The use of accounting and corporate governance information in the prediction of securities class actions

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ABSTRACT

During the last fifteen years the conventional lawsuit has been transformed to a modern type of massive litigation; the securities class actions. This topic has been investigated by some researchers in the past but still the prediction of it has not been adequately been approached. This study examines this alternative way of litigation gathering the largest sample so far (2,072 USA firms) during 2003-2011. The aim of this research is to provide an understanding of the features of securities class action target firms and compare the alternative classification techniques, in order to predict this phenomenon. Having selected quantitative (accounting data) and qualitative data (corporate governance indices) we enrich literature with useful information concerning the profile of firms that are threatened by securities class action.

DEDICATION

To all those who will always stand by me...

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ACRONYMS

CA	Class Action
CAMEL	Capital, Asset quality, Management, Earnings, Liquidity
CG	Corporate Governance
CGQ	Corporate Governance Quotient
DA	Discriminant Analysis
D/E	Debt/Equity
EFA	Econometric Frontier Approach
EU	European Union
HC	Historical Cost
LA	Logit Analysis
LDA	Linear Discriminant Analysis
LSP	Legal Services Program
MCDA	MultiCriteria Decision Aid
MHDIS	Multi-group Hierarchical DIScrimination
MDA	Multiple Discriminant Analysis
NPM	Net Profit Margin
NPV	Net Present Value
NSCA	Non Security Class Action
OLS	Ordinary Least Squares
OP	Operating Performance
PSLRA	Private Securities Litigation Reform Act of 1995
QR	Quick Ratio
RH	Relative Hypothesis
ROA	Return On Assets
ROAA	Return On Average Assets
ROAE	Return On Average Equity
ROC	Receiver Operating Characteristics
ROE	Return On Equity
SA	Securities Act of 1933
SCA	Security Class Action
SEC	Securities and Exchange Act of 1934
SIC	Standard Industrial Classification
SLUSA	Securities Litigation Uniform Standards Act of 1998
SOX	Sarbanes-Oxley Act
SVMs	Support Vector Machines
US	United States
UTA	UTilités Additives
UTADIS	UTilités Additives DIScriminantes

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CHAPTER 1 INTRODUCTION

1.1 Overview

During the last decades, various corporate and accounting scandals resulted in mass litigations. For example, scandals like Enron, Tyco International, Adelphia, Peregrine Systems, WorldCom etc., cost investors billions of dollars when the share prices of the affected companies collapsed. Remarkably, in the immediate post Enron era, settlement amounts increased in cases with similar characteristics to Enron, relatively to cases settled prior to Enron and other accounting debacles (Simmons, 2011). Undoubtedly, public confidence in securities markets was shocked, giving rise to numerous massive lawsuits, enhancing the linkage between the Enron effect and litigation.

Prior to the Enron case, other facts that fired massive litigations existed, as the Y2K[1] that took place in 2000. The change, from year 1999 to 2000, increased investors' anxiety worldwide, especially in companies belonging to information technology sector or companies dependent on information technology (Smith and Morris, 1999). The most striking example is that of 'Medical Manager', where after seven class actions against the company, its share price declined from $26 to $20. The reason was that the majority of its shareholders used non - compliant software version, leading them to sell stocks based on misleading financial statements. The classes claimed compensation for omission of material facts from the Registration Statement and Prospectus.

Going back in time, the first recorded class action was formed in the seventeenth century in England. The 'Bill of Peace' (a creation of English Court of Chancery) was in force between the seventeenth and eighteenth centuries and referred to massive disputes with common characteristics. It was that period in time when courts began recognizing jurisdiction for shareholder actions too (Ripken, 1998). By 1855 the American courts had recognized the importance of shareholder's right to litigate against a company. Although the first class actions (CAs) took place in medieval

[1] Y2K is the problem arising when the year with two digits becomes problematic with logical errors arising upon "rollover" from x99 to x00.

England, they are considered to be an American phenomenon. Prior to mid-60's, two-thirds of poor citizens facing legal problems never sought assistance of an attorney and, if they did, they received free representation by private ones (Rose, 2009). In 1965, Legal Services Program (LSP) was created, in order to provide attorneys to the poor in civil cases.

It was not only large corporations like Enron, WorldCom or Adelphia that faced securities class action due to accounting disclosures and government investigations as referred earlier. Hundreds of companies – irrespective of their size – suffered mass litigation after a sharp stock price correction as a result of announcing bad news. In an effort to deter future fraud and increase the accountability of corporate executives and boards, Congress passed the Sarbanes Oxley Act in July 2002, after which there has been a decline in the frequency of dismissals.

After the tenth anniversary of the passage of the SOX, there has been an increase in allegations related to SOX reporting requirements. According to the '2011 Review and Analysis' of Cornerstone Research, there has been an increase in Class Actions (CAs) in 2011 contrary to 2010, originating from accounting misstatements and financial restatements. It is worth noting that CAs which are linked to accounting, take longer to resolve and are less likely to result in dismissal than settlement. However, accounting cases result in higher settlement outcomes. The year 2011 was characterized by increased stock market volatility, creating a dynamic environment for securities class action litigation. In recent years, there has been an increase in the number and value of securities class actions (SCAs), attracting the attention of various stakeholders such as investors, managers, policy makers, lawyers, etc.

The reasons that lead to the formation of a securities class action may be numerous such as misleading or false financial statements, failure to disclose material information, violation of corporate disclosure rules, breach of fiduciary responsibilities, violation of insider trading rules, false revenue disclosures which require a restatement, improper accounting policies and improper revenue recognition (Bajaj et al. 2003).

Over the years numerous class action lawsuits have been in the spotlight, most of them involving securities fraud. Table 1.1 shows the top ten securities class action lawsuits, which are either settled, still pending, or won.

Table 1.1: Top 10 Class Action Lawsuits

N/a	Name of company	Year of filing	Amount in $ billion
1	Master Tobacco	1998	206
2	Dukes v. Wal-Mart Stores	2000	11
3	Enron, Inc.	2006	7.2
4	World Com, Inc.	2004-2005	6.2
5	Exxon Mobil Corp.	1994-2001	5
6	Breast Implant Litigation	1994	3.4
7	Tyco International Ltd.	2005-2007	3.2
8	Cendant Corp.	2000	3.1
9	AOL Time Warner	2005	2.5
10	Nortel Networks	2006	2.4

Source: (Lawinfo, 2010)

It is worth noting, that even in regular securities class actions that received less media attention in recent years, the compensation exceeded $500 million (an undoubtedly material amount for any kind of firm). By and large, even median class action cases may reach settlements of millions of dollars (Buckberg et al. 2003). For example, Lucent Technologies and Raytheon Corporation agreed to compensate $673 and $535 million respectively, reinforcing the fact that a security class action can cause huge damages for an organisation.

Figure 1.1 shows the number of settlement cases from 2006 until 2011, as well as the percentage of cases that were related to accounting and non-accounting issues. Remarkably, the majority of these cases are related to accounting malpractices, misleading statements, improper accounting practices etc. Generally, accounting issues are typically less likely to be dismissed than non-accounting cases. The fact that extensions of class periods often include accounting related events, demonstrates not only the impact of accounting to mass litigation, but also strengthens the need to further examine accounting aspects as a trigger to the ‘Securities Class Action’ phenomenon.

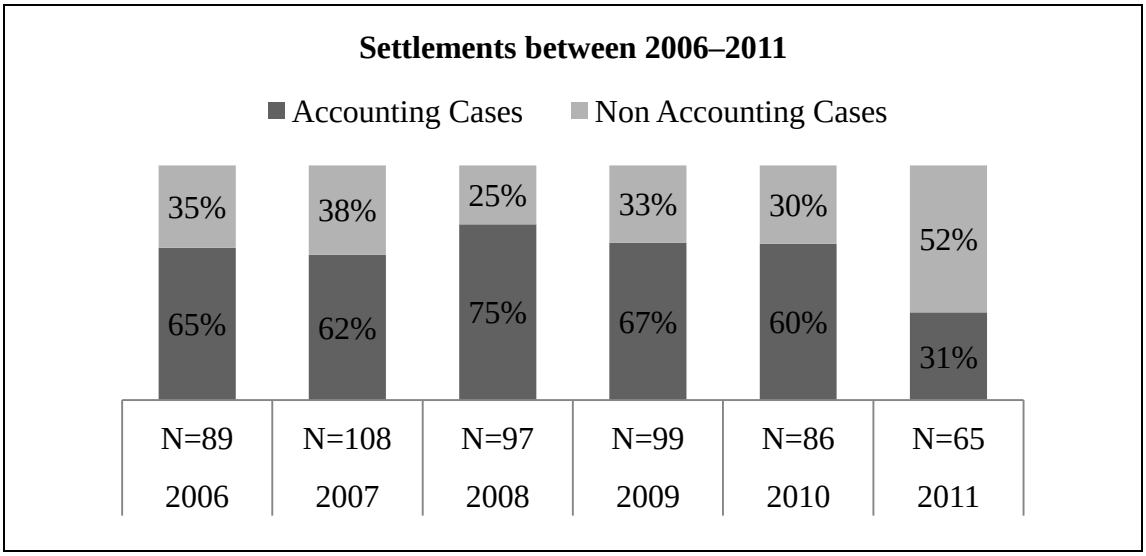


Figure 1.1: Settlements between 2006 and 2011

1.2 Securities Class Actions in Europe

The class actions phenomenon is not that widespread in Europe as it is in the USA. Still, collective actions are increasing in Europe, especially in the areas of product liability, securities and antitrust.

In the EU, 76% of consumers would be more willing to defend their rights in court, if they could join together with other consumers, than litigate alone[2]. Naturally, all Member States have relevant judicial procedures allowing individual consumers to bring their cases to court. A study launched by the European Commission shows that only 13 Member States (France, Germany, Finland, Sweden, Denmark, Bulgaria, Greece, the Netherlands, Italy, Spain, Portugal, Austria and UK) have introduced collective redress schemes in their legal system, some of them only very recently. These schemes are very different from one another. In some countries, the systems were created only very recently and the number of reported cases in these countries is limited. Schemes valid for a longer period of time are far from being totally effective proving their flaws and weaknesses. Existing national collective redress mechanisms have only been applied in a few cases in recent years. For example, the lowest number of consumers using a collective redress mechanism is in Germany, where only four in ten million people on average have participated in a redress action every year.

[2] Source: http://europa.eu/rapid/press-release_MEMO-08-741_en.htm

The highest collective compensation comes from Portugal, where a class action against a telecommunication company gave redress to some 3 million consumers. Another big compensation of €70 million shows the potential harm that a large entity can suffer. Overall, the studies indicate the average benefit to consumers in those Member States where collective redress exists, ranges from €32 million in Portugal to €332 million in Spain.

1.3 Importance of the study

In an economic environment with financial instability and multiple disorders, managers' daily attempt is to reduce company's total risk assuring the organisations' operation continuity and evolvement. To achieve this, they take various mandatory protection measures (e.g. in the banking sector - certain level of capital adequacy - Basel II) and use standard models of international credit rating agencies such as 'Fitch', 'Standard and Poor's', 'Moody's', etc. Some of them develop internal credit rating systems as Riskmetrics, Creditmetrics, Creditrisk-plus, Portfolio manager, etc. In this way companies attempt to minimize total risk, which may affect in material level not only the welfare of the business but also its so called «going-concern» thereafter.

Risk can take various types such as credit, insurance, country, operational, liquidity, reputational to name the most common ones. In recent years, there has been an increase in securities class action lawsuits indicating another type of risk; namely, the securities class action risk (Ryan and Simmons, 2007). Hence, it has been made evident that companies should operate in a way to avoid all type of risks including the risk stemming from mass litigations.

Pellegrina and Saraceno (2009) highlight the significance of the phenomenon in the banking sector indicating that the size of a class action may be a warning signal about the bank's stability. Accordingly, it is vital for all business sectors as well as investors and stakeholders (e.g. creditors, debtors, staff etc.) to be aware of the risk exposure that stems from a class action, before making an investment decision. For this reason, it would be beneficial to investors, who do not participate in a class action to be able to know if the company will face a class action in the future, long before it is

announced. Current research builds on the above and focuses on the development of a model to predict securities class actions.

1.3.1 Focusing on industrial sector

Prior research in the field has covered the examination of banking sector. Pellegrina and Saraceno (2011) focused on banking sector trying to understand the mechanisms that drive security class actions to take place and whether this event has an impact on bank soundness. Going a step further, they proposed that security class actions can complement public regulation, not only as a shield to investors, but enhancing banking supervision through the enforcement of market discipline. Additionally, effort has been made to develop classification models to forecast securities class actions filed against USA banks (Balla et al. 2013).

Apart from the banking and insurance sector, industrial sector has also attracted research interest (e.g. McTier and Wald, 2011; Freund et al., 2002). This is not surprising since, the industrial sector has been subject to the highest class actions of all time, such as the case of Master Tobacco ($206 billion), the case of Dukes v. Wal-Mart Stores ($11 billion), etc. (see Table 1.1). Furthermore, the recent financial crisis resulted in a number of credit-crisis cases filed since 2007. BP in Energy sector, NOVARTIS in Healthcare sector, NOKIA and YAHOO in Information technology sector are some characteristic examples that prove that the industrial sector is a major target of securities class actions (see chapter two for an extensive discussion of exiting literature). Therefore, the focus of the study lies in the industrial sector.

1.3.2 Focusing on USA

The legal framework of the USA that covers securities class actions is clearer than in any other country for many years now (approximately from 'The Reform Act of 1832'). In the United States federal courts, class actions and derivative suits are governed by Federal Rules of Civil Procedure Rule 23 (see Appendix 1), which amended LSP during 1966, introducing the modern class action procedure. That means that security class actions operate in a specific legal context, which is approved by the States, blocking ineligible and inappropriate securities class actions to take place that would be incorrectly traced. European jurisdictions and the EU have

different features compared to the USA class actions system. Specifically, USA juries are keen to punish large companies under the possibility of inflated damages awards, in contrast to European juries. Also, in the USA, the loser does not usually pay the winner's costs, encouraging speculative claims. In Europe (particularly in the UK), the loser usually has to pay at least part of the winner's costs. Another difference is that apart from the UK, document discovery is currently rare in Europe, whereas pre-trial witness depositions and document discovery are strong weapons used by USA class action plaintiffs to extract settlements.

Therefore, it is not only the fact that USA firms were chosen because they are all subject to the same jurisdiction as explained above, but also because this jurisdiction is considered to be more integrated than any other in the world. Hence, the lack of a common base upon which class actions operates causes difficulties in creating a homogeneous sample with comparable data, highlighting the appropriateness of a USA dataset. The unavailability of organised data in other countries as well as the lack of well-informed databases discourages the design of a comparative research project among continents pointing once again the appropriateness of creating a dataset that contains only USA enterprises.

1.3.3 Focusing after Securities Litigation Uniform Standards Act of 1998

The Private Securities Litigation Reform Act of 1995 (PSLRA), as well as the Securities Litigation Uniform Standards Act of 1998 (SLUSA), introduced a number of changes to the existing law that governs class actions such as suggesting that the investor with the largest financial stake could be named the lead plaintiff and the class representative. Under PSLRA and the SLUSA, not only it is required by the court to review the class action on the merits, imposing sanctions on frivolous class actions, but also enhances the role and the responsibilities of plaintiffs. One of the main contributions of PSLRA is that the court ensures that the attorney fees are reasonable (Choi, 2004). The PSLRA requires from plaintiffs to demonstrate that the company facing a class action intended to defraud. Plaintiffs are given great incentives to become the leading representatives, the ones who will step forward for the entire class in court, receiving a proportion of the outcome of the case or being reimbursed for non - pecuniary litigation costs (Eisenberg and Miller, 2005).

PSLRA contributed not only to the faster settlement of cases, but also to their dismissal pointing that the characteristics of settlements have changed after PSLRA (Bajaj et al., 2003). Moreover, there is enough evidence that proves that merits matter especially after these two changes (PSLRA and SLUSA) (Johnson et al., 2013); Freund et al., 2002). Before PSLRA, a little drop in stock price was enough reason for a class to be formed, irrespective of the existence of a material fraud or misstatement. In pre PSLRA enactment, a shareholder could file a class action with minimal evidence. That phenomenon caused frivolous, even nuisance litigation, which certainly cost enough money to the company that was sued (Choi, 2004).

Bearing the above in mind, the current study focuses on securities class actions that took place after the SLUSA 1998 Act.

1.3.4 Focusing after Sarbanes–Oxley Act

Having excluded class actions before 1998 this research project could have selected cases filed from 1999 to 2011. After Enron, Tyco International and other notorious scandals that burst out in 2002, Sarbanes–Oxley Act (SOX) enactment as a United States federal law introduced major changes to the regulation of financial practice and corporate governance. Since then, entities and especially listed ones were not expected to follow widely accepted reporting and corporate governance rules.

The importance of focusing on a post-SOX period is highlighted by Rice et al. (2013), who examined the consequences of failing to report existing control weaknesses as far as SOX 404[3] is concerned. They claim that SOX 404 reports are not always reliable, in that some firms claim to have effective internal controls over financial reporting when they actually have material weaknesses in those controls. Investors trust and confidence is shaken, misleading their investing decisions. The majority of restatements in financial statements occur at firms that have previously claimed to have effective internal controls over financial reporting. Extending the same concept,

[3] Sarbanes–Oxley Section 404 rules the assessment of internal control which requires management and the external auditor to report on the adequacy of the company's internal control on financial reporting; a rather costly procedure while companies are checked for appropriate implementation of relevant legislation (Source: Sarbanes-Oxley Act of 2002)

the current study examines whether the compliance with internal controls and corporate governance are determinants to the filing of a securities class action.

This study investigates how and to what extent accounting tools and corporate governance practices affect litigation. The firms that have been selected were all firms that faced a massive litigation after 2002 and consequently subject to SOX. In this way, the present research examines how corporate governance information affects securities class action analysing firms that are expected to comply with enhanced corporate governance standards. Therefore, firms having faced a class action between 1999 and 2002 are excluded from the analysis.

1.3.5 Securities class actions

A class action has been described by the Alberta Law Reform Institute[4] as follows:

> In an ordinary action, each litigant is a party in their own right. In a class action, one party commences an action on behalf of other persons who have a claim to a remedy for the same or similar perceived wrong. That party conducts the action as "representative plaintiff". Only the "representative plaintiff" is a party. Other persons having claims that share questions of law and fact in common with those of the representative plaintiff are members of the "class". Once the class has been determined, the class members are bound by the outcome of the litigation even though, for the most part, they do not participate in the proceedings. A number of statutory safeguards and an expanded role for the court help to ensure that the interests of the class members are protected. Instead of multiple separate proceedings deciding the same issues against the same defendant or defendants in proceedings brought by different plaintiffs, class actions decide common issues in one courtroom at one time.

There are many types of class actions depending on the reason of their creation[5]. Some known types of class actions are:

- securities class actions
- labour and employment class actions
- consumer class actions
- employee benefits class actions
- civil rights class actions
- debt collection class actions
- antitrust class actions
- commercial class actions

[4] http://www.law.ualberta.ca/alri/.
[5] However, rules governing class actions vary from court to court.

Securities class actions though dominate the federal class action docket of Rule 23 (see Appendix 1). Therefore, this research concentrates only on securities class actions, as this category represents a high per cent of all types of class actions (40% and 35% of total class actions in years 2006 and 2007 (Fitzpatrick, 2010).

1.3.6 Stakeholder management implications

The stakeholder theory contains three aspects, which are the descriptive, the instrumental and the normative one[6] (Donaldson and Preston, 1995). Security class action stakeholders will be explained under the normative aspect of this theory. The security class action risk affects several categories of stakeholders, like shareholders and investors, insiders, lawyers, policymakers, researchers/academicians.

Shareholders are the first to be affected to such an event as they are the first to be informed and the first to decide whether or not to join a class to go against a company, in which they have invested their money. However, the risk is not present after the filing of a class action. There is evidence to support that even the revelation of a potential fraud is capable of causing significant negative reactions to the stock price (Ferris and Pritchard, 2001). Undoubtedly, shareholders would be benefited from a quantitative model being able to predict the class action incidence.

The imminent risk of filing a securities class action affects significantly investors' decisions too. Investors constitute a type of stakeholders, who have great interest on knowing well in advance whether the company whose stock they possess or are about to acquire is a probable target for a massive litigation. Small investors, especially in the USA, are keen on suing directors for security law violations (La Porta et al., 1997). The development of a model to predict securities class actions enables investors to determine the optimum portfolio of stocks, decide when to sell or buy a stock and as a result to maximize its return. In other words, by using a quantitative predictive model they can create their portfolios in such way so as to add value to their investment. From another point of view, the average time for a class action to be

[6] Descriptive aspect describes the basic corporate characteristics and behaviors of each company. Instrumental aspect is referred to the connection between stakeholder management and the achievement of traditional corporate objectives (e.g. profitability, growth). Normative identification of moral or philosophical guidelines for the operation and management of corporations, such as individual or group "rights," "social contract," or utilitarianism (Donaldson and Preston, 1995).

settled varies between 3 to 4 years, even though there are cases that took 15 years to be settled (in a commercial case), while the shortest time is 105 days (in a labor and employment case). During this long period, the news that a firm has faced a massive litigation causes negative effects, not only to its share price, but also to its reputation and goodwill (Fitzpatrick, 2010). The company waits for the court to take a decision, so that it can continue operating relieved from accusations. So, from this perspective, investors are interested in being able to know whether a securities class action will be filed, which usually takes long to resolve but still during that time the firm's share price changes continuously due to the litigation incidence.

Directors, managers, chief executive officers and chief financial officers are very interested whether the company they work for, is probable to face a massive litigation, possibly leading to compensation of millions of dollars, creating a literal chaos to the going-concern of the business. The fact that securities class actions have merit proves that each time a class action is filed to the court, a drop in company's share price takes place. Therefore, a SCA prediction model could help strengthen the company's internal supervision, improving the quality of its control. In other words, the organization strengthens its internal control systems minimizing its total risk. This research ultimately contributes to the protection of a company's reputation, minimizing the probability of material errors in financial statements which could significantly influence the decisions of stakeholders maintaining at the same time its prosperity.

Also, the prediction of a security class action might help the early detection of defective corporate governance, as well as contribute to the strengthening of the relations between management and shareholders leading to the avoidance of representation - agency issues (Strahan, 1998). Interestingly enough, the company could utilize a model to predict securities class action in order to manage cash in an effective way by anticipating potential outflows in order to reimburse the entire class.

Lawyers have a very powerful incentive to sue companies whose stock has experienced a drop (Strahan, 1998). Especially after PSLRA, and since the framework of SCAs has become more tight and specific, not only compensation procedures but also contingent fees among others are determined in a more specific way. Important

evidence that supplements the theory of legal fees is that they decline as the recovery amount of a class action increases. Especially, in cases with recoveries of $100 million or more, legal fees are minimised, suggesting that aggregate litigation assists efficiency (Eisenberg and Miller, 2010). Consequently, lawyers would be interested in a decision tool that could allow them to identify potential firms that have great possibilities to face a security class action. This could allow them to estimate the expected legal fees as well as to prepare their defense strategy in advance. Similarly, institutional investors' or pension funds' involvement as lead plaintiff for the class have the same kind of interest in identifying potential target firms.

Policymakers try to corral security class actions. From their point of view, they don't know how much money change hands each time a settlement is decided by a court[7]. Given the fact that in many cases the recovery amount is enormous, this share of stakeholders are pretty much interested in a decision tool that could inform them whether enterprises are threatened by a class action. Bering in mind that policymakers are interested in maintaining or even improving the prosperity of a society, they have to be in a position to predict the number of filings of securities class actions in order to protect public interest and take corrective actions before it is too late.

It is very useful to academics and researchers to be able to determine the factors that drive a security class action and whether it can be accurately predicted. The current thesis provides evidence on the application of classification techniques for the first time in the literature. The comparison of various techniques enriches the reader's knowledge on the securities class action phenomenon and its prediction.

1.4 Aims

The current research aims to fill the gap in the literature regarding the prediction of securities class action lawsuits using accounting ratios and corporate governance indicators. More detailed, the current study specifically aims to:

[7] This was particularly evident between the Reform Act of 1832 and Rule 23 Federal rules of civil procedure in 1966.

1. Identify the underlying factors-variables and in particular accounting and corporate governance information that contribute to the classification of firms to the Class Action group (CA) and the Non Class Action group (NCA).
2. Compare alternative methods for the development of the prediction. In more detail, it focuses on the development of prediction models for the identification of securities class actions filed against USA enterprises over the period 2003-2011, by comparing and evaluating the following classification methods: Discriminant Analysis (DA), Logit Analysis (LA), Utilités Additives Discriminantes (UTADIS), Multi-group Hierarchical Discrimination (MHDIS) and Support Vector Machines (SVM). Also, it empirically investigates whether an integrated model can improve the prediction accuracy.

