MULTIDIMENSIONAL ANALYSIS OF PETROBRAS VALUATION

ANÁLISE MULTIDIMENSIONAL DO *VALUATION* DA PETROBRAS

ANÁLISIS MULTIDIMENSIONAL DE LA VALORACIÓN DE PETROBRAS

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RESUMO

Objetivo: Este estudo teve como objetivo avaliar se houve impacto em relação os eventos de corrupção e as fraudes no *valuation* da empresa Petrobras
Relevância: A relevância desse estudo encontra-se em reforçar a importância econômica e financeira no processo de avaliação de empresas, de forma a direcionar as decisões dos *stakeholders* e dos próprios acionistas num ambiente desfavorável e também motivar novos trabalhos no processo de avaliação de empresas e de gestão baseada no valor. Esta pesquisa pode ser utilizada como um guia compacto para comparação das diversas métricas de *valuation* na estimação do valor, tendo como base de uma das maiores empresas do segmento de petróleo com eventos de corrupção e fraudes. Esses modelos de avaliação são usados por muitos analistas, empresas de investimento e instituições em um nível altamente detalhado, a fim de determinar o valor mais justo de uma empresa para fins de fusões, cisões e aquisições, dissolução de sociedade, liquidação de empresas, investimentos e avaliação de performance de gestores. Essas demandas implicam em decisões que determinam a continuidade ou a descontinuidade de um investimento ou negócio.
Resultado: Como resultado, verificou-se uma discrepância nos modelos analisados, apesar de alguns modelos seguirem a mesma tendência de queda ou alta. Os métodos de Valor de Mercado e o Patrimonial Contábil foram os que mais se aproximaram, sugerindo que a Petrobras possui baixo *Goodwill*, e que o preço formado pelo mercado se aproxima do seu valor patrimonial. Cada método possui sua limitação, bem como algumas avaliações possuem certo grau de subjetividade, pois lidam com expectativas, como no caso dos cenários projetados para o modelo de FDC ou CFF, devido incorporar premissas subjetivas e hipóteses. Destaca-se que o valor da empresa Petrobras, nas múltiplas dimensões de valuation, teve um impacto de deterioração em decorrência das fraudes, corrupção e por outros contratempos na gestão do negócio, como baixa eficiência operacional, alta concentração de endividamento e uma sistemática contínua de desinvestimentos, que está alinhada ao planejamento da companhia.
Conclusão: não existe uma métrica de valuation mais correta ou mais assertiva em sua totalidade, mas sim, um parâmetro direcional, no qual deve ser utilizado como base para a tomada de decisão concomitantemente com outros indicadores.

Palavras Chave: Avaliação de empresas; Petrobras, Finanças.

ABSTRACT

Objective: This study aimed to assess whether there was an impact in relation to the events of corruption and fraud in the valuation of the company Petrobras
Relevance: The relevance of this study is to reinforce the economic and financial importance in the process of valuing companies, in order to direct the decisions of stakeholders and shareholders themselves in an unfavorable environment and also to motivate new work in the process of valuing companies and value-based management. This survey can be used as a compact guide for comparing the various valuation metrics in the estimation of value, based on one of the largest companies in the oil segment with events of corruption and fraud. These valuation models are used by many analysts, investment firms and institutions at a highly detailed level, in order to determine the fairest value of a company for the purposes of mergers, divisions and acquisitions, company dissolution, company liquidation, investments and performance evaluation of managers. These demands imply decisions that determine the continuity or discontinuity of an investment or business.
Result: As a result, there was a discrepancy in the models analyzed, although some models followed the same downward or upward trend. The Market Value and Book Equity methods were the ones that came closest, suggesting that Petrobras has low Goodwill, and that the price formed by the market is close to its book value. Each method has its limitations, as well as some evaluations have a certain degree of subjectivity, as they deal with expectations, as in the case of scenarios designed for the FDC or CFF model, due to incorporating subjective assumptions and hypotheses. It is noteworthy that the value of the company Petrobras, in the multiple dimensions of valuation, had an impact of deterioration due to fraud, corruption and other setbacks in the management of the business, such as low operational efficiency, high concentration of indebtedness and a continuous system of divestments, which is in line with the company's planning.
Conclusion: there is no more correct or more assertive valuation metric in its entirety, but a directional parameter, which should be used as a basis for decision making concurrently with other indicators.

Keywords: Evaluation of companies; Petrobras, Finance.

RESUMEN

Objetivo: Este estudio tuvo como objetivo evaluar si hubo un impacto en relación a los eventos de corrupción y fraude en la valoración de la empresa Petrobras.
Relevancia: La relevancia de este estudio es reforzar la importancia económica y financiera en el proceso de evaluación de empresas, con el fin de orientar las decisiones de los propios grupos de interés y accionistas en un entorno desfavorable y también motivar nuevos trabajos en el proceso de evaluación de empresas y valor. -gestión basada. Esta encuesta se puede utilizar como una guía compacta para comparar las diversas métricas de valoración en la estimación de valor, con base en una de las empresas más grandes del segmento petrolero con eventos de corrupción y fraude. Estos modelos de valoración son utilizados por muchos analistas, empresas de inversión e instituciones a un nivel muy detallado, con el fin de determinar el valor más justo de una empresa a efectos de fusiones, escisiones y adquisiciones, disolución de empresas, liquidación de empresas, inversiones y evaluación del desempeño de gerentes. Estas demandas implican decisiones que determinan la continuidad o discontinuidad de una inversión o negocio.
Resultado: Como resultado, hubo una discrepancia en los modelos analizados, aunque algunos modelos siguieron la misma tendencia a la baja o al alza. Los métodos Market Value y Book Equity fueron los que más se acercaron, sugiriendo que Petrobras tiene un Goodwill bajo y que el precio formado por el mercado se acerca a su valor en libros. Cada método tiene sus limitaciones, así como algunas evaluaciones tienen cierto grado de subjetividad, ya que abordan expectativas, como en el caso de escenarios diseñados para el modelo FDC o CFF, por incorporar premisas e hipótesis subjetivas. Es de destacar que el valor de la empresa Petrobras, en las múltiples dimensiones de valoración, tuvo un impacto de deterioro por fraude, corrupción y otros retrocesos en la gestión del negocio, como baja eficiencia operativa, alta concentración de endeudamiento y un sistema continuo de desinversiones, acorde con la planificación de la empresa.
Conclusión: no existe una métrica de valoración más correcta o más asertiva en su totalidad, sino un parámetro direccional, que debe ser utilizado como base para la toma de decisiones de manera concurrente con otros indicadores.

