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# LOOKING A STEP AHEAD: THE EFFECT OF ACCOUNTING INFORMATION ON MACROECONOMIC VARIABLES IN BRAZIL

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## ABSTRACT

This work analyzes the effect of shocks on accounting variables on a set of macroeconomic variables in the Brazilian scenario, based on the assumption of the usefulness of accounting information and its potential effect on the economy. In the survey, the following macroeconomic variables are analyzed: gross domestic product (GDP), unemployment and basic interest rate (Selic). The research, of a quantitative nature, uses vector autoregression (VAR) models to verify the effect of shocks of accounting variables (operating cash flow; earnings before interest and taxes - Ebit; net income; and shareholders' equity) on Brazilian macroeconomic variables from 2000 to 2019, analyzing 79 quarters in all. The research assumption, based on the previous literature, is that the accounting information carries informational elements of the real economy, being able, therefore, to predict movements of macroeconomic variables, such as GDP (Konchitchki & Patatoukas, 2014a; Brito, 2017; Silva, 2019); inflation (Shivakumar & Urcan, 2017) and employment (Hann, Li & Ogneva, 2017; Nallareddy & Ogneva, 2017), among others. As main results, shocks in the accounting variables take effect up to five quarters later and soon dissipate. Shocks in net income and Ebit have positive effects on GDP and shocks in operating cash reduce unemployment most of the time, while shocks in Ebit have little effect on the Selic. The findings show, in particular, the ability of accounting information to anticipate movements in macroeconomic variables, constituting a viable alternative for the analysis of these macrovariables, serving as an additional tool in the decision-making process, especially for investment-related decisions, which are very sensitive to economic instabilities.

**Keywords:** Macroaccounting. Time series. Accounting information.

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## 1 INTRODUCTION

This work has its roots in the research of Ball and Brown (1968), who discussed, in summary, the properties and usefulness of accounting information. Although they did not directly carry out the analysis intended in this research, it is possible, to a large extent, thanks to its influence. Accounting numbers are useful for a number of decisions. From the efficient allocation of resources in stocks, to the decision making regarding the capital structure of companies, many decisions go through the analysis of accounting information. That is, it has a range of utilities with the potential to explain the behavior of many common situations in the daily lives of corporations.

In this sense, as reported by Kothari and Wasley (2019), a new aspect of accounting research associates accounting information with the forecast of macroeconomic variables, such as GDP, for example. That is, the potential of accounting information has been investigated to explain and even improve the forecast of macroeconomic information. This line of investigation has been called macroaccounting.

Recent research provides evidence that accounting information at the firm level can anticipate future movements of macroeconomic indicators, such as GDP growth (Konchitchki & Patatoukas, 2014a; Brito, 2017; Silva, 2019); inflation (Shivakumar & Urcan, 2017) and employment (Hann, Li & Ogneva, 2017; Nallareddy & Ogneva, 2017).

Thus, the research investigates the effect on GDP, unemployment and the basic interest rate of the economy (Selic) when shocks in accounting information occur at the firm level. The accounting variables tested are operating cash flow, net income (NI), earnings before interest and taxes (Ebit) and shareholders' equity (SE).

The operating cash flow was selected because it shows the company's ability to generate resources to finance its main operating expenses. It is assumed that companies with greater cash slack will have resources available to expand their operations. As a result, if there is a shock in this cash flow at the firm level, it is expected that there will be a response at the aggregate level (macroeconomic variables).

Ebit and NI are two important metrics on the performance of firms. The first is very much associated with operating results, and the second is associated with the performance of the firm after deducting all costs and expenses (including financial and tax) from its operations. Operating and net results are assumed to affect the aggregate level (Konchitchki & Patatoukas, 2014a; Brito, 2017; Silva, 2019). For this reason, the effect that shocks in these variables have on macroeconomic information is investigated.

Finally, the SE was also included in the analysis because it represents the firm's residual equity, after deducting all debts, reflecting all the company's net wealth, which includes its capital and the accrued earnings over the years. In addition, it is a proxy for the size of the firm. The higher the SE, the bigger the company. Thus, it is assumed that the larger the firm size (measured by the SE), the greater the reactions to macroeconomic variables tend to be when shocks occur in this variable. Also, according to Brito (2017), at the aggregate level, the SE is a measure of significant economic and financial performance for macroeconomic analysis.

Thus, the use of the accounting variables modeled in the research is justified. Regarding the choice of macroeconomic variables, the effect of shocks on accounting variables on GDP, unemployment and Selic is analyzed, variables that have a direct impact on the daily lives of companies and various market players. For this reason, understanding movements linked to them can contribute to reduce uncertainties, which are, according to economic theory, some of the main sources of contractionary effects on the economy, especially hampering investment decisions, necessary for economic growth (Barboza & Zilberman, 2018).

Anticipating movements in these macroeconomic variables, although small, can contribute to reducing this uncertainty and improving the allocation of resources by market players. As estimating GDP, unemployment and the Selic rate is not an easy process, nor is it

cheap and accessible, the research starts from a simpler alternative: to verify the effect, in these variables, of shocks in accounting numbers, which constitutes an alternative to understand the behavior of macroeconomic variables from the analysis of accounting information.

For this purpose, the research uses vector autoregression (VAR) models to conduct the analyzes, performing the entire series of econometric procedures linked to them, such as stationarity tests, lag analysis, model specification tests and other related procedures.

The analysis is carried out using the impulse-response function (IRF), aiming to meet the main objective of the research: to analyze the effect, in macroeconomic variables, of shocks in accounting information for the Brazilian scenario. In addition, the variance of these indicators is decomposed, in order to verify the contribution of each accounting variable to explain the variation in macroeconomic indicators. Finally, a Granger causality test is performed, in order to verify whether the accounting information causes (or not), in Granger's sense, the macroeconomic variables.

As a contribution, the research assists in the decision-making process, especially in investment, seeking to understand movements of macroeconomic variables through shocks in accounting variables.

A better understanding of the economy's macroeconomic conditions improves the resource allocation process in the economy. The literature suggests that problems in the economic environment, such as high levels of uncertainty, make investors and companies more resistant to making new investments, leading to a postponement of this resource allocation process, which can lead to decreases in the hiring of personnel, as well as in production volume, affecting economic growth (Bloom, Floetotto, Jaimovich, Saporta-Eksten & Terry, 2012; Kalay, Nallareddy & Sadka, 2016).

