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**THE MODERATING ROLE OF MARKET STRUCTURE ON THE RELATIONSHIP
BETWEEN FIRM OPERATIONAL PERFORMANCE AND DEGREE OF
OPERATING LEVERAGE**

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Dissertação de Mestrado apresentada ao Programa de Pós-Graduação em Ciências Contábeis do Centro de Ciências Jurídicas e Econômicas da Universidade Federal do Espírito Santo, como requisito parcial para obtenção do título de Mestre em Ciências Contábeis.

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*Àqueles que me concederam o dom de existir e sentido para viver,
meu eterno e incondicional amor. Aos que passaram pela minha
vida e se foram e deixaram um pedaço de si, minha mais profunda
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It ain't what you don't know that gets you in trouble. It's what you know for sure that just ain't so. – Josh Billings.

There is no such thing as free lunch. – Milton Friedman.

ABSTRACT

This thesis investigates the moderation role of market structure on the relationship between operational performance and firms' costs composition. The Herfindahl-Hirschman Index (HHI) were adopted as proxy for market structure; for operational performance, Return on Invested Capital (ROIC); and for firms' cost choices, the Degree of Operating Leverage (DOL). The database covers non-financial firms at Brazilian market from 1996 to 2016, third quarter. The output points toward to market structure moderation of the relationship between ROIC and DOL with an increase of the effect when markets comes near to a monopolistic structure. Overall results suggests the existence of a relation between firms' operational performance and cost behavior, indicated by a negative relationship between ROIC and DOL. Furthermore, we notice a moderating role of Size on market structure (HHI) moderation role on the relationship between ROIC and DOL, in the extent that market structure 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 Structure. Size, Moderation.

RESUMO

Esta dissertação investiga o papel de moderação da estrutura de mercado na relação entre desempenho operacional e composição dos custos das empresas. Como proxy para a estrutura de mercado, adotou-se o Índice Herfindahl-Hirschman (HHI); para o desempenho operacional, foi utilizado como proxy o retorno sobre o capital investido (ROIC); e para composição dos custos das empresas, o Grau de Alavancagem Operacional (DOL). A base de dados abrange empresas não financeiras no mercado brasileiro de 1996 a 2016, terceiro trimestre. Resultados apontam que a estrutura de mercado modera a relação entre ROIC e DOL, tendo maior efeito há medida que os mercados se aproximam de uma estrutura monopolística. Resultados em geral, sugerem a existência de relação entre o desempenho operacional das empresas e comportamento dos custos, indicado por uma relação negativa entre ROIC e DOL. Observa-se, também, um papel moderador significativo do Tamanho na função de moderação da estrutura de mercado (HHI) na relação entre ROIC e DOL, na medida em que a estrutura do mercado avança para configurações próximas do monopólio, o efeito moderador HHI torna-se mais latente.

Palavras-chave: Grau de Alavancagem Operacional. Retorno no capital investido. Estruturas de mercado. Tamanho. Moderação.

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1. INTRODUCTION

This research examines the moderating role of market structure on the relationship between firm operational performance and the cost structure, using return on invested capital (ROIC) as proxy for firm operational performance and the degree of operating leverage (DOL) as proxy for cost behavior, for non-financial Brazilian public firms.

Financial performance has nonfinancial measures as leading indicators and it justifies their use as measure of performance evaluation (BANKER; MASHRUWALA, 2007), we adopt the Cost-Volume-Profit (CVP) approach, according to the neoclassical economic theory of markets at equilibrium (FRANÇA; LUSTOSA, 2011; LUSTOSA; 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 in our sectors independently of the sectors competition level. The introduction of Size as a moderating variable of the Herfindahl-Hirschman Index (HHI) moderating role, also aligns with the Porter (1979) and Marcus (1969) findings that indicates the importance of analyzing the size impact on profitability of firms within an industry.

The traditional CVP analysis derives from the economic optimization concept under uncertainty. Based on the premise that Marginal Costs (MC) and Marginal Revenues (MR) are only impacted by Fixed Costs (FC) on the short run, the CVP analysis allows to build the idea of Contribution Margin (CM), which means the difference between price and variable costs (ADAR; BARNEA; LEV, 1977).

The management accounting literature views the firm's profit maximization through production approach, without consider exchange and consumption problems, at least for items that are not of first-order concern. Markets that tend to equilibrium reduce the role of the management in generating greater profits, since there is no economic profit at perfectly competitive markets. Under this perspective, management researchers focus their effort to a partial equilibrium orientation (BROMWICH, 2006). On the other hand, DOL implicitly accepts a perfect and

complete market as main economic environment and model relies on the premise that firms operate in a perfect competition or monopolistic market (KARNANI, 1983).

Under a deterministic microeconomic analysis, firms in perfectly competitive markets are price-takers, which means that they have to operate with the ratio $\frac{MR}{MC}$ close one to have a positive Contribution Margin (CM) and be more profitable (LUSTOSA; FRANÇA, 2012). On the other hand, firms operating with high monopoly power tend to operate outside the economic equilibrium point where marginal costs and marginal revenues ratio is equal to one, since they are price-makers. For example, monopolistic firms may operate with idle capacity to respond market demand fluctuations or use this idle capacity as an entry barrier (THOMPSON; FORMBY, 2002), which do not correspond to a perfect market equilibrium and may lead to worse operational performance.

Banker and Mashruwala (2007) argues that the relation between non-financial measures and financial performance can only be understood when competition is take into account. Porter (1989) states that competition shapes firms' strategy and markets tend to vary between perfect competition levels and monopoly. Accepting the existence of market power, firms pursue competitive advantage to gain economic profits and more market power. Assuming that the main objective of the firm is to generate more profit, there is a deterministic force that drives managers to take optimal decisions that also affect costs behavior and plant size.

Managers tend to be risk-takers in order to increase firm revenues. The firm leverage over its systematic risk can be measured by DOL (GAHLON, 1981), and have been modeled in several studies (CHUNG, 1989; DANTAS; MEDEIROS; LUSTOSA, 2006; DARRAT; MUKHERJEE, 1995; DUGAN; MINYARD; SHRIVER, 1994; FRANÇA, 2012; GAHLON, 1981; GRIFFIN; DUGAN, 2003; HODGIN; KIYMAZ, 2005; HUFFMAN, 1983; LUSTOSA; FRANÇA, 2012).

Considering previous researches, as shown above, we face a problem that take into account those findings and lead us to the following research problem: **Is the relationship between firm's operational performance and the degree of operating leverage subject to the moderation of market structure?**

Through an operational proxy, consists as research main objective:

Objective: Investigate the relationship between firms cost behavior and firms performance and observe the existence of a moderating influence of market structure on the relationship.

As consequence, the research is subdivided in secondary objectives that provide the support to further analyses:

O₁: Investigate the relationship between cost behavior and risk metrics with firms' operational performance.

O₂: Investigate the relation between cost behavior and risk metrics with firms' operational performance when moderated by market structure.

O₃: Investigate the impact of firms' size, as a moderator of the market structure moderation, on the relation between cost behavior and risk metrics.

The CVP approach has its origins in the neoclassical economic theory (WICKRAMASINGHE; ALAWATTAGE, 2007) and addresses allocation problems, since managers face the economic problem of scarcity. In addition, managers can take it as a tool to allocation problems decisions (DOPUCH; BIRNBERG, 1969; KARNANI, 1983). Despite its utility, the CVP premise that firms operate in a perfect competition or monopolistic market (KARNANI, 1983), lead us to investigate the impact of market structure on the relation between operational risk and operational returns.

Following Adar and Barnea (1977) construction of CM, we may expect that firms adjust their production considering the market they compete in. Firms that compete in markets with higher competition level tend to present better overall performance when they adjust their DOL to a lower level (LUSTOSA; FRANÇA, 2012), maximizing the production factors usage, since the firm do not hold any market power.