Palabras Clave: Evaluación de empresas; Petrobras, Finanzas.

1. INTRODUCTION

Establishing the value of a business or investment is paramount in the context of finance. Damodaran (2007) states that evaluation is at the heart of much of what is dealt with in corporate finance, whether in the study of market efficiency and issues related to corporate governance or the comparison of different investment decision rules in the capital budget and thus knowing the value of a company and what determines it is prerequisites for a practical assessment. The evaluation methods can be used together or in isolation; however, no single way can be considered the most correct, unquestionable, or exact; each requires different information and approaches. Assaf Neto (2012) corroborates that there are several methodologies for calculating valuation and ratifies the problem of estimating an ideal or correct fair value since measurement requires cohesion, logic, analysis, impartiality, and rigor in the choice of premises and the evaluation model to be admitted because of the company's actual situation.

At the time of the assessment, a fair economic value must be reached: the value that represents the potential and prospects of the company in a balanced way. However, according to the premises and scenario in which the company is located, there are more consistent assessment metrics that may prove to be technically more appropriate, given the circumstance of the assessment and accessible information. Numerous models and methodologies emerge from the complexity of finding a fair and balanced value, which becomes a challenge given the significant fluctuations in the price of companies' shares, the continuous cycles of crises, and financial bubbles that have occurred in the last century. Modigliani & Miller (1958) highlight a reason that can be attributed to these events, which is the substantial domination of speculation about the fair value of assets and abnormal premiums, risk premiums or risk discounts, paid by the market, leading to financial decisions unfavorable circumstances, to an increase in high-risk and uncontrolled investments.

Kothari (2001) states that valuation is one of the main demands in research on the capital market. Damodaram (2012) considers that to analyze whether markets are efficient, it is necessary to assess whether asset prices diverge from their real value and, if so, how quickly these prices revert, the greater the speed and divergence between prices, the more significant the volatility and the risk. Bremmer (2005) argues that in an emerging market, the issues and facts that involve firms are as relevant as a country's economy and interfere with market instability. These facts and matters can be subject to corruption and fraud, covering both the public and private areas. Zhang (2012) warns that corruption deals with a cultural and political phenomenon, being an influential factor. It correlates with the volatility of financial markets, bringing adverse effects to society and the economy, being more intense in emerging countries.

Thus, expanding and institutionalizing the management culture based on value creation at all organizational levels, prioritizing the wealth of capital providers must be a continuous and sustainable action for the continuity of the business itself. Generating a result with economic profit becomes a random variable, and its maximization has no operational and financial significance (Modigliani & Miller, 1958). Thus, considering the relevance of measuring value, its metrics, and factors that include evaluation, the problem that stimulated the realization of this article was: what is the impact of corruption and fraud events on the evolution of value? From PETROBRAS in the period from 2009 to 2017, using the main valuation measurement metrics?

In this context, the objective outlined for this study was to assess whether there was an impact on corruption and fraud in Petrobras' valuation. For that, we used the comparison of the six most used valuation metrics: Book Equity, Market Value, Price / Profit Ratio (P / E), Sector Multiple EBITDA (Earnings Before Interests, Taxes, Depreciations, and Amortization), Economic Value Added (EVA), Discounted Cash Flow (FDC). This article was based on studies by Teruel (2017), who researched corruption in Brazil and the behavior of the stock market in the face of the disclosure of news of corrupt practices, and this study differs in that it deals with the impact of corruption events and frauds about the company's valuation measured by the primary metrics.

The relevance of the work is to reinforce the economic and financial importance in evaluating companies to direct the decisions of stakeholders and shareholders themselves in an unfavorable environment and to motivate new jobs in the process of company valuation value-based management. This survey can be used as a compact guide for comparing the various valuation metrics in the estimation of value, based on one of the largest companies in the oil segment with events of corruption and fraud. These valuation models are used by many analysts, investment firms, and institutions at a highly detailed level to determine the fairest value of a company for mergers, divisions and acquisitions, company dissolution, company liquidation, investments, and performance evaluation of managers. These demands imply decisions that determine the continuity or discontinuity of an asset or business.

As a result, a discrepancy in the models was analyzed, although some models followed the same downward or upward trend. The Market Value and Book Equity methods were the ones that came closest, suggesting that Petrobras has low Goodwill and that the price formed by the market is relative to its book value. Each method has its limitations. Some evaluations have a certain degree of subjectivity, as they deal with expectations, as in scenarios designed for the FDC or CFF model, due to incorporating subjective premises and hypotheses. It was also observed that the impact of a deterioration in value in all methods due to the events of corruption and fraud is evident. Analyzing this situation in conjunction with other indicators, it is clear that the company has several doubts regarding its management.

This article is divided into five sessions in addition to this introduction. The following section discusses the literature review on the topics of interest and the main valuation metrics. The third section addresses the methodological aspects. The fourth concerns the results obtained; the fifth ratifies the pre-salt layer, and, finally, the final considerations are presented.

2. THEORETICAL FRAMEWORK

2.1. CORRUPTION AND FRAUD

Noonan Jr. (1987) reports that corruption has been present in people's daily lives since antiquity under varied but persistent contours. Corruption and fraud are due to the distortion of human relations, which occurred due to the lack of transparency and abuse of power. The interest of one of the parties involved in some process in obtaining undue advantages is privileged. Huntington (1968) argues that corruption stems from the behavior of public agents, who run away from acceptable norms to achieve personal ends. Shleifer and Vishny (1993) describe government corruption as the sale of public property with a view to private interests.

Regarding corruption at the corporate level, most managers who seek business in a global context are morally and economically confronted with the reality of bribery (Zekos, 2004). In this context, the generation of wealth for capital providers should not be the sole objective of organizations; they have significant responsibilities towards a nation, as they commit to any person or entity affected by their activities (Freeman, Wicks & Parmar, 2004). So that, in this way, the interest of all parties is taken into account and that their contributions to the value creation process are fully effective; therefore, the company's value must also be related to issues related to social responsibility (Fatemi, Fooladi & Tehranian, 2015).

According to Zhang (2012), few studies deal with corruption and the capital market. The author verified whether crime impacts the stability of financial markets with financial data from Index Funds of 29 countries in the period from 2002 to 2007. This study confirmed a stronger correlation between corruption and the stability of the financial market more than any other. Social and economic factors analyzed.

