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THE IMPACTS OF DISCLOSED FRAUD ON FIRM VALUE

DISSERTAÇÃO APRESENTADA À ESCOLA BRASILEIRA DE ADMINISTRAÇÃO PÚBLICA E DE EMPRESAS PARA OBTENÇÃO DO GRAU DE MESTRE

VITOR CAVALIERE MACHADO

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VITOR CAVALIERE MACHADO

"THE IMPACTS OF DISCLOSED FRAUD ON FIRM VALUE".

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ASSINATURA DOS MEMBROS DA BANCA EXAMINADORA

Lars Norden
Orientador(a)

Joaquim Rubens Fontes Filho
Membro Interno

Marco Antonio Cunha de Oliveira
Membro Externo

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ABSTRACT

Purpose – This study aims to determine how disclosed fraud could have an impact on the value of firms in quantitative terms.

Design/Methodology – The methodology applied in this study was based on the event study method proposed by MacKinlay (1997). Our sample included Brazilian public firms listed on SEC (Securities Exchange Commission) and traded on the NYSE (New York Securities Exchange) that were subject to securities class action lawsuits in the United States. Measures of the firms´ abnormal returns were calculated using the market model as the normal returns. A multiple day event window was selected in order to identify possible spillovers. Parametric tests were conducted to support the study and non-parametric tests were used to provide more robustness to the obtained results.

Findings – Overall results support the hypothesis that fraud, once disclosed to the market, provides negative stock price reactions, in line with the existing literature on the influence of fraud on firms' valuation and the Market Efficiency Theory

Research limitations – The main limitations of this study are: (i) the selection criteria of fraud events related to Petrobras, based on a qualitative analysis; (ii) the option for not using the risk-adjusted market model to calculate the abnormal returns; and (iii) and a relatively small number of events used in the sample.

Practical implications – This research contributes, not only to U.S investor's wealth management, but also as an incentive to increase the bargain power of individual investors in Brazil.

Social implications – This study's findings may benefit not only business agents and executives in understanding the financial impact of fraud and its legal consequences to the firms, but also individual and institutional investors with relevant information in relation to possible impacts on their investments and the possibility of claiming for reimbursement.

Originality – To the best of our knowledge, this is the first study to present a quantitative analysis on the impacts of detected fraud to the value of Brazilian companies after the outbreak of "Lava-Jato" and "Zelotes" Operations.

Keywords: Disclosed Fraud; Market Efficiency Theory; Securities Class Actions; Institutional and Individual Investors; Anti-Corruption Measures

Paper category: Master´s thesis/Research paper

RESUMO

Objetivo – Este estudo pretende determinar como os casos de fraude, uma vez detectados, impactam no valor das empresas, em termos quantitativos.

Metodologia – Para alcançar seu objetivo principal, este estudo utilizou o método de estudo de eventos, proposto por MacKinlay (1997). A amostra da pesquisa incluiu grandes empresas brasileiras listadas na SEC ("Securities Exchange Comission") e negociadas na NYSE ("New York Securities Exchange") sujeitas a ações de classe nos EUA. Os parâmetros dos retornos anormais das empresas foram calculados utilizando-se o modelo de mercado. Foi definida uma janela de 21 dias para cada evento, com o intuito de identificar possíveis efeitos não incorporados no dia do evento. Testes paramétricos foram conduzidos para apoiar o estudo e testes não paramétricos foram utilizados para fornecer mais robustez aos resultados obtidos.

Resultados – Os resultados obtidos suportam a hipótese de que a fraude, uma vez divulgada para o mercado, provoca reações negativas no preço das ações das empresas, o que está em linha com a literatura existente sobre a influência da fraude na avaliação das empresas e a Teoria da Eficiência de Mercado.

Limitações – Destacam-se como principais limitações deste estudo (i) os critérios de seleção de eventos de fraude relacionados à Petrobras, baseados em uma análise qualitativa; (ii) a opção pela não utilização do modelo de mercado ajustado ao risco para calcular os retornos anormais das ações; e (iii) e um número relativamente pequeno de eventos utilizado na amostra.

Contribuições práticas – A partir dos resultados obtidos esta pesquisa serve de insumo, não apenas para a gestão de patrimônio dos investidores americanos, mas também como um incentivo para aumentar o poder de barganha dos investidores pessoa-física no Brasil.

Contribuições sociais – Além disso, este estudo é capaz de contribuir de maneira significativa para aprofundar a discussão acadêmica relacionada à fraude no Brasil e incentivar as empresas brasileiras de capital aberto a se preocuparem cada vez mais com suas práticas de conformidade e combate à corrupção e se prevenirem em relação aos seus possíveis riscos, desdobramentos e impactos jurídicos e financeiros.

Originalidade – Pelo nosso conhecimento, é o primeiro estudo que apresenta uma análise quantitativa sobre os impactos da fraude, uma vez detectada, no valor de empresas brasileiras, após a deflagração das Operações Lava-Jato e Zelotes.

Palavras-Chave: Divulgação de Fraude; Teoria da Eficiência de Mercado; Ações de Classe; Investidores Institucionais e Pessoa-Física; Medidas Anticorrupção

Categoria do artigo: Dissertação de Mestrado/Artigo original

SUMMARY

1. INTRODUCTION

1.1. Research Problem Contextualization

In 2009, the Brazilian Federal Police together with the Brazilian Federal Public Prosecutor launched an investigation process called "Operação Lava-Jato", in order to identify money laundering practices and other related illegal practices in several Brazilian states. In 2014, as the investigation developed, the authorities found a scheme of improper payments, involving Petrobras, a large state-owned company in the Oil and Gas industry and other Brazilian firms. According to estimates, this is so far an over 10 billion reais scheme, which may be the biggest fraud scandal in Brazil's history (INFOGRAPHS ESTADÃO, 2016).

Based on available information, a group of Brazilian companies in the construction sector, between 2004 and 2012, engaged in a cartel with the purpose to split among themselves contract awards with Petrobras and other Brazilian firms. This huge money-laundering and corruption cartel worked by imposing overpriced contract amounts to the firms, in order to finance bribery payments to political parties, elected officials and other members of political parties among others involved in the scheme. In addition to that, the ongoing investigations also identified bribery and kickback practices involving companies other than the cartel members, and current and former Petrobras and the other firms' employees (INFOGRAPHS ESTADÃO, 2016).

In addition to "Operação Lava Jato", the Federal Police, also with the aim of containing corruption, launched another investigation, called "Operação Zelotes". Like Petrobras, other Brazilian companies were involved in the fraud scheme, related to tax evasion practices. Since the beginning of the investigations, over a hundred people were arrested and many already investigated and condemned by the Brazilian justice, including former and current employees of the firms involved. In addition to the developments in the individual criminal sphere, the abovementioned fraud practices resulted in other legal and financial implications from a business perspective, mainly related to lawsuits filed by shareholders who claimed to have lost part of their investments as a result of fraud. (INFOGRAPHS ESTADÃO, 2016; VALOR ECONÔMICO, 2016).

From an accounting perspective, the overvalued contracts executed between contractors and Petrobras and other Brazilian firms as well as the tax evasion had fully influenced the historical price associated to the firms' assets, which were overestimated in the firms' financial statements.

Specifically in the case of Petrobras, the company´s top management, in light of the international accounting standards, considered that the additional costs incurred as a result of this illegal payment scheme, should not have been capitalized. In this sense, the company first signaled to the market about the possibility, and then, in fact, announced an asset write-down of approximately R$ 6.5 billion, by revising its asset values after impairment tests, which were reflected on the 2014 financial statements, officially released only on April 22, 2015 (PETROBRAS 2014 ANNUAL REPORT, 2015).

From a business-academic perspective, the phenomenon of corruption can be analyzed not only from an accounting standpoint, but also from a finance, corporate governance, compliance and legal perspective. In addition, the corruption phenomenon is often related to an increase in monitoring and internal controlling practices, which are established in order to ensure compliance with internal and external regulations (GIOVANINI, 2014), as anticorruption laws and the Sarbanes-Oxley: an act passed by the U.S. Congress, designed to ensure transparency in the management of businesses (GITMAN, 1997).

In this sense, although measures to fight against corruption and internal control practices are increasing in the business environment, it is still possible to find evidences of corruption problems related to fraud, as observed in the case of Petrobras and the other Brazilian firms (DYCK, MORSE AND ZINGALES, 2010). In addition to the compliance issues evidenced on Petrobras' asset write-down, it is worth mentioning that, not only Petrobras but also other Brazilian firms have shares publicly traded, not only in Brazil, but also in the United States. Therefore, all firms must comply with the provisions determined by the Securities Exchange Commission (SEC), in accordance with the Foreign Corrupt Practices Act (FCPA) (SEC 2016 INTERNATIONAL REGISTERED AND REPORTING COMPANIES REPORT, 2016).

In this sense, after the fraud events disclosed in the media, several lawsuits against Petrobras and other Brazilian firms were filed in the American Department of Justice (DoJ) by U.S. investors. In the case of Petrobras, in February 2016, the judge in charge of the actions issued a decision certifying two different classes of investors, a process that gives name to a specific type of lawsuit: the securities class actions. The lawsuit claims are that Petrobras has violated rules established by SEC, including false and misleading statements and omission of relevant information related to asset values, internal controls over financial reporting and anti-corruption policies, among others. According to the plaintiffs, as a consequence, Petrobras´ ADRs (American Depositary Receipts) have fallen nearly 46% between September and November 2014, and therefore, investors have the right to be financially reimbursed (SECURITIES CLASS ACTION CLEARINGHOUSE, 2016).

From an academic perspective, the arguments presented by the plaintiffs are directly related to the efficient market hypothesis, which states that in efficient markets security prices reflect in full all publicly available information (FAMA, 1970).

In this sense, considering the fraud scheme involving Petrobras and the other Brazilian firms and its alleged impacts, in addition to a possible cause and effect relationship between fraud and security prices, we propose through this research to answer the following question: *How can the disclosure of fraud impact Firm Value?*

1.2. Delimitation of the Study

This study mainly focusses on large Brazilian companies that, according to the available information, have gone through fraud and are listed in the US Securities Exchange Commission. In relation to firm value, despite being of our knowledge that other securities have influence on market value, this research will focus on the behavior of Brazilian companies' ADRs, one kind of foreign companies' securities traded in the U.S. securities market.

The scope defined by the author as well as the evidences required in this research are mainly focused on Brazilian companies, legal entities, institutional and individual investors, consultants and academics, interested in the financial consequences of fraud cases involving Brazilian companies listed in the U.S. securities market.

1.3. Research Goals

1.3.1 Final Goal

Determine how disclosed fraud could have an impact on the value of firms in quantitative terms

1.3.2 Specific Goals

- Verify the applicability of market efficiency hypothesis and examine the efficiency of the American market for Brazilian ADRs;

- Consolidate theoretical framework on a national and international level related to Securities Class Actions and the financial risks involved;

- Discuss about the available literature on methodologies for calculating possible shareholders' reimbursement due to financial damages caused by fraud

1.4. Relevance of the subject

In line with the conjuncture presented in this introduction section, it is possible to infer that the phenomenon of corruption has recently proved to be of great importance, not only in Brazil, but also internationally. This can be noticed by the increasingly strict anti-corruption laws and regulations (e.g. the Brazilian anti-corruption Law No. 12.846 and the FCPA). The implementation of new accounting standards, in order to guarantee transparency (Sarbanes-Oxley Act) and the creation of corruption monitoring institutions, such as International Transparency, also corroborate with this idea. However, although anti-corruption practices have apparently increased, it is still possible to observe the incidence of fraud schemes in the business environment, whose developments threaten the companies' financial health. Consequently, it is becoming increasingly common for investors to seek for reimbursement through securities class action lawsuits. In this sense, it is expected from this study to identify a negative correlation between fraud and firm value.

