Operational Sustainability of the Firm The operational performance versus financial solvency binomial - OPFS

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ABSTRACT

This article presents the research results that assess a firm's operational sustainability by combining the Degree of Operating Leverage (DOL) with the Current Liquidity Ratio (CLR) to present the Operational Performance versus Financial Solvency (OPFS) binomial, using a non-parametric model. The combination of the DOL with the CLR identifies metrics that indicate that a firm operates at full installed capacity and injects synergy at the generation of financial assets. The model was tested with data from standardized financial statements from 48 firms distributed among 6 sectors of the Brazilian economy, from 2007 to 2017. The results obtained suggest that, when a firm operates at full installed capacity, the DOL varies between 1 and 2, and the CLR is higher than the DOL. From the 6 sectors contemplated by the sample, 4 stand out by operating at full installed capacity with the CLR higher than the DOL, and 2 sectors signal some idleness with the DOL above 2 and the CLR lower than the DOL, such as the Public Utilities Sector (PU) indicating the highest efficiency among all. These results are relevant to illustrate that the combination of the DOL with the CLR is robust enough to evaluate a firm's operational sustainability.

Key-words: Operational Performance versus Financial Solvency, nominal payment capacity, degree of operating leverage (DOL), firm's operational sustainability.

1 INTRODUCTION

This article presents the *Operational Performance versus Financial Solvency* (OPFS) binomial as a reference indicator to signal a firm's operational sustainability, resulting from the combination of the Degree of Operating Leverage (DOL), which measures the level of applicability of the installed capacity, with the Current Liquidity Ratio (CLR), which represents the nominal payment capacity in the short term.

The **DOL**, as approached in the literature, refers to a measure of profit sensitivity in relation to the variation of the sales' net operating income, as in Garrison, Noreen & Brewer (2013), or to the potential use of fixed costs to increase the effects of changes on sales in relation to profit, as addressed by Gitman (2002). The **CLR**, in turn, is the indicator that shows the sufficiency of the net working capital in the solvency of a firm's obligations, as widely addressed in the literature.

In a study that assesses the optimal level of **DOL**, controlled by the sales' net income, De França and Lustosa (2011) and De França (2012) introduce robust evidences that a firm is economically efficient if it presents a **DOL** around 2. Said study takes into consideration that the firm uses constant installed capacity, in terms of plant, to a certain production volume, in an estimated time period, because it implies the maintenance and linearity of fixed costs (**FC**), as discussed by Van Horne and Wachowich (1975). By using the DOL as a starting point, and linearly combining it with the CLR, the present article aims at proposing a model of operational sustainability of a firm.

Traditionally, liquidity is evaluated with **CLR**-focused financial indicators, with an expected score at least equal to 1. Despite the **CLR** being widely used as the ratio for the relation between a firm's current asset (CA) and current liability (CL), it does not reveal the effective payment capacity since it does not incorporate time estimators, as argued by Richards and Laughlin (1980), and Assaf Neto (2014). This CLR limitation was studied by De França and Sandoval (2019), who incorporated into it the effects of the operating cycle and the financial cycle, which resulted in the proposition of the Liquidity Sustainability Ratio (LSR).

But, even if the CLR incorporates time estimators, like the operating cycle and the financial cycle, it is not able to guarantee effective liquidity, because market events called *immediacy*, as discussed by Grossman and Miller (1988), cannot be captured since they read past transactions, in a given period in time. In addition to this observation, Diamond and Rajan (1999) also add capital structure fragility that allows the relationship lender to take loans against the full value of granted illiquid loans, making financial fragility create liquidity.

In the short term, the **DOL**, as an operational performance indicator, signals the efficiency level in the allocation and use of **FC**, whereas the **CLR** only indicates the nominal capacity of the financial and non-financial assets to liquidate the obligations, even if this signal depends on the timeliness of asset liquidation.

A firm's operational dynamics promotes constant modifications on the assets that compose the means of payment of obligations and on the assets destined to production. The combination of these modifications, which are reflected on the relationship between the **DOL** and the **CLR**, constitutes the main motivation of this research. The assets that compose the means of payment and those destined to production are the ones declared, respectively, in the current asset and in the fixed asset of a firm's financial statement.

Because of the importance of this theme for the literature and for the market, by using data from standardized financial statements from a sample of 48 firms listed on B3 (*Brasil, Bolsa, Balcão*), distributed in six sectors of the Brazilian economy from 2007 to 2017, this research investigates a firm's sustainability through the combination of the DOL with the CLR, supported by the OPFS binomial metrics, within the liquidity context. To conduct this investigation, the established goals are (**a**) to calculate the DOL and its relationship with FC, EBIT (Earnings Before Interest Tax), and CLR; (**b**) to test the differences between the means and analyze the descriptive statistics from the six sectors of the economy contemplated in the sample; and (**c**) to test the behavior of the CLR level in relation to the DOL level to evaluate the firm's operational sustainability signaled by the OPFS.