2.2 VALUATION

Evaluation is a process by which performance estimates are converted into a projection of the company's value or some part of it (Palepu, Healy, & Bernard, 2004). The investment value involves several factors, such as macro and microeconomic conditions, corporate governance structure, assumptions, models, and scenarios adopted. An accounting system and reliable information are essential in making projections, forecasts, and economic assessments of companies. In the face of ineffective internal and accounting control, financial reporting will consequently be less reliable and, therefore, there will be a greater risk for capital providers. What is expected is that management and internal control problems, as well as possible liabilities and material facts, will be disclosed and influence the capital providers' assessment of the tolerable risk and expected cash flows and, thus, they take the correct capital allocation decision (Moodys's Investors Service, 2006).

The role of accounting and financial statements in the capital allocation process in the economy and the business is a fundamental issue of accounting (Sun, 2016). Bushman and Smith (2001), Healy and Palepu (2001) argue that high-quality accounting information improves capital allocation and increases investment efficiency. The investment must be determined comparatively by investment opportunities adjusted to risk and equivalent to certainty (Modigliani & Miller, 1958). The content of an assessment is related to the quality and reliability of the data and facts, information, and the time dedicated to understanding the assessed business. In this way, the manager's focus must be concentrated on the variables of the company, the market, and segment, on the issues that involve it, and on the evaluation process itself, not simply on its final result. Yoon, Lee & Byun (2018) analyzed whether corporate social responsibility plays a significant role in promoting their companies' market value in an emerging market, Korea. The authors used environmental, social, and corporate governance scores to assess performance and examine its impact on its value. They concluded that governance practices, social and ecological, positively and significantly affect the market value, but differently according to the characteristics of each company.

2.3 MAIN VALUATION METRICS

2.3.1 Accounting Equity Method

Perez and Famá (2008) approach that the Accounting Equity method (PC) is based on the financial and accounting statements of the company, that is, this model has as its basic premise the value of assets and liabilities based on their historic cost, through the book values, it is determined that the company's value by the Shareholders' Equity itself, also titled the company's equity value or Book Value. On the other hand, Paiva (2001) classifies valuation by book value as the most direct method for valuing companies, as it is based only on the information provided by the Balance Sheet and the historical cost.

The model defines the value with a static focus, which does not express a possible evolution of the company in the future with the concept of the time value of the currency. Given this context, the value of assets and liabilities stands out as a limitation of this method since they are based on their historical costs, bringing about a significant divergence from market values. Several operations are not recorded in the formal financial statements, which can be very relevant for determining the economic value of a company, such as: leasing operations, derivatives, guarantees offered, among others, and a large part of the so-called intangible assets, Goodwill. Thus, according to Martins (2000), this model may be more suitable for companies where their equity does not differ significantly from its market value, that is, those that do not have significant Goodwill.

This method will be calculated according to the equation below, adapted in an attempt to minimize its limitations about historical cost:

$$PC = \sum (A - P) \quad \text{[Eq. 1]}$$

Where: A: Active; Q: Passive.

2.3.2. Market Value Method (VM)

According to Hayek (1945), prices in the stock market have the role of efficiently contemplating all the various information to establish a value through which investors can make a decision. DeHaan et al. (2015) infer that the stock market, over time, even if it conditions the impact of bad news, managers intend that the slow dissemination of terrible news revealed in their corporate announcements reduces the sanction of the reputation that they could anticipate. Fama (1970) states that significant changes obtained through information are followed by actual prices, while minor modifications generated by the info tend to be followed by small prices. Miller (1977) suggests that the high volume of business makes investors evaluate a particular asset in more detail. Kaniel, Ozoguz, and Starks (2012) also state that the share return value premium is present in developed and developing markets.

For Gaio, Alves, and Pimenta Júnior (2009), the HEM test, Market Efficiency Hypothesis, is necessary due to the importance of using quantitative methods to support investment decision-making in a stock market subject to constant variations. The market price reflects three critical components: the intrinsic value of the stock, which is directly related to the actual result of the company's past, present, and future, according to the premium discount margin as an effect of the behavioral market forces related to daily trading and, finally, a third component which is the irrational speculative effect of investors. The price should be close and reflects more the actual value of the underlying asset, in addition to a realistic development of the supply and demand market. However, it is rare when the market reflects an efficient state and is weakly correlated (Shreiber, 1979).

Investors come from fundamentals to technical evaluation to obtain profits that translate into periodic bubbles over time (Schmitt & Westerhoff, 2014). Yu et al. (2017) consider the evaluation bias resulting from the lack of information from the buyer about a particular product and argue that this evaluation bias has positive and negative effects on the seller. The authors also report that the existence of the valuation bias increases the excellent price and the profit of the seller within certain limits. Li and Tong (2018) show that information uncertainty affects an investor's valuation and premium. Teruel (2017) suggests that the volatility of companies with the worst governance practices is more affected than companies with best practices, indicating that the information content related to the dissemination of corruption news is asymmetric.

The basic premise of this method is the Market Efficiency Theory, Fama (1970), which determines the company's Market Value based on investors' expectations. Through this method, the company's value is calculated by the following equation:

$$VM = \sum (CON \; x \; QON + CPN \; x \; QPN) \quad \text{[Eq. 2]}$$

Where: CON: quotation of common shares; QON: number of common shares issued; CPN: citation of preferred shares; QPN: number of preferred shares issued.

2.3.3. Multiple Method of Similars Price / Profit Ratio (P / E)

This model consists of multiplying the price and profit per share ratio of similar companies (economic segment, technology, and management system) by the profit value of the evaluated company (Santos, Schimidt & Fernandes, 2003). The premise of this method is the comparison of performance and value between analogous companies, usually from the same segment, being comparable, who share the same economic, financial, market, administrative, and performance drivers, as well as share the same risks.

This Price / Earnings ratio (P / E) can be estimated using current earnings per share (current P / E) or expected earnings per share for the next period (forward P / E). To arrive at the value of the enterprise, the relationship between the share price and the profit per share of similar entities is multiplied by the gain of the evaluated company, Martins (2000), with the following equation:

$$Fator\ K = M\left(\frac{CmA}{LmA}\right) \quad \text{[Eq. 3]}$$

$$P/LL = (Fator\ K\ x\ LLi) \quad \text{[Eq. 4]}$$

$$P/LE = (Fator\ K\ x\ EBITDAi) \quad \text{[Eq. 5]}$$

Where: P / LL: value based on Net Income; P / LL: deal based on EBITDA; CmA: average share price; LmA: Average earnings per share; LLi: Net profit of the company; EBITDAi: EBITDA of the company.

