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Analysis of the Impact of Macroeconomic Variables on The Company's Profit: Case Study of the Brazilian Oil Sector

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Abstract: Due to the Brazilian economic context of high volatility and its influence on national companies a better understanding of the cause-effect relationship between the variables of the economic system and the organization within it is more and more sought. In face of this fact, the problem of this research can be enunciated as follows: how do the macroeconomic variables impact the results of the company petrobras? Therefore, the general objective of the work is to carry out an econometric modeling which reaches macroeconomic variables that can affect the organizational result of one of the biggest companies in Brazil. concerning the specific objectives, some accounting relationships are estimated, so that, a model for oil offer and demand in the Brazilian market is also analyzed. The method proposed was based on the use of multivariate regression models of time series with panel data. The results point to empirical evidences that the Brazilian Macroeconomic scenario significantly affects the results of Petrobras and based on the models used in this research, the company can antecipate external impacts and make the most of the possible future economic scenarios.

Key words: Macroeconomic variables, petrobras, oil market, problem, macroeconomic, Brazil

INTRODUCTION

This research aims to verify the impacts of some macroeconomic variables on the company's profit and demonstrate the importance and the efficiency of the use of econometric methods of time series and panel data on companie's balance sheets. Therefore, there is the union of the methods used in researches driven to the field of economics applied to financial accounting, more specifically in financial statements for the oil sector in public companies.

Verified there was the need of speculation of a new field of studies for accounting which was called quantitative methods applied to accounting which would be the field that would apply quantitative methods in solving accounting issues. On this way, the researcher had already recognized that there was a field in economics, the econometrics which carried out quantitative projections making use of mathematical and statistical methods and that it would be possible to join both sciences in favor of accounting information prediction. Such accounting information prediction was called by other researchers (Figueiredo and Heber, 2001; Silva *et al*., 2005) as being a fundamental tool for accountants in the evolution of the occupation, since, it is of utmost importance for the information flow between them and the companie's managers, making accounting a science in the informational decision process.

In the same line of thought, Saltzman (1967), Stowe *et al*. (1980) and Ang *et al*. (1983), Wild (1987), Burns and Faurot (1992) carried out works which aimed to estimate multivariate regressions of time series with business accounting data. Nevertheless, according to Medeiros *et al*. (2011), the current literature in the accounting field has a fewer number of empirical and quantitative studies in comparison to studies in the financial and economics field. Recently, the worldwide competition for the oil added to the importance of the

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Brazilian state-owned oil company, Petrobras, to the national stock market and to the country as a whole, highlight the importance of a quantitative study on the determiners of the company's financial statement values and their relationship to the economic market.

According to Medeiros *et al*. (2011), studies which refer to the search of the cause and effect which affect the financial statement are of utmost importance and in his work, the researcher seeks two goal. The first one is to develop empirical studies in the accounting field and the second one is not only to use regression models as validation tools of the hypothesis on the accounting relationships but also elaborate financial projections from financial statements, empirically testing such causal relationships. Therefore, the researcher carried out empirical tests on the balance sheet of one of the biggest Brazilian companies, Petrobras. Afterwards Medeiros *et al*. (2011) continued the research of Medeiros *et al*. (2011), performing empirical checks on the impacts of economical variables affecting the financial statements of the same company.

Due to the its importance and lack of empirical works in this field, this research will lengthen the econometric use of some already estimated models and it will analyze a model which adjusts the best to the data and which measures the magnitude of the impact of macroecomonic variables on the company's profit making use of the time-series econometric theory.

Thus, considering the importance of the use of quantitative studies applied to financial statements and due to the current context of the state-owned company, Petrobras which is in a great world oil competition, the general objective of this study is to check the impact of economic variables on the company's profit through time-series methods contributing to a convergence of methodology used in works with macroeconomic variables with the financial accounting literature.

Therefore, the research problem of this work can be enunciated in the following way: how do the macroeconomic variables impact the profit of Petrobras. There is as the hypothesis for this research, the premise that there are significant impacts on the results presented by the company caused by some economic variables, mainly the positive impact of GDP which is a variable measuring the level of economic growth of the offer and the price of oil which are market variables and which suffer impacts according to, the external enviroment. Such a matter is justified due to the size of the company analyzed and its proportion and representativeness both in the Brazilian and international markets because as time goes by the companies seek mechanisms aiming to protect them against the market atypicalities.

Thus, the general objective of this research is to propose an econometric model which covers macroeconomic variables that may affect the organizational result of Petrobras. Concerning the specific objectives, the work will make the estimate and the analysis of a model for offer of oil demand in the Brazilian market, besides checking the effects of macroeconomic variables on the company's revenues and other specific accounts of the company. The research will be performed by the use of multivariate econometric methods with time series techniques. Moreover, the work has as a second objective to contribute to the financial accounting literature, checking not only what concerns the macroeconomic aspects that is the company within the organizational context but also the macroeconomics of the Brazilian financial market.

The studies on the impacts of macroeconomic variables on the company's profit are justified by the fact that the companies need more and more information on how they can protect themselves against such impacts and which is the way that is the most consistent but not biased methodology for measuring those impacts. Therefore, this study contributes to the literature in order to evince these impacts and their resulting magnitudes.

This research is organized in other 4 parts, besides this introduction. The second part will present the literature review that is the explanation of the importance of the quantitative analysis and the studies of the companies inserted in the stock market and how the market relation of those companies are aiming to show the importance of quantitative tests for the fortification of the financial accounting theory. The third part will present the research methodology in which the variables and their sources will be presented, the models which are going to be estimated and their hypothesis and finally, the tests used to form the models proposed. The fourth part will bring the results and discussions aroused from the tests of models. And finally, the fifth part will present the final considerations.