Therefore, with the use of accounting information, it is sought to see, a few steps ahead, how the economy may behave, which can contribute to better decision making. In the specific case of this research, accounting information is used to analyze GDP, unemployment and Selic, important macroeconomic variables capable of influencing investment decisions of several market players.

In addition, this work expands the little explored literature on macroaccounting, in particular bringing to the discussion the analysis of Granger's causality, hitherto unexplored in national research on the topic.

The article has the following structure: this introduction, a literature review, a methodological section, the discussion of the results and the final considerations.

## 2 LITERATURE REVISION

Since the research by Ball and Brown (1968), several other studies have focused on the relevance of accounting information in the most different areas of accounting literature. However, the studies little analyze the relationship between accounting and macroeconomic information, mainly from the “micro-macro” perspective, which points to an influence of the (micro) company level on macroeconomic results. That said, Ball and Sadka (2015) state that there is a convergence between macroeconomics and accounting research. Corroborating this statement, Kothari and Wasley (2019) pointed to the emergence of a new stream of research in Accounting that examines the magnitude of accounting data and its influence on macroeconomic measures.

In this sense, the Keynesian current emerges, based on the demand aspect. For Keynes (1936), the expectations of the agents involved determine decisions about a country's economic activity (investment, production and employment). That is, macroeconomic results stem from joint movements, in an aggregate way, from decisions taken at the microeconomic level. Thus, it becomes credible to infer that accounting information is useful in the analysis of macroeconomic indicators (Silva, 2019).

Supported by the theoretical aspects defended by Keynes (1936), some research aimed to verify the importance of accounting information in the macroeconomic scenario: in GDP (Konchitchki & Patatoukas, 2014a; Konchitchki & Patatoukas, 2014b; Brito, 2017; Silva, Paulo, Bianchi & Queiroz , 2018; Silva, 2019); inflation (Shivakumar, 2007; Cready & Gurun, 2010; Kothari, Shivakumar & Urcan, 2013; Shivakumar & Urcan, 2017); and employment (Hann, Li & Ogneva, 2017; Nallareddy & Ogneva, 2017).

The study by Konchitchki and Patatoukas (2014a) analyzed the relationship between accounting information, that is, aggregate accounting earnings, and the macroeconomic scenario, represented by the United States' GDP. They concluded that the aggregate growth of accounting earnings is an important indicator of nominal GDP growth. In addition, the authors examined whether accounting information, through the indicators of aggregated profitability, is timely in forecasting real GDP (Konchitchki & Patatoukas, 2014b). Again, the results demonstrated that the analysis of the accounting information applied at the aggregate level is useful to assess the macroeconomic perspectives.

Brito (2017) analyzed the relationship between accounting information, using performance indicators and some accounting variables (total assets, net income, shareholders' equity and net revenue), and economic growth, represented by GDP. The author found that the accounting variables were predictive of explaining real GDP, with ROE (return on equity), shareholders' equity and net income being the most significant.

Still from the perspective of GDP, Silva *et al*. (2018), using the DuPont method, analyzed the relationship between the aggregated profitability (RNOA) of Brazilian firms and economic activity, investigating how this relationship behaves during periods of expansion and recession. Initially, it was observed that there is an influence of RNOA indicators on real economic growth and that this impact is more consistent in the phases of economic crisis. Such findings reflect the prerogative advocated by Keynes (1936), pointing out the relevance of accounting information at an aggregate level for macroeconomic predictions.

In the 2019 survey, Silva sought to investigate by the DuPont method not only the influence of RNOA and its drivers, but also other performance indicators of Brazilian companies and real GDP, in addition to verifying this behavior of the different phases of the economic cycles: expansion, recession, contraction and recovery. Following the findings of the other studies, the influence of accounting information on macroeconomic dynamics was verified. With regard to economic cycles, the results pointed to an increasing movement in the explanation of real GDP by the accounting variables in the phases of economic growth (expansion and recovery), unlike the fall phases (recession and contraction), which showed a decreasing relationship.

From the perspective of inflation, Shivakumar (2007) presented preliminary evidence that aggregate earnings are positively associated with future inflation. Likewise, Cready and Gurun (2010) found that the earnings of North American companies convey information about inflation, since the returns on bonds tend to respond directly to future inflation expectations. In turn, Kothari *et al*. (2013) investigated, among some points, whether accounting earnings are useful in forecasting inflation. It was shown that the surprises in aggregate earnings have timely and relevant information about future inflation, that is, the earnings reported in addition to what was forecast by analysts in a given month foresee future inflation forecast errors.

The work of Shivakumar and Urcan (2017) proposes to examine empirically which probable explanations and paths lead the aggregate growth of earnings to be causally related to future inflation. The authors reached two motivations, one based on the change in investments by companies in response to the growth of their profitability and the other according to consumerism, since the aggregate growth of earnings can alter the wealth of people in the short term, thus, changing, the demand curve for consumer goods at the aggregate level.

Finally, regarding the employment rate, Hann *et al*. (2017) examined the association between aggregate accounting earnings and the labor market, with job creation or destruction

being one of the measures verified. The results suggest that aggregate earnings contain timely information on the dynamics of the labor market. Earnings news can signal persistent changes in corporate profitability, which allows you to see the creation and total destruction of jobs up to four quarters ahead. These results indicate that accounting information at an aggregate level has relevant information about future conditions in the labor market. The research by Nallareddy and Ogneva (2017) corroborates this statement by documenting a positive relationship between earnings news and future changes in employment at the company level.

## 3 METHODOLOGY

### 3.1 Composition and treatment of data

This study aims to analyze the effect, on macroeconomic variables, of shocks in accounting information for the Brazilian scenario. As a vector of accounting variables, NI, Ebit, SE and operating cash of Brazilian publicly-held companies were used. As for macroeconomic variables, there is GDP, unemployment and Selic. The data used in the survey are quarterly and the period analyzed runs from the first quarter of 2000 to the third quarter of 2019. The accounting data of the companies were collected at Economatica. Data related to macroeconomic variables were collected on the Sidra-IBGE portal and on Ipea-Data, both public portals with information available to anyone.