Within this context, the research presents the OPFS as a linear combination of the **DOL** with the **CLR** to measure a firm's sustainability in the generation of financial assets, indicated by the nominal payment capacity measured by the CLR.

The expected results are relevant for the literature as they signal that a firm operating with optimal use of its installed capacity generates financial assets that inject synergy into the nominal payment capacity measured by the CLR. The results also differ from those from previous studies because they identify the sectors of the economy that best combine the DOL with the CLR to indicate a firm's operational sustainability.

In addition to this introductory section, the article is structured as follows: section **2, Operating Leverage**, discusses the concepts and contributions of the DOL as an indicator of a firm's operational performance. Section **3, Liquidity as nominal payment capacity,** discusses significant contributions of the literature about the limitation of the liquidity index as nominal payment capacity. Section **4, Firms by sectors of the economy and variables of interest,** identifies the firms of the sample, the sectors of the economy in which the firms operate, and describes the variables of interest. Section **5, Methodology**, specifies and describes the equations that compose the research model. Section **6, Result Analysis,** analyzes the responses of the sample data produced by the application of the research model. Section **7, Conclusions,** summarizes the main research findings; and, lastly, **References,** and the **Appendix**.

2 OPERATING LEVERAGE

Operating Leverage, as addressed by Gitman (2002), is understood as the potential use of fixed costs, of an operational nature, to increase the effect on profit as a consequence of the changes in the sales revenue.

Equivalently, operating leverage is also identified as an indicator of economic efficiency, in the use of the installed capacity, which shows that a firm still has a margin to absorb fixed costs with an increase in production, or that it already operates at an optimal level of efficiency. This context is explored by Garrison, Noreen, and Brewer (2013) to indicate the DOL as a measure of profit sensitivity in relation to the variation of the sales net income, acting as a multiplier. This declaration is at first supported by Van Horne and Wachowich (1975), who link operating leverage to the installed capacity that produces fixed costs, maximizes production, and eliminates idleness.

De França and Lustosa (2011) and De França (2012) studied the relations of the DOL with a firm's profit and cost structure. This study reveals that the lower the DOL, the higher the profit, establishing an inverse relation between the two, and, consequently, the firm's operational performance is more robust. On the other hand, the higher the DOL, the higher the unused fixed cost, revealing idleness of the installed capacity. The study also shows that, for a firm with optimal operational performance, the DOL must be around 2. These results are aligned with the findings of Stowe and Ingene (1984) and Gahlon (1981), who reveal that the DOL's elasticity is inverse to that of the operational profit as well as to the sales elasticity.

Within the context of marginal productivity, Mankiw (2009) states that a firm reaches an optimal DOL, as an operational efficiency concept, when the marginal revenue equals the marginal cost, showing that, at full employment, the installed capacity would be used at its full potential, without idleness.

3. LIQUIDITY AS NOMINAL PAYMENT CAPACITY

Liquidity is composed of a set of indicators that measure specific stages of a firm's financial capacity. In the literature, in general, these indicators measure a nominal liquidity because they only prioritize the relation between the values, this also being the context of the present study when it comes to the choice of the current liquidity ratio (CLR).

The CLR, as an indicator of nominal payment capacity, reveals the relation between the positive part and the negative part of a firm's working capital, in terms of quotient. As addressed by Assaf Neto (2014), the CLR has the objective of measuring a firm's payment capacity or its ability to fulfill its obligations. With this approach, it is expected that the CLR, resulting from the relation between the current asset (CA) and the current liability (CL), be a ratio at least equal to 1. However, this CLR quantum does not take into consideration the requirements of activity indicators, and mainly, the closure of the financial cycle; that is why it can only be accepted within the context of nominal payment capacity.

Contradicting the traditional concepts of nominal liquidity measured by the CLR, Richards and Laughlin (1980) analyzed the literature's contributions to working capital management and observed that it receives less attention than the others. Their contributions alert that such inattention may result in inefficiency due to short-term adverse events, and signal that a sole test of the conventional liquidity relations and the statistics of financial statements may generate bias on a firm's nominal liquidity positions, since they do not incorporate time estimators. According to this statement, the CLR requires a combination with activity indicators in order to be effective.

But nominal liquidity can be implicated by a manipulation bias, as indicated by Gill and Mathur (2011). The authors state that they investigated factors that influence liquidity management in firms in Canada, based on a sample of 164 firms listed on the Toronto Stock Exchange, from 2008 to 2010. They argue that managers have the power to transform assets in their benefit because they have implicit rights over the assets' liquidity, and that an alteration on this liquidity would affect such rights. Lastly, they conclude that liquidity retention is also influenced by the firm's size, by the net working capital, the almost liquidity, short-term debt, investments, and by internationalization and business segment.

Lancaster, Stevens and Jennings (1998) also analyzed the relations between liquidity and competence-driven acknowledgement versus cashflow in static and dynamic aspects. They declare to "have found

evidence that the operations' cashflow is significantly related to the liquidity ratios and with the financial cycle, and that this relation has incremental and significant explanation for the revenue of each period".