Literature review: In the literature about the study of companies financial statements and their relationships, Saltzman (1967) was one of the first researchers in this line of thought. Making use of quarterly data of a company in the field of laundry equipment situated in an oligopoly market, he estimated the simultaneous equation model with 5 defined equations and 10 relationships of significant variables. Amongst the equations of his models, he used the following endogenous variables: sales revenue, product prices, number of products, stock, variable costs, items of expense and investiment and as exogenous variables: price of raw material, wages, among

other exogenous determiners of demand. When estimating such equations by the ordinary least square method and by the two-stage square method, the researcher did not observe major differences between the results estimated. Two conclusions about elasticities were determined and both were that the elasticity of the demand concerning the price and concerning the production costs are inelastic, therefore, next to 0. The researcher concluded that the inelasticity comes from the market location in which the company is inserted in because since, it is a competitive market, the demand will behave mostly due to factors inherent to the company itself and in case there is price discrimination, the companies eliminate such advantages fast.

Stowe *et al.* (1980) developed a research aiming to analyze the relationship between the two sides of the financial statements balance having as premise that the decisions of investments are made apart from the financing ones. The researcher concluded that the companies aim to align their asset maturity with their liabilities in the course of their operational and financial activities. Marsh (1982) contributed to this discussion atating that the companies are influenced by market conditions and previous prices of their shares when making a decision between obtaining equity capital and third-party capital.

In an extensive research Ang *et al.* (1983) used quantitative methods in estimating 5 models with a monthly data period from June 1971-June/1978 in order to try to foresee some specific accounting accounts of an industrial rubber and plastic company. They reached some conclusions on the variables estimated, among them: the company's net sales has positive and significant effect on the cash variabl, the stocks are affected negatively and significantly by new purchase requests and by a basic interest rate, the receivables variable has significant and positive influence of the revenues with net sales, the expenses with sales and industrial production that in the model work as a proxy for the industrial activity of the sector, affect positively and significantly the revenues with net sales the product costs are affected significantily and positively by the variable of industrial production and by the revenues with net sales, the variable of expenses with sales are affected positively and significantly by the variables of sales prices of the products in wholesale and by the revenues with net sales and significantly but negatively by profit growth. The main relationship found in the researcher's list was that the profit growth is affected significantly and negatively by sales prices and by net sales revenues and negatively by the expenses with sales. Concerning the models used for the forecasts, the researcher reached the conclusion that multivariate time series models have a better performance in estimate results. Wild (1987) carried out performance analysis of quantitative models in accounting accounts structure and found a more accurate performance about the multivariate time series models. The researcher examined one of the biggest manufacturing companies of the United States with both monthly and quarterly data from 1971-1979 and concluded that not only the multivariate model is the best one to forecast the variables estimated by the study such as sales revenue, amount of sales, marketing expenses and capital expenses but also that the models with the best forecasts are the ones in which the data is monthly, not quarterly analyzed.

Also aiming to forecast the balance sheet accounts of the companies, Burns and Faurot (1992) carried out a study with econometric modeling to forecast the revenue variable for two parking companies in the business center of Kansas USA with monthly data from January/1978 to March/1984, two models were proposed; The first one was an Autoregressive Integrated Moving Average (ARIMA) and the other one was a multivariate model. Corrections with dummy variables were made in the models concerning seasonal factors such as sales flow in certain months and a proxy variable was put to measure the local economic activities. Concerning the models, the researchers concluded that both models are flexible and do not require many time difference lags and that the multivariate model seems to be better specified for certain periods of time than the ARIMA Model as observed by Ang *et al.* (1983) and Wild (1987).

Peixoto developed a work with 3 econometric models for the demand comprehension of a company in the field of health, hygiene and beauty with data from January/2002-2005. Among the models proposed, the researcher estimated a linear multiple regression model, a mixed model in which he used independent explanatory variable and lagged dependent variables as explanatory variables and ARIMA Models making use of autoregressive and moving average components of the demand variable itself to explain its behavior. Among the several significant variable to explain this company's demand, the following significant explanatory variables were found: the price with a negative sign, a variable used which represented the special offers and funds for points of sales with positive sign and the lagged sales revenue having negative sign.

Aiming to check the existence of correlation between some of the financial-economic indexes estimated a regression model to try to forecast information for companies in the civil construction sector. To carry out the study, the researcher collected data of 17 companies

listed at the BM&FBOVESPA and organized some companie's indexes in a pearson linear correlation matrix of linear correlation in which he tested the significance levels between the indexes. After finding correlated indexes, a model between the Return on Investment (ROI) variable and the financial leverage variable (net equity/third-party capital) was estimated. Therefore, the researcher reached the conclusion that those indexes are of major importance in the company's decision-making and help the company to be able to advance in face of the economic scenario the institution is within.

Medeiros *et al.* (2011) aimed to develop an empirical study in the accounting field and use the regression models aiming to validate the hypothesis about the accounting relationships for the company Petrobras during the period that goes from 1991-2001. Thus, the researcher estimated several models, among them: a model for the demand and a model for the company offer one for the revenue a model for the company cost one for the current assets, one for permanent assets one for current liabilities one for total assets and finally a model for the total liabilities of the company. In this comprehensive research, the researcher concluded that the current assets is mostly explained by the gross income of the company, the permanent assets, considered by the researcher as the company capital stock is explained by the company offer and by the permanent assets of the previous period, the current liabilities is 60% determined by the current assets and the permanent liabilities is explained by the permanent assets and by the permanent liabilities stock of the previous period.