Once the data of the companies were collected (accounting variables), the outliers were treated with 5% winsorization. After this treatment, and following the procedure adopted by Konchitchki and Patatoukas (2014b), the average of each accounting variable per quarter was calculated, working with the average NI of all companies per quarter, the average Ebit of all companies per quarter, and so on. After that, the quarterly averages were logarithmic. Then, the stationarity of each variable was tested. For this, the Dickey-Fuller test was used, which has the null hypothesis that the time series has a unit root. When running the test, none of the variables was shown to be stationary in level, making it necessary to differentiate them. All of them proved to be stationary in the first difference.

### 3.2 Vector autoregression (VAR) models

As the work involves the management of time series, the equations of a VAR were adopted for this study. Initially, it was sought to know the order of the lag of the VAR model to be estimated, analyzing through the criteria (AIC, HQIC and SBIC). In the case of the models discussed in this work, the tests indicated a lag of 4 lags according to all the analysis criteria and for all models.

Knowing the order of the model's lags and since the variables are stationary, the VAR model was estimated, which allows the analysis of interrelationships between multiple variables, identifying the exogenous component of each variable and allowing the estimation of the effect of a shock on this variable over the others (Cavalcanti, 2010). The VAR can be expressed according to Equation (1) (Giordano, Momigliano, Neri & Perotti, 2007):

$$X_t = B(L)X_{t-1} + U_t \ (1)$$

Where $X_t$ is the vector of variables, B(L) is an autoregressive polynomial of lags and is the vector of innovations. Emphasizing that the VAR model is run with the number of lags identified in the tests previously carried out, following the decision criteria already mentioned (AIC, HQIC, SBIC and others). For each macroeconomic variable analyzed (GDP, Selic and unemployment), a VAR was run with a vector of accounting variables (NI, Ebit, SE e operating cash).

VAR modeling is done through repetitions until the most suitable model is found. For the model to be considered adequate, it is necessary to carry out the diagnostic tests of the residues: normality (Jarque-Bera test), heteroscedasticity (White test), autocorrelation (Breusch-Godfrey test) and, finally, stability of the roots of the polynomial AR. All tests were performed and confirmed the robustness of the models run.

Then, arriving at the appropriate model, the impact, in these macroeconomic variables, of a shock in each accounting variable was analyzed. This analysis is possible through the IRF, which synthesizes the behavior of the series included in the VAR model, in response to an exogenous shock in one of the variables over the others in the system (Sanches, Zanin, Alves & Jacomini, 2016). In this sense, the impulse-response functions show how an impulse or an innovation in a given variable has effects on the others (Triches & Fiorentin, 2018). Still according to Triches and Fiorentin (2018), the IRF can be expressed by the following Equation (2):

$$Y_t = \mu + \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-2} + \cdots (2)$$

Thus, the matrix $\Psi_s$ is interpreted by Equation (3):

$$\Psi_s = \frac{dy_{t+s}}{de_t'} \ (3)$$

In this last equation, $\Psi_s$ refers to a matrix of multipliers of the effects of an innovation or

of an innovation or shock on endogenous variables. The rows and columns of that matrix capture the results of an innovation $\varepsilon_t$ in the value of the i-*th* variable at time *t+s* (Triches & Fiorentin, 2018).

In addition to the analysis of the IRF, the variance was decomposed, which indicates which percentage of the variance of the forecast error stems from each endogenous variable over the forecast horizon (Sibin, Silva Filho & Ballini, 2016). The variance decomposition explains how much one variable affects the variance of another variable (Pereira, Melo & Xavier, 2017). The variance decomposition of forecast error, according to Farias (2008), answers the following question: What proportion of the variance of forecast error when forecasting $X_{T+h}$ is due to

structural shock $\eta_j$? Equation (4) is the algebraic proof of this question (Farias, 2008):

$$X_{T+h} - X_{T+h|T} = \sum_{s=0}^{h-1} \Theta_s \, \eta_{t+h-s} \ (4)$$

For a specific variable $X_{i,T+h}$, the forecast error has the form given by Equation (5):

$$X_{i,T+h} - X_{i,T+h|T} = \sum_{s=0}^{h-1} \Theta_{i1}^s \, \eta_{1,t+h-s} + \cdots + \sum_{s=0}^{h-1} \Theta_{in}^s \, \eta_{n,t+h-s} \ (5)$$

Considering that the structural errors are orthogonal, the variance of the forecast error h-steps ahead is given by Equation (6):

$$var(X_{i,T+h} - X_{i,T+h|T}) = \sigma_{\eta j}^2 \sum_{s=0}^{h-1} (\Theta_{i1}^s)^2 + \sigma_{\eta j}^2 \sum_{s=0}^{h-1} (\Theta_{in}^s)^2 \ (6)$$

On what $\sigma^2_{\eta j} = var(\eta_{jt})$. Through Equation (7), it is observed that part of $var(X_{i,T+h} - X_{i,T+h|T})$, due to the shock $\eta_j$, is then:

$$DVEP_{i,j}(h) = \frac{\sigma^2_{\eta j} \sum_{s=0}^{h-1} (\Theta^s_{ij})^2}{\sigma^2 \sum_{s=0}^{h-1} (\Theta^s_{i1})^2 + \cdots \sigma^2 \sum_{s=0}^{h-1} (\Theta^s_{in})^2} \quad i,j = 1,2,\ldots,n. \ (7)$$

Finally, after analyzing the variance decomposition, the Granger causality test was performed to identify the direction of causality among the variables analyzed in the models. According to Cavalcanti (2010), one variable *X* causes another variable *Z*, in the sense of Granger, if the observation of *X* in the present or in the past helps to predict the future values of *Z* for some time horizon. Granger's causality test is operationalized using a VAR model, which verifies the interactions of the dynamic relationship between variables with the specifications presented in Equations (8) and (9) (Nunes, Costa Junior & Meurer, 2005).

$$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j=1}^{n} \beta_j X_{t-j} + u_{1t} \ (8)$$

$$Y_t = \sum_{i=1}^{n} \lambda_i Y_{t-i} + \sum_{j=1}^{n} \delta_j X_{t-j} + u_{2t} \ (9)$$

In the case of these regressions, X and Y represent the series under analysis. With this model it is possible to know the dynamic relationship between the reaction time of the responses of some variables to the shocks in the other variables, in addition to the direction and duration of these responses (Santana, Silva & Ferreira, 2018).