Empirical research on operating leverage in Brazilian market is still incipient, with few evidences of this issue in emergent market (DANTAS; MEDEIROS; LUSTOSA, 2006; FRANÇA, 2012; LUSTOSA; FRANÇA, 2012). These studies do not verify the influence of market structure on the relationship between operating leverage and returns. For example, França (2012) analyzes only Manufacture industry as a competitive market; Dantas *et al.* (2006) research also does not consider different market structures. Our approach answers to economic

theory not only by adopting the CVP approach, but also by considering the market structure of firms' industry to fill this gap on the literature.

This chapter shows a preview of the following inquiry, contextualizing and presenting motivations and justification. The following chapter provides the theoretical basis for hypothesis development, presenting the main researches and concepts that permeate the following study and supports the hypothesis structuring. The third chapter will present the applied methodology, describing the sample selection, variables construction. The fourth chapter presents the econometric issues. The fifth debates the main results of the econometric models. The sixth is our conclusion, brings possibly implications of research discoveries, debates the research limitations and indicates further researches.

2. HYPOTHESES DEVELOPMENT

2.1. MARKET STRUCTURE

The economic theory of the firm analysis the relation between a single firm and its industry, and states that the output result is the outcome of the market forces, considering market price (ALDRICH; PFEFFER, 1976). Differences in market-structure impacts on price and production decisions of competing firms on their industries (MAS-COLELL, WHINSTON; GREEN, 1995; THOMPSON; FORMBY, 2002). Under this concept, Besanko (2006) argues that the firm relies its conduct considering the market competitiveness. Also, at perfectly competitive markets, accounting numbers and economic theory are able to converge (BEAVER; DEMSKI, 1979), since there are no opportunity costs and we can identify that firms as price-takers and consider that MR and MC ratio is equal to 1 (FRANÇA, 2012).

Competition level and market-share are also broadly analyzed due to its importance for the firm management decisions and profitability generation capability (GALE, 1972; RHOADES, 1993; SCHERER, 1965; SHEPHERD, 1972). However, assuming that markets, in general, price is not characterized as a certain item, as seen in Baron (1970) under economic perspective, and Jaedicke (1964) in managerial approach.

Particular strategic orientation is impacted by the level of market dynamism where the firm competes (HAMBRICK, 1983; MCKEE, VARADARAJAN; PRIDE, 1989; SNOW; HAMBRICK, 1980), suggesting a link between business performance and competition, as an environmental condition.

There is empirical evidence that alterations at economic conditions imposes significant limitation to firms (HALL, 2004), so that the competition plays a moderating effect between nonfinancial indicators and financial performance (BANKER; MASHRUWALA, 2007). Also, an increase of competitiveness and structural uncertainty exert opposite effects at the managerial ties capability of fostering firms' performance in an emergent market (LI; POPPO; ZHOU, 2008).

Banker and Mashruwala (2007) show that nonfinancial measures of performance may make sense in high competitive markets since that market structure gives power to consumers to

choose the same product offered by different firms and to employees more firms to work. But in near monopoly markets that affirmative may not be true for the opposite reasons.

The relation between competition level with firms' characteristics shown by previous studies denotes the necessity to consider the impact of the industry structure in our analyses. Then, we take managerial issues, such as plant size and cost structure, as the main decision due to its impact on firms' operating capacity. Those decisions also determine the minimum selling price and production volume, leading us to the analysis of the structure and operating risk.

2.2. 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 (BESANKO *et al.*, 2006; PORTER, 1979), with firms inserted in a causality chain where firm's size influences its performance (THOMPSONSON; FORMBY, 1996).

However, under an operational perspective, Size may lay different roles. On firms' strategy, it may act as a barrier to entry, or be a source of economies of scale. On the other hand, Size also may corrode firms' operational performance by operating with idle capacity and making the firm susceptible to market fluctuation with more rigid structure, considering market configuration. Firms' cost structure may lead the firms to under-optimum resources remunerations especially in near perfect competition markets and to a lower operational performance, as consequence.

Fiegenbaum and Karnani (1991) pointed to the necessity of big firms to operate with intense exploration of economies of scale. Also emphasizes that there is 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 that the smaller firms do not incurs in economies of scale, managers are encouraged to perceive better performance by other means.

The presence of small firms responds to theoretical requirements for the classical economists' theory of perfectly competitive markets, where perfect competition plays its role at its fullest. On the other hand, a market with small number of firms (or even one firm) tends to the

monopolistic aspect of market configuration. The fluctuation between those two extreme points that market structure indicates an intrinsic relationship between size, operational performance and market structures. It also justifies the analysis of the moderating role of size on the moderation of market structure on the relationship between the operational performance and firms' cost behavior.

Researches have shown the relationship between increasing returns to scale and higher wages payment (PULL, 2003), with faster employment adjust for small Dutch firms (LEVER, 1996), and indications that small size is the optimal firm size for export-oriented firms in Taiwan, when considering the relationship between size and productive efficiency (CHUANG, 1999).

Marcus (1969) findings indicates 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 prior literature, we believe that size act as moderator of the moderating role of market structure on the relationship between DOL and operational performance.

2.3. X'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; BIRNBERG, 1969). The CVP analysis is a simple analytical tool for management decisions (GUIDRY; HERRIGAN; CRAYCRAFT, 1998) that provides a wide financial overview of firms' decision process (HORNGREN, FOSTER; DATAR, 1994).

Based on economic model of optimal output decision under uncertainty, Adar, Barnea and Lev (1977) presented a comprehensive approach to CVP analysis. They provide a model where the managers can make decisions due to determination of optimal output, considering the expected return of alternative plans involving changes in costs, price and technology. The model can also determine the economic consequences of fixed costs variance, and the results have more broad range than only CVP analysis and fixed-cost variance analysis. The model also reaches

accounting problems such as common-cost allocation, transfer pricing systems and joint product pricing for divisionalized firms, by assuming price as the only source of uncertainty related to variable and fixed costs, which equals to determine the income through the difference between Contribution Margin and Total Fixed Costs. Under certainty, fixed costs do not have relevance.

The accounting approach of cost structure analysis considers the linearity of fixed costs and fixed expenses, sales prices and variable costs per unit. Such relation assumes that, when firms approach the accounting break-even point, the income tends to zero, while Contribution Margin (CM) and fixed costs and expenses ratio tends to one. A production beyond the accounting break-even point generates a CM and fixed costs plus expenses ratio greater than 1, while income tend to be greater than 0. In competitive markets, accounting information have the informational capability that allows economic agents to take investment decision in order to increase their utility, since accounting numbers can capture changes on firm's structure. However, economic results do not characterizes as an accounting information, impairing the approach applicability.

To solve it, researchers have used the DOL as a proxy to capture how market reacts to results of managerial decisions. Theoretical and empirical researches related to DOL aim to reveal a relationship between the metric and the operating income, under effect of other variables as sales and costs (DUGAN; MINYARD; SHRIVER, 1994; DUGAN; SHRIVER, 1989; FRANÇA, 2012; GAHLON, 1981; HORNGREN; FOSTER; DATAR, 1994). França and Lustosa (2011) establishes an optimal production level using mathematically determined DOL as reference for competitive markets, which allows the economic agent to determine when firms are operating at an optimal level or with idle capacity (leveraged in fixed cost).

Following this argument, it is possible to establish a relation between operational leverage and the law of diminishing returns (FRANÇA, 2012), so that an increment of a productive factor leads to an increment less than proportional on productiveness, *ceteris paribus* (THOMPSON; FORMBY, 2002). We assume the Operating Income by the function:

$$OI = CM - FC_t \quad (1)$$

Where OI is operating income, CM is contributing margin and FC_t total fixed cost. Comprehending CM as constant at unitary terms of each production level until the point of inflexion. Accounting concepts identifies increasing returns when the firm has a positive DOL, combining production volume and installed capacity. Neoclassical economic theory, however, focuses on acquiring the highest possible benefit level, anchored at the diminishing returns premise.