Grossman and Miller (1998) analyzed liquidity in light of the stock market crisis of 1987, through the price perspective. They present models that show the limitations of traditional liquidity but that are not the solution for preventing future stock market crashes. Even though the liquidity discussed by the authors is aimed at the financial market, the context is applicable to this study because the CLR also measures nominal solvency in a given period, and, due to market adversities, it does not guarantee the condition for future payment because of the change in consumers' purchasing power and in macroeconomic conditions.

The liquidity fragility in the banking sector was analyzed by Diamond and Rajan (1999), who discuss that fragility of the capital structure enables the relationship lender to take loans against the full value of the illiquid loan they hold, and that, due to a liquidity shock, financial fragility enables the creation of liquidity. This context is pertinent to the theme of the present article because, when a non-financial firm offers its clients credit, in order to obtain solvency, it negotiates these credits at a necessary amount to get flow while liquidity with the clients does not occur.

Studying the CLR limitations, De França and Sandoval (2019) incorporate into this indicator the effects of the operating cycle and the financial cycle to adjust the nominal payment capacity to the effective capacity and, with that, they present the Liquidity Sustainability Ratio (LSR) that approximates the CLR to a financial solvency indicator.

The revision and discussion explored in this section does not claim to have exhausted the literature's contributions, but rather to have recovered those that are most identified with and most contribute to the conducted research. As surmised by the analysis of the contributions, liquidity can be influenced by several factors apart from the DOL's performance, yet the research focus is limited to the DOL versus LCR binomial and, complementarily, DOL with FC and EBIT.

4 FIRMS BY ECONOMY SECTORS AND VARIABLES OF INTEREST

To identify the firms that have publicly released their management data through standardized financial statements, the B3 (former BM&FBOVESPA) repository was consulted, within the reference period of the research. Once the firms were identified, the next step was to gather the data from the aforementioned standardized financial statement, recovering them from the consulting platform Economática's database, and to elect the firms that meet the research criteria. The research criteria are: completeness of the standardized financial statement, required by the accounting standard, and that the selected firms be distributed over six sectors of the economy (Table A2)

The variables of interest (Table 1), all quantitative, are associated to the specification of the model to promote the answers for the research inquiries.

Table 1: Variables of interest of the research that compose the analytical model equations.

Variable	Denomination	Description
DOL	Degree of Operating Leverage	It is a measure of operational risk, which assesses the sensitivity of profit in relation to the sales variation. It measures the level of a firm's installed capacity usage. The closer it gets to 2, the higher the firm's economic efficiency is.
FC	Fixed Cost	It is the dimensioned cost for the size of the plant. In unitary terms, it decreases. The closer the firm's production is to the full employment of the installed capacity, the lower the unitary value of the fixed cost is.
EBIT	Earnings before interest and taxes	It is the profit seen as a management measure. It does not include taxes nor direct taxes over profit. It must be positive ($EBIT^{+}$).
GP	Gross Profit	It is the difference between net income and variable cost, and must be sufficient to recover remaining costs, taxes, and the shareholders' compensation. It is also called Contribution Margin (CM).
PTIB	Profit before income taxes	It is the profit of the firm before direct tax over profit (DT).
DT	Direct tax over profit	Corporate Income Tax (IRPJ in portuguese) and social contribution on net profit (CSLL in portuguese).
SE	Sales Expenses	They are the variable expenses related to sales operations.
FR	Financial Result	It is the difference between earnings with the application of financial assets and the expenses in the employment of a firm's financial obligations.
PE	Patrimonial Equivalence	It is the difference between the profits and the losses obtained by a firm with related-party investments.
CLR	Current Liquidity Ratio	It is the quotient between the current asset (CA) and the current liability (CL) of the Financial Statement and measures the firm's nominal payment capacity at a point in time, in the short term.
CA	Current Asset	Account group that accumulates cashflow and cashflow equivalent, receivable and stock inventories with expected realization in the short term (12 months).
CL	Current Liability	Account group that accumulates demandable obligations in the short term (12 months).

Variable	Denomination	Description
OPFS	*Operational Performance and Financial Solvency*	Reference indicator of a firm's sustainability, resulting from the combination of the Degree of Operating Leverage (DOL) and the Current Liquidity Ratio (CLR).
NCC	Net Current Capital	Difference between the CA and the CL. Is expected to be positive or negative ($NCC^{\pm}$). It is also called net working capital (NWC).