## 4 ANALYSIS AND DISCUSSION OF RESULTS

### 4.1 Analysis of time series

Descriptive statistics for the data under analysis are shown in Table 1.

Table 1
**Descriptive statistics**

| Variable | N | Average | Median | Minimum | Maximum | Standard deviation | Coefficient of variation |
|---|---|---|---|---|---|---|---|
| PIB | 79 | 2.42 | 2.50 | -5.50 | 9.20 | 3.12 | 1.29 |
| Unemp. | 79 | 9.18 | 8.90 | 5.20 | 13.70 | 2.34 | 0.25 |
| Selic | 79 | 13.10 | 12.55 | 5.66 | 24.75 | 4.71 | 0.36 |
| CXOP | 79 | 3.41 | 4.46 | 0.00 | 4.85 | 1.98 | 0.58 |
| Ebit | 79 | 4.61 | 4.63 | 3.95 | 4.93 | 0.21 | 0.05 |
| NI | 79 | 4.33 | 4.38 | 3.49 | 4.67 | 0.26 | 0.06 |
| SE | 79 | 5.61 | 5.65 | 5.36 | 5.81 | 0.16 | 0.03 |

**Note.** GDP: Gross Domestic Product; Unemp.: Unemployment Rate; Selic: Special System for Settlement and Custody - Basic Interest Rate of the Economy; CXOP: Operational Cash; Ebit: earnings before interest and taxes; NI: net income; SE: shareholders' equity.
Source: Research data (2020)

The variables have great amplitude. This condition is interesting for the research, since a low variability would have little to add to the discussions related to the topic. Exploring the analysis with more varied data can contribute to foster relevant discussions about the phenomenon studied. For example, GDP, in the analyzed period, varies between -5.5 and 9.2. Unemployment levels are also wide, from 5.2 to 13.7. The same is true for all other variables. This variability, as stated, can report important findings for the research.

Depending on what was exposed in the methodology (section 3), before starting the analysis, stationarity must be tested, which, in this study, was done using the increased Dickey-Fuller test. When working with time series, it is necessary to make sure that the series are stationary, thus avoiding spurious regressions and mistaken inferences. In this sense, when a time series has a unit root, the forecasts become inaccurate and biased (Silveira, Mattos & Konrath, 2017).

The series under analysis showed a unit root, that is, they were non-stationary. With that, the first difference was applied in each of the series, so that, with that, they all showed to be stationary (Table 2).

Table 2
**Stationarity test – Dickey-Fuller**

| Serie | Z(t) | 1% | 5% | 10% | Prob. |
|---|---|---|---|---|---|
| CXOP | -15.996 | -3.544 | -2.909 | -2.590 | 0.0000 |
| Ebit | -15.127 | -3.544 | -2.909 | -2.590 | 0.0000 |
| NI | -15.735 | -3.544 | -2.909 | -2.590 | 0.0000 |
| SE | -15.758 | -3.544 | -2.909 | -2.590 | 0.0000 |
| PIB | -11.329 | -3.544 | -2.909 | -2.590 | 0.0000 |
| Unemp. | -13.051 | -3.544 | -2.909 | -2.590 | 0.0000 |
| Selic | -10.989 | -3.544 | -2.909 | -2.590 | 0.0000 |

**Note.** GDP: Gross Domestic Product; Unemp.: Unemployment Rate; Selic: Special System for Settlement and Custody - Basic Interest Rate of the Economy; CXOP: Operational Cash; Ebit: earnings before interest and taxes; NI: net income; SE: shareholders' equity.
Source: Research data (2020).

## 4.2 Validity and analysis of VAR models

Since the time series were shown to be stationary, the number of lags in the VAR model should be identified. For that, criteria such as AIC, HQIC and SBIC are used, according to what is discussed in the methodology (section 3). In the case of the tests sent in this research, for both models (GDP, SELIC and Unemployment), the number of lags reported was four lags. The results of the tests and the criteria used are shown in Table 3.

Table 3
***VAR model lags***

| | | | | | **PIB** | | | |
|---|---|---|---|---|---|---|---|---|
| ***lag*** | **NI** | **LR** | **df** | **p** | **FPE** | **AIC** | **HQIC** | **SBIC** |
| 4 | -3856.11 | 209.47* | 36 | 0 | 5.0e+41* | 112.848* | 114.749* | 117.629* |
| | | | | | **SELIC** | | | |
| 4 | -3818.15 | 218.05* | 36 | 0.000 | 1.7e+41* | 111.779* | 113.68* | 116.559* |
| | | | | | **UNEMPLOYMENT** | | | |
| 4 | -3784.74 | 202.72* | 36 | 0 | 6.7e+40* | 110.838* | 112.739* | 115.618* |

Source: Research data (2020).

It appears that in the "*" indicated in each of the models, according to all the calculation criteria, the number of lags indicated in the tests is 4 lags. As the data are quarterly, this refers to 1 year. Thus, when running the vector autoregression (VAR) models, this number of lags was

adopted. Considering that the analysis revolves around the IRF and the variance decomposition, the output of the VAR model will be omitted, first because it is of little relevance to the discussion carried out and, second, for space reasons, given that they are large tables, which would occupy too much space and would add nothing to the discussion. All models met the waste tests, as shown in the methodology (section 3).

Table 4 shows the variance decomposition for the variables Selic, GDP and unemployment. This table complements Figures 1, 2 and 3.

Figure 1 shows the IRF for Selic. As noted, an increase in companies' operating cash has a positive initial effect, causing the Selic to rise in the first quarters, however, close to the fifth quarter the effect is reversed, causing the rate to decrease. Subsequently, the shock dissipates and in the tenth quarter, there is a new effect on the Selic rate, causing it to rise and then fall.

As for Ebit, the increase is felt in the initial quarters, slightly raising the Selic rate, followed by a fall that makes it return to close to the initial levels. After that, the effect is dissipated. An increase in NI has an effect close to the fifth trimester, findings similar to those found by Shivakumar (2007), Kothari *et al*. (2013) and Shivakumar and Urcan (2017), whose results showed that the earnings of organizations positively affect future inflation.