Considering the abovementioned expected result, this research intends to help improve scientific knowledge related to the relationship between corruption and firm value, especially in the Brazilian context. In addition, I believe that the relevance of this study relates not only to its expected results by themselves, but also to its contribution in terms of academic literature. I believe this research will help increase the theoretical framework on securities class actions as a consequence of corruption acts and its potential financial risks in Brazil. It will be also relevant if this study can contribute to increase the debate related to the methodologies used to estimate the possible reimbursement of shareholders due to financial damages caused by fraud, given that there is not much debate on this subject in Brazil. I believe that an increase in the debate on this topic will be beneficial to help increase individual and institutional investors bargain power and legal rights when facing fraud issues. This may also benefit the firms themselves, in a sense that it may stimulate improvements on compliance and anti-corruption practices and prevention of possible risks and legal consequences.

Not by chance, two of the study´s specific goals are in line with the arguments provided above. One is to consolidate theoretical framework on a national and international level related to securities class actions, which main object is the reimbursement of shareholders that claim for investment losses due to fraud, and the financial risks involved. The other one is to discuss about the available literature on methodologies for estimating the possible compensations to shareholders due to financial damages caused by corruption.

Therefore, at the end of this research I intend to obtain results and valuable contributions that will benefit entrepreneurs, executives, managers and legal entities in assessing the financial impact of corruption and its legal consequences to the companies. It is also expected that the results of this project can benefit institutional and individual investors by providing relevant information in relation to securities class actions as a result of fraud, possible impacts on their investments and the possibility of future reimbursement.

2. LITERATURE REVIEW

On Section II, I will address the main topics from the Introduction Section and discuss in more detail the theories and fundamental principles encountered in the literature.

2.1 Corruption and Fraud

The definition of corruption is somewhat divergent and it is cause for much discussion. (BREI, 1996). However, in light of the study’s goals, it becomes necessary to find an appropriate definition for such a phenomenon that has been part of the society for many years. According to the Black´s Law Dictionary, corruption can be defined as

> All multivarious means which human ingenuity can devise, and which are resorted to by one individual to get an advantage over another by false suggestion or surpression of the truth. It includes all surprise, trick, cunning or dissembling, and any unfair way by which another is cheated

In a social context, some authors even claim this word have such ancient origins as the phenomenon itself (ANDVIG ET AL., 2001), which early references date back to the fourth century B.C. (AIDT, 2003; BARDHAN, 1997). From a business perspective, according to the Germany-based organization called Transparency International, corruption is “the abuse of entrusted power for private gain" (TRANSPARENCY INTERNATIONAL, 2015), which is a recurring problem that affects companies and governments around the world.

The Transparency International provides some sort of categorization for corruption and its variants, by dividing the phenomenon in two categories, which take into account hierarchical aspects of those involved. The first category is called “petty corruption” and refers to corruption acts made by low-and mid-level public officials derived from their relationship with ordinary citizens. The second one is “grand corruption” and relates to the abuse of power by relevant institutions (government, courts). There is also a sub-category (called “political corruption”) which refers to corruption acts by policy-makers through the manipulation of policies, rules, institutions and procedures related to the allocation of finances (TRANSPARENCY INTERNATIONAL, 2015). It is also possible to find other categorization for corruption. The Anti-Corruption Resource Centre, for example, classifies this phenomenon as sporadic (occasional) or systemic (occurs repeatedly), by taking into account the frequency of corruption (ANTI-CORRUPTION RESOURCE CENTRE, 2015).

Academic researchers also allow us to understand more about this concept. Liana, Pinto and Pil (2008), for example, suggest two different dimensions of corruption in organizations: i) weather the individual or organization benefit from a corrupt initiative ii) weather the corrupt activity is undertaken by one or more individuals. Hence, these two dimensions help to define, in addition to the idea of corrupt organizations, a new conceptualization of corruption: the organization of corrupt individuals. Aidt (2003) introduces another theoretical discussion, which focus on three main conditions that favors corruption: i) public officials must have power to act in a discretionary manner

(LING AND TRAN, 2012); ii) decision-makers must benefit from the manipulation of their decisions; and iii) institutions must be weak in terms of structures and political processes (SHLEIFER AND VISHNY, 1993). It is possible to find a broader discussion on other theoretical aspects of corruption in Greco et al. (2017).

In addition to that, the Anti-Corruption Resource Centre and The Global Infrastructure Anti-Corruption Centre list many different ways corruption may occur. The most common are: bribery, extortion, abuse of power, embezzlement, conflict of interest, nepotism and fraud. The latter, according to them, “involves rogue deceiving innocent party to gain some financial or non-financial advantage” (ANTI-CORRUPTION RESOURCE CENTRE, 2015; GIACC, 2014). This definition is able to summarize such a broad concept and, therefore, may perfectly apply to the context of this study, which aims to investigate fraud in the corporate sector.

2.2 Financial Misrepresentation, Market Efficiency Theory and Securities Class Actions

One way fraud may be evidenced in a corporate context, according to Karpoff et al. (2012) is through a financial statement misrepresentation. In fact, we are able to find evidence in the literature, such as in Habib (2014), that corrections made in financial statements are a strong indication that inaccurate information was previously disclosed, and that unlawful behavior was practiced. Examples of misrepresentation include earnings overstatement, failure to properly disclose risks of potential liabilities, and accounting irregularities (REASOR AND ZHOU, 2015), which are to a certain extent linked to the recent fraud scandal involving Brazilian firms. As discussed in the introduction section, in the case of Petrobras, as a consequence of an asset overvaluation due to corruption, the firm had to reassess its asset values, given that inaccurate asset values should not be capitalized. This process of re-evaluating the potential future benefits of its assets, which determine the firm’s real asset value, is known as Impairment. If the company detects a difference in terms of value after impairment tests, a revision of its financial statements is required, to which an asset write-down shall be applied, according to IFRS’ IAS 16 standard provisions. Financial misrepresentation, such as in the case of Petrobras and the other Brazilian firms, when disclosed to the market as a consequence of fraud, considering the context of publicly traded corporations, may cause a large drop in the company´s share price, based on the premises of the Market Efficiency Theory (FAMA, 1970; FAMA, 1990).

Fama (1970, 1990) states that in efficient markets all publicly available information directly affect security prices. Thus, in efficient markets a bad information disclosed to the market would necessarily generate a negative impact on stock prices. According to Fama (1970, 1990) there are three forms of financial market efficiency: weak, semi-strong and strong. The first one refers to the type of market efficiency in which only information on the stocks historical prices affects the current stock price of a company. The second one relates to the effects of other information that are obviously publicly available (e.g., earnings announcements, stock splits, etc.) on stock prices. The third presumes that stock price formation is affected by all publicly information available, including news published in the media. Different ways of measuring Market Efficiency are found in the literature. A list of studies is presented by Reesor & Zhou (2015) (BALL AND BROWN, 1968; FAMA, 1991; PATELL & WOLFSON, 1984). Academic researches conducted in Brazil also bring different approaches to Market Efficiency measures. Forti, Peixoto and Santiago (2009), which carries out a qualitative analysis about the state of the art on Brazilian market efficiency studies, compiles many of them.

In addition to financial consequences, large share price drops may also involve a legal discussion. According to Dyck, Morse and Zingales (2010), after every value-relevant share price drop, specialist attorneys start looking for a cause to file a lawsuit. In this case, a special type of lawsuit, called securities class action. This concept, which according to Habib (2014) emerged in the United States in 1966, refers to reimbursement claims on behalf of shareholders due to fraud in the business. The discussion on this subject began with what legal experts call “the presumption of reliance” concept attributed to the fraud-on-the-market theory, which is in line with the aforementioned Market Efficiency Theory. The fraud-on-the-market theory is also based on the assumption that in an open and developed securities market, a firm´s stock price is determined by the available material information about the company and its business. Inaccurate or bad information released, therefore, may result on a possible investment loss by investors, which will depend if the investor based on that information to make their investment decision. The idea is similar to the one of the Market Efficiency Theory, which infers that in efficient markets a company’s stock price is necessarily affected negatively when a fraud occurs. The legal argument for such claim is based on the violation of the Securities Exchange Act of 1934, Rule 10b-5, which allows shareholders to file lawsuits against any institution in case of corruption and subsequent share price drop, as long as the securities are acquired in efficient markets.

In this perspective, academic studies have found a positive correlation between corrections in the financial statements and the likelihood of litigation (PALMROSE & SCHOLZ, 2004). Other authors observed that since law firms have mechanized the filing of securities class action lawsuits by responding to any negative movement in share prices due to financial misrepresentation, it is highly unlikely that a relevant fraud scandal could emerge without a subsequent lawsuit filling (COFFEE, 1986; CHOI, NELSON, AND PRITCHARD, 2008).

According to Rose (2008), a securities class action lawsuit in the US works as follows: a leader investor, represented by a law firm specialized in securities litigation (leader plaintiff), proposes the action. It is usual that other people, groups and investment funds with similar claims join the action during the process. In general, the plaintiffs claim that the defendant, in this case a business or institution, violated certain rules established by SEC, as abovementioned, and therefore, are liable for financial damages to investors.

On the other hand, we are not able to find a corresponding process in the Brazilian legislation. In cases where either institutional or individual investors want to claim for losses due to fraud and aim for reimbursement in Brazil, they need to file a civil action. However, this process has some limitations, which may keep individual investors away, since only legal institutions with at least one year of existence are allowed to file the action. In the case of state-owned institutions, it is the Federal Public Prosecutor, the Public Defender's Office and local authorities' responsibility to take the initiative to claim for reimbursement on behalf of the institutions. In addition, CVM ("Comissão de Valores Mobiliarios"), the Brazilian institution responsible for overseeing, regulating, disciplining and developing the securities market in Brazil, also does not provide, by means of its regulation, that investors are allowed to file an action against firms that possibly caused them financial losses due to fraud (BRAZILIAN ANTICORRUPTION LAW - No. 12.846, 2016).

2.3 Anticorruption Laws and SOX Regulation

Dyck, Morse and Zingales (2010) affirm that fraud cases have happened quite often in recent years, and have motivated immediate legislative response. In fact, internal control procedures and anticorruption legislation have become stricter, in order to mitigate the risks of wrongful behavior. In this sense, anticorruption laws started to play an important role in the corporate environment, especially in the context of public listed companies. In Brazil, for example, the recently passed Law No. 12.846 is the one that refers to corruption acts and measures for prevention and control of legal entities. The Brazilian Anticorruption Law imposes civil and administrative liability for companies that operate in Brazil, due to harmful acts against the public administration limited to the Brazilian territory. However, a company may only be held liable for harmful acts in case of objective guilt evidence and not by wrongful conduct. This means that a company is held liable for any wrongdoings only if it is t proved that an illegal act was actually committed, even if unintentionally. The Brazilian anticorruption Law also states that a companies' liability for unlawful acts does not exclude the individual liability of its managers, directors, or any other individual with a personal interest in the acts performed. The opposite also applies, and the company is held liable regardless of its employees' individual liability (MAGALHÃES, 2014).

In the United States, national and foreign companies doing business in the country, including the ones listed on SEC, or any other company that is subject to US laws, must be in accordance with the FCPA and the Securities Exchange Act. Differently from the Brazilian Anticorruption Law, the FCPA provides that all companies may be held liable for illegal conduct that contravene the provisions of the FCPA. This applies if the corruption acts are practiced not only by its own employees, but also by commercial agents, representatives or others acting on its behalf, whether inside or outside the United States (THE FOREIGN CORRUPT PRACTICES ACT, 2017; SECURITIES EXCHANGE ACT OF 1934, 2017). This is the reason why American investors were allowed to file securities class actions against Brazilian firms, due to fraud practiced in Brazil.

In addition to the anticorruption laws, other types of procedures have emerged in order to help prevent misconduct. Given the increase of questionable ethical and moral activities, for example as in accounting scandals involving large companies such as Enron, the American Senator Paul Sarbanes and the congressman Michael Oxley created a regulation, known as Sarbanes-Oxley (SOX), in order to prevent possible fraud against the companies' financial statements. Their intent was to force companies to ensure credibility on the disclosure of financial information, by creating a number of mandatory internal procedures throughout the companies' financial statements elaboration process (GITMAN, 1997).

