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Recognition of losses to impairment of assets: impairment in oil operation and production assets

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ABSTRACT: Losses to impairment of assets are placed in the context that assets cannot be registered above their recoverable amount, through use or sale of by the company. In the oil sector, the representativeness of exploration and production assets is relevant and meaningful. Therefore, the practice in the industry is not new and dates of the 70's. Moreover, oil companies are obligated to publish additional information about their typical activities. Thus, the purpose is to analyze how this additional information about oil exploration and production are related by oil companies to impairment losses of E&P assets. We conducted a regression with panel data, using 212 observations of 53 oil companies for the period from 2005 to 2008. Findings suggest that the variables: price per barrel, reserves proved undeveloped, reserves x production ratio, development expenditures incurred, valuation standard of reserves and earnings per barrel are relevant to the recognition of loss to the impairment of E&P assets. The scarcity of empirical research allows importance to this study, but it has limitations and its findings remain restricted to the sample, variables and econometric tool used.

Keywords: Impairment; recoverable value; panel data; E&P assets.

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1. INTRODUCTION

The oil industry is typically capital intensive by nature, that is, it demands great amount of resources in order to build its assets and has oil and gas fields in productive conditions. Besides these companies high degree of immobilization, the activity of oil and gas exploration and production (E&P) involves high risks and long periods of maturation of the investment. Writhe and Gallun (2008) argue that, due to the lack of correlation between the magnitude of the expenditure incurred and any resulting value in reserves, difficulties in the economic recovery of the values allocated and capitalized may occur. In this context it is important to consider that "asset" stands for the probable future economic benefit obtained or controlled by a particular entity as a result of past transactions or events. Since the register value of an asset does not always represent its real economic value, the impairment stands as a tool used to adjust the value of the asset to its real capacity of economic return (Silva et al., 2006).

In the normative field, regulators have established procedures to ensure that assets are not accounted for greater value than that which can be recovered through use or sale in order to enhance the informative power of financial statements. When there is clear evidence that there are assets valued by non-recoverable future value, the entity must immediately acknowledge the depreciation of the asset with the constitution of loss to the impairment. The main rules on this issue are: International Accounting Standards No. 36 (IAS 36) - Impairment of Assets, in International Accounting Standards Board (IASB), 1988 and Statements of Financial Accounting Standards No 144 (SFAS 144) - Accounting for the Impairment or Disposal of Long-Lived Assets, in Financial Accounting Standards Board (FASB), 2001. Important to note that SFAS 144 replaced SFAS 121 in force since 1995[i].

In Brazil, the matter appears in *Pronunciamento Técnico* (Technical Statement) CPC 01 – *Redução ao Valo Recuperável do Ativo* (CPC 01), of *Comitê de Pronunciamentos Contábeis*, 2007. This announcement has been approved by the *Comissão de Valores Mobiliários* (Securities Commission), *Conselho Federal de Contabilidade* (Federal Accounting Council), *Banco Central* (Central Bank), SUSEP and ANEEL. Moreover, the corporate law (Law 6.404/76) itself has suffered recent changes in order to incorporate the impairment test, making it mandatory for corporations. In the oil sector, according to Silva (2007), the representativeness of assets related to exploration and production activity in relation to total assets is very relevant and significant, representing the majority of assets of some companies. Therefore, Wright and Gallun (2008) consider that the oil industry has very

unique characteristics, differing from others in several respects. Gonçalves (2008), for example, exposes one of these questions by arguing that the financial reports published by the oil companies have requirements and information needs that go beyond those usually posted by companies in other segments. In fact, oil companies are required to disclose additional information, such as data on reserves, value of investments made in each of the exploration and production stages and value of expenditures capitalized as E&P assets, among other.

Godoy (2004) explains that the accounting theoretical and normative frameworks of the oil sector are in accordance to the FASB's standards, considering that the accounting practices previously developed for this segment have not been overcome. Moreover, they are widely used by companies acting globally, due to the need of fundraising and operating in the U.S. market. Even under IFRS there are no specific standards for the industry, the only guidance provided by IFRS 6, that companies could maintain their practices in use until the issuance of a specific IFRS. Thus, has the FASB Statements of Financial Accounting Standards No. 19 (SFAS 19) - Financial Accounting and Reporting by Oil and Gas Producing Companies, 1977, which dictates the rules for accounting for the expenses incurred in the discovering of oil deposits and Statements of Financial Accounting Standards No. 69 (SFAS 69) - Disclosures about Oil and Gas Producing Activities[ii] of 1982, which deals with requirements concerning the dissemination of standardized information on oil and gas reserves.

Moreover, the practice of impairment in oil sector is not new and dates of the 70's. In the case of oil companies using the accounting method known as capitalization of expenditures (full cost), the Securities and Exchange Commission (SEC) requires them to perform what is called "ceiling test" laid down in Regulation SX Rule 4-10 (Financial Accounting and Reporting for Oil and Gas Producing Activities Pursuant to the Federal Securities Laws and the Energy Policy and Conservation).

For other companies, especially those using the capitalization of expenses by the successful efforts method, the E&P assets related to unproven property of oil should be tested in accordance with the rules laid out in SFAS 19, applying what is known as "valuation allowance". In the case of E&P assets related to proved oil and gas property the practice is coeval with SFAS 144 and IAS 36. Given the requirement for disclosure of additional and specific data (here called "E&P data") and long-standing practice adopted by oil companies, this research presents the following question problem: *What is the predictive ability oil sector*

companies E&P data regarding the impairment of assets in exploration and production of oil?

Therefore, the objective is to analyze how E&P data relate to the losses made by economic devaluation of the assets of E&P (*impairment*), so that we can confirm or refute the hypothesis that additional information on exploration and production activities have significant predictive ability regarding this phenomenon in the petroleum segment.

