structure on the relationship between DOL and operational performance, exerting a double-moderating effect.

Considering such evidences of size’s role on firms’ operational performance, we bring it into our model as a control variable. The following chapter presents the applied methods, in order to define our sample, the variables construction, and the applied econometric issues.

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**METHOD**

**Performance measurement: return on invested capital**

We use the ROIC as a performance measurement in order to capture the operational approach of the firm and its sensitivity or exposure to different cost structure (SIMONS, 1999):

\[
ROIC = \frac{EBITDA_{t}}{Asset_{Adjt}}
\]  

(1)

This research aims to study firm operational performance, detached from the exposure to taxes among industries. The Earnings before interests, taxes, depreciation, and amortization (EBITDA) overrides other profit lines on the income statement, such as NOPLAT, NOPAT, EBIT or Net Income, due to its alignment with the research purposes.
**Degree of operating leverage**

The Degree of Operating Leverage means the sensitivity of income to a variation of the revenues. We follow Garrison and Noreen (2001) to calculate the traditional observed DOL:

\[
\frac{\Delta OI_{i,t}}{\Delta \left[ (NR)_{i,t} \right]} \tag{2}
\]

Where \( OI_{i,t} \) is the operating income of firm \( i \) at quarter \( t \); and, \( NR_{i,t} \) is the net revenue of firm \( i \) at quarter \( t \). The variable aim to capture how market reacts to results of managerial decisions regarding firm costs structure.

**Market structure**

Dhaliwal, Huang, Khurana et al. (2008) and Gjerde, Knivsflå and Sættem (2002) concur that industry specific facts exert impact on firm performance variability. In this perspective, we use the Herfindhal-Hirshman as a metric of product market competition. Following Besanko, Dranove, Shanley et al. (2006), we adopt the function:

\[
HHI = \sum_{i=1}^{n} \left( \text{Market} - \text{share} \right)^2 \tag{3}
\]

Where \( \text{Market-share} \) is the net operating revenue of a firm \( i \) (or its total assets) scaled by the total of the industry. Kelly (1981) and Rhoads (1993) agree that the Herfindhal Index ought to be carefully interpreted due to its limitations, such as requiring public data of each firm, which is unavailable. Besanko, Dranove, Shanley et al. (2006) consider the relative size of the biggest firms to be a major factor on the management and, consequently, on the performance. We approach the subject through concentration level, when we adopt \((\text{market-share})^2\) as measure with the intention to capture firms’ market power.

**Degree of Financial Leverage**

Following the findings of Campanella and Serino (CAMPANELLA and SERINO, 2019) research that shows existence of correlation between firm financial leverage and key firm aspects as age, size and profitability, which indicates the importance of analyzing the DFL impact on firms’ profitability we include DFL as a moderating variable at our model, following Mandelker and Rhee (1984):

\[
DFL = \left( \frac{EAIT_{j,t}}{EAIT_{j,t-1}} \right)^{-1} \frac{X_{j,t}}{X_{j,t-1}} \left( \frac{X_{j,t}}{X_{j,t-1}} \right)^{-1}
\]
Where $\text{EAT}_{jt}$ is the earnings after interest and taxes of firm $j$ at time $t$ and $X_{jt}$ denotes the earnings before interest and taxes of firm $j$ at time $t$. The DFL captures the sensitivity of a company’s earnings per share to fluctuations in its operating income, as a result of changes in its capital structure and we expect a positive effect on ROIC.

**Size**

Size has been subject of analysis over the years. Shepherd (1972), Hansen and Wenerfelt (1989) and Leon Li and Huang (2011) points toward a positive relationship between Size and return. However, Lever (1996), Chuang (1999) and Pull (2003) shows a counter-hypothesis, that Size plays a negative role on firm’s performance. Porter (1979) approach the same subject and in recent study adopt size as control variable on a firm performance research (WANG, SHARMA and CAO, 2016). The firm’s size proxy adopted is given by the following equation:

\[
\text{Size} = \text{Firm’s total assets} - \text{Mean sector’s asset}
\]

To understand the role of Size at Brazilian market on the relationship between DOL and operational performance we will address the question by observing Size as a moderating variable of the relationship between DOL and ROIC.