In this point of view, performance analyses considering DOL as independent variable, answers to neoclassical economic theory of competition markets by two aspects, as shown by França (2012): First, by the intersection between the curves of Sales Prices and Total Cost that indicates the firm's accounting break-even point, measured by:

$$BE = \frac{FC_t}{CM_{unit}} \quad (2)$$

Where BE are the break-even point, which is represented in terms of volume, since the denominator has unitary volume representation; FC_t total fixed costs and fixes expenses; and, CM – or Contribution Margin – which is represented at unitary terms.

The second aspect emerges from the firm revenue. At this point, the revenue is equalized to costs, indicating the minimum point of the firm's revenue so that it does not 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. The function shows that the revenue generated by each new sold unity may vary positively or negatively, since that a reduction on prices would increase the product demand, *ceteris paribus*. 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; 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).

DOL also explains why value premium is weak across industries and strong within industries as shown in a recent research (NOVY-MARX, 2011).

2.4. RETURN ON INVESTED CAPITAL – ROIC

The accounting income configures as the main contribution of the accounting model to the firm and interested parties on the business, due to its characteristics, specifically, to accrual basis premise, which demands the confrontation of revenues with the expenses and costs necessary to generate them. The accounting metric reflects the performance of a firm in a given period, regardless of the financial flow linked to the operation (PENMAN, 2010).

Empirical researches that are based on the accounting model, adopt proxies from the accounting numbers 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 (LOUZADA, 2015).

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.

According to Simons (1999), Hough (2006), Misangyi *et al.*, (2006), Chen and Huang (2006) and Goldszmidt (2010), the ROIC excludes the interests and taxes effects, seeking to isolate the operational return of the available operational resources to the firm. 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, it configures as a relation between operational profits and operational revenues, acting as a reliable investment decision indicator (LOUZADA, 2015).

2.5. HYPOTHESES

At Brazilian market, the relationship between returns and DOL has been studied by Tabak and Guerra (2002), Dantas *et al.* (2006), Lustosa and França (2011) and França and Lustosa (2012). França and Lustosa (2012) points that in a near competitive market that is a negative relationship between DOL and returns. 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 Operational Performance.

Nature and degree of competition shapes firms' strategy (PORTER, 1989). Considering that market structure impacts on firms' costs behavior and industry returns. Then, we hypothesize that:

H_2 – The relation between operational return and cost behavior is moderated by the market structure, measured by market competition level

As literature suggests, size may have significant impact on firm performance, as source of organization costs (SHEPHERD, 1972) or as source of scale economies (BESANKO, 2006; THOMPSON; FORMBY, 2002; VARIAN, 2006). Considering the relation between organizational variables and economic variables and that firms' size may influence on firms' operational performance and market structure, we hypothesize that:

H_3 – Market competition level moderation of the relationship between operational return and cost behavior is moderated by firms' size.

Figure 1 represents the 3 hypotheses in the research design:

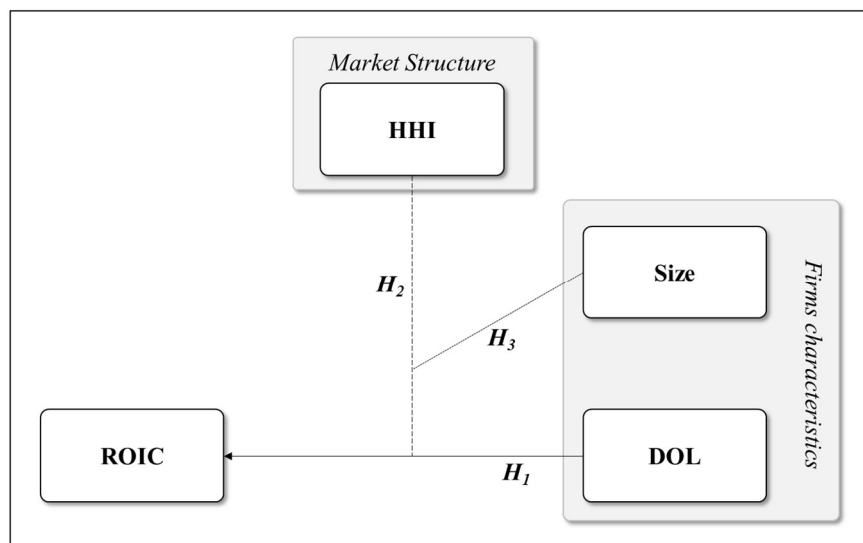


Figure 1 – Hypotheses design.

The following chapter presents the applied methods, in order to define our sample, the variables construction and the applied econometric issues.

3. METHOD

3.1. VARIABLES

3.1.1. Performance Measurement: Return on Invested Capital (ROIC)

We use the Return on Invested Capital (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):

$$ROIC = \frac{EBITDA_t}{Asset_Adj_t} \quad (3)$$

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.

These three income measures consider the amount of embedded taxes. Net Income, NOPLAT and NOPAT are limited proxies for our analyses since they capture taxes, and we are looking at the firm's operational capability to generate profit. As long as the firms are competing, their fixed capital structure will respond differently to the same level of production, which reflects different depreciation levels, as captured by EBIT.

3.1.2. 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) on the following equation to calculate the traditional observed DOL:

$$\frac{\Delta OI_{i,t}}{\Delta(NR_{i,t})} \quad (4)$$

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.

3.1.3. Market Structure

Dhaliwal *et al.* (2008) and Gjerde *et al.* (2002) concurs that industry specific facts exert impact on firm performance variability. In this perspective, we may use the Herfindhal-Hirshman as a metric of product market competition. According to Besanko *et al.* (2006), the index is captured by the function:

$$HHI = \sum_{i=1}^n (\text{Market} - \text{share}_i)^2 \quad (5)$$

Where *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.

Table 1 shows the market structure classification of the research. We follow Besanko (2006) approach for the HHI.

Table 1 - Market Structure and Competition Level

| Nature of Competition | Range of Herfindahls | Intensity of Competition |
|--------------------------|----------------------|---|
| Perfect Competition | Usually bellow .2 | Fierce |
| Monopolistic Competition | Usually above .2 | Fierce or light, depending on product differentiation |
| Oligopoly | .2 to .6 | Fierce or light, depending on interfirm rivalry |
| Monopoly | .6 and above | Light, unless that is an entry threat |

Source: Besanko (2006).

Besanko *et al.* (2006) consider the relative size of the biggest firms to be a major factor on the management and, consequently, on the performance. Then, the information quality conveyed by the HHI justifies its usefulness.

3.1.4. 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.

The firm's size is given by the following equation:

$$\text{Size} = \text{Firm's total assets} - \text{Mean sector's asset} \quad (6)$$

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.

4. DESCRIPTIVE STATISTICS

4.1. DATA SELECTION AND TREATMENT

4.1.1. Data Selection

Firms listed at BM&FBovespa between 1998 and 2016 compose the sample. We exclude firms from Financial, Funds, Security industries due to its intrinsic characteristics. Also, sectors under regulation demand a different approach due to different sector dynamics, which may impact on the observed firms returns.

Table 2 - Sample Selection

| Sectors | Original | Sub-sample |
|---|------------|------------|
| Farming | 9 | 9 |
| Food Processors & Beverage | 51 | 51 |
| Commerce | 35 | 35 |
| Construction and Engineering | 11 | 11 |
| Electronics and Household Appliance | 20 | 20 |
| Electric Utilities | 87 | - |
| Financial Intermediaries & Securization | 157 | - |
| Financial Management and Mutual Funds | 3 | - |
| Machines and Equipments | 11 | 11 |
| Mining | 13 | 13 |
| Non Metalics | 9 | 9 |
| Others | 208 | - |
| Wood and Paper | 13 | 13 |
| Oil, Gas and Biofuels | 11 | 11 |
| Chemicals | 43 | 43 |
| Steel and Metalurgy | 52 | 52 |
| Software and Services | 5 | - |
| Textiles | 39 | 39 |
| Transportation | 74 | 74 |
| Vehicles and Components | 28 | 28 |
| Total | 879 | 419 |
| Percentage | 100% | 57.56% |

Source: Author

The characteristics of our research and characteristics of some sectors demand not to consider all database. In addition to the exclusion of the *Finance and Insurance* and *Funds* sectors due to their specific regulations, *Others* sector were excluded due to the difficult to stablish firm

market competition level. The *Energy* sector exclusion is due to the strong regulation and other industry specific characteristics. *Software and data* exclusion occur due to the reduced number of observations. The report of exclusions is shown on Table 2 that discriminates the database per sector. All data were non-consolidated and obtained at ECONOMATICA[®] and 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 were applied to missing values. Table 3 shows the number of excluded observations:

Table 3 - 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: Author

From the original 26.571 observations that remained after our first sample selection by exclusion of subsectors, we found 13.497 observations in our database that compose the Full Sample after the second sample selection. As represented on Table 3, Negative EBIT shows as the main reason for observation exclusion with 10.665 observations exclusions.