According to Gitman (1997), the purpose of SOX regulation is to ensure the creation of audit procedures and information security, in order to force companies to restructure their internal processes and increase control. This would enable them to mitigate potential risks to the business, prevent and detect fraud, in order to guarantee management transparency. This way, firms keep investors comfortable in relation to the companies' corporate governance and more confident about their financial investments. In addition to that, Dyck, Morse and Zingales (2010) understand that the SOX regulation was established upon the idea that the existing organizations supposed to discover fraudulent initiatives did not succeed and, therefore, businesses should improve their incentives as well as their monitoring against fraud themselves.

2.4 Fraud Detection

The literature on corporate fraud is very extensive and spread through different areas of knowledge. In accounting and finance, many studies have investigated the most effective mechanisms for detecting corporate fraud. Dyck, Morse and Zingales (2010), for example, enriches the discussion on the actors who bring fraud to light and their motivations by testing the traditional views. Firstly, the legal view attributes fraud detection to auditors and securities regulators. On the other hand, the private litigation view (COFFEE, 1986) predicts it to law firms. Lastly, the finance view (FAMA, 1970; FAMA, 1990) claims that fraud detection belongs to the ones with residual claims (equity and debt holders) and their agents. However, Dyck, Morse and Zingales' (2010) findings indicate that the actors who actually play a key role in detecting fraud are non-financial market regulators, the media and firm employees. The motivations are many, but all of them rely on costs of gathering and identifying fraud-relevant information, reputation, monetary reward and insider information.

Other studies focus on the characteristics of companies involved in fraud (RICHARDSON, TUNA, AND WU, 2002; BURNS AND KEDIA, 2006; EFENDI, SRIVASTAVA, AND SWANSON, 2007). The likelihood of fraud given CEO Connectedeness and other business conditions such as IPOs (KHANNA, KIM AND LU, 2015; WANG, WINTON AND YU, 2010), and the incidence of fraud during boom periods (POVEL, SINGH AND WINTON, 2007) are also object of study in the literature related to fraud disclosure.

Subsequent costs that may incur after the detection of corporate fraud is another topic explored in the academia. Dyck, Morse and Zingales (2013) (hereafter DMZ), for example, estimates the pervasiveness of corporate fraud by comparing its costs with the costs of implementing SOX controls. The idea is to analyze if such a large-scale intervention is worth to implementing, from a cost-benefit perspective. In accessing the costs of fraud, besides considering the observed or detected fraud, which refers to an illegal behavior that is caught, it is also considered by the authors the fact that a firm may engage in a fraud and never get caught.

In this sense, in order to evaluate caught fraud incidence, DMZ selected a sample of firms that were subject to Securities class action lawsuit fillings compiled by the Stanford Securities Class

Action Clearinghouse (SCAC), a methodology based on Dyck, Morse and Zingales (2010). Other studies also use the same methodology (CHOI, 2007; GRIFFIN, GRUNDFEST, AND PERINO, 2001 AND THOMPSON AND SALE, 2003). According to them, this sample is close to the population of caught fraud companies, since every time a large share price drop happens, law firms search for a cause to file a class action lawsuit. Considering that share prices drop when a fraud is detected, it is very likely that SCAC includes that company in their database, since a lawsuit will necessarily be filled (COFFEE, 1986). Evidences provided by Karpoff et. al (2012) also support these findings.

The literature presents different methodologies for defining fraudulent firms. Wang, Winton and Yu (2010), for example, built a sample of firms, considering as fraudulent firms that had an Accounting and Auditing Enforcement Release (AAER) and/or had a securities class action filled that: i) was not dismissed; ii) exceeded the $2mn threshold; iii) was related to financial reporting.

Whereas it is also possible that fraud is not detected, DMZ based on basic probability rules in order to estimate the incidence of fraud among the companies. Firstly, they calculate the probability of a firm to have a fraud detected and then multiply by the probability of a firm to engage in a fraud. Overall results show that 15% of the firms engage in frauds at a point in time, of which 4% engage in fraud that will eventually be detected and 11% experience fraud that will never be detected. In order to meet its purposes, this study will focus on the analysis of detected fraud firms, given that we are interested on the fraud that actually happened and its eventual impact on firm value.

2.5 Corporate Fraud and Firm Value

Reesor & Zhou (2015) defines firm value as being equal to the total amount of funding instruments (total equity) in the company's capital structure subtracted from the estimate of its bankruptcy costs (total debt). Also, according to them, as already mentioned, companies use several mechanisms to finance their operations, including employee's stock options, different debt instruments and common and preferred stocks. In the context of public listed companies, the latter is a good estimation of the firm value under the market´s perspective. In this sense, according to Fernandez (2007), valuation mechanisms can be used to determine and compare the value obtained with the stock´s price in the market, and to decide whether to buy or sell the stocks.

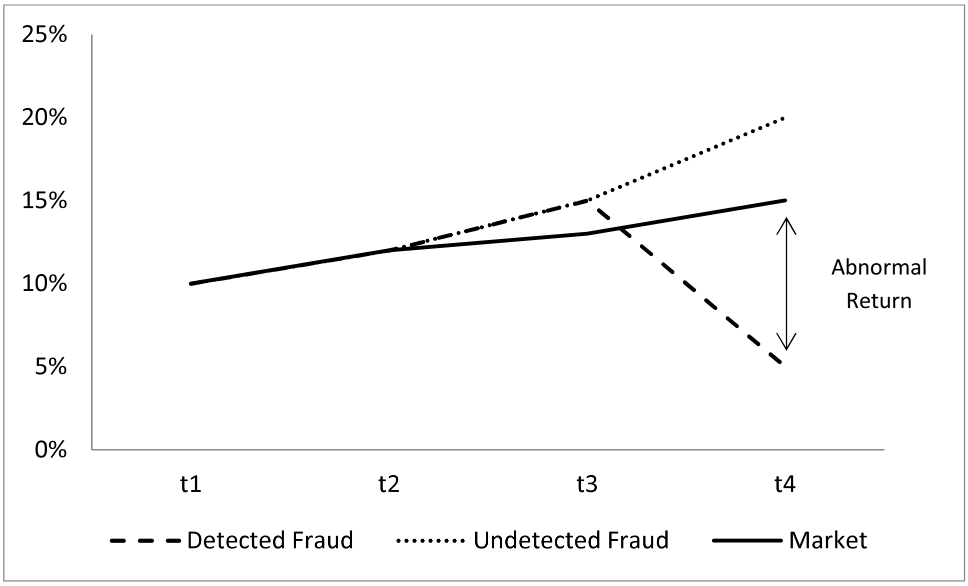
Different methodologies are used to estimate a security's true value and consequently the firm´s value, which, according to Reesor & Zhou (2015), may help to estimate fraud damages. A nonextensive list of works may be encountered also in Reesor & Zhou (2015). DMZ, for example, analyze changes in the value of the firms over the whole fraud period using industry multiples. Taking into account the beginning date and the end date from the securities class action, they collect data on the firm´s post enterprise value (equity value + debt´s book value) and enterprise performance (EBITDA, Sales and Total Assets) and compare to "counterfactual" multiples constructed by them. The "counterfactual" multiples are built by estimating an industry-typical multiple change, using firms in the same industry that were not involved in fraud and applying these multiple changes to the fraudulent firms' multiples during the period prior to the fraud. Then, a 'non-fraud implied enterprise value' is obtained by multiplying the 'counterfactual' multiple by the post fraud actual multiple (EBITDA, Sales or Total Assets). The difference between the 'non-fraud implied enterprise value' and the actual enterprise value after the fraud represents the total value loss from the fraud.

Another way to analyze a possible decline on equity prices, specifically in the moment a fraud is disclosed, relies on the event study approach, a methodology that allow us to correlate an economic event to a company's share price behavior (MACKINLAY, 1997). According to DMZ, the event study may be a good measure under two conditions: i) if the event is the first indication of the fraud to the market; and ii) if the share price drop may only be attributable to the fraud, and not to another firm-specific bad information.

The applicability of this methodology is very diverse and may be found in several studies. (MACKINLAY, 1997; CAMPBELL, LO, AND MACKINLAY, 1997; KOTHARI AND WARNER, 1997; FAMA, 1998; SMITH, 1986; JENSEN AND RUBACK, 1983; JENSEN AND WARNER, 1988; JARRELL, BRICKLEY, AND NETTER, 1988; KOTHARI, 2001). As already mentioned event studies base on the premise that, given a certain level of market efficiency, the effects of an economic event will immediately affect the company's stock price. Therefore, this methodology is an important tool in the financial analysis of mergers and acquisitions, disclosure of quarterly results, issue of debt and equity instruments (MACKINLAY, 1997).

The first step in conducting an event study, according to MacKinlay (1997), is to define the event of interest and identify the period in which the company's stock prices will be analyzed (the event window). After identifying the event, the next step is to determine the selection criteria to include a given company in the study. Lastly, determining the impacts of such event to firm value requires appraisal of the abnormal return during the period of analysis, which will determine if a company's stock price return behaved in an unexpected way. Figure 1 better illustrates the aforementioned idea, considering both detected and undetected fraud scenarios.

Figure 1: Abnormal Return given detected and undetected fraud



Source: Elaborated by the author

Figure 1 shows that, in t1, no fraudulent activities had happened, therefore, price returns are equal to market returns. In t2, fraud begins without anyone knowing, however, in t3, the fraud scandal is disclosed to the market. Considering that the stocks are traded in an efficient market, after the fraud disclosure the company's share price instantly drops, reflecting the market expectation of future additional costs that may be incurred as a consequence of future penalties imposed by the courts. This explains the gap (Abnormal Return) between the company and the market returns in t4, projected by the broken and the bold lines respectively. On the other hand, in case the fraud is never detected, the companies' assets would remain overvalued, which explains the company´s increasing returns, as projected by the dotted line.

It is possible yet to find in the literature other approaches of the event study methodology applied to investigate the impact of fraud. Palmrose and Scholz (2004), for example, study the relationship between certain restatements and company characteristics and the likelihood of litigation, mostly class actions lawsuits, against firms' management and boards of directors, outside auditors and others. They used a sample of 492 companies, which announced restatements from 1995 to 1999. The study aimed to observe share price changes related to restatement announcements (for prior and post announcement periods) among the variables observed. Results show a significant correlation between corrections in the financial statements and the likelihood of litigation, with negative market reactions, although the results are not too robust in a subset of restatements with auditor defendants.

Gande and Lewis (2009), instead of analyzing financial restatements, focus on the impact of a lawsuit filling date on shareholders wealth, using a sample of 605 lawsuit fillings from 1996 to 2003. Their initial analysis focused exclusively on the shareholder losses around a lawsuit filing date. A subsequent analysis estimates the probability of a firm to be sued and its relationship with lawsuit-related shareholder losses for both sued and non-sued companies. They find a significant relation between shareholder initiated class action lawsuits and negative stock price reactions. They also find that shareholders losses may be partially anticipated depending on the likelihood of them being sued, which may underestimate the magnitude of shareholders losses exclusively focused on the filling date.

Other academic researchers find evidences that corporate fraud may cause harm not only to the company affected by the fraud activity, but also to the financial market as a whole, by keeping household investors away from stocks. Giannetti and Wang (2015) found empirical evidences that investors have decreased their holdings in fraudulent and non-fraudulent companies, even if they did not hold equity from fraudulent firms. In this sense, they conclude that the lack of trust in the stock market is responsible for the negative effect of fraud detection on stock market participation. In addition to that, even though direct evidence do not exist, the author suggests that a reduction in equity holdings may represent a negative externality for the non-fraudulent firms by increasing their cost of capital, which affects the firm´s ability to raise equity.

