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FINANCIAL STATEMENT FRAUD IN EUROPE

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Resumo

Nos últimos anos são cada vez mais os casos de fraude detetados em grandes empresas o que tem vindo a abalar a confiança dos mercados. No entanto, apesar de esta ser uma realidade, o estudo da temática na europa continua a ser bastante escasso.

Assim sendo, apesar de um aumento na capacidade de regulação, do maior enfoque na temática nos últimos anos e de haver uma crescente consciencialização para os efeitos que advêm deste tipo de atos, são ainda poucas as ferramentas efetivas de prevenção a nível comunitário. Além disso, são poucos os traços diretores para os agentes com um papel fulcral não na sua identificação mas prevenção, os auditores financeiros.

O objetivo da presente dissertação é de preencher esta lacuna existente na investigação sobre fraude na europa. Através do estudo de casos de fraude contabilística devidamente identificados pelas diversas agências europeias por terem incorrido em ilegalidades a nível de contabilidade enganosa, foram identificados os indicadores que melhor explicam o evento de fraude na europa, atingindo um total de variância explicada de 90,5%.

Em suma, os indicadores identificados são rácios financeiros como a proporção dos passivos da empresa relativamente aos ativos da mesma, uma medida dos dias que a entidade necessita para fazer face às suas dividas a terceiros, uma medida de mudanças no rendimento liquido e, ainda, o tamanho da empresa auditora da respetiva entidade. Assim sendo, as variáveis mais significativas que explicam o fenómeno de Fraude Contabilística na Europa são medidas de alavancagem financeira, desempenho, e risco financeiro.

Palavras-Chave: Fraude Contabilística, Contabilidade Forense, Prevenção de Fraude, Europa

Classificação JEL: M4 – Contabilidade e Auditoria

Abstract

In recent years, more and more fraud cases have been detected in large companies, which undermined the confidence of the markets. However, although this is a reality, the study of the subject in Europe continues to be quite scarce.

Therefore, despite an increase in regulatory capacity, a greater focus on the subject in recent years and a growing awareness of the effects of this type of action, there are still few effective prevention tools at the community level. In addition, there are few guiding traits for agents with a central role not in their identification but prevention, the financial auditors.

The purpose of this dissertation is to fill this gap in the research on fraud in Europe. Through the study of cases of accounting fraud duly identified by the various European agencies for having incurred in misleading accounting, the indicators that best explain the fraud event in Europe were identified, reaching a total explained variance of 90.5%.

In sum, the identified indicators are financial ratios such as the proportion of firm liabilities to total assets, a measure of the days that the entity needs to meet its debts with third parties, a measure of changes in net income, and the size of the auditor firm. Thus, the most significant variables that explain the phenomenon of Financial Statement Fraud in Europe are measures of financial leverage, performance, and financial risk

Key words: Accounting Fraud, Forensic Accounting, Fraud Prevention, Europe

JEL classification: M4 – Accounting and Auditing

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Introduction

The term fraud has been present in economic and financial history for centuries. However, the XX and XXI centuries are being marked by a greater perception of accounting fraud**.**

The development of the study of the subject is unquestionable, however the dimension of the study carried out in the European Union is considerably smaller compared to the United States.

The little investment in the study and prevention of accounting fraud in the European Union contrasts with the many cases already discovered of companies that committed Financial Statement Fraud in the same region.

Despite the notorious lack of investment at the academic level, there are other players with an equally critical role in investigating and finding Financial Statement Fraud cases as the financial auditors. While this is not the focus on a day-to-day auditing work, its profession is marked with constant skepticism and sensitivity to issues such as Financial Statement Fraud that can affect the remaining work being done.

In this sense, their work is guided by global accounting standards regulated by the various national and community institutions such as CMVM (Portugal), CNMV (Spain), AMF (France), AFM (Netherlands), among others. These institutions set standards for entities providing services in the countries where they are based and investigate themselves possible cases of accounting fraud.

Therefore, considering the lack of formal studies of Financial Statement Fraud in the European Union, the author of this dissertation proposes to study the financial indicators that should be taken into account when studying the Financial Statement Fraud phenomenon in the European Union.

The presented dissertation has the following layout: In the first part it was presented and discussed a literature review referencing the most relevant scientific works about Financial Statement Fraud. In Chapter 2 was presented the methodology and the data description. In Chapter 3 was provided the full study and its empirical results. In Chapter 4 were presented the overall conclusions about this dissertation regarding European

Union context. Finally, the last chapter concludes about the general Financial Statement Fraud theme and the added valued of the presented dissertation.

Chapter 1 - Literature Review

1.1. Fraud

Fraud is not only a phenomenon that impacts the organization itself but also the whole environment in which the organization is inserted and, in some cases, may have repercussions at the international level, being a phenomenon with increased complexity, which rises the relevance of the combat and prevention of economic and financial fraud (Afonso & Pimenta, 2012).

The concept has a latin origin "fraus, fraudis" that means "damage done to someone". Pickett (2000) defines fraud as any act whose goal is to obtain an advantage over others. According to Pedneault (2009), fraud is defined as “the conscious distortion of truth or concealment of material fact with the objective of inducing other people to act to the detriment of their own interests”. The concept is so extensive that it is studied in different scientific areas such as law, criminology, psychology, auditing, among others (Afonso & Pimenta, 2012).

Lopes de Sá (1982) defines fraud as "an error committed intentionally for the purpose of harming someone". According to the National Independent Auditing Standards, the terms “fraud” and “errors” are distinct, the first being "The intentional act of omission or manipulation of transactions, adulteration of documents, records and accounting statements," and the second "unintentional act resulting from omission, inattention or misinterpretation of facts in the preparation of accounting records and statements ".

The International Federation of Accountants (IFAC) specific standard that is in force and which treats the FSF is the International Standard on Auditing (ISA) 240 - Fraud and Error. ISA 240 defines "fraud" as an intentional act by administrative, employee or third-party members, resulting in false accounting statements. Thus, fraud may involve: misappropriation of assets; manipulation, falsification or alteration of records or documents; omission of the effects of transactions on records or documents; or improper application of accounting policies.Therefore, fraud by itself is a generic term that encompasses several forms of misrepresentation in the presented accounting information.

Therefore, any act of illegality that is characterized as concealing, deceiving or violating trust, act without resorting to threat, violence or physical force, is considered fraud. Fraud

can include any crime with the ultimate goal of making profit by imposing a false idea, which would lead to damages for the victim, usually financial damages. Thus, according to Wells (2009), there are four elements that must be present in order for an act of fraud to occur: a materially false statement, knowledge at the time of the statement that it was false, trust in the statement by the victim and the resulting damages.

However, social tolerance for acts of fraud depend on each individual consumer and its attitudes towards fraudulent acts, as well as on the network of influence of each individual. Thus, the greater the tolerance in society and acceptance of fraud acts as natural, the greater the likelihood that the individuals that comprise this group adopt similar behaviors, leading to low probabilities of detection of fraudulent behaviors (Tennyson, 2008).

The Association of Certified Fraud Examiners (2017) categorizes and organizes the concept of fraud through a Fraud Tree, including misappropriation of assets and corruption, which are considered internal frauds, and Financial Statement Fraud (FSF) which is considered to be external fraud. It is considered internal or external fraud according to whom is most affected by the fraud. Internal fraud greatly affects the organization through the loss of assets, and external fraud has serious consequences for external users through the release of incorrect financial information. Corruption is then understood as any scheme by which influence is used in a transaction in order to obtain an associated and unauthorized benefit. Misappropriation of assets is understood as any scheme involving the theft of assets of a company. Finally, FSF is understood as the intentional falsification of the financial information of a company in order to make it look more profitable for all the stakeholders.

In another perspective, Almeida (2003) considers that there are two types of fraud, organizational fraud and fraud against the company itself. The author defines the first as being committed for the benefit of the organization and against external parties, such as creditors, partners, shareholders or tax administration, usually resulting in the falsification of the financial statements.The second is defined as any act against the company itself and in favor of the perpetrator of the fraudulent act, which consists ultimately in the theft of company assets.

Ferreira (2007) proposes a third approach which consists of the articulation between the two main ideas previously presented. The author concludes, on one hand, that corruption

and misappropriation of assets can be classified as fraudulent acts against the company and, on the other hand, that organizational fraud also called FSF presupposes the manipulation of accounting records for the benefit of the company itself and encourages the use of practices that act against the economic external agents. As such, the company is involved, being an active part in the fraud act, an aspect not highlighted in the classification advocated by the Association of Certified Fraud Examiners (2017) and by Almeida (2003).

The generic term fraud encompasses several definitions of misconduct, however, in this dissertation the focus will be on the phenomenon of FSF.

1.2. Financial Statement Fraud

Financial statement fraud (FSF) refers to the intentional omission or distortion of accounting data or important facts in order to change the perception of who have access to this information and, consequently, its final decision regarding the company (Certified Fraud Examiners, 2012). Consequently, FSF is a deliberate way to lubricate users through material distortions in the financial statements (Rezaee, 2005).

According to the Association of Certified Fraud Examiners, FSF is a deliberate mistake made by an employee or manager with no basis in the organization's true accounting information, such as fictitious revenue or lower reported costs (as cited in Tarjo & Herawati, 2015). FSF is defined by the International Standards on Auditing 240 as the manipulation of readers of financial statements through intentional errors or omission of relevant information in the presentation of the financial statements (as cited in Kamal, Salleh & Ahmad (2016)).

It is important to distinguish between FSF and earnings management, since the FSF is perpetuated through a breach of GAAP (Generally Accepted Accounting Principles), and earnings management also harm investors but only resorts to legal issues (Dechow & Skinner, 2000). Therefore, earnings manipulation consists of actions taken by the company in order to deceive about the true financial performance of the company. Often external agents are led to believe that the company's disclosure is more robust, and that its financial position is generally safer than it truly is (Schilit & Perler, 2010). These results are achieved through the use of accounting techniques that involve judgment but do not constitute, by themselves, a violation of GAAP.

According to Rezaee (2005), FSF should be strongly condemned for several reasons: 1) It is a serious threat to investor confidence in financial markets; 2) It involves high costs in terms of fines or lack of investment for organizations when fraud cases are discovered, and 3) is an illegitimate and unacceptable attitude on the part of organizations.

According to Kamal, Salleh, Ahmad (2016), FSF is the type of fraud with higher costs as it leads to loss of investors' confidence, and negatively affects the capital market as well as the reputation of the organization. It leads to significant declines in stock price which consequently leads to losses for shareholders, and possible outflow of the stock exchange.

FSF is an event that has greatly impacted the business world, economies, societies, as well as all stakeholders involved. Ultimately, a FSF case can affect an economy in such a way that leads to the relocation of a company that has great impact on the economy of a country. Therefore, there is a growing focus on the regulation and supervision of the accounting information released, in order to mitigate possible material risks associated with FSF.

1.3. Fraud Regulation and Prevention

It is notorious the increasing focus on regulation and the attempt to predict possible fraud cases, what does not mean that the consequences of discovered cases have been less devastating. Most cases are discovered years after they occurred and, in certain cases, when the company is already in insolvency. The role of regulators is therefore increasingly important in the financial markets, exerting greater pressure on economic agents to act in accordance with the principles of regulation. In this sense, it is necessary to have mechanisms and procedures that aim to reduce the occurrence or minimize the effects of fraudulent practices. Wells (2009) argues that it is important to know the motivation of those who commit fraud in order to improve risk assessment, increase fraud prevention and the capacity for detection.

The fraud policies in the European Union are characterized by a severe fragmentation which creates a coordination issue when working internationally, with different legal and accounting systems (Quirke, 2000). It is therefore difficult to effectively and efficiently coordinate the fraud policies of the different European institutions.

UCLAF was the main EU institution in combating fraud until 1999, whose main objective was to protect the financial interests at the community level. However, the primary

responsibility in the fight against fraud, prediction and discovery, was always on the side of the member states. Specifically, Article 209 of the Treaty of Amsterdam states that Member States must take measures against fraud at community level, equivalent to those taken to combat fraud affecting their own interests. Although UCLAF was created with the goal of coordinating the member states, the institution also began investigating fraud cases.

In 1999, the European Parliament approved the establishment of the European Fraud Prevention Office (OLAF), which carries the responsibilities of conducting investigations into fraud within the member states, including in institutions at the community level. As such, OLAF safeguards the financial interests at Community level, ensuring independence in investigations but with responsibility of reporting to the Commission, the Parliament, the Council and the Court of Auditors.

Although, the fight against fraud in the EU continues to be marked by significant differences between member states and a lack of independence in the institutions that regulate and investigate fraud cases. There has been a convergence in accounting standards at the Community level, which increases business comparability between European Union (EU) countries.

The application in the EU of the International Financial Reporting Standard (IFRS), a Global Generally Accepted Accounting Principles (GAAP) accepted by the International Accounting Standard Board (IASB) has increased significantly the harmonization within the financial information published (Okpala, 2012).

Therefore, according to (Ugochukwu, Justina & Chukwunonso, 2015), in spite of the many advantages that the IFRS have in terms of greater risk mitigation to possible fraud in the financial statements, the first years of application are a challenge for the auditors since they are dealing with different methods with significant differences. Accordingly, the IFRS is expected to promote increased comparability, transparency, and signaling of outliers.

The FSF cases that have come to the public in recent years lead the auditor role to change, having become much more overwhelmed and scrutinized, which led to the need of developing new techniques to increase the efficiency of the auditor's work or even in the study of fraud phenomena by researchers.

Auditors have a crucial role in the discovery of fraud cases and, above all, a driving force in the prevention of these same cases, which DeAngelo (1981) identifies as an auditor quality **(**as cited in Stice, 1991). Bearing that in mind, the International Standard on Auditing (ISAs) are an important guide to auditor work, since it is expected that conducting an audit according with ISAs will result in financial statements free from material misstatements. However, even so, auditors must maintain an attitude of professional skepticism in order to ensure that all material misstatements are found in the released financial information.

The ISA 450 defined misstatement as "the difference between the amount, classification, presentation or disclosure of a reported financial statement item and the amount, classification, presentation or disclosure that is required for the item to be in accordance with the applicable financial reporting framework."

It is clear the influence of Cressey's theory on the accounting standards that deal with the subject of fraud. An example is the ISA 240, which states that "Fraud, whether fraudulent financial reporting or misappropriation of assets, involves incentive or pressure to commit fraud, a perceived opportunity to do so and some rationalization of the act".

1.4. Fraud Triangle

Donald R. Cressey (1953) developed a fraud triangle that would become a reference in the study of the phenomenon of fraud and used by accounting professionals, regulators, researchers or auditors. The framework explains the main issues that must exist for the fraud occurrence.

Cressey's work led him to be considered as the most influential developer of the fraud triangle, which was largely presented in his book "Other People's Money" (Cressey, 1953). According to the framework, the occurrence of fraud is dependent of the existence of three main issues: pressure, opportunity, and rationalization.

Regarding pressure, it can take the form of financial, peer pressure, or even pressure for results. In the business world, it is common to work for numbers, profits, or specific results, what can pressure managers or employees to work unethically to meet the business expectations. Additionally, the pressure factor can also result from a financial need, when it is a personal choice to commit fraud in order to achieve a better financial position. Therefore, it is expected that firms that have not been able to achieve the market

expectations, are more susceptible to commit fraud, reason why performance indicators are a good starting point for fraud analysis.

Secondly, opportunity exists when some circumstances end up providing chances to commit fraud, such as difficult transactions with high inherent risk, such as transactions that have high subjectivity, accounting estimates considered significant but that may not be possible to verify. However, opportunity happens not only when there is lack of regulation but it can be generated by an individual itself, i.e., even if opportunity is not present, the opportunity to commit fraud can be created by managers with capability to do it. Therefore, the factor "opportunity" prepossess that the individual possesses the capability of understanding that the opportunity is in place.