Afterwards Medeiros *et al.* (2011), continuing his 2004 work, carried out empirical verification on the impacts of economic variables affecting the financial statements, extending the data from 1990-2006 with quarterly periodicity and checking the correlation of macroeconomic variables with accounting variables. The macroeconomic variables used were: the basic interest rate, selic, the libor interest rate used as proxy for the international interest rates, the real-dolar exchange rate the national GDP used as the proxy for the country's income and as a national activity level indicative variable and the international price of crude oil. The accounting variables used by the researchers were: current assets, fixed assets, current liabilities, long-term liabilities, equity, net income, net profit.

The researchers determined that there was a high and positive correlation between the variations of current assets and net income of the operations with the variations of other accounting accounts. They also found out that the liabilities is caused by variations of the net operating revenue and also by exchange rate variations. concerning the profit it was found out that it was sensitive in a significant way to the international price of oil and to the net operating revenue. The main conclusion was that the oil price preceded the net operating revenue of the company and influenced its profitability that is a change in the price of oil influences the operating revenue which in turn, influences the profit. In terms of prediction, the researcher concluded that a VAR Model has better prediction power than a model of multiple-equation system.

Therefore, aiming to use quantitative methods and apply them in accounting data to seek causality relationships and carry out forecasts seeking the best model of adjustment to the data collected, this research aims to fill the gaps of lack of researches that try to seek such casualty relationships in balance sheet accounts and income statements presented by Petrobras.

In the following part, there is the presentation of the models which will be estimated in the current research, the tests applied to the models to check whether the models are significant and whether they are well specified.

MATERIALS AND METHODS

To estimate the Petrobra's accounting relationships and the oil offer and demand curves, a database was built making use of information from 1998-2014 with quarterly frequency. The regressions were estimated by the E-views® econometric software and the accounting data were collected in the Economatica® database. For the oil offer data, the "oil production" variable (measured in barrels) was used, the Gross Domestic Product (GDP) (measured nominally). For the oil demand, the comsumption of oil derivates was used as proxy variable. All these macroeconomic variables were collected at the site of the Instituto de Pesquisa Economica Aplicada-IPEAData. These data are available monthly but they were changed into quarterly from the closing of the quarter in order to enable the comparison with the accounting data which are closed quarterly.

For the price data, the internationally quoted oil barrel price was used in the offer curve and the price level measured by the Indice Geral de Preços-Disponibilidade Interna (IGP-DI) was used for the demand curve. From the data collection of these variables, the model presented in Eq. 1 was estimated:

$$\text{Oil demand}_t = \alpha_0 + \text{oil price}_t + \alpha_2 GDP_t + \varepsilon_t \quad (1)$$

From the model presented in Eq. 1, the result similar to the one of a function of traditional demand is expected to be obtained for the "Oil price". Thus, the expected

coefficient of "Oil price" is negative that is in case there is an increase in oil price in the international market, there would be ceteris paribus, a reduction in demand for oil derivates. Now, in the case of the GDP, the expected signal is positive because if there is an increase of the country income, the demand for such a product would, ceteris paribus increase. Equation 2 presents the second model used in this study in which the "Oil offer" will be estimated in relation to "Oil price", "Brazilian GDP" and "Exchange rate":

$$\text{Oil offer}_t = \beta_0+\beta_1 \text{ oil price}_t+\beta_2 GDP_t+\beta_3 \text{exchange}_t+\varepsilon_t \quad (2)$$

In the Model Eq. 2, it is expected that the three coefficient be positive because as the oil price increases, the companies would be more willing to offer a greater number of products. On the other hand for the GDP variable it is expected that due to the size of the Petrobras and its impact in the Brazilian economy as the country income increases and consequently, the Brazilian market increases, there is the growth of the company as a whole and thus, the company will offer a greater number of products. Finally, for the "Exchange" variable, it is expected that the exchange affects the oil offer that is this economic variable influences positively the level of the company offer. The model presented in Eq. 3 aims to estimate the "Oil cost":

$$\text{Cost}_t = \tau_0+\tau_1 \text{ oil offer}_t+\varepsilon_t \quad (3)$$

In Eq. 3, it is expected that the "Oil offer" influences negatively the "Cost" of the company goods because as the company starts to offer a greater amount of oil at a higher price, the costs of the products sold tend to be greater. The model presented in Eq. 4 aims to estimate the "Current assets":

$$\text{Current assets}_t = \delta_0+\delta_1 \text{ revenue}_t+\varepsilon_t \quad (4)$$

With Eq. 4 model, it is intended to observe what the relationship of the revenue effect being allocated to the group of current assets in the course of time is. Since, it is known that the current assets is composed by accounts with greater rotation and flow, it is expected that the relationship between revenue and current assets be positive indicating that increases in the company revenue also causes an increase in its current assets. The model presented in Eq. 5 aims to estimate the "Non-current assets" of the Petrobras which is object of this study:

$$\text{Non-current assts}_t = \theta_0+\theta_1 \text{ Offer}_t+\theta_2 \text{ non-current assts}_{t-1}+\varepsilon_t \quad (5)$$

With the equation modeled in item 5 it is intended to observe what the relationship of the revenue effect through the product offer, being allocated to the group of non-current assets in the course of time is. As known in the balance sheet, the non-current assets is formed by the following subgroups: long-term receivables, investments, property and intangible assets. From this formation, the relationship between the company offer that is the company total production and its non-current assets can be made, since, from the moment the company starts to produce a greater number of products it will need a greater amount of capital, investiment and property. Therefore, a positive coefficient from this relationship is expected.