1.5 Empirical objectives

An identification of the objectives is considered rather vital, in order to assist the study approach its aims. Therefore, the **first objective** of current thesis is to investigate whether accounting information is useful in the prediction of securities class actions. The **second objective** is to examine if the addition of corporate governance indicators to the models could enhance the predictability accuracy. The **third objective** is to compare the individual models and result to which technique can provide higher classification accuracies. The **fourth objective** is to examine the stability of the models during the crisis. This will be achieved by splitting the training sample and the validation sample in a way that will reflect the crisis of 2008. The **fifth objective** is to investigate whether an integrated method, namely Majority Voting, could enhance the classification accuracy in relation to the other methods applied (LA, DA, UTADIS, MHDIS and SVMs).

1.6 Contributions of the study

This thesis contributes to the literature in the following two ways.

Firstly, the existing literature presents descriptive and statistical evidence for securities class actions trying to investigate the factors (financial and non-financial) that cause this phenomenon. Part of the literature applies statistical analysis, which either relates to the consequences of SCAs or investigates its effect to the share price.

Unfortunately, the literature has failed to develop models that can predict securities class actions, indicating the gap that this thesis aims to fill. Thus, the first contribution of this research is that it employs five classification techniques plus an integrated method, in order to predict the phenomenon of security class actions. In other words, it is the first study that examines the prediction of securities class actions in industrial sector basing its data on the most recent period (2003-2011) employing the largest sample so far[8].

Secondly, it is the first study that uses corporate governance variables in conjunction to accounting variables, in order to develop prediction models for securities class actions. Even though corporate governance information had been used in the past to determine the lawsuit, it has never been used in developing quantitative methods for its prediction.

1.7 Outline of the thesis

The first chapter aimed to provide to the reader with an overview of class actions and clarify the significance of this thesis presenting the aims and the objectives of the thesis. More importantly, chapter one clears up the contribution of this thesis. The rest of the thesis is organised as follows. Chapter two presents a background discussion on the securities class actions. This includes evidence about the merit of the class action and the advantages/disadvantages of this kind of litigation. It also presents a detailed analysis of the effects and a review of class actions, making the reader more familiar with the research topic. It presents an extensive study by study review of the empirical literature on prediction of securities class actions. Chapter three presents the methodological framework of the current research; namely, the way the Discriminant Analysis (DA), Logit Analysis (LA), UTADIS, Support Vector Machines (SVMs), MHDIS and Majority Voting (MV) work. Chapter four presents the sources of data, the construction of the sample and the criteria upon which the accounting variables and corporate governance indicators are collected. Chapter five presents the results obtained using all the methods described in the previous chapter, while using accounting information from publicly available sources. In chapter six the models are

[8] Existing literature concentrates on corporate events such as bankruptcy, mergers and acquisitions etc. Most of it shows encouraging results in predictive accuracy, even though they seem to differ according to the event, the country as well as the methodology used.

re - estimated while adding corporate governance indicators. In both chapters five and six, the models are critically evaluated according to their capability to predict securities class action. Lastly, chapter seven summarises the findings and the conclusions of the study, while it presents the limitations of the thesis and suggests areas for further research.

CHAPTER 2 BACKGROUND DISCUSSION AND LITERATURE REVIEW

2.1 Introduction

The current chapter presents the nature of securities class actions and their basic characteristics. It provides evidence supporting that the subject under examination has merit, fact which strengthens its research necessity. Moreover, it analyses the causes of securities class actions, as well as the implications that they have to the financial statements. The following sections will present the motives of securities class action filing, as well as the disadvantages for the investors. The rationale of this chapter is to provide the reader with background information, according to the various aspects of the securities class action phenomenon. Throughout the chapter there is a discussion about the existing evidence regarding the prediction, using accounting and corporate governance information, revealing the gap that this study is going to fill. Rule 23 of Federal Rules of Civil Procedure, which governs class actions, is cited in Appendix 1 and provides the reader with further information on the legal framework.

2.2 The merit of class actions

The majority of security class actions are not false alarms. Public attention on accounting improprieties matters, especially after PSLRA. Naturally, shareholders would be more likely to initiate a class action lawsuit if they perceive it to have merit[9]. There is a positive correlation between purchases by top executives and abnormal stock returns, one day before the class period, meaning that insiders benefit from earnings overstatement (Iqbal et al., 2007; Johnson et al., 2002). Moreover, the real merit on security class actions is due to its positive linkage to CEO turnover (Niehaus and Roth, 1999). More specifically, CEOs turnover is higher in meritorious cases, indicating the correlation of a security class action to disciplining actions from managers. Also, merit based factors are found to be significantly associated with settlement amounts (Simmons, 2011).

Another aspect that enhances the general belief that security class actions have real merit is that of representation. A security class action allows a representative

[9] When a legal action has merit means that it will end up compensating the plaintiffs.

stakeholder to initiate a legal suit against a corporation on behalf of a number of other stakeholders, who are in similar situation. Through these actions, stakeholders can act against directors and controlling shareholders. Due to their flexibility, they are increasingly used in the last ten years. Since each class action may be constituted by hundreds of shareholders, it is quite impossible for the whole class to follow each phase of the litigation process. Class representatives play this role which is to protect the interests and rights of absent class members and deal with their obligations (Kim, 1998). From the moment a class action representative is allowed to proceed, the result is bound to all class members, irrespective of whether they are absent or not.

Settlements that are always settled for zero dollars regardless of the merit are limited to the initial public offering (IPO) cases and to those where the ultimate outcome of the litigation is not its real objective, like in class actions being filed only to disrupt the financing of a start-up company for strategic purposes (Alexander, 1991).

The following acts aim to limit frivolous securities lawsuits in the United States of America, providing a better and coherent framework of class action litigation and simultaneously promising greater efficiency screening cases.

1. The Reform Act 1832
2. The Securities Act of 1933
3. The Securities Exchange Act of 1934
4. Rule 23 Federal rules of civil procedure revised in 1937
5. Rule 23 Federal rules of civil procedure revised in 1966
6. The Private Securities Litigation Reform Act of 1995
7. Securities Litigation Uniform Standards Act 1998
8. The Class Action Fairness Act 2005

Hence, a security class action is being seen as a serious matter and its legal framework undergoes continuous enrichment over time, remaining always up-to-date in order to confront the challenges of business alterations.

2.3 Class actions motives

The cost associated with the filing class actions prevents shareholders from litigating individually. Class actions have the incentive of compensation for director's past mistakes (Kim, 1998). Minimisation of agency costs, saving costs (attorneys' fees), lower litigation costs (as this cost is divided among members of the class), and greater judicial efficiency (less cumulative court time involving at the same time fewer judges) are major advantages. More specifically, class actions promote economies of scale, effort and provide uniformity of judgement for cases that have similar legal characteristics. Class actions serve judicial procedures saving time, expense and effort, promoting uniformity of adjudication for similar cases. In other words, class actions allow courts to adjudicate the rights of multiple similar cases in one time. This characteristic of class actions promotes consequently judicial efficiency (Rose, 2009). Another important aspect is that class actions allow the poor to challenge the legality of their case, in a way that addresses all dimensions of the problem, irrespective if these shareholders were fully aware of them or not, at the time they entered the class. On the other side, organisations manage their operations taking into account the implications to public accountability.

Legal fees decline as the recovery amount of the case increases encouraging investor's participation. Litigation costs and expenses contain a small percentage of the class recovery (Eisenberg and Miller, 2010). Furthermore, the class recovery amount, the legal fees, the hours reported in the court’s opinion and the age of the case in years, where found to relate positively to expenses. This proves that costs like legal fees, in mega cases (where the settlement amount exceeds $100 million) have scale effects (Fitzpatrick, 2010).

In cases where the representative investor of the class owns a small share of a company, then this investor will litigate more often with class-action privileges and contingent legal fees, than will the investor with no class action privileges and fixed legal fees (DeJong, 1985).

Last but not least, the fact that late opt-ins and opt-outs are possible, increases the probability to create a big class, as it gives flexibility to its formation (Che, 1996).

2.4 Class actions disincentives

Class actions entail some disadvantages though for the investors. The representative makes all the decisions in account of the entire class, meaning that the rest of the class lack entirely the decision making control. In case of an unsuccessful lawsuit, individual class members usually do not have the right to bring individual lawsuits at a later date. These cases almost always settle solely for financial compensation, as other types of compensation are not sought.

Moreover, agency problems can arise after a class action lawsuit for two reasons. The first is that the class members are often disorganized and the second reason is that the regulatory system, under which attorneys are controlled, is inadequate (Che, 1996).

Even though there are disadvantages, there are still enough incentives that drive shareholders to litigate than discourage them. Accordingly, it is worth examining this subject since more and more shareholders tend to resort to this solution.

2.5 The effects of securities class actions

The following evidence illustrates the importance, as well as the necessity to study the possibility of a security class action taking place. As it is discussed below, security class actions affect stock returns, goodwill, liquidity, cost of capital, corporate governance structure, investment, capitalisation, etc.

Stock returns

There are many studies that prove the negative effect of security class actions on stock returns. Abnormal security returns will be observed not only when misrepresentations are discovered in a company's financial statements, but also in periods preceding discovery (Kellogg, 1984). Alexander (1996) agrees that the non-disclosure of material adverse information that inflates the price of a stock harms the investors who purchase the stock. Supporting evidence suggests that a security class action might be seen as an event of three stages (Ferris and Pritchard, 2001). The first is the stage is the revelation of a potential fraud, in which there is significant negative reaction to stock price. The second stage is the filing of the fraud to court, in which the significance is smaller but still the reaction to stock price is negative. Lastly, there is the third stage of the judicial resolution during which there is no reaction to stock

price. This evidence shows that only the revelation of a potential fraud has immediate reaction to stock price. Shareholders are not much interested about the outcome of the lawsuit (third stage); rather about the revelation of the incidence (first stage) and its filing (second stage). A related empirical study proved that the revelation of a potential fraud is linked to an abnormal negative return of 21.5% during a three day period surrounding the announcement of negative information, 23.5% during the formation of the class and until two days before the announcement, and to a 43.8% during the entire class period (Niehaus and Roth, 1999).

Cost of equity

According to Chava et al. (2010) security class actions are likely to increase firm's perceived risk in corporate governance, information asymmetry, and operation and therefore its cost of equity capital. They found that after the lawsuit is filed, firm's cost of equity capital increases significantly. Also, security class actions are associated with indirect costs such as difficulty in recruiting directors and auditors after a lawsuit has occurred. More importantly, security class actions disrupt the relationships between an entity and its suppliers and customers (Black et al., 2006).

CEO turnover

Securities class actions affect CEO turnover too. Out of a sample of 309 companies that were sued and settled between 1991 and 1996, their board structure did not change significantly after a lawsuit, whereas insider holdings declined. The probability of CEO turnover increases for both high and low settlement cases, from about 9% per year before to about 23% per year after the settlement (Strahan, 1998). A class action's announcement harms CEO's and CFO's future job prospects. After such an event CEO's turnover takes place as well as pay-cuts and takeovers, causing a negative market reaction (Humphery-Jenner, 2012).

Investment

A class action results in decrease of overinvestment. This decrease matches with an increase in cash holdings, a decrease in payouts, and an increase in leverage. Firms that have faced a class action in the past, change their behaviour towards better governance, greater focus, and lower overinvestment (McTier and Wald, 2011).

2.6 Accounting information in securities class actions

Bearing in mind that the aim of this study is to explore the ability of accounting information to classify the securities class action lawsuits into SCA and NSCA group, this section focuses on the causes of class actions and the evidence related to their prediction. Hence, the main focus is on accounting information and whether this could be conceived as an important determinant for the prediction of this phenomenon.

It is not surprising that a growing strand of the literature examines the causes of securities class actions, providing insights into the litigation process and analysing the effects of lawsuits on corporations (e.g. McTier and Wald, 2011). Others examine the factors that influence the probability of a security class action (e.g. Strahan, 1998). However, there are no studies on the development of quantitative models to predict security class actions, in advance of their occurrence and this is a material gap that this research is going to fill.

It should be noted that the existing literature on security class actions examines the topic from the law point of view. Interestingly, there are studies that link security class actions with ethics, but such a research is beyond the scope of this thesis due to lack of information[10].

The disclosure of bad news increases the probability of security class actions. Kinney et al. (1989) claim that when firms restate their financial statements, due to material errors, the yield of the stock returns is directly affected, increasing once more the probability of a lawsuit. There is evidence to link the size of the company with the lawsuit proposing that larger companies have higher probability to face a class action, as they promise large damage compensation (Sarra and Pritchard, 2010).

The following table summarizes the existing studies on the phenomenon under examination, the number of lawsuits in each one of them, the period of reference, the employed methodology and the database used to collect the data.

[10] The massive litigation can be considered a signal of unethical strategy from the part of directors and managers of the business. Insiders with poor ethics, working under poor ethical corporate policies increase the probability of misstatements in financial statements, giving rise to class actions as well (Abdolmohammadi and Sultan, 2002).

Table 2.1: Summary of studies examining accounting in prediction of SCA

Paper	No SCA lawsuits	Period	Methodology	Database
Kellogg, (1984)	56	1967-1976	T-test	CRSP, WSJI
Johnson et al. (2013)	114	1991-2000	Logistic regression	SUSCAC, PwC, CRSP, Compustat
Gande et al. (2009)	377	1996-2003	Probit model	SUSCAC CRSP ExecuComp
Donelson et al. (2012)	423	1996-2005	Logistic regression	Factiva, Lexis-Nexis, SUSCAC
McTier and Wald (2011)	202	1996-2005	Probit regression	SUCAC, CNA, CRSP, ExecuComp CSID I/B/E/S
Pellegrina et al. (2011)	126	2000-2008	Logistic regression	BankScope SUSCAC
McShane et al. (2012)	785	1996-2004	Hierarchical Bayesian model	RGSCASD, Yahoo! F, CRSP GNA KFDL
Balla et al. (2013)	240	2002-2011	Logistic regression Discriminant analysis UTilités Additives DIScriminantes K-Nearest Neighbours Artificial Neural Networks Probabilistic Neural Networks CART	BankScope Riskmetrics

Notes: CRSP: Center for Research in Securities Prices, SUSCAC: Stanford University Securities Class Action Clearinghouse, PwC: PricewaterhouseCoopers, ExecuComp: Compustat Executive Compensation Database, RGSCASD: Riskmetrics Group's Securities Class Action Services Division, CNA: Compustat North American annual files, CSID: Compustat Segment Information Database, I/B/E/S: Institutional Brokers Estimates System, Yahoo! F: Yahoo! Finance (2011), GNA: Google News Archive (2011), KFDL: Kenneth French's Data Library (French, 2011)

2.6.1 Kellogg (1984)

This study is a milestone in the area. Its importance lies with the fact that it is not only the first time that securities class actions are investigated from an empirical accounting point of view, but also the first study that can assist shareholders with their investment decision making.

Kellogg examines whether the stock returns are associated with earnings changes. It is found that negative returns are observed months before misrepresentations are discovered. He claims that this can be explained as lawsuits are more likely to occur when negative returns have preceded financial statement revisions or stock price decline is effect of selective leakages of information of prior financial statements contained misrepresentations. Periodic asset valuations lead to restatement of financial statements and cause revisions which are associated to different patterns of security returns. The information that asset realizable values are being revised is linked to great abnormal returns prior to announcement.

Further he investigates whether the stock price is an incentive for securities class actions and concludes that stock price declines are incentives to a security class action lawsuit. Classification of misrepresentations based on hypothesized relations between announcements and security returns results in observed differences in the association between litigated accounting announcements and common stock returns.

Conclusively, it is the first time that someone compares the return series associated with earnings changes resulting from different events. All future academicians base their research upon this paper, even though at that time the legal environment was quite unstable and undefined.

2.6.2 Johnson et al. (2013)

This study examines the relationship between restatements and lawsuits. Focusing on high technology firms the authors examine the role of earnings forecast and insider trading to the class action incidence. The next table presents the results of this study in the pre and post PSLRA period.

Table 2.2: Factors Associated with Lawsuit Filings (Johnson et al. 2007)

Variables	Pre PSLRA period	Post PSLRA period
Restatement	2.42***	4.77***
Abnormal insider trading	-2.08**	-4.03***
Positive forecast	1.03*	0.77
Negative forecast	-0.46*	-0.85
Earnings warning	3.32***	2.09***
Average Tenure	-0.09	-0.04
Busy	0.60**	0.23
Independent	-1.63	-2.22
Audit meetings	-0.01	0.17
Independent audit	0.15	0.60
Market Capitalization	0.49***	0.65***
Turnover	0.39	1.32
Minimum Return	0.55	-5.75***

Notes: Restatement: Indicator variable equal to one if the firm restated class period earnings; zero otherwise, Abnormal insider trading: Shares purchased less shares sold (in millions) during the class period by directors, chief executive officers, chief operating officers, chief financial officers, presidents, and vice presidents less the same measure for an equal length period preceding the start of the class period , Positive forecast: Indicator variable equal to one if the firm made a positive forecast during the class period; zero otherwise, Negative forecast: Indicator variable equal to one if the firm made a negative forecast during the class period other than on the minimum return date or the end of the class period; zero otherwise, Earnings warning: Indicator variable equal to one if the firm made a negative forecast on either the class end or minimum return dates; zero otherwise, Average Tenure: Mean number of years that outside directors have been on the firm's board, Busy: Mean number of external directorships of public companies held by outside directors, Independent: The percentage of outside directors on the firm's board, Audit meetings: Number of meetings held by the audit committee, Audit independence: The percentage of outside directors on the audit committee, Market Capitalization: Log of market value of common equity (in millions of dollars) at the end of the fiscal year preceding the beginning of the class period Turnover: 1-(1-Turn)X, where Turn is average daily trading volume divided by the number of shares outstanding and X is the number of trading days during the class period, Minimum Return: Minimum 1-d return during the class period plus 1 d after the end of the class period.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

The above table examines the determinants of lawsuit filings in the pre and post PSLRA period. The firms that restate their earnings have higher probability to be sued both before and after the PSLRA. Especially, during the post PSLRA period the risk of being sued for earnings restatements is greater than in the pre PSLRA. Class actions are also more highly and negatively correlated with abnormal insider stock sales in the post PSLRA period. Issuing a forecast of positive earnings news or an earnings warning significantly increases the probability of a class action in both periods. On the contrary, issuing a forecast of negative earnings news does not reduce the probability of a class action. Moreover, there is little evidence that corporate governance variables play a significant role in the probability of a class action, apart from the variable 'Busy' in pre PSLRA period. Once again, and as expected, firm size plays a significant role in both periods, in determining the litigation matter. 'Share turnover' is insignificant in both periods, and 'Minimum Return' in the pre PSLRA

period. Conclusively, restatements and abnormal insider stock selling are materially related to the probability of security class action mainly in post PSLRA. Lastly, earnings warning are a consistent predictor of class action lawsuits.

Even though this paper provides an interesting set of results about the determinants of litigation, the authors admit that this model cannot explain all the variation in the incidence of class action. They claim that the unexplained variation has both merit and non-merit aspects and accept that they have not completed their research according to the post PSLRA period. In more detail, they refer that their research has not addressed one of the greater aspects that PSLRA imposed, which is whether the enactment of PSLRA discourages the filing of a lawsuit. Another limitation of this paper is that it does not examine whether SOX (enacted after 2002) may reduce litigation risk since the data they used were from 1991 until 2000. The authors argue that the impact of SOX law should be examined as further extension of their paper.

2.6.3 Gande et al. (2009)

This is another study that examines the causes of filing a lawsuit. Among others it investigates the price reactions to the phenomenon of class actions. It mainly documents significant stock price reactions to shareholders' class action lawsuits. Table 2.3 presents the variables that determine the incidence of securities class actions as well as their statistical significance. The propensity for a company to face a security class action is estimated using factors that associate to the size of potential damages, the litigation environment, and firm's specific characteristics. Entities with higher damage awards and higher share turnover are more likely to be sued. 'Deep pocketed' firms are more likely to be sued, an evidence which is consistent with the rest of the literature. Furthermore, the litigation environment affects the likelihood of a class action. Firms that faced a massive lawsuit once in the past are more probable to face one again. High stock returns prior to the lawsuit are positively linked to litigation. Regarding the effect of corporate governance, firms that pay managers relatively high bonuses are less likely to be sued, whereas firms that continue to pay managers relatively high bonuses even after the firm experiences poor operating performance are more likely to be sued. CEO share ownership is negatively related to

massive litigation. Profitable firms and firms that provide investors with "good news" on earnings announcement dates are less likely to be sued.

Table 2.3: Factors affecting lawsuit filings (Gande et al., 2009)

Variables	Security Class Action
Share turnover	0.569***
Volatility	-0.473
Estimation period stock return	-0.257***
Log of market capitalisation	0.099***
Previous lawsuit dummy	1.494***
Litigation intensity	-0.239***
Litigation intensity (squared)	0.010***
Regulation dummy	-0.187
Financial dummy	0.236**
Technology dummy	-0.299***
Retail dummy	0.410
Return on Assets	-0.152**
Discretionary Accruals	0.031**
Discretionary Accruals lag 1	0.002
Discretionary Accruals lag 2	0.004
Standard unexpected earn	-0.038***
Proportion of bonus compensation	-0.603***
Bonus × neg. ROA dummy	0.503**
CEO Share ownership	-0.099

Notes: Share turnover: Estimated using the procedure defined in Field, Lowry, and Shu (2005) over the six month estimation period preceding the lawsuit filing date, Volatility: Estimated as daily standard deviation of the rate of return in the six-month estimation window preceding the lawsuit filing date, Estimation period stock return: compounded stock return, measured over the six-month estimation period preceding the lawsuit filing date, Previous lawsuit dummy: takes a value of 1 if a firm has been sued before, and 0 otherwise, Litigation intensity: number of class action lawsuits that have been filed against other firms in the same four-digit SIC code as the sued firm during the six-month estimation period preceding the lawsuit filing date, Regulation dummy: takes a value of 1 if a firm's four-digit SIC is between 4000 and 4999, and 0 otherwise, Financial dummy: takes a value of 1 if a firm's four-digit SIC is between 6000 and 6999, and 0 otherwise, Technology dummy: takes a value of 1 if a firm's four-digit SIC is within 2833–2836, 3570–3577, 3600–3674, 7371–7379, or 8731–8734, and 0 otherwise, Retail dummy: takes a value of 1 if a firm's four-digit SIC is between 5200 and 5961, and 0 otherwise, Discretionary accruals: estimated from a modified Jones model as of the financial year preceding the lawsuit filing date, Std. Unexpected earn.: estimated as the difference between actual quarterly earnings and the First Call consensus earnings estimate for the quarter immediately preceding the lawsuit filing date scaled by the standard deviation of First Call consensus earnings forecast, Proportion of bonus compensation: the sum of the dollar values of salary, bonus, other compensation, savings plans, properties and insurance, long-term incentive payments, restricted stocks, and stock options, Bonus×neg. ROA dummy: interacts proportion of bonus compensation with a dummy variable that takes a value of 1 if return on assets is negative, and 0 otherwise, CEO Share ownership: Dollar value of CEO shareholdings.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

2.6.4 Donelson et al. (2012)

This paper provides an interesting insight into the incidence of litigation as it examines whether timely revelation of bad earnings news is associated with a lower probability of litigation. Alternatively, the interest lies in whether the timeliness of

total earnings news differs significantly between firms that faced a class action and firms that never faced a class action. To measure the timeliness of total earnings news, the evolution of the consensus analyst earnings forecast for a sample of sued and non-sued firms is examined.

Table 2.4: The effect of timely revelation of earnings news on litigation (Donelson et al., 2012)

Variables	All Suits	Dismissed Suits	Settled Suits
Timeliness	-0.51 (-7.34) ***	-0.65 (-5.81) ***	-0.43 (-4.70) ***
News	0.03 (0.75)	0.01 (0.23)	0.00 (0.02)
Size	0.03 (2.78) ***	0.04 (1.88) *	0.02 (1.77) *
BV	-0.62 (-3.44) ***	-1.13 (-2.99) ***	-0.51 (-2.41) **
Cumulated daily stock return	-0.04 (-10.25) ***	-0.04 (-6.62) ***	-0.04 (-7.33) ***
Highlit	0.20 (0.97)	-0.22 (-0.68)	0.48 (1.78) *
Share_turn	0.55 (4.45) ***	0.59 (2.97) ***	0.67 (3.67) ***
Volatility	-0.01 (-0.28)	-0.16 (-1.56)	0.03 (0.47)
Follow	0.05 (2.48) **	0.04 (1.21)	0.07 (2.65) ***

Notes: Timeliness: The average proportion of total news that was revealed up to a given day in the quarterly revelation window, News: For sued firms, this is the "earnings revelation" at the end of the class period less the beginning consensus forecast (which is measured at least one day after the prior quarter earnings announcement) scaled by stock price one day after the prior quarter earnings announcement. Size: The market value of the firm obtained from CRSP and measured on the day after the prior quarter's earnings were announced. Expressed in billions of U.S. dollars, BM: The ratio of total shareholder equity in the litigation quarter to market value of equity at the beginning of the quarterly revelation window, Highlit: An indicator variable that is set to one when the firm operates in a high litigation risk industry and is equal to zero otherwise, Share_turn: The average daily turnover (volume / shares outstanding) over the quarterly revelation window, expressed as a percentage, Volatility: The standard deviation of daily returns over the quarterly revelation window, expressed as a percentage, Follow: The number of analysts following the firm during the quarterly revelation window.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

The results show that there is a negative relation between 'Timeliness' and the probability of a lawsuit. Control variables are generally significant in the predicted direction. Exceptions include the 'High litigation risk industry' variable and 'Volatility'. First, sued firms are accused of fraud, and there may be something fundamentally different about the timeliness of information flow when firms actually commit fraud. Second, dismissed lawsuits are those that courts deem to be "non-meritorious". Exposure to "non-meritorious" litigation is arguably the type of litigation that early revelation of bad news may best pre-empt. Overall the basic

innovation of this paper is the introduction of timeliness of earnings disclosure to the determination of the dismissed or settled suits. The sooner the revelation of bad earnings news the lower is the incidence of litigation. Apart from that all other variables used have been repeatedly examined in other papers such as Kellogg (1984) and Johnson et al. (2007).