Finally, rationalization is considered a grey area in the fraud triangle, since the first two mentioned are considered or not, however, rationalization depends on individuals itself, in its attitude towards fraud as a justification of its actions. Either pressure, opportunity, or rationalization are fraud-risk factors that must co-exist for the occurrence of fraud, however, the existence of them, per se, are not an indicator of fraud.

In fact, there are red flags identified for each of the fraud-risk factors developed by Cressey and adopted by several authors. Specifically, red flags related to pressure are those such as management compensation schemes or earnings expectations. In a study by Efendi, Srivastava & Swanson (2007), links were found between equity-based compensation levels and the probability of irregularities in accounting.

Red flags related to opportunity are, for example, weak corporate governance and lack of efficient internal control function. Farber (2004) has shown that firms with fewer independent board members and fewer meetings with the audit committee are more likely to commit fraud. Finally, red flags related with rationalization reveal management attitude toward fraud. According to Feng, Ge, Luo & Shevlin (2011), if the management has propensity to commit fraud but executives do not share this attitude, the last are likely to resign.

In recent years, new techniques for studying phenomena such as fraud have emerged, leaving aside much question-based studies.

1.5. Models

In 1980, Ohlson developed a bankruptcy prediction model using a logistic analysis, which included measures of firm size, liquidity, leverage, and performance. It included a sample of 105 bankrupt firms and 2.058 non-bankrupt firms from 1970 to 1976. The author was a pioneer in introducing a logit function in the study of bankruptcy, resulting in a reference model in the accounting research and market analysis.

The study of corporate financial distress has been conducted by several authors along the years. Specifically, the central focus in this type of studies it is to identify early signals that may be indicators that a firm may go distress in the short term. Therefore, different models have been developed over the years as a way to improve the capability to predict FSF cases.

Beaver (1966) is considered the pioneer in the introduction of the Univariate Discriminant Analysis (UDA) through which he discovered that certain ratios, in particular cash flow / total debt ratios, are able to predict corporate default before the business failure.

In 1968, Altman developed the work of Beaver and was the first using Multiple Discriminant Analysis (MDA). His sample consisted of 33 failed companies and 33 non-failed companies, which resulted in 95% of the companies being correctly classified, in the period one year before the failure of the firms. The results obtained by using MDA technique were considered more satisfactory than the results of Beaver, when using UDA.

Overall, the Altman model measures the financial health of firms and the likelihood that a company go bankrupt within two years. Altman was an influencer in the fraud and company failure literature, and many other authors followed using the MDA technique (Charitou, Neophytou & Charalambous (2004)). Md. Zeni & Ameer (2010) believe that the Altman model is the most systematically tested and generally accepted distress prediction model.

In the last decades several other models have been developed, which has greatly developed the study of fraud.

Beneish (1997) developed a probit analysis model, which resulted in an index measuring the probability of manipulation for a company. The author's sample consisted of 64 companies that had violated the GAAP and a control sample consisting of companies considered to be non-fraud, from 1987 to 1993. The model highlights the positive

correlation between fraud and accounting manipulation, which clarifies that firms with weaker financial health are more likely to commit FSF (Guler, Emgin & Uçma (2013).

Beneish's model indicates that the probability of manipulation increases with unusual increases in receivables, deteriorating gross margins, decreasing asset quality, sales growth, and increasing accruals and this model is useful for predicting manipulators (Beneish, 1999). The Beneish model proved to be a forensic tool capable of detecting 76 percent of publicly listed companies in the US and receiving SEC enforcement accounting and predicting 71 percent of the largest financial reporting scandals before they were publicly announced, based only on information released by the companies in the annual accounts reports. Thus, this model can be used to study companies that tend to commit FSF (Beneish, Lee & Nichols, 2012).

Although the models used were built some decades ago and are based on samples with distinct characteristics**,** Grice & Dugan (2003) state that there is no evidence that the referred models are sensitive to time and industry changes, and that this the main reason why authors are able to obtain satisfactory results from the use of them in studying firms' financial position. On the whole, the predictive power of the models are considered for not being affected by time periods, financial conditions, or even industries.

Even though some of the models are bankruptcy based and others financial distressed based, since both are related with each other, both serve the goal of study the bankruptcy phenomena. In fact, firms that are in financial distress situations are more prone to go bankrupt or have the incentive to commit fraud.

Chapter 2 - Methodology

2. 1. Sample and Data Description

The selected sample is composed by 14 european publicly traded firms, with sizes ranging between 162 million euros and 139.002 million euros, whose majority of the information was accessed through the database DataStream. In order to make the data consistent and comparable, all monetary values have been converted into a single monetary unit, the Euro. However, when information was missing in DataStream, it was analysed the Statement of Consolidated Accounts of those firms, and the currency was converted according to the exchange rates for each year, accessed through the *Banco de Portugal* website.

On the whole, 42 annual reports were analysed, corresponding to 3 annual reports for each firm, in a time period from 1999 to 2014.

The final sample is composed by 7 firms identified as fraudulent[1] by the regulatory commissions (AFM[2], AMF[3], BaFin[4], FSA[5], and CNMV[6]). Firms from banking, finance and related institutions were excluded, since they do not fit the typology of this study. The firms of the sample were - at the time of the analyse - part of the following stock exchanges: Euronext Amsterdam, Euronext Paris, Frankfurt Stock Exchange, London Stock Exchange, and Madrid Stock Exchange.

A control sample of 7 firms[7] was used, which was chosen through a matching process[8], similar to what was done by researchers such as Beaver (1966), Beasley (1996), Kaminski, Wetzel, & Guan (2044), Yap, Yong & Poon (2010), and Wang & Campbell (2010).

The firms were matched according to the following criteria:

1. Firm size: Each manipulator firm was matched with a non-manipulator firm from the same size measured in terms of total assets. In the cases that this was not possible, it was selected the firm with the closest size (Yap et al. (2010), and Wang & Campbell (2010)), i.e., between ± 30% of the total assets of the manipulator firm (Beasley, 1996). Moreover, this criteria is of extreme importance since, according to Beaver (1966), the selection of the non-manipulator firms would be inappropriate if attention is not paid to the asset size.

2. Industry: Each manipulator firm was matched with a non-manipulator firm belonging to the same industry (Beasley (1996), Wang & Campbell (2010), and Yap et al. (2010)).

[1] That will be denominated, from now on, as "manipulators"

[2] Authority for the Financial Markets – Netherlands

[3] *Autorité des Marchés Financiers* - France

[4] *Bundesanstalt für Finanzdienstleistungsaufsicht* - Germany

[5] Financial Services Authority – United Kingdom

[6] *Comisión Nacional del Mercado de Valores* - Spain

[7] That will be denominated, from now on, as "non-manipulators"

[8] A matching process corresponds, according to Beaver (1966), to a paired-sample design "to help provide a "control" over factors that otherwise might blur the relationship between ratios and failure." (p.74).

The firms of the sample belong to industries such as retail, fishing, oil and telecommunications.

3. Stock exchange: Both manipulator and non-manipulator firms must be part of a Stock Exchange of the European territory[9].

4. Time period: After meet the previous criteria, data for the same time period was gathered for manipulator and non-manipulator firms (Beasley, 1966). Since, according to Arshad, Iqbal & Omar (2015), "Comparing companies for similar time period will be more reflective in nature" (p.41). The analysed period of time started the year before it was made public that the firm committed Financial Statement Fraud (FSF) and backwards, covering three years (Kaminski et al. (2004)).Therefore, as an example, if it was made public during the financial year of 2013 that the firm committed FSF, the data will be analysed from 2010 to 2012.

In addition, it was given special attention to the Accounting Standards[10] used by both manipulator and non-manipulator firms during the study period, as a way to guarantee a comparison of the numbers and reliability of the results.

[9] According to Beasley (1966), the stock exchange should be the same for both companies. However, since the study covers the European territory and the manipulator firms are part of a broad range of stock exchanges, it was not possible to match the manipulator firm with a corresponding non-manipulator firm within the same stock exchange in all cases, having in mind that it has to be fulfilled also the previous criteria.

[10] As a way to reduce accounting diversity, a harmonization of accounting and reporting has been made, named IFRS, allowing the use of a single accounting language between companies of different countries and their stakeholders.

Chapter 3 - Study and Results

3.1. Method

"Organizations can identify at an early stage the possibility of them tumbling into financial distress or detecting possibility of fraudulent financial reporting by using some prediction tools such as ratio analysis, Beneish Model and Z-score Model." (Arshad, Iqbal & Omar, 2015, p.36). Therefore, in order to study the FSF phenomena it will be used the models previously enumerated and, additionally, the Ohlson Model. The aim is to test which variables better explain the FSF phenomenon in Europe in the current times.

3.1.1. Beneish Model

Furthermore, it was adopted the Beneish Model to test whether firms have manipulated its earnings and, consequently, assess the reliability of the reported earnings. The model was designed by Beneish (1999) to capture distortions in the financial statements of the firms or conditions that might incentive the firms to do it (Roxas, 2011). The model has been extensively used in the literature by researchers such as Brickell (2011), Roxas (2011), Guler, Emgin & Uçma (2013), and Arshad, Iqbal & Omar (2015).

The model developed by Beneish (1999) is the following:

$$\text{M-Score} = -4.84 + 0.92\ X_1 + 0.528\ X_2 + 0.404\ X_3 + 0.892\ X_4 + 0.115\ X_5 - 0.172\ X_6 + 4.679\ X_7 - 0.327\ X_8 \quad (1)$$

Where:

X_1 = DSRI
X_2 = GMI
X_3 = AQI
X_4 = SGI
X_5 = DEPI
X_6 = SGAI
X_7 = TATA
X_8 = LVGI

The classification of the M-Score should be done as following:

M-Score<−2.22 'Not manipulator';
M-Score>−2.22 'Manipulator'.

Beneish Model	Ratio	Formula
1	Days' sales in receivables index	$DSRI = \frac{[\text{Account receivables/sales}]\ t}{[\text{Account receivables/sales}]\ t-1}$
2	Gross margin index	$GMI = \frac{[(\text{Sales-COS})/\text{Sales}]\ t-1}{[\text{Sales-COS})/\text{Sales}]\ t}$
3	Asset Quality Index	$AQI = \frac{[1 - (\text{Current Assets} + \text{Net Fixed Assets}) / \text{Total Assets}]\ t}{[1 - (\text{Current Assets} + \text{Net Fixed Assets}) / \text{Total Assets}]\ t-1}$
4	Sales growth index	$SGI = \frac{\text{Sales } t}{\text{Sales } t-1}$
5	Depreciation index	$DEPI = \frac{\text{Depreciation } t-1 / (\text{Depreciation } t-1 + \text{PPE } t-1)}{\text{Depreciation } t / (\text{Depreciation } t + \text{PPE } t)}$
6	Sales, general and administrative expense index	$SGAI = \frac{\text{Sales, general and administration expense } t / \text{Sales } t}{\text{Sales, general and administration expense } t-1 / \text{Sales } t-1}$
8	Total accruals to total assets	$TATA = \frac{(\Delta \text{ Current Assets} - \Delta \text{ Cash}) - (\Delta \text{ Current Liabilities} - \Delta \text{ Current Portion LTD} - \Delta \text{ Taxes Payable}) - \text{Depreciation and amortisation } t}{\text{Total Assets } t}$
7	Leverage index	$LVGI = \frac{(\text{LTD } t + \text{Current liabilities } t) / \text{Total assets } t}{(\text{LTD } t-1 + \text{Current liabilities } t-1) / \text{Total assets } t-1}$

FIGURE 1 - THE VARIABLES THAT CONSTITUTE THE BENEISH MODEL AND ITS FORMULAS. SOURCE: ADAPTED FROM BENEISH (1999).

Days Sales in Receivables Index (DSRI): the ratio measures whether variations in receivables are consistent with changes in sales. If the ratio increases, it may be for two reasons: (1) there is a trend to make more sales on credit rather than on cash, or (2) the firm may be with problems gathering its receivables.

Gross Margin Index (GMI): measures if firm's gross margins have deteriorated or not. If that happened, it suggests negative future firm scenarios. Moreover, increases in the index indicate that the margins declined and, consequently, the accounts should be looked deeper since, it may be a signal of manipulation to increase the profit of the firm.

Asset Quality Index (AQI): measures variations in assets' quality of a firm. Increases in the index, i.e. a declining asset quality, proposes a growing trend of the firm to involve itself in cost deferral.

Sales Growth Index (SGI): the ratio measures the growth of sales between two periods. Although the index is not a measure of manipulation by itself, it trials the possible pressure for the firms to commit fraud to continue to grow at similar rates.

Depreciation Index (DEPI): measures changes in the depreciation. Increases in this index suggest firm efforts in order to decrease depreciation and increase earnings.

Selling, General and Administrative Expense Index (SGAI): increases in the index have to be carefully analysed and, an uneven increase in sales, to be seen as a signal of possible material distortion of sales in order to defer costs.

Total Accruals to Total Assets (TATA): measures whether the firm make discretionary accounting choices through its accruals, to modify its earnings. Thus, a ratio greater than 1 results in an increased debt rate.

Leverage Index (LVGI): the ratio intend to detect the incentives to comply with debt covenants. An increase in the index is a negative signal to the firm's prospects.

The model (1) is constituted by measures of firms' ability to produce earnings and cash flows from its business activities (DSRI, GMI, and TATA), measures of firms' investment in assets and capacity to monitor costs (AQI, DEPI, SGAI), and to measure the firms' capability and motivation to manipulate GAAP[11] (SGI, LVGI) (Barsky, Catanach, & Kozlowski (2003)).

3.1.2. Altman Model

Altman (1968) developed a model capable of measuring the financial health of firms and, consequently, be able to predict bankruptcy within two years, relying on Multiple Discriminant Analysis (MDA) technique.

Although several other models were developed years later, this model is believed to be the most tested and generally accepted model of distress prediction (Md. Zeni & Ameer (2010)).

Therefore, the model is the following:

$$Z\text{-Score} = 1.2\ X_1 + 1.4\ X_2 + 3.3\ X_3 + 0.6\ X_4 + 1.0\ X_5 \quad (2)$$

Where:

X_1 = WCTA
X_2 = RETA
X_3 = EBITTA
X_4 = MVEBVTL
X_5 = SALTA

The Z-Score should be classified as following:

Z-Score < 1.80 'Bankrupt', i.e. Distress Zone;
1.80 < Z-Score < 2.99 'Zone of ignorance', i.e. Gray Zone;
Z-Score > 2.99 'Non-bankrupt', i.e. Safe Zone.

[11] Generally Accepted Accounting Principles.

Altman Model	Ratio	Formula
1	Working Capital to Total Assets Ratio	$WCTA = \frac{\text{Working Capital}}{\text{Total Assets}}$
2	Retained Earnings to Total Assets Ratio	$RETA = \frac{\text{Retained Earnings}}{\text{Total Assets}}$
3	Earnings Before Interest and Taxes to Assets Ratio	$EBITTA = \frac{\text{EBIT}}{\text{Total Assets}}$
4	Market Value of Equity to Book Value of Total Liabilities Ratio	$MVEBVTL = \frac{\text{Market Value of Equity}}{\text{Book Value of Total Liabilities}}$
5	Sales to Assets Ratio	$SALTA = \frac{\text{Sales}}{\text{Total Assets}}$

FIGURE 2 - ALTMAN MODEL VARIABLES AND ITS FORMULAS. SOURCE: ADAPTED FROM ALTMAN (1968).

Working Capital to Total Assets (WCTA): is a measure of liquidity, which tests the firm's ability to pay its short term financial obligations. A low ratio indicates a potential source of bankruptcy.