For this purpose, we relied on a regression with panel data, using 212 observations of 53 oil companies for the period from 2005 to 2008. In a bibliometric study, Zandonai and Borba (2009), did a survey on research about the topic impairment in English language journals and found 62 papers on the theme, and only 13 of them were related to empirical research, demonstrating that this still is a relatively unexplored subject, including internationally. In this context, the research developed here takes on added importance and relevance in academia.

2. THEORETICAL PLATFORM

The accounting theory states that an element of equity (tangible or intangible) can only be considered an asset, among other factors, if it provides the controlling entity with the possibility of obtaining future economic benefits (IUDÍCIBUS; MARTINS; Gelbcke, 2008). Assets are initially recorded in the books at cost value, assuming the economic value the asset will generate in the future through its use will be sufficient to cover at least its recorded value. However, it is known that the economic environment is constantly changing, technological advances occur ever faster, new products are launched daily and new processes are developed, not to mention that consumers are increasingly demanding, among other factors, making certain assets to loose most of its ability to generate future economic benefits, originally planned and existing by the time they were acquired.

The test of economic recoverability of the assets value or impairment test is within the context in which the premise is that no asset can be a value other than that recoverable through sale or use by the company. If the cost value of the asset is greater than its recoverable amount, it must be adjusted by recording a low or a direct loss for the difference or, otherwise, it is said that the asset has passed the test of recoverability and there is nothing to do (IUDÍCIBUS; MARTINS; GELBCKE, 2008).

Despite the logic of the impairment test be present in accounting theory from its foundations - as in the rule for the valuation of inventories to cost or market, whichever is

shorter, this systematic is gaining more prominence, especially after the issuance by the FASB and IASB of SFAS 121 (SFAS 144 currently) and IAS 36, respectively. On the trail of the two organs, Brazil amended its corporate law to predict the test and published on CPC, FRS 01, now approved by various regulatory spheres. As already mentioned, one can say that research on the subject, especially the empirical, are still incipient. The next items presents a survey of some of the articles published in Brazil and internationally.

2.1 National Surveys

Research on this subject in Brazil were published in scientific meetings and most of them are essentially theoretical and aimed to compare the main differences between the standards, in particular IAS 36 and SFAS 144. Other studies are characterized by being applied in cases arising in specific segments, especially in the oil sector and communication sector, with a qualitative approach to data analysis. We can find these studies in Chart 1.

Source	Research Objective	Disclosure Means
Machado (2003)	Present the impairment test of long duration assets according to the SFAS 144, to the IAS 36 and to the CVM rules.	Dissertation
Silva *et al.* (2006)	Analyze the particulars of the rules SFAS 144 and IAS 36 and the accounting impacts of their application in the net worth, through a simulation in an oil company.	Annals
Raupp and Beuren (2006)	Analyze the process of measurement of the fixed assets economic value, having as basis the integration of the fair value and of the impairment test.	Annals
Gouveia and Martins (2007)	Compare the treatment methods of the acquired goodwill (amortization and impairment test) based on the accounting conceptual structure.	Annals
Rodrigues and Goncalves (2007)	Comparatively analyze the companies' valuation methods by the discounted cash flow and by the residual profit, in the realization of the impairment test.	Annals
Silva (2007)	Analyze the level of adherence of the oil companies' accounting statements as for the mandatory disclosures contained in the SFAS 144 and IAS 36, referring to the impairment test application.	Dissertation
Cruz (2008)	Analyze the impact of the impairment adjustments on the result of the European companies recorded in the NYSE elapsing from the differences between the SFAS 144 and the IAS 36.	Annals
Baesso *et al.* (2008)	Analyze the losses due to impairment recorded by the American mobile phone companies in the period from 2000 to 2006.	Annals
Souza, Borba and Dutra (2008)	Investigate how the Brazilian companies that negotiate shares in Brazil (BOVESPA) and in the United States (NYSE) evidence the impairment test in their financial statements.	Annals
Smith, Ferrarezi and Cia (2008)	Analyze the impact produced by the losses due to impairment in certain indicators of limited responsibility companies.	Annals
Domingues *et al.* (2009)	Analyze the main divergences of the rules SFAS 144 and IAS 36 and test the relationship between the extra-balance factors and the impairment expenses in 2007 of oil companies registered in the NYSE.	Annals
Zandonai and Borba (2009)	Bibliometric survey of the empirical researches about the impairment test published in English Language journals between 2000 and 2008	Qualis B4 Journal

Chart 1 - Major national surveys on impairment
Source: elaborated by the authors.

2.2. International research

Zandonai and Borba (2009) conducted a bibliometric survey on international journals with the purpose of analyzing the literature on impairment test. The authors found a total of 62 studies on the subject, but only 13 were characterized as empirical research. Among the 13 articles analyzed, it has been observed that most, either directly or indirectly, dealt with the impairment test of goodwill, with 8 items in this line. Another aspect observed refers to the application of the test by oil companies.

No comments will be made on articles that dealt with this issue, due to the fact that this has been the object of Zandonai and Borba's study (2009). We will only highlight Alciatore, Easton and Spear (2000) research, Boone and Raman (2007) and Al-Jabr and Spear (2004), the latter not addressed by the authors in their bibliometric survey.

Alciatore, Easton and Spear (2000) studied 78 oil companies that follow the full cost accounting method, encompassing 148 observations covering the period 1984 to 1987. The goal was to analyze the impact of disclosure of recognized losses in the application of the ceiling test on companies' inventories. Results suggested that somehow the market already had some implicit information on the amount of losses, pricing down the shares price even before the disclosure of recognized losses.