**DESCRIPTIVE STATISTICS**

**Data selection and treatment**

Firms listed at the Brazilian Stock Exchange between 1996 and 2016 compose the sample, totalizing 879 firms. The characteristics of our research and characteristics of some sectors demand not to consider all database. As consequence were excluded Finance and Insurance and Funds sectors due to their specific regulations; Others sector due to the difficult to establish firm market competition level; Energy sector exclusion is due to the strong regulation and other industry specific characteristics; and, Software and data sector due to the reduced number of observations. After the exclusions, 419 firms remained, totalizing 57.56% of the original sample.

All data were non-consolidated and obtained at Comdinheiro®, specialized databases for market information. From the original 879 firms, 419 firms remained on the database after sector exclusions, which represents 47.67% of the original sample. In addition, negative results were also excluded from our database. The same treatment was applied to missing values. Table 1 shows the number of excluded observations:
From the original 26,571 observations that remained after our first sample selection by exclusion of subsectors, we found 13,497 observations that compose the Full Sample after the second sample selection.

Previous analysis (available upon request) on the dependent variable shows the ROIC mean greater than median, which suggest a significant skewness and a kurtosis. In addition, there is a large distance between median and maximum value, denoting an asymmetry distribution, which leads to a high standard deviation, indicating presence of outliers on the distribution. Outliers may disturb the regression significance, and the selected procedure was the exclusion of outliers.

**TABLE 1
Sample selection process**

| Excluded Observations                  | Number of Observations |
|----------------------------------------|------------------------|
| Original sample                        | 26,571                 |
| Negative Gross Revenue                 | 1,709                  |
| Negative EBIT                          | 10,665                 |
| Negative Net Revenue                   | 37                     |
| Other negative results or missing values | 663                   |
| Total                                  | 13,497                 |

*Source: Elaborated by the authors.*

**TABLE 2
Descriptive Statistics**

| Stats               | ROIC<sub>c</sub> | DOL<sub>RG</sub> | HHI     | DFL<sub>RG</sub> | SIZE<sub>RG</sub> |
|---------------------|------------------|------------------|---------|------------------|------------------|
| Num. of Observation | 13,497           | 13,497           | 13,497  | 13,497           | 13,497           |
| Mean                | -0.7925132       | 0.0094421        | 0.2583533 | -48.78015        | 0.0875421        |
| Standard Deviation  | 7.813952         | 0.0457071        | 0.176205 | 2123.724         | 0.1570579        |
| Kurtosis            | 602.7083         | 326.3715         | 6.750022 | 1900.5           | 14.36719         |
| Skewness            | 18.54133         | 16.55806         | 1.698413 | -34.67193        | 3.217954         |
| Coef. of Variation  | -9.859712        | 4.840796         | 0.6820311 | -43.53665        | 1.794085         |
| Minimum             | -18.93342        | 0                | 0.0677249 | -138268.7        | 0                |
| Maximum             | 353.9422         | 1                | 0.8766502 | 48688.31         | 1                |
| p25                 | -2.679531        | 0.0010099        | 0.1276707 | 0.2311875        | 0.0073415        |
| p50                 | -1.490238        | 0.0021058        | 0.2569522 | 0.2569522        | 0.0284723        |
| p75                 | 0.1536622        | 0.0066064        | 0.3479501 | 0.3479501        | 0.0866556        |

*Source: Elaborated by the authors.*

**Notes:**
(i) ROIC<sub>c</sub> represents the centered Return on Invested Capital; (ii) DOL<sub>RG</sub> represents the Degree of Operating Leverage in range; (iii) HHI represents the Herfindah-Hirschman Index, which contemplates the market competition level on the sector; and, (iv) DFL<sub>RG</sub> represents the Degree of Financial Leverage in range; (v) SIZE<sub>RG</sub> represents the firm size in range.
Considering that the variables variance allows to standardize the DOL and Size variables, we were able to put those variables in range. The procedure increases the data quality since it provides a sensible unit scale. In this sense “Scaling should be performed in such a way that the variances of the measurements reflect their relative importance” (KRESTA, MACGREGOR and MARLIN, 1991, p. 44), which is what we aim to capture with those variables in our research. Table 2 shows the final sample descriptive statistics.

Differences between sectors structure lead to differences on firm operational return demands. Centering the variable waives the real and effective number in order to allow a more trusted analysis since the comparability analysis refers to the distance of firms’ ROIC from the sector’s ROIC mean. The outlier exclusions solved the high standard deviation and mean greater than median problems with the dependent variable, allowing considering ROIC in range.