2.3.4. Sector Multiple Method (EBITDA)

In this method, the accounting profit is replaced by the company's EBITDA, making the other information on the other items of the income for the year irrelevant. This option can have satisfactory effects on those projects that do not have an accounting system or are not reliable. EBITDA is the potential for cash generation produced by genuinely operational assets (Martins, 2001). EBITDA disregards the demands for retention of funds for new investments, thus disregarding the usual continuity of business operations.

The market adopts EBITDA as an indicator of operating performance and, in some cases, the basis for evaluating the business. The premise of this method is also the comparison of performance and value between similar companies in the same sector. In this method, companies are evaluated with the following equation:

$$Fator\ \alpha\ = m\left(\frac{FV}{EBITDA}\right) \quad \text{[Eq. 6]}$$

$$MSE = [(Fator\ \alpha)x\ EBITDAi)] \quad \text{[Eq. 7]}$$

Where: FV: Firm Value; MSE: value per Sector Multiples by EBITDA; EBITDAi: EBITDA of the company.

2.3.5. Economic Value Added (EVA) method

EVA is "a fundamental measure of corporate performance, which is calculated considering the spread (difference) between the return on capital and the cost of capital, added to that of invested capital" (Stewart, 1990, p. 137). The return on capital to which Stewart refers is the economic profit, better known as the residual profit that remains after tax. The cost of capital includes the cost of capital from third parties, which are the interest in short- and long-term loans, such as the cost of equity, which is the return expected by investors. Using similar techniques, both the EVA and the Discounted Cash Flow method suffer from the same limitations.

According to Wernke and Lembeck (2000, p. 86), EVA is used to calculate the wealth created in a given period, seeking to calculate the actual return on the applied capital. They also clarify that "EVA is an indicator of the added economic value that allows executives, shareholders, and investors to assess whether the capital employed in a given business is being well applied." In this method, companies are evaluated with the following equation, according to Stewart (1990):

$$EVA = [(VPLEVAf) + m\ Invest.T)] \quad \text{[Eq. 8]}$$

VPEVAf: Net Gross Value of EVA's Futures; Invest.T: Total investment (Capital employed).

2.3.6. Discounted Cash Flow Method (FCD)

The method of valuing companies through the Discounted Cash Flow better expresses the value of a business, despite some subjective elements (Martins, 2001). Copeland, Koller, and Murrin (2006) add that NPV, Net Present Value, is the method that mainly consists of maximizing shareholder wealth, as it is achieved only after creditors and shareholders receive the expected risk-adjusted rates of return. In this sense, Assaf Neto (2012) confirms that a business must be valued by its economic wealth expressed at a present value determined by the future expectation of the cash benefits generated, discounted at an opportunity rate.

By this method, the Free Cash Flow (explicit period), in table 3, is projected for a long-term period, usually between 5 and 10 years, based on the company's history. Then, a discount rate (opportunity cost) is estimated in this present work represented by the weighted average cost of capital (WACC - Weighted Average Capital Cost). When considering the WACC, it is implicitly assuming that the amounts will return expected interest payments to creditors and expected dividends to shareholders (Copeland; Koller & Murrin, 2006). With this, the present value of the Cash Flow is calculated, the value of the perpetuity (cash flow not explicit, after the projected period of 5 or 10 years), and the Present Net Value (NPV) of the infinity. Finally, the company's value will be given by the sum of the present values of free cash flow and infinity.

Warren, Dilellio, and Dyer (2018) report that many professionals prefer to estimate cash flows adjusted to the expected NPV and apply a risk-adjusted discount rate. In this case, the authors also propose that the risk premiums are relevant to the development of the forecast. As the NPV must be unique, the correct discount rate adjusted to the risk that considers the expected risk premiums must be inferred. Cash flows grow indefinitely at a constant annual rate (g). The growth rate (g) of expected profits is estimated based on the company's operating drivers, such as return on invested capital (ROI - Return on Investment) and the volume of re-investments made in new capital assets as technology modernization, among others. Others, also known as CAPEX (CAPital EXpenditure) (Assaf Neto, 2012). The FCD determines the company's value according to the equations:

$$TR = (CAPEX - Dp + IG)/LL \quad \text{[Eq. 9]}$$

$$g = (TR\ x\ ROI) \quad \text{[Eq. 10]}$$

$$FCD = (VPLFCpe\ x\ VPLFCp) \quad \text{[Eq. 11]}$$

Where: TR: Reinvestment Rate; Dp: Depreciation; IG: Investment in Giro; LL: Net Income; VPLFCpe: NPV of Cash Flow in the Explicit Period; VPLFCp: NPV of Cash Flow in Perpetuity.

3. METHODOLOGICAL ASPECTS

In methodological terms, the research is descriptive, which according to Gil (2002), aims to describe the characteristics of a particular population or a specific phenomenon. As for the approach to the problem, this is quantitative research. According to Beuren (2013, p. 92), "this approach is characterized by the use of statistical instruments, both in the collection and treatment of data." A case study was developed to apply the multiple dimensions of valuation metrics to expand the analytical benefits. The accounting and financial reports of the company Petrobras from 2009 to 2017 were analyzed. This period was defined as a result of the International Accounting Standards (IFRS) standardization issued by the International Accounting Standards Board (IASB).

The values of the analyzed statements were adjusted by the IGP-M (General Market Price Index) accumulated for the period to reflect the reality of the matters at present value, bringing monetary uniformity to the assessment that for Martins (2000), this adjustment seeks to correct the deficiency of historical cost, updating the importance to cover the effects of the change in the purchasing power of the currency. The year 2014 was taken as a comparable basis as it was when Operation Lava Jato began, including the company releasing its audited balance of competence 2014 with a five-month delay. DeHaan et al. (2015) and Michaely et al. (2016) relate managers' efforts who aim to exploit the investor's limited attention strategically when disclosing their corporate ads.

To determine the rate of return by treating the ratio of value and risk, the Sharpe-Lintner-Mossin model of the CAPM (Capital Asset Pricing Model) was used, in which the Beta index of the sector was used for the calculation. The rate of return of 11.6% in the study was considered constant for the projections made for 2018 to 2027. The Selic rate (reference rate of the Special System of Settlement and Custody) was used as the free rate of risk, treating a more realistic scenario with the lowest rate in the period, with the target for 2018 of 6.5%. The average annual variation of the Bovespa Index carried out in the period was 11.8% for the high-risk rate. The growth rate (g), for the projection of the statements and subsequent calculation of the present values of free cash flow and perpetuity, calculated in the order of 5.4%, was based on the average growth of the company in the analyzed period, considering the return of invested capital and the reinvestment rate.