3. DATA AND METODOLOGY

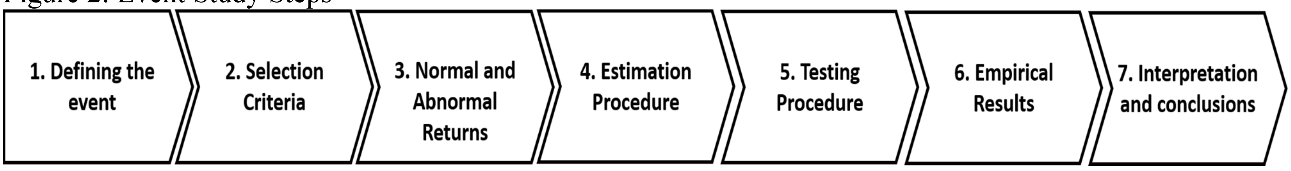
The quantitative research method takes an important role among the different methodology approaches used to study the corporate business environment. The quantitative approach is usually characterized by its stricter proposal in terms of structure, which uses statistical models applied to data obtained from the routine of the companies, in order to find out something that is believed to have actually existed in the past (FIELD, 2009). It is common that, in order to reach a breakthrough on certain phenomena of the business routine, we make use of a cause and effect relationship between two variables. Thus, by investigating this type of relationship, if certain assumptions are met, we can determine how one variable affects another (MURNANE, 2010). One possible way to investigate a cause and effect relationship between two variables, from an economic and financial perspective, is through an event study methodology.

As already mentioned, the event study is a research methodology, which aims to measure the effect of a particular economic event on firm value (MACKINLAY, 1997). Event studies are based on the premise that, given a certain level of market efficiency, the effects of an economic event will immediately affect the company's stock price. Therefore, this methodology can be an important tool in the financial analysis of mergers and acquisitions, disclosure of quarterly results, issue of debt and equity instruments and fraud events.

3.1. Event Study Steps

MacKinlay (1997) and Campbell, Lo and MacKinlay (1997) divide the event study methodology in seven steps, as per Figure 2.

Figure 2: Event Study Steps



Source: Rostagno, Soares and Soares (2002)

The first step in conducting an event study is to define the economic event of interest and to identify the period in which the company's stock prices will be analyzed (the event window). After identifying the event, it is important to determine the selection criteria to include a given firm in the study. In addition to that, assessment of the event´s impact requires a measure of the security's normal and abnormal returns, during the period of analysis. One can calculate the abnormal returns after estimating the parameters for the normal performance model. Next comes designing testing frameworks for abnormal returns. This will determine if a firm's security price return behaved in an unexpected way. The presentation of the empirical results and conclusion comments complete the study.

3.1.1. Defining the Event

As already discussed over the initial sections of this paper, this study aims to determine how disclosed fraud can affect firm value. In this sense, as we are interested in the information content provided once a fraud scheme is revealed, the event of interest for this research is any news related to fraud published in the media. As far as the event window, according to MacKinlay (1997), for better examination purposes it is common to define the event window to be larger than a single event day, in this case the day fraud was disclosed to the market. The idea is to investigate the possibility of information related to fraud to be acquired by the market prior to the actual announcement or news release. Likewise, it is also suitable to observe the stock prices and returns during the post announcement/news release period, in order to analyze their behavior patterns after the fraud was detected. Thus, this study's event window encompasses the 10 trading days before the fraud disclosure, the day of the fraud disclosure and 10 trading days after the fraud disclosure.

Choosing the event window is particularly important because the effects of a fraud announcement may not only be observed in the exact day the announcement is made. Firstly, it is possible that investors anticipate the economic effects of a potential fraud, which may occur after information leakage or even by a process in which the market gradually learns about the forthcoming event. Also, it is feasible to find evidences of price drop effects the day after the announcement is made, which may happen if the fraud disclosure is announced after the close of the market. In this sense, the event window is an important estimation issue and in this case was defined assuming that it is sufficiently long to capture most of the effects of fraud on stock prices.

3.1.2. Firm Selection Criteria

As a consequence of the recent fraud scandal, which is being investigated by the Brazilian Justice through different task forces captained by the federal police, a few Brazilian public firms, listed on SEC and traded on the New York Stock Exchange (NYSE), were subject to securities class action lawsuits filed in the DoJ, as of the end of 2016. In this sense, our selection criteria based on the following premises: large Brazilian public firms, listed on SEC, whose securities are traded on NYSE, which were subject to securities class actions lawsuits as of December 31st, 2016.

The extensive list of Brazilian companies registered and reporting with the U.S. Securities and Exchange Comission (SEC) was obtained from SEC's year-end 2016 annual report. Twenty-five firms were on this list. In order to assemble data on the firms involved in fraud, we replicated the fraud sample used in Dyck, Morse and Zingales (2010), which selects firms that are subject to securities class actions lawsuits, as compiled by the SCAC. The information provided by SCAC includes the class action period, the fraud disclosure date and a summary of the indictment. According to the authors, this sample is close to the population of caught fraud companies, since every time a large share price drop happens, law firms search for a cause to file a class action lawsuit. Considering that share prices drop when a fraud is detected, it is very likely that SCAC includes that firm in their database, since a lawsuit will necessarily be filled. In this sense, this study's fraud firms sample is composed of five Brazilian firms currently charged for fraud in the United States.

Considering the full sample of twenty-five Brazilian firms listed on SEC, data on daily stock (ADR) prices were collected from Economática database for the period from January 2010 to September 2016, including the five companies with a lawsuit filled and the remaining firms, without a lawsuit filled (except from three, whose information was not available on Economática). It is also worth to mention that four companies did not have its stocks traded at certain trading dates, therefore, no price data was available. However, this made no relevant impact to the overall analysis. In addition, I defined common share prices as a default and, if not available, preferred share prices were used instead.

In sum, the proposed methodology and the firms were chosen considering this study is focused on large Brazilian companies that have faced similar fraud-related issues and possible consequences in terms of firm value given the relevance of the subject to the actual political and economic contexts of the country.

3.1.3. Normal and Abnormal Returns

Determining the impact of an event to firm value requires a measure of the security's abnormal return. MacKinlay (1997) defines the abnormal return as "the actual ex post return of the security over the event window minus the normal return of the firm over the event window". The normal return, in turn, is the expected return of the firm's stocks in case the event had not happened. In this sense, for a given firm (i) and event date (τ) the abnormal return can be expressed as

$$AR_{i\tau} = R_{i\tau} - E(R_{i\tau}|X_\tau) \quad (1)$$

where $AR_{i\tau}$, $R_{i\tau}$ and $E(R_{i\tau}|X_\tau)$ are the abnormal, actual and normal returns for the given time period τ. X_τ is the conditioning variable used in the model.

There are two main ways of measuring the normal return (i) the constant mean return model and (ii) the market model. The first one assumes that the mean return of a security remains the same throughout the entire period ($X\tau$ is constant). The second one relies on the premise of a stable linear relationship between the market and the security returns ($X\tau$ varies according to the market). In theory, the market model represents an improvement in relation to the constant mean model, as it may reduce the variance of the abnormal returns. Therefore, the market model is supposedly the most appropriate to calculate the stocks' abnormal returns. For a given security *i,* it can be expressed as follows

$$E(Ri\tau) = \alpha i + \beta i Rm\tau + \varepsilon it \qquad (2)$$

$$E(\varepsilon it = 0) \qquad \text{var}(\varepsilon it) = \sigma^2 \varepsilon i$$

where $Ri\tau$ and $Rm\tau$ are the expected and the market portfolio returns in time τ. εit is the zero-mean disturbance term. $\alpha i, \beta i$ *and* $\sigma^2 \varepsilon i$ are the market model parameters that will determine the relation between the market and the stocks' returns.

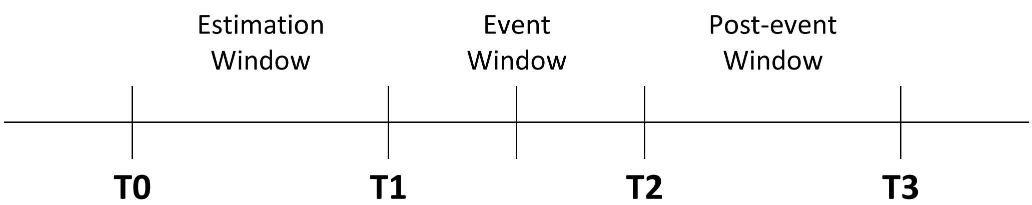
For the market portfolio, broad based stock indexes (eg. S&P 500, Ibovespa) are popular choices. However, I found more suitable to derive an own index composed of the Brazilian firms traded on NYSE, as in this case it seems to be a more realistic estimation of the market behavior. In this sense, I calculated daily prices and returns for the index weighted by the firms' stock prices and market values. Firms' market value data was also collected from Economática (except from two firms, which data was not available). The final sample was composed of 20 firms, five of them involved in fraud and fifteen not involved in fraud, which served as control group when included in the market index calculation. The list of the fifteen firms not involved in fraud and the five fraud firms, as well as their respective average index weights can be found in the Appendix.

Data related to the fraud events was collected from SCAC. As already mentioned, the information provided by SCAC includes the class action period, the fraud disclosure date and a summary of the indictment. Additional analysis revealed that the class action end date matches with the fraud disclosure date in four out of five cases, which allowed me to define an initial sample of four specific fraud event dates for Bradesco, Braskem, Eletrobras and Gerdau. However, for Petrobras this premise did not apply. In the case of Petrobras, I found that more than one class action lawsuit was filled and none of their end dates matched with fraud disclosure dates. Additionally, further researches revealed many different dates in which a fraud report related to Petrobras was published in the media. This makes sense given the large-scale fraud scandal faced by the firm. This way, I found more appropriate to analyze Petrobras and a list of 13 selected fraud disclosure dates separately and then add to the other four firms' fraud events, in order to draw overall conclusions.

3.1.4. Estimation Procedure

To estimate the abovementioned parameters, according to MacKinlay (1997), firstly it is important to define a so-called estimation window. The idea is to set a default period over which the data required to calculate the parameters will be collected. The ideal situation is to choose a period prior to the event window, in order to prevent the event on influencing the parameters' normal performance. For this study, I defined a 2-year period prior to the event window as default. The choice of estimation window is also an important decision, considering that this study investigates the impact of fraud on share prices. A dilemma takes place given that if we chose a too recent estimation window, the stock prices may be overestimated due to the fraud. On the other hand, if we try to find a period prior to the beginning of the fraud, the analysis of the relationship between stock and market returns may not reflect the reality. In this sense, I found more appropriate to select the most recent estimation windows possible. Figure 3 better illustrates the timing sequence of this event study, as per MacKinlay (1997).

Figure 3: Time line for an event study



Source: MacKinlay (1997)

As far as the parameters calculation, also according to MacKinlay (1997), the ordinary least square (OLS) is a reliable estimation procedure, under general conditions. In this sense, considering the i^{th} firm and the estimation window, the OLS parameters' estimators are the following

$$\hat{\beta}_i = \frac{\sum_{\tau = T_0+1}^{T_1} (R_{i\tau} - \hat{\mu}_i)(R_{m\tau} - \hat{\mu}_m)}{\sum_{\tau = T_0+1}^{T_1} (R_{m\tau} - \hat{\mu}_m)^2} \tag{3}$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i \hat{\mu}_m \tag{4}$$

$$\hat{\sigma}^2_{\varepsilon_i} = \frac{1}{L_1 - 2} \sum_{\tau = T_0+1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2 \tag{5}$$

where

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau = T_0+1}^{T_1} R_{i\tau}$$

and

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau = T_0+1}^{T_1} R_{m\tau}$$

$Ri\tau$ and $Rm\tau$ are the expected and the market portfolio returns during time τ.