The correlation matrix for the numeric variables used in the models (available upon request) indicates the absence of high correlation between independent variables. We also confirmed this issue by the Variance Inflation Mean of 5.25 denoting that the variables do not show multicollinearity problems.

**Market structure**

We categorize the sectors considering the observed mean HHI. Industry and Commerce subsectors of our sample as classified as Oligopolistic markets. The Services sector, however, as monopolistic market. Table 3 summarizes the sample:

| Sectors     | Observations | Mean   | Classification |
|-------------|--------------|--------|----------------|
| Industry    | 19,573       | 0.4317 | Oligopoly      |
| Commerce    | 2,563        | 0.5690 | Oligopoly      |
| Services    | 6,426        | 0.6690 | Monopoly       |
| Full Sample | 28,562       | 0.5540 | Oligopoly      |

*Source:* Elaborated by the authors.

Despite the difficulties when considering data quality for the Brazilian market, such as the low number of observations or the high level of concentration, these results shed lights to the firm’s choices and to the consequent analysis of the its impacts and this also indicates those firms that conducted the best output on the period.
MODELS AND ECONOMETRIC ISSUES

To test the hypotheses 1, the study demands the estimation of the models 1 and 2:

\[
ROIC_{i,t} = \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \beta_3 Size_{i,t} + \epsilon_{i,t}
\]

Where \( ROIC_{i,t} \) means the operational Return Over Invested Capital of firm \( i \) at the quarter \( t \); \( DOL_{i,t} \) represents the degree of operational leverage for firm \( i \) at the quarter \( t \); \( HHI_{i,t} \) represents the Herfindahl-Hirschman Index for firm \( i \) at the quarter \( t \); and, \( Size_{i,t} \) represents firms’ size of firm \( i \) at the quarter \( t \). We test DOL variable in order to determine the most significant coefficient to proceed our main analysis with HHI and Size as control variable. According to the arguments exposed on Hypothesis Development, we expect a negatively relation between DOL and ROIC.

In addition, we estimate the following model:

\[
ROIC_{i,t} = \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \beta_3 Size_{i,t} + \beta_4 DFL_{i,t} + \epsilon_{i,t}
\]

Where \( DFL_{i,t} \) means the Degree of Financial Leverage of firm \( i \) at the quarter \( t \). With the addition of DFL at the model as control variable, we expect to verify the impact of DFL at firm’s operational performance and cost behavior relationship.

To test the second and third hypotheses, we estimate the model 3:

\[
ROIC_{i,t} = \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \beta_3 Size_{i,t} + \beta_4 DFL_{i,t} + \beta_5 HHI_{i,t} * DOL_{i,t} + \beta_6 HHI_{i,t} * DFL_{i,t} + \beta_7 DOL_{i,t} * HHI_{i,t} + \beta_8 DOL_{i,t} * DFL_{i,t} + \epsilon_{i,t}
\]

Where we test the moderating role of market structure on this relationship. Then, we expect the \( \beta_4 \) to be negatively related with the dependent variable, and this will weak the significance of the \( \beta-1 \) coefficient. In addition, with the \( \beta_7 \) we analyze the existence of Size moderation at the moderating role of market structure on the relationship between operational performance and cost behavior. We use the proxies represented on Table 4.

**TABLE 4**

Variables description

| Variable | Expected signal | Name   | Description                                                                 | Reference                      | Syntax          |
|----------|-----------------|--------|-----------------------------------------------------------------------------|--------------------------------|-----------------|
| ROIC     | Dependent Variable | ROIC   | Captures operational performance of the firm, detached from the exposure among the industries. | Simons (1999); Goldszmidt (2010) | \( ROIC = \frac{EBITA}{Asset_{Adj}} \) |
| DOL      | Negative        | DOL    | Captures income sensitivity to a variation of the revenues.                 | Garrison and Noreen (2001)     | \( \frac{\Delta OI_{i,t}}{\Delta[(NR)_{i,t}]} \) |