Retained Earnings to Total Assets (RETA): is a leverage ratio, which is expected to be an indicator of possible future bankruptcy whenever the ratio has a low value, since it is a signal that the firm may have been financing itself through debt rather than through cumulative earnings.

EBIT to Total Assets (EBITTA): is a measure of productivity, which measures the efficiency of the firm in using its assets to generate profit. Therefore, a high ratio indicates that the firm is highly efficient in using its assets and, ultimately, there is less risk of bankruptcy.

Market Value of Equity to Book Value of Total Liabilities (MVEBVTL): is a measure of solvency, which captures the reaction of the market to the financial position of the firm. A small ratio is a possible indicator of bankruptcy.

Sales to Assets (SALTA): measures the ability of the firm to generate earnings from its assets. A high ratio indicates that the firm is able to capture a big portion of revenue from small investments and, therefore, is less prone to go bankrupt.

3.1.3. Ohlson Model

Ohlson (1980) built a bankruptcy prediction model through a Logistic Regression, after the several critiques to the MDA that arose over the years.

The Ohlson Model is a reference in the accounting literature in a wide number of research papers, what have turned it into a reference in the market analysis (Durán-Vázquez, Lorenzo-Valdés & Castillo-Ramírez, 2014).

The model is the following:

$$\text{O-Score} = -1.32 - 0.407\ X_1 + 6.03\ X_2 - 1.43\ X_3 + 0.076\ X_4 - 2.37\ X_5 - 1.83\ X_6 + 0.285\ X_7 - 1.72\ X_8 - 0.521\ X_9 \quad (3)$$

$$P = \frac{\exp(O - Score)}{1 + \exp(O - Score)}$$

Where:

X_1 = SIZE
X_2 = TLTA
X_3 = WCTA
X_4 = CLCA
X_5 = ROA
X_6 = FUTL
X_7 = INTWO
X_8 = OENEG
X_9 = CHIN

The probability resulting from the O-Score should be classified as following:

P<0.5 ‘Safe Position’, i.e. Non-Bankrupt;
P>0.5 ‘Default Position’, i.e. Bankrupt.

Ohlson Model	Ratio	Formula
1	Size measure	SIZE= Log (total assets/GNP Deflator)
2	Total Liabilities to Total Assets Ratio	TLTA= Total Liabilities / Total Assets
3	Working Capital to Total Assets Ratio	WCTA= Working Capital / Total Assets
4	Current Liabilities to Current Assets Ratio	CLCA= Current Liabilities / Current Assets
5	Return on Assets	ROA= Net Income / Total Assets
6	Funds from Operations to Total Liabilities Ratio	FUTL= FFO / Total Liabilities
7	Dummy for loss	INTWO= 1 if net income negative for the last two years, 0 otherwise
8	Dummy for financial obligations	OENEG = 1 if total liabilities exceeds total assets, 0 otherwise
9	Net Income Change Ratio	CHIN= NI t-NI t-1 / |NI t|+|NI t-1|

FIGURE 3 - THE VARIABLES THAT COMPOSE THE OHLSON MODEL AND ITS FORMULAS. SOURCE: ADAPTED FROM OHLSON (1980).

SIZE: is a measure of the size of the firm, which uses an economic metric such as GNP[12] deflator.

Total Liabilities to Total Assets (TLTA): is a measure of firm leverage, which outlines the financial obligations of the firm against its assets. A high ratio indicates that there is increased financial risk and, therefore, it is expected the ratio to be positively related to bankruptcy.

Working Capital to Total Assets (WCTA): is a measure of liquidity, which trials the ability of the firm to address its short term financial obligations. A low ratio may be a potential indicator of bankruptcy.

Current Liabilities to Current Assets (CLCA): is a measure of liquidity that analyses the ability of the firm to pay its current obligations through its most liquid resources. A high ratio may indicate a potential source of future bankruptcy.

Return on Assets (ROA): is a measure of performance, which demonstrates how efficient the firm is generating earnings through invested capital. It is expected a negative relation between this ratio and bankruptcy.

Funds from Operations to Total Liabilities (FUTL): is a measure of leverage, which relates the operating earnings against firm's financial obligations. The lower the ratio, the higher the financial risk of the firm and, therefore, higher the risk of bankruptcy.

Dummy for loss (INTWO): is a measure of performance, which tests whether the firm had losses rather than profit in at least two consecutive years. It is expected a positive relation between this dummy variable and the risk of bankruptcy.

[12] It was used 2010 as the year base of the calculation.

Dummy for financial obligations (OENEG): is a measure of leverage, which tests whether the firm is able to pay its financial obligations with the resources that it owns. A positive relation is expected between the dummy variable and bankruptcy.

Net Income Change Ratio (CHIN): is a measure of performance, which captures changes in net income between two periods. A low ratio is expected to be related with high financial risk and, consequently, to be a possible source of future bankruptcy.

3.1.4. Financial Ratios Model

Despite the poor theoretical guidance with regard to the choice of variable selection, the 'Financial Ratios Model' was built through several variables that were found to be extensively used in the FSF literature, and are not covered by the remaining presented models. The chosen variables are classified according to the three main factors of the fraud triangle[13] and are, per se, measures of liquidity, safety, efficiency and performance.

3.1.4.1. Pressure

The first dimension captures the perceived pressure for the members of the firm to commit fraud, usually to meet external expectations (e.g. from the market or from the stakeholders). Therefore, it is proposed that when a firm is under more financial pressure, it is more susceptible to commit fraud.

To capture the aspects of pressure, several variables were used as showed below.

When firm have a high debt structure, they may have the incentive to manipulate its financial statements to meet its debt obligations, which supports the idea that higher levels of debt may increase the probability of fraud (Kirkos, Spathis & Manolopoulos (2007)).

Attempting to measure this dimension, the **Current Ratio** was used, which has been studied by researchers such as Beneish (1999), Kirkos, Spathis & Manopoulos (2007), Ravisankar, Ravi, Rao & Bose (2011), and Borba & Wuerges (2014). If the ratio is lower than 1, it means that the firm does not have enough assets to meet its short term debt and, the higher the ratio the stronger the ability of the firm to pay its financial obligations. According to Borba & Wuerges (2014), it is expected this variable to be negatively related to FSF.

Following the same reasoning, it was also included the **Total Debt to Total Assets (TDTA)** ratio to measure the signposted dimension (Beneish (1999), Kirkos, Spathis & Manopoulos (2007), and Lou & Wang (2009)). The ratio is a measure of leverage, and the greater the ratio the higher the financial risk of the firm. According to Lou & Wang (2009), a positive relationship between the ratio and fraud is predictable.

The **Quick Ratio (QR)** is a measure of short term liquidity used by authors such as Ravisankar, Ravi, Rao, Bose (2011), and Arshad, Iqbal & Omar (2015). It measures the

[13] Fraud Triangle encompasses three factors: Pressure, Opportunity, and Rationalization.

ability of the firm to meet its short term debt obligations through its most liquid assets. According to Ravisankar, Ravi, Rao & Bose (2011), it is expected a negative relation between the ratio and FSF.

A complementary variable of liquidity was used, the **Cash to Total Assets (CASHTA)** ratio. Authors such as Kirkos, Spathis & Manopoulos (2007), Gaganis (2009), and Borba & Wuerges (2014) used this variable, attempting to measure the ability of the firm's assets to generate cash. It is expected this variable to be negatively associated to fraud (Gaganis, 2009).

An additional liquidity variable, the **Working Capital to Total Sales (WCTS)** ratio, was used. This ratio illustrates the need for sales contribution in the firm's financial obligations, and a high ratio indicates that there is a higher need for extra funding.

The **Debt to Equity (DEQ)** ratio was used as a measure of safety, which was similarly used by Kirkos, Spathis & Manopoulos (2007), Ravisankar, Ravi, Rao & Bose (2011), and Arshad, Iqbal & Omar (2015). It represents the relationship between the assets financed by the firm's creditors and the assets financed by the firm's shareholders. A high ratio is associated with financing mostly through debt and is related to higher risk.

According to Kirkos, Spathis & Manopoulos (2007), there are accounts that are more subjective than others and, therefore, are more difficult to accurately audit. Accounts receivables is one example and, wherefore, are more easily subject to manipulation. As illustrated by Fanning & Cogger (1998), "The fraudulent activity of recording sales before they are earned may show up as additional accounts receivable" (p.28).

Hence, it was used the **Accounts Receivable to Assets (ARTA)** ratio (Fanning & Cogger (1998), Kaminski, Wetzel & Guan (2004), and Borba & Wuerges (2014)). It is expected that firms with high ratios may be less financially secure, and more vulnerable to fraud (Borba & Wuerges (2014)).

An additional variable used to measure financial security was **Total Liabilities to Total Assets (TLTA)** ratio (Kaminski, Wetzel & Guan (2004), Ettredge, Sun, Lee & Anandarajan (2008), and Borba & Wuerges (2014)). A high ratio indicates that the shareholder equity is low relatively to total liabilities, therefore, it is expected a positive relationship between the ratio and FSF.

In order to measure efficiency, it was used the **Cost of Goods Sold to Sales (COGSSAL)** ratio, which demonstrates the resources required to produce sales (Kaminski, Wetzel & Guan (2004), and Borba & Wuerges (2014)). It is expected this ratio to be positively associated to the probability of fraud, since an increase in the ratio may be an indicator of a decrease in firm's capacity to compete (Borba & Wuerges (2014)).

Some other efficiency measures - to evaluate how well the firm manages its assets - were used, such as **Account Receivables Turnover in Days (ARTD)** (Gaganis (2009)), **Account Payables Turnover in Days (APTD), Inventory Turnover in Days (ITD)** and **Asset turnover (ASST),** all of them used by Arshad, Iqbal & Omar (2015).

As an attempt to include a measure of performance, since the FSF may be an alternative for poorly performing firms, it were included the **Return on Equity (ROE)** (Fanning & Cogger (1998), Ravisankar, Ravi, Rao & Bose (2011), and Arshad, Iqbal & Omar (2015))

and **Return on Assets (ROA)** ratios (Gaganis (2009), Ravisankar, Ravi, Rao, Bose (2011), and Borba & Wuerges (2014)), which capture the firm's ability to generate a return from its resources. It is expected both ratios to be negatively related do FSF.

In the same way, a decrease in profitability may create pressure which can led the firm to commit fraud. Therefore, it was used **the EBIT (Earnings Before Interest and Taxes) to Total Sales (EBITSAL)** ratio as a predictor of fraud (Borba & Wuerges (2014)). Therefore, it is expected a negative relation between this variable and FSF.

Following the same reasoning, it was used a **dummy for loss** (Krishnan & Krishnan (1996), Gaganis (2009), and Lou & Wang (2009)) that takes the value 1 if the firm reported loss in, at least, one of the analysed years, and takes the value 0 if that did not happen. It is expected this variable to be positively related to FSF.

3.1.4.2. Opportunity

The second dimension captures the perceived opportunity to commit fraud, typically when the agent is in a position of power and trust to do so. Therefore, it is anticipated that whenever exists the opportunity, the firm if more susceptible to FSF.

To capture the aspects of opportunity, it were used the indicators described as following.

Attempting to measure the impact of complex financial schemes on fraud, it was used the **Equity Investment (EINR)** ratio (Lou & Wang (2009)). A high ratio indicates a higher ownership by the firm's shareholders, and, instead, a low ratio may be an indicator of big debts.

The economic theory and corporate laws are not clear about the ideal structure and composition of the board of directors, which has led to a significant diversity. The results of Baysinger & Butler (1985) are an indicator that firms with highly average financial performance are prone to have more outside directors than firms with lower average performance. Therefore, to proper monitor the accounts and processes, it is essential that the board chairman position is separated from chief executive officer (CEO), since the aggregation of both in the same person may result on incentives to fraud (as cited in Lou & Wang (2009)).

Consequently, it was studied whether the board of directors is independent, for what was used a **dummy variable** that takes the value 1 if **the board of directors is not independent**, and takes the value 0 if that does not happen. It is expected a positive relation between this dummy variable and FSF.

3.1.4.3. Rationalization

The third dimension captures the rationalization of fraud, as an acceptance and justification of that behaviour.

To capture the aspects of rationalization, indicators were used as following.

According to Sorenson, Grove, & Selto (1983), a firm may change its auditor in order to reduce the probability of fraud detection (as cited in Lou & Wang (2009)). Thus, it was used a **dummy variable** that takes the value 1 if the **auditor changed** in the period, and takes the value 0 if that did not happen (Fanning & Cogger (1998), Borba & Wuerges (2009), and Gaganis (2009)).

However, it has to be taken into consideration the size of the auditor firm, since domestic (i.e. national) auditor firms may develop stronger relationships with the board of the audited firms (Gaganis (2009)). In this sense, it is expected a higher level of audit quality from bigger audit firms (i.e. international). Thus, it was used a **dummy variable** that takes the value 0 if the **auditor firm** is one of the **"Big 4"**, and 1 otherwise, similarly to what was done by the researchers such as Fanning & Cogger (1998), Ettredge, Sun, Lee & Anandarajan (2008), Gaganis (2009), and Ravisankar, Ravi, Rao & Bose (2011)). To note that "Big 4" is the name given to the four biggest auditor firms: EY, PwC, Deloitte, and KPMG.

	Ratio	Formula
Pressure		
	1 Current Ratio	$CR = \frac{\text{Current Assets}}{\text{Current Liabilities}}$
	2 Total Debt to Total Assets	$TDTA = \frac{\text{Total Debt}}{\text{Total Assets}}$
	3 Quick Ratio	$QR = \frac{\text{(Current Assets-Inventories)}}{\text{Current Liabilities}}$
	4 Cash to Total Assets	$CASHTA = \frac{\text{Cash}}{\text{Total Assets}}$
	5 Working Capital to Total Sales	$WCTS = \frac{\text{Working Capital}}{\text{Total Sales}}$
	6 Debt to Equity	$DEQ = \frac{\text{Total Liabilities}}{\text{Shareholder's Equity}}$
	7 Accounts Receivable to Assets	$ARTA = \frac{\text{Account Receivables}}{\text{Total Assets}}$
	8 Total Liabilities to Total Assets	$TLTA = \frac{\text{Total Liabilities}}{\text{Total Assets}}$
	9 Cost of Goods Sold to Sales	$COGSSAL = \frac{\text{COGS}}{\text{Sales}}$
	10 Account receivables turnover in days	$ARTD = \frac{\text{Account Receivables} * 365}{\text{Sales}}$
	11 Account payables turnover in days	$APTD = \frac{\text{Account Payables} * 365}{\text{Cost of Sales}}$
	12 Inventory turnover in days	$ITD = \frac{\text{Inventory} * 365}{\text{Cost of Sales}}$
	13 Asset turnover	$ASST = \frac{\text{Sales}}{\text{Total Assets}}$
	14 Return on Equity	$ROE = \frac{\text{Net profit}}{\text{Total Assets - Total Liabilities}}$
	15 Return on Assets	$ROA = \frac{\text{Net profit}}{\text{Assets}}$
	16 EBIT to Total Sales	$EBITSAL = \frac{\text{EBIT}}{\text{Sales}}$
	17 Dummy for loss	1 if reported loss in at least one year 0 Otherwise
Opportunity		
	18 Equity Investment Ratio	$EINR = \frac{\text{Total Shareholder Equity}}{\text{Total Assets}}$
	19 Dummy for independence	1 if the board is not independent 0 Otherwise
Rationalization		
	20 Dummy for auditor change	1 if the auditor changed in the period 0 Otherwise
	21 Dummy for auditor' size	1 if auditor is not a "Big 4" 0 Otherwise

FIGURE 4 - VARIABLES OF THE 'FINANCIAL RATIOS MODEL' AND ITS FORMULAS. SOURCE: THE AUTHOR.