Table 4
**Variance decomposition - SELIC, GDP and Unemployment**

| | SELIC | | | | | PIB | | | | | Unemployment | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **T** | **CXOP** | **Ebit** | **NI** | **SE** | **Σ[a]** | **CXOP** | **Ebit** | **NI** | **SE** | **Σ** | **CXOP** | **Ebit** | **NI** | **SE** | **Σ** |
| 0 | 0 | 0 | 0 | 0 | 0.00% | 0 | 0 | 0 | 0 | 0.00% | 0 | 0 | 0 | 0 | 0.00% |
| 1 | 0 | 0 | 0 | 0 | 0.00% | 0 | 0 | 0 | 0 | 0.00% | 0 | 0 | 0 | 0 | 0.00% |
| 2 | 0 | 0 | 0 | 0 | 0.35% | 0.01 | 0 | 0.03 | 0 | 4.51% | 0 | 0 | 0.03 | 0.02 | 4.53% |
| 3 | 0 | 0.01 | 0 | 0.01 | 2.49% | 0.03 | 0.02 | 0.08 | 0 | 13.53% | 0.01 | 0 | 0.08 | 0.03 | 11.92% |
| 4 | 0 | 0.02 | 0 | 0.02 | 3.96% | 0.03 | 0.04 | 0.08 | 0.02 | 16.66% | 0.03 | 0 | 0.09 | 0.03 | 15.24% |
| 5 | 0.01 | 0.02 | 0.03 | 0.01 | 7.44% | 0.03 | 0.04 | 0.07 | 0.04 | 17.97% | 0.06 | 0 | 0.08 | 0.03 | 17.41% |
| 6 | 0.03 | 0.02 | 0.07 | 0.01 | 13.16% | 0.02 | 0.03 | 0.08 | 0.06 | 19.80% | 0.07 | 0 | 0.08 | 0.04 | 19.39% |
| 7 | 0.03 | 0.01 | 0.09 | 0.01 | 14.86% | 0.03 | 0.03 | 0.08 | 0.08 | 21.91% | 0.07 | 0 | 0.08 | 0.05 | 20.35% |
| 8 | 0.03 | 0.01 | 0.09 | 0.02 | 15.79% | 0.03 | 0.04 | 0.09 | 0.07 | 22.41% | 0.07 | 0 | 0.09 | 0.05 | 21.32% |
| 9 | 0.03 | 0.01 | 0.09 | 0.02 | 16.43% | 0.02 | 0.04 | 0.08 | 0.08 | 21.98% | 0.09 | 0 | 0.09 | 0.05 | 22.73% |
| 10 | 0.03 | 0.01 | 0.09 | 0.02 | 16.60% | 0.02 | 0.03 | 0.08 | 0.09 | 23.39% | 0.09 | 0 | 0.09 | 0.06 | 24.23% |
| 11 | 0.05 | 0.01 | 0.1 | 0.02 | 18.05% | 0.02 | 0.03 | 0.08 | 0.11 | 25.09% | 0.09 | 0 | 0.09 | 0.1 | 27.07% |
| 12 | 0.06 | 0.01 | 0.1 | 0.03 | 20.28% | 0.02 | 0.03 | 0.08 | 0.11 | 25.26% | 0.09 | 0 | 0.08 | 0.12 | 29.12% |
| 13 | 0.07 | 0.01 | 0.1 | 0.02 | 20.88% | 0.02 | 0.03 | 0.08 | 0.11 | 24.89% | 0.1 | 0 | 0.08 | 0.12 | 30.71% |
| 14 | 0.07 | 0.02 | 0.1 | 0.03 | 21.07% | 0.02 | 0.03 | 0.08 | 0.11 | 25.01% | 0.1 | 0.01 | 0.08 | 0.13 | 31.67% |
| 15 | 0.07 | 0.02 | 0.11 | 0.03 | 21.40% | 0.02 | 0.03 | 0.08 | 0.11 | 25.28% | 0.1 | 0.01 | 0.08 | 0.13 | 32.30% |
| 16 | 0.07 | 0.02 | 0.11 | 0.03 | 21.60% | 0.02 | 0.03 | 0.08 | 0.11 | 25.22% | 0.1 | 0.01 | 0.08 | 0.13 | 32.63% |
| 17 | 0.07 | 0.02 | 0.11 | 0.03 | 22.28% | 0.02 | 0.03 | 0.08 | 0.11 | 25.13% | 0.11 | 0.01 | 0.08 | 0.14 | 33.46% |
| 18 | 0.07 | 0.02 | 0.11 | 0.04 | 23.15% | 0.02 | 0.03 | 0.08 | 0.12 | 25.31% | 0.11 | 0.01 | 0.08 | 0.14 | 34.40% |
| 19 | 0.07 | 0.02 | 0.1 | 0.04 | 23.29% | 0.02 | 0.03 | 0.08 | 0.12 | 25.51% | 0.11 | 0.02 | 0.08 | 0.15 | 35.05% |
| 20 | 0.07 | 0.02 | 0.11 | 0.04 | 23.48% | 0.02 | 0.03 | 0.08 | 0.12 | 25.50% | 0.11 | 0.02 | 0.08 | 0.15 | 35.18% |

**Note.** CXOP: operating cash; Ebit; earnings before interest and taxes; NI: net income; SE: shareholders' equity; Σa: sum of variances of accounting variables.
Source: Research data (2020).

After this increase, the rate decreases and soon thereafter increases, followed by a further fall near the tenth quarter. For the remaining time windows, some oscillations follow, with the effect dissipating.

Kothari *et al*. (2013) found that the aggregated information resulting from the earnings anticipates the inflation news in subsequent periods. The authors justify, among other reasons, that loans and earnings are positively correlated, that is, capital providers (banks) see less risk in

loans as the profitability of entities increases, contributing to an increase in loans. In other words, greater availability of credit in the market leads to greater demand for services and products, leading to increased inflation.

Finally, an increase in the SE of the companies has an initial positive effect, followed by a return to the initial state, impacting the following quarters (close to the tenth), following even smaller effects in the following quarters until it dissipates.