On the one hand, the relationship between the non-current assets at the moment (t) with itself even being lagged in a period (t-1) is related to the fact that the group of non-current assets is of a long-term nature and possibly when estimating regressions it is expected to find a strong relation of the variable in the time.

On the other hand, the non-current liabilities is composed by all the debts with maturity greater than a year. Thus, the equation expressed in the Model 6 represents the formation and distribution of the company third-party capital. In case the results evince a positive coefficient for π_1 it can indicate that the company acquires on average, non-current assets with a greater amount of third-party capital:

$$\text{Non-current liabilities}_t = \pi_0+\pi_1 \text{ non-current assests}_t+\pi_2 \text{ non-current liabilities}_{t-1}+\varepsilon_t \quad (6)$$

If a significant correlation between the lagged non-current liabilities and the running current liabilities, π_2 is observed there may be a hypothesis that the company is increasing as the time after time, its non-current liabilities and therefore, it is financing itself with a greater amount of third-party capital. The model presented in the Eq. 7 aims to analyze the relationship between the current assets and current liabilities of the Petrobras:

$$\text{Current liabilities} = \phi_0+\phi_1 \text{ current assets}_t+\varepsilon_t \quad (7)$$

Model 7 intends to check whether the coefficient ϕ_1 is positive and significant which would evince the company finances its short-term assets with short-term liabilities as well. In turn, the equation raised in Eq. 8 aims to check the composition of the total assets account of the Petrobras:

$$AT_t = \sigma_1 \text{ current assets}_t + \sigma_2 \text{non-current assets}_t + \sigma_3 \text{ long-term receivables}_t + \varepsilon_t \quad (8)$$

Differently from the estimation models described before this model aims to analyze the evolution of the values of total assets in each of the subaccounts of the balance sheet. The model presented in Eq. 9 in turn, aims to study the relationship between the "Oil offer" and the "Net income" of the Petrobras as well as the "Oil price" with the company "Net income". The reason will be to check how an increase in oil offer and price impacts the revenue of the Petrobras:

$$\text{Net income}_t = \varphi_1 \text{ offer}_t + \varphi_2 \text{ oil price}_t + \varepsilon_t \quad (9)$$

Finally, the model presented in Eq. 10 aims to investigate a comprehensive relationship in the determinants of the Petrobras profit and it has the "oil offer", the exchange relationship between real and dolar, the gross domestic product and the oil price in the international market as explanatory economic variables:

$$\text{Profit}_t = a_1 \text{ offer}_t + a_2 \text{ exchange}_t + a_3 \text{ GDP}_t + a_4 \text{ oil price}_t + \varepsilon_t \quad (10)$$

The expected signals for this model's coefficients are all positive. It is expected that the greater the amount of oil offered, the greater the company revenue which increases the profit. It is also expected that a devaluation of the real compared to the dolar encourages the export of the Petrobras and consequently it increases the company's revenue. As the GDP is a proxy for the level of industrial activity of the economy it is expected that the more the economy grows, the greater the company profit growth is. Now, concerning the oil price it may have two interpretations. First, if the oil price increases and the amount sold is kept constant (or increases) there will be an increase of the revenue and of the company's net profit as well. However, if there is an increase in price and a fall in the amount sold there will then be revenue reduction and profit reduction as well.

Based on these models, the aim of this research is to make a quantitative analysis of the relationships presented beforehand and also tell about some of their practical implications. With such estimates it will be possible to test the significance of the coefficients and also show how, empirically, the demand behavior for oil derivates due to price variations take place. Finally, it will be analyzed how the Petrobras reacts not only to changes in the world offer of oil but also changes of the barrel price in the international market.

These models were used by Medeiros *et al.* (2011) who studied a different period from the proposed study. The model extensions can bring greater contribution for the analysis of a stiffer period of the company which sees not only the competition increase in the international market but also goes through corruption problems involving high executive positions which has been leading to changes in its structure of corporate governance.

To deal with time series, it is necessary before estimating the models to check the nature of the series that is its data generator process in order to find out whether the variables are stationary and therefore have the steady average on time. In case there is regression of non-stationary series, the researcher will incur to the problem of bias in the estimates and thus, the statistics usually used will be interpreted in the wrong way (Enders, 1995).

Therefore, in order to solve this problem it is necessary to carry out some tests. The tests performed in this work to check whether the variables are stationary were: Dickey and Fuller (1979, 1987)'s test and Phillips and Perron (1988)'s test. Both tests have the same purpose which is to check whether the variable has unitary root but the main difference between both tests is that Phillips and Perron (1988)'s test while analyzing if the unitary root of the variable, makes a correction for the model heteroscedasticity. Thus, carrying out both tests for each variable was of great importance, so that, greater accuracy for the stationarity of the variables was obtained.

After having the models used in this research presented and the tests carried out, the next part presents a statistical data description, the graphs with comparisons between the variables, the tests carried out and the results of all the models proposed in this research.

RESULTS AND DISCUSSION

First, a descriptive statistical analysis of the economic variables of the models will be carried out.