Al-Jabrand Spear (2004), with 1623 quarterly observations, for the period from 1995 to 2001 regarding 94 oil companies, studied the frequency and magnitude of recorded loss to impairment, considering companies following the method of capitalization of total expenditures and those that follow the successful efforts method. Findings showed the recognition of loss to impairment had greater impact on full cost companies. However, companies that had chosen successful efforts showed a greater homogeneity in terms of frequency of recognition of losses, suggesting that either the successful efforts method has better adapted to the rules of the impairment test introduced by SFAS 121, or the full cost method, with the completion of the ceiling test being more sensitive to significant variations in oil price, showing there are differences in recognizing impairment losses between the two groups of companies.

Boone and Raman (2007), also focusing on the accounting methods and based on 255 observations concerning 565 oil companies impairment losses in the period of 1996 to 2001, studied the association of these losses to the encouragement given to managers to perform the so-called "opportunistic reports" (reports that aim to discourage managers to hide or conceal

information that could harm their interests). The results suggest that there are important differences between the two types of methods (groups of companies), where losses reported by companies having adopted the successful efforts method are associated with encouragements for opportunistic reports. Results were inconclusive regarding companies following full cost method.

2.3. Accounts of Oil Exploration and Production

According to Santos, Silva and Sancovschi (2006), in the oil sector Accounting is based on two methods: the method of capitalizing (activation) total expenditures and the method of capitalizing successful efforts.

According to Jennings, Feiten and Brock (2000), aspects distinguishing the two methods involve the obligation to follow permission to activate some E&P expenditures and not others. Table 1 summarizes the main differences between the two methods. For elucidation on other specific concepts it is suggested to consult Jenning, Feiten and Brock (2000), Santos, Silva and Sancovschi (2006) and Wright and Gallun (2008), among others.

TABLE 1 - COMPARISON OF ACCOUNTING METHODS

Types of Costs / Features	Successful Efforts (Successful Efforts)	Total Expenditures (*Full Cost*)
Geological and Geophysical Expenditures	Expenditures	Capitalized
Acquisition expenditures	Capitalized	Capitalized
Operating Expenses - dry wells	Expenditures	Capitalized
Operating Expenditures - successful wells	Capitalized	Capitalized
Development expenditures - dry wells	Capitalized	Capitalized
Development expenditures - successful wells	Capitalized	Capitalized
Production Expenditures	Expenditures	Expenditures
Basic Standard	SFAS 19	Regulation SX Rule 4-10

Source: Santos Silva and Sancovschi (2006).

2.4. Disclosures of E&P Operations Information

SFAS 69 determines that oil companies, by the time of annual financial statements, must disclose: data relating to proved reserves of oil and gas, the amount of capitalized (activated) expenditures; costs incurred in the acquisition of mineral properties and in activities exploration and development of production and the method of accounting these expenditures; summary of operating income from oil and gas production and the standardized measuring of future cash flow, discounted proved reserves quantities.

Information on the method of accounting shall include the financial statements themselves and other disclosures are considered supplementary information, more commonly known as SMOG (Standardized Measure of Oil & Gas).

About the relevance of SMOG information Boynton IV Booneb and Coe (1999) conducted a survey in order to evaluate the usefulness of the information on costs of discovery (exploration, development and production expenses) as indicators of exploratory efficiency and profitability potential. The results suggest the costs of discovery are of statistical significance on the analysis of oil companies.

2.5. E&P Assets Impairment

The issue involving the methods of accounting for expenditures of E&P with respect to the fact that impairment losses in the petroleum industry vary according to the characteristics of the asset being valued and the method of accounting for expenditures adopted by the company, as shown above.

Some studies have approached this question, as Titard and Pariser (1991) and Adams et al. (1994). In the first case, the authors, prior to SFAS 121 issuing, discussed the inconsistency of SEC requirements and the relevance of companies following the successful efforts methods also performing the impairment test. Also according to Pariser and Titard (1991), a significant amount of companies has changed from total expenditures to successful efforts method, apparently to avoid impairment loss. In contrast, *Adams et al.* (1994) criticize the *ceiling test* on grounds that the test is not realistic enough, since the calculation method for establishing the ceiling does not represent the fair value of E&P assets, resulting that the test does not provide evidence that the future economic benefit of the asset was reduced.

3. RESEARCH METHODOLOGY

The study is classified as theoretical and empirical, considering it seeks to identify relevant variables for recognition of impairment losses regarding E&P assets and to assess their statistical significance carrying on a regression with panel data containing 212 observations of 53 oil companies for the period from 2005 to 2008, to confirm them or refute them according to research hypothesis.

3.1 Definition of Sample

The target population for the survey represents the oil companies covered by Evaluate Energy ®, founded in 1988 and specialized in analyzing companies and conducting market research on oil and gas industry worldwide. The database of Evaluate Energy ® consists of about 156 oil companies worldwide, not including here the so called National Oil Companies (NOCs), i. e., 100% state control companies.

To select the sample of the research the following criteria were used: (1) being an International Oil Company (IOC) with full information available for the period 2005 to 2008, (2) having their financial reports prepared according to U.S.(GAAP) or international (IFRS) standards and (3) having its shares listed on the stock exchanges of New York (NYSE). After these filters, there was a sample composed of 53 oil companies.

It is important to highlight that, according to Corrar and Théophile (2004), the sample was determined by convenience, i. e., it is a non-probability sample in which elements of the population were selected according to their availability for study. This option was adopted as the initial exploratory research, therefore the results being restricted to that sample.

3.2 Definition of Variables

The dependent variable in the study refers to impairment losses formed or reversed each year, provided they are related to oil exploration and production assets. Evaluate Energy ® database provides segregated information to the Exploration and Production segment. During the period from 2005 to 2008 there were 66 records of impairment loss (or reversal) out of 212 possible records.