2.6.5 McTier and Wald (2011)

Financing choices is the centre if interest in this study. It enriches the literature by importing to the analysis variables like 'Overinvestment', 'Dividends', 'Repurchases', 'Acquisitions' that had never been examined before. Once again the main goal is to determine the causes and consequences of shareholder's class action lawsuits. The following table shows the coefficients and the statistical significance of variables used in five alternative combinations of the probit regressions. Firms that pay larger dividends are less likely to face class actions, whereas large firms that make greater repurchases and retain more cash are less likely to face suits mostly in model one. That is proven by the positive coefficients on pre suit overinvestment indicating that firms which overinvest are more prone to massive lawsuits. Acquisitions also affect positively the litigations but they are not statistically significantly. In summary, reviewing the coefficients of 'Overinvestment', 'Acquisitions', and 'Dividends', we find evidence that firms that overinvest acquire more, and payout less cash are more likely to be sued. As far as the opacity variables are concerned, there is a highly statistically significant and negative relationship between tangibles and the probability of suit. Additionally, there is a statistically significant and positive relation between the probability of a class action and 'AQ', analyst coverage, and analyst dispersion. The positive relation between the probability of suit and the idiosyncratic risk implies that lawyers may be more likely to opportunistically sue firms with independent movements. Also, 'Sales growth' is positively related to the litigation in four of the probit regressions models. The final firm specific control variable is the issuance of equity. It is statistically significant and positively related to the probability of a suit. Regarding the corporate governance variables used in probit regressions, the evidence is mixed. 'Compensation', 'Ownership', 'Age', or 'Tenure' is not related to lawsuits. However, CEO duality is positively associated to the litigation.

One of the drawbacks of this paper is that it focuses its analysis on a rather old period; 1996-2005, which has already been examined by other researchers like Gande et al. (2009) and Donelson et al. (2012) offering little to the literature from that perspective. Still, it offers valuable evidence to overinvestment as a significant determinant of security class actions.

Table 2.5: Factors Associated with Lawsuit Filings (McTier et al., 2011)

Variables	Model 1	Model 2	Model 3	Big firms	Small firms
Overinvestment	2.344*** (7.31)	2.146*** (2.93)	3.074*** (3.21)	2.496*** (5.63)	1.616*** (3.21)
Acquisitions	0.505** (2.30)	0.258 (0.64)	−0.210 (−0.37)	0.342 (1.30)	0.688 (1.64)
Dividends	−3.928** (−2.14)	−1.590 (−0.73)	−1.867 (−0.68)	−1.172 (−0.69)	−23.588*** (−3.54)
Repurchases	−1.358*** (−2.82)	−1.096* (−1.80)	−0.889 (−1.19)	−1.451*** (−2.82)	−0.160 (−0.16)
Cash retained	−0.0478 (−1.21)	−0.170** (−2.28)	−0.025 (−0.15)	−0.148*** (−2.97)	0.018 (0.35)
Tangibles	−1.027*** (−6.72)	−0.682*** (−2.58)	−1.019*** (−2.99)	−1.133*** (−6.06)	−0.779*** (−2.67)
AQ/proxy for earnings opaqueness		2.340*** (3.43)	2.061* (1.83)		
Analyst dispersion		0.035*** (3.72)	0.007 (0.43)		
Analyst coverage		0.132*** (3.11)	0.153** (2.33)		
Beta	0.206*** (8.19)	0.055 (1.17)	−0.052 (−0.70)	0.115*** (3.53)	0.269*** (5.91)
Idiosyncratic risk	6.273*** (8.41)	7.185*** (4.09)	15.087*** (4.03)	11.644*** (9.59)	6.114*** (4.86)
Return	−0.082*** (−3.45)	−0.017 (−0.40)	−0.053 (−0.69)	−0.075*** (−2.81)	−0.149*** (−2.82)
Market value	0.196*** (17.12)	0.139*** (4.98)	0.146*** (3.10)	0.171*** (11.09)	0.3760*** (8.37)
MV/BV	−0.016* (−1.83)	−0.014 (−0.87)	−0.018 (−0.78)	−0.016 (−1.59)	−0.032 (−1.59)
Leverage	−0.296*** (−2.97)	0.241 (1.28)	0.662** (2.21)	−0.251** (−2.05)	−0.801*** (−4.32)
Sales growth	0.087*** (8.26)	0.075** (2.30)	0.104 (1.43)	0.1280*** (8.19)	0.0437** (2.41)
Diversification	−0.024 (−1.15)	0.013 (0.44)	−0.001 (−0.04)	−0.016 (−0.70)	0.041 (0.74)
Equity issuances	0.086*** (4.71)	0.072 (1.57)	0.066 (0.79)	0.069*** (3.24)	0.118*** (3.22)
Compensation			0.002		

			(0.04)		
Option compensation			0.176 (1.05)		
Shares owned			0.649 (0.83)		
Age			−0.002 (−0.45)		
Tenure			−0.002 (−0.54)		
CEO dual			0.165** (2.04)		
E-index			0.028 (0.92)		

Notes: Acquisitions: scaled by total assets, Overinvestment: the difference between the firm's investment-to-asset ratio and mean industry investment-to-asset ratio by year, Dividends/Repurchases: dividends and repurchases are divided by total assets, Cash retained: the log of one plus cash divided by sales, Tangibles: gross property, plant, and equipment divided by total assets, AQ/proxy for earnings opaqueness: accrual quality measure, Analyst coverage: equals the log of one plus the number of analysts' annual forecasts for the firm's earnings, Beta: calculated as the coefficient of the regression of the stock return over the 150 days prior to the fiscal year-end close on the S&P Composite Index return, Idiosyncratic risk: calculated as the standard deviation of the residuals from this regression. Return: the one-year cumulative stock return from CRSP, Market value: equals the sum of the market capitalization of the firm's common stock, book value of the firm's preferred stock, and book value of the firm's long-term debt, Leverage: calculated as the company's total debt divided by the sum of the company's market value of equity and total debt. Growth: the one-year growth rate in net sales, Diversification: the number of operating segments with different industry codes, Equity issuance: defined as the increase in the market value of the firm's stock net of the effect of market return and is scaled by firm assets, Compensation: the log of total compensation, Option compensation: the option grants as a fraction of total compensation, Shares owned: are the shares owned by the CEO as a fraction of total equity outstanding, CEO dual: a dummy variable that equals one if the CEO is also the chairman or co-chairman of the board in a given year, E-index: includes six provisions that protect the existing management: staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, supermajority requirements for charter amendments, poison pills, and golden parachutes.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

2.6.6 Pellegrina and Saraceno (2011)

According to Pellegrina and Saraceno (2011) security class actions can become a *«warning signal of instability, as well as a risk evaluation tool for bank managers»*. Focusing only on the banking sector, they created a dataset of banks that have faced at least one SCA in the past and another dataset that is composed of banks that have never faced a lawsuit in the past (control group).

It is clear from the next table that good governance may protect a bank from a class action, as those banks which exhibit bad corporate governance are SCA targets. Also, the positive and strongly significant for size ‘TA’ variable indicates that "Deep pocketed" banks have more probabilities to face a massive lawsuit. This means that in a way large companies guarantee that they can successfully repay damaged investors. Another significant variable is the ratio of ‘impaired loans to gross loans’ which

seems to affect positively the SCAs. Furthermore, SCAs seem to take place more frequently against banks with a low 'net interest margin' and a low share of 'earnings to total assets'. Clearly, 'dividend payout ratio', 'ROE to standard deviation ROE' and 'bank soundness' seem to play no part in the prediction of securities class actions as indicated in Table 2.6.

Table 2.6: Regression results (Pellegrina and Saraceno, 2011)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
TA	0.002*** (0.000)	0.002*** (0.000)	0.003*** (0.000)	0.002*** (0.000)	0.002*** (0.000)
Imp_ loans gross	0.023 (0.038)	−0.078 (0.142)	0.100* (0.055)	0.018 (0.035)	0.021 (0.035)
Ear_assets TA	−0.032 (0.039)	−0.070 (0.061)	−0.051* (0.029)	−0.035 (0.027)	−0.039 (0.027)
Net_int. margin	−0.098 (0.110)	−0.801*** (0.223)	−0.115 (0.112)	−0.116 (0.125)	−0.123 (0.127)
Equ. fund	−0.087 (0.062)	0.099 (0.080)	−0.041 (0.058)	−0.117* (0.061)	−0.130** (0.061)
Rat. gov	−0.235*** (0.072)	−0.293*** (0.085)	−0.279*** (0.073)	−0.246*** (0.077)	−0.255*** (0.077)
Invbank	1.479** (0.676)	60.078 (31,740)	1.140** (0.540)	1.092** (0.519)	1.295** (0.526)
Lloss prov_intrev	0.001 (0.006)				
Tot_cap.ratio		−0.167* (0.092)			
Div_payout			−0.001 (0.002)		
Sharp ratio				−0.009 (0.016)	
Z-score					0.001 (0.001)

Notes: TA: total assets, Imp_ loans gross: impaired loans to gross loans, Ear_assets TA: earnings to total assets, Net_int. Margin: net interest margin, Equ. Fund: equity to deposits ratio, Rat. Gov: governance rating, Invbank: investment bank, Lloss prov_intrev: loan loss provisions to interest revenues, Tot_cap.ratio: capital to risk weighted assets, Div_payout: dividend payout ratio, Sharp ratio: ROE to standard deviation ROE.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

The advantage of this paper is that it is the only research so far that focuses on the banking sector, instead of including other industries into the analysis as well. On the other hand, it does not refer to the importance of SOX enactment to the incidence of litigation, even though the period covered in the analysis could assist that kind of

investigation and the indicator for corporate governance is statistically significant in all cases.

Lastly, the sample size is rather small (126 SCAs). Given that the analysis covers eight years, the authors accounted only for approximately 16 security class actions per year whereas the total number of security class actions that took place in the banking sector in that period is more than 500 (source: SUSCAC[11]).

2.6.7 McShane et al. (2012)

The goal of this study is to apply Bayesian hierarchical model, in order to predict the incidence of class actions as well as the amount of settlements post PSLRA. In more detail, this study identifies the variables that can be used as predictors of settlement incidence and settlement amount. The following table shows the variables used in the Bayesian hierarchical model.

Table 2.7: Variables examined (McShane et al., 2012)

Continuous	**Binary**	**Single categorical**
Total Number of securities	File prior to class end	Institutional
Filing time	Class length is zero	Individual
Market capitalization	IPO	Empty
Company return	GAAP	
Company Return	Restated	
Industry Return	10b5	
S&P 500 Return	Section 11	
Google hits	Insider Trading	
	Transactional	

A great number of them have a statistically significant predicting power, whether a security fraud class action lawsuit is settled or dismissed. A high return on the S&P 500 during the class period, whether or not GAAP allegations were made and having an individual plaintiff listed, leads a case to a settlement. On the other hand, factors that increase the likelihood of a case being dismissed are the longer filing times, higher market capitalization, a high return during the class period, being a 10b-5 case, having no plaintiff listed and a large number of Google hits.

[11] Stanford University Securities Class Action Clearinghouse

The industry sectors that are examined are: Business Equipment, Chemical and Allied Products, Consumer Durables, Oil - Gas and Coal Extraction and Products, Healthcare, Medical Equipment and Drugs, Manufacturing, Finance, Consumer Non-Durables, Wholesale, Retail and Some Services, Telephone and Television Transmission, Utilities and Other. For circuit - industry combinations for which a case is most likely to be dismissed, the results are examined dividing coefficients in ten bottom combinations and top ten combinations. The results show that the fourth and the sixth circuit as well as the chemicals and shops industry are included in the bottom ten coefficients. On the other hand, cases which are more likely to settle are those in the tenth circuit and belong to 'Non Durables' industry (see figure 2.1).

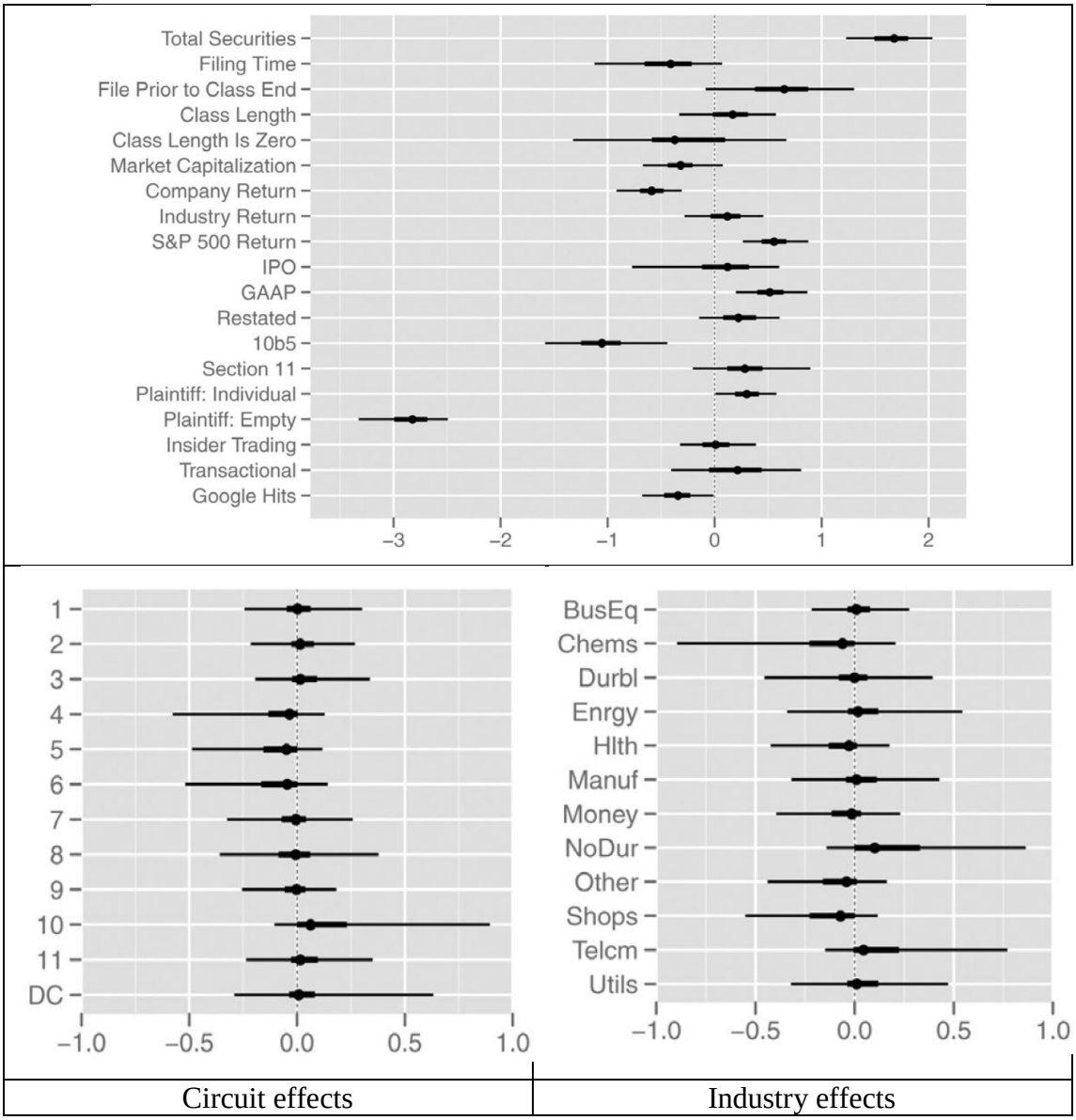


Figure 2.1: Settlement/dismissal model coefficient estimates (McShane et al., 2012)

Concerning to prediction of settlement amounts the total number of securities types, the length of class period, the market capitalization, the company return during the class period, whether or not earnings are restated, whether it is a section 11 case, whether or not insider trading was alleged and the number of Google hits affect positively the settlement amounts. Conversely, long filing times and having no institutional plaintiff listed lead to lower settlement amounts.

Two models against the observed data are created in order to check for robustness. The results remain strong, enhancing the fact that the model predicts the settlement incidence quite well. Predicted probabilities of settlement and predicted amounts are uncorrelated, meaning that cases which are predicted to be more likely to settle will not settle for high amount. Cases with GAAP violations are more likely to settle but for a low amount of compensation. This is maybe of interest for those who want to pursue a class action as a plaintiff.

One of the most important contributions of this paper is that it entails the first evidence in the prediction of securities class action. Using hierarchical Bayesian model, the incidence of a settlement, as well as the outcome of it, are highly predictive at the time of a company filing. As such it uses only variables calculated on the exact day of the filing. This however may be considered as a drawback as it is questionable whether somebody can predict a certain event basing its data only on the date that this event occurred.

Another contribution is that the model identifies cases which are not very likely to settle but if they do, the settlement amount will be very high, like cases coded 10b-5.

2.6.8 Balla et al. (2013)

This paper develops classification models to predict securities class actions filed against U.S. banks. They compare classification accuracies using tenfold cross validation and in order to test the stability of the model over time they use walk-forward approach. Moreover, they examine whether the inclusion of corporate governance indicators can improve further the classification accuracies. The variables used are based on the CAMEL model and on the paper of Pellegrina and Saraceno

(2011). The sample consists of 120 SCA cases matched by an equal number of NSCA cases for the period 2002 to mid-2011.

The results in Table 2.8 show the average weights of the six criteria. The logarithm of total assets appears to be the most important criterion in the UTADIS model with an average weight equal to 42.48% (a consistent finding with that of Pellegrina and Saraceno (2011). The variables 'Loan Loss Reserves to gross loans' and Return on assets account together for another 44.35%. 'Equity to Total Assets' also plays a moderate role with an average weight equal to 11.38%. In contrast, 'Liquid Assets to deposits and short term funding' and 'Net loans to total assets' do not appear to contribute in the model.

Table 2.8: Weights of criteria in the UTADIS model (Balla et al., 2013)

Variables	Weight (%)
EQAS	11.38
LLR	24.64
ROAA	19.71
LIQ	1.79
Loans	0.00
LOG TA	42.48

Notes: EQAS: Equity to Total Assets, LLR: Loan Loss Reserves to gross loans, ROAA: Profits to Average total assets, LIQ: Liquid Assets to deposits and short term funding, Loans: Net loans to total assets, LOG TA: Logarithm of Total Assets.

The Table 2.9 presents the classification accuracies with the overall correct classifications at the training stage ranging between 27.52% (CART) and 85.19% (PNN). With the exception of the CART method, all the models are able to provide a satisfactory distinction between SCAs and NSCAs. According to validation sample all the models are quite robust in terms of the achieved classification accuracies. However, UTADIS records the lowest decrease, with the overall classification accuracy falling by just 0.10%. At the same time the accuracy of PNN decreases by 6.68% and that of ANN by 1.96%. As a result, the UTADIS model achieves the highest classification accuracy in the out-of-sample validation. Second, UTADIS outperforms the rest of the models in both group-specific accuracies, classifying correctly 82.89% of banks in SCAs group and 76.10% of banks in NSCAs group. The

corresponding figures are 81.81% and 75.21% in the case of PNN, and 81.17% and 72.58% in the case of ANN.

Table 2.9: Cross validation (Balla et al., 2013)

Models	NSCA (%)	SCA (%)	Overall
Training			
UTADIS	83.71	75.47	79.59
OLR	80.26	75.74	78.00
DA	81.50	72.61	77.05
KNN	76.85	72.31	74.58
ANN	82.41	75.27	78.84
PNN	86.95	83.43	85.19
CART	20.88	34.17	27.52
Validation			
UTADIS	82.89	76.10	79.49
OLR	79.72	73.40	76.56
DA	79.64	70.94	75.29
KNN	76.35	70.22	73.29
ANN	81.17	72.58	76.88
PNN	81.81	75.21	78.51
CART	21.42	36.74	29.08

In order to test the stability of the model over time, the authors applied the walk-forward technique. The results in Table 2.10 show that the classification accuracy of the models developed through UTADIS ranges between 66.67% (2011) and 81.25% (2008) in the validation sample, with the average over the entire period being equal to 75.21%. Thus, the performance of the UTADIS model appears to be quite robust over time.

Table 2.10: Classification results of UTADIS model with the walk forward approach (Balla et al., 2013)

Models	Training	NSCA (%)	SCA (%)	Average	Validation	NSCA (%)	SCA (%)	Average
Model 1	2002-2007	88.10	80.95	84.52	2008	84.38	78.13	81.25
Model 2	2002-2008	87.84	79.73	83.78	2009	82.61	78.26	80.43
Model 3	2002-2009	86.60	75.26	80.93	2010	75.00	70.00	72.50
Model 4	2002-2010	83.76	77.78	80.77	2011	100.00	33.33	66.67
Average		86.57	78.43	82.50		85.87	64.93	75.21

As SCAs should be related to corporate governance due to managerial agency problems, an inclusion of corporate governance related characteristics in the dataset is being made, in order to examine whether they could improve the classification accuracy of the models.

Table 2.11: Classification results of UTADIS model with Corporate Governance and financial variables, based on tenfold cross validation (Balla et al., 2013)

Models	Training			Validation		
	NSCA (%)	SCA (%)	Average	NSCA (%)	SCA (%)	Average
Financial variables only	87.44	86.20	86.82	80.33	80.07	80.20
Financial variables + CGQ	86.72	88.37	87.54	76.17	78.40	77.29
Financial variables + BOARD	88.90	87.16	88.03	78.67	80.07	79.37
Financial variables +COMP_OWNER	91.07	89.84	90.45	89.00	85.40	87.20
Financial variables +ANTITAKE	87.94	85.73	86.83	80.33	76.74	78.54
Financial variables + AUDIT	87.44	86.20	86.82	80.33	80.07	80.20

Notes: CGQ: index which quantifies the quality of a firm's governance practices in relation to other firms from the same sector, BOARD: board composition, nominating committee's composition, compensation committee's composition, governance committee, board size, changes in board size, cumulating voting, boards served on by the CEO, former CEOs on the board, Chairman/CEO separation, board attendance, related-party transactions involving officers and directors, majority voting, etc. COMP_OWNER: (i) ownership, (ii) executive and director compensation, (iii) progressive practices (iv) director education, ANTITAKE: considers (i) the Charter/Bylaws and (ii) the state of incorporation, AUDIT: considers the independence of the members of the audit committee, audit fees, auditor ratification, the financial expert composition of the audit committee, financial results restatements during the past 24months etc.

Owning to missing data for the CGQ index, the sample is restricted to 46 SCAs matched with another set of 46 NSCAs. The CGQ index obtains a small weight in the UTADIS model that is equal to 3.22% as shown in Table 2.12. The results in Table 2.11 show that the classification accuracy in the training sample improves slightly compared to the model that contains only the financial ratios (i.e. 87.54% versus 86.82%). However, this is no longer the case, when assessing the performance of the model in the validation sample, with the classification accuracy being 80.20% (financial ratios) and 77.29% (CGQ and financial ratios). The inclusion of the 'BOARD' and 'ANTITAKE' variables worsens slightly the performance of the model, with the average accuracy being 79.37% and 78.54%, respectively. The model that includes the variable 'AUDIT' yields exactly the same results as the one that includes only the financial variables. The picture changes when we consider the model that includes the 'COMP_OWNER' variable. In this case, the accuracy of the model improves by 8.67% in the case of the NSCA group, and by 5.33% in the case of the SCA group. As a result, the average accuracy of this model stands at

87.20%that is a considerable improvement compared to that of the model which includes only the financial ratios (i.e. 80.20 %).

Table 2.12: Weights of criteria in the UTADIS model developed with corporate governance and financial variables (Balla et al., 2013)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
EQAS	15.15%	15.62%	15.72%	10.70%	14.94%	15.15%
LLR	36.25%	34.36%	35.24%	31.20%	35.72%	36.25%
ROAA	22.59%	23.63%	22.42%	25.18%	23.04%	22.59%
LIQ	0.23%	0.25%	0.23%	0.00%	0.23%	0.23%
Loans	2.27%	1.44%	2.43%	0.12%	2.04%	2.27%
LOG TA	23.50%	21.48%	22.34%	20.49%	23.34%	23.50%
CGQ		3.22%				
BOARD			1.61%			
COMP_OWNER				12.30%		
ANTITAKE					0.69%	
AUDIT						0.00%

Notes: CGQ: Corporate Governance Quotient aggregate index, BOARD: Sub-index for board quality, COMP_OWNER: Sub-index for executive and director compensation and ownership, ANTITAKE: Antitakeover sub-index, AUDIT: Sub-index for auditing quality.