*Continue*
| Variable | Expected signal | Name | Description | Reference | Syntax |
|----------|----------------|------|-------------|-----------|--------|
| Market Structure | ? | HHI | Captures market structure and its impacts on firms’ operational performance. | Besanko, Dranove, Shanley et al. (2006) | $HHI = \sum_{i=1}^{n} (\text{Market Share}_i)^2$ |
| Degree of Financial Leverage | Positive | DFL | Captures the sensitivity of a company’s earnings per share to fluctuations in its operating income, as a result of changes in its capital structure | Griffin and Dugan (2003); Mandelker and Rhee (1984) | $DFL = \left( \frac{EAIT_{jt}}{EAIT_{jt-1}} \right)^{-1} \left( \frac{X_{jt}}{X_{jt-1}} \right)^{-1}$ |
| Size | Positive | SIZE | Captures the impact of size on the moderating role of market competition of the relationship between DOL and ROIC. | Marcus (1969); Porter (1979) | $Size = \text{Firm’s total assets – Mean sector’s asset}$ |

**Source:** Elaborated by the authors.

We consider there is no evidences enough, to expect a signal for Market Structure on the Dependent Variable, aligned with the exploratory purpose of the paper. All following models are robust to heteroskedasticity.

**Full sample model**

We run an OLS regression for the Full Sample, subdivided in three models that contemplates all variables. investigate the existence of a moderating effect of market structure on the relationship between ROIC and DOL. At The model (1), we consider the relation of DOL with firms’ operational performance, adding HHI and Size as control variables. Considering DFL correlation with firms’ profitability (CAMPANELLA and SERINO, 2019) and the possible moderating effect on ROIC and DOL relationship, model (2) adds DFL as control variable to measure the impact of firms’ financial leverage on ROIC. Model (3) includes the moderation of HHI and the combined moderation HHI-DOL on the analysis to answer to the second and third hypotheses.

Our models allow us to visualize a number of relations between our leverage variables, HHI and ROIC, as shown on our Figure 1. However, the focus of the present work is to investigate the moderating effect of market structure on the ROIC and DOL relationship. Since our scope is restricted, and we will focus on lines 1, 2 and 3. Line 4 shows the combined moderation and will allows to increase our comprehension of the moderating effect of market structure, thus we will often address to its results.
We find a negative signal for DOL in all models, and compared to the mean, an increase on DOL impacts negatively on firms’ operational performance at 1% of alpha. The negative impact of DOL on ROIC is expected, considering that higher levels of operational leverage suggest that firms are profiting on margin rather than volume, and high levels of operational performance indicates maximization usage of firms’ available resources.

![Figure 1: Research Design](image)

For the HHI variable, at 1% level, we find that more competition relates negatively with ROIC at all models, which aligns with expected results at Brazilian market. When market tends to monopoly, firms’ maximization point differs from \( MR = MC \) maximization point of perfect competition markets. Including DFL as control variable in our model (2) enhance the quality of our results. The DOL and HHI variables remains significant at 1% level, and DFL shows statistical significance at 1% with the expected positive signal.

The third model includes HHI as proxy for market structure moderating the relationship between DOL and ROIC, and DFL as a moderating variable of the HHI moderation, which indicates that firms’ must consider market structure when making cost-structure related decisions. For our full sample, the moderating role of market structure on the relationship between DOL and ROIC shows statistical significance at 1%, but the combined moderation HHI-DFL do not presents itself as significant.

The positive signal of HHI moderation indicates that market competition exert an positive effect on firms’ performance, which indicates that at mean, firms with lower DOL present shows greater operational performance when compared with firms that possess higher DOL. The model suggest that, for our full sample, when markets walks toward competition, firms perceive more influence of the DOL on firms’ ROIC. Which means that managers tends
to reduce DOL when markets becomes more competitive, adjusting production to market structure.

For our Full Sample analysis, the results indicate that we shall accept $H_1$ and $H_2$ hypothesis, however $H_3$ shall be reject due the lack of statistical significance. To increase our understanding of the moderating effect of market structure on the relationship between ROIC and DOL, we segregate our sample in three major sectors. Literature suggest that the heterogeneity between different sectors and market structure may have a major role in the absence of statistical significance (HANSEN and WERNERFELT, 1989; PORTER, 1979, 1989; SHEPHERD, 1972), especially when we consider the assumption of perfect competition or monopoly where the DOL roots (WICKRAMASINGHE and ALAWATTAGE, 2007).

**Model by sectors**

McGahan and Porter (1997) shows that profitability has a complex relationship with different characteristics, as industry effects, and how those variables impact on profitability depends of firms’ sector. Following the argument, we divide ours sample in three major groups that relies on the difference of structures: Industry, Commerce, and Services. At Table 5 we can visualize our results. The models shows greater adherence to Industry sector, with Commerce sector showing lowest adherence level.