3.2. Results

3.2.1 Beneish Model results

Profile analysis

The analysis will begin with the descriptive statistics that include a set of measures specifically measures of central tendency (mean and median), which help to describe the centre of distribution of the values of each respective variable in the sample used.

The following figure shows the summary statistics for the independent variables for both groups (manipulators and non-manipulators), in the two periods[14].

	Manipulators						Non-Manipulators					
Variables	Obs.	Mean	Median	Std. Deviation	Min.	Max.	Obs.	Mean	Median	Std. Deviation	Min.	Max.
					t-1 / t							
DSRI	7	1,06	1,00	0,37	0,65	1,81	7	0,92	0,90	0,08	0,82	1,06
GMI	7	0,96	0,97	0,10	0,75	1,05	7	1,00	1,00	0,03	0,96	1,05
AQI	7	1,14	0,97	0,31	0,93	1,63	7	1,10	1,05	0,27	0,83	1,67
SGI	7	1,43	1,16	0,77	0,83	3,08	7	1,17	1,06	0,36	0,89	1,96
DEPI	7	1,25	1,36	0,34	0,83	1,65	7	1,12	1,10	0,09	1,00	1,25
SGAI	7	1,07	0,99	0,29	0,66	1,60	7	1,02	1,06	0,16	0,73	1,22
LVGI	7	1,22	1,10	0,29	0,97	1,70	7	1,08	1,11	0,13	0,86	1,21
TATA	7	-0,07	-0,04	0,11	-0,32	0,01	7	-0,10	-0,07	0,07	-0,25	-0,03
					t / t+1							
DSRI	6	1,85	1,05	2,27	0,46	6,44	7	0,95	0,96	0,15	0,73	1,15
GMI	6	0,80	1,01	0,48	-0,16	1,04	7	1,34	0,98	0,91	0,89	3,39
AQI	6	0,97	0,90	0,45	0,29	1,49	7	1,23	0,99	0,71	0,55	2,75
SGI	6	0,98	1,04	0,39	0,29	1,43	7	1,05	1,00	0,12	0,94	1,27
DEPI	6	0,97	0,97	0,39	0,34	1,58	7	1,02	0,99	0,08	0,90	1,15
SGAI	6	1,30	0,98	1,01	0,46	3,29	7	1,08	1,11	0,08	0,96	1,20
LVGI	6	1,13	0,97	0,53	0,72	2,18	7	1,01	1,03	0,11	0,88	1,21
TATA	6	0,02	-0,03	0,16	-0,14	0,32	7	-0,11	-0,04	0,18	-0,52	0,00

FIGURE 5 - BENEISH MODEL DESCRIPTIVE STATISTICS. SOURCE: THE AUTHOR.

It has to be considered that the Company 9 is not part of the sample in the second period of calculation. The firm is classified as a "Manipulator Firm" and, as a consequence of the FSF event, the firm began an insolvency process after the year t, reason why there are no information regarding the period between year *t* and *t+1*.

Overall, it is notorious that the ratios deteriorate, on the whole, for both groups as it crosses the year of the FSF event, although the manipulator firms present more prominent results.

[14] To note that there are two periods in analyze: (*t-1 / t)* and *(t / t+1)*, in which t represents the year before it was made public that the company committed fraud, in order to maintain coherence throughout this study; *t-1*, that characterizes the period two years before the event; and, finally, *t+1* represents the year of the event in which it was made public the fraud.

As seen in the above figure, the value of **Days' Sales in Receivables Index** (**DSRI)** is higher for manipulator firms in both periods with an increasing trend, which may demonstrate problems in receivables collection by the manipulator firms. This result diverges from Güler, Emgin & Uçma (2013) but supports the findings of Beneish (1999).

From the viewpoint of **Gross Margin Index (GMI**), in the first period, the profit margin of the manipulator firms are lower compared to the non-manipulator firms, which is not supporting the assumption of Beneish (1999), but is supportive of the finding of Güler, Emgin & Uçma (2013). Moreover, for the second studied period, gross profit margins of the manipulator firms decreased, and increased for non-manipulator firms, indicating a decline in margins.

The **Asset Quality Ratio (AQI)** of manipulating entities in the first period is slightly higher than for non-manipulator entities, indicating that the first group have worse asset quality, which agrees with Beneish (1999) and Güler, Emgin & Uçma (2013). Nevertheless, in the second period, it showed a reverse trend, since AQI decreased for manipulator firms and increased for non-manipulator firms.

Sales Growth Index (SGI) is higher in the first period for the manipulator firms than for non-manipulator firms, which supports the findings of Beneish (1999), indicating a possible source of pressure to continue to follow a positive growth path. However, in the second period, this was not true.

Depreciation Index (DEPI), in the first period, supports the implication that manipulator firms make a higher effort relatively to the non-manipulator firms, to decrease depreciation and increase earnings, which is consistent with the results of Beneish (1999) and Güler, Emgin & Uçma (2013). However, in the second period, the value of the index decreased for both groups.

Selling, General and Administrative Expense Index (SGAI) is higher for manipulator firms in both periods, which is distinct from Beneish (1999) but consistent with Güler, Emgin & Uçma (2013). In addition, in the second period, the index for both groups increased, which may indicate a possible source of manipulation.

The Leverage Index (LVGI) is higher for manipulator firms in both periods in analyse. It supports the assumption of Beneish (1999) for manipulator firms and agrees with the results of the first period in the study of Güler, Emgin & Uçma (2013).

Total Accruals to Total Assets (TATA) is higher for manipulator firms in both periods, which agrees with Beneish (1999). Additionally, the value is negative for both groups in the first period, which supports the findings of Güler, Emgin & Uçma (2013). In the second period, non-manipulator firms continue to have negative mean values and manipulator firms have a positive value, however, near zero, which implies that the entities financed their operational capital through leverage.

Detailed analysis

The companies scoring the highest M-Score totals in ranking order are Company 9[15] (-1.38), Company 7 (-2.08) in the first period and, for the second period, Company 5 (-0.04), Company 7 (-0.56) and Company 6 (-1.41).

Moreover, it is possible to compare the results with the threshold suggested by Beneish (1999) for manipulators (1.47 for DSRI, 1.19 for GMI, 1.25 for AQI, 1.61 for SGI, 1.08 for DEPI, 1.04 for SGAI, 1.11 for LVGI, and 0.03 for TATA), and for non-manipulators (1.03 for DSRI, 1.01 for GMI, 1.04 for AQI, 1.13 for SGI, 1.00 for DEPI, 1.05 for SGAI, 1.4 for LVGI, and 0.018 for TATA) (as cited in Kamal, Salleh, Ahmad, 2016).

	Variables								
Company	DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA	M-score
					t-1 / t				
1	1,0933	1,0517	0,9859	0,9291	0,9638	0,6563	1,0100	-0,0564	-2,6480
2	1,0601	0,9797	1,0168	0,9772	1,0541	1,0178	0,9909	-0,0321	-2,5930
3	1,1026	0,9668	0,9663	0,8276	1,5695	1,2143	0,9711	0,0061	-2,5040
4	0,9997	1,0473	1,0751	1,0620	0,9981	1,0582	1,1142	-0,0968	-2,8701
5	0,9262	0,9911	0,9567	1,0676	0,9099	0,9857	0,9975	0,0076	-2,4814
6	0,8987	1,0259	1,0543	1,1001	1,0414	0,9342	1,2054	-0,0681	-2,8177
7	0,9968	0,9671	1,6299	3,0791	1,6540	1,5995	1,5341	-0,3185	-2,0842
8	0,8913	0,9602	1,0917	1,9552	1,1799	0,7325	1,1868	-0,2472	-2,8630
9	1,8070	0,9406	1,5470	1,5972	1,4624	0,9720	1,6956	-0,0422	-1,3821
10	0,8153	1,0057	0,9444	0,8857	1,0957	1,0583	1,1740	-0,0638	-3,1259
11	0,6519	0,7454	0,9328	1,3783	1,3646	1,0657	1,2418	-0,0174	-2,7542
12	0,9278	1,0015	1,6690	1,1800	1,1926	1,1350	0,8562	-0,1446	-2,7452
13	0,8569	1,0424	0,9587	1,1325	1,0344	0,7898	1,1643	-0,0196	-2,5932
14	0,8218	1,0289	0,9312	1,1562	0,8344	0,9641	1,1007	-0,0853	-2,9620
					t / t+1				
1	1,0800	1,0218	0,8401	1,0668	0,9540	1,1367	1,0563	-0,0255	-2,5665
2	1,1050	0,9835	0,9714	0,9953	1,0912	1,0125	0,9661	-0,0386	-2,5692
3	1,0156	1,0167	1,4877	1,1911	1,0069	0,9207	0,7204	-0,0261	-2,1054
4	0,9883	1,2142	1,2602	1,0596	0,9007	1,2029	1,0449	0,0018	-2,2718
5	6,4440	-0,1617	0,2922	0,2875	0,9671	3,2949	2,1827	-0,0535	-0,0418
7	0,8842	0,9068	0,9514	1,4316	1,5825	0,4580	0,9033	0,3230	-0,5674
8	0,8568	0,8915	2,7525	1,2722	0,9933	1,1092	0,8839	-0,5190	-4,1284
10	1,1546	1,0393	1,1368	0,9388	1,1520	0,9599	1,0756	-0,0062	-2,3457
11	0,4626	1,0086	1,4638	1,0138	0,3359	0,9240	1,0321	-0,1389	-3,4940
12	0,7266	0,9710	0,5529	1,1114	1,0033	1,1063	1,2109	-0,0998	-3,3821
13	1,2064	1,0221	0,9896	0,9518	1,0347	1,0267	1,0785	-0,1629	-3,1142
14	1,1871	1,0356	0,7719	0,8945	0,9642	1,0393	0,8848	0,0265	-2,3245

FIGURE 6 - MEAN VALUES OF THE VARIABLES AND M-SCORE. SOURCE: THE AUTHOR.

[15] It has to be considered that the Company 9 is not part of the sample in the second period of calculation. The firm is classified as a "Manipulator Firm" and, as a consequence of the fraud event, the firm began an insolvency process after the year t, reason why there are no information regarding the period between year *t* and *t+1*.

To note that the firms that exceeded the defined threshold in more variables are the ones highlighted before as having the higher M-Score, which may indicate possible harsh earnings manipulation.

Including, for the first period: Company 7 in Asset Quality Index (AQI=1.62), Sales Growth Index (SGI=3.07), Depreciation Index (DEPI=1.65), Sales, General and Administrative Expense Index (SGAI=1.59), and Leverage Index (LVGI=1.53), and Company 9 in Days' Sales in Receivables Index (DSRI=1.80), Asset Quality Index (AQI=1.54), Depreciation Index (DEPI=1.46), and Leverage Index (LVGI=1.69).

Similarly, for the second period: Company 5 in Days' Sales in Receivables Index (DSRI=6.44), Sales, General and Administrative Expense (SGAI=3.29), and Leverage Index (LVGI=2.18), Company 6 in Gross Margin Index (GMI=3.38), and Sales, General and Administrative Expense Index (SGAI= 1.045), and Company 7 in Depreciation Index (DEPI=1.58), and Total Accruals to Total Assets (TATA=0.32).

Additionally, it is possible to state that the variables in which the firms exceeded more the defined threshold suggested by Beneish (1999) were, for the first period, DEPI (10 out of 14, 71.43%), LVGI (8 out of 14, 57.14%), SGAI (7 out of 14, 50%), and AQI (6 out of 14, 42.86%); and, for the second period, SGAI (6 out of 13, 46.15%), AQI (5 out of 13, 38.46%), and DEPI (4 out of 13, 30.77%).

Nevertheless, it has to be considered that this comparison increases its strength when compared with the overall score results and interpretation. Therefore, the main factors possible to highlight as the global sources of manipulation in this sample are the techniques used for decreasing depreciation that results in increased earnings, and incomparable high values of sales.

Model Performance

		Predicted		
		MANIPULATION		Percentage Correct
Observed		No	Yes	
		(t-1 / t)		
MANIPULATION	No	7	0	100,0
	Yes	5	2	28,6
Overall Percentage				64,3
		(t / t+1)		
MANIPULATION	No	6	1	85,6
	Yes	3	3	50,0
Overall Percentage				69,2

FIGURE 7- PERFORMANCE OF THE ORIGINAL BENEISH MODEL. SOURCE: THE AUTHOR.

Based on the above figure, it is clear that, in the first period *(t-1 /t*), 64.29% (9 out of 14) of the firms in analyse were correctly classified, i.e., manipulators were classified as manipulators and non-manipulators classified as non-manipulators. However, the Type

of Error I[16] happened in 35.71% (5 out of 14) of the cases. For the second period *(t / t+1)*, 69.23% (9 out of 13) of the firms in analyse were properly classified. However, 23.08% (3 out of 13) manipulator firms were classified as non-manipulators, and 7.69% (1 out of 13) non-manipulators were classified as manipulators[17].

Furthermore, by using a cut-off point of -2.22 it will be ensured fraudulent firms to be detected at 64.29% and 69.23% accuracy, in the first and second period, respectively. Using different cut-off as the ones used by Kamal, Salleh, Ahmad (2016), i.e. -1.78 and -1.89, the model would perform in the same way – the resulting accuracy rate would be exactly the same. Overall, it is possible to state that the model performs better in classifying 'Non-Manipulators' than classifying 'Manipulators', although, the final accuracy rate is satisfactory. However, the accuracy rate is lower than the value achieved by Beneish (1999) of 76% and 71% of Beneish, Lee and Nichols (2013). Nevertheless, this finding supports the idea that the Beneish Model is reliable in detecting the majority of companies committing Financial Statement Fraud.

Additionally, it was computed the Pearson Correlation Matrix[18] which gave indications of possible multicollinearity problems between the variables. This was confirmed in additional tests (VIF[19] and TOL[20]) (see Appendix 1). Therefore, there are strong linear correlations between the different variables, reason why it was performed a Principal Components Analysis (PCA)[21] (see appendix 1.1). From this resulted 4 factors that account for 89,142% of the variance explained, which are composed by: Factor 1, SGAI, DSRI, and LVGI; Factor 2, TATA, and AQI; Factor 3, DEPI, and SGI; and Factor 4, GMI. After the re-estimation of the model[22], just the Factor 4 demonstrated to be statistically significant in explaining the dependent variable, which led to a poor model performance (see Appendix 1.2).

[16] The Type of Error I is considered to be a misclassification of the firms such as classifying manipulator firms as non-manipulators firms.

[17] Classifying as non-manipulator a firm that, in fact, is a manipulator gives rise to the Type of Error II.

[18] The matrix allows to compare the level of correlation (between -1 and1) and the direction (if positive or negative) of the relationship between the variables. The higher the coefficient, the greater the interrelation between the variables.

[19] Variance Inflation Factor (VIF) shows in which extent a variable is explained by the other variables, which may inflate the variance of the estimator. It is common practice to consider that a VIF higher than 10 indicates that are thoughtful collinearity problems between the variables.

[20] Tolerance (TOL) is considered to be the inverse of VIF. Therefore, a value of TOL lower than 0.1 indicates that there are serious problems of correlation between the variables.

[21] The Principal Components Analysis replaces the initial variables by a smaller number of new dimensions, which are not correlated with each other, i.e. principal components.

[22] The re-estimation of the model was done through a Backward Logistic Regression. The method removal testing is based on the probability of the likelihood-ratio statistic based on the maximum partial likelihood estimates.

3.2.2. Altman Model results

Profile analysis

This chapter includes the profile analysis of the different variables of the Altman Model. The following figure demonstrates the summary statistics for both groups, in the three periods of analyse[23].