In the Ratio / Profit method, to calculate the sector multiple, accounting and financial information from companies analogous to the sector were used, which are: CZLT33; CSAN3; OGXP3; PRIO3; QGEP3; BRDT3; LUPA3 and PETR3 and PETR4 itself, where an average multiple of 6.0 was estimated. To theoretically evidence the variance between the "ex-ante" and "ex-post" periods, the t-test between the two corresponding periods was used.

3.1. RESEARCH SAMPLE - PETROBRAS

In 1953, the Brazilian Congress approved the project for the creation of Petrobras, which started its activities in 1954, being a publicly-held corporation that operates in an integrated and specialized manner in the oil, natural gas, and energy industry and is present in the segments as exploration and production; refining; commercialization; transport; petrochemicals and derivatives distribution, natural gas, electricity, gas-chemicals, and biofuels, as reported on its institutional website. According to company data, Petrobras is among the largest oil companies in the world and the largest state-owned company in Brazil, having won the position of the largest company in Latin America.

The company is present in 19 countries, has investments of R $ 48.22 billion, more than 600,000 shareholders, 62,703 employees, daily production of 2 million and 767 thousand barrels of oil equivalent per day, 9.7 billion barrels of oil equivalent (boe) ², 120 platforms in production, 13 refineries, production of derivatives of 1 million and 800 thousand barrels per day, 55 fleets of ships, 7,719 km of pipelines and 9,190 km of pipelines, 5 biofuel production units, 20 thermoelectric plants operated, stakes in 4 wind power plants, 1 solar power plant, 8,277 service stations and 3 fertilizer plants (Petrobras, 2018).

Given this representativeness and relevance of Petrobras for the Brazilian economy, the economic structure of the whole country was shaken by the sequence of corruption and fraud scandals that permeated the company. The political influence over the company brought significant impacts on the results and stability of the business, which required revisions in its plans years of investments, changes in its organizational structure, or contracts with suppliers and partners.

4. RESULTS AND DISCUSSIONS

4.1 VALUATION METRIC APPLIED TO PETROBRAS

In the Book Equity or Book Value method, its value is its own Shareholders' Equity. For Petrobras, after the initial period of Operation Lava Jato, in 2014, the company lost an average of 47% of its net value. Equity values often differ from the market value since they do not have significant goodwill, making this a limitation for this valuation method. What did not occur in this study, according to Tables 1 and 2, wherein this method the company's valuation surpassed the Market Value Method, which can be explained by the occurrence of fraud in overpriced contracts, causing an overvaluation in the accounting of fixed assets. Martins (2000) points out that even with its limitations, the Book Equity value is valuable information, as it demonstrates the economic and financial situation of the company, wherein the evaluated company the value has been deteriorating since the beginning of the news of frauds and corruption in 2014.

Table 1
Evolution of valuation using the Accounting Equity method.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
PC	266.770,5	503.912,6	485.390,8	480.200,9	450.401,0	379.697,2	303.969,7	269.456,2	269.609,0
Var. (R$)		237.142,1	-18.521,9	-5.189,8	-29.800,0	-70.703,8	-75.727,4	-34.513,5	152,8
Var. (%)		88,9%	-3,7%	-1,1%	-6,2%	-15,7%	-19,9%	-11,4%	0,1%

Source: research results. Note: Var .: Variation.

The Market Value method is based on the Market Efficiency Theory and calculates the company's market value by varying the share price quotation in line with investors' expectations. In Table 2, the Market Value was calculated, considering Petrobras' outstanding ON and PN shares. This method showed significant volatility over the evaluated period. It can be said that the company has also been losing value when compared to the year 2010, where it peaked, and a decrease of 60% is accentuated.

Table 2
Evolution of valuation using the Market Value (VM) method.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Vra. (ON)	36,3	27,5	21,4	18,6	15,4	9,6	8,6	16,9	16,9
Vrac.(ON)	58,1	44,7	31,2	25,9	19,9	11,7	10,1	18,1	16,9
Vra. (PN)	30,1	23,2	19,0	17,7	16,1	10,0	6,7	14,9	16,1
Vrac. (PN)	48,2	37,8	27,7	24,5	20,7	12,2	7,9	15,9	16,1
Nac. ON	5.073	7.442	7.442	7.442	7.442	7.442	7.442	7.442	7.442
Nac. PN	3.701	5.602	5.602	5.602	5.602	5.602	5.602	5.602	5.602
VM	472.910,7	544.332,4	387.761,6	330.000,6	264.175,6	155.809,7	119.400,0	223.223,1	216.044,8
Var. (R$)		71.421,7	-156.570,8	-57.761,0	-65.825,0	-108.365,9	-36.409,7	103.823,1	-7.178,3
Var. (%)		15,1%	-28,8%	-14,9%	-19,9%	-41,0%	-23,4%	87,0%	-3,2%

Source: research results. Note Vra .: Share price; Vrac .: Corrected share value, Nat .: Number of outstanding shares in mi. Var .: Variation.

In the Multiples of Similars method, comparisons are made through transactions with similar companies in the same sector and publicly traded. Despite being companies in the same segment, they have varying indexes, which can become a bias for the model. When the company Petrobras is evaluated by the net result, together with the sector multiple, thus considering the financial part of the company, by the Net Profit, there is marked destruction of value, adding almost 149%, when comparing the averages between the period before and after 2014. Evaluating Petrobras using the Similars Method using EBITDA, taking into account only the cash generation portion of the operation, the loss of value is less, comparing the averages in the same period, around 45%. In this method, the statement of authors Martelanc et al. (2005) in which the EBITDA multiple can overvalue the company, bringing a bias to the model.

Table 3
Calculation of Indicator (k) of Multiple of Similars (P / LS)

Company (Amounts in R $)	Code	Price Share	Profit Share	K = Price / Earnings Share
COSAN LTD	CZLT33	32,6	2,1	15,5
COSAN	CSAN3	41,5	3,2	13,0
PETROBRAS	PETR3; PETR4	16,5	-0,0	xx
OGX PETROLEO	OGXP3	3,2	11,0	0,3
PETRORIO	PRIO3	81,8	3,9	21,2
QGEP PART	QGEP3	9,4	1,4	6,8
PETROBRAS BR	BRDT3	16,7	1,0	16,8
LUPATECH	LUPA3	2,9	-0,6	xx
Indicador k				12,3

Source: research results.