4.1.2. Data Treatment

Previous analysis on our dependent variable shows the ROIC mean greater than median¹, which suggest a positive skewness; kurtosis, denoting a high level of information in the extremes of the distribution; and, we observe a maximum value of 5,745.80, which causes an expressive difference between mean and median for our dependent variable. In addition, there is a large distance between median and maximum value, denoting an asymmetry distribution. As consequence, ROIC shows a high standard deviation, which denotes a presence of outliers on

¹ As show on table 15 at append.

the distribution. Outliers may disturb the regression significance, and the selected procedure was the exclusion of outliers.

Taking into account 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; MARLIN, 1991, p. 44), which is what we aim to capture with those variables in our research. Table 4 shows the final sample descriptive statistics²:

Table 4 - Descriptive Statistics

| Stats | ROIC _c | DOL _{rg} | HHI | SIZE _{rg} |
|----------|-------------------|-------------------|-----------|--------------------|
| N | 13,497 | 13,497 | 13,497 | 13,497 |
| mean | -0.7925132 | 0.0094421 | 0.2583533 | 0.0875421 |
| sd | 7.813952 | 0.0457071 | 0.176205 | 0.1570579 |
| kurtosis | 602.7083 | 326.3715 | 6.750022 | 14.36719 |
| skewness | 18.54133 | 16.55806 | 1.698413 | 3.217954 |
| cv | -9.859712 | 4.840796 | 0.6820311 | 1.794085 |
| min | -18.93342 | 0 | 0.0677249 | 0 |
| max | 353.9422 | 1 | 0.8766502 | 1 |
| p25 | -2.679531 | 0.0010099 | 0.1276707 | 0.0073415 |
| p50 | -1.490238 | 0.0021058 | 0.2569522 | 0.0284723 |
| p75 | 0.1536622 | 0.0066064 | 0.3479501 | 0.0866556 |

Notes: (i) ROIC_c represents the centered Return On Invested Capital; (ii) DOL_{rg} 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) Size_{rg} represents the firm size in range.

The ROIC treatment, in turn, considers the variable and study object characteristics. Differences between sectors structure lead to differences on firm operational return exigencies. Centering the variable allows a more trusted analysis, since the comparability analysis refers to the distance of firms ROIC from the sector ROIC mean.

The treatment enhanced the quality of the variables. The outlier exclusions solved the high standard deviation and mean greater than median problems with the dependent variable, allowing to consider ROIC in range and proceed with the research. It is noteworthy that the

² Descriptive statistics with outliers on append, table 16.

negative ROIC observations, after we center the variable, do not represent negative ROIC effectively, but how distant the observation is from the corresponding sector mean.

4.2. MARKET STRUCTURE

For data exploitation and additional tests, we also investigate subsectors HHI, which represents the market competition level for each subsector within the three sectors. For robust analyses, the competition level was determined for each subsector to maintain the analysis of firm performance in comparison with the market competition level of its subsector. Table 5 represents the HHI for each subsector and the competition level classification in accordance with the approach adopted by Besanko (2006):

We identify 18 subsectors in our full sample, grouped in three sectors. From those 18 subsectors, we identify one perfect competition sector, eleven oligopolistic sectors and six near monopoly sectors on our database, which indicates the low level of competitiveness at Brazilian market. The output of grouping the sub-sectors into sectors are demonstrated in the following Table 5, which represents the HHI that we adopt in our models.

When the index walks toward zero, we have less monopolistic power, which means that when the coefficient comes near zero the market walks toward competitiveness. When the HHI is over 0.6, we have more concentration, which means that the market has more monopolistic structure characteristics. This interpretation is aligned with Besanko (2006) approach, as demonstrated at Table 1.

We categorize the Industry and Commerce subsectors of our sample as Oligopolistic markets due the mean HHI observed for those sectors. The Industry sector, however, shows itself as the more approximated of a perfectly competition market, when compared with other sectors of our sample. Commerce have only two highly polarized subsector allocated in it. Services shows the lowest dispersion and the subsector is classified as a monopolistic market.

The intrinsic market characteristics and the reduced quality level of data at Brazilian market may play a major role on the explanation of the observed behavior for all variables. The treatment that we applied are in the best of our knowledge the preferred treatment for the problems that we faced during the research.

Table 5 - Subgroups Market Structure

| Sectors | Subsectors | Observations | Mean | Classification |
|-----------------|-------------------------------------|---------------------|---------------|-----------------------|
| <i>Industry</i> | Textiles | 2,342 | 0.1277 | Perfect Competition |
| | Steel and Metalurgy | 3,546 | 0.2312 | Oligopoly |
| | Food Processors & Beverage | 3,681 | 0.2504 | Oligopoly |
| | Wood and Paper | 870 | 0.2580 | Oligopoly |
| | Vehicles and Components | 1,7 | 0.3480 | Oligopoly |
| | Non Metalics | 674 | 0.3507 | Oligopoly |
| | Chemicals | 3,03 | 0.3523 | Oligopoly |
| | Electronics and Household Appliance | 1,369 | 0.4641 | Oligopoly |
| | Software and Services | 324 | 0.5156 | Oligopoly |
| | Machines and Equipments | 720 | 0.5483 | Oligopoly |
| | Oil, Gas and Biofuels | 495 | 0.8581 | Monopoly |
| | Mining | 822 | 0.8767 | Monopoly |
| | Mean | 19,573 | 0.4317 | Oligopoly |
| <i>Commerce</i> | Commerce | 2,481 | 0.2648 | Oligopoly |
| | Oil, Gas and Biofuels | 82 | 0.8581 | Monopoly |
| | Mean | 2,563 | 0.5614 | Oligopoly |
| <i>Services</i> | Transportation | 5,476 | 0.2570 | Oligopoly |
| | Construction and Engineering | 727 | 0.6842 | Monopoly |
| | Oil, Gas and Biofuels | 161 | 0.8581 | Monopoly |
| | Mining | 62 | 0.8767 | Monopoly |
| | Mean | 6,426 | 0.6690 | Monopoly |

Source: Author

The main result of the existence of this limitation regarding the database is the need of precaution when interpreting our outputs. Our variables are mainly endogenous and the difficulties that we face when considering data quality for the Brazilian market, as the low number of observations, prevents us to do any prevision about firms future behavior but allows us to look upon firms choices and analyze those choices impacts and indicate those who led the best output on the period.

4.3. CORRELATION

Table 6 shows the Pearson correlation for the variables used in the models. The results show multicollinearity problems between the variables. Varying between -1 and 1, any result close to the extreme points indicates a strong positive (negative) correlation between the variables.

Table 6 - Pearson's Correlation Matrix

| | ROIC_c | DOL_{rg} | Size_{rg} | HHI |
|--------------------|-------------------------|-------------------------|--------------------------|------------|
| ROIC _c | 1 | | | |
| DOL _{rg} | -0.0649*** | 1 | | |
| Size _{rg} | -0.0137* | -0.0239*** | 1 | |
| HHI | 0.000000 | 0.138*** | 0.0937*** | 1 |
| Observations | 35324 | | | |

Notes: (i) **ROIC_c** represents the centered Return On Invested Capital; (ii) **DOL_{rg}** represents the Degree of Operating Leverage in range; (iii) **Size_{rg}** represents the firm size in range; (iv) **HHI** represents the Herfindah-Hirschman Index, which contemplates the market competition level on the sector.