As in the paper of Pellegrina and Saraceno (2011), the size of the sample is considered small even though Balla et al. (2013) account for smaller period of time.

2.6.9 Overall comparison

The first issue that should be noted is that of methodology. It is obvious from the above discussion that half of the papers used logistic regression and the other half probit regression, in order to determine the variables that play an important role. This is considered as sufficient given the fact that they did not aim for developing models in order to predict. The current study will apply more advanced techniques (UTADIS, MHDIS, SVMs) filling this gap and enriching a rather poor literature, as far as the methodology is concerned.

Even though the first study comes from Kellogg (1984), including data from 1967 to 1976, the researchers that followed did not include in their analysis data between 1977 and 1990 and therefore this period was never researched. The era that most authors examined is between 1996 and 2004, mainly because during that period the enactment of PSLRA and SLUSA took place giving incentive to academicians to investigate its

impact on the phenomenon. The current study ranks among three other studies (Poulsen et al., 2010; Pellegrina et al., 2011; Balla et al., 2013) that account for the most recent period of 2003-2011.

The only literature that directly relates to the current study comes from McShane et al. (2012) who use Hierarchical Bayesian model and Balla et al. (2013) who developed classification models to forecast the incidence of security class action. All other researches examine whether certain variables affect the filing of a lawsuit. Consequently, this is the third study that will research the prediction of securities class actions and the second that will apply multicriteria techniques in order to predict the phenomenon of securities class action.

2.7 Corporate governance information in securities class actions

A securities class action is a significant externally imposed corporate governance measure (Collins et al., 2008). Table 2.13 presents the basic information from all the papers that examine the impact of corporate governance information on the securities class action and which will be discussed in the following sections.

Table 2.13: Summary of papers examining corporate governance

Paper	No SCA lawsuits	Period	Methodology	Database
Strahan (1998)	309	1991-1996	Probit Analysis	Standard & Poor's Compustat, CRSP
Ferris et al. (2007)	174	1982-1999	Logistic Regression	WSJI, Compustat, LexisNexis
Peng and Roell (2008)	479	1996-2001	Probit Analysis	ExecuComp, SSCAC
Collins et al. (2008)	30	1997-2003	Logistic Regression Ordinary Least Square	Proquest, LexisNexis, ExecuComp
Amoah and Tang, (2010)	41	1997-2002	Logistic Regression	USGAO, CRCP, SECs EDGAR
Poulsen et al. 2010	461	2005-2008	Population averaged Poisson model	TONE, DataStream
Rice et al. (2013)	482	2004-2010	Probit Analysis	Audit Analytics, SSCAC

Notes: CRSP: Center for Research in Securities Prices, WSJI: The Wall Street Journal Index, SSCAC: Stanford Securities Class Action Clearinghouse, USGAO: Financial Restatement Database of United States General Accounting Office (GAO, 2002), CRCP: Center for Research in Security Prices, TONE: Thomson ONE Banker's Worldscope database, ExecuComp: Compustat Executive Compensation Database.

2.7.1 Strahan, (1998)

This work constitutes probably the most important study in this strand of the literature as it is the first to examine the effect of corporate governance in security class actions. One of the main findings of this paper presented in Table 2.14 is that large, risky, young, low market to book ratio and non-dividend paying firms have higher probability to face security class actions. The CEO turnover increases from about 9% per year before to about 23% per year after the filing of a lawsuit. The following tables present the results of the regressions that include the board composition and ownership structure variables.

Table 2.14: Causes of securities class actions (Strahan, 1998)

Variables	Model 1	Model 2	Model 3	Model 4
Log of MV	0.212*** (0.027)	0.211*** (0.024)	0.274*** (0.035)	0.262*** (0.036)
MV/BE	-0.086* (0.047)		-0.116** (0.056)	-0.105* (0.057)
HM/B		-0.133* (0.078)		
PPE/Assets	-0.434** (0.190)	-0.452** (0.177)	-0.608*** (0.234)	-0.639*** (0.235)
Returns	4.757*** (1.099)	4.445** (0.964)	4.298*** (1.440)	4.192*** (1.444)
TV/Shares	0.0018*** (0.0006)	0.0020*** (0.0006)	0.0026*** (0.0008)	0.0027*** (0.0008)
Years	-0.007** (0.003)	-0.007*** (0.003)	-0.008** (0.004)	-0.010*** (0.004)
Reg. firm	0.101 (0.152)	0.199 (0.136)	0.030 (0.175)	-0.039 (0.183)
Bank firm	-0.237 (0.237)	-0.290 (0.219)	-0.024 (0.268)	0.031 (0.274)
Computer firm	0.141 (0.147)	0.132 (0.138)	0.051 (0.162)	0.046 (0.162)

Notes: Log of MV: log of market value of equity, MV/BE: market value to book equity, HM/B: indicator for high market-to-book firms, PPE/Assets: property, plant & equipment / assets, Returns: standard deviation of stock returns, TV/Shares: trading volume/shares outstanding, Years: number of years stock has traded, Reg. Firm: regulated firm, Bank firm: banking firm.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Table 2.15: Corporate governance characteristics as causes to litigation (Strahan, 1998)

Variables	Board size		Proportion of board members who are officers	
	Simple specification	Specification with merit	Simple specification	Specification with merit
Indicator for post lawsuit period	0.226 (0.260)	0.224 (0.278)	-0.008 (0.019)	-0.006 (0.020)
Merit*Indicator for post-lawsuit period		0.019 (0.994)		-0.024 (0.071)
During class period indicator	0.497** (0.224)	0.497** (0.225)	-0.011 (0.016)	-0.011 (0.016)
CEO turnover indicator	-0.294* (0.159)	-0.294* (0.159)	0.013 (0.011)	0.013 (0.011)
Stock performance	-0.162 (0.107)	-0.162 (0.108)	0.009 (0.008)	0.009 (0.008)

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Board structure does not change after the security class action, although there is a significant increase in the board size during the class period. The CEO turnover indicator seems to influence the board size of the entity at 10% both in merit and non-merit cases. None of the variables tested affected significantly the 'Proportion of the board members who are officers' as shown in Table 2.16.

Table 2.16: Ownership as a consequence of massive litigation (Strahan, 1998)

Variables	Insider holdings		Large blockholdings		Holdings by institutions	
	Simple specification	Specification with merit	Simple specification	Specification with merit	Simple specification	Specification with merit
Indicator for post lawsuit period	-0.047*** (0.014)	-0.048*** (0.016)	0.032 (0.028)	0.016 (0.032)	-0.026 (0.019)	-0.036* (0.022)
Merit*Indicator for post-lawsuit period		0.015 (0.079)		0.166 (0.162)		0.149 (0.113)
During class period indicator	-0.038*** (0.013)	-0.038*** (0.013)	0.027 (0.025)	0.025 (0.025)	0.039** (0.017)	0.037* (0.017)
CEO turnover indicator	-0.009 (0.008)	-0.009 (0.008)	0.005 (0.016)	0.005 (0.016)	-0.015 (0.011)	-0.015 (0.011)
Stock performance	0.003 (0.005)	0.003 (0.005)	0.020* (0.010)	0.020* (0.010)	0.038*** (0.007)	0.038*** (0.007)

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Insider holdings decline after a class action lawsuit. Large block holdings do not affect significantly the incidence of massive litigation either in the simple specification or in the specification with merit.

Table 2.17: CEO turnover examination after securities class actions (Strahan, 1998)

Variables	Basic specification	Specification with merit interaction
Indicator for post lawsuit period	1.405** (0.644)	0.776 (0.708)
Merit*Indicator for post-lawsuit period		1.600* (0.870)
During class period indicator	0.250 (0.614)	0.314 (0.621)
CEO age in prior year	0.152*** (0.035)	0.147*** (0.034)
Stock performance	-0.566** (0.247)	-0.561** (0.246)
Lagged stock performance	-0.296 (0.256)	-0.272 (0.256)

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

As far as the CEO turnover is concerned, its increase appears to be driven by the high merit cases. The variable 'Stock performance' is negatively correlated and statistically significant to CEO turnover, highlighting the importance of stock performance signal to the CEO turnover, even though this does not agree when lagged data are examined (see Table 2.17). The probability of CEO turnover increases for both high and low settlement cases.

Conclusively, class action probability increases when stock price declines leading to CEO turnover. Overall, the author finds no evidence that corporate governance mechanisms can predict the occurrence of the litigation, except that CEO turnover is positively linked to the lawsuit.

2.7.2 Ferris et al. (2007)

This paper examines the determinants of security class actions that are related to derivatives in the U.S. In more detail, it examines whether board changes and agency issues affect the derivative lawsuit.

It can be seen from the Table 2.18 that firm size, market-to-book ratio, return volatility, and free cash flow influence positively the likelihood of a derivative lawsuit, while prior year's performance is significant and negatively related. On the other hand, when it comes to corporate governance variables, none of them seems to

affect the probability of the lawsuit at any level of statistical significance. It arises from the signs of the coefficients that entities with large boards and a higher proportion of inside representation on the board are expected to have poor corporate governance and therefore more probabilities to face a derivative lawsuit. Higher levels of insider equity ownership increase agency conflicts between managers and shareholders implying that agency problems are linked to shareholders' litigation.

Table 2.18: Logistic regression of determinants of a lawsuit action (Ferris et al., 2007)

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Log of the MV of equity	0.331**	0.552**	0.359**	0.414**
MV/BV		0.507**	0.542*	0.602*
Return Volatility	0.352**	0.276**	0.447**	0.397*
Prior year's performance	-0.447*		-0.343*	-0.299*
Share turnover	0.051	0.038	0.062	0.043
Free cash flow	0.273***	0.571***	0.395**	0.491**
Insider equity holdings	0.037		0.083	0.059
Institutional equity holdings	-0.125		-0.077	-0.055
Block holder equity holdings	-0.133		-0.167	-0.198
Board size				0.033
Percent of outside directors				-0.041
Percent of insider directors				0.017
Percent of gray area directors				0.011

Notes: MV/BV: the book value of assets plus the market value of common equity less the book value of common equity divided by the book value of assets, Return volatility: the variance of daily returns over the 250 days preceding the filing of a lawsuit, Prior year's performance: the nominal return to equity calculated over the 250 days preceding the filing of the lawsuit, Share turnover: calculated for the 120 trading days immediately preceding the filing of the lawsuit, Board size: the number of directors on the board, Outside, inside and gray area directors: are defined as per Yermack, (1996).

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

One could argue that the period examined (1982-1999) is considered rather inappropriate. SOX enactment started after 2002. This means that investigating corporate governance variables in a period where firms were not supposed to operate under corporate governance policies, could distort the importance of the provided results.

2.7.3 Peng and Röell. (2008)

This paper examines the impact of executive compensation on private securities lawsuit. Influenced by the perception of option portfolio management and the stock value held by executives of Jensen and Merphy (1990) and Core and Guay (1999),

this study constitutes an interesting evidence enriching literature as far as JM[12] and CG[13] theory is concerned. They hypothesised that litigation is positively related to managers' wealth, to artificially inflated earnings and that during litigation class period managers exercise more options and sell more stocks. The final set of data includes 479 class action lawsuits, between fiscal years 1996 and 2001.

Table 2.19: Probit analysis of litigation class periods and manager incentives by JM (Peng and Röell, 2008)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Bonus	-0.3140 (0.1790) *	-0.1267 (0.2302)	-0.1661 (0.2427)	-0.0941 (0.2336)	-0.1716 (0.2488)
ShareownJM	-0.0040 (0.0032)	0.0039 (0.0040)	0.0006 (0.0044)	0.0034 (0.0040)	0.0004 (0.0044)
OPTDELTAJM	0.0230 (0.0114) **	0.0581 (0.0163) ***	0.0490 (0.0172) ***	0.0559 (0.0163) ***	0.0493 (0.0173) ***
Size		0.2437 (0.0232) ***	0.2205 (0.0262) ***	0.2438 (0.0238) ***	0.2125 (0.0273) ***
Turnover		0.1816 (0.0428) ***	0.1571 (0.0482) ***	0.1532 (0.0455) ***	0.1538 (0.0500) ***
Volatility				0.3917 (0.1753) **	0.0775 (0.1919)
Skewness				-0.0413 (0.0283)	-0.0489 (0.0317)
Leverage				0.5807 (0.1717) ***	0.5851 (0.1901) ***
BM			-0.0614 (0.1053)		-0.1086 (0.1099)
Sales Growth			0.3087 (0.0523) ***		0.2883 (0.0519) ***
ROA		-0.8648 (0.2580) ***	-0.8131 (0.2884) ***	-0.6543 (0.2747) **	-0.7331 (0.3055) **
Tangible		-0.9283 (0.2161) ***	-0.8319 (0.2196) ***	-1.0613 (0.2175) ***	-0.9877 (0.2218) ***
Dividend		-0.1596 (0.0859) *	-0.0594 (0.0916)	-0.1124 (0.0902)	-0.0498 0.0974)
Acquisition		0.1602 (0.0586) ***	0.1374 (0.0626) **	0.1367 (0.0601) **	0.1011 (0.0643)
Equity Issue		0.0302 (0.0637)	-0.0144 (0.0703)	0.0316 (0.0652)	-0.0133 (0.0721)

Notes: ShareownJM: the change in the value of stocks owned by the top five executives as a fraction of the change in firm value, OPTDELTAJM: the change in the value of options owned by the top five executives as a fraction of the change in firm value.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

In both cases (JM and CG) there is a significant relationship between option based executive compensation and security class action (see Tables 2.19 and 2.20). On the contrary, bonus compensation and executive share ownership do not affect litigation.

[12] Jensen and Merphy (1990)
[13] Core and Guay (1999)

Table 2.20: Probit analysis of litigation class periods and manager incentives by CG (Peng and Röell, 2008)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Bonus	-0.2502 (0.1881)	-0.1523 (0.2283)	-0.1863 (0.2403)	-0.1337 (0.2317)	-0.2032 (0.2461)
ShareownCG	0.8209 (0.0613) ***	0.0328 (0.0330)	0.0070 (0.0353)	0.0296 (0.0331)	0.0083 (0.0356)
OPTDELTACG		0.2990 (0.1180) **	0.2949 (0.1260) **	0.2640 (0.1190) **	0.2814 (0.1280) **
Size		0.1565 (0.0320) ***	0.1347 (0.0366) ***	0.1646 (0.0329) ***	0.1289 (0.0378) ***
Turnover		0.1866 (0.0426) ***	0.1624 (0.0481) ***	0.1611 (0.0453) ***	0.1627 (0.0499) ***
Volatility				0.3624 (0.1724) **	0.0397 (0.1892)
Skewness				-0.0357 (0.0281)	-0.0453 (0.0317
Leverage				0.5822 (0.1704) ***	0.5854 (0.1886) ***
BM			-0.0841 (0.1039)		-0.1332 (0.1081)
Sales Growth			0.3085 (0.0518) ***		0.2905 (0.0513) ***
ROA		-0.8598 (0.2616) ***	-0.8077 (0.2913) ***	-0.6611 (0.2795) **	-0.7385 (0.3092) **
Tangible		-0.9399 (0.2158) ***	-0.8422 (0.2203) ***	-1.0825 (0.2176) ***	-1.0058 (0.2229) ***
Dividend		-0.1844 (0.0857) **	-0.0756 (0.0917)	-0.1397 (0.0897)	-0.0689 (0.0974)
Acquisition		0.1596 (0.0588) ***	0.1398 (0.0629) **	0.1358 (0.0602) **	0.1027 (0.0646)
Equity Issue		0.0394 (0.0624)	-0.0124 (0.0694)	0.0427 (0.0638)	-0.0103 (0.0710)

Notes: ShareownCG: the change in the value of stocks owned by the top five executives for a 1% change in stock price, OPTDELTACG: the change in the value of options owned by the top five executives for a 1% change in stock price.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

ROA and 'Tangibles' are statistically significant at 1% at all models, implying that firms with high level of tangibles and with good profitability, have more chances to face a class action. Moreover, the bigger the size of the firm the higher the probability for a class action, as 'Size' is positively related to litigation.

The innovation of this study lies on the introduction of JM and CG variables, even though only 'Option portfolio CG' plays a statistically significant role in all the models. The rest of the variables (Size, ROA, BM, Bonus compensation etc.) they can be regarded as basic since they have already been used by other authors.

2.7.4 Collins et al. (2008)

Following Peng and Rõell (2008), this paper contributes to the literature by introducing the CFO characteristics to the incidence of class actions. The study develops four models. The first model examines whether CFO turnover is associated with earnings restatements. The second model examines whether CFO turnover is associated with restatements of financial statements that led to security class action. The third model examines whether there is a CFO bonus compensation associated with earnings restatements and the fourth model examines whether there is CFO bonus penalty associated with earnings restatements based on firms that faced security class actions. For all models the sample consists of 162 firms half of which have restated their financial statements. Furthermore, 30 out of 81 faced a class action. The results of this study appear on the Table 2.21.

Table 2.21: Analysis of CEO turnover and bonus compensation (Collins et al., 2008)

Variables	CFO turnover	CFO turnover	CFO bonus compensation	CFO bonus compensation
ROA t	−0.0096 (−0.63)	−0.0040 (−0.24)	0.0350 (2.92) ***	0.0319 (2.64) ***
ROA t − 1	−0.0423 (−1.70)*	−0.0434 (−1.68) *		
Return t	−0.8694 (−1.97) **	−0.7741 (−1.65) *	0.6033 (2.04) **	0.5846 (1.99) **
Return t − 1	−0.3307 (−0.73)	−0.1827 (−0.39)		
LN Asset	−0.0787 (−0.64)	−0.0610 (−0.49)	0.2554 (2.74) ***	0.2552 (2.75)
Lastyr			−0.1611 (−0.44)	0.0383 (0.10)
TrendLastyr	7.2204 (0.76)	6.0535 (0.59)		
Trend Bonus			1.7545 (1.39)	1.7292 (1.38)
Restate	0.4503 (1.11)		–0.6072 (−1.99) **	
Suit		1.4931 (2.96) ***		−1.1430 (−2.58) **
Non suit		−0.3983 (−0.76)		−0.3599 (−1.06)

Notes: ROA t and ROA t – 1: are the return on assets for firm i in years t and t−1, Return t and Return t – 1: are the annual percentage change in stock price for firm i in years t and t−1, Lastyr: takes the value of 1 if year t is the last year in which the CFO for firm i is listed among the top executive officers, and 0 otherwise, TrendLastyr: controls for macro-economic trends in top executive turnover, Trend Bonus: a construction trend variable that uses the natural log of the CPI-adjusted median value of bonus compensation, Restate: takes a value of 1 if firm i is a restatement firm in year t, and 0 if firm j is a control firm.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

For CFO turnover models two logistic regressions were applied. In model 1, the lagged ROA and 'Return' are negatively related to CFO turnover, suggesting that the worse the performance, the more probable it is for the CFO to change. These results are consistent with the ones of Land (2010), who found that the severity of restatement is likely to result in CEO turnover, even though they used CEO turnover variable instead of CFO. In model 2, 'lagged ROA' and 'Return' are again significant and also negative, indicating that the worse restatements related to class actions, the more probability there is for the CFO to alter.

Also, the CFO turnover occurs when the lawsuit is undertaken by the shareholders. Considering the CFO bonus compensation, two OLS regressions were performed. In model 3, performance is positively linked to the CFO bonus compensation, as well as to the size of the company. The 'Restate' variable is negatively linked to the CFO bonus compensation, suggesting that in a way CFO is punished when earnings suffer a restatement. Finally in model 4 the variable 'Suit' is significant at the 5% and negatively related to the CFO bonus compensation, meaning that CFOs receive low bonuses when earning restatements result in a lawsuit.

The main contribution of this paper is that the disciplinary actions against CFO for earnings restatements are dependent upon whether firms face earnings restatement induced securities class action litigations. This clearly suggests that a securities class action is a significant externally imposed corporate governance measure.

The main limitation of this paper is that, although they examine whether in post SOX period, CFOs received bonus compensation as a result of overstated earnings, by partitioning the sample between pre SOX (94) and post SOX (68) observations, it is still not referred which of these 68 observations after SOX enactment faced earnings restatement securities class actions. This weakens their contribution of the effect of corporate governance in securities class actions. Moreover, they focus on 81 firms that have restated financial statements. Only 30 out 81 firms faced a class action lawsuit, due to restatements, which is a rather small sample.

2.7.5 Amoah and Tang (2010)

In this study, the authors have three goals. The first is to examine the role of board and audit committee in restatement-induced litigation in the post PSLRA period. The second is to provide evidence on whether the board and audit committee monitoring is a restatement-induced litigation merit factor. The third is to provide evidence on whether PSLRA assessed merit in restatement-induced litigation cases. They cover the 1997-2002, and their sample includes 41 firms, which is of similar size to that in Johnson et al. (2007). They use logistic regression, with the dependent variable being the restatement induced class action lawsuit (i.e. it equals one in case where the restatement of financial statements leads to a class action and zero otherwise) and a total of fourteen independent variables.

The results of the following table illustrate five points. First, the more independent the board of a firm is, the less likely it is for the firm to experience restatement-induced shareholder litigation.

Second, firm size is positively linked to the probability of restatement-induced securities class actions, indicating that deep pocket effects influence the decision to file restatement-induced class actions.

Third, having financial experts on the audit or corporate audit committees composed of only independent directors does not influence the shareholders' perception of the class action lawsuit's merit. Furthermore, the board and audit committee activity, during the misstatement period, does not influence the perceived merit of a restatement-induced class action lawsuit.

Fourth, the board independence measure is negatively associated with the probability of restatement-induced class action lawsuits, suggesting a positive relation between board independence and perceived merit of a restatement-induced class action lawsuit.

Fifth, class action firms with weaker boards and audit committees are more likely to pay larger compensations to shareholders in the settlement.

Table 2.22: Logistic regression of probability of restatement induced class action lawsuits (Amoah and Tang, 2010)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Cumulative Abnormal returns	−0.4244*** (0.0012)	−0.4595*** (0.0010)	−0.4616*** (0.0011)	−0.4569*** (0.0012)	−0.4902*** (0.0009)	−0.4946*** (0.0010)	−0.4911*** (0.0010)
Board Independence					−3.8755 ** (0.0101)	−3.7307** (0.0129)	−3.7240** (0.0134)
Audit Independence		−0.5011 (0.3849)	−0.4083 (0.4738)	−0.3487 (0.5519)			
Accounting expertise		0.4954 (0.4360)			0.5915 (0.8162)		
Financial expertise			−0.2505 (0.7741)			−0.1943 (0.8334)	
Majority financial expertise				−0.2811 (0.5935)			−0.3182 (0.5447)
Audit committee meetings		−0.2100 (0.0785)	−0.1936 (0.1043)	−0.1949 (0.0985)	−0.2200 (0.0633)	−0.2040 (0.0863)	−0.2025 (0.0860)
Board meetings		0.1435** (0.0495)	0.1411 (0.0522)	0.1357 (0.0639)	0.1351 (0.0524)	0.1297 (0.0607)	0.1223 (0.0802)
Revenue restatement	1.3450 ** *(0.0059)	1.3751 *** (0.0061)	1.3733 *** (0.0061)	1.3720 *** (0.0060)	1.5138 *** (0.0043)	1.5088 *** (0.0042)	1.5054 *** (0.0043)
Accts No	−0.0338 (0.9048)	−0.0992 (0.7502)	−0.0378 (0.9009)	−0.0402 (0.8947)	−0.1044 (0.7358)	−0.0420 (0.8904)	−0.0438 (0.8855)
Years restated	0.3327 (0.2343)	0.3311 (0.2729)	0.3638 (0.2369)	0.3673 (0.2334)	0.3880 (0.2010)	0.4213 (0.1782)	0.4215 (0.1807)
Size of Restatement	0.0248 (0.6261)	0.0373 (0.4958)	0.0338 (0.5376)	0.0310 (0.5556)	0.0269 (0.6628)	0.0245 (0.6898)	0.0230 (0.7034)
Long term debt to TA	−1.9698 (0.1984)	−2.9703 (0.0996)	−2.9186 (0.1101)	−2.8727 (0.1088)	−4.0472 ** (0.0381)	−3.9350 ** (0.0454)	−3.9734 ** (0.0410)
Log MV	0.7327 *** (0.0001)	0.9015 * ** (0.0001)	0.8906 * ** (0.0001)	0.8936 * ** (0.0001)	1.0767 * * *(0.0001)	1.0621 * ** (0.0001)	1.0732 * ** (0.0001)
MV/BV	−0.0066 (0.8951)	−0.0146 (0.8078)	−0.0255 (0.6972)	−0.0244 (0.7010)	−0.0146 (0.8307)	−0.0283 (0.6989)	−0.0310 (0.6624)

Notes: Board independence: proportion of independent directors on the board, Audit independence:1 if the audit committee is fully independent, 0, otherwise, Accounting expertise:1 if an independent accounting expert (CPA, auditor, auditor, principal financial officer, controller or principal accounting officer) serves on the audit committee, 0, otherwise, Financial expertise: 1 if firm has at least one independent audit committee financial expert (CPA, auditor, auditor, principal financial officer, controller, principal accounting officer, CEO or President), 0, otherwise. Majority financial expertise: 1 if majority of audit committee members are independent audit committee financial experts, 0, otherwise, Audit committee meetings: number of meetings of the audit committee in the fiscal year, Board meetings: number of meetings of the board in the fiscal year, Revenue restatement:1 if the restatement affects revenues; 0, otherwise, Accts No =number of accounts affected by the restatement, Years restated: number of years restated with: restatement of a quarter being 0.25, Size of restatement: (initially reported net income less restated net income)/market value of equity.