Much empirical research involving this segment, other than the research already referred to above, aimed to evaluate the relevance of the value (and information) of oil reserves on stock price and the market value of these companies, such as: Bryant (2003), Dharan (2004); Misund, Osmundsen and Asche (2005), Gill (2008), among others. Additionally, in Wright and Brock (1999) a survey on two decades of research on these themes can be found.

Because this was an exploratory study, there is no consolidated theory about impairment losses applying to the oil sector capable of supporting the choice of explanatory variables and / or the expected relationships.

Thus, explanatory variables were chosen mostly based on traditional accounting rules followed by the oil companies, notably the SFAS 19 and SFAS 69, impairment loss standing as dependent variable. For this study, it was necessary to calculate each company values of variables since Evaluate Energy ® database already provides that information.

a) Index of Replacement of Reserves (IRR)

Represents the relation between the variation of the oil equivalent recoverable volumes between two periods and the net production of oil equivalent in this period. This

indicator shows how many barrels of oil equivalent have been reset for each barrel of oil equivalent produced and is known through the ratio between new appropriations during the period and net production in the period. The ratio expected is a negative coefficient β, i. e., the higher the rate of reserve replacement is, the less likely there will be impairment losses.

According to Wright and Gallun (2008, p. 70), this ratio measures the company's success in restoring the amount extracted in a given period and at the same time demonstrates the company's ability to continue operations in the future. A company that does not reset its drawn reserves will be or forced to either buy deposits already discovered (which is much more expensive than the normal process of discovery) or close business (Wright, Gallun, 2008).

b) Reserve x Production (RP)

Represents the relationship between the total proven reserves of oil equivalent at the beginning of a period and the net production in terms of oil equivalent in this period. Presents an estimated useful lifetime of the company's reserves in number of years in case the same level of production is maintained, without new reserves being added. The expected ratio is a negative β coefficient, i. e., the higher the rate of reserve replacement the less likely there will be impairment losses.

c) Exploration Success Rate (SUCEXPLO)

This index indicates, for each well drilled, in how many of them there was success, i. e., either oil or gas was discovered. It is obtained through the relationship between the total number of successful wells and the total number of wells drilled during the period.

The expected ratio is a negative β coefficient, i. e., the higher the rate of reserve replacement the less likely there will be impairment losses. According to Wright and Gallun (2008), it measures the company's future profitability.

d) Gain a Barrel (GANHOBOE)

Indicates the gain (revenue minus cost) obtained from each produced and sold barrel of oil equivalent. Therefore, this indicator shows the company's achievement average value against the average unit cost incurred. For a case like this we, intuitively, expect a negative β coefficient, i. e., the larger the company's earnings per barrel the less likely impairment losses are.

e) Exploration Expenses Incurred (CAPEXEX)

It refers to expenses incurred in the exploration phase with the aim of finding oil, being the final product a bounded and economically viable oilfield (proven reserves).

f) Developments Expenses Incurred (CAPEXDES)

If there is a bounded and proven quarry, it is necessary to provide conditions so that oil can be extracted. Investments required to meet these conditions refer to development expenditures.

So much for CAPEXEX, and for the CAPEXDES, it seems the β coefficient is negative, i.e., the greater the variation of the expenses incurred, the less likely impairment losses are, as figures show the level of investment by the company and thus the expectation for the future.

g) Developed Proved Reserves (RPDES)

Refers to the volume of oil expected to be recovered considering the wells, equipment and methods of operation and existing economic conditions. In this case, conditions of production are already there.

h) Undeveloped Proved Reserves (RPNDES)

Refers to the volumes to be recovered through future drilling of wells in not perforated areas or the need for construction and installation of equipment and employment of additional resources in order to set fields under production conditions.

It is expected that β coefficients obtained for both RPDES and RPNDES to be negative, i. e., the greater the change in proved reserves, developed and undeveloped, less likely impairment losses are.

i) Standardized Valuation of Reserves (FCDRESERVA)

According to Wright and Gallun (2008, p. 637), Reserves represent the major oil companies' "assets", although not configured in corporate balance sheets. Therefore, SFAS 69 requires companies to disclose the value of future cash flows related to the quantities of proved reserves owned by the companies. This flow represents the present value of future cash flow from the development, production and sale of reserves in sito.

Is a standardized measure, common to all companies since the premises are defined in advance and applied equally, following the practice of a 10%discount rate of per annum for

each company equally. Intuitively, it is expected that the larger the standardized value of the company's reserves is, the less likely there will be impairment losses, and hence a negative β coefficient.

Nevertheless, this indicator has received several criticism not to represent the true value of a company's proven reserves because it doesn't adequately cover estimated future prices, costs and technologies (Wright, Gallun, 2008). Moreover, Wright and Brock (1999) argue that the valuation of proved reserves, as required for disclosure, is not considered accurate and reliable, based on several studies published between 1982 and 1999. So, it is possible to achieve a result different than expected.

j) Accounting Method (METHOD)

For this variable, a dummy was used in order to identify the accounting method followed by the company, the value "0" in case the company follows the capitalization of total expenditures method, and "1" for the successful efforts method.

Since the assets value of companies using full cost tends to be higher than companies that use the successful efforts and that most of these assets do not generate future economic benefit, it is expected that the recognition of impairment losses be more relevant in the total expenditures method. Being "1" the reference value, it is expected a negative behavior for β coefficient.

k) Normative Basis (GAAP)

There are significant differences between the U.S. standards (U.S. GAAP) and international standards (IFRS) concerning impairment. In a theoretical study, Silva et al. (2006) concluded that the adoption of FASB and IASB standards affect the book value of assets differently, with significant impacts on the company's income and economic-financial indicators.

Important to note that when using cash flow as a recoverable value / fair value parameter, it is more likely to recognize impairment loss whenever following IAS 36 rather than following SFAS 144.