There is statistical significance for the correlation between the variables except for ROIC and HHI. However, all statistical significances coefficients were near zero, which denotes a weak correlation between variables. Some correlation level was predicted due to variables endogeneity.

4.4. VARIANCE INFLATION TEST

Variance Inflation test (VIF) verifies the existence of multicollinearity problems within the regression variables. Fávero (2009) argues that a VIF above five indicates the possibility of Type II errors occurs and, in a less conservative position, Gujarati (2006) suggest that multicollinearity problems occurs when VIF is above 10. Table 7 shows the VIF test for our variables.

Table 7 - Variance Inflation Test Results

| Variable | VIF | 1/VIF |
|-----------------|------------|--------------|
| DOL | 5.19 | 0.192708 |
| HHI | 1.47 | 0.680328 |
| DOL*HHI | 5.14 | 0.194553 |
| Size | 4.57 | 0.21865 |
| DOL*Size | 7.56 | 0.132329 |
| HHI*Size | 5.67 | 0.176521 |
| DOL*HHI*Size | 7.88 | 0.126826 |
| Mean VIF | 5.35 | |

Source: Author

Following Fávero (2009) we found that there is a small chance of errors Type II to occur, and in Gujarati (2006) perspective, our variables do not show multicollinearity problems.

5. MODELS AND ECONOMETRIC ISSUES

In order to test the hypotheses 1, the study demands the estimation of the models 1 and 2:

$$ROIC_{i,t} = \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \varepsilon_{i,t}$$

Where $ROIC_{i,t}$ means the Operational return over invested capital of the firm i at the quarter t ; $DOL_{i,t}$ represents the degree of operational leverage for firm i at the quarter t ; and, HHI represents the Herfindahl-Hirschman Index for firm i at the quarter t . Accordingly with the arguments exposed in section 2.3, we expect a positively relation between DOL and ROIC.

In addition, we estimate the model 2:

$$ROIC_{i,t} = \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \beta_3 Size_{i,t} + \varepsilon_{i,t}$$

Where $Size_{i,t}$ represents firms' size of firm i at the quarter t ; with the addition of Size at the model as control variable we expect to verify the impact of Size at firms operational performance.

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

$$\begin{aligned} ROIC_{i,t} = & \beta_0 + \beta_1 DOL_{i,t} + \beta_2 HHI_{i,t} + \beta_3 Size_{i,t} + \beta_4 DOL_{i,t} * HHI_{i,t} \\ & + \beta_5 DOL_{i,t} * Size_{i,t} + \beta_6 HHI_{i,t} * Size_{i,t} + \beta_7 DOL_{i,t} * HHI_{i,t} \\ & * Size_{i,t} + \varepsilon_{i,t} \end{aligned}$$

Where we test the moderating role of market structure on this relationship. Then, we expect the β_4 to be negatively related with the dependent variable, and this will weak the significance of the β_1 coefficient. Also, with the β_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 8.

Table 8 - Variables description

| | Variable | Expected signal | Name | Description | Reference | Syntax |
|----------------------|------------------------------|--------------------|------|--|----------------------------------|--|
| Interest Variable | Return On Invested Capital | Dependent Variable | ROIC | Captures operational performance of the firm, detached from the exposure among the industries. | (SIMONS, 1999; GOLDSZMIDT, 2010) | $ROIC = \frac{EBITDA_t}{Asset_Adj_t}$ |
| | Degree of Operating Leverage | Negative | DOL | Captures income sensitivity to a variation of the revenues. | (GARRISON. NOREEN, 2001) | $\frac{\Delta OI_{i,t}}{\Delta(NR_{it})}$ |
| Moderating Variables | Market Structure | ? | HHI | Captures market structure and its impacts on firms' operational performance. | (BESANKO, 2006) | $HHI = \sum_{i=1}^n (Market - share_i)^2$ |
| | 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) | $Size = \frac{Firm's\ total\ assets}{Mean\ sector's\ asset}$ |

Source: Author

All following models are robust. The next subtopics bring the results and debate the findings of our models.

5.1. FULL SAMPLE MODEL

We run the regression for our Full Sample, subdivided in three models that contemplates all variables. We aim to analyze if we have the evidences for the theoretical approach of market characteristics playing an important role in firm's performance (CAVES; CHRISTENSEN; TRETHERWAY, 1984). The microeconomic theory also points toward a major impact of market structure on firms' costs structure (MAS-COLELL; WHINSTON; GREEN, 1995) and McGahan and Porter (1997) shows the existence of a relation between firms' performance and industry specific effects. The table 9 presents the output of the three models of our research, when regressed for our Full Sample.

The model (1) considers the relation of DOL, with HHI as control variable, with firms' operational performance. Considering the relation between plant size and cost structure with firms' operational performance and the possible impact on firms' cost structure choices, model (2) add Size as control variable to measure the impact of firms' structure on ROIC.

Table 9 - Full Sample Output

| Variables | <i>Full Sample</i> | | |
|--------------------------------|------------------------------|------------------------------|------------------------------|
| | (1) | (2) | (3) |
| Constant | 1.924*** (17.05) | 1.909*** (16.40) | 2.667*** (15.34) |
| DOL | -6.533*** (-7.075) | -6.506*** (-7.045) | -6.946*** (-3.161) |
| HHI | -10.28*** (-25.34) | -10.28*** (-25.36) | -11.07*** (-22.00) |
| Size | | 0.156 (0.708) | -2.371*** (-3.646) |
| DOL * HHI | | | 1.570 (0.219) |
| HHI * Size | | | 7.656*** (3.133) |
| DOL * Size | | | 29.79 (1.031) |
| DOL * HHI * Size | | | -82.15 (-1.135) |
| Observations | 13497 | 13497 | 13497 |
| <i>R</i> ² | 17.70% | 17.70% | 18.00% |
| <i>Adjusted R</i> ² | 17.60% | 17.60% | 17.90% |
| <i>Industry Control</i> | No | No | No |
| <i>F-Stat</i> | 367.2 | 245.9 | 116.5 |

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.

The previous two models intend to demonstrate the existence of the relationship between DOL and ROIC at Brazilian market and act as a pre-test for the main model and respond to the inquiry of our first objective. Model (3) analyze the relation between DOL and operational performance moderated by market structure and analyze the impact of Size, when acting as moderator of the HHI moderation.

We found a negative signal for DOL at model (1), and our output shows that when compared to the mean, an increase on DOL have a negative impact on firms' operational performance when compared with sectors' mean, with statistical significance at 1% level. The results also contributes to França and Lustosa (2012) findings for Brazilian market that shows market, on the mean, punishes those firms who operates under the economic efficiency, in a competitive market, shown by a negative correlation between stock return and DOL.

For the HHI variable, with statistical significance at 1% level, we found that more competition relates negatively with ROIC, which align with previous results on the relationship between DOL and performance at Brazilian market. More competition lead to lower economic profit. When market are in perfect competition there is no opportunity costs and all firms operates on MR and MC ratio equal to 1, with no abnormal profit (VARIAN, 2006).

Firms' size influences firm performance (MARCUS, 1969) and may influence on firm operational performance. Including Size as control variable in our model (2), however, do not alters the regression output and the variable do not show statistical significance. In addition, it does not alter HHI significance, signal or coefficient magnitude. For DOL, significance and signal remains the same, but it does have a subtle impact on DOL's coefficient, which indicates that Size plays a role on the relationship between degree of operating leverage and firms' operational performance.

This output raises questions about Size role to the firm's operational performance. It leads to the analysis of the relationship under the perspective of size acting as a moderator variable of the HHI moderating role on the relationship between operational performance and degree of operating leverage and consider the different impacts that Size may have between and within sectors.

To verify the validity of this approach, our third model includes HHI as proxy for market structure moderating the relationship between DOL and ROIC, and Size as a moderating variable of the HHI moderation.