**Significant at p<0.05, ***Significant at p<0.01

Despite being the first study focusing on corporate governance and audit information as determinants of securities class actions, there are three limitations that could be pointed out. The first important limitation is that the study examines whether corporate governance or audit existence, plays an important role in massive litigation, focusing on companies in the pre SOX period, which were not obliged by the law to follow any kind of compulsory corporate governance framework. In other words, it is

somehow questionable to examine corporate governance significance using companies which are not expected to be aligned with such rules. The current research is going to focus on post SOX data that is after 2002.

The second one is that this study does not aim to predict restatement induced securities class actions. Rather, it uses only logistic regression to determine the factors that affect restatement induced securities class actions. As such, other methods could be used, in order to be compared with logistic regression, while focusing on the prediction of securities class actions.

The third limitation is that even though the study focuses on restatement induced securities class actions, the employed sample is rather small (i.e. only 41 out of 919).

2.7.6 Poulsen et al. (2010)

This paper analyses the impact of voting power on shareholder activism in the case of Swedish shareholder meetings.

The authors provide us with evidence according to the influence of the opinion expressed to the litigation incidence. As shown in Table 2.23, the board proposals have a positive effect on voting against; the more proposals, the more there are to vote against, while negative to opinions expressed. Controlling for ownership concentration and firm value, firm size may be an indicator of the amount invested by individual stakeholders. This shows that shareholders are more likely to vote against, the more they have invested in the firm. The opinions expressed are not influenced by amenability, or by board proposals or foreign ownership.

Control variables such as stock return, return on equity, and firm size do not have any significant effect on opinions expressed. It turns out that the opinions expressed by shareholders have little to do with what is happening in the firm and should perhaps be regarded as noise rather than a meaningful conservation between managers and shareholders.

Table 2.23: Determinants of negative influence and opinion expressed (Poulsen et al., 2010)

	Proposals voted against			Opinions expressed		
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Amenability	-0.18 (-1.41)	-0.21 (-1.69)	-0.31* (-2.30)	-0.09 (-0.56)	-0.09 (-0.55)	-0.14 (-0.82)
Board proposals	0.17*** (4.88)	0.17*** (4.96)	0.17*** (5.07)	-0.00 (-0.04)	-0.00 (-0.03)	0.00 (0.03)
Foreigner		0.31 (1.55)	0.31 (1.55)		-0.03 (-0.11)	-0.03 (-0.11)
Stock return	0.01 (0.05)	0.02 (0.14)	-0.35 (-1.41)	0.23 (1.21)	0.23 (1.21)	-0.01 (-0.03)
Return on equity	0.000 (0.57)	0.00 (0.39)	0.00 (.48)	-0.00 (-0.53)	-0.00 (-0.52)	-0.00 (-0.57)
Firm size	0.23*** (4.77)	0.22*** (4.48)	0.22*** (4.51)	0.08 (1.26)	0.08 (1.26)	0.08 (1.24)
Firm value	-0.00 (-0.57)	-0.00 (-0.58)	-0.00 (-0.61)	-0.16 (-1.94)	-0.16 (-1.94)	-0.16 (-1.89)
Leverage	-0.35 (-0.68)	-0.28 (-0.54)	-0.34 (-0.65)	-1.19 (-1.82)	-1.19 (-1.82)	-1.22 (-1.85)

Notes: Amenability: the average percentage decrease in the largest shareholder's voting power when one more shareholder successively is added to the decision-making process, Board proposals: the number of proposals made by the board, Foreigner: a dummy variable equal to 1 if the largest shareholder is a foreigner and 0 otherwise, Stock return: the dividend-adjusted stock return in the year prior to the shareholder meeting, Return on equity: the book return on equity in the year prior to the shareholder meeting, Firm size: the natural logarithm of the book value of total assets in the year of the shareholder meeting, Firm value: the market value of equity plus the book value of total debt all divided by the book value of total assets in the year of the shareholder meeting, Leverage: the book value of total debt divided by the book value of total assets also in the year of the shareholder meeting.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

The amenability measure is negatively associated with proposals by other shareholders and the number of proposals that voted against. As expected, there is more activity in large firms, and less activity in leveraged firms. In contrast, the substitution effect of board proposals (the more board proposals, the fewer shareholder proposals) remains significant throughout and foreign ownership also tends to lead to fewer proposals by other shareholders, regardless of the specification. The results underline the uniqueness of the institutional environment, which shapes shareholder activism as well as all other aspects of corporate governance.

2.7.7 Rice et al. (2013)

Among other things, this paper investigates whether previous disclosure of weaknesses in control can affect the likelihood of a class action after a restatement and whether the internal control weaknesses lead to management and auditor turnover. The following table presents the results of the probit analysis.

Table 2.24: Probit analysis for litigation (Rice et al., 2013)

Variables	Litigation	Litigation excluding dismissed cases
Report ICW	0.2350 (0.1752)	0.3817* (0.2133)
Rest Magnitude	-2.9105*** (1.1475)	-2.6799** (1.3522)
Irregularity	0.3266 (0.2694)	0.5105 (0.4082)
Rest revenue	0.3904** (0.1978)	0.3428* (0.2458)
Rest count	0.0657* (0.0424)	0.0643 (0.0528)
Rest years	0.0831*** (0.0306)	0.1030*** (0.0361)
CAR	-6.1209*** (1.1941)	-4.6125*** (1.3418)
Previous return	-0.5021*** (0.1969)	-0.3985* (0.2476)
Share turnover	1.2221*** (0.5138)	1.1654** (0.6789)
Size	0.1702*** (0.0660)	0.1268* (0.0814)

Notes: Report ICW: coded one if the firm disclosed the existence of a material weakness in internal control over financial reporting in any SOX 404 report during their misstatement period, zero otherwise, Rest magnitude: the cumulative earnings effect of the restatement scaled by the total market value of common equity at the end of the misstatement period, Irregularity: includes those misstatements classified as fraud and where SEC investigations and board member involvement ensued, Rest revenue: coded one if any part of the restatement is due to revenue recognition problems, zero otherwise, Rest count: the number of distinct accounting issues, Rest years: the number of years of the restatement period, CAR: the cumulative abnormal return, calculated as the raw stock return minus the CRSP equally weighted market portfolio return measured over a window (0, +1), with day 0 indicating the restatement announcement, Previous return: the buy-and-hold abnormal return equally weighted market portfolio return, with day 0 indicating the restatement announcement, Share turnover: probability that a share was traded within a given period, Size: natural log of the total market value of common equity at the end of the misstatement period.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Firms that report their control weaknesses prior to restatements are more likely to face class action lawsuits. Litigation is more likely following more severe restatements, for larger and more heavily traded firms, and when the previous announcement returns are more negative. The estimated coefficients on 'Report ICW' (that is whether or not firms reported their internal control weaknesses prior to their restatements) are positive in both cases. The change in reported income (Rest Magnitude) is negatively related to both cases of litigation and statistically significant at 1%. The variable 'Rest revenue' (whether or not reported revenue is restated) affects positively the litigations.

The following table presents the results of probit analysis for management and auditor turnover.

Table 2.25: Probit analysis for management and auditor turnover (Rice et al., 2013)

Variables	Management turnover	Auditor turnover
Report ICW	0.3082** (0.1390)	0.3513** (0.1548)
Rest Magnitude	-0.9676 (0.9777)	-1.1676 (1.1019)
Irregularity	0.4017** (0.1960)	0.1011 (0.1985)
Rest revenue	0.3135** (0.1640)	0.0586 (0.1818)
Rest count	0.0101 (0.0360)	0.0339 (0.0394)
Rest years	0.0496** (0.0260)	-0.0798 (0.0353)
Cumulative abnormal return	-2.0141** (0.9915)	-0.7711 (1.1403)
Previous return	-0.4990*** (0.1638)	-0.2329 (0.1771)
Size	-0.0145 (0.0527)	0.0598 (0.0614)
BIG 4		-0.6277*** (0.1990)
Notes: BIG4: coded one if the firm received a SOX 404 audit opinion from any of the largest four audit providers during the misstatement period, zero otherwise. The largest four audit providers are Deloitte, Ernst and Young, KPMG, and PricewaterhouseCoopers.		

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

The estimated coefficients on 'Report ICW' are positive and statistically significant in determining management and auditor turnover. These results are consistent with reported control weaknesses leading to increased turnover as firms seek to improve the credibility of their financial reporting. Poorer performing firms (as measured by 'Previous return'), and firms with more severe restatements are more likely to experience management turnover. Auditor turnover increases as firms seek to improve the credibility of their financial reporting. The most important control variable appears to be auditor size (BIG4[14]), with turnover being less likely for large auditors. Last but not least, 'Previous return' is negatively correlated to management turnover at 1%.

[14] BIG 4 are the largest international auditing firms; Ernst & Young, KPMG, Deloitte and PricewaterhouseCoopers.

2.7.8 Overall comparison

Once again the issue of methodology should be discussed. Almost half of studies presented use logistic regression in order to determine the variables that play important role in securities class action incidence. As explained in the previous section (2.6.9) the current study will apply more advanced techniques (UTADIS, MHDIS, SVMs) in order to predict the securities class action incidence enriching the existing literature.

Poulsen et al. (2010) and Rice et al. (2013) are the only studies that investigate the incidence of litigation in approximately the last five years. As in case of accounting information (section 2.6.9) the rest of the literature examines a rather old period when corporate governance policies were not in place. The current thesis focuses on the post - SOX and post - credit crisis period inserting the most recent period in the literature.

There is no existing study that focuses on the prediction to phenomenon of securities class action using corporate governance characteristics in conjunction to accounting variables. All the papers use simple techniques in order to determine which variables influence class actions. The current study will fill this gap by inserting lagged data and employing advanced multicriteria techniques to predict the class actions.

All the papers use the corporate governance variables in addition to accounting ratios. The current study will follow the same approach; however, with a different goal aiming to investigate whether they could increase the predictability accuracies provided by UTADIS, SVMs, MHDIS and MV. The corporate governance variables selected by CGQ Risk Metrics Group have never been examined before. More detailed, aggregate variables from all categories that constitute corporate governance (Board, Executive / Director Compensation and Ownership, Takeover Defences, Audit) will be used. Furthermore, a comparison to Relevant Market Index (e.g. S&P 500, Mid-Cap 400, etc), called the Index CGQ and a comparison to industry peer group (i.e. the industry group) are selected to be inserted to the dataset.

2.8 Conclusions

Chapter two aimed to discuss the relevant literature and illustrate the gap that exists in the literature, as far as the prediction of securities class action is concerned. Sections 2.6 and 2.7 explained in detail what has been done so far, not only in the area of accounting, but also in the area of corporate governance.

As explained in previous sections the evidence is very limited. As explained above the only evidence comes from McShane et al. (2012), who use Hierarchical Bayesian model to predict the phenomenon of massive litigation and from Balla et al. (2013) who focus on the banking sector. Conclusively, the present study will enrich the literature by introducing advanced techniques to the prediction of securities class action.

CHAPTER 3 METHODOLOGICAL FRAMEWORK

3.1 Introduction

The present chapter explains the classification techniques that will be used in predicting securities class actions. According to this methodological framework, there is a set of independent variables and a set of firms that are to be classified to a set of predefined groups. In other words, there is a set of $X = \{x_1, x_2, x_3, \dots, x_n\}$ of n alternatives (the independent variables), a set of $g = \{g_1, g_2, g_3, \dots, g_m\}$ of m independent variables (the firms), that are to be classified into a set of C of predefined groups (SCA group and NSCA group). Section 3.2 reviews the five alternative methods; namely Discriminant Analysis (DA), Logit Analysis (LA), UTilités Additives DIScriminantes (UTADIS), Multi-Group Hierarchical Discrimination (MHDIS), Support Vector Machines (SVMs), along with the Majority Voting (MV) approach. Lastly, section 3.3 concludes the chapter.

3.2 Review of methods

There are various classification methodologies in the field of statistics and operational research for developing prediction models. The present research examines the methods that follow.

3.2.1 Discriminant Analysis (DA)

The first multivariate statistical classification technique was proposed by Fisher (1936). Altman (1968) applied it in finance and developed a bankruptcy prediction model. The statistical techniques are very popular in developing classification models. DA has been a leading technique in prediction for many years (Karels and Prakash, 1987) and has been applied in problems of accounting, economics and finance. More specifically, DA has been extensively used in many cases like business failure prediction (Zopounidis and Doumpos, 1999; Gaganis et al., 2006), bank acquisition targets (Pasiouras and Tanna, 2010) as well as the acquisition of listed companies (Ouzounis et al., 2009) and portfolio returns, replicating credit ratings (Doumpos and Pasiouras, 2005), predicting qualified audit reports etc. DA has also been used in comparison to other non-parametric techniques. There is evidence that examines

whether traditional statistical techniques can outperform non parametric ones like Nearest Neighbours (k-NN). Again DA and LA proved that they can provide higher classification accuracies in 'Qualified Reports' than k-NN (Gaganis et al., 2007). Also DA has been used in comparison to other techniques like MCDA. UTADIS and MHDIS were applied in order to examine whether they could provide better classification results in predicting business failure (Zopounidis and Doumpos, 2002). Furthermore, DA has been used as a benchmark for MCDA techniques (UTADIS, MHDIS) for auditing decisions and more specifically for the prediction of qualified audit reports (Pasiouras et al., 2007) and for sorting decision problems in the case of financial distress (Zopounidis and Doumpos, 1999).

As it has been explained, DA has found many applications in the field of finance in the past, not only because it is a relatively simple method, but also because it is considered to be a basic traditional technique in classification problems and as such it can be used for comparison purposes. Given that this method has never been applied in the prediction of securities class action before, current research tries to fill this gap by applying this method to its data, hoping that the classification results that will come out of it, will be used as a benchmark for other multicriteria techniques.

DA is a technique where a set of data are classified into predefined groups. According to this method, alternative observations are classified into mutually exclusive groups as accurately as possible by maximizing the ratio of among - groups to within - groups variance. In our case, there are two groups; firms that have faced class action and firms that have not faced a class action. Assuming m variables g_1, g_2, ... gm, for each firm the discriminant function has the following form:

$$D_x = p_0 + p_1 g_1 + p_2 g_2 + \cdots + p_m g_m$$

Where D_x is the discriminant score for each firm, $p_0$is the constant term, $p_j (j = 1, \dots, m)$ are the coefficients in the discriminant function and g_j(j=1,...,m) are the independent variables.

Assuming that all misclassification costs and a-priori probabilities are equal (case of LDA), the cut - off point is calculated. Then, each firm is classified into the SCA or the NSCA group. Firms with discriminant scores greater than the cut - off point are classified into SCA group and firms with discriminant scores lower than the cut - off point are classified into the NSCA group. Alternatively, firms can be classified into one group or another depending on their probabilities.

3.2.2 Logit Analysis (LA)

Logit analysis has been used numerous times for prediction purposes like banking failure (Martin, 1977; Min and Lee, 2005; Doumpos and Zopounidis, 2002; Gaganis et al., 2005), credit ratings (Doumpos and Pasiouras, 2005), auditing (Gaganis et al., 2007; Pasiouras et al., 2007), bank acquisitions (Pasiouras and Tanna, 2010) etc. As with DA, LA has extensively been used in several fields mainly for comparison purposes. Moreover, LA provides maximum likelihood methods when regressors are not normally distributed and DA cannot be used. It is a basic and simple method to apply and being one of traditional techniques it can be used for comparison purposes. Like DA, LA has never been applied in the prediction of securities class action before. Therefore, in this thesis DA as a basic classification technique will be applied and will be used as a benchmark for other multicriteria techniques.

LA is another statistical parametric technique where the probability of alternative x_j belonging to a group is defined as follows:

$$P_i = \frac{1}{(1 + e^{-Zi})}$$

where $Z_i = ln\left(\frac{P_i}{1-P_i}\right) = b_0 + b_1x_1 + b_2x_2 + \cdots b_mx_m + e_i$ is the probability that the firm is going to face a class action, b_0 is the constant term, b_j (j=1,...,m) represents the coefficients associated with the corresponding independent variables x_j (j=1,...,m) for each firm. The log likelihood function is maximized and then firms are classified to group A or B (CA firms, NCA firms) depending the cut - off point. The results are produced after type I and type II errors are minimized.

3.2.3 UTilités Additives DIScriminantes (UTADIS)

UTADIS is a classification method that uses an additive utility function, in order to score firms and decide upon their classification. It is a variant of the well-known UTA method (UTilités Additives). Its first use was in 1980 by Devaud et al. and it has been utilised in several cases since then; namely, in the prediction of acquisitions and portfolio returns (Ouzounis et al., 2009), in the identification of acquisition targets (Pasiouras et al., 2007) in bankruptcy prediction (Zopounidis and Doumpos, 1999; Doumpos and Zopounidis, 2002), in assessing bank soundness (Ioannidis et al., 2010), in financial decision making (Zopounidis and Doumpos, 2002) in credit ratings (Doumpos and Pasiouras, 2005) and in auditing decisions (Pasiouras et al., 2007). While this method was rarely used until the mid-1990s, only after 1997 did it start its application in the development of classification models in financial decision making problems (Zopounidis and Doumpos, 1997).

Its general form is:

$$U(g) = \sum_{i=1}^{n} p_i u_i(g_i)$$

where g_i= (g_1 , g_2,.... g_n) is the vector of evaluation criteria, p_i is a constant indicating the significance of criterion $g_i(p_1 + p_2 + \cdots p_n = 1)$ and $u_i(g_i)$ is the marginal utility of criterion g_i. The evaluation criteria g_1,g_2,...,gn involve all the characteristics (qualitative and/or quantitative) of the alternatives that affect their overall evaluation. In the case of the class action's prediction, the evaluation criteria involve the financial ratios and the corporate governance indicators. The alternatives under consideration are classified by the decision maker into q classes C_1, C_2, ..., Cq (in our case there are 2 classes; the first, contains the firms that faced CA at least once in the past, and the second, firms that never faced CAs so far).

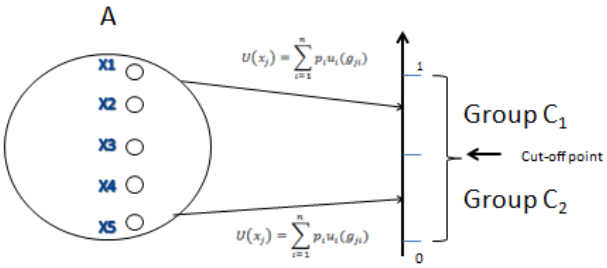


Figure 3.1: Classification of the alternatives on the basis of their global utilities

Figure 3.1 illustrates how the global utilities are used for classification purposes in a two group case. The global utility of each alternative is compared with a cut-off point, defined in a scale of 0 to 1. In group C_1 are classified the alternatives that have global utilities higher than the cut-off point, and consequently in group C_2 are classified those that have global utilities lower than the cut-off point.

To classify the alternatives into their original classes, utility thresholds u_1, u_2, ..., u_{q-1} are estimated. Comparing the global utilities of the alternatives with the utility thresholds, the classification of this alternative is achieved in the following way:

$$\left.\begin{array}{ll} U(x) \geq u_1 & \Rightarrow x \in C_1 \\ u_2 \leq U(x) < u_1 & \Rightarrow x \in C_2 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \\ U(x) < u_{q-1} & \Rightarrow x \in C_q \end{array}\right\}$$

The estimation of the global utility model and the utility thresholds is being done through the solution of the following linear program:

Minimise $F = \sum_{x \in C_1} \sigma^+(x) + \cdots \sum_{x \in C_k} [\sigma^+(x) + \sigma^-(x)] + \cdots \sum_{x \in C_q} \sigma^-(x)$

Subject to

$$\sum_{i=1}^{m} u_i[g_i(x)] - u_1 + \sigma^+(x) \geq 0 \qquad \forall x \in C_1$$

$$\left.\begin{array}{l} \sum_{i=1}^{m} u_i[g_i(x)] - u_{k-1} - \sigma^-(x) \leq -\delta \\ \\ \sum_{i=1}^{m} u_i[g_i(x)] - u_k + \sigma^+(x) \geq 0 \end{array}\right\} \qquad \forall x \in C_k$$

$$\sum_{i=1}^{m} u_i[g_i(x)] - u_{q-1} - \sigma^-(x) \leq -\delta \qquad \forall x \in C_q$$

$$\sum_{i=1}^{m} \sum_{j=1}^{a_i - 1} w_{ij} = 1$$

$$u_{k-1} - u_k \geq s \qquad k = 2, 3, \ldots, q-1$$

$$w_{ij} \geq 0,\ \sigma^+(x) \geq 0,\ \sigma^-(x) \geq 0$$

where:

x_i is the number of subintervals $[g_i^j, g_i^{j+1}]$ into which the range of values of criterion g_i is divided,

w_{ij}= is the difference between the marginal utilities of two successive values g_i^j and g_i^{j+1} of criterion i ($w_{ij} \geq 0$),

δ is a threshold used to ensure that $U(x) < u_{k-1}$, $\forall x \in C_k$, $2 \leq k \leq q-1$ ($\delta > 0$)

s is a threshold used to ensure that $u_{k-1} > u_k$ ($s > \delta > 0$),

$\sigma^+(x)$ and $\sigma^-(x)$ are the classification errors (over-estimation and under-estimation errors respectively).

After the solution of F* a post optimality stage is carried out to examine the existence of other optimal or near optimal solutions, which can provide a more consistent representation of the decision maker's preferences.

3.2.4 Multi-group Hierarchical Discrimination (MHDIS)

An alternative MCDA non-parametric approach is the Multi-Group Hierarchical Discrimination (MHDIS) method. MHDIS has been successfully applied in classification problems in finance, such as bankruptcy prediction (e.g. Pasiouras et al., 2004b), credit risk (e.g. (Doumpos and Zopounidis, 2002), auditing (e.g. Pasiouras et al., 2004a), M&A's (Zopounidis and Doumpos, 2002). MHDIS distinguishes the groups progressively, starting by discriminating the first group from all the others, and then proceeds to the discrimination between the alternatives belonging to the other groups.

Therefore, instead of developing a single additive utility function that describes all alternatives, two additive utility functions are developed in each one of the q-1 steps, where q is the number of groups. The first function $U_k(x)$ describes the alternatives of group Ck, while the second function $U_{\sim k}(x)$ describes the remaining alternatives that are classified in lower groups Ck+1,…,Cq.

$$U_k(x) = \sum_{i=1}^{m} p_{ki}\, u_{ki}(g_i) \text{ and } U_{\sim k}(x) = \sum_{i=1}^{m} p_{\sim ki}\, u_{\sim ki}(g_i),$$
$$k = 1,2,\ldots,q-1$$

The corresponding marginal utility functions for each criterion g are denoted as $U_{ki}(g_i)$ and $U_{\sim ki}(g_i)$ which are normalised between 0 and 1, while the criterion weights p_{ki} and $p_{\sim ki}$ sum up to 1, i.e. $\sum_{i=1}^{m} p_{ki} = 1$. Throughout the hierarchical discrimination procedure it is assumed that the marginal utility function $u_{ki}(g_i)$, are increasing functions on the criterion's scale concerning the classification of an alternative in group Ck; while on the other hand the marginal utility of a decision concerning the classification of an alternative, according to criterion g_i, into a lower (worse) group than Ck [denoted as $u_{\sim ki}(g_i)$,] is a decreasing function on the criterion's scale. Denoting as g_i^j and g_i^{j+1} the two consecutive values of criterion g_i ($g_i^{j+1} > g_i^j$, $\forall$gi$\in$G), the monotonicity of the marginal utilities, can be expressed in mathematical terms through the following constraints:

$$u_{ki}(g_i^1) = 0 \qquad u_{ki}(g_i^{j+1}) > u_{ki}(g_i^j)$$
$$u_{\sim ki}(g_i^{p_i}) = 0 \quad u_{\sim ki}(g_i^{j+1}) < u_{\sim ki}(g_i^j)$$

These constraints can be simplified by introducing a small positive constant t as the lower bound of the difference between the marginal utilities of the consecutive values g_i^j and g_i^{j+1} as follows:

$$w_{kij} \geq t \text{ and } w_{\sim kij} \geq t$$

where:

$$w_{kij} = u_{ki}(g_i^{j+1}) - u_{ki}(g_i^j)$$
$$w_{\sim kij} = u_{\sim ki}(g_i^j) - u_{\sim ki}(g_i^{j+1})$$

Thus, the marginal utility of criterion g_i at point g_i^j can be calculated as:

$$u_{ki}(g_i^j) = \sum_{l=1}^{j-1} w_{kil} \text{ and } u_{\sim ki}(g_i^j) = \sum_{l=j}^{p_i-1} w_{\sim kil}$$

As mentioned above, the model is developed in q-1 steps, where q is the number of groups. In the first step, the method develops a pair of additive utility functions $U_1(x)$ and $U_{\sim 1i}(x)$ to discriminate between the alternatives of group C1 and the alternatives of the other groups C2,…,Cq. On the basis of the above function forms the rule to decide upon the classification of any alternative has the following form:

If $U_1(X) \geq U_{\sim 1}(X)$ then x_j belongs in C1

Else if $U_1(X) \geq U_{\sim 1}(X)$ then x_j belongs in (C2, C3,…,Cq)

The alternatives that are found to belong into class C1 (correctly or incorrectly) are excluded from further analysis. In the next step, another pair of utility functions $U_2(X)$ and $U_{\sim 2}(X)$ is developed to discriminate between the alternatives of group C2 and the alternatives of the other groups C3,…,Cq. As in step 1, the alternatives that are found to belong to group C2 are excluded from further analysis. This procedure is repeated up to the last stage q-1), where all groups have been considered. The overall hierarchical discrimination procedure is presented:

The hierarchical discriminant procedure in MHDIS

If $U_1(X) \geq U_{\sim 1}(X)$ then $x_j \in C_1$

Else If $U_2(X) \geq U_{\sim 2}(X)$ then $x_j \in C_2$

……

Else If $U_{q-1}(x) \geq U_{\sim q-1}(x)$ then $x_j \in C_{q-1}$

Else $x_j \in C_q$

The utility functions in MHDIS do no indicate the overall performance but rather serve as a measure of the conditional similarity of an alternative to the characteristics of group Ck when the choice among Ck and all the lower groups Ck+1,…, Cq is considered. However, similarly to the UTADIS, the estimation of the weights of the criteria in the utility functions as well as the marginal utility functions is accomplished through mathematical programming techniques. More specifically, at each stage of the hierarchical discrimination procedure, two linear programming and a mixed-integer programming problems are solved to estimate the utility thresholds and the two additive utility functions in order to minimise the classification error, as summarised.