Source: Authors

5 METHODOLOGY

The methodology is analytical, supported by a non-parametric model. The model is composed of functional equations that measure the DOL (equation 1), the FC (equation 2), the CLR (equation 3), the EBIT (equation 4), means and differences between means (equations 5 and 6), the OPFS (equation 7). For every equation, ***j*** is the firm and varies from 1 to 48, ***k*** is the sector of the economy and varies from 1 to 6, and ***t*** is the quarter, in each year, and varies from 1 to 4.

a) DOL

As an operational risk measure, the DOL is not directly observed on standardized financial statements. The DOL reveals the level of usage of a firm's installed capacity. It indicates that the firm tends to optimal production if the DOL quantum varies between 1 and 2. But, for a DOL equal to 1, this would imply fixed cost equal to zero, or a profit tending to infinity, which are not feasible hypotheses in the business world. For a DOL equal to 2, it implies the fixed cost to be equal to the profit, as equation (1) shows.

$$\boldsymbol{DOL_{jkt}} = 1 + \frac{FC_{jkt}}{EBIT_{jkt}} \geq 1, \qquad \forall\ EBIT_{jkt} > \mathbf{0} \qquad (1)$$

Given that, at the installed capacity level, the **FC** is constant, the **DOL** is inverse to the **EBIT**. Hence, when the **EBIT** decreases/increases, the **DOL** increases/decreases.

Theorem 1: The necessary condition for the DOL to be 1 is:

If the FC tends to zero and the $EBIT^{+}$ is much higher than the FC, this implies that the second term, to the right, of Equation (1) equals zero.

Proof 1:

$\frac{FC_{jkt}}{EBIT_{jkt}} \to 0.\ FC\ \to 0,\ EBIT\ \to\ +\infty, therefore, \frac{0}{\infty} \equiv 0.$

Theorem 2: The necessary condition for the DOL to be 2 is:

If the FC and the $EBIT^{+}$ have equal value, this implies that the second term, to the right, of Equation (1) is equal to 1.

Proof 2:

$\forall\ FC, EBIT > 0, FC = EBIT, \frac{FC_{jkt}}{EBIT_{jkt}} = 1\ .$

b) FC

The **FC** is distributed over a firm's production cost and general expenses. That is why it is not directly observed on standardized financial statements. Thus, a reasonable way to obtain it is through proxy. The FC volume is related to the firm's plant size.

$$\boldsymbol{FC_{jkt}} = GP_{jkt} - PTIB_{jkt} - SE_{jkt} + FR_{jkt} + PE_{jkt} > 0 \qquad (2)$$

Given the firm's installed capacity (plant), theoretically, the FC is constant in volume.

c) CLR

As a nominal payment capacity, the CLR is the commonly used indicator to measure a firm's liquidity in the short term. The quantum expectation is for it to be at least equal to 1. However, its variation scale depends on the magnitude of the net current capital's value and signal ($NCC^{\pm} = CA - CL$).

$$\mathbf{CLR_{jkt}} = \frac{\mathrm{CA_{jkt}}}{\mathrm{CL_{jkt}}} > 0 \qquad (3)$$

For the specification of the model to any NCC ≥ 0, the answer is CLR ≥ 1. Otherwise, CLR < 1.

d) EBIT

As a measure of adjusted profit, it is not directly observed on standardized financial statements. As a management performance indicator, it excludes from managers' evaluations the variables that they do not control.

$$\boldsymbol{EBIT_{jkt}} = PTIB_{jkt} + FR_{jkt} + DT_{jkt} \quad > 0 \qquad (4)$$

e) Mean ($\bar{X}$)

The result obtained is a parametric indicator of all variables of interest (VI) in the central position.

$$\bar{\boldsymbol{X}}_{jkt} = \frac{VI_{jkt}}{n} > 0 \qquad (5)$$

In which VI is the variable of interest (DOL, EBIT, CLR, FC).

f) Test of difference between means (t_{test})

The metric of this test is the distribution *t* (Student), as in Spiegel (1993, p. 286), used to differentiate a segment from another or a firm from another. The comparison is made with the critical statistical parameter ($t_{critical}$). If $t_{test} > t_{critical}$, this implies that the means are not equal. Otherwise, the hypothesis that the means are not different is not rejected.

$$t_{test_{jkt}} = \frac{\bar{X}_{jkt} - \bar{Y}_{jkt}}{\sqrt{\frac{{X_{x_{jkt}}}^2}{n_{jkt}} + \frac{{y_{y_{jkt}}}^2}{n_{jkt}}}} \qquad (6)$$

In which $\bar{X}_{jkt}$ is the mean of the reference sector; $\bar{Y}_{jkt}$ is the mean of the compared sector; $\frac{X^2_{x_{jkt}}}{n_{jkt}}$ is the reference variance; $\frac{Y^2_{y_{jkt}}}{n_{jkt}}$ is the variance of the compared sector.