For SFAS 144 is an initial test, conducted on basis of future cash flows undiscounted. Only in case the asset does not pass this initial test, discounted future cash flow is then used but, in this case, to ascertain the value of the loss. As per IAS 36 there is not an initial test, carrying on, immediately, the comparison of book value against discounted cash flow value.

Thus, as the value of undiscounted future cash flow (SFAS 144 test initial base) is greater than the discounted cash flow (IAS 36), the recognition of the loss to the impairment is more likely under international standards than under U.S. GAAP (Silva et al., 2006).

For the test a dichotomous variable was used according to which the "0" code stands for the U.S. standards (U.S. GAAP) and "1" for international standards (IFRS). Aiming to corroborate Silva et al proposition. (2006), it is expected that the calculated β coefficient is positive, indicating that by adopting international standards the probability of loss on impairment is higher.

l) Oil Barrel Price (PREBI)

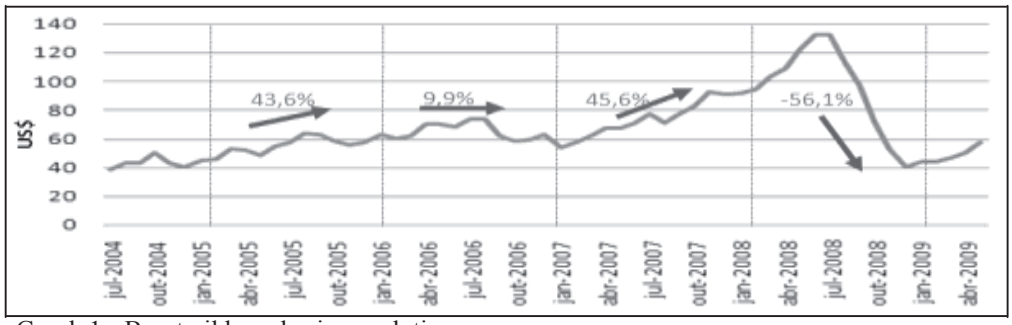
The price of a barrel of oil is one of the most important variables in the oil industry as a whole. It is a daily quoted commodity and serves as a parameter for setting values of services, equipment, E&P and to study the economic viability of exploration projects, among others.

Parise and Titard, (1991) argue that significant changes in the price of a barrel can have a dramatic effect on the value of assets, net income and company's value, especially for companies that adopt the full cost. These authors criticize even the fact that many companies manage the choice of accounting method, changing from full cost to successful efforts in periods of declining prices in order to avoid the recognition of impairment losses.

Wright and Gallun (2008) call attention to the fact that, especially according to North American standards, a temporary decline in the price of a barrel of oil should not be enough to require the test for impairment, unless such decline be judged as permanent or at least long lasting.

For purposes of this study it was not possible to consider a series of quotations of oil barrel price since the recognition of impairment loss normally occurs during the preparation of annual financial statements. Even if the quotation of the barrel price by the end of each year was used, the value of the variable would be equal for all 53 firms.

Thus, to consider the impact of the price of oil, we used a dummy variable to determine if the change in oil prices was positive or negative in a given period. The year the variation was positive (relatively to the previous year), value "0" is assigned and value "1" when the variation was negative. Graph 1 shows the evolution of a barrel of Brent oil type (market benchmark) from July 2004 to April 2009.



Graph 1 - Brent oil barrel price evolution
Source: Energy Information Administration (EIA).

As can be seen in the chart, in 2005 there was an increase of 43.6%, on barrel price from U.S. $ 45.51 earlier this year to U.S. $ 56.86 at the end. So, for 2005, value "0" for PREBI dummy is assigned. The same occurred on year 2006 (increase of 9.9%) and 2007 (increase of 45.6%).

In 2008, however, despite the oil price has reached record levels in July, with price at U.S. $ 132.72, there was a sharp fall in the second half driven by the financial crisis that swept the world with prices $ 39.95 a barrel at year end. This way, a negative growth of 56.1% was shown in 2008 and value "1" is assigned as an attribute of dummy.

Thus, it is expected the calculated β coefficient behavior to be positive in relation to recognition of the impairment loss, i. e., in periods of negative change in the oil barrel price the probability of recognition of losses increases, keeping in mind that code "1" of is the reference dummy in this case.

3.3 Descriptive Statistics

Table 2 presents the descriptive statistics of the sample. It is noticed that companies have recognized the amount of $ 313 million average as impairment loss of assets on E&P. each year.

On average, out of every 100 barrels produced, they managed to replace 72.6 barrels as new reserves, the reserves being 13 years life long, on average. Exploratory success of companies has averaged 67%, i. e., for every 100 wells drilled, oil is found in about 67 of them.

In the sample period, the average gain was U.S. $ 12.69 per barrel of oil produced and sold and the company invested an average of $ 10.7 billion to explore and develop its oil fields, which have an average 2.8 billion barrels in proven reserves, generating cash flow of $ 25.2 billion.

TABLE 2: DESCRIPTIVE STATISTICS

Variables	Descriptive Statistic				
	Average	Medial	Standard Deviation	Maximum	Minimum
IMPAIRMENT (US$ million)	313	11	1,136	10,379	-2,475
IRR (%)	72.6%	67.2%	177.4%	717.8%	-1793.0%
RP (years)	13	12	5	32	3
SUCEXPLO (%)	67.8%	68.3%	22.9%	100.0%	0.0%
GANHOBOE (US$/Barrel)	12.69	13.67	16.57	156.46	-98.25
CAPEXDES (US$ million)	3,033	1,516	3,599	18,004	3
CAPEXEX (US$ million)	7,709	4,235	913	5,432	1
RPDES (million BOE)	1,771	729	2,581	13,388	1
RPNDES (million BOE)	1,111	346	1,771	8,651	1
FCDRESERVA (US$ million)	25,212	9,512	41,470	253,704	-2,044

Source: Research data.