Table 3.1 Mathematical programming formulations in MHDIS

LP1: Minimising the overall classification error	MIP: Minimising the number of misclassifications	LP2: Maximising the minimum distance
Min $F = \sum e(x)$ s.t. $\sum_{i=1}^{m}\sum_{j=1}^{r_{ai}-1} w_{kij} - \sum_{i=1}^{m}\sum_{j=r_{ai}}^{p_i-1} w_{\sim kij} + e(x) \geq s$, $\forall x \in Ck$ $\sum_{i=1}^{m}\sum_{j=r_{bi}}^{p_i-1} w_{\sim kij} - \sum_{i=1}^{m}\sum_{j=1}^{r_{bi}-1} w_{kij} + e(x) \geq s$, $\forall x \notin Ck$ e(x), s≥0, t≥0.	$F = \sum_{\forall x \in MIS} [I(x)]$ Min s.t. $\left.\begin{array}{l} \sum_{i=1}^{m}\sum_{j=1}^{r_{ai}-1} w_{kij} - \sum_{i=1}^{m}\sum_{j=r_{ai}}^{p_i-1} w_{\sim kij} \geq s, \ \forall x \in C_k \\ \sum_{i=1}^{m}\sum_{j=r_{bi}}^{p_i-1} w_{\sim kij} - \sum_{i=1}^{m}\sum_{j=1}^{r_{bi}-1} w_{kij} \geq s, \ \forall x \notin C_k \end{array}\right\}$, ∀x∈COR $\left.\begin{array}{l} \sum_{i=1}^{m}\sum_{j=1}^{r_{ai}-1} w_{kij} - \sum_{i=1}^{m}\sum_{j=r_{ai}}^{p_i-1} w_{\sim kij} + I(x) \geq s, \ \forall x \in C_k \\ \sum_{i=1}^{m}\sum_{j=r_{bi}}^{p_i-1} w_{\sim kij} - \sum_{i=1}^{m}\sum_{j=1}^{r_{bi}-1} w_{kij} + I(x) \geq s, \ \forall x \notin C_k \end{array}\right\}$, ∀x∈MIS s≥0, t≥0, I(x) integer.	Max d s.t. $\left.\begin{array}{ll} \sum_{i=1}^{m}\sum_{j=1}^{r_{ai}-1} w_{kij} - \sum_{i=1}^{m}\sum_{j=r_{ai}}^{p_i-1} w_{\sim kij} - d \geq s & \forall x \in C_k \\ \sum_{i=1}^{m}\sum_{j=r_{bi}}^{p_i-1} w_{\sim kij} - \sum_{i=1}^{m}\sum_{j=1}^{r_{bi}-1} w_{kij} - d \geq s & \forall x \notin C_k \end{array}\right\}$, ∀x∈COR′ $\left.\begin{array}{ll} \sum_{i=1}^{m}\sum_{j=1}^{r_{ai}-1} w_{kij} - \sum_{i=1}^{m}\sum_{j=r_{ai}}^{p_i-1} w_{\sim kij} \leq 0 & \forall x \in C_k \\ \sum_{i=1}^{m}\sum_{j=r_{bi}}^{p_i-1} w_{\sim kij} - \sum_{i=1}^{m}\sum_{j=1}^{r_{bi}-1} w_{kij} \leq 0 & \forall x \notin C_k \end{array}\right\}$, ∀x∈MIS′ d≥0, s≥0, t≥0.

(Source: (Doumpos et al., 2001)

Note that each of the three mathematical programming formulations incorporates two constraints to ensure the monotonicity of the marginal utilities, as well as to normalise the global utilities in the interval [0,1]. The classification error in LP1 is denoted using the error function e. For an alternative x∈Ck such that $U_k(x) \leq U_{\sim k}(x)$ the classification error is e(x) = $U_{\sim k}(x) - U_k(x) + s$. Similarly, for an alternative x∉Ck such that $U_k(x) \geq U_{\sim k}(x)$ the classification error is e(x) = $U_k(x) - U_k(x) + s$. The small positive real constant s is used to ensure the strict inequalities $U_k(x) > U_{\sim k}(x)$ and $U_k(x) < U_{\sim k}(x)$.

If after the solution of LP1, there exist some alternatives for which e(x)>0, then these alternatives are misclassified. However, it may be possible to achieve a "re–arrangement" of the classification errors leading to the reduction of the number of misclassifications. In MHDIS this possibility is explored through a mixed-integer programming (MIP) formulation. Since MIP formulations are difficult to solve, especially in cases where the number of integer variables is large, the MIP formulation used in MHDIS considers only the misclassifications that occur through the solution of LP1, while retaining all the correct classifications. This reduces significantly the number of integer variables, which are associated to each misclassified alternative, thus reducing the computational effort required to obtain a solution. In the MIP formulation used in MHDIS, COR denotes the set of correctly classified alternatives after solving LP1, and MIS denotes the set of misclassified alternatives. The first set of constraints in MIP ensures that all correct classifications achieved by solving LP1 are retained, while the second set of constraints is applied only to alternatives that were misclassified by LP1. The integer error variables I indicate whether an alternative is misclassified or not.

Through the solution of LP1 and MIP the "optimal" classification of the alternatives is achieved, where the term "optimal" refers to the minimisation of the total number of misclassified alternatives. However, the correct classification of some alternatives may be "marginal", that is, although they are correctly classified, their global utilities according to the two utility functions developed may be very close. The objective of LP2 is to clarify the obtained classification, through the maximisation of the minimum difference between the global utilities of the correctly classified alternatives

achieved according to the two utility functions. Similarly to MIP, COR´ denotes the set of correctly classified alternatives after solving LP1 and MIP, and MIS´ denotes the set of misclassified alternatives. The first set of constraints in LP2 involves only the correctly classified alternatives. In these constraints d represents the minimum absolute difference between the global utilities of each alternative according to the two utility functions. The second set of constraints involves the misclassified alternatives and it is used to ensure that they will be retained as misclassified.

3.2.5 Support Vector Machines (SVMs)

Support Vector Machines (SVMs) can be used for regression as well as for classification. SVMs are a family of learning algorithms first introduced by Vapnik in 1995 that can solve linear and nonlinear problems. They have been applied to a wide range of problems in various fields, such as computational biology (Ding and Dubchak., 2001), fluid mechanics (Trafalis and Papavassiliou, 2005), meteorology (Trafalis et al., 2007), bioinformatics and gene analysis (Santosa et al., 2007), inventory transactions (Beardslee and Trafalis, 2005), as well as in the area of finance such as short-term portfolio management (Ince and Trafalis, 2006), exchange rate prediction (Ince and Trafalis, 2006), small firms failure prediction (Gaganis et al., 2005), credit rating analysis (Huang et al., 2004), acquisitions and portfolio returns prediction (Ouzounis et al., 2009), in bankruptcy prediction (Min and Lee, 2005).

In current research SVM_{light} was applied in classifying SCAs. SVM_{light} is an implementation of basic SVM for the problem of pattern recognition. The optimization algorithms used in SVM_{light} can handle problems with many thousands of support vectors efficiently. SVMs are based on Structural Risk Minimization principle from computational learning theory. SVM is a method that uses decision boundaries and performs classification tasks by constructing hyper planes in a multidimensional space that separates cases of different class labels. There are two cases. The first case is the linearly separable case, where the decision rule defined by an optimal separating hyperplane for the binary decision class. This can be represented by the following equation:

$$y = b + \sum y_i a_i \, \mathrm{x} \bullet \mathrm{x_i}$$

where y is the outcome, y_i is the class value of the training example x_i, and $\bullet$ is the dot product. The vector x corresponds to an input, the vectors x_i are the support vectors and b and a_i are parameters that determine the hyperplane ($a \geq 0$). From the implementation point of view, Vapnik (1995) showed how training a SVM and finding the parameters b and a leads to a quadratic optimisation problem with bound constraints and one linear equality constraint. This means that the solution of SVMs is unique, optimal and absent from local minima (Cao and Tay, 2001). Since most real-world problems seem not to be linearly separable, SVMs can work in combination with the technique of "kernels", which automatically realises a non-linear mapping into a feature space. The second case is the nonlinearly separable case. The high-dimensional version of the above equation is given as:

$$y = b + \sum y_i a_i \, K(\mathrm{x}, \mathrm{x_i})$$

where the function $K(\mathrm{x}, \mathrm{x_i})$ is the kernel function for generating the dot products to construct machines with different types of non-linear decision surfaces in the input space. Any function satisfying Mercer's theorem can be used as the kernel. For constructing decision rules, two typical examples are the polynomial kernel function $K(x_i, x_j) = (x_i \bullet x_j + 1)^d$ where d is the degree of the polynomial kernel, and the Gaussian function with kernel $K(x_i, x_j) = \exp\left(-1/\delta^2 (x_i - x_j)^2\right)$ where δ^2 is the bandwidth of the Gaussian kernel.

In the general non-separable case the development of an SVM model involves two objectives: the maximisation of the separation margin and the minimization of the misclassifications for the training sample. The relative firms in the importance of the two objectives is taken into consideration through a user-defined constant ($C \succ 0$) representing the importance given to the minimisation of the misclassification as opposed to the margin maximisation objective. Implicitly C defines an upper bound on the coefficients a of the separating function.

3.2.6 Majority Voting

Majority voting (MV) is a simple framework that allows us to combine different methods operating on binary classification outputs (class actions / non class actions). The MV method goes with the decision where there is a consensus that at least half of the classifiers agree on it. Let us assume that there is a system L of K classifiers, L = {l1, …, lM}, and yk(xi), i=1, …, n and k=1, …, K denote the output of the k^{th} classifier for the i^{th} multidimensional input sample x_i. Given the binary outputs from the M classifiers for a single input sample, the decision of the MV classifier can be represented as follows:

$$y_i^{MV} = 0 \text{ if } \sum_{k=1}^{K} y_k(x_i) \leq K/2$$
$$y_i^{MV} = 1 \text{ if } \sum_{k=1}^{K} y_k(x_i) \leq K/2$$

Figure 3.2 illustrates the application of the majority voting combining the output of three classifiers. Classifiers 1 and 2 indicate that the firm has faced a class action, whereas classifier 3 indicates the opposite. Therefore, just because two out of three classify the firm as facing a class action, the final decision under majority voting rule is that the firm will be classified in the group with the class action firms.

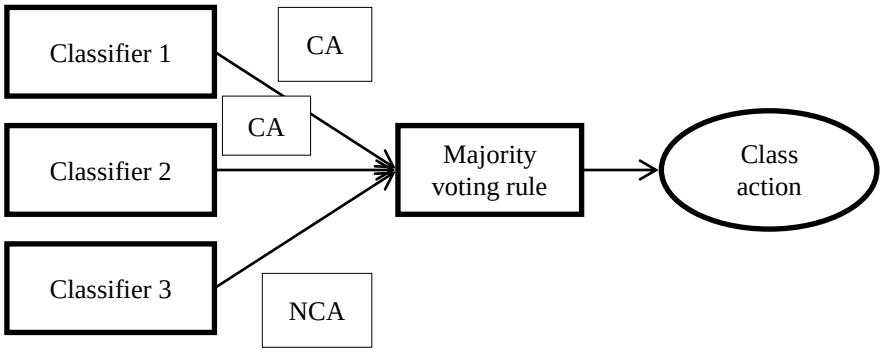


Figure 3.2: Majority voting rule

The combination of multiple classifiers has received increased attention in recent applications in finance such as credit scoring (Doumpos, 2002) and the prediction of acquisitions (Pasiouras et al. 2005).

3.3 Conclusion

This chapter presented the techniques that will be used in current research for the development of the securities class action prediction models. Five well known classification methods (DA, LA, UTADIS, MHDIS and SVMs) as well as integration method are presented. The procedures of each technique will be applied in the following chapters for empirical analyses.

CHAPTER 4 CONSTRUCTION OF DATA

4.1 Introduction

This chapter discusses the construction of the dataset, the selected variables and the preliminary analysis. Its context is divided into five sections. Section 4.2 presents the sources of accounting and corporate governance data. Section 4.3 provides information about the construction of the two samples, e.g. the split of the sample in training and validation datasets, the way in which the matching of SCAs and NSCAs is performed and other relevant considerations. The following section, (4.4), explains step by step the procedure through which the variables were selected, in order to be used in the models. Also, it presents the application of parametric and non-parametric tests, as well as the correlation analysis. The final section, (4.5), concludes the chapter.

4.2 Sources of data

The current research investigates firms that faced a security class action lawsuit at least once during the period 2003 to 2011. These firms are matched with another set of firms that did not face a security class action lawsuit during the same period.

1) The financial data are drawn from the OSIRIS Database of Bureau van Dijk. This database, frequently used in academic research, contains financial data for over thousands of firms around the world. OSIRIS is the selected database for three main reasons. Firstly, it is a comprehensive database of financial information, ratings, earnings estimates, notes and stock data about firms around the world with coverage of over 125 countries, containing over 37.000 companies. Secondly, companies may be displayed and exported in a variety of customizable formats, assisting comparisons among the selected data. Last but not least, OSIRIS is one of the best known providers of accounting and other financial data for firms worldwide among DataStream, Compustat Global, Company Analysis, Worldscope, Thomson Financial, Extel Financials, BankScope and Amadeus and it has been extensively used for research in the area of accounting and finance (Lara et al., 2006).

2) The corporate governance data are from the Risk Metrics Group. This database contains corporate governance indicators for more than 7.500 companies worldwide[15]. It is a leading provider of risk management and corporate governance services to the global financial community. It has been broadly used in studies on banking performance (Peni et al., 2012), and on corporate governance credit ratings (Ertugrul and Hegde, 2009).
3) The list of firms that faced SCAs is drawn from the Securities Class Action Clearinghouse[16] maintained by the Stanford Law School in cooperation with Cornerstone Research. This database maintains an Index of Filings of thousands of issuers that have been named in federal SCA lawsuits since the passage of the PSLRA in 1995.

In order to include firms subject to SCAs in the sample, they should meet the following criteria:

a. Only filings that took place between 01/01/2003 until 31/12/2011 are considered for inclusion in the sample. This is due to unavailability of financial data in the online version of OSIRIS Database of Bureau van Dijk, prior to 2001.
b. SCAs should be filed to USA courts.
c. All firms should be classified in OSIRIS as Industrial companies.
d. Data should be available in OSIRIS for at least one year prior to the SCA that is if a SCA took place in 2004, then financial data of 2003 should be retrieved form OSIRIS.
e. In the case of the models that include corporate governance indicators, the selected firms should be included in Risk Metrics Group database.
a. To include NCAs firms into the matching sample, they should meet the same criteria, the only exception being that they should not have been subject to a SCA. To be more specific, when a company in Energy sector faced a SCA in 2007, it should be matched with another company of the same sector that did not face a class action in the same year. In both cases, financial data from the year prior to the event (i.e. 2006) should be available in OSIRIS.

[15] The Corporate Governance Quotient rates 5.600 US firms and 2.200 non-US using public available documents and Web site disclosure.
[16] Website: http://securities.stanford.edu/

4.3 Sample construction

There are two samples to be used in current research. The first one is formed on the basis of availability of accounting information, (i.e. accounting ratios from published financial statements). The second one is formed on the basis of availability of corporate governance information (i.e. qualitative variables). The sample that uses accounting information consists of 2,072 firms and the sample that uses corporate governance with accounting ratios consists of 460 firms. The following sections explain in detail the construction of these two samples.

4.3.1 Accounting information

Initially we identified a total of 1,204 US firms that faced a SCA, which were matched by size and industry with an equal number of NSCA firms. Then, 168 firms were excluded due to unavailability of data, reducing the sample to 1,036 SCA and 1,036 NSCA firms. Therefore, the total number of filings is 2,072 companies operating in the US over the period 2003 - 2011.

Figure 4.1 presents the distribution of the SCAs over the period of the analysis. For example, our sample includes 136 companies that faced a SCA during 2005. The total number of SCAs is 1,036.

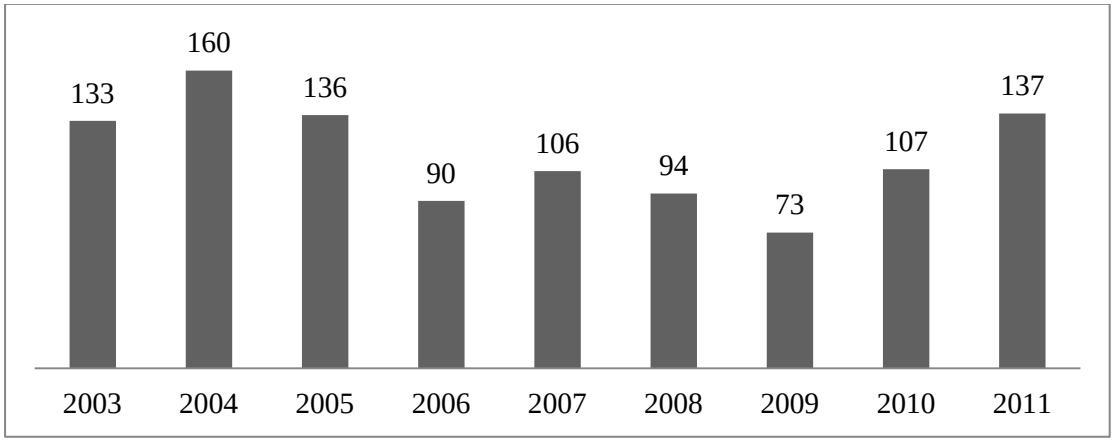


Figure 4.1: Number of SCAs per year

Table 4.1 presents the nine sectors that were used in the analysis. For example, the "Industrials" sector contains firms that relate to manufacturing, construction industry etc., the "Consumer Staples" sector contains products that satisfy essential needs such as food, beverages, tobacco items and so on. The "Information technology", the

"Healthcare", the "Consumer discretionary" and the "Industrials" are the sectors with the largest average number of class action filings for the period under examination. It also presents the total number of class actions per sector under investigation. For instance, in the "Consumer Staples" sector 63 SCAs were filed during the period 2003 - 2011. Therefore, we collected financial data of 63 SCA firms from the same sector, lagged by one year.

Table 4.1: Description and number of filings by sector

	Sector	Details	Number of SCAs
1	Utilities	Electric, gas and water firms as well as integrated providers.	23
2	Telecommunication Services	Cable, satellite, TV internet, Radio and telephony companies.	25
3	Materials	Mining and refining of metals, chemical producers and forestry products.	37
4	Information Technology	Electronics manufacturing, software creation, products and Services relating to information technology.	278
5	Industrials	Construction and manufacturing firms. Aerospace and defence, industrial machinery, tools production, cement and metal fabrication firms.	107
6	Healthcare	Healthcare management firms, health maintenance organizations, biotechnology	240
7	Energy	Oil, gas companies and integrated power firms.	59
8	Consumer Staples	Essential products such as food, beverages, tobacco and household items.	63
9	Consumer Discretionary	Retailers, consumer services companies, consumer durables and apparel companies, and automobiles and components companies	204

The matching was made according to the sector and to the year the class action took place. For example, for a company in the “Energy” sector that faced a class action during the year 2003, financial data from the prior year (i.e. 2002) were gathered and

were matched to another company from the "Energy" sector, that was not subject to a SCA, using data from the same year (i.e. 2002). In other words, in both cases (SCA and NSCA firm) financial data from the previous year (i.e. 2002) were used.

The total sample must be split into two subsamples. The training sample and the validation sample. The training sample will be used for model development and the validation sample will be used to test the predictive ability of the models. Although there are several techniques that can be used for re-sampling[17], the current research splits the sample in the two subsamples under the "2/3 rule" (Model A) and under the "Crisis rule" (Model B) as it will be explained further.

Training and validation sample (Model A)

As mentioned earlier, the total sample consists of 1,036 firms that faced a SCA during 2003 - 2011 and 1,036 firms that were not subject to a SCA over the same period. The training sample amounts a total of 1,382 firms so that 2/3 of the sample will be used for training purposes (66%).

The validation sample consists of the remaining 345 firms (i.e. not used in the training dataset) that faced a SCA during 2010 - 2011 matched with another 345 firms that did not face a SCA during the same period. That makes a total validation sample of 690 firms, which is around 33% of our total sample.

Table 4.2: Summary of training and validation samples (Model A)

Sample	Securities Class Action	Non Securities Class Action	Total
Training sample	691	691	1,382
Validation sample	345	345	690
Total sample	1,036	1,036	2,072

Training and validation sample (Model B)

A further test will be applied over the credit crisis period to examine whether the performance of the models is robust. On the basis of a cut-off point in time, the two

[17] E.g. cross-validation, jackknife and bootstrap

subsamples that are produced correspond to the pre - credit and post - crisis period. So, the training sample contains data from 2003 until 2007.

The validation sample consists of 411 firms that faced a SCA between 2008 and 2011 and 411 firms that did not face a SCA. Therefore, the total size of the validation sample is 822 firms, corresponding to 40% of the total sample. Table 4.2 summarises the construction of the training and validation samples under the division of the 2/3 rule (Model A) and Table 4.3 summarises the construction of training and validation samples taking into consideration the crisis that occurred in 2008 (Model B).

Table 4.3: Summary of training and validation samples (Model B)

Samples	Years	Securities Class Action	Non Securities Class Action	Total
Training sample	2003-2007	625	625	1,250
Financial data (1 year lag)	2002-2006			
Validation sample	2008-2011	411	411	822
Financial data (1 year lag)	2007-2010			
Total sample	2003-2011	1,036	1,036	2,072
Financial data (1 year lag)	2002-2010			

4.3.2 Corporate governance information

In the case of the models that incorporate the corporate governance information, the same approach is followed for the matching of the firms. The total number of filings that faced a SCA is 230 US firms, which is matched by size and industry with an equal number of NSCA firms. The only difference is that the period slightly changes, altering the total number of SCA to be examined. This happened because: (i) the corporate governance database did not include data for the year 2010, and (ii) because some of the firms that were included in the previously constructed dataset, were not included in Risk Metrics database. These two facts reduced the sample to 460 firms, half of which faced a SCA. Therefore in the case of the model with the corporate governance information the period is restricted to 2002 – 2009. Figure 4.2 shows the number of SCAs per sector. "Information technology", "Healthcare", "Consumer discretionary" and "Industrials" are again the sectors with the largest average number of class action filings during the period under examination.

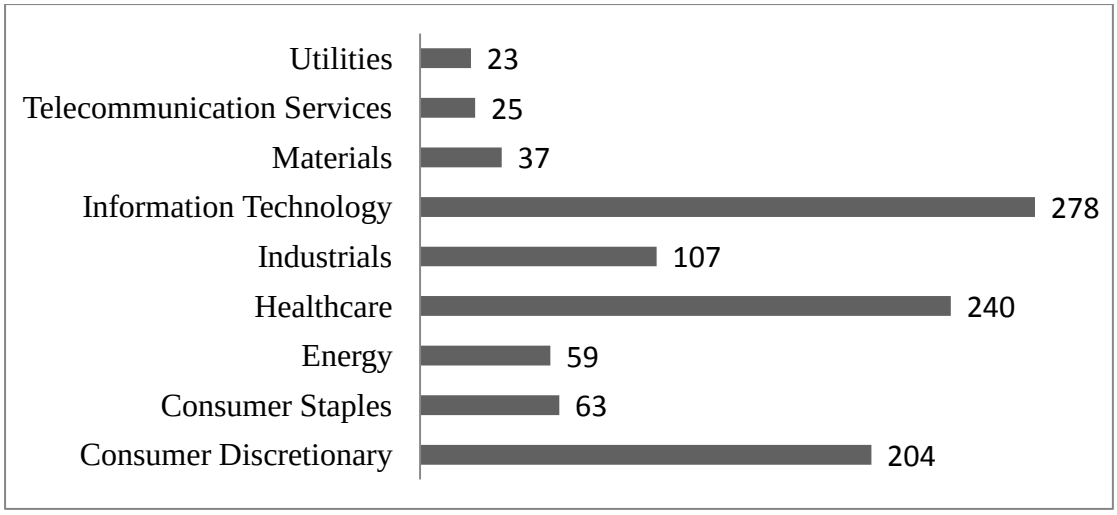


Figure 4.2: Number of SCA filings per sector: sample with corporate governance and accounting information

Figure 4.3, presents the number of SCAs during 2002-2009. For example, the sample includes 34 companies that faced a SCA during 2006. The total number of SCAs is 230.