Table 1: Statistical description of the variable

Statistics (unit)	Demand (Number of barrels day thousands)	Offer (Number of barrels day thousands)	International price (Dollars)	Price (Dollars)	Exchange (R$)	GDP (R$ millions)
Median	1,437	1,812	$ 60.93	$ 63.55	R$ 2.09	R$ 198,748
Maximum	2,008	2,338	$ 131.52	$ 130.30	R$ 3.63	R$ 424,448
Minimum	1,175	1,090	$ 10.41	$ 19.99	R$ 1.20	R$ 82,649
Standard deviation	227	351	$ 33.55	$ 36.17	R$ 0.49	R$106,093
Observations	63	63	63	63	63	63

Own authorship from data available by the Ipeadata and Banco central

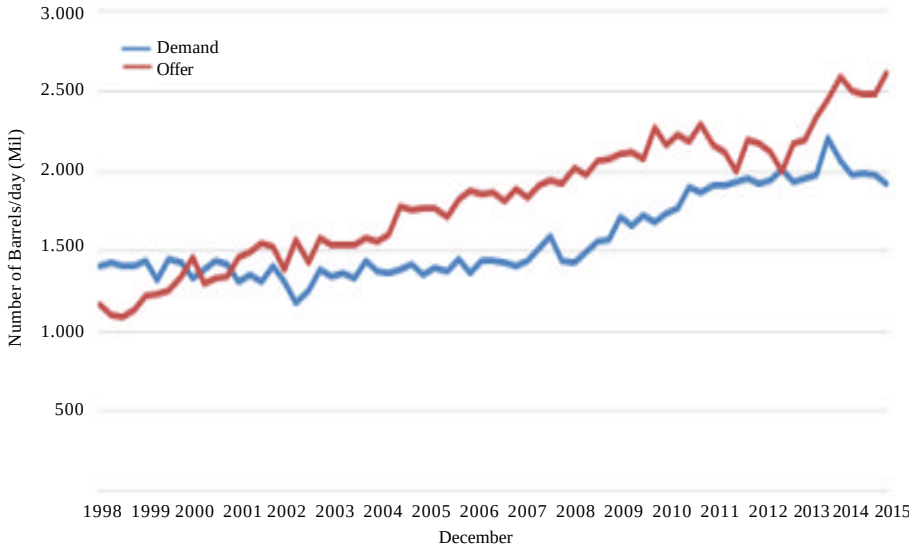

Fig. 1: Demand and offer of oil barrels demanda offerta

Table 1 presents the average, median, maximum and minimum series points, standard deviation, number of observations and the measure unit of each variable.

For the demand and offer variables, the number of barrels produced per day is shown. The international price and the price used for the internal market are measured in dollars and for the last one, the import price was selected. The exchange presented is the average purchase exchange for each quarterly period, the fact the purchase exchange was selected instead of the sales was due to the model in which the variable was used. Finally, the GDP is presented in unit of millions of reais, elaborated for a quarterly period.

Figure 1 represents the demand and offer of oil Cbarrels per day. It can be observed that from August/2000-June/2001 and from February/ 2013 December/2013, the amount of oil offered and demanded intersect. An interesting fact in the graph is that from August/2001 on, the number of barrels offered is greater in the whole graph than the number of barrels demanded which can arise a hypothesis that this dynamism makes the price of oil fall. Continuing the analysis of the graph above, Fig. 2 indicates the historical oil prices both in the national and international markets.

When putting both series in each axis in the graph above it is possible to perform a magnitude analysis that is of the variations of the variables. When analyzing the variations of each variable it is possible to check that in the 2008 crisis period, the national price quotation had slightly greater quotation than the international one. However, in March/2011, there was a detachment between the price relationship that is the national quotation becomes even>the international quotation exactly as the scenario pointed out in December/1998.

From now on 3 tables will be exposed, the first 2 will present the results of the tests indicated in the methodology of this research to be known: Dickey and Fuller (1979, 1981)'s test and Phillips and Perron (1988)'s test. Table 4 will indicate the integration order for each variable that is the necessary integration, so that, the series becomes stationary. Table 2 and 3 indicate: the test statistics of the both tests carried out with their respective significance levels, the gap used in both and also the deterministic components. From the test statistics and significance level, it is possible to infer about the rejection or not of the null hypothesis which consists of the existence of the unit root for the series.

Fig. 2: Comparison between the prices of oil, international perice national perice

Table 2: Table of the statistics test of the variable unit root

	Specifications					
	Gaps		Deterministic components		Test statistic	
Variables	ADF	P.P.	ADF	P.P.	ADF	P.P.
Oil price	0	0	1	1	0.474344	-3.505056**
International oil price	2	0	1	1	0.597184	-3.572627**
Demand	8	0	1	1	1.340730	1.858965
GDP	10	0	1	3	0.831883	-3.847594**
Offer	1	0	1	3	2.446806	-4.386739***
Exchange	2	0	1	1	-0.035059	0.084728
Cost of product sold	0	0	3	3	-4.583658***	-4.594373***
Current assets	1	0	1	3	1.430049	-3.290465*
Sales revenue	0	0	1	3	0.547805	-4.626316***
Non-current assets	7	0	1	1	0.892796	5.027196***
Current liabilities	3	0	1	3	1.524451	-4.520943***
Non-current liabilities	3	0	1	1	2.222731	4.500415
Long-term receivables	0	0	1	1	-0.152197	-0.152197
Total assets	0	0	1	1	3.901166	4.230983
Fixed assets	0	0	1	1	8.214222	13.147500
Net profit	2	0	1	3	-0.671406	-4.872962***