For the monetary variables (USD) and indicative of the amount of barrels (BOE) we proceeded to the transformation of those raising each observation to the square and then calculating the respective logarithm to eliminate the size effect.

In the case of dummy variables, 88 companies in the sample using the method of total expenditures and 124 of the successful efforts method, 168 companies reported their information according to U.S. standards (U.S. GAAP) and 44 according to international standards (IFRS). Finally, 159 observations are for periods of positive change in the price of oil and 53 observations in periods of negative growth.

3.4 Treatment of Variables

The processing of statistics was conducted by the statistical program, by using the regression technique with data on panel. It was not intended to get through this methodology to a model that is able to predict results of the dependent variable, but only to understand "how" the variables are related.

Once the database refers to information from a single unit (company) over four years, the regression with panel data proves to be the most appropriate (GUJARATI, 2006).

In regression with panel data, the same unit cross section (a family, a company, a state) is tracked over time, with three approaches: combined effect, fixed effect and random effect (GUJARATI, 2006).

It is important to note that because we used three dummy variables (GAAP METHOD PREBI and) it was not possible to make use of the fixed effects approach, as Gujarati (2006, p.) highlighted. 520) By introducing binary variables, we lose many degrees of freedom as a function of many units in cross section (53 companies) being observed in a short period of time (4 years). Moreover, it would be possible to identify the impact of variables that do not

change over time, as it is the case of GAAP and METHOD variables or that change over time but have the same value for all units in cross section (PREBI).

Relatively to remaining approaches to the combined effect and random effect, Chow test (Table 4) was used to decide which approach would be best.

3.5 Assumptions and Econometric Model

In order to identify the most appropriate approach, regression by OLS (Minimum Ordinary Squares) was conducted for both the combined approach and the random effect. Regression data are shown in table 3.

TABLE 3 - REGRESSION WITH PANEL DATA – COMBINED AND RANDOM EFFECT

Regression Data	Combined Effect	Random Effect
Square R	0,397264	0,381319
Adjusted Square R	0,360918	0,344012
F-statistic	1,093011	1,022100
Probability (F-statistic)	0,000000	0,00000
Durbin-Watson Statistic	1,213134	1,743009

Source: Research data.

The regressions were significant in view of the probability of F statistics in both cases be less than 0.05, considering 5%.significance level. In the regression with the combined effect independent variables explain 36% of the variation in the dependent variable IMPAIRMENT, and explanatory power was 34%considering the random effect.

Relatively to the hypothesis stating residuals are not auto-correlated, we find the Durbin-Watson statistic of 1.213, in the combined effect case, is well below the acceptance range, considering the tabulated value closest to the survey data [range 1.655 to 1.896 for N = 210 and K = 13], showing problems concerning that premise in function, presumably, the specification of the model since it implies that the coefficients are constant over time and between individuals.

Regarding the regression with random effect, the Durbin-Watson statistic (1.743) is inconclusive as to the serial residual autocorrelation because they stand between critical values of 1.655 and 1.896.

Based on the regression data it was possible to perform the Chow test (GUJATATI, 2006, p. 518), as shown in Table 4, in which $R2_{SR}$ is the determination coefficient of the random effect and $R_{2\ R\ of\ combined\ effect}$; *N the number of cross-sections*; NT the total number of observations and K the number of estimated parameters.

TABLE 4 - CHOW TEST

Chow Test	$F_{calculated}$	$F_{critical}$
$F = \frac{(R^2_{SR} - R^2_R)/(N-1)}{(1-R^2_{SR})/(NT-K)}$	0.098630	1.408403

Source: Research data.

Because the F calculated in the module, *was lower than the critical F,* the hypothesis that the intercepts are equal for all cross-sections can't be rejected, i. e., that the combined model is most appropriate in this case and presents the following generic specification:

$$Y_{it} = \beta_0 + \beta_1 x_{1it} + \beta_{2it} x_{2it} + ... + \beta_k x_{kit} + \mu_{it} \quad (1)$$

Where Y is the dependent variable each unit of cross section i *in time t*; β 0 is the intercept, β $1_{,\beta\ 2}$; β k are the angular coefficients of the explanatory variable and they are identical for all firms, i.e., all coefficients are constant over time and between individuals, and μ is the error term cross-section i *in time t*.

Decided by the combined effect with regression, other regression assumptions were observed, besides the residual serial autocorrelation already analyzed.

The hypothesis that regression residuals as a whole follow a normal distribution was not rejected at a 5% significance level, according to the Jarque-Bera (JB = 0.531268 and p - value = 0, 766,720).

For the assumption of no residual heteroscedasticity tests indicated in Table 5 were used.

TABLE 5 - RESIDUAL HOMOSCEDASTICITY TEST

Tests for Heteroscedasticity	Value	Proportion
Bartlett	5.874263	0.3186
Levene	2.357486	0.0416
Brown-Forsythe	2.072568	0.0702

Source: Research data.

According to Bartlett and Brown-Forsythe tests there is no violation of assumption (p-value> 0.05), leading to accept the hypothesis that the variance of the residuals is constant for all observations for each set of values of independent variables.

In Levene's test, however, the homoscedasticity at 5% hypothesis is rejected. In order to correct this problem and that of residual autocorrelation, Gujarat (2006, p.) guidelines were consulted 523) and indicate inclusion of autoregressive terms in the model and use of the White correction (coefficient covariance robust).