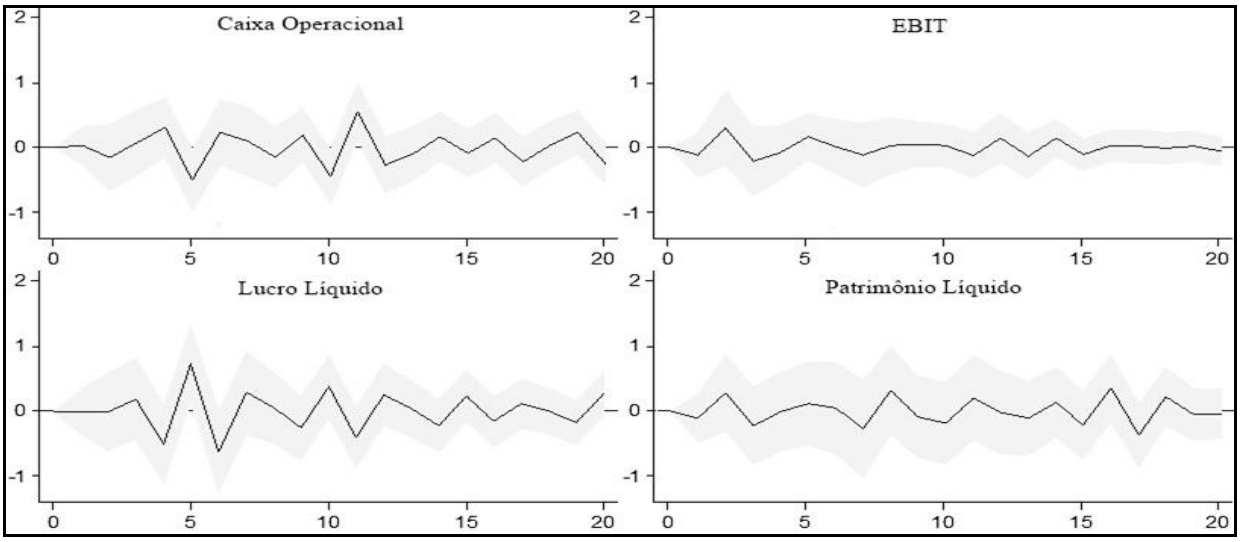


**Figure 1.** Impulse-response function (IRF) for Selic
Source: Research data (2020).
Legend: Operating Cash, EBIT, Net Income; and Shareholders' Equity

It is noted that the accounting information presents the biggest shocks in the macroeconomic variable (Selic) in the first five quarters, which then dissipate. The analysis of the IRF of the accounting variables in relation to the Selic shows that most of the time, the effect of the increase in the accounting numbers generates decreases in the Selic, that is, reductions in the basic interest rate of the economy. With this, it is emphasized the existence of informational load about the real economy contained in the accounting information, corroborating the findings of Shivakumar (2007), Cready and Gurun (2010), Kothari *et al*. (2013) and Shivakumar and Urcan (2017).

Table 4 complements the analysis of the IRF graphs for all variables. Regarding the Selic, the accounting information explains, four quarters ahead, 3.96% of variance, and these numbers increase over time. This fact shows that companies' accounting information carries an important component of the real economy, capable of contributing to a better explanation of the macroeconomic phenomena experienced (Shivakumar, 2007; Cready & Gurun, 2010; Kothari *et al*., 2013). The importance of the NI in the decomposition of the Selic variance is highlighted, presenting, since the initial quarters, a relevant weight for its explanation.

Regarding the model that verifies the effect that GDP reflects from the accounting variables, it is observed that its behavior has the following characteristic, as shown in Figure 2: when there is a shock in the variable operating cash, a small positive effect immediately appears in GDP, followed by a negative and a slightly positive effect, dissipating after that. All of this occurs before the fifth quarter.

It was to be expected that, with a greater availability of cash in companies, the effect on GDP would be strictly positive, however the data show that, in Brazil and in the analyzed period, this linear relationship is not observed. This may indicate that the surplus cash from these companies may not have been used in productive activities, which would contribute to GDP growth.

Regarding Ebit, the behavior is very similar to that of operating cash, however, when there is growth in Ebit for companies, the positive effect on GDP is greater than the negative, occurring before the fifth quarter. After that, Ebit still has some impact on GDP, but soon it is dissipated. The IRF shows that most of the time the effect of Ebit on GDP is positive, indicating that the variable carries information related to the growth of the economy.

As for NI, as with Ebit, most of the time earnings increases for companies generate economic growth, given that the IRF shows positive effects of corporate earnings until close to the tenth quarter, then dissipating. In other words, earnings carry strong evidence of economic growth for several quarters ahead. As a result, there is strong evidence that this information is very useful for estimating future economic growth.

These findings are consistent with those found in the works of Konchitchki and Patatoukas (2014a), Konchitchki and Patatoukas (2014b), Brito (2017), Silva *et al.* (2018) and Silva (2019), who showed that earnings causes a positive influence on earnings, thus demonstrating the predictive capacity of organizations' profitability at the macroeconomic level, notably in GDP.

Finally, with regard to the companies' SE and GDP, the signal was oscillating throughout the sample period. There is great variability in the movements of the GDP when the movement of the SE. The effect is dissipated around the tenth quarter. Brito (2017) also found greater influence in the first ten quarters, that is, the influence of the accounting variable on the macroeconomic occurred within a horizon of one year.

Table 4 also presents the variance decomposition for GDP. It appears that in the fourth quarter the modeled set of accounting variables explains 16.66% of GDP variations. In eight quarters, that number rises to 22.41% and continues to increase over time to 25.5%. It is observed that the GDP variability is explained in greater intensity by the NI and the SE. Brito (2017) also found that both NI and SE, in their respective models, were able to explain in greater magnitude the GDP variance than the other variables in the model.