Table 3: Table of the unit root statistics of the variables in difference

	Specifications					
	Gaps		Deterministic components		Test statistic	
Variables	ADF	P.P.	ADF	P.P.	ADF	P.P.
D (Oil price)	0	0	3	3	-7.894619***	-8.730306***
D (International oil price)	0	0	3	3	-7.130607***	-12.30048***
D (Demand)	0	0	3	3	-11.01454***	-23.30996***
D (GDP)	1	0	3	3	-5.509152***	-30.55439***
D (Offer)	0	0	3	3	-12.26437***	-38.93067***
D (Exchange)	0	0	3	3	-6.878113***	-6.908813***
D (Current assets)	0	0	3	3	-11.00923***	-11.13711***
D (Sales revenue)	0	0	3	3	-10.09846***	-34.48845***
D (Non-current assets)	6	0	1	3	-0.910695	-7.213507***
D (Current liabilities)	0	0	3	3	-7.790970***	-12.98235***
D (Non-current liabilities)	2	0	3	3	-3.908113**	-8.545704***
D (Long-term receivables)	0	0	3	3	-7.746311***	-7.746596***
D (Total assets)	3	0	3	3	-3.185457*	-8.612323***
D (Fixed assets)	0	0	3	3	-9.191481***	-10.02181***
D (Net profit)	0	0	3	3	-13.91549***	-25.43078***

Key for the deterministic components; No constancy, no tendency; Constancy, without tendency; Constancy and tendency; Rejection of unit root; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%

Table 4: Integration order of the variables integration order

Variables	Integration
Oil price	I (1)
International oil price	I (1)
Demand	I (1)
GDP	I (1)
Offer	I (1)
Exchange	I (1)
Cost of sold products	I (0)
Current assets	I (1)
Sales revenue	I (1)
Non-current assets	I (1)
Current liabilities	I (1)
Non-current liabilities	I (1)
Long-term receivables	I (1)
Total assets	I (1)
Fixed assets	I (1)
Net profit	I (1)

Table 5: Model for the oil demand (Model 1)

Variable type	Variables	Coefficient	t-statistic
Endogenous variable	D (Demand)	N/A	N/A
Constant	C	10.1309	1.139288
Exogenous variable	D (Oil price)	1.459207	2.435918**
Exogenous variable	D (GDP)	-0.000703	-1.255368

R^2: 0.115188; Adjusted R^2: 0.085195; Rejection of the null kypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 2, all the variables are found in levels. Among them, the cost of products sold variable was the only rejected variable in the unit root hypothesis (for both tests) and therefore, it will be built in the models in levels. For the other variables, tests with the series in difference were carried out which can be seen in Table 3.

Thus, the remaining variables when built from their differences are stationary or in other words are integrated of order 1. That is the hypothesis of unit root is rejected. Table 4 is representing the integration order of each variable used in the research and it can be concluded that the "Cost of Products Sold" is integrated of order 0 that is it is stationary in level and the other variables are integrated of order 1 and need to be built from their corresponding differences in order to be stationary.

To analyze the heteroscedasticity, two kinds of tests were performed: the white's test and the Breusch-Pagan-Godfrey one. To analyze the models estimated it is important to analyze its significance and its signal that is what the level of significance for the rejection of the null hypothesis of which the variable coefficient is equal to 0 and whether its influence is positive or negative on the endogenous variable. It is also important to check the R^2 and the adjusted R^2, since, this statistics shows how much the model is being explained in relationship to the endogenous variables being explained by the exogenous variables.

Table 6: Model for the oil offer (Model 2)

Variable type	Variables	Coefficient	t-statistic
Endogenous variable	D (Offer)	N/A	N/A
Constant	C	6.68792	0.593662
Exogenous variable	D (Oil price)	0.577458	0.738632
Exogenous variable	D (GDP)	0.002113	2.995986***
Exogenous variable	D (Exchange)	-36.55187	0.4726

R^2: 0.157565; Adjusted R^2: 0.113991; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 7: Model of the cost of products sold (Model 3)

Variable type	Variables	Coefficient	t-statistic
Endogenous variable	Cost of products sold	N/A	N/A
Constant	C	35306776	7.26232***
Exogenous variable	D (Offer)	-2,815,731	-0.012079

R^2: 0.000002; Adjusted R^2; -0.01666; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 5 indicates the estimate of Model 1. From this table it can be seen that only the variable of oil price difference is significant at 5% and it influences positively the differentiation of the demand variable.

For the variable of the GDP difference, a significant coefficient was not obtained. Therefore, no inference can be performed on the non-significant coefficients. When observed the R^2 and the adjusted R^1 obtained, respectively, 11.5 and 8.5%, it is seen that the values are considered low. Such values are interpreted as a percentage in which the model is explaining the endogenous variable "Demand". It indicates that the demand for oil is also explained by other variables besides the country's GDP and the oil price.

Further on, it will be observed on Table 15, concerning Model 1 of Table 5, that for the homoscedasticity tests, the homoscedasticity hypothesis was not rejected. Therefore, the model has homoscedastic variance which in this case is positive for the consistence of the model.

The results of Model 2 are presented in Table 6. For this model, positive and significant coefficient was found for the difference of GDP. It indicates that when the country's economic activity increases, an increase in the industrial activity is also expected and consequently, the increase of product offer by the company.