Thus, the final econometric model used to meet the goal of the research shows the following specification:

$$IMPAIRMENT_{it} = \beta_0 + \beta_1 * CAPEXDES_{it} + \beta_2 * CAPEXEX_{it} + \beta_3 * FCDRESERVA_{it} + \beta_4 GAAP_{it} + \beta_5 * GANHOBOE_{it} + \beta_6 * IRR_{it} + \beta_7 * METODO_{it} + \beta_8 * PREBAR_{it} + \beta_9 * RP_{it} + \beta_{10} * RPDES_{it} + \beta_{11} * RPNDES_{it} + \beta_{12} * SUCEXPLO_{it} + [AR(1) = \beta_{13}] \quad (2)$$

Where IMPAIRMENT= *impairment losses;* = CAPEXDES development expenditures incurred, exploration expenses incurred CAPEXEX =; FCDRESERVA: standardized measure of reserves; = GAAP regulatory basis used; GANHOBOE = gain per barrel; IRR reserve replacement rate ; METHOD = method of accounting used; PREBI = change in oil prices this year; RP = reserve index / production; = RPDES developed reserves; = RPNDES proved undeveloped reserves; SUCEXPLO = index of exploration success, and AR (1) = autoregressive term of first order.

4. ANALYSIS OF RESULTS

The regression with panel data using the combined effect of the robust covariance coefficient method and the inclusion of an autoregressive first order AR (1) term has generated the results shown in Table 6.

TABLE 6 - REGRESSION WITH PANEL DATA – COMBINED AND RANDOM EFFECT (WITH CORRECTION)

Variable	Coefficient	Standard Error	t Statistic	Probability
CAPEXDES	0.200648	0.078419	2.558675	0.0115
CAPEXEX	-0.024318	0.061691	-0.394198	0.6940
FCDRESERVA	0.759725	0.366474	2.073068	0.0399
GAAP	0.512970	0.464100	1.105300	0.2709
GANHOBOE	-0.494222	0.196938	-2.509537	0.0132
IRR	-0.087031	0.088769	-0.980411	0.3285
METODO	-0.853573	1.018039	-0.838448	0.4032
PREBAR	2.425548	0.336233	7.213893	0.0000
RP	-0.117327	0.043360	-2.705908	0.0076
RPDES	0.560050	0.640937	0.873799	0.3837
RPNDES	-0.744264	0.225563	-3.299583	0.0012
SUCEXPLO	0.597912	0.503181	1.188264	0.2367
AR(1)	0.40335	0.069539	5.800344	0.0000
β_0 (interceptive)	-1.705916	1.923223	-0.887009	0.3765
Square R	0.510943	**F-Statistic**		11.65299
Adjusted Square R	0.467096	**Probability (F-Statistic)**		0.000000
Durbin-Watson Statistic		2.001867		2.001867

Source: Research data.

Reviewing again the assumptions of regression, hypotheses that the residuals follow a normal distribution were accepted, are homoscedastic and not auto-correlated, at 5% significance level, according to tests reported in Table 7.

TABLE 7 - REGRESSION ASSUMPTIONS TEST

Assumptions Tests	Value	Probability
Jarque-Bera	1.849546	0.3966
Bartlett	4.644703	0.1997
Levene	2.277985	0.0818
Brown-Forsythe	1.914138	0.1296
Durbin-Watson	**4 - D_U**	**4 - D_L**
2.001867	2,093	2.355

Source: Research data.

Since the regression was considered valid and met all the basic assumptions after the corrections, the degree of explanation of the model increased to 46.7%, with six significant variables at 5% level, leading to accept the hypothesis that some information specific segment of E&P have significant predictive ability to damage the impairment of assets of E&P of oil companies.

The price of a barrel of oil (PREBI) was statistically the most important variable and the sign of the coefficient obtained met the expectations, i. e., was positive. Thus, periods of negative changes in the price of oil tend to cause firms to increase their impairment losses, confirming the propositions and Titard Pariser (1991). In fact, accessing the database the year when oil prices suffered a sharp drop (2008), out of the 53 sample companies, only six of them did not constitute such losses.

As might be expected, the main source of revenue from oil companies (stocks) are fundamental to the recognition or not of impairment losses. However, only the Proved Reserves Undeveloped (RPNDES) were statistically significant, indicating that the larger the company's effort to hold more reserves, the lower the chances of having to record losses for impairment of E&P assets.

As pointed out by Dominguez et al. (2009), the sign of the coefficient obtained was equal to the expected RPNDES: negative. However, besides the variable RPDES (Reserves Proved Developed) carrying no statistically significant predictive value, the sign of the coefficient obtained did not meet expectations, indicating additional studies for its understanding.

If proved reserves denote the estimate of the number of barrels of oil existing in the deposit, the variable Reserve x Production (RP) represent the lifetime of these reserves, which was considered significant, i e, has predictive value regarding the recognition of impairment loss of E&P assets.

Therefore It can be stated that the more we reduce the lifetime cost of reserves, the greater the likelihood of having to recognize losses, confirming the hypothesis.

These results are fundamental for the analysis of oil companies, mainly because, as argued by Writh and Gallun (2008), one of the main features of the E&P is that there is a clear correlation between the magnitude of the expenditure incurred and any amount resulting in reserves. With the results achieved, it is understandable that the increase in loss to impairment amounts to a major indicator of business efficiency in translating their efforts (the formation of E&P assets) in the future economic results.

The variable GANHOBOE also proved itself significant and bearing predictive value for the recognition of impairment losses. Given this variable is expressed as the average value of the undertaking, which is directly impacted by the oil barrel price, an inverse behavior of the coefficient facing the dependent variable was expected. The hypothesis was confirmed by tests showing that the higher the earnings per barrel, the lower the probability of having to acknowledge the loss.

CAPEXDES FCDRESERVA variables can be considered of predictive value regarding the recognition of impairment of E&P loss. However, contrary to expectations, the signs of the regression coefficients obtained were opposite to expectations.