Given the market model parameters, it is possible to measure and analyze the abnormal returns for each event. Considering $ARi\tau$ the Abnormal Returns for firm *i* in the event window, I compute abnormal returns as per the formula below

$$\widehat{AR}_{i\tau} = R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau}. \tag{6}$$

In order to accommodate multiple sampling intervals within the event window, the concept of cumulative abnormal returns (CAR) is a useful approach. Given that CÂR (τ1,τ2) is the sample cumulative abnormal return from τ1 to τ2, where T1< τ1 ≤ τ2 ≤ T2 and CAR from τ1 to τ2 is the sum of the abnormal returns in a given event window,

$$\widehat{CAR}_i(\tau_1, \tau_2) = \prod_{\tau = \tau_1}^{\tau_2} (1 + \widehat{AR}_{i\tau}) - 1 \tag{7}$$

For comparison purposes, I also use a different model for measuring abnormal returns for a given security *i*, which does not take into consideration the historical relationship between the firms stock returns and the market returns. In this sense, I define the outcome variables as “simplified abnormal returns” and compute them as

$$\widehat{AR}_{i\tau} = R_{i\tau} - R_{m\tau}. \tag{8}$$

In order to accommodate multiple sample intervals, I use the same approach as the one used for the market model, which I define as “simplified cumulative abnormal returns” and calculate as

$$\widehat{CAR}_i(\tau_1, \tau_2) = \prod_{\tau=\tau_1}^{\tau_2} (1 + \widehat{AR}_{i\tau}) - 1 \tag{9}$$

To draw overall inferences, the abnormal returns must be aggregated along securities. Considering the two abovementioned approaches (the market model and the simplified abnormal return), I compute the aggregated abnormal returns for Petrobras and its 13 events and the other four firms and their single events as follows

$$\overline{AR}_\tau = \frac{1}{N} \sum_{i=1}^{N} \widehat{AR}_{i\tau} \tag{10}$$

The next step is to sum the included abnormal returns along the event window by using the same approach used to calculate the cumulative abnormal returns for each security *i*

$$\overline{CAR}(\tau_1, \tau_2) = \prod_{\tau=\tau_1}^{\tau_2} (1 + \overline{AR}_\tau) - 1 \tag{11}$$

3.1.5. Testing Procedures

Once the parameter estimates for the normal performance model are defined and the abnormal returns and cumulative abnormal returns are calculated for each security *i* we shall proceed to designing the testing frameworks.

The first testing procedure is conducted assuming that, under the null hypothesis, the abnormal returns and the cumulative abnormal returns will be jointly normally distributed with a zero-conditional mean and conditional variance. In fact, the distributional properties of the abnormal returns allow us to draw inferences over any period within the event window, under the assumption that the event has no impact on the behavior of stock returns (mean or variance). The statistical approach employed to test this hypothesis is the t test. The idea is to standardize each cumulative abnormal returns by using an estimator of its standard deviation, which will determine their statistical significance. This approach is better illustrated as per below:

$$SCAR_i(\tau_1,\tau_2) = \frac{CAR_i(T_1,T_2)}{\frac{\widehat{\sigma_i}(T_1,T_2)}{\sqrt{n}}} \quad \sim N(0,1) \tag{12}$$

This parametric method assumes, under the null hypothesis, that cumulative abnormal returns are equal to zero (H0: SCAR = 0). On the other hand, the alternative hypothesis is that cumulative abnormal returns are smaller than zero (H1: SCAR < 0). In order to identify possible informational spillovers and to draw more accurate inferences in relation to the behavior of stock returns, the ttests were conducted considering six different event windows ([-10; +10], [-10; -1] [+1; +10], [-5; +5], [-5; -1] and [+1; +5]).

In addition to the abovementioned parametric method, other alternative approaches, free of specific assumptions related to the distribution of returns, are also available and allow us to check the robustness of the results. A non-parametric approach that matches this criterion and perfectly applies to this event study is the sign test, which focus on the sign (either positive or negative) of the abnormal returns. This test assumes that, under the null hypothesis, the probability of CAR to be positive or negative is equal to 0,5. Thus, our null hypothesis is H0: $p \geq 0{,}5$ and the alternative hypothesis is H1: $p < 0{,}5$. The statistic of the test is given by

$$J = \left[\frac{N^+}{N} - 0{,}5\right] X \; \frac{\sqrt{N}}{0{,}5} \quad \sim N(0,1) \tag{13}$$

Given this study is interested in the analysis of a fraud event, it is feasible to assume a higher probability for negative abnormal returns to be associated to the event.

In addition to testing procedures across the entire event window for a given individual security and/or a group of securities, cross-sectional tests may also be of good value. In fact, it is also important to analyze abnormal return variations within each event date. In order to that, both ttests and sign tests are conducted considering three different groups. The first group comprises the four single event securities (Bradesco, Braskem, Eletrobras and Gerdau) aggregated. The second group includes Petrobras and its 13 events. The last group consist of the entire event sample (the four single-event securities plus the 13 events for Petrobras). The idea is to use heteroscedasticity-consistent statistics and its resultant standard errors to test the null hypothesis that abnormal returns are homoscedastic within each event date.

4. RESULTS

Table 1 presents abnormal returns (AR) and cumulative abnormal returns (CAR), considering the two normal return models (the market model and, for comparison, the simplified model). The results for each firm individually were included in the Appendix. CAR plots, presented in Figures 4 (Market model) and 5 (Simplified model), also help us to draw overall inferences.

Table 1 – Abnormal returns and cumulative abnormal returns from event day -10 to event day 10.

Market Model			Simplified Model		
Event Day	AR	CAR	Event Day	AR	CAR
-10	-0,012	-0,012	-10	-0,010	-0,010
-9	0,005	-0,007	-9	0,008	-0,002
-8	0,012	0,005	-8	0,011	0,009
-7	0,007	0,012	-7	0,002	0,011
-6	-0,004	0,008	-6	-0,006	0,005
-5	-0,003	0,005	-5	0,000	0,005
-4	0,004	0,009	-4	0,002	0,007
-3	0,009	0,019	-3	0,011	0,018
-2	0,002	0,020	-2	0,001	0,019
-1	-0,004	0,017	-1	-0,003	0,016
0	-0,042	-0,026	0	-0,043	-0,027
1	-0,012	-0,038	1	-0,013	-0,040
2	0,004	-0,034	2	0,006	-0,035
3	-0,007	-0,041	3	-0,006	-0,040
4	0,010	-0,031	4	0,008	-0,033
5	0,006	-0,024	5	0,008	-0,026
6	-0,001	-0,025	6	-0,001	-0,027
7	0,005	-0,020	7	0,004	-0,023
8	0,007	-0,013	8	0,007	-0,016
9	0,007	-0,007	9	0,007	-0,009
10	-0,002	-0,009	10	-0,001	-0,010

Source: Elaborated by the author

Table 2 – Ttests and sign tests for event days 0 and 1, considering abnormal returns and cumulative abnormal returns.

		Market Model				Simplified Model			
		Event Time	mean	St. Dev.	p-value	Event Time	mean	St. Dev.	p-value
Ttest	AR (All firms)	[0]	-0,042	0,048	0,001	[0]	-0,043	0,048	0,001
		[1]	-0,012	0,035	0,081	[1]	-0,013	0,035	0,068
	AR (excluding Braskem and Eletrobras)	[1]	-0,004	0,028	0,284	[1]	-0,005	0,028	0,246
	CAR (All firms)	[0]	-0,026	0,141	0,264	[0]	-0,027	0,140	0,252
		[1]	-0,038	0,149	0,185	[1]	-0,040	0,145	0,163
	CAR (excluding Eletrobras)	[0]	-0,040	0,123	0,107	[0]	-0,043	0,119	0,087
		[1]	-0,046	0,144	0,109	[1]	-0,050	0,138	0,083

		Market Model				Simplified Model			
		Event Time	Returns < 0	% of Returns < 0	p-value	Event Time	Returns < 0	% of Returns < 0	p-value
Sign test	AR (All firms)	[0]	16	94%	0,000	[0]	17	100%	0,000
		[1]	11	65%	0,166	[1]	12	71%	0,072
	AR (excluding Braskem and Eletrobras)	[1]	9	60%	0,304	[1]	10	67%	0,151
	CAR (All firms)	[0]	10	59%	0,315	[0]	12	71%	0,072
		[1]	11	65%	0,166	[1]	13	76%	0,025
	CAR (excluding Eletrobras)	[0]	10	63%	0,227	[0]	12	75%	0,038
		[1]	11	69%	0,105	[1]	13	81%	0,011

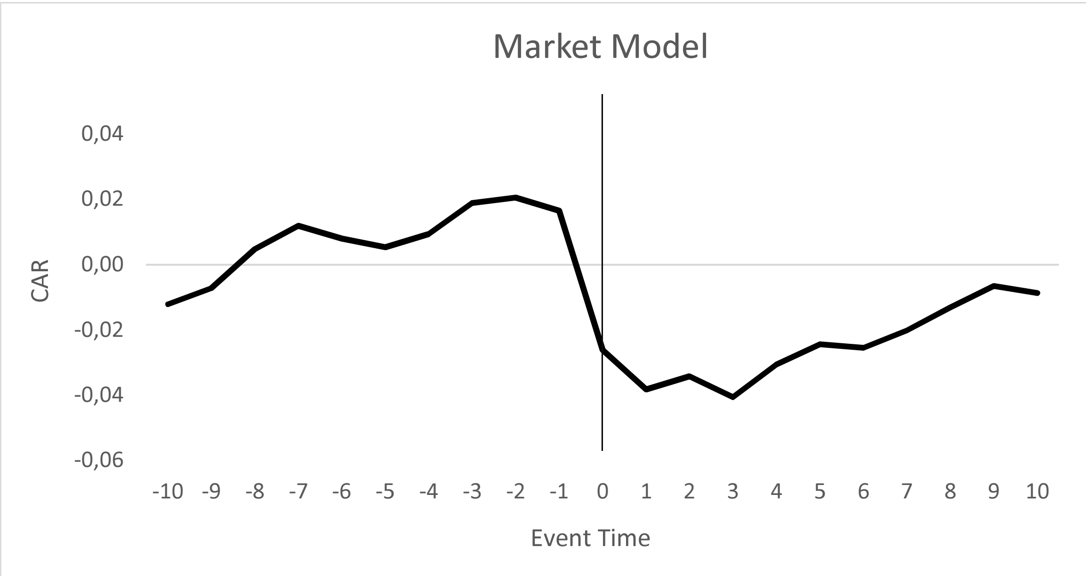
Source: Elaborated by the author

Focusing on the fraud disclosure date (date 0), the abnormal return considering the market model averages -0,042, which is the highest negative number in the sample. The result is almost three times the sample standard deviation (0,012), indicating a possible influence of fraud over the returns, in line with my expectations. Considering Petrobras and the other four firms separately, the results are similar averaging -0,079 with a standard deviation of 0,024 for the four firms and -0,031 for Petrobras with a standard deviation of 0,010. For robustness purposes, cross sectional tests were conducted to check the variation of abnormal returns on date 0 among all events, which are presented in Table 2. Ttest results are statistically significant with p-value below 1%, rejecting the null hypothesis that abnormal returns are equal to zero. Sign tests are also significant at the 1% level of significance. Given that 94% of the abnormal returns are negative, it is possible to reject the null hypothesis that the probability of AR to be positive or negative is equal to 50%, which provides more robustness to the results obtained. The results not only corroborate the idea that at the date of the event returns are significantly negative, but also reiterates the Market Efficiency Theory, indicating that the market is rational and immediately incorporates new public information to asset prices.

The second highest negative number is the abnormal return on day one (date 1), which averages -0,012 considering all firms, -0,005 for Petrobras and -0,034 for the four single-event firms separately. As observed in Table 2, Cross sectional ttest results for all firms aggregated show that abnormal returns are negative and statistically significant at 10%. However, even though 65% of abnormal returns are negative, sign tests do not allow us to reject the null hypothesis, as p-value equals 0,166. Despite non-significant sign test results, it is still possible to find some evidence of fraud disclosure on day one, especially if focusing on the four single-event firms, whose testing results are presented in the Appendix. Firstly, ttests indicate that although the sample mean number draws attention, standard deviation is higher at 0,046 and p-value is not statistically significant (0,116). The same applies to sign test results, in which p-value equals 0,687, given that 50% of abnormal returns are lower than zero. In other words, only two firms show negative abnormal returns (Braskem and Eletrobras).