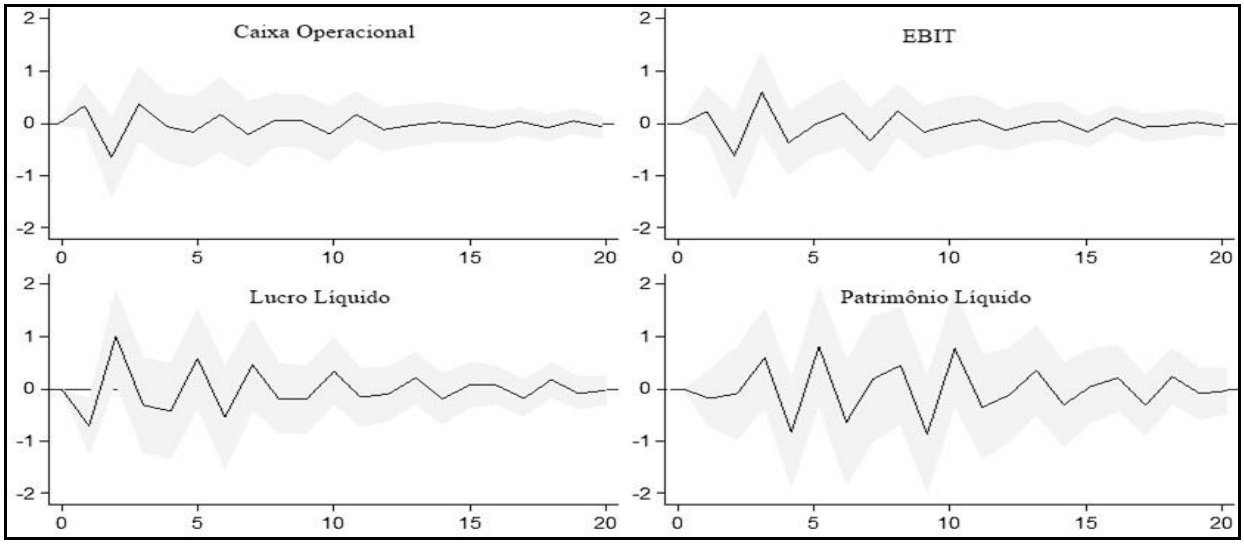


**Figure 2.** Impulse-response function (IRF) for GDP
Source: Research data (2020).
Legend: Operating Cash, EBIT, Net Income; and Shareholders' Equity

The model's accounting variables contribute to the explanation of GDP (Konchitchki & Patatoukas, 2014a; Konchitchki & Patatoukas, 2014b; Kuosmanen & Vataja, 2014; Brito, 2017; Silva *et al*, 2018; Silva, 2019). In the initial quarters, the contribution is lower, but as the quarters pass, the explanatory power increases, showing that the accounting information has explanatory power and carries information about the real economy.

Finally, Figure 3 shows the IRF of the accounting variables in relation to the macroeconomic variable unemployment. Analyzing the operating cash in relation to unemployment, there is a succession of intense effects on unemployment until at least the tenth quarter, with a subsequent reduction and consequent dissipation. Looking at the IFR, it seems clear that an increase in cash causes, most of the time, negative effects on unemployment, so it is possible to conclude that the more cash available to companies, the lower the unemployment levels in the economy.

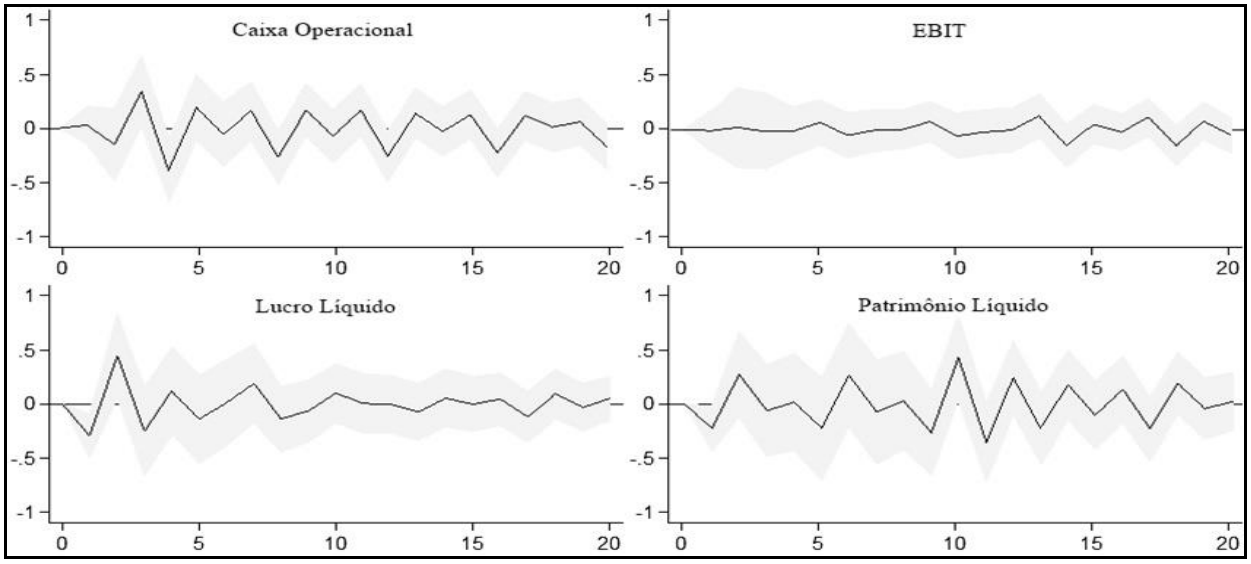


**Figure 3.** IRF impulse-response function for unemployment
Source: Research data (2020).
Legend: Operating Cash, EBIT, Net Income; and Shareholders' Equity

This finding is quite consistent, as, as companies have higher levels of cash, it is natural that there are more resources to be used in productive activities. Higher production requires more labor, which directly impacts unemployment levels. Although the IRF shows some positive peaks in unemployment (that is, increases), clearly the effect, over most of the time, is negative, being possible, therefore, to infer that the accounting information related to the companies' operating cash carries informational load about unemployment levels in the economy.

As for Ebit, it appears that a shock of this variable has a more modest effect on unemployment. This finding is not surprising, because a company does not necessarily need to produce more in order to verify higher levels of Ebit. This goal can be achieved by reducing costs, cutting staff, optimizing, among other actions. As it turns out, a shock to Ebit has little effect on unemployment levels.