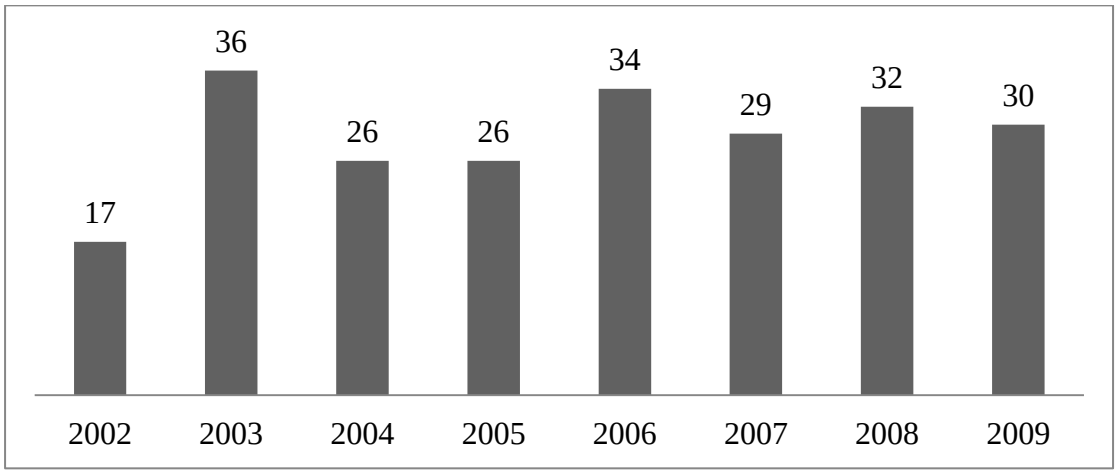


Figure 4.3: Number of SCAs per year

Again the total sample must be split into two subsamples. The training sample and the validation sample. The training sample will be used for model development and the validation sample will be used in order to classify the firms to SCA and to NSCA categories.

Training and validation sample

The total sample consists of 230 firms that faced a SCA during 2003 - 2010 and 230 firms that were not subject to a SCA over the same period. The training sample amounts a total of 304 firms. As before, 2/3 of the sample is being used for training purposes (66%) and 1/3 for validation purposes.

The validation sample consists of the remaining 78 firms (i.e. not used in the training dataset) that faced a SCA during mid-2008 to 2010 with another 78 firms that did not face a SCA during the same period. That makes a total sample of 156 firms, which is around 33% of our total sample and was used for validation purposes.

Table 4.4: Summary of training and validation sample

Sample	Securities Class Actions	Non Securities Class Action	Total
Training sample	152	152	304
Validation sample	78	78	156
Total sample	230	230	460

4.4 Selection of variables

This thesis examines the usefulness of accounting and corporate governance information in the development of quantitative multicriteria models for the prediction of SCAs. Therefore, following section will introduce the variables that will be used in the current research.

4.4.1 Accounting variables

For the development of the models, the candidate variables need to be identified and the final set of input variables has to be selected.

Data collected from the database were short listed under the criteria of country, given the fact that only US companies were to be included in the sample (as explained in section 1.3.2), and of industry (as explained in section 1.3.1), leaving out banking and insurance sector. OSIRIS contains numerous variables quantitative and qualitative as well. In the beginning various basic pre-calculated ratios were extracted; Gross margin (GM), Return on assets (ROA), Return on capital employed (ROCE), Current

ratio (CR), Liquidity ratio (LR), Equity to Total Assets (E/TA), Gearing (GR), Total assets (TA). Additional to these, the following variables were constructed: Cash or Equivalent to Total Liabilities and Debt (CE/TLD), Goodwill to Total Assets (G/TA), the historical background of each company to SCAs (PAST) and Net Sales to Total Assets (NS/TA). Consequently, the total number of variables to be examined is twelve and summarized in Table 4.5.

Table 4.5: Initial set of accounting variables

1	ROA	Profit & Loss for the Period/Total Assets
2	NS/TA	Net Sales/Total Assets
3	CR	Current Assets/Current Liabilities
4	Log TA	Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles
5	E/TA	Shareholders' Funds/Total Assets
6	G/TA	The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets.
7	PAST	The number of SCA that each company has faced in the past
8	CE/TLD	The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account. TLD includes Total current liabilities, total long-term interest bearing debt, minority interest, deferred taxes, provisions and other long term liabilities.
9	GM	Gross Profit/Operating Revenue
10	ROCE	Profit & Loss for the Period- Interest Expense/(Shareholders' Funds + Non-Current Liabilities)
11	LR	Current Assets Stocks/Current Liabilities
12	GR	(Non-Current Liabilities + Loans)/Shareholders' Funds

After the above data were exported, variables with missing values of more than 5% were excluded from the analysis (ROCE, GR, LR and GM). So, the final set of accounting variables is limited to the rest eight: ROA, NS/TA, CR, Log TA, E/TA, G/TA, PAST, CE/TLD.

Profitability

Return on assets (ROA), one of the most important profitability ratios, is calculated as profit or loss for the period divided by total assets measuring the overall profitability of a company. This ratio shows how much profit or loss can be produced by the use of total assets. Therefore, it shows how efficiently a company funds its assets, in order to

generate profits. This ratio has been used in determining the SCAs incidence mainly due to its predictive power. In the study of Peng and Röell (2008), firms with low ROA are more likely to be sued, possibly because of poor performance. In the current study it is expected that firms with inefficient management are more likely to face a SCA.

Leverage

Leverage will be measured via the Equity to Total Assets ratio (E/TA). Some researchers promote it as a key variable in prediction in case of SCAs. Peng and Röell (2008) used it in order to investigate whether executive pay affects shareholder's litigation. In this study the authors used the ratio debt to total assets to measure the leverage, which was found to be statistically significant at 5%. More detailed, they claimed that firms with high leverage (high level of debt compared to total assets) may indicate poor performance; assets write downs or forced heavy borrowing leading to shareholders dissatisfaction. Strahan, (1998) used the ratio debt to assets and found it to be significantly related to the likelihood of facing a class action. Firms with high leverage are more likely to face a class action. On the other hand, Amoah and Tang (2010) proved that there is a negative association between leverage and restatement induced litigation. The current thesis will use the ratio 'Equity to Total Assets' to capture the level of leverage of the firm. This variable is calculated as shareholder's funds to total assets and provides a slightly different view of the financial leverage of the firm. The higher the level of equity funds is the more shareholders exist, a fact which increases the probability of a creation of a class against the company. From another point of view, firms with higher leverage could have a lower probability of facing a class action because shareholders may perceive such firms as being in financial distress and less capable of paying damage awards to shareholders. Therefore, it is expected that firms with high level of equity instead of debt will be more prone to SCAs.

Liquidity

Liquidity will be measured with two ratios. The first one is current ratio (CR) which is considered to be the most important in this category and has been used in various studies (Pasiouras et al., 2007; Zopounidis and Doumpos, 1999) and the second one is cash or cash equivalent to total liabilities and debt (CE/TLD) and has been used in the

past in the case of prediction of corporate financial distress (Hua et al., 2007). CR expresses how efficiently a company may deal with everyday liabilities using all of its current assets and CE/TLD expresses how efficiently a company may deal with its total liabilities by using only its cash or cash equivalent.

Pasiouras et al. (2007) selected CR, in order to examine whether it could discriminate firms between qualified and unqualified opinions. Even though they excluded this variable, due to its high correlation to quick ratio, they expected that high liquidity might increase the likelihood of qualified audit opinion and companies with poor liquidity are more probable to receive going concern modifications. Likewise, in the case of SCAs, firms that received qualified audit opinion for their financial statements, have high probability to be involved in malpractices, frauds, errors and consequently high probability to face securities class actions. On the other hand, excess liquidity may signal a lack of investment opportunities or a poor allocation of assets (Walter, 1994). Therefore, it is expected that companies with high level of CR will be considered to have excess liquidity in order to compensate the class and as such will be more prone to SCA.

In the study of Hua et al. (2007), it is examined whether cash and cash equivalents to current liabilities can assist in the prediction of financial distress. The results show that this variable plays a negative and significant role in classifying the firms into bankrupt and non-bankrupt. Even though cash and cash equivalents to total liabilities ratio is a stricter variable, it is expected that it could play a negative and significant role in predicting securities class action. Thus we assume that firms which cannot settle their liabilities using their cash have higher probability to face a security class action.

Size

Log TA has extensively been used in the literature of securities class actions. Consistent with Pellegrina and Saraceno (2011), size will be measured using the logarithm of total assets (Log TA). The results show that the logarithm of total assets is positively related to SCAs. Firms that are large in size can guarantee successful repayment of damaged investors. Consequently, it is expected in the current thesis that firms with high levels of total assets are more probable to face a SCA. From

another point of view, larger firms are more likely to be target of litigation, not only because they are more likely to engage in fraudulent behavior, but also because they are more promising targets in terms of potential payoffs.

Another variable that we will use is the goodwill to total assets (G/TA). Jennics et al. (1996) used this variable to examine the relation between goodwill and equity. They concluded that there is a positive association between equity and recorded goodwill. As equity values reflect investor's beliefs about firms' future cash flows, goodwill is viewed by investors as an economic resource that in some cases declines and in some others increase in value. In the current thesis, firms with high level of equity values (high level of TA) reflect increased expectations of future cash flows from shareholders. So, the lower the ratio is, the higher the probability to face a SCA.

Chauvin and Hirschey (1994) is another study that used also goodwill to investigate the influence of it on the profitability and the market value of the firm. They used goodwill to total assets to measure how much goodwill a company is recording compared to the total level of its assets. Firms with great reputations are usually firms that manage their business more efficiently and effectively than others. Therefore, the greater the ratio of G/TA the less likely it is for firms to face SCAs.

Productivity

Productivity will be measured by the turnover ratio and more specifically by the net sales to total assets ratio (NS/TA). The capital turnover ratio is a standard financial ratio illustrating the sales generating ability of the firm's assets. It is a measure of management's capability in dealing with competitive conditions. Altman (1968) used this ratio as one of the critical variables to predict bankruptcy. Therefore, the lower NS/TA, the higher the probability there is for a firm to face a SCA.

Historical background in litigation

Finally, a variable called "PAST" indicates how many times a certain firm has faced a SCA. Donelson et al. (2012) use a similar variable. In their case it is set to one when the firm operates in a high litigation risk industry, and therefore has higher probability to have a history in litigation, and is equal to zero otherwise. They claimed that firms that face lawsuits are those that have been accused of fraud. Others also examined the

history background in litigation of a set of firms. Gande and Lewis (2009) show that firms are significantly more likely to be sued if they have previously been sued. Furthermore, Pellegrina and Saraceno, (2011) include in their dataset a similar variable that measures the number of SCA per year and per sued bank. Once again they confirm earlier findings showing that firms which are going to face a SCA are those which have already faced at least in the past one. In the current study, it is expected that firms that have already faced a SCA in the past are more likely to face again one in the future. So, the higher value of this variable, the higher the probability there is for a firm to face a SCA.

Variables reduction process

To select the final set of variables to be included in the models we use a combination of univariate tests of mean differences and correlation analysis.

a. Descriptive statistics

Before starting the analysis it is very useful to review the differences that exist between the two groups. In the next table the mean and the standard deviation for all eight variables and for the 2,072 firms are presented over the period 2003-2011, while distinguishing between the two groups (SCA and NSCA).

Table 4.6: Descriptive statistics for the two groups

	Variables	NCA/CA	N	Mean	Std. Deviation
1	ROA	SCA	1,036	-2.808	21.018
		NSCA	1,036	3.896	11.489
		TOTAL	2,072	0.543	17.262
2	NS/TA	SCA	1,036	0.904	0.782
		NSCA	1,036	1.107	0.988
		TOTAL	2,072	1.005	0.897
3	CR	SCA	1,036	2.995	2.771
		NSCA	1,036	1.960	2.505
		TOTAL	2,072	2.477	2.691
4	Log TA	SCA	1,036	5.824	0.932
		NSCA	1,036	6.308	0.567
		TOTAL	2,072	6.066	0.808
5	E/TA	SCA	1,036	50.577	28.746
		NSCA	1,036	42.965	25.404
		TOTAL	2,072	46.771	27.386
6	G/TA	SCA	1,036	0.120	0.157
		NSCA	1,036	0.141	0.161
		TOTAL	2,072	0.130	0.159

7	PAST	SCA	1,036	0.190	0.439
		NSCA	1,036	0.144	0.400
		TOTAL	2,072	0.167	0.420
8	CE/TLD	SCA	1,036	0.619	1.003
		NSCA	1,036	0.289	0.464
		TOTAL	2,072	0.454	0.798

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, CE/TLD: The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account.

The main results from the above tables are summarised below:

- As far as the profitability is concerned, the results offer a preliminary indication that earnings generated from invested capital (assets) are more in firms belonging in the NSCA group than those belonging in the SCA group. In other words, firms belonging in NSCA group make use of their assets more efficiently than firms belonging in SCA group. Gande and Lewis, (2009) provide supporting evidence that firms that have lower profitability ratio will face a SCA.
- In terms of liquidity, the firms that belong in the SCA group have better liquidity than those belonging in the NSCA group. This suggests that firms which belong in SCA group have better working capital management than those firms which belong in the other group.
- Concerning the productivity, the firms that belong in the SCA group have lower ratio of net sales to total assets than those which belong in the NSCA group. High ratio indicates effective pricing strategy. Firms with low profit margins tend to have high asset turnover, while those with high profit margins have low asset turnover. So, it is clear that firms belonging in SCA group have lower productivity than firms belonging in the NSCA.
- The firms that belong in the SCA group are firms with low level of total assets compared to the NSCA group. Therefore, this is an indication that small entities are SCA targets, even though Pellegrina and Saraceno (2011) and Donelson et al. (2012) proved that the log of TA is positively linked to the litigation.
- Firms belonging in SCA group do not have high goodwill compared to firms belonging in the NSCA category. This stems from the fact that G/TA is lower

in the SCA group than that of firms than belong in NSCA group, although the difference is quite small.

- The figures for leverage suggest that SCA is attracted by firms with high level of equity, given that the SCA firms tend to have higher levels of Equity to Total Assets ratio than the NSCA firms. This indicates that shareholders will file a class action against a firm that has increased equity in relation to total assets. McTier and Wald (2011) found that leverage[18] is negatively correlated with statistical significance at the 1% level in all models except one, in which the correlation is not statistically significant.
- Finally, it seems that the firms belonging in the SCA group are those which have historical background in litigation. This is supported by the higher mean of SCA group. Gande and Lewis (2009) used a dummy called 'Previous lawsuit' in order to examine whether the legal past of a business plays significant role. The results showed that this dummy is positively correlated and statistically significant at 1%.

It must be emphasized at this point that the above tables provide only a general idea about the characteristics of the two groups. In order to arrive at more reliable conclusions about the statistical significance of the differences we will use a univariate test.

b. Univariate test of two groups

A parametric approach is applied, in order to test whether the means of the retained variables differ among the two groups of firms. Table 4.7 shows that all the variables are statistically significant at the 1% level, except from the seventh variable, PAST, which is significant at the 5% level.

[18] Leverage is calculated as the company's total debt divided by the sum of the company's market value of equity and total debt

Table 4.7: Independent Samples Test

	Variables	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
1	ROA	220.649	0.000	-9.009	2070	0.000	-6.704	0.744
2	NS/TA	11.466	0.001	-5.192	2070	0.000	-0.203	0.039
3	CR	92.014	0.000	8.921	2070	0.000	1.035	0.116
4	Log TA	207.710	0.000	-14.253	2070	0.000	-0.483	0.033
5	E/TA	20.769	0.000	6.386	2070	0.000	7.611	1.191
6	G/TA	1.474	0.225	-2.946	2070	0.003	-0.020	0.007
7	PAST	20.827	0.000	2.456	2070	0.014	0.045	0.018
8	CE/ TLD	193.510	0.000	9.622	2070	0.000	0.330	0.034

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, CE/TLD: The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account.

The results are the same when a non-parametric approach is applied (see Table 4.8). All the variables are statistically significant at level 1%. Thus, all the variables seem to have discriminative power between SCA and NSCA firms under the assumption that the two groups are not normally distributed.

Table 4.8: Non parametric test

	Variables	Mann-Whitney U	Wilcoxon W	Z	Asymptotic Sig. (2-tailed)
1	ROA	433976.0	971142.0	-7.540	0.000
2	NS/TA	459674.0	996840.0	-5.653	0.000
3	CR	440453.0	977619.0	-7.065	0.000
4	Log TA	332805.0	869971.0	-14.97	0.000
5	E/TA	435581.5	972747.5	-7.422	0.000
6	G/TA	473457.0	1010623.0	-4.690	0.000
7	PAST	513086.0	1050252.0	-2.776	0.006
8	CE/ TLD	429495.0	966661.0	-7.869	0.000

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, CE/TLD: The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account.

c. Correlation analysis

An important issue of concern is multicollinearity. If there is a strong correlation among the variables, the estimates of the regression model may become unstable. The

outcome of the non-parametric test shows that further attention needs to be paid on the statistical significant variables. Thus, we examine the correlation among the variables. The following table shows the correlation coefficients.

Table 4.9: Pearson correlation among the variables

Variables	ROA	NS/TA	CR	Log TA	E/TA	G/TA	PAST	CE/LTD
ROA	1							
NS/TA	0.165**	1						
CR	-0.037	-0.129**	1					
Log TA	0.202**	-0.118**	-0.290**	1				
E/TA	0.134**	-0.075**	0.420**	-0.311**	1			
G/TA	0.049*	-0.100**	-0.129**	0.129**	0.027	1		
PAST	-0.062**	-0.029	0.014	0.041	-0.007	0.014	1	
CE/ TLD	-0.067**	-0.144**	0.554**	-0.377**	0.501**	-0.166**	0.031	1
**. Correlation is significant at the 0.01 level (2-tailed).								
*. Correlation is significant at the 0.05 level (2-tailed).								

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, CE/TLD: The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account.

The variable CE/LTD is considered to highly correlated with CR, which is somehow expected, since they belong to the same category representing liquidity. Therefore, CE/TLD will be excluded from further analysis. The rest of the variables do not seem to correlate with each other, a fact which allows us to consider them in further analysis. The final set of variables to be included to the classification models are the ones shown in Table 4.10.

Table 4.10: Final set of input variables

	Balance sheet and other characteristics	Variables
1	PROFITABILITY	ROA
2	PRODUCTIVITY	NS/TA
3	LIQUIDITY	CR
4	SIZE	Log TA
5	LEVERAGE	E/TA
6	SIZE	G/TA
7	HISTORICAL BACKGROUND	PAST

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, CE/TLD: The total of all immediate negotiable medium of exchange or instruments normally accepted by banks for deposit and immediate credit to a customer account.

4.4.2 Corporate governance variables

The Corporate Governance Quotient (CGQ) gathers data on four groups related to corporate governance categories, which are used to evaluate the firm's practices in terms of: (i) board of directors, (ii) audit, (iii) antitakeover, and (iv) compensation / ownership. In more detail, each company's CGQ is compared with other companies in the same index and industry group. The available corporate governance data that have been retrieved are the two general indicators: Index CGQ (IX-CGQ) and Industry CGQ (ID-CGQ). In further analysis, we use also the Board Subscore (BS), Compensation Subscore (CS), the Takeover Defenses Subscore (TDS) and the Audit Subscore (AS). Table 4.11 presents further information on these variables.

Table 4.11: Corporate governance variables

A. Index CGQ	General index score that is made of comparison peer group based on stock exchange index were the firm is traded (S&P 500, Mid-Cap 400, Small-Cap 600, Russell 3000, and CGQ Universe)
B. Industry CGQ	General industry score that is made of comparison peer group based on the S&P "GICS" (Global Industry Classification System) of 24 industry groups
C. Board Subscore	Board composition Nominating committee composition Compensation committee composition Governance committee Board structure Board size Changes in board size Cumulative voting Boards served on – CEO Boards served on – Other than CEO Former CEOs on the board Chairman/CEO separation Governance guidelines Response to shareholder proposals Board attendance Board vacancies Related-party transactions - CEO Related-party transactions - Other than CEO Majority Voting ISS Recommendation of Withhold Votes
D. Compensation Subscore	Cost of option plans Option repricing permitted Shareholder approval of option plans Compensation committee interlocks

	Director compensation Option burn rate Performance-based compensation Option expensing
E. Takeover Defenses Subscore	Poison pill adoption Poison pill – shareholder approval Poison pill – TIDE provision Poison pill – sunset provision Poison pill – qualified offer clause Poison pill – trigger Vote requirements – charter/bylaw amendments Vote requirements – mergers Written consent Special meetings Bylaw amendments Capital structure – dual class Capital structure – blank check preferred
F. Audit Subscore	Audit committee Audit fees Auditor ratification Financial experts Financial Restatements Options Backdating

Source: CGQ Best Practices Manual Risk Metrics Group, Inc. 2008

Financial globalization has led many firms to adopt corporate governance practices. Agency theory is directed at the agency relationship, in which one party (the principal) delegates work to another party (the agent) who performs the work. In other words, the agency theory attempts to describe the relationship between the two parties of a contract. Agency theory has been extensively being examined, even if it is controversial whether it addresses clear problems. Perrow (1986) claimed that agency theory cannot cause any problems to the operation of a business, whereas Hirsch and Friedman (1986) proved that agency theory can severely affect stock price. Agency theory is an important issue that it has been proven to contribute to organization theory (Jensen and Meckling, 1976). It provides a unique, realistic and empirically testable perspective on problems of cooperative effort (Eisenhardt, 1989).

It is known that the agency problem (the 'separation and control' issue) occurs when cooperating parties have different interests and it is expensive or difficult for the principal to verify what the agent is actually doing. Agency costs also generated by the existence of debt and outside equity, arises the problem who bears the costs and

why (Jensen and Meckling, 1976). Another problem arising from the agency theory is that the principal and the agent may have different attitude towards risk and because of that, they may prefer different actions. There are many ways to monitor shareholders' interest towards executive behavior. One of them is the board of directors. When boards provide rich information, the executives are more likely to behave accordingly to shareholder's interests. Another is the director's compensation. When for example the bonuses are high, the directors are supposed to be more willing to act in shareholder's interests. The current study will examine whether parameters such as the existence and the structure of board of directors, the executives' compensations, the poison pill strategies as well as the existence of an audit committee (see Table 4.11), affect the likelihood of SCAs. More detailed, it will be examined whether the corporate governance characteristics affect the probability of a lawsuit and eventually assist in achieving higher classification accuracies.

Therefore, the final set of variables to be examined in this section, include the ten corporate governance ratios shown in Table 4.12.

Table 4.12: Corporate governance variables

1. IX – CGQ
2. ID – CGQ
3. BS-Index
4. BS - Industry
5. CS – Index
6. CS - Industry
7. TDS - Index
8. TDS - Industry
9. AS - Index
10. AS - Industry
Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

a. Descriptive statistics

Table 4.13 presents the descriptive statistics for the ten corporate governance variables for the period 2002-2009 while distinguishing between the two groups.

Table 4.13: Descriptive statistics for the two groups

	variables	SCA/NSCA	N	Mean	Standard Deviation
1	IX-CGQ	SCA	230	52.438	27.180
		NSCA	230	47.282	31.045
		TOTAL	460	49.860	29.259
2	ID-CGQ	SCA	230	65.945	25.188
		NSCA	230	66.521	28.198
		TOTAL	460	66.233	26.708
3	BS-Index	SCA	230	3.247	1.396
		NSCA	230	2.760	1.474
		TOTAL	460	3.004	1.455
4	BS-Industry	SCA	230	3.795	1.249
		NSCA	230	3.708	1.375
		TOTAL	460	3.752	1.313
5	CS-Index	SCA	230	3.017	1.404
		NSCA	230	3.056	1.451
		TOTAL	460	3.037	1.426
6	CS-Industry	SCA	230	3.473	1.366
		NSCA	230	3.578	1.379
		TOTAL	460	3.526	1.372
7	TDS-Index	SCA	230	3.000	1.408
		NSCA	230	3.047	1.454
		TOTAL	460	3.023	1.430
8	TDS-Industry	SCA	230	2.813	1.390
		NSCA	230	2.795	1.403
		TOTAL	460	2.804	1.395
9	AS-Index	SCA	230	3.708	1.410
		NSCA	230	3.613	1.451
		TOTAL	460	3.660	1.430
10	AS-Industry	SCA	230	3.839	1.355
		NSCA	230	3.995	1.368
		TOTAL	460	3.917	1.363

Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

Form the above table it is obvious that the results are mixed and they depend on the side we are in and whether it is relevant to the industry or the stock exchange index. On the one hand firms that face SCAs have higher scores in BS-Industry, AS-Index, TDS-Industry and IX-CGQ. On the other hand, in a number of cases the scores do not differ much; still they provide the reader with valuable information about the characteristics of the two groups.