As stated Godoy (2004, p. 95), expenditures incurred in order to develop a field and have it able to produce are related to proved reserves of oil and gas, or what is known by the estimate future economic benefits. Thus, it was expected that the behavior of CAPEXDES variable followed a reverse trend of the constitution of impairment losses.

The positive sign of the coefficient of CAPEXDES thus can be understood by reference to Writh and Gallun's argument (2008) that there are no clear correlations between the expenses incurred to have a deposit of oil and the revenues derived therefrom.

The behavior of the variable FCDRESERVA, follows the same positive changes in the loss to the impairment of E&P assets. In a way, one can understand the statements of Wright and Gallun (2008) and the conclusions of Wright and Brock (1999) regarding the relevance of this measure, shrouded in criticism on how to calculate cash flow, following standard assumptions as the use of the oil barrel price traded on the last day of the year as a benchmark for the cash flow assumptions.

Regarding variables without predictive power in face of losses to E&P assets impairment (CAPEXEX, GAAP, IRR and methods), we stress the fact that, at least, the expected sign of coefficients followed the expectations formulated.

Thus, even without being able to make inferences, there is an indicator for future investigations that the increase of success and exploration expenses, as well as using the full cost method and international standards (IFRS) could increase the likelihood of recognition of impairment losses, according to the hypotheses.

Finally, the variable SUCEXPLO proved not to be significant and has not met the expectations regarding the behavior of the coefficient, not confirming Wright and Gallun's arguments (2008) that it is a measure of the company's future profitability, which could reduce the chances of recognition of losses. It is important to understand the simple fact of finding oil does not necessarily translate into a source of future revenue for the company, considering that the quantity and quality of oil found, above all, must be economically viable.

In table 8 we can find a summary about the behavior of the studied variables and whether they were accepted or rejected in face of the statistical significance observed under the assumption that E&P information carries predictive relevance referring to losses through impairment of assets in this segment.

TABLE 8 - CONCLUSIONS ON THE EXPLANATORY VARIABLES

Variable	Expected Sign	Accept/ Reject	Obtained Sign
CAPEXDES	(-)	Accept	(+)
CAPEXEX	(-)	Reject	(-)
FCDRESERVA	(-)	Accept	(+)
GAAP	(+)	Reject	(+)
GANHOBOE	(-)	Accept	(-)
IRR	(-)	Reject	(-)
METODO	(-)	Reject	(-)
PREBAR	(+)	Accept	(+)
RP	(-)	Accept	(-)
RPDES	(-)	Reject	(+)
RPNDES	(-)	Accept	(-)
SUCEXPLO	(-)	Reject	(+)

Source: Research data.

Since some variables have been transformed, it is important to highlight Corrar, Paulo and Dias Filho's observation (2007, p.) 46) that "it is advisable the use the indicators to interpret the model with the original variables rather than just giving priority to variables with data processing."

Thus, seeking only to broaden the understanding the behavior of variables, particularly those that have undergone transformation and behaved differently than expected, we proceeded to the regression with the same parameters of the regression shown in Table 6. Information on significant variables and deviant behavior are shown below.

TABLE 9 - BEHAVIOR OF VARIABLES WITH NON-TRANSFORMED DATA

Variable	Expected Sign	Coefficient	t Statistic	Probability	Obtained Sign
CAPEXDES	(-)	0.15592	4.15950	0.0001	(+)
FCDRESERVA	(-)	-0.00501	-4.78973	0.0000	(-)

Source: Research data.

According to table 9, one realizes that even with the non-transformed data, the behavior of the coefficient of CAPEXDES remained distinct from the expectation. However, for the variable FCDRESERVA, the coefficient signal with the original data would serve the proposed hypothesis regarding the behavior of the variable in face of the loss to the impairment of E&P assets. An interesting question for deeper future studies.

5. CONCLUSIONS

Given the goal of determining how the oil company's information on exploration and production of oil relate to the constitution of impairment losses of economic assets (impairment), we could identify eight variables that behave according to stated hypotheses.

In terms of statistical significance, we identified six variables with determining predictive value to recognition of impairment losses of E&P assets at a 5% significance level. These variables were: the Oil Barrel Price(PREBI), the Proven Undeveloped Reserve (RPNDES), the Ratio Reserve x Production (RP), the Development Costs incurred (CAPEXDES) Gain per Barrel (GANHOBOE) and Standardized Appreciation of Reserves (FCDRESERVA).

The presented model formulated a 46.7% degree of explanation, showing, of course, there are other factors determining the recognition of loss to the impairment of E&P assets.

You cannot fail to note that the decision recognize or not provisions (losses) of any kind is the manager's discretionary decision. Thus, research in line with the theory of earnings management (*earnings management*) would also be relevant to the expansion of the determinants of impairment of E&P assets. One line of thought could be to verify the predisposition of oil companies that use international standards in relation to those that use the U.S. standards in managing their result through provisions for the impairment.

Finally, it is important to mention this research has limitations, notably that conclusions are restricted to the sample, to selected variables and to the econometric tool used, i.e., cannot be generalized.

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[i] On June 30, 2009, the Financial Accounting Standards Board - FASB issued SFAS 168 "The FASB Accounting Standards Codification and the Hierarchy of Generally Accepted Accounting Principles," establishing a single source for the U.S./American?? accounting standards called the "Accounting Standard Codification - ASC. Thus, the FASB Statements - SFAS, FASB Staff Positions - FSP, FASB Interpretation - FIN or Emerging Issues Task Force Abstracts - EITF accounting topics have been renamed "ASC Topic". SFAS 144 became part of the ASC Topic 360 - Property, Plant and Equipment.

[ii] The pronouncements SFAS 19, 25 and 69 were renamed to ASC Topic 932 - Extractive Activities - Oil and Gas.