We present the model’s output subdivided by sectors and between our three models. HAIR JUNIOR et al. (2008) states that moderating effect occurs when an independent variable can affect a regression by changing the relation between the independent variable of the regression and a dependent variable when the value of the moderator variable changes.

**Industry**

For the Industry subsector, we can point that DOL are statistically significant at 1% level, with a negative signal, to model (1) and model (2), and 5% significance level at model (3), with reduction on significance level and subtle change on coefficient when compared with our Full Sample, which indicates a reduction of DOL role on performance at Industry sector. The HHI is statistically significant at 1% level with negative signal.

Comparing with Full Sample, we can observe that in the Industry sector the impact of market structure is perceived with higher intensity when compared with our Full Sample, at all models. At model 3, we find that is a moderating impact of market structure on DOL and ROIC relationship, with a positive effect on operational performance of firms’ that, at mean, present lower DOL when compared with firms that possess higher DOL operational performance. The significance of the combine moderation of DFL and HHI, with signal alteration, indicates that at mean firms with lower DOL performs poorly than firms with higher DOL when market structure tends to greater competition and the leverage on firms’ capital structure are observed – with similar result is found for the Services sector.
When we look at our HHI, we find that Industry shows the lowest HHI level, which indicates that it is the most competitive sector of our database, despite of still being classified as an oligopoly. However, it is also our major dataset with 7,435 firms. As we expect, DOL and DFL show statistical significance and our results indicate that, at Industry sector, competition exert a disciplinary behavior when competition increase with firms’ with lower DOL performing better operationally. Furthermore, when DFL moderates the moderating impact of market structure, the combined moderation, our results indicate that there is an optimal combination of both leverage levels that lead firms to better operational result. The reason behind such results is that, *ceteris paribus*, firms may profit from positive economies of scale due to increase on firms’ margin by reducing unitary costs and that capital structure play an important role on firms’ performance. At Industry sector, we accept all research hypothesis, which indicates that DOL and DFL exert influence over ROIC and that market structure exert influence on firms’ cost decisions. However, DOL do not present expected signal.

**Commerce**

In Commerce sector, at model (1) and model (2), DOL is the only variable that presents statistical significance, at 1% level. Such results indicate that HHI do not exert an impact on the sector. However, in our model (3), when we aim to capture the moderating effect of HHI, there is a change in our results, with HHI and DFL presenting statistical significance at 1% level. The moderating effect variables and DOL, at model (3), no longer shows statistical significance. When we consider the HHI level for Commerce sector, we observe a strong oligopolistic market (0.569) and low level of adherence of our models for both sectors. We expected such result especially for DOL, since the CVP approach roots on neoclassical microeconomic theory of markets in equilibrium, where markets are on perfect competition configuration (WICKRAMASINGHE and ALAWATTAGE, 2007). The results support such claim when we highlight the result of our variable HHI*DFL, which presents statistical significance at 1% level and negative signal. Such result indicates that financial leverage may play important role on commerce firms’ strategy and that DFL may exert major impact on firms of commerce sector, concomitantly with market structure, being the leading leverage that impacts firm performance.
| Variables          | Full            | Industry        | Commerce       | Services        |
|-------------------|-----------------|-----------------|----------------|-----------------|
|                   | (1)             | (2)             | (3)            | (1)             | (2)             | (3)            | (1)             | (2)             | (3)             |
| Constant          | 2.428***        | -0.201          | 8.855***       | -0.236          | 8.598***        | 0.535          | 1.628*          | -136.3***       | 1.784**         | -7.360*         | -25.73          |
|                   | (15.51)         | (-0.709)        | (20.19)        | (17.43)         | (-0.670)        | (17.42)        | (1.062)         | (1.767)         | (-4.197)        | (2.317)         | (-1.664)        | (-0.660)        |
| DOL               | -8.744***       | -6.912***       | -9.755***      | -7.994***       | -6.009***       | -6.634**       | -11.72***       | -12.53***       | -66.55          | -9.606***       | -4.353          | -198.8**        |
|                   | (-7.529)        | (-6.242)        | (-3.345)       | (-6.653)        | (-4.936)        | (-2.287)       | (-2.592)        | (-3.058)        | (-1.094)        | (-2.831)        | (-1.419)        | (-2.477)        |
| HHI               | -9.809***       | -8.821***       | -37.87***      | -11.36***       | -9.937***       | -40.39***      | -1.085          | -18.60          | 265.6***        | -1.402          | -1.255          | -96.71          |
|                   | (-21.18)        | (-20.47)        | (-34.29)       | (-23.75)        | (-21.16)        | (-34.26)       | (-0.820)        | (-1.521)        | (3.713)         | (-0.976)        | (-0.871)        | (-1.274)        |
| DFL               | 2.942***        | -9.664***       | 3.082***       | -10.18***       | 7.267           | 298.4***       | 9.244**         | 27.58           |                 |                |                |                |
|                   | (8.896)         | (-17.36)        | (8.776)        | (-17.53)        | (1.446)         | (4.507)        | (2.055)         | (0.695)         |                 |                |                |                |
| HHI*DOL           | 25.37***        | 24.99***        | 230.7          | 961.1***        |                 |                |                |                |                 |                |                |                |
|                   | (2.883)         | (2.822)         | (1.493)        | (3.389)         |                 |                |                |                |                 |                |                |                |
| HHI*DFL           | 42.27***        | 48.97***        | -614.1***      | 98.76           |                 |                |                |                |                 |                |                |                |
|                   | (28.87)         | (29.17)         | (-4.282)       | (1.268)         |                 |                |                |                |                 |                |                |                |
| DOL*HHI*DFL       | -27.26          | -62.55***       | 81.25          | -894.9***       |                 |                |                |                |                 |                |                |                |
|                   | (-1.157)        | (-3.092)        | (0.398)        | (-3.004)        |                 |                |                |                |                 |                |                |                |