The test results are expected to be symmetrical with any level of statistical significance.

g) OPFS

As a reference indicator of a firm's *Operational Performance versus Financial Solvency* binomial, the OPFS shows a combination of the level of employment of the installed capacity with the nominal liquidity.

$$OPFS_{jkt} = DOL_{jkt} * CLR_{jkt}^{-1}, \quad (7)$$

$$OPFS_{jkt} = \begin{cases} 1 & if\ DOL = CLR \\ > 1 & if\ DOL > CLR \\ < 1 & if\ DOL < CLR \end{cases}$$

Statement 1: $DOL = CLR$

At an optimal level of usage of a firm's installed capacity ($\mathbf{1 < DOL \leq 2}$), an OPFS equal to 1 implies that the DOL and the CLR are equal. As the CLR is a nominal payment capacity indicator, this quantum meets the firm's liquidity demand. However, this identity can occur in other intervals, but without the full use of the installed capacity.

Statement 2: $DOL > CLR$

For OPFS higher than 1 and ($\mathbf{1 < DOL \leq 2}$), the signal is that the CLR quantum varies within the interval of 1 and 2, but is lower than the DOL quantum. If the CLR quantum is lower than 1, this jeopardizes the firm's nominal payment capacity. However, if the firm is not operating at an optimal usage level of the installed capacity, the DOL quantum is expected to be higher than the CLR quantum. In this case, the nominal payment capacity will only be jeopardized if NCC ≤ 0.

Statement 3: $DOL < CLR$

If the OPFS is lower than 1, necessarily $\frac{FC_{jkt}}{EBIT_{jkt}} < 0$. This situation implies that the firm needs other sources to generate financial assets to honor the short-term commitments.

6 RESULTS ANALYSIS

The results are presented in a comparative, intra-sectoral and intersectoral manner, for every model variable, obtained through the specified equations of the previous section, by using the free domain statistical packet *gretl*. As already indicated, the sample is composed of data from standardized financial statements from 48 firms (Table A1), distributed over 6 sectors of the economy (Table A2), totalizing 2,112 quarterly observations, from 2007 to 2017. The test results are exhibited in Tables 2, 3, 4, and 5, respectively, the differences between the means, correlation matrix coefficients, descriptive statistical estimators, and OPFS binomial.

6.1 Analysis of the test on the difference between means

The coefficients of the differences between the means are exhibited in Table 2 and were obtained according to the model defined by Equations (e) and (f) of section 5. The tested variables are FC, EBIT, DOL and CLR, as defined in Table 1. The test results are symmetrical and signal that the hypothesis that the means are not different cannot be rejected, considering that the observed differences are lower than the standardized parameters of statistics **t** ($t_{test} < t_{critical}$) for trust levels of 90%, 95% and 99% (1.43; 1.94

e 2.44). However, regarding the DOL variable, in the HC vs PU combination, the hypothesis that the means are not different is successful at 99% of trust; in the HC vs NCS, HC vs IG, and HC vs FN, the hypothesis of no difference between the means is observed at 95% and 99% of trust. These results are relevant to indicate that the intra-sectoral and intersectoral Brazilian economy is competitive.

It is relevant still to observe that the differences between means are centered at less than one standard deviation, except in DOL test (c), in the combinations HC vs IG; HC vs NCS; HC vs FN; and HC vs PU, which present scores between 1.40 and 2.24.

Table 2: Difference between variables of interest's two-tailed means by sector of the Brazilian economy: 2007:1 to 2017.

Sectors	IG	CS	NCS	FN	HC	PU
a) FC Means Test						
IG	0	-0.4240	-0.6618	-0.3050	-0.4240	-0.5655
CS	0.4240	0	-0.5141	-0.6992	-0.0931	-0.1563
NCS	0.6618	0.5141	0	-0.7324	-0.5546	-0.4468
FN	0.3050	0.6992	0.7324	0	-0.8435	-0.8204
HC	0.4240	0.0931	0.5546	0.8435	0	-0.2647
PU	0.5655	0.1563	0.4468	0.8204	0.2647	0
b) EBIT Means Test						
IG	0	-0.5862	-0.7071	-0.0086	-0.1291	-0.6999
CS	0.5862	0	-0.5068	-0.6757	-0.8131	-0.3480
NCS	0.7071	0.5068	0	-0.7182	-0.7484	-0.2745
FN	0.0086	0.6757	0.7182	0	-0.1739	-0.7323
HC	0.1291	0.8131	0.7484	0.1739	0	-0.7923
PU	0.6999	0.3480	0.2745	0.7323	0.7923	0
c) DOL Means Test						
IG	0	-0.2905	-0.0572	-0.2704	-1.4044	-0.7645

Sectors	IG	CS	NCS	FN	HC	PU
CS	0.2905	0	0.3070	0.3676	-0.1711	0.4770
NCS	-0.0572	-0.3070	0	0.2189	-1.4768	0.7195
FN	-0.2704	-0.3676	-0.2189	0	-1.6461	0.4427
HC	1.4044	0.1711	1.4768	1.6461	0	2.2420
PU	-0.7645	-0.4770	-0.7195	-0.4427	-2.2420	0
d) CL Means Test						
IG	0	-0.2336	0.4741	0.2753	-0.0996	0.0631
CS	0.2336	0	0.4497	0.3711	0.2064	0.1522
NCS	-0.4741	-0.4497	0	-0.1190	-0.7872	-0.0246
FN	-0.2753	-0.3711	-0.1190	0	-0.4198	-0.0005
HC	0.0996	0.2064	0.7872	0.4198	0	0.0796
PU	-0.0631	-0.1522	-0.0246	-0.0005	-0.0796	0

The meaning of the acronyms is described in Tables 1 and A2.