Code

It reads: the K factor (Table 4) was not calculated for companies with a negative Profit / Share index, as the method is not feasible for companies with losses.

Table 4
Evolution of valuation using the Ratio / Net Profit (P / LL) method.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
P/LL	654.120,0	716.213,0	593.682,9	357.582,8	364.046,2	-328.794,5	-508.689,3	-170.683,9	4.626,8
Var. (R$)		62.093,0	-122.530,1	-236.100,1	6.463,4	-692.840,7	-179.894,8	338.005,4	175.310,7
Var. (%)		9,5%	-17,1%	-39,8%	1,8%	-190,3%	54,7%	-66,4%	102,7%

Source: research results. Note: Var .: Variation.

Table 5
Evolution of valuation using the Ratio / EBITDA method (P / LE)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
P/LE	1.183.373,2	1.206.738,2	1.111.137,8	908.347,6	994.086,1	131.373,8	367.165,8	850.802,6	984.894,9
Var. (R$)		23.365,0	-95.600,4	-202.790,2	85.738,4	-862.712,2	235.791,9	483.636,8	134.092,3
Var. (%)		2,0%	-7,9%	-18,3%	9,4%	-86,8%	179,5%	131,7%	15,8%

Source: research results.

The Sector Segmentation Multiples method considers the "Firm Value or Enterprise Value," which comprises the company's market value, plus net debt, and divided by EBITDA (Table 6). EBITDA will deal with the payment of obligations with partners, third parties (debt creditors), and tax obligations. This relative valuation method is indicated as more straightforward, faster, and considers the market expectation. Despite having some limitations, where it disregards financial efficiency, it is widely used by the market. In the valuation of Petrobras (Table 7) weighted by the operational cash generation and ignoring the economic and tax effects, by this method, the company's value is plagued in 2014 at 87%. Still, it resumes in the second subsequent year.

Table 6
Calculation of the Sector Multiple (EBITDA)

Company	Code	Number of outstanding shares	Market Value (1)	Net Debt (2)	Part. ñ. cont. (3)	"Firm Value" (1 + 2 + 3)	EBITDA	Sector Multiple (FV / EBITDA)
COSAN LTD	CZLT33	243.199	7.921,0	19.696,1	495,3	28.112,4	7.834,3	3,6
COSAN	CSAN3	406.298	16.861,4	6.536,0	195,2	23.592,6	3.463,3	6,8
PETROBRAS	PETR3, PETR4	13.044.497	216.044,8	280.541,0	823,0	497.408,8	80.251,0	6,2
OGX PETROLEO	OGXP3	32.360	101,9	55,4	0,0	157,3	363,0	0,4
PETRORIO	PRIO3	12.664	1.035,9	-476,3	0,0	559,6	44,5	12,6
QGEP PART	QGEP3	258.873	2.424,5	-1.882,8	0,0	541,7	407,9	1,3
PETROBRAS BR	BRDT3	1.165.000	19.401,4	4.229,0	0,0	23.630,4	3.067,0	7,7
LUPATECH	LUPA3	15.130	43,9	163,3	1,4	208,5	22,0	9,5
Indicator								6,0

Source: research results. Note: Part. ñ. Cont .: Non-controlling interest.

Table 7
Evolution of valuation using the Sector Multiple methods by EBITDA (MSE)

	2009	2010	2011	2012	2013	2014	2015	2016	2017
MSE	580.171,6	591.626,7	544.756,8	445.335,0	487.369,9	64.408,6	180.010,1	417.122,4	482.863,8
Var. (R$)		11.455,1	-46.869,9	-99.421,8	42.034,9	-422.961,4	115.601,6	237.112,3	65.741,3
Var. (%)		2,0%	-7,9%	-18,3%	9,4%	-86,8%	179,5%	131,7%	15,8%

Source: research results. Note: Var .: Variation.

Considering the model based on Economic Profit, Petrobras, made a fall, that is, a loss of value in the order of 25.6%, when compared the value of 2017 with 2013, Table 8, but in the projections of results in the horizon of the next 10 years, from 2018 to 2027, because of the realistic scenario with an expected discount rate of 11.6%, and considering the current operational and resource structure that make up the company, its value falls by 7.1% compared to a value calculated in 2017.

Table 8
Evolution of valuation using the Economic Value Added (EVA) method

	2009	2010	2011	2012	2013	2014	2015	2016	2017
EVA	453.048,5	693.996,8	701.101,3	724.251,1	773.807,9	743.373,3	769.550,3	602.920,8	576.059,1
Var. (R$)		240.948,3	7.104,5	23.149,8	49.556,8	-30.434,6	26.177,0	-166.629,5	-26.861,7
Var. (%)		53,2%	1,0%	3,3%	6,8%	-3,9%	3,5%	-21,7%	-4,5%

Source: research results. Note: Var .: Variation.

Table 9
Projection of valuation using the Economic Value Added (EVA) method

Valuation Method (Billion R $)	Scenario Projection
Economic Value Added (EVA)	535.020,1
Variation (R $) between the value of 2017	-41.039,0
Deviation (%) between the value of 2017	-7,1%

Source: research results.

Considering the expected economic benefits of cash, the risk associated with the desired results, and the required return, the company manages to generate good FCD or CFF value, more significant 54% than the Market Value calculated in 2017, thus demonstrating the continuity in its operation, projected in an average growth scenario of 5.4%. This valuation analysis by the FCD (forecast) was carried out and made up of assumptions adopted given the theoretical framework indicated in the statement of the current operational potentials of the company and may vary according to new criteria and assumptions.

Table 10
Valuation projected by the discounted cash flow method (FCD)

Valuation Method (Billion R $)	Scenario Projection
Present Value of FCD in the explicit period	-956,0
FCD Present Value in perpetuity	332.954,6
Company value using the DCF method	331.998,6

Source: research results.

4.2. COMPARATIVE BETWEEN DIFFERENT VALUATION METRICS

Table 11 shows all the market values measured by the multiple valuation dimensions, demonstrating how mutable they are from each other and dependent on bold assumptions. However, some models follow the same downward or upward trend. Several factors may interfere in the analysis, from conditions of the macroeconomic scenario as variables of the business itself. It can be seen, in Figure 1, that the P / L Ratio (EBITDA) and P / LL Ratio between Similars and the Multiple Sector Model (EBITDA) methods, despite diverging in absolute values, follow the same upward trend and fall. It appears that the caveat regarding EBITDA multiples concerning the overvaluation of the company's weight in the P / E Ratio method could be reaffirmed (Martelanc, Pasin, & Cavalcante, 2005).