With regard to SE and NI, both positive and negative impacts are perceived over the sample period. A negative shock in the first quarters shows that an increase in profitability incurs a decrease in the unemployment rate. According to Hann *et al*. (2017), the demand for labor by organizations can be determined by the demand for products and the form of their production function and, in case of positive profitability, it is likely to lead to investments and contraction, that is, causing a fall in unemployment rate.

Analyzing the unemployment variance decomposition, it can be noted that the accounting variables, four quarters ahead, explain 15.24% of their variability, much of which is driven by the NI. After that, the SE interestingly presents the greatest explanatory power of the variations in unemployment.

It is evidenced here that the accounting variables, as occurred with the previous models, offer a good explanatory set for the variations in the macroeconomic variable (unemployment),

corroborating the findings of Hann *et al.* (2017) and Nallareddy and Ogneva (2017). With this, the information provided by accounting can be used to anticipate possible movements in unemployment levels in the economy, since companies serve as a kind of thermometer, emitting useful signals to estimate unemployment levels (and other economic variables) given that accounting information itself carries information about the country's real economy.

### 4.3 Granger's causality

In addition to the analysis of impulse-response and variance decomposition, a Granger causality test was run, aiming to identify causal relationships and the direction between the variables studied. The result of the Granger test is shown in Table 5.

Table 5
**Granger's causality**

| VM[a] | VC[b] | Prob>chi2 | VM[a] | VC[b] | Prob>chi2 | VM[a] | VC[b] | Prob>chi2 |
|---|---|---|---|---|---|---|---|---|
| Unempl. | CXOP | 0.002 | Selic | CXOP | 0.002 | PIB | CXOP | 0.002 |
| Unempl. | Ebit | 0.002 | Selic | Ebit | 0.002 | PIB | Ebit | 0.002 |
| Unempl. | NI | 0.013 | Selic | NI | 0.013 | PIB | NI | 0.013 |
| Unempl. | SE | 0.070 | Selic | SE | 0.070 | PIB | SE | 0.070 |
| Unempl. | All | 0.000 | Selic | All | 0.000 | PIB | All | 0.000 |

**Note.** VMa: macroeconomic variable; VCb: accounting variable; CXOP: operating cash; Ebit: earnings before interest and taxes; NI: net income; SE: shareholders' equity.
Source: Research data (2020).

Evidently, what matters, for research purposes, is only the causality between accounting and economic variables. Therefore, the table was largely omitted, with no causality between accounting variables being presented. As shown in Table 5, in all cases, the accounting variables cause the macroeconomic variables. This finding complements the analysis of IRF and the variance decomposition previously treated.

Note that in all cases, causality is statistically significant. In most cases, the significance is 1%, in some 5% and others (few occurrences) 10%. In any case, accounting variables cause economic variables, which can be inferred with statistical security.

## 5 FINAL CONSIDEARTIONS

This study aimed to analyze the effect, on macroeconomic variables, of shocks in accounting information for the Brazilian scenario. Specifically, it was sought to assess whether shocks in certain accounting variables (NI, Ebit, SE and operating cash) impacted, and to what extent, GDP, SELIC and unemployment, which constitute the set of macroeconomic variables of interest to the research. In summary, it is investigated if the accounting information carries data about the real economy and if it is useful to predict movements of macroeconomic variables.

Why does a study of this nature matter? It is important to test an assumption, made by Ball and Brown (1968), that accounting information is useful in different contexts. In this sense, research analyzing the relevance of accounting information is recurrent, especially from the perspective of financial market decisions, on capital structure, as an input for forecasting future earnings of firms, among other jobs enshrined in the literature. However, a little explored line of research has recently emerged, studying the impact of accounting information on macroeconomic information.

As discussed in the results presentation section, shocks in the analyzed accounting variables impact, to a greater or lesser extent, the macroeconomic variables. In addition to the IRF, the variance decomposition of each of these macroeconomic variables was analyzed, and in

all cases the accounting variables contribute to their explanation, again, to a greater or lesser extent. This reinforces what was discussed in the analysis of the IRF about the informative capacity of these accounting variables and the fact that they carry information useful for explaining real-world economic phenomena.

A causality analysis was also carried out, which showed that the studied accounting variables cause, in Granger's sense, all the economic variables analyzed. This reinforces the findings discussed and constitutes another important indication of the central topic of the research discussion: that accounting information carries elements of the real economy, being able, therefore, to partially explain it.

These results are in line with those found in the studies by Konchitchki and Patatoukas (2014a), Konchitchki and Patatoukas (2014b), Brito (2017), Silva *et al* (2018) and Silva (2019), for GDP; Shivakumar (2007), Cready and Gurun (2010), Kothari *et al*. (2013), Shivakumar and Urcan (2017), for inflation; and, finally, Hann *et al*. (2017), Nallareddy and Ogneva (2017), for the unemployment rate. Such findings are relevant, as they open perspectives for better estimation of these variables, as well as opportunities for further research. With that, economic analysts, and even governments, can use this information to make better and more refined estimates of this economic variable.

In this way, the general objective of the research - to analyze the effect, on the macroeconomic variables, of shocks in accounting information for the Brazilian scenario - was fully met, since, as evidenced by the empirical analysis, shocks in the accounting variables influence the macroeconomic variables, some to a greater extent (such as NI in relation to Selic), others to a lesser extent (such as Ebit in relation to unemployment). The findings suggest the effective influence of accounting information on macroeconomic components, contributing to better decision making, in particular investment and capital allocation, since it is possible to better understand macroeconomic dynamics through accounting information. Although the research results are robust and important from a practical and academic point of view, the study has limitations. The first is that the analysis was only in the Brazilian context. An analysis with countries in Latin America, or even with a sample of countries from different economic scenarios, could report different findings and new findings.

In addition, the study chose not to deflate the variables. Working with deflated variables can generate different findings, which also serves as a recommendation for future research. Finally, the number of accounting variables analyzed is small. Undertaking research with a greater number of variables can help to identify different relationships among them and economic information. Justifiably looking for a larger set of accounting variables can shed light on new findings, deepening discussions initiated in this research.

Still, as a suggestion for future investigations, it can be sought to better understand why Ebit has greater explanatory power than NI for some variables and not others, and so on. Understanding why, in a given situation, a certain variable explains variations in economic information more than another (which is not the subject of this research) will contribute to the development of research on the topic.

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