	Manipulators						Non-Manipulators					
Variables	Obs.	Mean	Median	Std. Deviation	Min.	Max.	Obs.	Mean	Median	Std. Deviation	Min.	Max.
						t						
WCTA	7	0,06	0,04	0,17	-0,12	0,37	7	-0,03	-0,07	0,15	-0,14	0,31
RETA	7	0,11	0,10	0,24	-0,32	0,45	7	0,12	0,26	0,36	-0,64	0,40
EBITTA	7	0,07	0,05	0,10	-0,07	0,25	7	0,05	0,05	0,07	-0,01	0,19
MVEBVTL	7	0,04	0,03	0,03	0,01	0,10	7	0,31	0,05	0,66	0,03	1,80
SALTA	7	1,01	0,74	0,78	0,30	2,58	7	0,96	0,71	0,68	0,29	1,80
						t-1						
WCTA	7	0,08	0,03	0,26	-0,13	0,63	7	0,01	-0,05	0,15	-0,10	0,34
RETA	7	0,14	0,15	0,18	-0,21	0,35	7	0,10	0,13	0,35	-0,60	0,47
EBITTA	7	0,11	0,08	0,07	0,04	0,22	7	0,09	0,08	0,06	0,02	0,20
MVEBVTL	7	0,13	0,04	0,26	0,01	0,73	7	0,34	0,05	0,71	0,04	1,95
SALTA	7	0,93	0,79	0,57	0,28	1,93	7	0,95	0,65	0,69	0,30	1,74
						t-2						
WCTA	7	0,06	-0,02	0,20	-0,12	0,49	7	-0,01	-0,07	0,16	-0,15	0,29
RETA	7	0,12	0,09	0,08	0,04	0,24	7	0,09	0,10	0,32	-0,53	0,51
EBITTA	7	0,08	0,07	0,05	0,02	0,17	7	0,07	0,06	0,05	-0,01	0,12
MVEBVTL	7	0,09	0,04	0,15	0,01	0,43	7	0,46	0,05	0,99	0,04	2,70
SALTA	7	0,87	0,71	0,51	0,17	1,63	7	0,99	0,71	0,67	0,31	1,79

FIGURE 8 - ALTMAN MODEL DESCRIPTIVE STATISTICS SOURCE: THE AUTHOR.

In general, for both groups, the ratios deteriorate as it comes closer to the year of manipulation. Nevertheless, it is clear that there is a change in the trajectory between *t-1* and *t* that ends in the results exposed in the figure 8.

However, even with similarities in the trend, there are differences between the two groups.

Working Capital to Total Assets (WCTA) measures the ability of the firm to address its short term financial obligations, which, unexpectedly, has higher mean values in all three years for the manipulator firms.

Retained Earnings to Total Assets (RETA) tests the way the firm have financing its activity, which presents higher values for manipulator firms than non-manipulators in *t-2* and *t-1*, but not for year *t*, since there is a decreasing trend between *t-1* and *t* for manipulators, and, in the same period, an increasing trend for non-manipulators.

[23] To note that there are three years in analyze*: t, t-1*, and *t-2*. The year *t* represents the year before it was made public that the company committed fraud; *t-1* depicts the period two years before the event; and, finally, *t-2* represents the period three years before the fraud event.

Therefore, a decreasing trend of this ratio value may indicate possible problems with firms' profitability and, consequently, a possible source of bankruptcy.

EBIT to Total Assets (EBITTA) measures the productivity of firm assets before any contractual obligation to be paid. The ratio has, in the three years, higher values for manipulators than for non-manipulators. The ratio was following a growing trend for both groups, and between *t-1* and *t*, the ratio decreased for both groups. Nevertheless, the higher decreasing was for manipulators group and, therefore, this group of firms started to be less effective using its assets.

Market Value of Equity to Book Value of Total Liabilities (MVEBVTL) has, in all years, values considerably higher for non-manipulator firms, in which the most significant difference happened in *t-2*. Additionally, manipulator firms' value decreased from *t-1* to *t*, which reflects a negative market reaction to the financial position of that group of firms.

Sales to Assets (SALTA) is a measure of efficiency in the use of assets in generating revenue. The ratio has higher values for non-manipulators both in *t-2* and *t-1*, however, in year *t*, the value for manipulators was higher. Therefore, during *t-2* and *t-1*, non-manipulator firms were performing better.

In general, manipulator firms' group presented a good capability to address its financial obligations, productivity of its assets and profitability over time.

The standard deviation of the variables is reasonably small for both groups. However, note that all variables have higher standard deviation for non-manipulator firms than for manipulator firms, except for WCTA and EBITTA in all years. Therefore, the group of manipulator firms is more consistent among itself than the group of non-manipulator firms.

Detailed analysis

The companies scoring the smallest Z-Score totals in ranking order are: in year *t*, Company 10 (-0.66), Company 11 (0.12), Company 12 (0.39) and Company 7 (0.87); in year *t-1*, Company 10 (-0.36), Company 11 (0.57), Company 12 (0.61); and, in year *t-2*, Company 10 (-0.36), Company 11 (0.61), Company 12 (0.66), and Company 5 (0.98). Therefore, the results are robust over the years.

According to the results, in year *t* and *t-1*, 57.14% (8 out of 14) of the firms are considered to be on the distress zone, i.e., will bankrupt, from which 62.5% (5 out of 8) were classified as manipulators. However, in year *t*, 1 firm was considered to be in the safe zone, i.e. will not bankrupt (which was classified as manipulator), and 5 firms in the gray zone, i.e. the zone of ignorance. Contrary, in *t-1*, 2 firms were considered to be in the safe zone (1 classified as manipulator and 1 classified as non-manipulator), and 4 firms in the gray zone.

In year *t-2*, 64.29% (9 out of 14) of the firms were considered to be on the distress zone, from which 55.56% (5 out of 9) were classified as manipulators, 1 firms were considered to be in the safe zone (classified as non-manipulator), and 4 firms were in the gray zone.

Overall, the model holds a higher performance accuracy[24] in the periods of two years (*t-1*) and three years (*t-2*) prior the event of fraud.

	Variables					
Company	WCTA	RETA	EBITTA	MVEBVTL	SALTA	Z-score
			t			
1	-0,1176	0,2128	0,0473	0,0103	1,2947	1,6137
2	-0,0790	0,1492	0,0501	0,0532	1,7985	2,1099
3	0,1019	0,2346	0,0800	0,0296	0,6013	1,3337
4	-0,1345	0,4002	-0,0088	0,0310	1,6479	2,0364
5	0,1479	0,1013	0,0527	0,0716	0,7352	1,2713
6	0,3079	0,3581	0,0773	1,8015	0,7081	2,9148
7	0,0371	0,0741	0,1108	0,1002	0,3015	0,8757
8	-0,0671	0,3072	0,1895	0,0641	0,4195	1,4326
9	0,3720	0,4525	0,2485	0,0108	1,1280	3,0347
10	-0,0568	-0,6399	-0,0134	0,0458	0,3180	-0,6628
11	-0,0897	0,0141	-0,0694	0,0430	0,4182	0,1272
12	-0,0455	0,0220	0,0130	0,1359	0,2941	0,3947
13	-0,0522	-0,3191	0,0096	0,0138	2,5816	2,1122
14	-0,1366	0,2638	0,0635	0,0504	1,5626	2,0079
			t-1			
1	-0,1258	0,2377	0,0811	0,0098	1,2715	1,7267
2	-0,0480	0,1257	0,0241	0,0483	1,7400	1,9669
3	0,0590	0,2313	0,0831	0,0356	0,7852	1,4752
4	-0,0942	0,4691	0,0903	0,0380	1,7209	2,5855
5	0,0756	0,0901	0,0445	0,0736	0,7168	1,1246
6	0,3414	0,1346	0,2021	1,9469	0,6489	3,0822
7	-0,0777	0,1397	0,1923	0,7251	0,3900	1,5622
8	0,0315	0,3061	0,0973	0,1172	0,3034	1,1611
9	0,6331	0,3489	0,2242	0,0232	1,1345	3,1366
10	-0,0291	-0,6049	0,0445	0,0511	0,3373	-0,3668
11	-0,0469	0,1514	0,0367	0,0394	0,2761	0,5767
12	-0,0557	0,0032	0,0835	0,1116	0,3316	0,6117
13	0,0263	-0,2141	0,0755	0,0130	1,9258	1,9145
14	-0,1007	0,2843	0,0545	0,0547	1,5521	2,0420
			t-2			
1	-0,1243	0,2413	0,0849	0,0117	1,2921	1,7678
2	-0,1452	0,1042	-0,0130	0,0429	1,7224	1,6768
3	0,0586	0,2237	0,0684	0,0489	0,6063	1,2449
4	-0,0995	0,5065	0,0989	0,0457	1,7916	2,7351
5	-0,0206	0,0846	0,0416	0,0778	0,7114	0,9890
6	0,2911	0,0217	0,1015	2,6962	0,7131	3,0455
7	0,0640	0,0937	0,1202	0,4275	0,1749	1,0360
8	0,1135	0,2584	0,1218	0,1545	0,4620	1,4548
9	0,4940	0,1074	0,1732	0,0297	1,1716	2,5043
10	-0,0675	-0,5283	0,0354	0,0535	0,3075	-0,3643
11	-0,0171	0,0394	0,0179	0,0396	0,5005	0,6181
12	-0,0329	0,0167	0,0636	0,1585	0,3792	0,6682
13	-0,0542	0,0453	0,0704	0,0123	1,6288	1,8670
14	-0,1429	0,2702	0,0585	0,0530	1,5523	1,9840

FIGURE 9- ALTMAN MODEL MEAN VALUES AND Z-SCORES. SOURCE: THE AUTHOR.

[24] The performance of the Altman Model, in this dissertation, is taken into account as mere indicative. This is because the model itself aims to study bankruptcy and, not necessarily, fraud. Although the phenomena in some cases are related, identifying firms that have committed fraud as bankruptcy firms would not be coherent at all or even true. However, it will be used in this study since some of the variables are prone to add value to our study.

Additionally, it was determined the Pearson Correlation Matrix which demonstrated that the variables are little or not related at all, showing no indication of multicollinearity problems on the model (see appendix 2). Therefore, the re-estimation[25] of the model showed that only two of the variables are statistically significant explaining the dependent variable in the sample in question: WCTA and MVEBVTL (see Appendix 2.1).

3.2.3. Ohlson Model results

Profile analysis

In order to analyse the profile of both groups (manipulators and non-manipulator firms), the mean and standard deviation of all ratios were computed for each separately year in analyse. Thus, even though it is not a predictive test, this analyse is a way to understand the relation between both groups (Beaver, 1966).

The following figure exhibits the summary statistics for the three periods of analysis[26].

[25] The re-estimation of the model was done through a Backward Logistic Regression. The method removal testing is based on the probability of the likelihood-ratio statistic based on the maximum partial likelihood estimates.

[26] To note that there are three years in analyze: *t*, *t-1*, and *t-2*. The year *t* represents the year before it was made public that the company committed fraud; *t-1* depicts the period two years before the event; and, finally, *t-2* represents the period three years before the fraud event.

	Manipulators						Non-Manipulators					
Variables	Obs.	Mean	Median	Std. Deviation	Min.	Max.	Obs.	Mean	Median	Std. Deviation	Min.	Max.
						t						
SIZE	7	6,95	7,21	1,09	5,21	8,38	7	7,32	7,33	0,84	6,17	8,43
TLTA	7	0,71	0,67	0,20	0,41	1,01	7	0,58	0,56	0,11	0,48	0,80
WCTA	7	0,06	0,04	0,17	-0,12	0,37	7	-0,03	-0,07	0,15	-0,14	0,31
CLCA	7	0,94	0,85	0,38	0,40	1,45	7	1,31	1,44	0,52	0,29	2,01
OENEG	7	0,14	0,00	0,38	0,00	1,00	7	0,00	0,00	0,00	0,00	0,00
ROA	7	0,03	0,03	0,09	-0,10	0,18	7	0,03	0,03	0,04	-0,02	0,11
FUTL	7	0,15	0,09	0,20	0,02	0,60	7	0,13	0,12	0,12	-0,08	0,33
INTWO	7	0	0	0	0	0	7	0	0	0	0	0
CHIN	7	0,18	0,15	0,33	-0,37	0,71	7	-0,18	-0,26	0,46	-0,83	0,56
						t-1						
SIZE	7	6,86	7,15	1,24	5,02	8,41	7	7,58	7,36	1,24	6,03	9,66
TLTA	7	0,63	0,64	0,25	0,31	1,00	7	0,54	0,51	0,13	0,44	0,81
WCTA	7	0,08	0,03	0,26	-0,13	0,63	7	0,01	-0,05	0,15	-0,10	0,34
CLCA	7	0,97	0,92	0,43	0,20	1,50	7	1,13	1,20	0,47	0,28	1,74
OENEG	7	0,00	0,00	0,00	0,00	0,00	7	0,00	0,00	0,00	0,00	0,00
ROA	7	0,07	0,04	0,06	0,02	0,17	7	0,06	0,05	0,04	0,03	0,14
FUTL	7	0,25	0,11	0,28	0,04	0,76	7	0,23	0,24	0,11	0,07	0,35
INTWO	7	0	0	0	0	0	7	0	0	0	0	0
CHIN	7	0,16	0,07	0,17	0,00	0,40	7	0,27	0,44	0,33	-0,12	0,65
						t-2						
SIZE	7	6,73	7,11	1,25	4,73	8,10	7	7,20	7,32	0,92	5,67	8,20
TLTA	7	0,68	0,66	0,21	0,38	1,00	7	0,55	0,52	0,14	0,44	0,84
WCTA	7	0,06	-0,02	0,20	-0,12	0,49	7	-0,01	-0,07	0,16	-0,15	0,29
CLCA	7	0,95	1,04	0,36	0,32	1,49	7	1,20	1,36	0,52	0,30	1,74
OENEG	7	0,00	0,00	0,00	0,00	0,00	7	0,00	0,00	0,00	0,00	0,00
ROA	7	0,06	0,05	0,04	0,02	0,13	7	0,04	0,04	0,02	0,01	0,07
FUTL	7	0,16	0,10	0,15	0,06	0,49	7	0,20	0,23	0,13	-0,02	0,40
INTWO	7	0	0	0	0	0	7	0	0	0	0	0
CHIN	7	0,21	0,17	0,19	0,06	0,62	7	-0,16	-0,17	0,14	-0,30	0,06

FIGURE 10 - OHLSON MODEL DESCRIPTIVE STATISTICS. SOURCE: THE AUTHOR.

Similarly to the Altman Model analysis, in the Ohlson Model the same years (from *t-2* to *t*) will be analysed.

In a general way, for both groups, the ratios deteriorate as it approximates the year of bankruptcy. However, a decreasing trend between *t-1* and *t* is clear, which was also noted in the analysis of the Altman Model.

To note that both groups hold very different values in the ratios, inclusively in the mean **SIZE** of the firms that belong to both groups, which is in the three years higher for non-manipulator firms. However, consider that the manipulator firms' mean size increased throughout the three years, and the non-manipulator firms' mean size followed the trend and decreased between *t-1* and *t*.

Total Liabilities to Total Assets (TLTA) tests how much are the assets of the firms constituted by liabilities. The ratio presents higher values for manipulator firms in all three years, which may indicate a possible source of bankruptcy.

Working Capital to Total Assets (WCTA) helps analysing the amount of assets necessary for the daily operations of the firm. Surprisingly, the ratio has in all the three years a higher mean value for manipulator firms than for non-manipulator firms, which

may be justified by the way the firm realizes its revenues from sales and does its payments to suppliers.

Current Liabilities to Current Assets (CLCA) analyses the capability of the firm to pay off its current obligations through its most liquid assets. The mean value for non-manipulator firms is higher for the three years, which diagnoses that manipulator firms are in worse financial health.