The Accounting Equity Method and the Economic Value Added Method (EVA) are the ones that showed less volatility over the analyzed period. And the Market Value Method followed the same trend and was closer to the Accounting Equity Method. In most models, between the years 2014 and 2015, the beginning of the operations of Operation Lava Jato was the moment when the company reached its least favorable valuation.

Table 11
Evolution of Petrobras company values by metric.

Mét.	2009	2010	2011	2012	2013	2014	2015	2016	2017
PC	266.770,5	503.912,6	485.390,8	480.200,9	450.401,0	379.697,2	303.969,7	269.456,2	269.609,0
VM	472.910,7	544.332,4	87.761,6	330.000,6	264.175,6	155.809,7	119.400,0	223.223,1	216.044,8
P/LL	654.120,0	716.213,0	593.682,9	357.582,8	364.046,2	-328.794,5	-508.689,3	-170.683,9	4.626,8
P/LE	1.183.373,2	1.206.738,2	1.111.137,8	908.347,6	994.086,1	131.373,8	367.165,8	850.802,6	984.894,9
MSE	580.171,6	591.626,7	544.756,8	445.335,0	487.369,9	64.408,6	180.010,1	417.122,4	482.863,8
EVA	453.048,5	693.996,8	701.101,3	724.251,1	773.807,9	743.373,3	769.550,3	602.920,8	576.059,1

Source: research results.

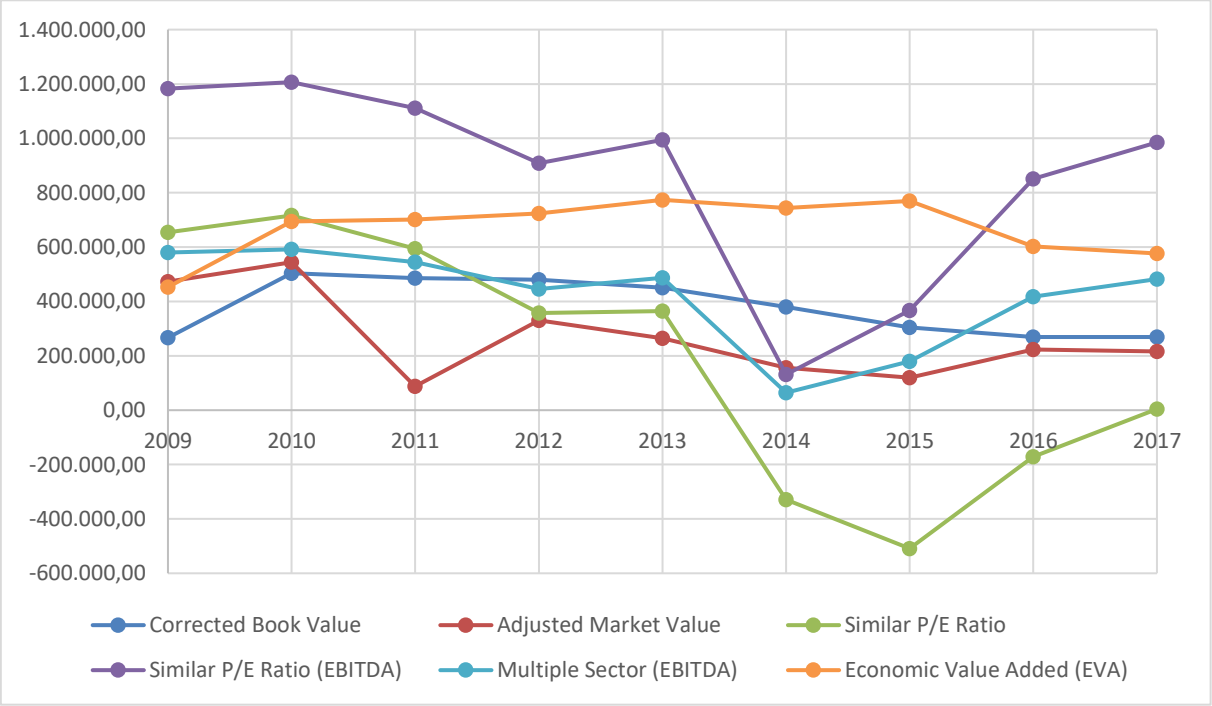

Figure 1. Evolution of Petrobras company values by Valuation.
Source: research results.

Table 12 lists the variation between the arithmetic averages between the ex-ante (2010 to 2013) and ex-post (2014 to 2017) periods, showing the negative percentage fall in all metrics, with more significant variation in the methods of Similar P / E Ratio (LL), which showed a drop of 149% and the Market Value with a decline of 53%.

Table 12
Analysis between "ex-ante" and "ex-post" periods.

Método	MAea	MAep	VMD	VMA%	DPea	DPep	CVea	CVep
PC	479.976,33	305.683,01	-174.293	-36%	19.215,98	44.985,41	4,0	14,7
VM	381.567,53	178.619,41	-202.948	-53%	103.646,96	43.062,06	27,2	24,1
P/LL	507.881,21	-250.885,23	-758.766	-149%	153.331,50	189.902,25	30,2	-75,7
P/LE	1.055.077,41	583.559,27	-471.518	-45%	113.350,48	347.774,02	10,7	59,6
MSE	517.272,11	286.101,22	-231.171	-45%	55.572,27	170.502,94	10,7	59,6
EVA	723.289,27	672.975,90	-50.313	-7%	31.238,66	84.532,52	4,3	12,6

Source: research results. Note: MAea: "ex-ante" arithmetic mean; MAep: arithmetic mean "ex post facto"; VMD: variation between the averages in absolute values; % VMA: percentage variation between arithmetic means; DPea: "ex-ante" standard deviation; DPep: standard deviation "ex-post facto"; CVea: "ex-ante" variation coefficient; CVep: "ex-post facto" variation coefficient.

Table 13 used the t-test to test hypothesis H1 at a significance level of 0.05. The examination of the differences between the arithmetic means paired in the ex-ante (2010 to 2013) and ex-post (2014 to 2017) periods was performed, which rejected H0 (null hypothesis) and evidenced H1 (alternative view), indicating theoretically the natural and significant variation between the averages of the periods determined by the two-tailed P value of 0.03 and therefore the deterioration of the company's value.

Table 13
T de *Student - paired t-test*.