For our full sample, the moderating role of market structure on the relationship between cost structure and operational performance do not show statistical significance, not even when moderated by Size. However, literature suggest that the heterogeneity between different sectors and market structure may have a major role in the absence of statistical significance (HANSEN; WERNERFELT, 1989; PORTER, 1979, 1989; SHEPHERD, 1972), especially when we consider the assumption of perfect competition or monopoly where the DOL roots (WICKRAMASINGHE; ALAWATTAGE, 2007).

5.2. 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 divided our sample in three major groups: Industry, Commerce and Services. The main criteria for this subdivision resides in the difference of structures for those three major groups.

The Table 10 gives us the model output for the three groups separated by sector, and we can observe that the variable signals for DOL, HHI and Size for all sectors remains the same as for the full sample regression. In addition, for the model (1) we have a reduction on statistical significance for DOL variable in Commerce and Services groups.

For the Commerce and Service groups, we found in model (1) that market structure highly influences on firms' operational performance, *ceteris paribus*, more than Industry sector, as captured by HHI coefficients on the regression. We can also interpret the HHI coefficient at model (1) for Full Sample regression in the same way.

On model (2), we can identify that Size have statistically significance at 1 % as a controlling variable for Commerce and Services sector, with negative signal for both groups and bigger coefficient on Services sector.

This output indicates that firm structure have different impacts between sectors and is aligned with the expectancy of increase on models relevance when subdivide the database. The addition of Size as controlling variable led to slightly difference in HHI and DOL coefficients, without any signal changes.

The model (3) is our main model, and we subdivided the analysis in three sectors to a better understand of our findings and to allow us to compare with our full sample. The model (3) aim to capture the moderating effect of market structure on the relationship between DOL and ROIC and analyze the double-moderation role exert by Size on market structure moderation of the relationship between ROIC and DOL.

Table 10 - Outputs subdivided by sectors

| Variables | <i>Full Sample</i> | | <i>Industry</i> | | <i>Commerce</i> | | <i>Services</i> | |
|-------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| | (1) | (2) | (1) | (2) | (1) | (2) | (1) | (2) |
| Constant | 1.924*** (17.05) | 1.909*** (16.40) | 1.158*** (8.902) | 1.186*** (8.715) | 6.357*** (45.14) | 6.487*** (42.15) | 4.769*** (9.635) | 5.290*** (8.496) |
| DOL | -6.533*** (-7.075) | -6.506*** (-7.045) | -7.378*** (-7.133) | -7.441*** (-7.129) | -10.35* (-1.824) | -10.42* (-1.837) | -7.060** (-2.148) | -7.729** (-2.254) |
| HHI | -10.28*** (-25.34) | -10.28*** (-25.36) | -7.107*** (-14.96) | -7.090*** (-14.99) | -25.10*** (-80.40) | -25.25*** (-78.81) | -16.99*** (-17.58) | -17.11*** (-16.86) |
| Size | | 0.156 (0.708) | | -0.318 (-1.240) | | -0.911*** (-2.747) | | -5.652*** (-3.275) |
| <i>Observations</i> | 13497 | 13497 | 7435 | 7435 | 1141 | 1141 | 2137 | 2137 |
| <i>R²</i> | 17.70% | 17.70% | 10.50% | 10.60% | 64.80% | 65.00% | 6.00% | 6.30% |
| <i>Adjusted R²</i> | 17.60% | 17.60% | 10.50% | 10.50% | 64.70% | 64.90% | 5.93% | 6.16% |
| <i>Industry Control</i> | No | No | No | No | No | No | No | No |
| <i>F-Stat</i> | 367.2 | 245.9 | 151.6 | 101.4 | 3295 | 2200 | 162.0 | 113.4 |

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.

HAIR *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. The following subsectors shows the output results for model (3), which captures the moderating effect, when compared to Full Sample results.

5.2.1. INDUSTRY

Observing the outputs for Full Sample regression, we found that HHI, DOL and Size are statistically significant at model (3). However, the moderation effect of market structure, captured by DOL moderated by HHI, or double-moderation effect, captured by Size's moderating impact of the HHI moderation of DOL, were not statistically significant at model (3).

For the Industry subsector, we can point that DOL are statistically significant at 10% level with a negative signal, 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. Table 11 presents the regression outputs:

Table 11 - Industry Sector Output

| Variables | <i>Full_Sample</i> | Industry |
|-------------------------------|-------------------------------------|-------------------------------------|
| | (3) | (3) |
| Constant | 2.667*** (15.34) | 0.916*** (5.184) |
| DOL | -6.946*** (-3.161) | -6.195* (-1.772) |
| HHI | -11.07*** (-22.00) | -6.226*** (-9.634) |
| Size | -2.371*** (-3.646) | 1.417** (2.037) |
| DOL * HHI | 1.570 (0.219) | -5.327 (-0.435) |
| HHI * Size | 7.656*** (3.133) | -5.397** (-2.020) |
| DOL * Size | 29.79 (1.031) | 30.65 (0.836) |
| DOL * HHI * Size | -82.15 (-1.135) | -29.66 (-0.393) |
| <i>Observations</i> | 13497 | 7435 |
| <i>R²</i> | 18.00% | 10.80% |
| <i>Adjusted R²</i> | 17.90% | 10.80% |
| <i>Industry Control</i> | No | No |
| <i>F-Stat</i> | 116.5 | 51.15 |

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.

The HHI is statistically significant at 1% level with negative signal. Comparing with Full Sample, we also observed a reduction of coefficient, indicating that in the Industry sector the impact of market structure is perceived with lower intensity when compared with our Full Sample.

Size shows some alterations regarding model (3) for Industry and in comparison with model (3) for our Full Sample: Size as controlling variable become statistically significant at 5% level, with a positive sign, in comparison with the Full Sample regression.

Industry is the sector with lower HHI, indicating that is the nearest to competition sector. The output for Size shows that larger firms in Industry sector have better operational performance when compared with the sectors mean, *ceteris paribus*, which indicates that firms may profit from positive economies of scale due increase on firms' margin by reducing unitary costs. Only

Industry sector shows a positive sign and statistically significant coefficient for Size, indicating that this sector have characteristics that differentiates it from others.

Market structure do not exert a moderating role on the relationship between DOL and ROIC, not even when market structure moderation is moderated by size, as indicated by the absence of statistical significance for both variables (DOL*HHI and DOL*HHI*Size), leading to the rejection of the H₂ and H₃ for Industry.

5.2.2. COMMERCE

In Commerce sector, at model (3), DOL do not present statistical significance; the HHI coefficient maintain its statistical significance at 1% level with negative signal; and, Size does not shows statistical significance. Table 12 presents the output for Commerce:

Table 12 - Commerce Sector Output

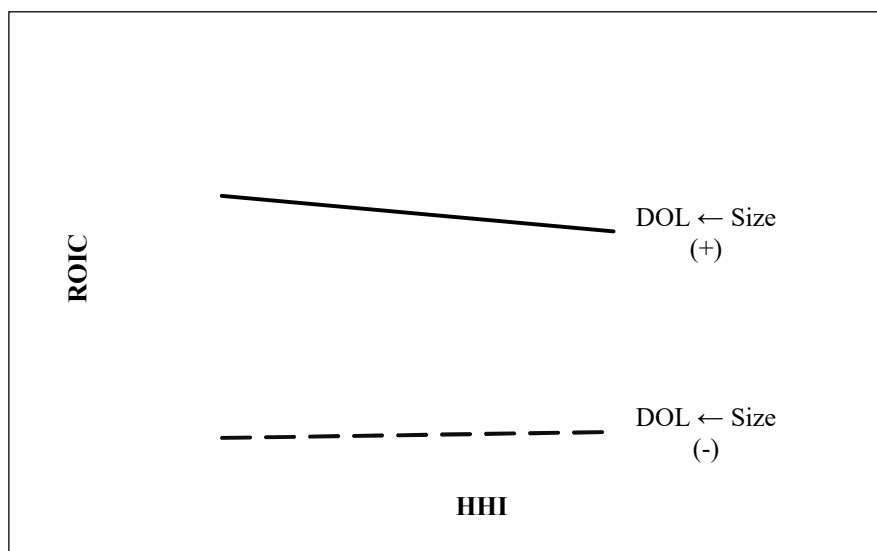
| Variables | <i>Full Sample</i> | <i>Commerce</i> |
|-------------------------------|-------------------------------------|-------------------------------------|
| | (3) | (3) |
| Constant | 2.667*** (15.34) | 6.120*** (12.16) |
| DOL | -6.946*** (-3.161) | -24.84 (-0.514) |
| HHI | -11.07*** (-22.00) | -23.91*** (-13.08) |
| Size | -2.371*** (-3.646) | -502.6 (-0.964) |
| DOL * HHI | 1.570 (0.219) | 59.64 (0.331) |
| HHI * Size | 7.656*** (3.133) | 1,896 (0.963) |
| DOL * Size | 29.79 (1.031) | 94,411* (1.799) |
| DOL * HHI * Size | -82.15 (-1.135) | -356,666* (-1.800) |
| <i>Observations</i> | 13497 | 1141 |
| <i>R²</i> | 18.00% | 65.30% |
| <i>Adjusted R²</i> | 17.90% | 65.00% |
| <i>Industry Control</i> | No | No |
| <i>F-Stat</i> | 116.5 | . |