Return on Assets (ROA) measures the profitability of the firm relatively to its assets. The ratio is higher for manipulator firms in all the three years, which means that this group of firms is earning more money on less investment.

Funds from operations to Total Liabilities (FUTL) is a measure of firm leverage. In year *t* and *t-1*, the ratio has higher values for manipulator firms, which means that they are in a better situation to pay its financial obligations from its operating earnings.

Net Income Change (CHIN) captures the changes in net income. The ratio is higher for manipulator firms than for non-manipulator firms in year *t-2* and *t*, which shows that in those two years, manipulator firms were more capable of earning more comparatively to the year before. However, in year *t-1*, the reality was different, with a decrease in the earnings of the manipulator firms.

Globally, the manipulator firms are considered to have poor financial health and a large proportion of its assets composed by liabilities, however, they are considered to earn, on average, more money from few investments and to have a positive change in net income between the analysed years.

The standard deviation is, for the majority of the variables, higher for the group of manipulator firms than for non-manipulator firms, excepting CLCA in all three years, and CHIN in years *t* and *t-1*. Therefore, the group of non-manipulator firms is considered to be more consistent, contrasting with a more dispersive group (with larger differences) for manipulator firms. Besides that, the values of the standard deviation are reasonably small for all variables for both groups, except for SIZE, since there are considerable differences in the size of the different firms of the groups.

The trend of the results are, overall, quite consistent with the work of Grice and Dugan (2003), except for some isolated situations such as: WCTA and ROA in all three years, and FUTL and CHIN in *t-2* and *t*.

Concluding, there is a significate deterioration between the three years before the manipulation event, the groups are quite consistent among themselves but there are signposted differences between both groups.

Detailed Analysis

The companies scoring the highest O-Score totals in ranking order are: in year *t*, Company 11 (0.78), Company 2 (0.74), Company 13 (0.64), and Company 5 (0.60); in year *t-1*, Company 11 (0.77), Company 5 (0.56), and Company 13 (0.53); and, in year *t-2*, Company 13 (0.77), Company 2 (0.59), and Company 5 (0.50). Thus, the results are consistent over the years in analyse.

Therefore, in year *t*, 28.57% (4 out of 14) of the firms were considered to go into bankruptcy, from which 75% (3 out of 4) were labelled as manipulators. And, in the same year, 71.43% (10 out of 14) of the firms were considered to be in a safe position, from which 60% (6 out of 10) it was really the case.

In year *t-1* and *t-2*, 21.43% (3 out of 14) of the firms were classified as going into bankruptcy and 78.57% (11 out of 14) were considered to be in a safe position. However, in year *t-1*, 100% (3 out of 3) of the firms that were in a bankruptcy position were classified as manipulators and 63.64% (7 out of 11) of the firm as being in a safe position were classified as non-manipulators. Contrary, in year *t-2*, the values are 66.67% (2 out of 3) and 54.55% (6 out of 11), respectively.

Thus, the model holds more accurate results[27] in year t and *t-1*, being *t* the previous year to finding out that the firms committed FSF.

Furthermore, the Pearson Correlation Matrix was computed which gave indications of possible multicollinearity problems, which was confirmed with the VIF and TOL tests (see appendix 3). Thus, strong linear correlations between some of the variables were found, reason why it was performed a PCA (see Appendix 3.1). The test resulted in three factors which account for 82,149% of the variance explained. Factor 1 is composed by NITA, FUTL, and TLTA; Factor 2 is composed by CLCA, WCTA, and SIZE; and Factor 3 by CHIN, and OENEG. INTWO was excluded of the analysis since its values were constant. In addition, it was performed a stepwise logistic regression[28], which showed that just two out of the three factors are statistically significant in explaining the dependent variable: Factor 2 and Factor 3 (see appendix 3.2).

[27] The performance of the Ohlson Model, in this dissertation, is taken into account as a mere indicative. This is because, the model itself aims to study bankruptcy and, not necessarily, fraud. Although the phenomena in some cases are related, identifying firms that have committed fraud as bankruptcy firms would not be coherent at all or even true. However, it will be used in this study since some of the variables are prone to add value to our study.

[28] The re-estimation of the model was done through a Backward Logistic Regression. The method removal testing is based on the probability of the likelihood-ratio statistic based on the maximum partial likelihood estimates.

	Variables										
Company	SIZE	TLTA	WCTA	CLCA	OENEG	ROA	FUTL	INTWO	CHIN	O-score	P
						t					
1	7,6957	0,6572	-0,1243	1,4939	0	0,0610	0,1376	0	0,0669	-0,6288	0,3478
2	7,6486	0,8384	-0,1452	1,3559	0	0,0086	-0,0206	0	-0,1687	1,0383	0,7385
3	7,1073	0,5948	0,0586	0,8177	0	0,0422	0,0937	0	0,1939	-1,0203	0,2650
4	7,0672	0,4475	-0,0995	1,7421	0	0,0688	0,2273	0	0,0584	-1,8329	0,1379
5	6,2960	0,7246	-0,0206	1,0449	0	0,0179	0,0567	0	0,0605	0,4177	0,6029
6	6,3981	0,4383	0,2911	0,3027	0	0,0691	0,2348	0	-0,3039	-2,1097	0,1082
7	5,5337	0,5050	0,0640	0,7869	0	0,0829	0,1626	0	0,6238	-1,3781	0,2013
8	5,6658	0,5880	0,1135	0,6512	0	0,0372	0,3994	0	-0,1192	-0,9500	0,2789
9	4,7343	0,3827	0,4940	0,3190	0	0,1268	0,4883	0	0,1692	-2,9035	0,0520
10	8,1959	0,4592	-0,0675	1,5924	0	0,0568	0,2386	0	-0,0313	-2,2242	0,0976
11	8,0957	1,0000	-0,0171	1,0378	0	0,0173	0,0595	0	0,1217	1,3051	0,7867
12	8,1105	0,5231	-0,0329	1,2681	0	0,0134	0,1986	0	-0,2832	-1,5708	0,1721
13	7,6495	0,8732	-0,0542	1,1533	0	0,0480	0,0987	0	0,2226	0,5865	0,6426
14	7,3230	0,5474	-0,1429	1,4649	0	0,0332	0,1342	0	-0,2641	-0,8703	0,2952
						t-1					
1	7,7788	0,6420	-0,1258	1,4965	0	0,0573	0,1338	0	0,0651	-0,7358	0,3239
2	9,6581	0,8146	-0,0480	1,1093	0	0,0292	0,0693	0	0,5302	-0,6583	0,3411
3	7,1502	0,6001	0,0590	0,8044	0	0,0430	0,1023	0	0,0084	-0,9281	0,2833
4	7,0581	0,5069	-0,0942	1,7392	0	0,0638	0,1932	0	-0,0445	-1,3504	0,2058
5	6,3390	0,7266	0,0756	0,8454	0	0,0176	0,0601	0	0,0172	0,2770	0,5688
6	6,4631	0,4742	0,3414	0,2756	0	0,1371	0,3481	0	0,4351	-2,7474	0,0602
7	5,6028	0,3382	-0,0777	1,3719	0	0,1356	0,5386	0	0,3640	-2,8427	0,0551
8	6,0304	0,4981	0,0315	0,8363	0	0,0422	0,3458	0	0,5021	-1,7465	0,1485
9	5,0162	0,3099	0,6331	0,2042	0	0,1690	0,7620	0	0,4045	-4,3884	0,0123
10	8,2120	0,4387	-0,0291	1,1998	0	0,0501	0,2443	0	-0,0438	-2,4269	0,0811
11	8,4124	1,0000	-0,0469	1,1852	0	0,0153	0,0420	0	0,2326	1,2090	0,7701
12	8,2962	0,5628	-0,0557	1,4126	0	0,0480	0,2722	0	0,6509	-2,0670	0,1123
13	7,6947	0,8031	0,0263	0,9165	0	0,0432	0,1149	0	0,0045	0,1078	0,5269
14	7,3564	0,5140	-0,1007	1,3146	0	0,0253	0,1298	0	-0,1172	-1,2071	0,2302
						t-2					
1	7,7353	0,6722	-0,1176	1,4497	0	0,0287	0,0873	0	-0,3723	-0,1701	0,4576
2	7,6162	0,7983	-0,0790	1,1856	0	0,0320	0,0836	0	0,0179	0,3591	0,5888
3	7,2104	0,5703	0,1019	0,6884	0	0,0543	0,1209	0	0,1534	-1,3391	0,2077
4	7,0736	0,5579	-0,1345	2,0091	0	-0,0226	-0,0765	0	-0,4352	-0,0695	0,4826
5	6,3354	0,7169	0,1479	0,7094	0	0,0227	0,0695	0	0,1468	0,0092	0,5023
6	6,4055	0,5092	0,3079	0,2943	0	0,0494	0,1549	0	-0,4670	-1,4320	0,1928
7	6,1939	0,6607	0,0371	0,8539	0	0,0727	0,1008	0	0,3617	-0,3902	0,4037
8	6,1725	0,6462	-0,0671	1,4351	0	0,1051	0,3348	0	0,5580	-0,8831	0,2925
9	5,2062	0,4121	0,3720	0,4006	0	0,1783	0,6048	0	0,2581	-3,1192	0,0423
10	8,1812	0,5211	-0,0568	1,3408	0	0,0050	0,1153	0	-0,8286	-1,1154	0,2469
11	8,3755	1,0134	-0,0897	1,3231	1	-0,0991	0,0392	0	0,7107	-0,3162	0,4216
12	8,4274	0,4812	-0,0455	1,4391	0	-0,0210	0,1489	0	-0,2635	-1,7591	0,1469
13	7,5932	0,8902	-0,0522	1,1631	0	-0,0477	0,0196	0	-0,0235	1,2104	0,7704
14	7,3289	0,5598	-0,1366	1,4676	0	0,0332	0,1204	0	0,1343	-0,9893	0,2711

FIGURE 11 - MEAN VALUES OF THE OHLSON MODEL, O-SCORE AND ITS PROBABILITY. SOURCE: THE AUTHOR.

3.2.4 Financial Ratios Model results

Profile analysis

In this section, it will be made a descriptive analysis to the variables of the model, as previously done with the other models. A decreasing trend for both groups was noted between *t-1* and *t*, similarly to what was identified before (see appendix 4).

Current Ratio (CR) although the value for this ratio is higher than 1 for both groups, it is higher for manipulator firms than for non-manipulator in the three years of analysis, which demonstrates that this group of firms have an increasing capacity to pay its financial obligations. Additionally, in the year before the event *(t)*, the standard deviation was smaller for manipulator than for non-manipulator firms, which demonstrates that the manipulator firms' group is quite cohesive.

Total Debt to Total Assets (TDTA) is higher for manipulators than for non-manipulators' group in the three years, which reflects an increasing proportion of assets built through liabilities. However, it is possible to state that the decreasing trend between *t-1* and *t* affects the manipulator firms.

Quick Ratio (QR) measures the short term liquidity of the firms. The ratio of manipulator firms is higher in the three years of analyse, which illustrates, on average, a good liquidity position of the firms of that group.

Cash to Total Assets (CASHTA) demonstrates the aptitude of the firm's assets in generating cash. Even with similar values on average between both groups, the ratio is higher for non-manipulator firms in *t-2* and *t-1*. However, in the previous year to the event *(t)*, the group of manipulator firms demonstrated an increasing capability.

Working Capital to Total Sales (WCTS) is a measure of liquidity, which illustrates the part of the sales that must cover the financial obligations of the firm. The ratio presents higher values for manipulator firms over the three years, which demonstrates a high need for extra funding for that group of firms.

Debt to Equity (DER) is higher for manipulator firms than for non-manipulators in the three years, which is associated with a high level of debt financing and, consequently, to a higher level of risk and volatile earnings.

Accounts Receivable to Assets (ARTA) measures in which extent the firm assets are classified as receivables. The ratio has higher values for manipulator firms over the three years analysed, which may be a sign of less financial security and, consequently, more vulnerability.

Total Liabilities to Total Assets (TLTA) the ratio has, in the three years, higher values for manipulator firms than for non-manipulators, which demonstrates lower financial security given the proportion between assets and liabilities.

Cost of Goods Sold to Sales (COGSSAL) measures the operating efficiency of the firms. In year *t-2* and *t-1*, the ratio presents higher values for manipulator firms, however, in the year prior the fraud event *(t)*, the ratio presents a higher value for non-manipulator firms.

This may indicate a decrease in the capacity to compete of the manipulator firms against the non-manipulator firms.

Account Receivables Turnover in Days (ARTD) and **Account Payables Turnover in Days (APTD)** are both higher for manipulator firms than for non-manipulators over the three years. Therefore, this group of firms shows that is less efficient in managing its assets and, consequently, its receipts and payments, respectively.

Inventory Turnover in Days (ITD) is higher for manipulators in *t-2*, however, two years prior the event (*t-1*), manipulator firms were greatly affected in their ability to sell inventory. Contrary, in year *t*, the trend was reverse and that group of firms recovered their efficiency.

Asset turnover (ASST) presents higher values for non-manipulators in *t-2* and *t-1*. However, in year *t*, the group of manipulator firms presented a higher value, which represents its increasing capability to generate revenue from its assets.

Return on Equity (ROE) is higher for manipulators in *t-2*, however, in *t-1*, the values of the two groups approximated and, in the year prior to the event, non-manipulators had a higher ROE than the group of manipulators. Therefore, this is an indication of a decreasing performance of the manipulators' group against the non-manipulators group.

Return on Assets (ROA) presents higher values for manipulator firms than for non-manipulators in *t-2* and *t-1*, however, the values are, on average, very similar to each other. In year *t*, the group of manipulators managed to have a higher value of ROA than the group of non-manipulators, which exhibits an increasing efficiency in managing its assets to generate earnings.

EBIT to Total Sales (EBITSAL) presents some differences, however the values of the ratio over the three years are quite similar between the two groups. Therefore, there are no noticeable differences in the profitability of the two different groups or even in time.

The **dummy for loss (D1)** do not present significant changes over time and has similar values for both groups in all three years. Therefore, there are no significant differences in the number of firms reporting loss/profit between the two groups or in time.

Equity Investment (EINR) is a leverage ratio which measures in which extent the ownership of the firm is in 'shareholder hands'. The ratio is smaller for manipulator firms in all three years, which indicates that this group of firms have, on average, a high level of debt and, consequently, a greater predisposition to commit fraud.

The dummy for the independence of the board of directors (D2) is, in year *t-2* and *t-1*, equal for both groups in analyse. However, in year *t*, the mean value was higher for non-manipulator firms than for manipulator firms, which demonstrates less independent board of directors.

The dummy for auditor change (D3) is higher for manipulator firms over the three years, which demonstrates that this group of firms had more changes in the auditor than the other group of firms, on average.

The dummy for the auditor size (D4) is higher for manipulator firms' group in the three years of analyse. This illustrates that the auditors of that group of firms are, on average,

smaller auditors (measured in terms of belonging or not to the "Big 4" firms) than the ones of the non-manipulator firms.

Overall, the standard deviations are low for the different variables, except for DER, ARTD, APTD, and ITD in the three years. However, it is possible to note that, in a general way, the standard deviations are slightly higher for manipulator firms' group, which denotes that this group of firms is less consistent, i.e. there are more discrepant differences between the firms that constitute the group.

Detailed analysis

Additionally, the Pearson Correlation Matrix was calculated, which indicated that possible multicollinearity problems may exist. Therefore, additional tests were performed (VIF and TOL), which confirmed the previous suspicions (see Appendix 4.1). This demonstrates the need to perform a PCA to reduce multicollinearity effects. In this way, 4 factors that account for 73,99% of the variance in the original data matrix were extracted, which means that there is not much loss of information when using the 4 factors instead of the 17 variables (see appendix 4.1).