Concerning the other variables, it is not possible to performe inference, since, the statistic was not significant. It is worth to highlight that the difference of "Oil Price" has a positive coefficient, according to, the hypothesis for the model. However, significant statistic was not obtained. Concerning the homoscedasticity, the homoscedasticity hypothesis was not rejected which is important for the model. And for the statistics of the R^2 and the adjusted R^2 a value higher than in the previous model was found but it was still considered low for the model. Table 7 presents the results for Model 3. It can

Table 8: Model for current assets (Model 4)

Variable type	Variables	Coefficient	t- statistic
Endogenous variable	D (Current Assets)	N/A	N/A
Constant	C	1647938	1.160127
Exogenous variable	D (Sales revenue)	0.437112	1.985147*

R^2: 0.061632; Adjusted R^2: 0.045993; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%;Own authorship, data available at Ipeadata

Table 9: Model for the current assets with gap (Model 5)

Variable type	Variables	Coefficient	t-statistics
Endogenous variable	D (Non-current assets)	N/A	N/A
Constant	C	7,998,796	3.460766***
Exogenous variable	D (Offer)	-28,084,01	-1.196441
Exogenous variable	D (Non-current assets (-1)	0.186064	1.421838

R^2: 0.047508; Adjusted R^2: 0.014664; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 10: Estimated model for the non-current liabilities (Model 6)

Variable type	Variables	Coefficient	t-statistics
Endogenous variable	D (Non-current liabilities)	N/A	N/A
Constant	C	3658126	1.91558
Exogenous variable	D (Non-current assets)	0.225613	2.256327**
Exogenous variable	D (Non-current liabilities (-1))	-0.035851	-0.282559

R^2: 0.081050; Adjusted R^2: 0.049362; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

be seen that a negative coefficient was found for the offer difference which indicates the company when increasing the offer, reduces its production cost which would lead to evidences of economies of production. However, the test statistic found for this variable was not significant. Concerning the model heteroscedasticity, the homoscedasticity hypothesis was not rejected but the statistics of R^2 were low.

Table 8 presents the results of Model 4. In this model, a positive significance was found for the coefficient of sales revenue differentiation as explanatory variable for the current assets differentiation. That is as the sales revenue of the company increases in time there is also an increase in its current assets. The R^2 and the adjusted R^2 of the model are low which entails low explanatory power of the model. However, what is required with the model is to find whether in fact there is correlation between these variables instead of explaining the variations of the current assets. For this model, the homoscedasticity hypothesis was not rejected.

Table 9 presents the results of Model 5 which analyzed empirically whether the increases in the oil offer influenced positively increases in the current assets of the company. Nonetheless, a significant coefficient was found only for the constant what makes it impossible to make a statistical analysis of the model proposed. Table 10 presents the results of Model 6. As hypothesized concerning model 6 a positive and

Table 11: Model for current liabilities and current assets (Model 7)

Variable type	Variables	Coefficient	t-statistics
Endogenous variable	D (Current liabilities)		N/A N/A
Constant	C	467495.1	0.613009
Exogenous variable	D (Current assets)	0.137828	2.067390**

R^2: 0.066498; Adjusted R^2: 0.050940; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 12: Model for asset accounts (Model 8)

Variable type	Variables	Coefficient	t-statisctics
Endogenous variable	D (Current assets)	N/A	N/A
Constant	C	-668104.6	-0.419331
Exogenous variable	D (Non-current assets)	0.298231	3.186310***
Exogenous variable	D (Long-term receivables)	-0.261045	-0.765145

R^2: 0.147705; Adjusted R^2: 0.118814; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

significant coefficient was found for the the non-current assets difference which shows evidences that along the time as the company increases its non-current assets, there is also an increase in its non-current liabilities. The coefficient of this variable can be interpreted as follows: for every 1 unit increased from one period to the other in the non-current assets there was on the average an increase of 0.225613 units of non-current liabilities.

Concerning the heteroscedasticity test for Model 6, the hypothesis that the model is homoscedastic for the White's test was rejected. However, Breusch-Pagan-Godfrey test uses smaller number of degrees of freedom and the sample of the models of the work is low a greater weight will be given to this test over the White's test which makes use of a higher number of degrees of freedom and has better accuracy in the tests with a greater number of samples.

Table 11 presents the results of Model 7. In this model a significant and positive statistics for the current assets difference was found. The heteroscedasticity tests indicated that the model is homoscedastic for Breusch-Pagan-Godfrey test and heteroscedastic for the White's test. Nonetheless, the hypothesis that the model is homoscedastic will be adopted due to the size of the sample. Concerning the explanatory power of the model (R^2), the statistics presents numbers relatively low.

Table 12 presents the results of Model 8 which evidences the relationship of the Petrobra's asset accounts. According to, the data on Table 8 it is possible to perform the empirical casualty inference between the company's non-current and current assets. In this model, a positive and significant relationship between these two variables was found and the heteroscedasticity tests in this model indicate that the model is homoscedastic.