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.

That indicates an important role of market structure at Commerce sector, due the absence of significance for DOL, which represents firms' cost structure, or for Size.

We can visualize the effect looking at the extreme points of the Graph 1 straight lines. The impact of market structure on the relationship between operational performance and costs behavior is shows by the tendency of the relation when occurs a reduction on market competition. The continuous line indicates firms with higher DOL*Size, and the dotted line, those firms with lower DOL*Size:

GRAPH 1 – Double-moderation effect on Commerce sector



Notes: (i) Double-moderation $DOL \leftarrow Size$ represents $DOL * HHI * Size$ variable; (ii) **ROIC** represents the centered Return On Invested Capital; (iii) **DOL** represents the Degree of Operating Leverage in range; (iv) **HHI** represents the Herfindah-Hirschman Index, which contemplates the market competition level on the sector; and, (v) **Size** represents the firm size in range

Graph 1 shows that, on mean, firms with higher DOL shows greater mean returns when compared with firms' with lower DOL on Commerce sector. The Size moderation on the moderating role of market structure on the relationship between DOL and ROIC lead to differential effects on the relationship between DOL and ROIC. As the sector walks toward monopoly, larger firms shows a negative tendency while smaller companies shows a positive tendency, at mean. In addition, the lines slope indicates that bigger firms operational performance are more sensitive to a decrease on competitiveness than the smaller firms are.

5.2.3. SERVICES

The Services sector, as also observed in Commerce, do not show statistical significance for DOL in our model (3), differing from our Full Sample. Market structure seems to have more important rule than firms' cost choices on firm operational returns, considering the statistical significance of HHI. However, on Services sector Size is statistical significant at 1%. It indicates that a decrease of competitiveness and lead to a reduction of firms' operational performance when compared to sector mean.

When compared with our Full Sample, we can observe that HHI have more influence on firms' operational performance due 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. The outputs for model (3) on Services sector are show on Table 13.

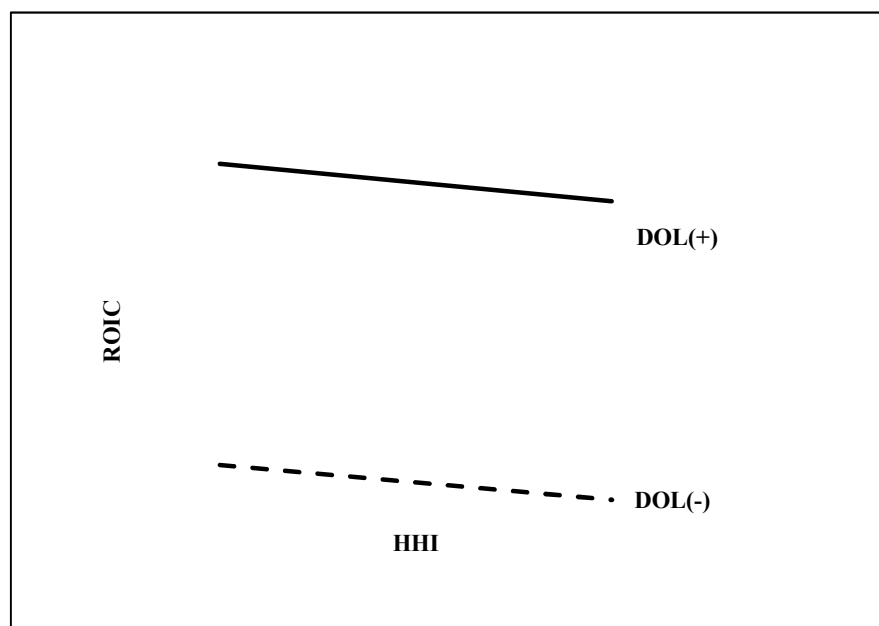
Table 13 - Services Sector Output

| Variables | <i>Full_Sample</i> | <i>Services</i> |
|-------------------------------|-------------------------------------|-------------------------------------|
| | (3) | (3) |
| Constant | 2.667*** (15.34) | 3.862*** (16.24) |
| DOL | -6.946*** (-3.161) | 8.729 (1.609) |
| HHI | -11.07*** (-22.00) | -17.81*** (-26.24) |
| Size | -2.371*** (-3.646) | -16.41*** (-13.13) |
| DOL * HHI | 1.570 (0.219) | -19.21*** (-2.917) |
| HHI * Size | 7.656*** (3.133) | 44.69*** (13.84) |
| DOL * Size | 29.79 (1.031) | -312.5*** (-3.030) |
| DOL * HHI * Size | -82.15 (-1.135) | 687.1*** (3.366) |
| <i>Observations</i> | 13497 | 2137 |
| <i>R²</i> | 18.00% | 36.50% |
| <i>Adjusted R²</i> | 17.90% | 36.20% |
| <i>Industry Control</i> | No | No |
| <i>F-Stat</i> | 116.5 | 116.7 |

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 Services sector we found statistical significance for the moderating effect of market structure on the relationship between ROIC and DOL. The result differs from our Full Sample, Industry and Commerce outputs where no statistical significance where found. At Services sector, the moderating role of market structure on the relationship between DOL and ROIC shows statistical significance at 1% level and negative sign. Graph 2 provide us with a comparable mean and tendencies acting as a guide to understand the regression output:

Graph 2 – Moderation of Market Structure on Services sector

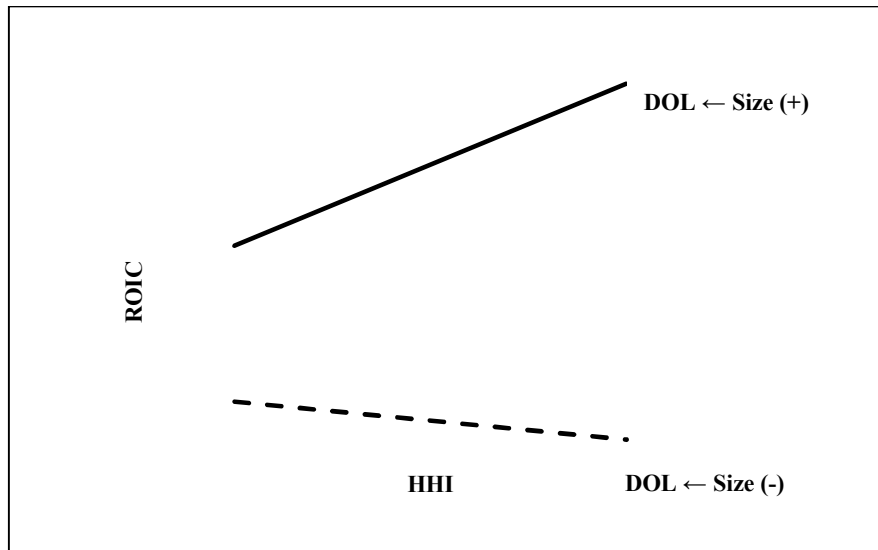


Notes: (i) The-moderation DOL represents $DOL*HHI$ variable; (ii) ROIC represents the centered Return On Invested Capital; (iii) DOL represents the Degree of Operating Leverage in range; and, (iv) HHI represents the Herfindahl-Hirschman Index, which contemplates the market competition level on the sector.