The first factor - that is able to capture more than 33% of the variance in the original variables - seems to be positively related to the financial health of the companies. It is positively related to the variables EINV, DEQ, TDTA, ROA, WCTS, CR and COGSSAL. It is also negatively related to the variables TLTA, QR, ROE and ASST. Results suggest that FACTOR 1 is highly related to firm's financing, firm's debts and its ability to pay its financial obligations, firm's profitability, and efficiency.

Factor 2 captures around 17% of the variance of the variables used. It is positively related to EBITSAL and CASHTA, and negatively related to ARTD. Results suggest that FACTOR 2 is highly related with firms' ability to generate cash from assets and with the time needed to collect its receivables.

Factor 3 captures around 14% of the variance of the variables used. It is positively related to APTD. Results suggest that FACTOR 3 is highly related with the time needed for the firms to pay its financial obligations.

Factor 4 captures around 9% of the variance of the variables used. It is positively related to ARTA, and negatively related to ITD. Results suggest that FACTOR 4 is highly related with firms' financial security and efficiency on sales.

Therefore, a logistic regression will be used to analyse the relationship between the dependent (dichotomous) variable and the independent variables (Beasley, 1996). The 4 factors were included and the 4 dummy variables were not included in the PCA.

The result of the re-estimation[29] showed that only one dummy variable (D4) and two factors: Factor 1 and Factor 3 are statistically significant in explaining the fraud event, in the analysed sample (see appendix 4.2).

Chapter 4 - Fraud in Europe

The final aim of this dissertation is to adapt the study of fraud to the European reality, through previous studies carried out in the last decades by different authors. Thus, through the study of these same models, the variables that currently best explain the Financial Statement Fraud (FSF) phenomenon in Europe were identified.

For this purpose, the following variables, related to the different models, were identified as being statistically significant: on the Beneish Model, Factor 4[30]; on Altman Model, WCTA, and MVEBVTL; on Ohlson Model, Factor 2[31] and Factor 3[32]; and on Financial Ratios Model, Factor 1[33], Factor 3[34] and D4[35].

Thus, through the use of a logistic regression[36] it was possible to identify which of these previously identified variables[37] are, in fact, central when identifying a FSF event.

The final result shows that the variables TLTA, APTD, D4, and CHIN are, from the set of variables used, those that best describe the FSF event in European firms today. Overall, the model performs better in predicting the firms that did not commit fraud (Figure 12). However, both have a great performance, accounting for a final accuracy rate of 90.5%, much higher than the value identified in the other models, for example, 73.8% of the Financial Ratios Model.

		Predicted		
		MANIPULATION		Percentage Correct
Observed		No	Yes	
MANIPULATION	No	20	1	95,2
	Yes	3	18	85,7
Overall Percentage				90,5

FIGURE 12 - PERFORMANCE OF THE FINAL MODEL. SOURCE: THE AUTHOR.

[29] The re-estimation of the model was done through a Backward Logistic Regression. The method removal testing is based on the probability of the likelihood-ratio statistic based on the maximum partial likelihood estimates.

[30] Factor 4 is related with GMI.

[31] Factor 2 is related with CLCA, WCTA, and SIZE.

[32] Factor 3 is related with CHIN, and OENEG.

[33] Factor 1 is positively related to EINV, DEQ, TDTA, ROA, WCTS, CR and COGSSAL; and negatively related to the variables TLTA, QR, ROE and ASST.

[34] Factor 3 is related with APTD.

[35] D4 is a dummy for auditor belonging to the 'Big 4' or not.

[36] It was used a Forward Selection (Likelihood Ratio), with entry testing based on the significance of the score statistic, and removal testing based on the probability of a likelihood-ratio statistic based on the maximum partial likelihood estimates.

[37] To note that the variables identified in the re-estimation of the Beneish Model were not included in the final regression, since the model showed a very poor performance.

Moreover, the designed final model is considered to be significant, which can be confirmed through the two measures of fit between the model and the data: Cox & Snell's R^2 (0,538)[38] and the Nagelkerke's R^2 (0,718)[39] (appendix 5).

Bearing that in mind, it is possible to analyze the variables that the study demonstrated to be significant in identifying FSF cases in Europe. In a general way, the identified variables are a measure of firm leverage, performance, financial risk, and auditor's size.

[38] The Cox & Snell's R^2 has an upper bound that is less than 1.

[39] Nagelkerke's R^2 is an adjusted version of the Cox & Snell R^2 that adjusts the statistic scale, making possible to range from 0 to 1.

Chapter 5 – Conclusion

Nowadays most organizations are exposed to a large number of situations that, for various reasons, can led them to commit fraud. These situations may have incalculable consequences that greatly affect the companies involved, including the loss of credibility in the financial markets and for all stakeholders such as investors, suppliers, and consumers.

Therefore, the market is susceptible to a high number of fraud situations, which usually have the ultimate goal of obtaining undue gains. However, it is important to recognize the impact on the reputation and credibility of the company as one of the biggest consequences of fraud. Although it may have countless financial losses, credibility is a factor that takes years to build which may not be possible to regain it, especially in the European market.

Accordingly, if the origin and the main motivations for fraud are recognized, then it will be easier and more effective for competent institutions to act in their prevention, discovery and punishment. In fact, it is important to increase the general credibility of organizations in the European market, since in recent years a number of fraudulent situations have been discovered in organizations that had the trust of the agents.

Therefore, the present dissertation aimed to develop the literature on accounting fraud in Europe, since most of the studies carried out - and developed models - fit the reality of the U.S.A., and the two territories are known for their sharp discrepancies at various levels.

The work base was constructed through 14 identified European companies - 7 of which were identified through the regulatory commissions of several European countries as having been in a fraud situation and, the remaining 7 firms, were chosen through a pair system -, whose annual accounting reports were analysed starting the year before it was made public that the firm committed Financial Statement Fraud (FSF) and backwards, in a total of three years. Besides the sample was built from 50% firms that have committed FSF, and 50% of firms that have not committed FSF, it is expected that the true rate of firms experiencing FSF within the total population is less than 50% (Beasley (1996)).

The data collection was very careful and exhaustive process, since four models were used, among them the Altman Model (1968), the Ohlson Model (1980), and the Beneish Model (1999). The fourth model refers to the 'Financial Ratios Model', whose ratios were chosen by the author of the dissertation through a careful analysis of the fraud literature. Although three of the models had a good performance in the chosen sample, the Beneish Model presented a notorious poor performance, reason why it was not included in the final stage of this dissertation. Therefore, the study was conducted considering the variables that showed a better performance in the remaining three models – Altman Model, Ohlson Model, and Financial Ratios Model -, which indicated that only four variables - Total Liabilities to Total Assets, Account Payables Turnover in Days, Net Income Change Ratio, and a dummy for Auditor Size - are significant in explaining accounting fraud in Europe, accounting for 90.5% of the variance explained, a very satisfactory result.

Despite the difficulties encountered, it was possible to obtain a suitable sample that led to the identification of variables to be analysed, in order to study the Financial Statement Fraud phenomenon in Europe, not only as a way of acting but with the ultimate goal of working on prevention of these actions and their consequences for the economy. Depending on the impact that an organization has in a country, a discovered action of fraud may lead, among others, to a large external divestment, which has a great impact on the development of most European countries.

Although the results have been quite satisfactory, it is clear that the size of the sample is small and, possibly, not very representative of most European firms. Therefore, it would be important in the future to continue to execute this study with a larger sample, in order to unequivocally improve fraud prediction mechanisms.

In any event, I consider the results to be of great value, to be applied mainly by auditors who, in their daily work, have to be alert to possible signs of fraud and, acting at the community level, by institutions such as OLAF (European Anti- Fraud Office). Be aware of the factors identified as having the greatest impact in the event of fraud and possibly prevent these cases from spreading over time, and their consequences to become irremediable, not only for those committing these acts but for those who find themselves in the same sphere. To avoid what, according to Adam Smith, is man's universal ambition, “to reap what he has never planted”.

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Appendixes

1. Beneish Model diagnosis

	MANIPULATION	DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA
MANIPULATION	1								
DSRI	,228	1							
GMI	-,276	-,440*	1						
AQI	-,121	-,344	,078	1					
SGI	,126	-,341	,060	,421*	1				
DEPI	,104	-,005	-,100	,045	,504**	1			
SGAI	,128	,887**	-,401*	-,260	-,219	-,020	1		
LVGI	,228	,761**	-,458*	-,272	,103	,186	,742**	1	
TATA	,272	,056	,049	-,640**	-,373	,146	-,171	-,116	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

FIGURE 13 - PEARSON CORRELATION MATRIX FOR BENEISH MODEL. SOURCE: THE AUTHOR.

In figure 13 is presented the correlation matrix of Pearson to the dependent and independent variables. Results demonstrate that, in a general way, the independent variables have weak (positive or negative) linear correlations with the dependent variable (MANIPULATION). However, to highlight the existence of positive strong correlations between SGAI and DSRI (0,887), LVGI and SGAI (0,742), and LVGI and DSRI (0,761). Therefore, since there are indications of possible multicollinearity problems, additional tests (VIF and TOL[40]) were performed, which confirms with the results of the previous test.

1.1. Beneish Model: Principal Component Analysis

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling		,564
Bartlett's Test of Sphericity	Approx. Chi-Square	118,375
	df	28
	Sig.	,000

FIGURE 14 - KAISER MEYER OLKIN MEASURE AND BARTLETT'S TEST FOR BENEISH MODEL. SOURCE: THE AUTHOR.

[40] The results of this tests will not be presented, since they were performed as confirmation to the previous results.

To perform a PCA it is required that the initial variables under analysis are correlated, which was proved to be true. The results of figure 14 regarding the Kaiser Meyer Olkin (KMO)[41] measure and Bartlett test[42], demonstrate that the data is appropriate to perform a PCA.

Factor	Eigenvalue	% of Variance	Cumulative %
Factor 1	2,726	34,079	34,079
Factor 2	1,855	23,188	57,266
Factor 3	1,557	19,458	76,725
Factor 4	0,993	12,417	89,142

FIGURE 15 - TOTAL VARIANCE EXPLAINED BY THE RESULTING FACTORS. SOURCE: THE AUTHOR.

Variable	Factor 1	Factor 2	Factor 3	Factor 4
SGAI	,941	-	-	-
DSRI	,908	-	-	-
LVGI	,885	-	-	-
TATA	-	-,940	-	-
AQI	-	,839	-	-
DEPI	-	-	,910	-
SGI	-	-	,790	-
GMI	-	-	-	,942

FIGURE 16 - RESULTING FACTORS LOADING FROM THE PRINCIPAL COMPONENTS ANALYSIS. SOURCE: THE AUTHOR.

1.2. Re-estimation of the Beneish Model

	Chi-square	df	Sig.
Step	-1,225	1	,268
Block	2,242	1	,134
Model	2,242	1	,134

FIGURE 17 - SIGNIFICANCE OF THE RE-ESTIMATED BENEISH MODEL. SOURCE: THE AUTHOR.

The re-estimated model has a Chi-square[43] of 2,242 and presents a p-value of 0,134, which demonstrates that the model is not statistically significant.

[41] The Kaiser-Meyer-Olkin measure of sampling adequacy indicates whether the sample under analysis is appropriate to perform a PCA. It ranges between 0 and 1, values above 0.6 being considered acceptable to perform PCA.
[42] The Bartlett's test is a hypothesis test to the null hypothesis that the correlation matrix is an identity matrix, i.e., that the initial variables are not correlated. In order to be able to conduct a PCA, the null hypothesis has to be rejected, concluding there are pairs of variables significantly correlated.
[43] The Chi-square indicates how well the logistic regression model fits the data.

Observed		Predicted		
		MANIPULATION		Percentage Correct
		No	Yes	
MANIPULATION	No	14	0	100,0
	Yes	13	0	0,0
Overall Percentage				51,9

FIGURE 18 - PERFORMANCE OF THE RE-ESTIMATED BENEISH MODEL. SOURCE: THE AUTHOR.

2. Altman Model diagnosis

	MANIPULATION	WCTA	RETA	EBITTA	MVEBVTL	SALTA
MANIPULATION	1					
WCTA	,214	1				
RETA	,034	0,151	1			
EBITTA	,131	,636**	,399**	1		
MVEBVTL	-,253	,416**	,036	0,258	1	
SALTA	-,026	-,174	,224	-,118	-0,196	1

**. Correlation is significant at the 0.01 level (2-tailed).

FIGURE 19 - PEARSON CORRELATION MATRIX FOR ALTMAN MODEL. SOURCE: THE AUTHOR.

Through the results of the figure, it is possible to conclude that the variables WCTA, RETA, and EBITTA have a weak linear correlation with the dependent variable, and MVEBVTL, and SALTA present a weak negative linear correlation with MANIPULATION. The remaining variables have weak (positive and negative) linear correlations among themselves. Accordingly, there are no indication of multicollinearity problems on the model.

2.1. Re-estimation of the Altman Model

	Chi-square	df	Sig.
Step	-0,039	1	,843
Block	10,987	2	,004
Model	10,987	2	,004

FIGURE 20 - SIGNIFICANCE OF THE RE-ESTIMATED ALTMAN MODEL. SOURCE: THE AUTHOR.

The re-estimated model presents a Chi-square of 10,987, which is statistically significant at 1 percent level.

Observed		Predicted		
		MANIPULATION		Percentage Correct
		No	Yes	
MANIPULATION	No	18	3	85,7
	Yes	6	15	71,4
Overall Percentage				78,6

FIGURE 21 - PERFORMANCE OF THE RE-ESTIMATED ALTMAN MODEL. SOURCE: THE AUTHOR.

3. Ohlson Model diagnosis

	MANIPULATION	SIZE	TLTA	WCTA	CLCA	OENEG	NITA	FUTL	INTWO	CHIN
MANIPULATION	1									
SIZE	-,244	1								
TLTA	,319*	,509**	1							
WCTA	,214	-,660**	-,421**	1						
CLCA	-,290	,575**	,190	-,890**	1					
OENEG	,156	,186	,353*	-,102	0,085	1				
NITA	0,103	-,644**	-,627**	,610**	-,463**	-,441**	1			
FUTL	-,001	-,629**	-,675**	,656**	-,448**	-,135	,807**	1		
INTWO	.b	.b	.b	.b	.b	.b	.b	.b		
CHIN	,312*	-0,185	0,139	0,151	-0,194	0,303	0,297	,305*	.b	1

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

b. Cannot be computed because at least one of the variables is constant.

FIGURE 22- PEARSON CORRELATION MATRIX FOR OHLSON MODEL. SOURCE: THE AUTHOR.

In one hand, there is weak a positive linear correlation between the variables TLTA, WCTA, OENEG, NITA, and CHIN and the dependent variable. SIZE, CLCA, and FUTL have a weak negative linear correlation with the dependent variable.

In other hand, there is a strong negative linear correlation between CLCA and WCTA, and a strong positive linear correlation between FUTL and NITA. The hypothesis of multicollinearity was confirmed with the VIF and TOL tests[44].

[44] The results of this tests will not be presented, since they were performed as confirmation to the previous results.

3.1. Ohlson Model: Principal Component Analysis

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,699
Bartlett's Test of Sphericity	Approx. Chi-Square	231,600
	df	28
	Sig.	,000

FIGURE 23 - KAISER MEYER OLKIN MEASURE AND BARTLETT'S TEST FOR OHLSON MODEL. SOURCE: THE AUTHOR.

The results presented in figure 23 demonstrate that the data is adequate to perform a PCA.

Factor	Total	% of Variance	Cumulative %
Factor 1	2,818	35,227	35,227
Factor 2	2,366	29,573	64,800
Factor 3	1,388	17,349	82,149

FIGURE 24- TOTAL VARIANCE EXPLAINED BY THE RESULTING FACTORS. SOURCE: THE AUTHOR.