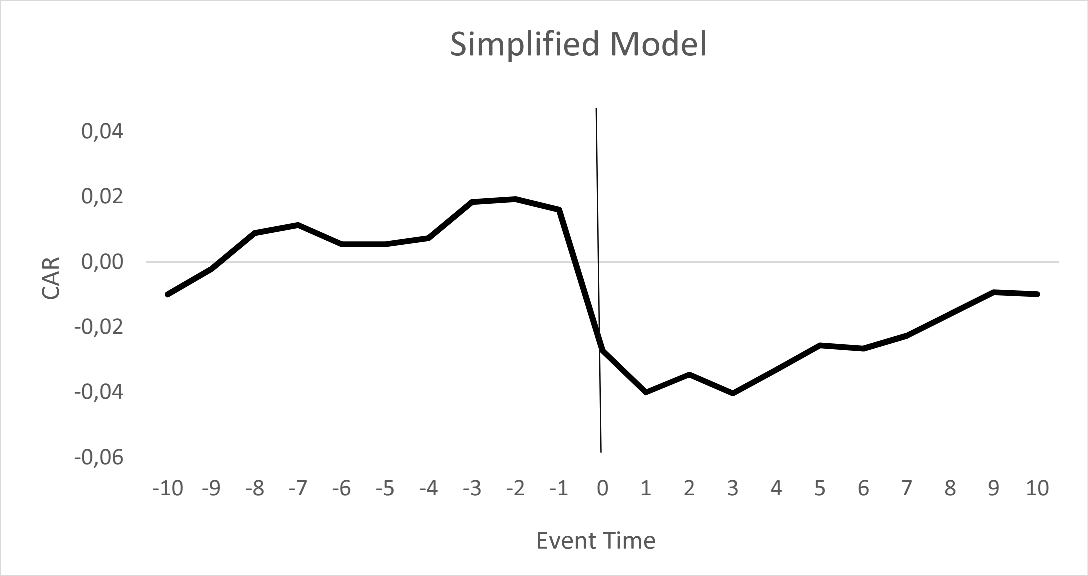
In order to verify whether overall results are impacted by these two specific events, I also tested abnormal returns on day one excluding the two firms from the sample. Both ttest and sign test results worsen in comparison to the initial sample as p-values equal 0,284 and 0,304 respectively. This way, the analysis of event date 1 indicates that, even though it is difficult to draw general inferences due to a strong influence of specific firms/events, it is still possible that returns are impacted by fraud one day after its disclosure. One reason for significant effects on day one may simply be that the price drop on date 0 was not sufficient according to the market, which appears to be the case of Braskem. Another reason is the absence of trading on that specific date, which is actually the case for Eletrobras, as the firm did not have its stocks traded on day 0. Therefore, the fraud disclosure only had an impact on the firm's stock price on day 1. In addition, it is possible that a fraud disclosure only occurs after the stock market closes, which would also explain significantly negative effects on share prices one day after the event.

Figure 4 – Plots of cumulative abnormal return for fraud from event day -10 to event day 10 using the market model



Source: Elaborated by the author

Figure 5 – Plots of cumulative abnormal return for fraud from event day -10 to event day 10 using the simplified model



Source: Elaborated by the author

Table 3 – Ttests and sign tests for event windows [-10 ; +10], [-10 ; -1], [+1 ; +10], [-5 ; +5], [-5 ; -1], [+1 ; +5], considering abnormal returns and cumulative abnormal returns.

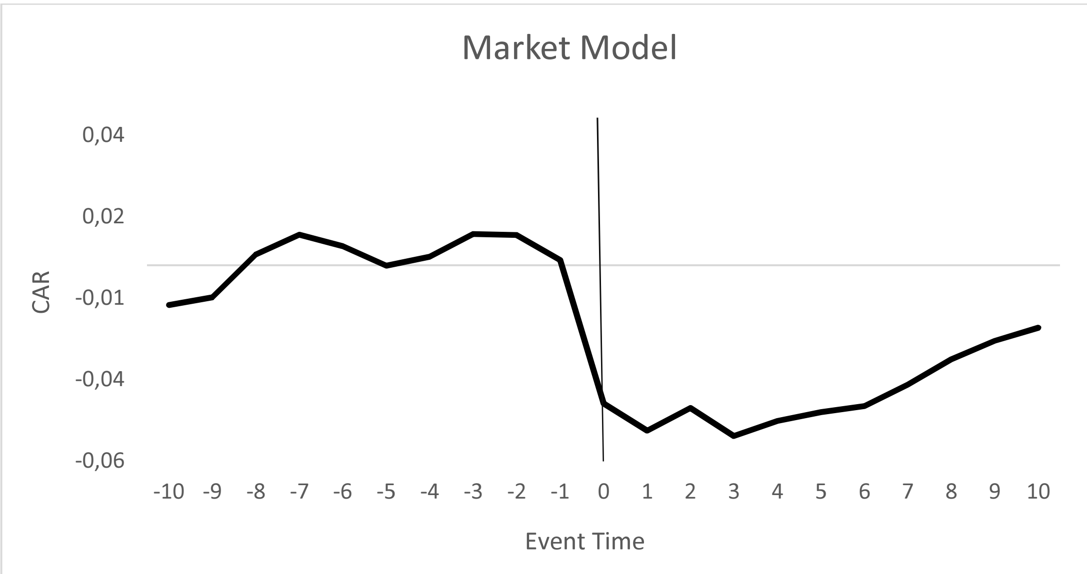
			Market Model		Simplified Model	
			All Firms	All Firms (excluding Eletrobras)	All Firms	All Firms (excluding Eletrobras)
Ttest	[-10 ; +10]	*mean*	-0,009	-0,020	-0,010	-0,021
		p-value	0,022	0,000	0,017	0,000
	[-10 ; -1]	*mean*	0,008	0,002	0,008	0,002
		p-value	0,974	0,781	0,988	0,818
	[+1 ; +10]	*mean*	-0,024	-0,039	-0,026	-0,042
		p-value	0,000	0,000	0,000	0,000
	[-5 ; +5]	*mean*	-0,011	-0,024	-0,012	-0,025
		p-value	0,083	0,008	0,068	0,006
	[-5 ; -1]	*mean*	0,014	0,005	0,013	0,003
		p-value	0,996	0,958	0,995	0,903
	[+1 ; +5]	*mean*	-0,034	-0,048	-0,035	-0,050
		p-value	0,000	0,000	0,000	0,000

			Market Model		Simplified Model	
			All Firms	All Firms (excluding Eletrobras)	All Firms	All Firms (excluding Eletrobras)
Sign test	[-10 ; +10]	*Number of CAR < 0*	13	14	13	15
		% CAR < 0	62%	67%	62%	71%
		p-value	0,192	0,095	0,192	0,039
	[-10 ; -1]	*Number of CAR < 0*	2	3	2	4
		% CAR < 0	20%	30%	20%	40%
		p-value	0,989	0,945	0,989	0,828
	[+1 ; +10]	*Number of CAR < 0*	10	10	10	10
		% CAR < 0	100%	100%	100%	100%
		p-value	0,001	0,001	0,001	0,001
	[-5 ; +5]	*Number of CAR < 0*	6	7	6	8
		% CAR < 0	55%	64%	55%	73%
		p-value	0,500	0,274	0,500	0,113
	[-5 ; -1]	*Number of CAR < 0*	0	1	0	2
		% CAR < 0	0%	20%	0%	40%
		p-value	1,000	0,969	1,000	0,813
	[+1 ; +5]	*Number of CAR < 0*	5	5	5	5
		% CAR < 0	100%	100%	100%	100%
		p-value	0,031	0,031	0,031	0,031

Source: Elaborated by the author

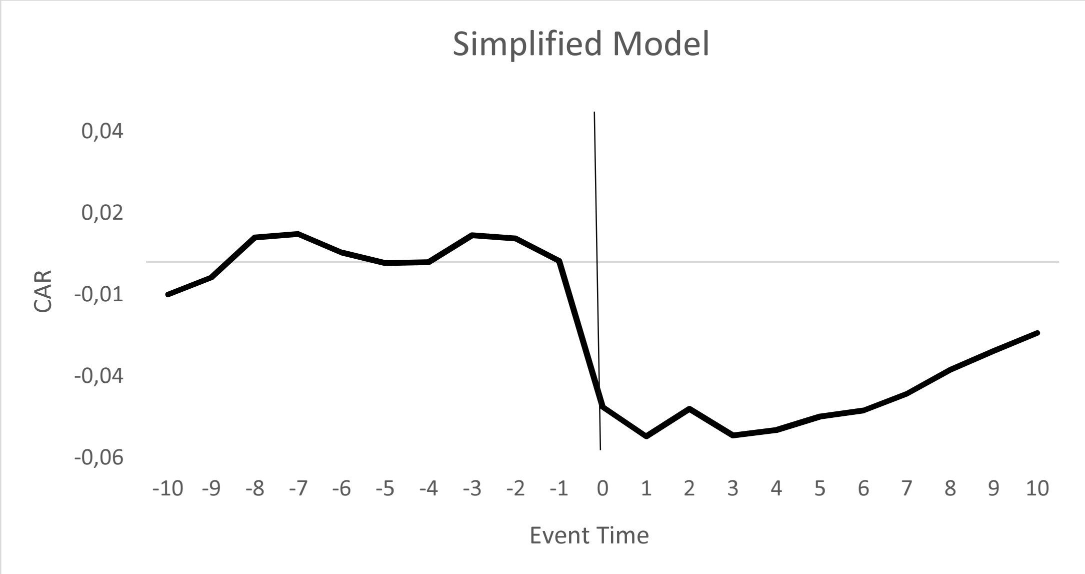
By looking over the aggregated CAR plots in Figures 4 and 5, it is possible to notice that the average CAR for the period prior to day 0 is relatively stable with a small increase a few days before the disclosure of fraud. At first sight, this goes against the idea that abnormal returns would remain zero considering no relevant facts. However, CAR test results, presented on Tables 2 and 3, may help us analysis this apparent evidence more carefully. As already mentioned, for comparison purposes tests were conducted using different event windows, in addition to specific event dates ([0] and [1]). For event windows [-10; -1] and [-5; -1], ttests show positive average CARs (0,008 and 0,014) with p-values 0,974 and 0,996 considering the alternative hypothesis (H1: CAR < 0). Sign tests indicate that 80% (for event window [-10; -1]) and 100% (for [-5 ; -1]) of CARs are positive with p-values 0,989 and 1,000 considering the alternative hypothesis of negative CARs. In this sense, the test results indicate that CARs are on average significantly positive. Similar numbers are obtained when analyzing Petrobras and the aggregation of the 4 single-event firms separately, whose test results are presented in the Appendix. By looking at the firms/events individually, however, it is possible to notice that the results for Eletrobras are excessively far from the standard. Thus, in order to avoid specific bias, additional testing procedures were conducted excluding Eletrobras from the analysis. Test results, also included in Table 2, show slightly different figures. Average CARs (0,002 and 0,005) are closer to zero for event windows [-10; -1] and [-5; -1], however not sufficiently different to be considered statistically significant as p-values equals 0,781 and 0,958 for ttests and 0,945 and 0,969 for sign tests. New CAR plots are presented in Figures 6 and 7.

Figure 6 – New plots of cumulative abnormal return for fraud from event day -10 to event day 10 using the market model, when excluding Eletrobras.



Source: Elaborated by the author

Figure 7 – New plots of cumulative abnormal return for fraud from event day -10 to event day 10 using the simplified model, when excluding Eletrobras.



Source: Elaborated by the author

In sum, the above results indicate that cumulative abnormal returns are positive prior to the event and increase the closer they get to date 0. This positive movement may be an indication that the market was not in a process of learning about the forthcoming event. In other words, it is possible to infer that, on average, no insider information has occurred prior to the event even though it looks like some speculative price movements may have influenced stock prices to outperform the market.

In this sense, considering positive abnormal returns prior to the event day, even when excluding Eletrobras from the analysis, it is possible that overall results for cumulative abnormal returns on dates 0 and 1 had been impacted. In fact, CAR testing results on Table 2 indicate an also significant difference when excluding Eletrobras from the sample. Ttests show that CAR means decreased from -0,026 with p-value 0,264 to -0,040 with p-value 0,107 on date 0 and from -0,038 (p-value = 0,185) to -0,046 (p-value = 0,109) on date 1. Sign tests also follow the same pattern, with p-values decreasing from 0,315 to 0,227 on date 0 and from 0,166 to 0,105 on date 1. Therefore, although CAR test results were not statistically significant on dates 0 and 1, it is important to consider that results were actually driven by an upward movement of abnormal returns.