TABLE 5

Outputs subdivided by sectors
### Variables

| Variables         | Full       | Industry  | Commerce  | Services |
|-------------------|------------|-----------|-----------|----------|
|                   | (1)        | (2)       | (3)       |          |
| DOL*DFL           | -7.916     | -4.942    | -89.20    | 135.0    |
|                   | (-0.782)   | (-0.582)  | (-1.074)  | (1.437)  |
| Size              | -1.68e-08*** | -1.58e-08*** | -1.29e-08*** | -1.28e-08*** |
|                   | (-11.30)   | (-11.06)  | (-7.928)  | (-2.946) |
| Num. Obs.         | 13,497     | 13,497    | 13,497    | 13,497   |
| R²                | 4.90%      | 5.40%     | 8.20%     | 9.10%    |
| Adjusted R²       | 4.83%      | 5.34%     | 8.18%     | 9.10%    |
| Industry Control  | No         | No        | No        | No       |
| F-Stat            | 292.2***   | 243.4***  | 371.5***  | 306.8*** |

### Source

Elaborated by the authors.

**Notes:** Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. (1) for Model (1) that represents DOL and HHI regressed against ROIC; (2) for Model (2) that represents DOL, HHI and Size regressed against ROIC; (3) for Model (3) that represents DOL, HHI, Size, DOL*HHI and DOL*HHI*Size regressed against ROIC.
For commerce sector, our model (3), which is the most robust model, rejects H1 and H3. The second hypothesis is accepted under model (3) approach, which indicates a more prominent force of capital structure on firms’ performance than operational factors and we find a moderating effect of market structure over DFL, which opens a debate over most suitable metrics.

**Services**

The Services sector show statistical significance for DOL in our model (1), at 1% level with negative signal, and in our model (3), at 5% with negative signal. Market structure do not shows statistical significance and DOL shows at our model (2), at 5% level and positive signal. The results regarding the signs of the variables are within our expectation and presents as the same signals observed for Industry sector and for our Full Sample. The inclusion of DFL in our regression captures the statistical significance of DOL found in model (1). However, the inclusion of our moderating variables in model (3) changes again the statistical significance. This result once again suggest that a composition between DOL and DFL, considering market configuration, is required to firms be able to perform operationally better than the sector mean.

When compared with our Full Sample, we can observe that HHI have more influence on firms’ operational performance due to the decrease of coefficient. In addition, the models output shows for Size statistical significance at 1% level and coefficient decrease, which indicates that larger firms have worse operational performance than mean in Services sector.