Table 13 presents the results of Model 9. This model shows the relationship between the difference of the Petrobra's net income and the differences of offer and oil price. As it can be observed in Table 13 a positive and

Table 13: Model for the net income (Model 9)

Variable type	Variables	Coefficient	t- statistics
Endogenous variable	D (Net income)	N/A	N/A
Constant	C	230860.3	0.340095
Exogenous variable	D (Offer)	2390.306	0.309405
Exogenous variable	D (Oil Price)	282503.5	5.874797***

R^2: 0.375109; Adjusted R^2: 0.353926; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%; Own authorship, data available at Ipeadata

Table 14: Result of the profit regression against economic variables (Model 10)

Variable type	Variables	Coefficient	t-statistics
Endogenous variable	D (Profit)	N/A	N/A
Constant	C	-80490.65	-0.184434
Exogenous variable	D (Offer)	8482.906	1.672724*
Exogenous variable	D (Exchange)	-4807111	-2.450898**
Exogenous variable	D (GDP)	-22.78102	-0.778454
Exogenous variable	D (Oil price)	48996.43	1.615122

R^2: 0.389209; Adjusted R^2: 0.363922; Rejection of the null hypothesis; ***Significance level of 1%; **Significance level of ; Own authorship, data available at Ipeadata

Table 15: Table of the heteroscedasticity tests

Specifications	Statistics of the F-test	
Variables	Breusch-Pagan-Godfrey	White
Model 1	0.115552	0.549297
Model 2	1.367248	1.176698
Model 3	0.012994	0.929312
Model 4	0.002776	0.173123
Model 5	0.610743	0.833113
Model 6	1.251306	3.084913**
Model 7	1.314614	3.017515*
Model 8	0.907352	0.869102
Model 9	2.408266*	1.352928
Model 10	1.837354	2.002647**

Homoscedasticity rejection; ***Significance level of 1%; **Significance level of 5%; *Significance level of 10%

significant coefficient was found at 1% for the oil price but it is not significant for the other explanatory variables. The positive coefficient of the oil price can be interpreted in the following way: in each period in which there is an increase in oil price there is also a positive variation in the net income of the Petrobras.

The heteroscedasticity tests of Model 9 indicate homoscedasticity for the White's test and heteroscedasticity for Breusch-Pagan-Godfrey test. Thus, it is concluded that the variance of the model is not constant for the whole period analyzed. For model 9, the statistics of the R^2 and adjusted R^2 obtained were relatively high for the series nature indicating good explanatory power of the model for the Petrobra's net income.

Table 14 presents the results of Model 10. This model sought to verify the relationship between the generation of the Petrobra's net income and some important macroeconomic variables. When estimating the model proposed, two significant coefficients were found: the coefficient of offer difference which presented positive sign and the coefficient of exchange difference which presented negative sign. The R^2 and adjusted R^2 statistics indicate that the model has good explanatory power for the profit variable. The White's test indicated the presence of heteroscedasticity and Breusch-Pagan-Godfrey test indicated homoscedasticity in the model.

Interpreting the coefficient signs of Model 10 we can check that there is positive relationship between the oil offer and the profit of the Petrobras which had already been proposed in this model's hypothesis. On the other hand a negative coefficient for the relationship of the exchange was found, contradicting the initial hypothesis. It is worth to highlight that the oil price difference is not significant at 10% but it is significant at a level of 12% which would lead to an empirical inference that an increase in oil price leads to greater profit for the company.

Finally, Table 15 was built aiming to indicate the statistics of the F-test for each model proposed, in order to judge the rejection or not of the presence of the heteroscedasticity in the models.

CONCLUSION

There is a fair number of studies which aim to apply econometric methods in accounting data to estimate models to seek to trace some relationships in financial statements of companies. To this end, this study sought to investigate some accounting relationships for the biggest Brazilian company, Petrobras. In general terms it aimed to seek casual relationships which captured significant relationships for economic variables that influence the company's result that is how the macroeconomic environment interacts with the company's business environment.

From the models estimated it was possible to obtain some important and significant relationships, among them in the estimate of the offer and demand models. In special, it was observed that the oil price affects the demand of the product positively. The GDP affects the oil offer positively as well.

For the accounting relationships, the models estimated also evinced some significant relationships, among the main ones: the sales revenue influences the current assets positively (result which was also obtained by Medeiros *et al*., 2004), the non-current assets positively affects the non-current liabilitie: the current assets positively affects the current liabilities the non-current assets positively affects the current assets and the oil price positively affects the company net income. The model estimated for the company net profit was the most

comprehensive one to capture economic variations affecting the organizational result. In this model, significant values were obtained for the coefficients of product offer with positive sign and for the exchange with negative sign. For the oil price, the hypothesis of the coefficient being equal to 0 was almost rejected, however, it would be necessary to increase the significance level from 10-12% which would lead to a positive and significant coefficient for this variable too. Different from the results found by Medeiros *et al.* (2011), no significance was found for the variable of price affecting the company net profit.

Another point that differs from the model of the present resaerch is that a time series linear regression model was used instead of a VAR or VEC; This choice was due to the number of samples collected being relatively small and the data being in quarterly frequency and because of the stationary nature of the series as well. Thus, one of the limitations found for carrying out the work was exactly the number of samples collected since the number is relatively small but afterwards it is possible to give sequence to the same theme with a greater number of samples causing more accuracy in the inference power of statistical tests. Concerning the general objective of the research, empirical evidences that some economic variables such as oil offer and exchange affect the company's profit were found. Moreover, the results present strong evidences that the external environment has significant influence in the company's profit generation. Therefore, this research shows the importance of the macroeconomic environment that is the macroeconomic policies and the agent's expectation on the Petrobras.

With the analyses carried out it was possible to conclude that there are empirical evidences that the macroeconomic scenario can affect the company results and it is up to the company to antecipate itself to such results and make the most of the possible economic scenarios. It is worth to highlight that for possible future works on this theme, researches which aim to understand the sample for the same relationships estimated and also which increase the number of companies for some sectors of the economy or even for a group of companies selected by the work can be carried out.

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