The next analysis focused on the post-event window. CAR plots presented in Figures 6 and 7 allow us to notice that cumulative returns are relatively stable, although there is an upward slope a few days after the event date. In this sense, besides analyzing specific event dates, the analysis of multiple event dates also help us to draw further conclusions. Considering the event windows [+1; +10] and [+1; +5] for comparison purposes, ttest results indicate that mean CARs are negative (-0,039 and -0,048) and statistically significant at 1%, as p-value equals 0,000 for both event windows. Sign tests are also significant at 1% (for event window [+1; +10]) and 5% (for [+1; +5]) levels. The results are, therefore, consistent and in line with the theory on fraud disclosure impacts on share prices. In addition, the results indicate that returns are not only negative, but also increase towards the end of the window. This increase can be related to better expectations from shareholders, since after a fraud disclosure it is common that firms show diligence, by taking anti-corruption measures, as for example by carrying out internal investigations to look into the accusations immediately after the event. This may often be interpreted positively by the market, which would explain the positive movement of abnormal returns a few days after the fraud was disclosed.

In order to observe the behavior of abnormal returns throughout the entire window, tests were also conducted considering pre-event and the post-event windows all together. Again for comparison purposes two different windows were selected ([-10; +10] and [-5; +5]). Ttest results show that overall CAR for event window [-10; +10] averaged -0,020 at the 1% level of significance (p-value equals 0,000) and -0,024 for the [-5 ; +5] event window with p-value also significant at 1% (0,008). On the other hand, sign test results are significant at 10% for event window [-10; +10] as p-value equals 0,095 but not statistically significant for event window [-5; +5] as p-value equals 0,274, which is also impacted by the upward movement of returns during the pre-event window.

In sum, overall results using the market model approach are consistent with the existing literature on the impact of fraud on firm value, supporting the hypothesis that fraud, once disclosed to the market, provides useful information in terms of firm valuation. The obtained results are also in line with the nature of claims that permeates the class actions attributed to the five firms in our sample, in which they are accused of materially false and misleading statements due to asset overvaluation. In other words, the disclosure of fraud may also be an indication that the firms' equity prices were indeed inflated, as a consequence of allegedly overvalued assets, and adjusted by the market once the fraud was revealed, which explains significant abnormal returns on date 0 and negative returns during the post event window.

On the other hand, results obtained from the abnormal returns calculated using the simplified model are consistent and very similar to the ones from the market model. However, differently from other studies that show some difference of precision between the two models, the overall results of this study do not indicate an increase in the variance of abnormal returns and a consequent loss of precision using the simplified model. Ttests reveal that when measuring cumulative abnormal returns using the simplified model the sample standard deviation averages 0,199 against 0,196 when using the market model, which evidences no significant difference. Similar results were obtained when analyzing Petrobras and the aggregation of the four single-event firms separately. One possible explanation for such results is that our sample firms' betas are on average very close to one (0,90). In this sense, there are not many important market components to be eliminated using the market model, which is the reason for the deviation to be very similar when comparing the two models.

5. CONCLUSIONS

This study aimed to determine how disclosed fraud could have an impact on the value of firms. In addition, this research intended to verify the applicability of market efficiency hypothesis and examine the efficiency of the American market for Brazilian ADRs. Consolidate theoretical framework on a national and international level related to Securities Class Actions and the financial risks involved and discuss about the available literature on methodologies for calculating possible shareholders' reimbursement due to financial damages caused by corruption were also other main goals of this research.

This study applied the event study method to verify whether disclosed fraud has in fact an impact on firm value. Our sample included Brazilian public firms listed on SEC and traded on the NYSE that were subject to securities class action lawsuits in the United States. Measures of the firms´ abnormal returns were calculated using the market model as the normal returns. A multiple day event window was selected in order to identify possible spillovers. Parametric tests were conducted to support the study and non-parametric tests were used to provide more robustness to the obtained results. Overall test results support the hypothesis that fraud, once disclosed to the market, provides negative stock price reactions, which is in line with the existing literature on the influence of fraud on firms' valuation and the Market Efficiency Theory, which evidences the efficiency of NYSE for Brazilian ADRs.

The results related to the pre-event analysis show an increase in abnormal returns, which indicates that, on average, no insider information has occurred prior to the fraud events. This makes sense considering that the Federal Police, through secret investigations, was accountable for identifying the frauds. Test results in date 0 show negative abnormal returns, statistically significant at 1%, which support the hypothesis that fraud has an impact on firm value. Cumulative abnormal returns figures are also negative, although influenced by a positive return trend before the event. The post-event analysis also indicate significantly negative CAR with a slight increase towards the end of the window, which may reflect positive expectations from investors as a consequence of anti-corruption measures taken by the firms immediately after the fraud event. On event date one specifically, results do not allow us to make general inferences, as they seem to have been influenced by specific events. However, it is still possible to identify evidence of fraud disclosure, which may be accounted for: (i) no stock trading, (ii) market underestimation or (iii) fraud disclosure after the close of the stock market. Additionally, no relevant loss of precision could be identified when using the simplified model in comparison to the market model to estimate normal returns. The reason for this is likely to be that our sample firms' betas are on average very close to one.

Despite of the obtained results, it is also important to highlight the limitations of this study. Firstly, even though the results obtained when using the market model approach are consistent with the existing literature on the impact of fraud to the value of firms, one could argue that other studies indicate that even more reliable results could be obtained by using the market model approach adjusted to risk. Although we acknowledge this limitation, we consider it extremely challenging to assess and turn the risks of fraud into numbers, especially when our object of study are Brazilian firms. Another point of criticism could be the selection criteria of fraud events related to Petrobras, made through a qualitative analysis based exclusively on the news and media reports. In this sense, it is possible that some corruption event has been unintentionally excluded from the analysis. The number of firms in the sample could also be questioned, considering that it becomes easier for a specific event to influence the final results. Given we are focused on Brazilian firms, a possible alternative to increase our sample would be to apply the exact same study taking as a sample large public companies listed on Ibovespa that recently faced corruption problems in the scope of Brazilian Federal Police anti-corruption operations. That would certainly allow us to have a larger sample. However, in order to that, the following issues must be considered: firstly, we are not able to find in Brazil an available source such as the SCAC, of which we could obtain the necessary information related to the fraud events. Secondly, even if it were possible to apply this exact same study to the firms listed in the Ibovespa, the conclusions would not benefit an important group of people equally interested in this type of analysis: the individual investors, which is definitely not our intention. The reason for this is that the Brazilian legislation is very restrictive for individual investors, especially with regard to claiming for reimbursements, even in proven cases of fraud involving the firms in which they invest. Therefore, even if evidences that fraud has impacted stock prices were found, no further legal measures could be taken by investors.

Despite the limitations and given that the study's sample was not composed of Brazilian firms listed in the Ibovespa, but rather of those listed on the NYSE, I believe that the obtained results, besides statistically significant, are also useful. In this sense, I consider that this study's findings may benefit not only business agents and executives in understanding the financial impact of fraud and its legal consequences to the firms, but also individual and institutional investors with relevant information in relation to possible impacts on their investments and the possibility of claiming for reimbursement.

Moreover, as discussions on corporate fraud should continue to gain ground here in Brazil, especially after the outbreak of Lava-Jato and Zelotes operations, it seems reasonable to say that it is necessary to continue studying its relationship with the value of companies. It is expected that, as the subject becomes more prominent, the databases will also expand and be more robust, as well as the methodologies for analyzing all variables involved.

It is also expected that the Brazilian legislation, especially the one related to the equity markets, as well as oversight and control institutions will continue to evolve in the sense of increasingly securing investor rights. Taking the American market as a benchmark, it is noticeable that Brazil still have enough room to evolve in order to reach a high standard.

Considering this scenario, it would be a good opportunity to adapt this study to the group of firms listed in the Brazilian stock exchange (BM&F Bovespa) that had problems related to fraud. This would increase our firm sample and consequently bring more robustness to the results obtained. Additionally, this would not only allow us to verify the impact of disclosed fraud on the value of Brazilian firms and on the investments of institutional and individual investors, but also to test the efficiency of the Brazilian stock market. The expected scenario for the coming years also indicate the firms increasing concerns with fighting against fraud as well as the improvement of legislation and corporate governance in favor of investors, which also poses a very fertile ground for new research.

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APPENDIX A – List of the fifteen non-lawsuit firms and the five lawsuit firms, as well as their respective average index weights

		Firm name	Avg. Index Weight
Non-lawsuit firms	1	Ambev S/A	0,200
	2	Brasilagro	0,000
	3	BRF S/A	0,030
	4	Sabesp	0,010
	5	Cemig	0,020
	6	CPFL Energia	0,020
	7	Embraer	0,010
	8	Fibria	0,010
	9	Gafisa	0,000
	10	Gol	0,000
	11	Itau Unibanco	0,140
	12	Oi	0,010
	13	Tim Part S/A	0,020
	14	Ultrapar	0,020
	15	Vale	0,150
Lawsuit firms	1	Bradesco	0,110
	2	Braskem	0,010
	3	Eletrobras	0,010
	4	Gerdau	0,020
	5	Petrobras	0,200

*Due to rounding the sum of the weights are not equal to 1

APPENDIX B – Abnormal returns and cumulative abnormal returns from event day -10 to event day 10 for each firm individually. Abnormal returns are calculated using the market model.

	Market Model											
	Bradesco		Braskem		Eletrobras		Gerdau		**4 Firms (Agg)**		Petrobras	
Event Day	AR	CAR	AR	CAR	AR	CAR	AR	CAR	**AR**	**CAR**	AR	CAR
-10	-0,016	-0,016	0,010	0,010	0,005	0,005	-0,020	-0,020	**-0,005**	**-0,005**	-0,014	-0,014
-9	-0,012	-0,028	0,034	0,045	0,029	0,034	-0,052	-0,071	**0,000**	**-0,005**	0,007	-0,008
-8	0,011	-0,017	-0,008	0,036	-0,007	0,027	0,031	-0,043	**0,007**	**0,001**	0,014	0,006
-7	-0,009	-0,026	-0,029	0,006	0,024	0,052	-0,039	-0,080	**-0,013**	**-0,012**	0,013	0,019
-6	-0,006	-0,032	-0,042	-0,036	-0,010	0,041	0,054	-0,030	**-0,001**	**-0,013**	-0,005	0,014
-5	0,011	-0,021	-0,006	-0,042	0,050	0,093	-0,057	-0,085	**0,000**	**-0,013**	-0,003	0,011
-4	0,001	-0,021	0,042	-0,002	0,024	0,120	0,025	-0,062	**0,023**	**0,009**	-0,002	0,009
-3	-0,010	-0,031	0,024	0,023	0,050	0,176	0,039	-0,025	**0,026**	**0,035**	0,004	0,014
-2	0,006	-0,024	0,041	0,065	0,031	0,212	-0,041	-0,065	**0,009**	**0,045**	-0,001	0,013
-1	-0,017	-0,041	0,016	0,082	0,055	0,279	-0,040	-0,102	**0,004**	**0,049**	-0,006	0,006
0	-0,026	-0,066	-0,204	-0,138	-0,010	0,267	-0,075	-0,169	**-0,079**	**-0,033**	-0,031	-0,025
1	0,006	-0,061	-0,075	-0,203	-0,073	0,174	0,005	-0,165	**-0,034**	**-0,066**	-0,006	-0,030
2	0,015	-0,046	0,048	-0,164	-0,046	0,120	-0,026	-0,187	**-0,002**	**-0,068**	0,006	-0,024
3	-0,007	-0,052	0,011	-0,155	0,034	0,158	-0,026	-0,208	**0,003**	**-0,066**	-0,009	-0,033
4	0,001	-0,052	-0,002	-0,157	0,099	0,272	0,029	-0,185	**0,031**	**-0,036**	0,004	-0,030
5	0,010	-0,042	0,030	-0,132	0,062	0,351	-0,011	-0,194	**0,023**	**-0,014**	0,001	-0,028
6	0,007	-0,035	0,012	-0,121	-0,049	0,286	0,022	-0,177	**-0,002**	**-0,016**	-0,001	-0,029
7	0,007	-0,028	0,013	-0,110	-0,019	0,261	0,035	-0,148	**0,009**	**-0,007**	0,004	-0,025
8	0,008	-0,020	0,055	-0,061	-0,006	0,253	-0,041	-0,183	**0,004**	**-0,003**	0,008	-0,017
9	0,009	-0,011	-0,015	-0,075	0,019	0,277	-0,005	-0,187	**0,002**	**-0,001**	0,008	-0,009
10	-0,004	-0,015	0,001	-0,074	-0,102	0,147	0,004	-0,184	**-0,025**	**-0,026**	0,005	-0,004

APPENDIX C – Abnormal returns and cumulative abnormal returns from event day -10 to event day 10 for each firm individually. Abnormal returns are calculated using the simplified model.