6.2 Analysis of the coefficients of the correlation matrix

The coefficients of the correlation matrix are shown in Table 3, in the set of firms, by variable, segregated by sector of the economy.

The answer to the DOL versus EBIT association shows an inverse relation in the six sectors of the economy. This inverse relation confirms the theory by showing that, when the EBIT increases/decreases, the DOL decreases/increases, as discussed by Stowe and Ingene (1984) and Gahlon (1981). The DOL versus FC association, in sectors IG, FN, and PU, shows a direct relation, confirming that the increase in FC implies an increase in DOL, but in sectors CS, NCS, and HC, the relation is inverse, contradicting the theoretical premise. The research did not investigate the reason for this violation of the premise.

The DOL versus CLR association shows a direct relation in sectors IG, FN, and HC, but, in sectors CS, NCS, and PU, the relation is inverse. The direct relation cannot be explained by the model because the DOL's quantum growth would imply a quantum reduction of the CLR, because it signals that there would be idle fixed cost, and, consequently, a lower generation of financial assets. But the inverse relation

is in accordance with the theoretical premise because the quantum reduction of the DOL implies an absorption of fixed cost by the sales income with a consequent increase in financial assets.

Table 3: Coefficients of the correlation matrix of the DOL association with the sectoral variables of the Brazilian economy: 2007:1 to 2017:4

	FC	*EBIT*	*DOL*	*CLR*	*FC*	*EBIT*	*DOL*	*CLR*
a) IG					***b) CS***			
FC	1				1			
EBIT	0.9387	1			0.6573	1		
DOL	0.0952	-0.1251	1		-0.0135	-0.0590	1	
CLR	0.1936	0.1659	0.1293	1	-0.2458	-0.2787	-0.0147	1
c) NCS					**d) FN**			
FC	1				1			
EBIT	0.8901	1			0.6892	1		
DOL	-0.0146	-0.1187	1		0.3156	-0.2834	1	
CLR	-0.2707	-0.2269	-0.1285	1	0.0911	0.1427	0.0040	1
e) HC					**f) PU**			
FC	1				1			
EBIT	0.7921	1			0.8180	1		
DOL	-0.0013	-0.2812	1		0.2274	-0.1059	1	
CLR	-0.3761	-0.3986	0.0330	1	-0.0719	-0.0688	-0.1072	1

The meanings of the acronyms are listed in Tables 1 and A2.

6.3 Descriptive Statistics

The estimators of the descriptive statistics of the observations of the distribution are presented in Table 4, by research variable and sector of the economy, in the set of the time horizon. It is immediately observable that, in all six productive sectors of the economy and in all variables, the mean is located in the upper part of the median. This reveals that more than half of the observations of the distribution, in the sample's time horizon, are below the mean.

In the FC and EBIT economic variables, the distance between the mean and median estimators is significantly large, but this distance can be explained by the size of the firm. Regarding the DOL and CLR variables, as they are not influenced by the size of the firm, the distance can be explained by operational performance.

In the productive sectors IG, FN, NCS, and PU, the average DOL is within the range from 1 to 2, which suggests that the firm operates at the optimal level of installed capacity, even if it presents an

excessively large coefficient in the higher part of the limit. In sectors CS and HC, the average DOL is located in a scale between 2 and 3, slightly above the interval that identifies the optimal use of the firm's plant. But this scale between 2 and 3 can also suggest an efficient production frontier, not necessarily meaning that firms with a DOL within this interval are not in full use of their installed capacity, even if they may have a fixed cost gap to be filled by the sales revenue. These results confirm the findings of De França and Lustosa (2011), who identified a DOL within these two intervals as a response of a firm's optimal production.

In relation to liquidity, the mean estimator reveals that sectors FN, NCS, and PU show a CLR quantum within the interval between 1.80 and 1.91; in sectors IG, CS, and HC, the estimator settles on a scale between 2 and 3. For all sectors, the CLR quanta satisfy the nominal payment capacity.

Thus, comparatively, the DOL mean estimators larger than 2 are in sectors CS and HC, and sectors IG, FN, NCS, and PU are within the interval larger than 1 and smaller than 2, indicating an optimal use of the installed capacity. Changing focus to the CLR average estimators, those larger than 2 are in sectors IG, CS, and HC, and sectors FN, NCS, and PU are in the interval larger than 1 and smaller than 2. This correspondence of magnitude between the DOL and CLR quanta is in line with the inverse behavior between these two indicators shown by the coefficients of the correlation matrix.