	Ex-ante	*Ex-post*
Average	610.844,0	296.008,9
Variance	59.807.668.356,0	107.570.912.832,4
Comments	6	6
degrees of freedom	5	
Stat t	2,998	
P (T <= t) uni-flow	0,015	
t single-flow critical	2,015	
P (T <= t) bi-flow	0,030	
t bi-flow critical	2,571	

Source: research results.

5. PRE-SALT LAYER AND OTHER INDICATORS

In mid-2006, Petrobras developed an exploration technique at high depth, which contributed to a massive discovery of extensive oil and gas reserves along the Brazilian coast, located in the pre-salt layer. This discovery has high commercial value and good quality, enabling, in 2016, the company to reach the mark of one million barrels per day (Petrobras, 2016).

Because of this favorable expansion scenario, with a high potential for generating value, Petrobras has been showing enormous volatility in its valuation, as shown in Figure 1. Despite the promising characteristic of the business itself, together with the pre-salt discovery, the harmful impacts influenced by the events of fraud and corruption were dealt with by the PF Operation Lava Jato, which directly reflected in the results and the company's value. Contrary to what was presumed at the time of the discovery of the pre-salt that Petrobras would become one of the significant promising companies of the Brazilian government and one of the largest oil companies in the world, the notes of fraud and corruption leave notoriety when it is done a joint assessment with other indicators, the demonstration that the damage caused by these schemes has occurred devastatingly.

The value derived from the losses generated and the possible liabilities is unpredictable; even if some amount is returned to the company's cash by MPF, the negative impacts on the company's results and valuation persist. Table 14 shows the process in the divestment system, as planned by the company, which brings a target of R $ 68.3 billion by June 2018, in line with the procedure for assigning rights to explore, develop and produce oil, natural gas, and other fluid hydrocarbons.

Table 14
Evolution of financial and economic indicators.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
DTL	109.739,3	89.972,7	142.088,5	204.365,2	285.249,7	344.285,3	461.517,1	334.579,5	280.541,0
EO	61,4%	37,4%	46,8%	56,8%	76,7%	113,0%	191,1%	152,6%	134,1%
GE	210,0%	166,8%	180,3%	196,2%	215,5%	255,3%	349,0%	318,5%	308,4%
ICAPEX	113.066,4	130.753,7	102.455,7	110.862,2	116.000,7	89.567,7	81.390,5	45.324,3	33.946,0
ROI	12,4%	8,4%	6,8%	3,9%	3,7%	-3,3%	-4,7%	-2,0%	0,1%
ROA	21,2%	14,7%	12,9%	10,5%	9,5%	10,1%	11,0%	11,2%	11,0%

Source: research results. Note: DTL: Total Net Debt, EO: Onerous Debt, GE: Degree of Indebtedness, ICAPEX: Investments in CAPEX.

As defined by Assaf Neto (2012), the ROA (Return on Assets) indicates the "rate of return generated by the investments made by a company in its assets. Indicates the return caused by each $ 1.00 invested by the company ", the return on Petrobras' assets, went from an average of 14% before 2014 to an average of 11% after this period, indicating the company's inefficiency in generating profitability with your assets. ROI (Return On Investment), return on investment, is an indicator of economic performance employed both in the constitution of the growth rate and in assessing value generation (Copeland et al., 2006; Assaf Neto, 2012). The segregation can realize its composition in turn and operating margin. Comparing the averages between the periods before and after 2014, there is 7% against -2.5%, a negative variation of 135%, signaling its low economic performance. The degree of dependence on the company's indebtedness about third-party capital went from an average of 194% to 308%, comparing the norms of the periods. Regarding the degree of onerous debt, Onerous Liabilities on Equity goes from an average of 56% to 148%.

Sun (2016) suggests that the disclosed quality of internal controls and security on financial reports directly impacts the company's investments; in Petrobras, there was a 45% drop in investments (CAPEX) comparing the averages of the periods before and after occurrences of improbities. Given the results presented, it appears that the company offers several problems in the management of the business in the face of fraud and corruption events, added to an intense governmental interference in the organization's strategies, where the ownership structure of Petrobras is represented by its controlling shareholder 50.26% Federal Government (National Treasury), 9.87% National Bank for Economic and Social Development (BNDES) and 3.24% Caixa Econômica Federal, totaling a concentration of ownership of 63.37% (Economática, 2018). Appel, Gormley, and Keim (2016) suggest that property diversification influences Governance decisions, resulting in more independent directors, removal of acquisition defenses, and more equitable voting rights.

6. FINAL CONSIDERATIONS

This article aimed to demonstrate and analyze the evolution of the various valuation metrics, impacted by the events of fraud and corruption, for the evaluation in the praxis of measuring the value of the company Petrobras in the period from 2009 to 2017.

There was a discrepancy in the models analyzed, although some models followed the same downward or upward trend. The Market Value and Book Equity methods were the ones that came closest. Each method has its limitations and some evaluations, which have a certain degree of subjectivity, as they deal with expectations, as in the case of scenarios designed for the FDC or CFF model, due to incorporating subjective premises and hypotheses. Regarding the valuation metrics of the company Petrobras, it was observed that, regardless of the method used, the impact of the deterioration in value due to fraud and corruption occurred is evident. Analyzing this situation together with other indicators, it is clear that the company has several problems in business management, low operating efficiency, high concentration of indebtedness, and a continuous system of divestments, which is in line with the procedure for assigning exploration rights, development, and production of oil, natural gas, and other fluid hydrocarbons, according to a project already defined, which is in line with the decisions and interferences adopted in the company's planning.

Because of the different assessment models, it is considered that it is not possible to establish a single methodology or a specific roadmap for its execution; no model provides a single and precise value but rather an estimate. The methods described in this article aim to identify which best shows the value of the evaluated company in a balanced way, which regardless of the method chosen, for a complete assessment, indicators and information from the business, the sector, the macroeconomic scenario should be considered together, the external system, among others that characterize and influence the company, directing the demand for which the evaluation is intended. Thus, it should be noted that there is no correct and assertive valuation metric in its entirety, but reference values determined by the various methodologies will serve as a basis for decision-making in conjunction with other indicators.

The limitations of this study are other factors that may have interfered with the company's value and were not related. The research presented significant comparative and demonstrative contributions when using the multiple dimensions of valuation metrics in praxis in an environment corrupted by fraud and corruption events. As future studies, an analysis of the facts of a political nature that impacted the valuation in Brazilian mixed-capital and state-owned companies under the influence of their controlling shareholder, which is the state itself.

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