Simplified Model

	Bradesco		Braskem		Eletrobras		Gerdau		**4 Firms (Agg)**		Petrobras	
Event Day	AR	CAR	AR	CAR	AR	CAR	AR	CAR	**AR**	**CAR**	AR	CAR
-10	-0,014	-0,014	0,010	0,010	0,005	0,005	-0,020	-0,020	**-0,001**	**-0,001**	-0,013	-0,013
-9	-0,014	-0,028	0,034	0,045	0,029	0,034	-0,052	-0,071	**0,003**	**0,002**	0,009	-0,004
-8	0,006	-0,022	-0,008	0,036	-0,007	0,027	0,031	-0,043	**0,003**	**0,006**	0,013	0,010
-7	-0,012	-0,033	-0,029	0,006	0,024	0,052	-0,039	-0,080	**-0,011**	**-0,005**	0,007	0,016
-6	-0,004	-0,037	-0,042	-0,036	-0,010	0,041	0,054	-0,030	**-0,001**	**-0,006**	-0,007	0,009
-5	0,006	-0,031	-0,006	-0,042	0,050	0,093	-0,057	-0,085	**0,002**	**-0,004**	-0,001	0,008
-4	0,002	-0,028	0,042	-0,002	0,024	0,120	0,025	-0,062	**0,022**	**0,018**	-0,004	0,004
-3	-0,010	-0,038	0,024	0,023	0,050	0,176	0,039	-0,025	**0,029**	**0,048**	0,005	0,009
-2	0,008	-0,030	0,041	0,065	0,031	0,212	-0,041	-0,065	**0,013**	**0,061**	-0,003	0,006
-1	-0,020	-0,050	0,016	0,082	0,055	0,279	-0,040	-0,102	**0,008**	**0,070**	-0,007	0,000
0	-0,031	-0,079	-0,204	-0,138	-0,010	0,267	-0,075	-0,169	**-0,081**	**-0,017**	-0,031	-0,031
1	0,010	-0,070	-0,075	-0,203	-0,073	0,174	0,005	-0,165	**-0,033**	**-0,049**	-0,007	-0,038
2	0,019	-0,052	0,048	-0,164	-0,046	0,120	-0,026	-0,187	**0,004**	**-0,045**	0,006	-0,032
3	-0,002	-0,055	0,011	-0,155	0,034	0,158	-0,026	-0,208	**0,004**	**-0,042**	-0,009	-0,041
4	0,001	-0,053	-0,002	-0,157	0,099	0,272	0,029	-0,185	**0,029**	**-0,014**	0,001	-0,040
5	0,014	-0,040	0,030	-0,132	0,062	0,351	-0,011	-0,194	**0,022**	**0,007**	0,003	-0,036
6	0,016	-0,025	0,012	-0,121	-0,049	0,286	0,022	-0,177	**0,003**	**0,010**	-0,002	-0,039
7	0,004	-0,021	0,013	-0,110	-0,019	0,261	0,035	-0,148	**0,004**	**0,015**	0,004	-0,035
8	0,000	-0,022	0,055	-0,061	-0,006	0,253	-0,041	-0,183	**0,000**	**0,015**	0,009	-0,026
9	0,009	-0,012	-0,015	-0,075	0,019	0,277	-0,005	-0,187	**0,005**	**0,020**	0,007	-0,019
10	-0,009	-0,021	0,001	-0,074	-0,102	0,147	0,004	-0,184	**-0,027**	**-0,008**	0,008	-0,012

APPENDIX D – Ttests and sign tests for event days 0 and 1, considering abnormal returns and cumulative abnormal returns for the 4 Firms Aggregated and Petrobras.

		Market Model							Simplified Model						
		4 Firms (Agg)			Petrobras				4 Firms (Agg)			Petrobras			
	Event Time	mean	St. Dev.	p-value	mean	St. Dev.	p-value	Event Time	mean	St. Dev.	p-value	mean	St. Dev.	p-value	
Ttest: AR (All firms)	[0]	-0,079	0,088	0,086	-0,031	0,023	0,000	[0]	-0,081	0,087	0,081	-0,031	0,023	0,000	
	[1]	-0,034	0,046	0,116	-0,006	0,030	0,252	[1]	-0,033	0,047	0,128	-0,007	0,030	0,203	
AR (excluding Braskem and Eletrobras)	[1]	0,006	0,001	0,969	-0,006	0,030	0,252	[1]	0,008	0,003	0,928	-0,007	0,030	0,203	
CAR (All firms)	[0]	-0,027	0,200	0,404	-0,021	0,128	0,286	[0]	-0,010	0,203	0,465	-0,027	0,126	0,223	
	[1]	-0,063	0,169	0,254	-0,024	0,149	0,285	[1]	-0,047	0,164	0,304	-0,032	0,146	0,220	
CAR (excluding Eletrobras)	[0]	-0,125	0,053	0,028	-0,021	0,128	0,286	[0]	-0,108	0,060	0,045	-0,027	0,126	0,223	
	[1]	-0,143	0,074	0,039	-0,024	0,149	0,285	[1]	-0,127	0,052	0,026	-0,032	0,146	0,220	

	Event Time	Returns < 0	% of Returns < 0	p-value	Returns < 0	% of Returns < 0	p-value	Event Time	Returns < 0	% of Returns < 0	p-value	Returns < 0	% of Returns < 0	p-value
Sign test: AR (All firms)	[0]	4	100%	0,063	12	92%	0,002	[0]	4	100%	0,063	13	100%	0,000
	[1]	2	50%	0,688	9	69%	0,133	[1]	2	50%	0,688	10	77%	0,046
AR (excluding Braskem and Eletrobras)	[1]	0	0%	1,000	9	69%	0,133	[1]	0	0%	1,000	10	77%	0,046
CAR (All firms)	[0]	3	75%	0,313	7	54%	0,500	[0]	3	75%	0,313	9	69%	0,133
	[1]	3	75%	0,313	8	62%	0,291	[1]	3	75%	0,313	10	77%	0,046
CAR (excluding Eletrobras)	[0]	3	100%	0,125	7	54%	0,500	[0]	3	100%	0,125	9	69%	0,133
	[1]	3	100%	0,125	8	62%	0,291	[1]	3	100%	0,125	10	77%	0,046

APPENDIX E – Ttests for event windows [-10 ; +10], [-10 ; -1], [+1 ; +10], [-5 ; +5], [-5 ; -1], [+1 ; +5], considering abnormal returns and cumulative abnormal returns for each firm individually.

			Market Model						Simplified Model					
			Bradesco	Braskem	Eletrobras	Gerdau	**4 Firms (Agg)**	Petrobras	Bradesco	Braskem	Eletrobras	Gerdau	**4 Firms (Agg)**	Petrobras
Ttest	[-10 ; +10]	*mean*	-0,033	-0,057	0,172	-0,122	**-0,012**	-0,009	-0,036	-0,002	0,188	-0,125	**0,004**	-0,014
		p-value	0,000	0,003	1,000	0,000	**0,053**	0,019	0,000	0,450	1,000	0,000	**0,720**	0,002
	[-10 ; -1]	*mean*	-0,026	0,019	0,104	-0,058	**0,009**	0,007	-0,031	0,056	0,112	-0,057	**-0,009**	0,005
		p-value	0,000	0,914	0,997	0,000	**0,862**	0,969	0,000	0,992	0,997	0,000	**0,163**	0,941
	[+1 ; +10]	*mean*	-0,036	-0,125	0,230	-0,182	**-0,031**	-0,023	-0,037	-0,054	0,253	-0,188	**-0,009**	-0,032
		p-value	0,000	0,000	1,000	0,000	**0,003**	0,000	0,000	0,002	1,000	0,000	**0,163**	0,000
	[-5 ; +5]	*mean*	-0,042	-0,075	0,202	-0,132	**-0,014**	-0,011	-0,048	-0,008	0,219	-0,137	**0,003**	-0,017
		p-value	0,000	0,018	1,000	0,000	**0,153**	0,058	0,000	0,399	1,000	0,000	**0,592**	0,013
	[-5 ; -1]	*mean*	-0,028	0,025	0,176	-0,068	**0,025**	0,011	-0,035	0,085	0,190	-0,075	**0,039**	0,005
		p-value	0,001	0,840	0,997	0,003	**0,949**	0,999	0,000	0,971	0,997	0,001	**0,975**	0,983
	[+1 ; +5]	*mean*	-0,051	-0,162	0,215	-0,188	**-0,050**	-0,029	-0,054	-0,089	0,236	-0,192	**-0,028**	-0,037
		p-value	0,000	0,000	0,997	0,000	**0,005**	0,000	0,000	0,001	0,997	0,000	**0,029**	0,000

APPENDIX F – Sign tests for event windows [-10 ; +10], [-10 ; -1], [+1 ; +10], [-5 ; +5], [-5 ; -1], [+1 ; +5], considering abnormal returns and cumulative abnormal returns for each firm individually.

			Market Model						Simplified Model				
			Bradesco	Braskem	Eletrobras	Gerdau	**4 Firms (Agg)**	Petrobras	Bradesco	Braskem	Eletrobras	Gerdau	**4 Firms (Agg)**	Petrobras
Sign test	[-10 ; +10]	*Number of CAR < 0*	21	14	0	21	**16**	13	21	12	0	21	**9**	14
		% CAR < 0	100%	67%	0%	100%	**76%**	62%	100%	57%	0%	100%	**43%**	67%
		p-value	0,000	0,095	1,000	0,000	**0,013**	0,192	0,000	0,332	1,000	0,000	**0,748**	0,095
	[-10 ; -1]	*Number of CAR < 0*	10	3	0	10	**5**	2	10	2	0	10	**3**	3
		% CAR < 0	100%	30%	0%	100%	**50%**	20%	100%	20%	0%	100%	**30%**	30%
		p-value	0,001	0,945	1,000	0,001	**0,623**	0,989	0,001	0,989	1,000	0,001	**0,910**	0,945
	[+1 ; +10]	*Number of CAR < 0*	10	10	0	10	**10**	10	10	9	0	10	**5**	10
		% CAR < 0	100%	100%	0%	100%	**100%**	100%	100%	90%	0%	100%	**50%**	100%
		p-value	0,001	0,001	1,000	0,001	**0,001**	0,001	0,001	0,011	1,000	0,001	**0,623**	0,001
	[-5 ; +5]	*Number of CAR < 0*	11	8	0	11	**7**	6	11	7	0	11	**6**	7
		% CAR < 0	100%	73%	0%	100%	**64%**	55%	100%	64%	0%	100%	**55%**	64%
		p-value	0,001	0,113	1,000	0,001	**0,274**	0,500	0,001	0,274	1,000	0,001	**0,500**	0,274
	[-5 ; -1]	*Number of CAR < 0*	5	2	0	5	**1**	0	5	1	0	5	**1**	1
		% CAR < 0	100%	40%	0%	100%	**20%**	0%	100%	20%	0%	100%	**20%**	20%
		p-value	0,031	0,813	1,000	0,031	**0,969**	1,000	0,031	0,969	1,000	0,031	**0,969**	0,969
	[+1 ; +5]	*Number of CAR < 0*	5	5	0	5	**5**	5	5	5	0	5	**4**	5
		% CAR < 0	100%	100%	0%	100%	**100%**	100%	100%	100%	0%	100%	**80%**	100%
		p-value	0,031	0,031	1,000	0,031	**0,031**	0,031	0,031	0,031	1,000	0,031	**0,188**	0,031