The intersectoral dispersion of the distribution of the CLR is lower than the standard deviation of the mean in sectors IG, FN, CS, HC, and NCS, and larger than 4 in the PU sector. In relation to the DOL, dispersion is only not lower than 1 standard deviation of the mean in sector CS, which corresponds to 5.49. In the other variables and sectors, dispersion is higher than 1 and lower than 2 standard deviations of the mean. This reveals that most observations of the distribution of the 48 firms, in the set of the time horizon, are concentrated around the mean, reinforcing the argument that Brazil's economy works in a competitive market.

Table 4: Descriptive Statistics of performance and liquidity by sector – 2007:1 to 2017:4

Estimators	***FC***	***EBIT***	***DOL***	***CLR***	***FC***	***EBIT***	***DOL***	***CLR***
a) IG					**b) FN**			
Mean	84,489	138,116	1.83	2.09	50,538	136,503	1.68	1.91
Median	33,268	61,944	1.54	2.08	19,450	1,188	1.40	1.85
Coef. Var.	1.44	1.48	0.64	0.32	1.29	1.15	0.57	0.48
Minimum	2,823	1,089	1.09	0.55	890	2,398	1.05	0.50
Maximum	681,682	1,182,412	11.56	4.16	291,336	654,242	7.89	4.69
Count	308	308	308	308	132	132	132	132
c) CS					**d) HC**			

Estimators	*FC*	*EBIT*	*DOL*	*CLR*	*FC*	*EBIT*	*DOL*	*CLR*
Mean	160,137	289,377	2.39	2.38	143,587	116,046	2.72	2.14
Median	79,041	199,797	1.50	1.66	84,214	65,320	2.34	2.00
Coef. Var.	1.37	1.08	5.49	0.76	1.13	1.21	0.52	0.32
Minimum	3,104	142	1.10	0.49	2,438	974	1.43	1.06
Maximum	1,620,132	2,038,218	262.02	10.19	824,663	792,584	12.49	5.86
Count	396	396	396	396	176	176	176	176
e) NCS					**f) PU**			
Mean	448,530	690,631	1.80	1.84	195,298	451281	1.48	1.91
Median	156,053	307,169	1.61	1.67	112,241	295783	1.40	1.11
Coef. Var.	1.96	1.84	0.38	0.34	1.17	1.15	0.28	4.30
Minimum	8,483	2,005	1.25	0.91	56	-1,503	0.75	0.14
Maximum	8,181,784	9,179,297	7.26	4.43	1,385,566	3334224	5.73	163
Count	264	264	264	264	836	836	836	836

The meanings of the acronyms are listed in Tables 1 and A2.

6.4 Analysis of the OPFS

In this analysis, an investigation is conducted on how the CLR quantum behaves in relation to the DOL quantum. The model specified in Equation (1), in 5(a), suggests that, when the firm operates at an optimal installed capacity, the DOL variates within the interval between 1 and 2. The model specified in Equation (3) reveals that the CLR, to support the nominal payment capacity, must be at least equal to 1. Equation (7), specified in 5(g), shows that the DOL relates linearly with the CLR to produce the OPFS coefficient. Thus, all else being equal, financial solvency must be understood, in the specific context of the OPFS, as a semantic equivalent to the nominal payment capacity.

The responses in Table 5 show OPFS scores lower than 1 and at least equal to 1. A score lower than 1 is a signal that the DOL produces synergy in the CLR quantum. A score higher than 1 indicates that the production of synergy of the DOL in the CLR quantum is reduced. And, for a score equal to 1, the DOL's contribution is indifferent.

In this context, sectors IG, FN, NCS, and PU show that the optimal use of the installed capacity increases the generation of financial assets because the CLR quantum is higher than the DOL quantum,

and this strengthens the nominal payment capacity. In the HC sector, the generation of financial assets is less strengthened by the DOL, even if the CLR shows a comfortable nominal payment capacity in being higher than 2 but lower than the DOL. Sector CS is indifferent because the DOL and the CLR show equal quanta. The most operationally efficient sector is that of public utilities (PU), for having the lowest DOL in the scale between 1 and 2, while the least efficient is health (HC), with the highest DOL.

Table 5: Operational performance and financial solvency of the sectors of the Brazilian economy: 2007:1 to 2017:4

Sectors	DOL	CLR	OPFS
IG	1.83	2.09	0.88
FN	1.68	1.91	0.88
CS	2.39	2.38	1.00
HC	2.72	2.14	1.27
NCS	1.80	1.84	0.98
PU	1.48	1.91	0.77

The meanings of the acronyms are listed in Tables 1 and A2.

As shown by the results, the OPFS model is adequately specified for indicating a firm's operational sustainability and that the Brazilian economy, both intersectoral and intra-sectoral, in the period encompassed by the sample, as an average, operates at full employment of the installed capacity in the firms, and confirms the opposing trend between the DOL and CLR quanta.