Services sector market configuration is classified as monopoly, with a HHI of (0.6690) and greater adherence of model 3 where previously expected in comparison with Commerce sector. The statistical significance level at 1% of both of our moderated variables, and signals that concurs with Industry sector results, indicates an influence of market structure and increase of DOL effectiveness when the metric is applied to markets that are at equilibrium. To services sector, the second hypothesis were rejected. The first and third hypothesis, which composes the main objective of the present research are accepted, with the expected signal.

**CONCLUSION**

Our findings suggest that market structure exert a moderator effect on the relation between DOL and ROIC for Industry and Services sectors, at Brazilian market. The findings are in accordance with the literature that indicates that perfect markets is an assumption of the CVP analysis and would be wise to managers consider the market structure of firms’ sector when using the tool. In addition, the results the results signalize a firms’ adjustment a firms’ adjustment of production considering the structure of the market that they are competing. For Commerce sector, our results evidence greater relevance of the DFL on firm performance.

Following previous researches at the Brazilian Brazilian market that approach the relation between DOL and returns, we found a negative relation between ROIC and DOL, with model
(3) approach, for Full Sample, Industry and Services, independently of competition level. Our findings align with previous researches and shows that an increase of operating leverage lead to worse operational performance (DANTAS, MEDEIROS and LUSTOSA, 2006; LUSTOSA and FRANÇA, 2012) and we expand the literature by comparing firms’ performance with sector mean. Additionally, our study indicates the existence of a moderating impact of market structure on firms’ operational performance, except for Commerce sector.

Our findings concurs with Liu (2018) that shows that higher competition level is associated with lower firm performance, and expand such findings by indicating that managers adjust their DOL to increase operational performance. Furthermore, Zhang (2016) supports such findings by presenting evidence of a link between product market competition and strategy-performance. The addition of DFL to increase the robustness of our research, following Campanella and Serino (2019), presents as important explanatory factor for our commerce sector. Commerce sector in our most adjusted model, indicates a more prominent impact of DFL on firm performance.

The addition of DFL, in a double-moderation analysis, aids our understanding of the market structure effects on firms’ costs behavior and operational returns and we find a statistical significance at 1% level to Industry and Services sectors, both with a negative signal. Such result indicates that even when a capital structure related variable is included in our model, the impact of DOL on ROIC remains and market structure also moderates such relationship, seen in our HHI*DOL variable.

The first model being statistically significant for all sectors and groups shows a relationship between operational performance and costs behavior. When we compare HHI coefficient between sectors, we can identify that when market structure walks toward strong oligopoly market the explanatory capacity of model (3) decreases. Industry shows an HHI of 0.4317 and statistical significance for all models. Services, with HHI of 0.669, results lead to accept our first and third hypothesis. However, Commerce results, with a HHI of 0.569, lead us to accept only our second hypothesis. The results also suggest that the market structure is relevant for firms’ operational performance, however moderation only occurs with markets at approximately of markets at equilibrium, which aligns with the Wickramansinghe (2007) perspective. It suggests that when market goes toward competition, firms’ need to adjust their cost structure to equalize with market structure to remain efficient and competitive.

Our research contributes to the literature by providing evidences that DOL metric is more adjusted for markets at equilibrium. Furthermore, our findings indicates that at strong oligopolistic markets, DOL may not be able to provide managers with a more adjusted results for decision making, with DFL showing more statistical significant results. Also, our main objective, which was to analyze the moderating effect of market structure on the relationship between ROIC and DOL is satisfied by the results presented by model (3) that shows the existence of market structure moderation.

Some limitations are intrinsic to the present research results. Due to the empirical characteristic, and as major empirical researches, the results are limited by the observed sample. As consequence, any inference or statement beyond the observed sample must be cautious. Our sample is unbalanced, and it may affect characteristics of the information. The research also has
a survival bias, due to the exclusion of missing values. The research approach of proxies also takes all limitations that characterize the methodology.

For further research, we indicate alter the sector criteria considering the production chain of each sector; apply Mandelker and Rhee (1984) approach of regression as a mean to measure the DOL and control the model by crisis, analyzing firms’ behavior during time of uncertainty. Also, we indicate an analysis of the main metrics that answers to operational performance at strong oligopolistic markets. Furthermore, HHI as a market structure proxy, despite of its refinement, are not the only proxy possible for market structure. Analyze environmental dynamism may contribute to our analysis, especially at developing markets.
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