Variable	Factor 1	Factor 2	Factor 3
NITA	,867	-	-
FUTL	,820	-	-
TLTA	-,820	-	-
CLCA	-	-,960	-
WCTA	-	,901	-
SIZE	-	-,597	-
CHIN	-	-	,894
OENEG	-	-	,678

FIGURE 25 - RESULTING FACTORS LOADING FROM THE PRINCIPAL COMPONENTS ANALYSIS. SOURCE: THE AUTHOR.

3.2. Re-estimation of the Ohlson Model

	Chi-square	df	Sig.
Step	-2,483	1	,115
Block	9,691	2	,008
Model	9,691	2	,008

FIGURE 26 - SIGNIFICANCE OF THE RE-ESTIMATED OHLSON MODEL. SOURCE: THE AUTHOR.

The re-estimated model is statistically significant at 1 percent level, with a Chi-square of 9,691.

		Predicted		
		MANIPULATION		Percentage Correct
Observed		No	Yes	
MANIPULATION	No	13	8	61,9
	Yes	4	17	81,0
Overall Percentage				71,4

FIGURE 27 - PERFORMANCE OF THE RE-ESTIMATED OHLSON MODEL. SOURCE: THE AUTHOR.

4. Financial Ratios Model diagnosis

	Manipulators						Non-Manipulators					
Variables	Obs.	Mean	Median	Std. Deviation	Min.	Max.	Obs.	Mean	Median	Std. Deviation	Min.	Max.
						t						
CR	7	1,26	1,17	0,62	0,69	2,50	7	1,08	0,70	1,03	0,50	3,40
TDTA	7	0,33	0,33	0,13	0,13	0,53	7	0,28	0,28	0,09	0,14	0,41
QR	7	0,98	0,69	0,73	0,39	2,50	7	0,61	0,63	0,23	0,20	0,96
CASHTA	7	0,06	0,05	0,05	0,02	0,16	7	0,05	0,04	0,03	0,01	0,11
WCTS	7	0,07	0,12	0,19	-0,21	0,33	7	-0,04	-0,09	0,21	-0,18	0,43
DEQ	7	2,87	2,01	2,52	0,70	8,29	7	1,76	1,29	1,17	0,94	4,34
ARTA	7	0,13	0,11	0,07	0,07	0,28	7	0,08	0,09	0,05	0,02	0,15
TLTA	7	1	0,66	0	0	1	7	1	0,56	0	0	1
COGSSAL	7	0,65	0,63	0,19	0,29	0,90	7	0,66	0,66	0,22	0,34	0,92
ARTD	7	67,80	68,77	40,31	12,99	134,23	7	45,72	47,29	27,05	4,13	79,61
APTD	7	122,06	103,13	82,83	34,11	258,14	7	53,16	51,14	19,83	26,80	78,55
ITD	7	55,54	32,25	66,46	0,04	194,26	7	51,39	19,18	85,36	7,20	243,93
ASST	7	1,01	0,74	0,78	0,30	2,58	7	0,96	0,71	0,68	0,29	1,80
ROE	7	0,01	0,09	0,27	-0,43	0,30	7	0,08	0,08	0,12	-0,05	0,28
ROA	7	0,03	0,03	0,09	-0,10	0,18	7	0,03	0,03	0,04	-0,02	0,10
EBITSAL	7	0,10	0,07	0,17	-0,17	0,37	7	0,09	0,04	0,16	-0,04	0,44
EINV	7	0,32	0,33	0,15	0,11	0,59	7	0,40	0,43	0,11	0,18	0,51
D1	7	0,29	0	0,49	0	1	7	0,29	0	0,49	0	1
D2	7	0	0	0	0	0	7	0,14	0	0,38	0	1
D3	7	0,57	1	0,53	0	1	7	0,14	0	0,38	0	1
D4	7	0,43	0	0,53	0	1	7	0	0	0	0	0
						t-1						
CR	7	1,52	1,09	1,50	0,67	4,90	7	1,23	0,83	1,08	0,57	3,63
TDTA	7	0,28	0,26	0,13	0,07	0,49	7	0,27	0,23	0,12	0,13	0,50
QR	7	1,26	0,73	1,61	0,48	4,90	7	0,72	0,64	0,30	0,24	1,17
CASHTA	7	0,05	0,06	0,03	0,02	0,09	7	0,06	0,05	0,05	0,01	0,15
WCTS	7	0,04	0,01	0,26	-0,20	0,56	7	0,03	-0,05	0,23	-0,17	0,53
DEQ	7	1,94	1,67	1,41	0,45	4,11	7	1,68	1,01	1,49	0,77	4,91
ARTA	7	0,12	0,12	0,03	0,08	0,16	7	0,09	0,08	0,04	0,02	0,14
TLTA	7	0,57	0,60	0,19	0,31	0,80	7	0,55	0,50	0,13	0,43	0,81
COGSSAL	7	0,67	0,72	0,18	0,32	0,90	7	0,66	0,65	0,21	0,36	0,91
ARTD	7	72,05	61,16	63,11	15,81	205,89	7	50,70	58,00	30,38	4,13	85,80
APTD	7	141,84	80,63	126,25	37,69	372,40	7	54,07	53,50	18,84	26,61	76,74
ITD	7	50,23	38,91	60,98	0,10	176,82	7	59,57	19,26	105,10	7,49	297,14
ASST	7	0,93	0,79	0,57	0,28	1,93	7	0,95	0,65	0,69	0,30	1,74
ROE	7	0,15	0,17	0,08	0,03	0,24	7	0,13	0,13	0,06	0,05	0,25
ROA	7	0,07	0,04	0,06	0,02	0,17	7	0,06	0,05	0,04	0,03	0,13
EBITSAL	7	0,16	0,11	0,16	0,04	0,49	7	0,16	0,13	0,13	0,01	0,32
EINV	7	0,41	0,36	0,20	0,20	0,69	7	0,44	0,50	0,14	0,17	0,56
D1	7	0	0	0	0	0	7	0	0	0	0	0
D2	7	0	0	0	0	0	7	0,14	0	0,38	0	1
D3	7	0,57	1	0,53	0	1	7	0,14	0	0,38	0	1
D4	7	0,43	0	0,53	0	1	7	0	0	0	0	0
						t-2						
CR	7	1,30	0,96	0,84	0,67	3,14	7	1,18	0,74	0,99	0,57	3,30
TDTA	7	0,33	0,36	0,15	0,05	0,50	7	0,26	0,24	0,10	0,17	0,46
QR	7	1,06	0,81	0,96	0,45	3,13	7	0,71	0,61	0,42	0,24	1,53
CASHTA	7	0,05	0,05	0,01	0,03	0,06	7	0,06	0,02	0,08	0,01	0,23
WCTS	7	0,10	-0,03	0,21	-0,10	0,42	7	0,02	-0,08	0,22	-0,22	0,41
DEQ	7	3,38	1,85	3,02	0,63	8,75	7	1,81	1,23	1,87	0,70	5,98
ARTA	7	0,17	0,14	0,07	0,10	0,30	7	0,09	0,09	0,04	0,02	0,15
TLTA	7	0,65	0,65	0,17	0,38	0,87	7	0,56	0,55	0,15	0,41	0,84
COGSSAL	7	0,71	0,74	0,13	0,51	0,89	7	0,68	0,75	0,21	0,42	0,91
ARTD	7	141,78	60,57	178,38	26,47	518,73	7	44,56	49,65	25,45	4,90	77,24
APTD	7	136,78	113,00	93,98	38,73	277,96	7	49,02	45,04	24,62	18,84	86,38
ITD	7	55,92	49,28	58,06	0,47	160,71	7	45,70	23,91	71,14	2,88	204,84
ASST	7	0,87	0,71	0,51	0,17	1,63	7	0,99	0,71	0,67	0,31	1,79
ROE	7	0,17	0,17	0,11	0,07	0,38	7	0,09	0,09	0,03	0,04	0,13
ROA	7	0,06	0,05	0,04	0,02	0,13	7	0,04	0,04	0,02	0,01	0,07
EBITSAL	7	0,16	0,06	0,23	0,04	0,69	7	0,11	0,11	0,09	-0,01	0,27
EINV	7	0,32	0,35	0,19	0,10	0,61	7	0,44	0,45	0,15	0,14	0,59
D1	7	0	0	0	0	0	7	0	0	0	0	0
D2	7	0	0	0	0	0	7	0	0	0	0	0
D3	7	0,43	0	0,53	0	1	7	0,14	0	0,38	0	1
D4	7	0,43	0	0,53	0	1	7	0	0	0	0	0

FIGURE 28 - FINANCIAL RATIOS MODEL DESCRIPTIVE STATISTICS. SOURCE: THE AUTHOR.

	MANIPULATION	CR	TDTA	QR	CASHTA	WCTS	DEQ	ARTA	TLTA	COGSSAL	ARTD	APTD	ITD	ASST	ROE	ROA	EBITSAL	EINV	D1	D2	D3	D4
MANIPULATION	1																					
CR	,116	1																				
TDTA	,202	-,307*	1																			
QR	,246	,777**	-,429**	1																		
CASHTA	,021	,037	-,015	,241	1																	
WCTS	,182	,900**	-,178	,665**	,173	1																
DEQ	,251	-,243	,631**	-,282	,078	-,192	1															
ARTA	,483**	,307*	-,018	,399**	-,003	,368*	,218	1														
TLTA	,219	-,427**	,706**	-,478**	,139	-,310*	,876**	,126	1													
COGSSAL	,021	-,170	-,064	-,339*	-,343*	-,140	,274	,046	,319*	1												
ARTD	,275	,038	,182	,144	-,027	,197	-,087	,568**	-,097	-,313*	1											
APTD	,511**	-,091	,238	,000	,061	-,040	,082	,430**	,080	-,261	,677**	1										
ITD	,029	,460**	,201	-,124	-,195	,483**	,068	,054	,089	,153	-,056	,073	1									
ASST	-,018	-,082	-,034	-,124	-,046	-,055	,472**	-,054	,378**	,697**	-,500**	-,471**	-,121	1								
ROE	,065	,303*	-,252	,310*	,144	,328*	-,205	,168	-,231	-,155	,024	-,042	,041	-,111	1							
ROA	,099	,579**	-,490**	,609**	,066	,548**	-,411**	,216	-,570**	-,287*	,061	-,070	,019	-,092	,796**	1						
EBITSAL	,052	,233	-,075	,293*	,222	,356*	-,348*	,142	-,391**	-,657**	,569**	,304*	-,045	-,468**	,454**	,618**	1					
EINV	-,264	,419**	-,709**	,468**	-,114	,317*	-,865**	-,171	-,988**	-,313*	,053	-,168	-,132	-,310*	,262	,604**	,414**	1				
D1	,000	-,169	,261	-,152	-,178	-,224	,208	-,161	,181	,056	-,043	-,029	-,105	,165	-,734**	-,583**	-,320*	-,196	1			
D2	-,209	-,062	,035	,008	,069	-,058	-,096	-,168	-,079	-,284	,035	-,083	-,096	-,226	-,147	-,153	,080	,074	,314*	1		
D3	,442**	,133	,262	,324*	-,099	,006	,241	,260	,095	-,305*	,138	,321*	-,257	-,059	-,048	,040	,053	-,126	,267	,074	1	
D4	,480**	,328*	-,112	,458**	-,054	,242	,085	,535**	-,027	,036	,215	,476**	,164	-,140	-,062	,062	-,129	-,080	,048	-,100	,340*	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

FIGURE 29 - PEARSON CORRELATION MATRIX FOR FINANCIAL RATIOS MODEL. SOURCE: THE AUTHOR.

There is a weak positive linear correlation between the dependent variable and CR, TDTA, QR, CASHTA, WCTS, DEQ, TLTA, COGSSAL, ARTD, ITD, ROE, ROA, and EBITSAL. However, the independent variables ASST, EINV, and D2 demonstrate to have a weak negative linear correlation with MANIPULATION. However, ARTA, APTD, D3, and D4 stand out since these variables show a stronger positive linear correlation with the dependent variable. Therefore, there are indications of possible multicollinearity problems.

Thereby, an additional multicollinearity test (VIF and TOL[45]) was performed to test in which extent the results are aligned. The test confirmed the existence of multicollinearity between the variables.

4.1. Financial Ratios Model: Principal Component Analysis

By one hand, the KMO measure of sampling adequacy ranges between 0 and 1, so a value of 0,537 is accepted as adequate. On the other hand, Bartlett's test is a hypothesis test to the null hypothesis that the correlation matrix is an identity matrix, i.e., that the initial variables are not correlated. Therefore, it is rejected the null hypothesis with a p-value equal to zero, concluding that there are variables significantly correlated in the sample and, finally, that the data under analysis is appropriate to conduct a PCA.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,537
Bartlett's Test of Sphericity	Approx. Chi-Square	866,944
	df	136
	Sig.	,000

FIGURE 30 - KAISER MEYER OLKIN MEASURE AND BARTLETT'S TEST FOR FINANCIAL RATIOS MODEL. SOURCE: THE AUTHOR.

Factor	Total	% of Variance	Cumulative %
Factor 1	5,726	33,680	33,680
Factor 2	2,925	17,205	50,885
Factor 3	2,368	13,928	64,813
Factor 4	1,562	9,185	73,999

FIGURE 31 - TOTAL VARIANCE EXPLAINED BY THE EXTRACTED FACTORS. SOURCE: THE AUTHOR.

[45] The results of this tests will not be presented, since they were performed as confirmation to the previous results.

Variable	Factor 1	Factor 2	Factor 3	Factor 4
TLTA	-,837	-	-	-
EINV	,836	-	-	-
DEQ	,826	-	-	-
TDTA	,741	-	-	-
QR	-,722	-	-	-
ROA	,697	-	-	-
WCTS	,661	-	-	-
CR	,653	-	-	-
ROE	-,593	-	-	-
COGSSAL	,538	-	-	-
ASST	-,501	-	-	-
EBITSAL	-	,802	-	-
CASHTA	-	,801	-	-
ARTD	-	-,571	-	-
APTD	-	-	,532	-
ARTA	-	-	-	,715
ITD	-	-	-	-,607

FIGURE 32 - RESULTING FACTORS LOADING FROM THE PRINCIPAL COMPONENTS ANALYSIS. SOURCE: THE AUTHOR.

4.2. Re-estimation of the Financial Ratios Model

	Chi-square	df	Sig.
Step	-1,798	1	,180
Block	22,273	3	,000
Model	22,273	3	,000

FIGURE 33 - SIGNIFICANCE OF THE RE-ESTIMATED FINANCIAL RATIOS MODEL. SOURCE: THE AUTHOR.

The statistical measure of the relationship between the dependent and independent variables is the Chi-square test, which has a value of 22,273, statistically significant at 1 percent level.

However, to examine the strength of the logistic regression, and inspect the accuracy or errors associated with the resultant model the classification accuracy needs to be looked at, which makes a comparison between the predicted group association to the known group association (observed). Therefore, the overall performance accuracy of the re-estimated model is 73,8%.

Observed		Predicted		
		MANIPULATION		Percentage Correct
		No	Yes	
MANIPULATION	No	17	4	81,0
	Yes	7	14	66,7
Overall Percentage				73,8

FIGURE 34 - PERFORMANCE OF THE RE-ESTIMATED FINANCIAL RATIOS MODEL. SOURCE: THE AUTHOR.

5. 'Final Model' significance

	Chi-square	df	Sig.
Step	5,405	1	,020
Block	32,468	4	,000
Model	32,468	4	,000

Cox & Snell R Square	Nagelkerke R Square
,538	,718

FIGURE 35 - SIGNIFICANCE OF THE RE-ESTIMATED 'FINAL MODEL'. SOURCE: THE AUTHOR.