6.5 Summary of the analyses

In summary, the results of the analyses are robust in indicating that a firm's operational sustainability is indicated by the *Operational Performance versus Financial Solvency* – OPFS binomial, with the DOL within the interval between 1 and 2, and, in this interval, it promotes synergy in the generation of financial assets, with a reduction of the DOL level and growth of the CLR level.

7 CONCLUSIONS

This article brought into discussion the research results on a firm's *Operational Performance versus Financial Solvency* (OPFS), as a reference indicator of the combination of the level of usage of the installed capacity, measured by the Degree of Operating Leverage (DOL), with the nominal payment capacity, in the short term, measured by the Current Liquidity Ratio (CLR), as a signal of a firm's operational sustainability.

By using data from the standardized financial statements of 48 firms, listed on B3, distributed across six sectors of the Brazilian economy, from 2007 to 2017, the research results show significant evidence of the inverse relation, in the intersectoral dimension, between the DOL and the EBIT. For the correlation between the DOL and the FC and with the CLR, half of the sectors present a direct relation, and the other half, an inverse relation.

In the intersectoral dimension, the DOL reveals quanta between 1.48 and 2.42. Among these quanta, four sectors behave within the interval between 1 and 2, which is the reference for optimal usage of the installed capacity, while two sectors score above 2. The CLR remains comfortable in the interval between 1.84 and 2.38, being that, in the two sectors with the DOL quantum exceeding 2, the CLR is lower than the DOL. The higher/lower operational efficiency is shown in sectors PU/HC, with DOL values of 1.48/2.72, respectively.

The results of the analyses produced by the model show robust evidence that, at a full use of the installed capacity, a firm is operationally sustainable, producing a DOL in the interval between 1 and 2 and a CLR quantum higher than a DOL quantum, and, consequently, produces an OPFS quantum lower than 1. This corroborates the fact that the model's specification is adequate, as well as the fact that the lowest DOL produces the lowest OPFS, and, consequently, the highest DOL produces the highest OPFS, with both indicators therefore having a direct relation.

In conclusion, the research results are shown to be robust, and, therefore contribute to the literature for the assessment of a firm's operational sustainability. The authors hope that subsequent research will test a wide application of the model, considering that the financial industry was not contemplated due to its peculiarities and specificities.

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APPENDIX

Table A1: Firms listed on B3 that satisfy the requirement for the completeness of the standardized financial statements – 2007:1 to 2017:4

Firm Code	Firm	Sector Code	Firm Code	Firm	Sector Code	Firm Code	Firm	Sector Code
E1	Afluente	PU	E17	Elektro	PU	E33	Multiplan	FN
E2	Ampla Energ	PU	E18	Fras-Le	IG	E34	Natura	NCS
E3	B2W Digital	CS	E19	Ger Paranap	PU	E35	Neoenergia	PU
E4	Baumer	HC	E20	Grazziotin	CS	E36	Odontoprev	HC
E5	Ceg	PU	E21	Grendene	CS	E37	Paul F Luz	PU
E6	Cemar	PU	E22	Iochp-Maxion	CS	E38	Proman	PU
E7	Cia Hering	CS	E23	JBS	NCS	E39	RaiaDrogasil	HC
E8	Coelba	CS	E24	Josapar	NCS	E40	Randon Part	IG
E9	Coelce	PU	E25	Light S/A	PU	E41	Rio Gde Ener	PU
E10	Comgas	PU	E26	Localiza	CS	E42	Sanepar	PU
E11	Conc Rio Ter	IG	E27	Lojas Americ	CS	E43	Sanepar	PU
E12	Copasa	PU	E28	Lojas Renner	CS	E44	Schulz	IG
E13	Copel	PU	E29	M.Diasbranco	NCS	E45	Tegma	IG
E14	Cosern	PU	E30	Marfrig	NCS	E46	Uptick	PU
E15	CPFL Energia	PU	E31	Menezes Cort	FN	E47	Valid	IG
E16	Dasa	HC	E32	Minerva	NCS	E48	Weg	IG

Source: Authors and B3 (Brasil, Bolsa, Balcão, 2018).

Table A2: Sectors of the Brazilian economy and number of firms in the sample

Code	Sector	Description of activities	No. of firms
IG	Industrial Goods	Trade; construction and engineering; machines and equipment; transport material; transport services; and various services	7
CS	Cyclical Stocks	Construction; hotels/restaurants; fabric/clothing/footwear; automobiles/motorcycles; media; and travel/leisure.	9
NCS	Non-Cyclical Stocks	Processed foods; agriculture and livestock; drinks; trade/distribution; and personal use/cleaning products.	6
FN	Finance	Financial/real estate; financial intermediaries; pension/insurance; receivables securitizers; and various financial services.	3
HC	Healthcare	Trade/distribution of medicines and other products; healthcare-related equipment; medical/hospital services; and analysis/diagnosis.	4
PU	Public Utilities	Supply of basic need services for the general population: electricity, natural gas, sanitation, and water.	19

Source: Authors and B3 (Brasil, Bolsa, Balcão, 2018).