Graph 2 shows that, on mean, firms with higher DOL shows greater mean operational returns when compared with firms' with lower DOL. When we consider the moderating effect of market structure on the relation between ROIC and DOL, the model suggests that with a decrease on competition level of the sector, firms perceive a reduction of the effect of DOL on firms' ROIC.

When we add Size on the regression, as a double-moderation of the relationship between ROIC and DOL, it presents statistical significance at 1% level and with positive sign. Graph 3 shows the effect of the double-moderation on Services sector.

Graph 3 – Double-moderation effect on Services sector



Notes: (i) Double-moderation DOL ← Size represents $DOL * HHI * Size$ variable; (ii) ROIC represents the centered Return On Invested Capital; (iii) DOL represents the Degree of Operating Leverage in range; (iv) HHI represents the Herfindah-Hirschman Index, which contemplates the market competition level on the sector; and, (v) Size represents the firm size in range

Graph 3 shows that, on mean, firms with higher DOL shows greater mean operational returns when compared with firms' with lower DOL. Size double-moderation on the relation between ROIC and DOL lead to an dispersive behavior of the relationship between DOL and ROIC when we compare the larger firms with smaller firms. As the sector walks toward monopoly, larger firms shows a positive tendency while smaller companies shows a negative tendency, at mean.

Models' output suggests that Size variable moderates the market structure moderation on the relationship between DOL and ROIC for Services sector, with the opposite effect of the effect founded for Commerce sector.

6. CONCLUSION

Our findings suggest that market structure exert a moderator effect on the relation between DOL and ROIC, with an increase of intensity of the moderation effect when competition level decreases. 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 points toward a firms' adjustment of production considering the structure of the market that they are competing.

Following previous researches of Brazilian market that approach the relation between DOL and returns, we found that ROIC and DOL are negatively related, for all sectors and independently of competition level. Our findings aligns with previous researches, and shows that an increase of operating leverage lead to worse operational performance when compared with sector mean. In addition of those studies findings, our study indicates the existence of a moderating impact of market structure on firms' operational performance.

Market structure is the only variable in our model that remains significant in all sectors and all models. The output, always with negative sign, indicates that a decrease of competitiveness lead to lower operational returns when compared to sector mean. This output need to be interpreted with caution due the characteristics of Brazilian market and proxy limitations. The market structure of Industry and Commerce sectors where classified as Oligopoly, with Services walking toward a monopoly

Size, as control variable, shows statistical significance on model (2) for Commerce and Services, with greater impact on Services sector, suggesting an increase of Size importance when markets tend to be more concentrated. For model (3), Size is statistical significant for Full Sample, Industry and Services sectors, with higher impact on Services sectors. For industry sector, we found a positive sign for Size coefficient, with negative sign for Services. That indicates the importance of consider the sector characteristic when analyzing the impact of Size in returns.

The addition of Size, in a double-moderation analysis, affects differently across sectors and within a sector. At Commerce sector, with increase of competition when compared to Services, Size acts as a homogenizing variable of firms' operational results. However, in Services sector

the opposite effect occurs, with a detachment of the operational performance of bigger firms from the small firms. It highlights Size to have impact on market structure moderating role and that in Services sector, which have more concentration, Size is a source of advantage. The difference of slope between the outputs for Industry and Commerce when relationship between ROIC and DOL is double-moderated, aligns with the literature that Size may have different impacts on firms within a sector and reassure the importance of differentiate the analyses segmented between sectors.

The first model being statistical 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 monopoly the explanatory capacity of model (3) increases. Industry shows a HHI of 0.4317 and statistical significance for models (1) and (2) variables, except Size. Services with HHI of 0.668 shows significance at all models and for all variables, except DOL on model (3). Table 14 summarize our main findings comparing with our three hypothesis and gives an overview of the research:

Table 14 - Research Findings

| Hypothesis | Model | Sector | Observed Signal | Findings |
|---|-------|-------------|-----------------|--|
| <i>H₁</i> <i>There is an association between the Degree of Operation Leverage and the Operational Performance.</i> | 1 | Full Sample | - | There is a negative association between DOL and Operational Performance |
| | | Industry | - | |
| | | Commerce | - | |
| | | Services | - | |
| | 2 | Full Sample | - | There is a negative association between DOL and Operational Performance |
| | | Industry | - | |
| | | Commerce | - | |
| | | Services | - | |
| | 3 | Full Sample | - | There is a negative association between DOL and Operational Performance <i>non-significant</i> <i>non-significant</i> |
| | | Industry | - | |
| | | Commerce | - | |
| | | Services | - | |
| <i>H₂</i> <i>The relation between operational return and cost behavior is moderated by the market structure, measured by market competition level</i> | 3 | Full Sample | - | Market structure moderates the relationship between DOL and ROIC <i>non-significant</i> <i>non-significant</i> <i>non-significant</i> |
| | | Industry | - | |
| | | Commerce | - | |
| | | Services | - | |
| <i>H₃</i> <i>Market competition level moderation of the relationship between operational return and cost behavior is moderated by firms' size.</i> | 3 | Full Sample | - | Size moderates the market structure moderation role leading to a change of signals, considering the sector <i>non-significant</i> <i>non-significant</i> |
| | | Industry | - | |
| | | Commerce | - | |
| | | Services | + | |

Source: Author

The results also suggest that the market structure is relevant for firms' operational performance by showing statistical significance for HHI as control variable for all models and sectors. However, moderation only occurs at markets that walks toward to a more concentrated structure. 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.

The results also show that the double-moderation effect on the relationship between ROIC and DOL for Full Sample and Industry. However, at Commerce and Services sectors, Size do moderates the moderating effect of market structure on the relationship between ROIC and DOL showing different impacts between sectors and within Services sector. The outputs differences when segmented by sector indicates that analyze firms comparing with similar companies improves research quality.

Some limitations are intrinsic to the present research results. Due 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 are unbalanced, and it may affect characteristics of the information. The research also have 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; control the model by crisis, analyzing firms' behavior during time of uncertainty; consider the operational cycle as moderating variable of the relationship between operational performance and firms' cost behavior; include the environmental dynamism as a moderating variable on model, expanding the analysis of the role of market structure on the relationship between operational performance and firms' costs behavior; and analyze by firm position on sector through firms' HHI.

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APPENDIX A DESCRIPTIVE STATISTICS

Table 15 - Descriptive statistic of ROIC and centered ROIC

| Stats | ROIC | cROIC |
|-------|----------|-----------|
| N | 15729 | 15729 |
| Mean | 4.109662 | -3.42E-08 |
| p50 | 2.1719 | -1.476338 |

Table 16 - Descriptive statistic with outliers

| Stats | ROIC | DOL | HHI | Size |
|----------|-----------|-----------|-----------|-----------|
| N | 15729 | 13602 | 34730 | 16332 |
| mean | -3.42E-08 | 0.0093955 | 0.2816405 | 0.0825714 |
| sd | 50.58485 | 0.0455379 | 0.1837006 | 0.1511914 |
| kurtosis | 10651.46 | 328.7573 | 5.865261 | 15.64703 |
| skewness | 97.71135 | 16.61709 | 1.556686 | 3.361684 |
| cv | -1.48E+09 | 4.846759 | 0.6522522 | 1.831037 |
| min | -18.93342 | 0 | 0.0677249 | 0 |
| max | 5726.832 | 1 | 0.8766502 | 1 |
| p25 | -2.665781 | 0.0010057 | 0.2311875 | 0.006342 |
| p50 | -1.476338 | 0.0020959 | 0.2569522 | 0.0256191 |
| p75 | 0.1906184 | 0.0065646 | 0.3479501 | 0.0834355 |