- As far as the Board Subscore (both BS-Index and BS-Industry) is concerned, the results indicate that security class actions take place when the company follows tight rules and procedures in terms of board composition, nominating committee composition, compensation committee composition etc. Supporting evidence from Ferris and Pritchard (2001) and Amoah and Tang (2010) found that board meetings, the board size as well as the percentage of inside directors are positively correlated to a SCA. Therefore this is an indication that the Board Subscore will be positively linked to the incidence of a SCA.
- According to the Compensation Subscore (both CS-Index and CS-Industry), the results indicate that firms which faced a SCA are those with lower Compensation Subscore than the others. CFO bonus compensation is negatively related to the incidence of a SCA in past studies (Peng and Röell, 2008; Collins et al., 2008). This indicates that the Compensation Subscore will be negatively related to SCAs. On the other hand, McTier and Wald (2011) proved otherwise as the compensation[19] and the option compensation[20] were found to be positively related to SCAs, although their results were not statistically significant.
- When it comes to the Takeover Defenses Subscore, there is no relevant literature. It would be expected though that firms with a high score will be stronger or have developed internal control systems so as not become an acquisition target and consequently to face a lawsuit. Table 4.13 indicates that firms that face a SCA have almost the same score of TDS-Index with those that have not faced a SCA. On the other hand, firms that have higher score of TDS-Industry seem to be more prone to the litigation.
- The audit independence and the audit committee meetings are negatively correlated to SCAs (Amoah and Tang, 2010; Johnson et al., 2013), whereas

[19] Measured as the log of total compensation
[20] Measured as the option grants as a fraction of total compensation

the accounting expertise (Amoah and Tang, 2010) and the Report ICW[21] (Rice et al., 2013) are positively correlated to it. The AS-Index is higher in firms that have faced a SCA and the AS-Industry is lower in firms that have faced a SCA.

- It should be noted that in the above studies none of discussed variables was statistically significant to securities class action. This is very interesting means and further research may shed additional light on the relationship between corporate governance and the SCA.

b. Univariate test of two groups

The results in Table 4.14 show that in case of corporate governance variables, only the variables IX-CGQ and the BS-Index are statistically significant.

Table 4.14: Independent Samples Test

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference
1	IX-CGQ	7.063	0.008	1.895	458	0.059	5.15604	2.72081
2	ID-CGQ	4.934	0.027	-0.231	458	0.817	-0.57600	2.49313
3	BS-Index	1.297	0.255	3.636	458	0.000	0.48696	0.13393
4	BS-Industry	3.512	0.062	0.710	458	0.478	0.08696	0.12254
5	CS-Index	1.047	0.307	-0.294	458	0.769	-0.03913	0.13318
6	CS-Industry	0.107	0.744	-0.815	458	0.416	-0.10435	0.12804
7	TDS-Index	0.841	0.360	-0.358	458	0.720	-0.04783	0.13348
8	TDS-Industry	0.084	0.772	0.133	458	0.894	0.01739	0.13031
9	AS-Index	0.257	0.612	0.717	458	0.474	0.09565	0.13345
10	AS-Industry	0.215	0.643	-1.232	458	0.219	-0.15652	0.12704

Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

[21] It accounts for the disclosure of internal control weaknesses. Coded one if the firm disclosed the existence of a material weakness in internal control over financial reporting in any SOX 404 report during their misstatement period, zero otherwise.

Once more, when a non-parametric approach is applied, only two out of ten variables (IX-CGQ and BS-Index) are statistically significant.

Table 4.15: Non parametric test

		Mann-Whitney U	Wilcoxon W	Z	Asymptotic Sig. (2-tailed)
1	IX - CGQ	23760.5	50325.5	-1.887	0.059
2	ID - CGQ	25240.5	51805.5	-0.848	0.396
3	BS-Index	21426.5	47991.5	-3.598	0.000
4	BS - Industry	25951	52516	-0.366	0.715
5	CS - Index	26042	52607	-0.292	0.770
6	CS - Industry	25178.5	51743.5	-0.921	0.357
7	TDS - Index	25923	52488	-0.377	0.706
8	TDS - Industry	26272.5	52837.5	-0.127	0.899
9	AS - Index	25323.5	51888.5	-0.826	0.409
10	AS - Industry	24269	50834	-1.649	0.099

Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

c. Correlation analysis

Table 4.16 presents the correlations as well as their statistical significance.

Table 4.16: Pearson correlation among the variables

	IX - CGQ	ID - CGQ	BS- Index	BS - Industry	CS - Index	CS - Industry	TDS - Index	TDS - Industry	AS - Index	AS - Industry
IX - CGQ	1									
ID - CGQ	0.741**	1								
BS- Index	0.773**	0.594**	1							
BS - Industry	0.585**	0.823**	0.718**	1						
CS - Index	0.453**	0.389**	0.167**	0.171**	1					
CS - Industry	0.338**	0.507**	0.140**	0.309**	0.837**	1				
TDS - Index	0.204**	0.145**	0.039	-0.012	0.013	0.034	1			
TDS - Industry	0.198**	0.063	0.028	-0.082	0.023	-0.008	0.914**	1		
AS - Index	0.313**	0.226**	0.231**	0.126**	0.114*	0.022	0.040	0.070	1	
AS - Industry	0.280**	0.308**	0.200**	0.210**	0.101*	0.077	0.036	0.041	0.913**	1

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

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

Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

It is clear that the variables that correlate with each other are the Index CGQ with Industry CGQ and all subscores related to Index and Industry (e.g. AS - Index with AS - Industry, BS - Industry with BS - Index etc.). This makes sense as the Index and Industry subscores are made of the same variables. Therefore, the final set of corporate governance indicators are shown in Table 4.17.

Table 4.17: Final set of input variables

	Characteristics	Variables	
1	Index/Industry	IX - CGQ	ID - CGQ
2	Board Composition	BS-Index	BS - Industry
3	Compensation	CS - Index	CS - Industry
4	Takeover Defenses	TDS - Index	TDS - Industry
5	Audit	AS - Index	AS - Industry

Notes: IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

4.5 Conclusion

This chapter began by explaining the sources of accounting and corporate governance data. The first sample consists of 2,072 firms, half of which faced a SCA and half did not in the relative year. The period under examination is 2003 until 2011. Based on availability of data sixteen variables were initially considered. After leaving in the sample only variables that have low correlation with each other and variables that demonstrate high discriminatory power in univariate tests, the remaining set of variables are limited to seven. The second sample consists of 460 firms, half of which faced a SCA and half of them did not in the relative year. The period under examination in this case is 2002-2009. As far as the corporate governance variables the initial set was 8 variables and the final to be used in the models is one along with the seven accounting variables of the first sample.

5.1 Introduction

Chapter 4 described the procedure used to construct the sample of SCA firms and NSCA firms and the variables to be used in the analysis. The current chapter has three aims. The first is the examination of the contribution of accounting information to the prediction of securities class action. The second is the comparison of five techniques that would classify firms into two groups, SCAs and NSCAs. The third is the development of an integrated method and the investigation of whether it could outperform the classification accuracy of the individual techniques.

5.2 Contribution of accounting in the prediction of SCAs

This section will examine which of the accounting variables selected in section 4.4.1, contribute in classifying the firms to the SCA and to the NSCA group. Before moving to the discussion of the results, it should be reminded that two approaches are followed for the analysis of the models; that is the 'Model A' (where 2/3 of the sample will be used for training purposes) and the 'Model B'[22] (where the training and validation samples were constructed in such way, as to correspond to the pre and post - crisis period[23]).

The Table 5.1 shows the coefficients of LA. All signs are as expected. First of all, ROA, NS/TA, Log TA and G/TA are negatively related to the probability of a SCA, while all the rest carry a positive sign. The variable PAST is statistically significant and positively related to the probability of SCAs. Apart from E/TA and G/TA all the rest variables are statistically significant in both cases.

[22] The empirical work for LA and DA was performed in SPSS, while rest methodologies were applied in MATLAB.

[23] For all methods cut-off point equals 0.5, an approach that is commonly used. Under this approach, firms with estimated probability higher than 0.5 will be classified to SCA group and firms with estimated probability lower than 0.5 will be classified to group NSCA.

Table 5.1: Coefficients of LA

	Variables	Model A	Model B
1	ROA	-0.022*** (0.000)	-0.024*** (0.000)
2	NS/TA	-0.292*** (0.000)	-0.292*** (0.000)
3	CR	0.105*** (0.005)	0.101*** (0.010)
4	Log TA	-0.722*** (0.000)	-0.752*** (0.000)
5	E/TA	0.003 (0.308)	0.002 (0.422)
6	G/TA	-0.027 (0.944)	-0.105 (0.797)
7	PAST	0.339** (0.012)	0.342** (0.014)

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Supporting results are provided by DA and SVMs in Table 5.2 showing the coefficients of these variables. Once more, all signs are as expected. As in case of LA, the variables ROA, NS/TA, Log TA and G/TA are negatively related to the probability of a SCA. Moreover, results do not differ materially in the case of the crisis robustness test (Model B).

Table 5.2: Coefficients of DA and SVMs

	Methods	Discriminant Analysis		Support Vector Machines	
	Variables	Model A	Model B	Model A	Model B
1	ROA	-0.372	-0.375	-0.350	-0.355
2	NS/TA	-0.331	-0.324	-0.329	-0.335
3	CR	0.230	0.222	0.217	0.212
4	Log TA	-0.697	-0.711	-0.767	-0.783
5	E/TA	0.102	0.080	0.047	0.031
6	G/TA	-0.005	-0.017	-0.004	-0.009
7	PAST	0.178	0.181	0.144	0.144

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past.

Table 5.3 presents the UTADIS and MHDIS weights of the model in both cases. As far as the UTADIS results are concerned, the ratio CR contributes the most to the classification (36.41% and 38.41% in both cases respectively). The Log TA variable follows by contributing 36.19% and 32.34%. NS/TA weights 12.42% and 13.47% again in both cases, and ROA contributes by 11.91% and 11.02%. Also, the variable PAST plays a role, although small to the classification of the firms, weighting 4.09% and 3.64% in both cases respectively. Thus, when a firm has faced a massive lawsuit in the past, it has many chances to face another one in the future. It is worth noting that once more all variables play a significant role to the classification, apart from G/TA, which does not affect the classification of firms in the two groups.

As far as MHDIS is concerned, CR contributes more to the classification 86.82% and 62.02% in NSCA group and in SCA group 0.00% and 24.00% under Model A and Model B respectively. The Log TA contributes 8.38% and 23.58% in NSCA group and 12.62% and 0.00% in SCA group, in both models respectively. The NS/TA ratio follows weighting 0.61% and 0.50% in NSCA group and in SCA group 11.55% and 12.03% in both cases. ROA weights 0.62% and 10.93% in NSCA group and 6.88% and 0.34%. G/TA ratio influences by 0.69% and 0.77% in NSCA group and 66.93% and 60.49% the classification of SCA firms in both cases respectively. Once more, all variables play a significant role to the classification.

Table 5.3: Weights of variables in the UTADIS and MHDIS

	Methods	UTADIS		MHDIS			
		Model A	Model B	Model A		Model B	
	Variables	TOTAL	TOTAL	NSCA	SCA	NSCA	SCA
1	ROA	9.91%	11.02%	0.62%	6.88%	10.93%	0.34%
2	NS/TA	12.42%	13.47%	0.61%	11.55%	0.50%	12.03%
3	CR	36.41%	38.41%	86.82%	0.00%	62.02%	24.00%
4	Log TA	36.19%	32.34%	8.38%	12.62%	23.58%	0.00%
5	E/TA	0.98%	1.12%	0.16%	2.03%	2.21%	0.00%
6	G/TA	0.00%	0.00%	0.69%	66.93%	0.77%	60.49%
7	PAST	4.09%	3.64%	2.72%	0.00%	0.00%	3.14%

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past.

The above clarifies that there is consistency in the results regardless of the employed method. Most of the selected accounting variables play a significant role in the

classification. Four out of the seven variables are statistically significant in discriminating between SCA and NSCA firms. These results can be linked to the weights given by UTADIS and MHDIS, which indicates that these four variables play the most important role in classifying firms into SCA and NSCA group.

Profile of SCA target firms

ROA relates negatively to SCA. The lower the ratio is, the more likely it is for a firm to face a SCA. This result is in line with **CR** which is linked to the SCAs in a positive way, implying that firms which are SCA targets are the ones that present increased current assets compared to current liabilities to the financial statements. Firms with high liquidity and low profitability have more chances of facing a massive litigation, due to the fact that the shareholders expect to be compensated by firms which have high liquidity. When a firm achieves high profitability compared to its total assets (high ROA) the shareholders are not willing to proceed to a SCA, showing a sense of trust to the financial management, as well as to generate expectations for a prosperous future performance (i.e. continuous and hopefully increased profitability in the future). It would not have been to the shareholders interest to turn against the firm disturbing its day to day operation, with unexpected consequences; either positive or negative. ROA and CR are statistically significant at 1% level, meaning that these variables are statistically reliable. Also, the weights in UTADIS are 9.91% and 11.02% in Model A and Model B accordingly, that is the fourth most significant variable playing an important role in the classification of the firms. As for CR, the weights in UTADIS are 36.41% are 32.34 in the Model A and the Model B accordingly, making it the second most significant variable. The weights in MHDIS are 0.00% (Model A) in SCA and 86.82% in NSCA. In the Model B the weight in SCA is 24.00%, while in NSCA is 62.02%. The results agree with those of Gande and Lewis (2009); Peng and Röell (2008), who found ROA to be negatively related to the SCA with statistical significance at 5% level.

NS/TA ratio is used to capture the productivity level of a firm. It turns out that NS/TA ratio is negatively related to SCA. The firm's productivity is directly affected, when it utilizes its assets inefficiently and therefore a satisfactory level of sales cannot be generated. From the shareholders' point of view, this is translated as a sign of inefficient financial management, a fact which makes them willing to start thinking of

creating a class. Linking this productivity ratio with the profitability ratio discussed above (ROA), firms with inefficient use of assets will likely face a SCA. NS/TA ratio is also statistically significant at the 1% level. Regarding UTADIS, it the third most influencing factor with 12.42% and 13.47% in both cases, showing that this variable plays a significant role along with ROA, CR and Log TA. MHDIS is also consistent with UTADIS results, generating 11.55% in SCA and 0.61% in NSCA (Model A) and 12.03% in SCA and 0.50% in NSCA (Model B).

Log TA is negatively related to SCA. Small size firms measured in terms of the Log of Total Assets have increased possibility to face a SCA, compared to their larger rivals. This is explained by the fact that the shareholders target small firms, which are probably being run by inexperienced managers and they can be an easier target in the case of a lawsuit compared large corporations instead. Log TA is statistically significant at the 1% level in Model A and also when crisis robustness is tested (Model B). McTier and Wald 2011 found that small firms are less likely to face a SCA provided they paid a high dividend. It can be assumed that the shareholders may be biased by this kind of dividend policy. However, it is doubtful whether the above would be the case if a small firm did not distribute profits. Pellegrina and Saraceno (2011) conclude that banks with high total assets have high probability to face a SCA, but they avoid such legal actions as they please shareholders through compensation mechanisms. Large banks in terms of total assets have the capability to distribute dividends, whereas small firms usually do not have this kind of flexibility, thereby increasing the possibility to face SCA. It should be kept in mind that Pellegrina and Saraceno (2011) focused only on banking sector, whereas the current study focuses on the industrial one. Moreover, the findings of the current study support the findings of Poulsen et al. (2010), who also found that the logarithm of total assets and ROA are negatively related to a SCA.

G/TA ratio relates negatively to the SCA, indicating that the lower the G/TA ratio is, the higher the possibility that a firm does not manage its intangible assets in the most effective way. The firms which receive lawsuits are the ones that have not paid significant attention to build their goodwill. Although it is not a statistically significant variable at all levels in either Model A or Model B, it is still included in the analysis as a measure of size control in addition to Log TA. According to MHDIS,

G/TA ratio weights 66.93% in SCA and 0.69% in NSCA and 60.49% in SCA and 0.77% in NSCA in Model A and Model B accordingly.

PAST is positively related to SCA. This indicates that massive lawsuits will take place in firms that faced SCAs in the past. Donelson et al. (2012) examine the incidence of a SCA in the case where the firm operates in a high litigation risk industry. They support that a firm in a high litigation risk industry is more likely to be sued compared to one belonging in an industry with no historical background in litigations. Gande and Lewis (2009) and Pellegrina and Saraceno (2011) agree with the above findings, showing that firms that experienced litigation activity in the past have higher likelihood of being sued again.

E/TA ratio is positively related to SCA. The higher a company's equity against its debt is, the higher is the probability of SCA. When existing shareholders invest more or/and new shareholders invest in a firm, this increases the possibility of SCA. Increased equity reflects increased expectations from the side of investors/shareholders. Hence, they would be willing to proceed to a SCA in case they would not be compensated for their investment. Additionally, increased equity stemming from new shareholders increases the possibility of finding a group of unsatisfied ones who would be willing to proceed to a SCA. Previous literature captures the leverage characteristic through the use of total debt to total assets claiming that higher leverage leads to higher probability of a SCA (Amoah and Tang, 2010; Poulsen et al., 2010). Evidence from Peng and Röell (2008) and Strahan (1998) support the idea that high debt may indicate a recent history of poor performance, asset write-downs or forced heavy borrowing and fueling shareholder satisfaction, leading to massive litigations. So, the higher the firm’s leverage, the higher the risk, and consequently the higher the probability of a SCA.

5.3 Discussion of classification accuracies

Table 5.6 summarizes the results of all six classification methods. The comparison of the results obtained in the training and validation datasets show that the models are quite stable, achieving similar accuracies in the two datasets.

Table 5.4: Summary of results

Panel A (Model A)			
Training (%)			
	Accuracy of SCA	Accuracy of NSCA	Overall
LA	62.10	74.80	68.50
DA	61.50	75.80	68.70
UTADIS	54.56	84.52	69.54
SVMs	57.31	83.07	70.04
MHDIS	58.90	69.18	64.04
MV	59.18	80.46	69.82
Validation (%)			
LA	54.80	80.00	67.40
DA	55.70	79.40	67.50
UTADIS	51.59	89.86	70.72
SVMs	49.57	88.12	68.84
MHDIS	57.97	75.94	66.96
MV	53.62	84.05	68.84
Panel B (Model B)			
Training (%)			
	Accuracy of SCA	Accuracy of NSCA	Overall
LA	62.20	75.00	68.60
DA	61.60	76.80	69.20
UTADIS	52.80	87.20	70.00
SVMs	57.60	84.32	70.96
MHDIS	60.32	69.28	64.80
MV	61.44	45.49	53.46
Validation (%)			
LA	53.80	80.80	67.30
DA	54.50	79.80	67.20
UTADIS	45.01	95.13	70.07
SVMs	50.36	87.83	69.10
MHDIS	56.45	74.45	65.45
MV	45.49	45.25	45.37

Panel A summarizes the overall accuracy in the validation sample. We observe that UTADIS provides the highest classification of 70.72%, followed by SVMs and MV (68.84%). DA and LA follow with 67.50% and 67.40% respectively. Turning to the accuracies in the SCA group, MHDIS provides the best classification with 57.97%, DA with 55.70% and LA with 54.80%. As for the NSCA group, UTADIS provides the best classification with 89.86%, SVMs with 88.12% and MV (as an integrated method) with 84.05%.

Panel B summarizes the results of all six classification methods when the crisis robustness test is applied (Model B). The classification results are generally in line

with the previous ones. As far as the overall accuracy in validation sample is concerned, UTADIS provides the highest classification of 70.07%, followed by SVMs and MV (69.10%). LA and DA follow with slightly lower accuracy (67.30% and 67.20% respectively). As it regards the accuracy in the SCA group, MHDIS provides the best classification with 56.45%, DA with 54.50%, LA with 53.80% and SVMs with 50.36%. Turning to the NSCA group, UTADIS provides again the best classification with 95.13% followed by SVMs and LA with 87.83% and 80.80% respectively.

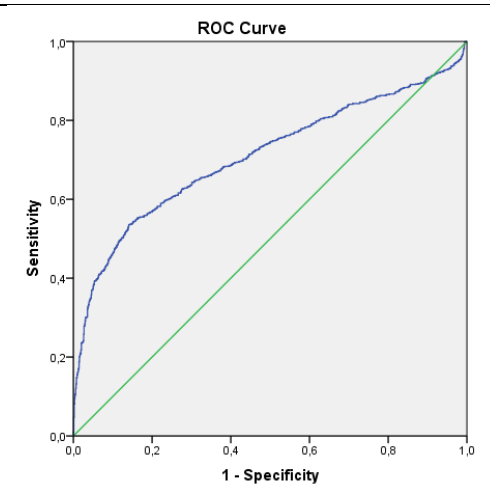
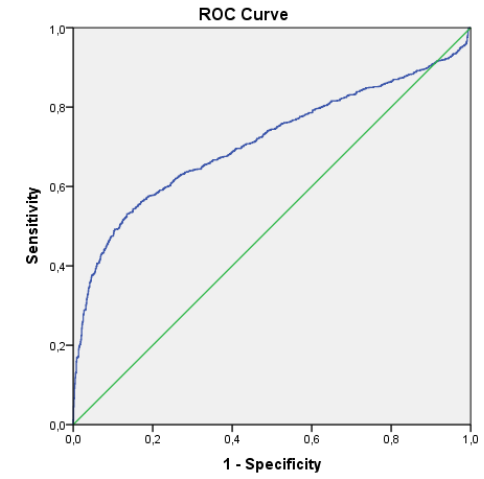
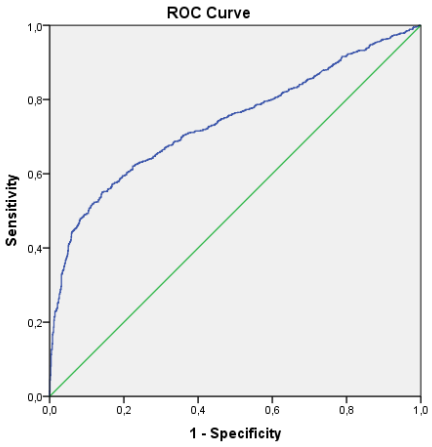
The results of the previous sections indicate that there is no perfect method for the prediction of firms that will face a SCA. Some methods are more accurate in classifying firms as NSCAs, while others appear to classify more accurately SCAs.

MV as a popular integration technique is applied, in order to examine whether the combination of different methods can lead to better classification results. It is clear from both tables that its application has not resulted in a significant improvement in the recorded classification accuracies. In more detail, in Table 5.6 (Panel A) the overall accuracy under MV in the training sample is 69.82% and in the validation sample is 68.84%. The overall accuracy in Table 5.6 (Panel B) in the training sample is 53.46% and in the validation sample is 45.37%.

5.4 ROC Curves

Further to the classification tables the current study uses ROC Curves[24] to compare the models.

[24] ROC Curve is a graphical plot which illustrates the performance of a binary classifier system. It has been used in medicine, radiology, machine learning and data mining research. In the accounting field it has been applied in the identification of qualified audit opinions (Gaganis et al. 2007). It is generated by plotting the fraction of true positives (otherwise named as Sensitivity) and the fraction of false positives (otherwise named as Specificity). AUC is the area under the curve that is equal to the probability that a classifier will rank a randomly chosen positive instance higher than a randomly chosen negative one (assuming positive ranks higher than negative).

LA		AUC 70.89%
DA		AUC 71.07%
UTADIS		AUC 73.78%

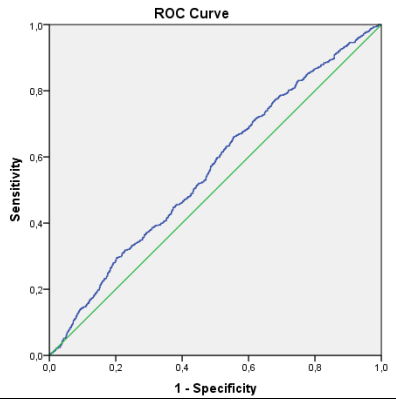
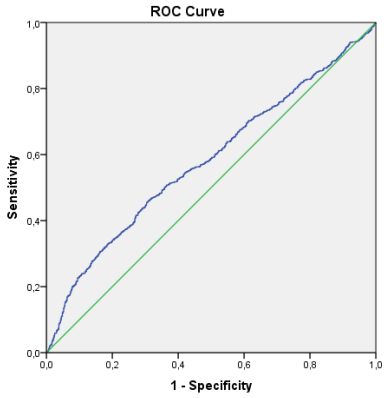
SVMs		AUC 56.15%
MHDIS		AUC 58.04%

Figure 5.1: ROC Curves of five methodologies

Figure 5.1 shows the ROC Curves obtained for the five selected methods. It is obvious that UTADIS provides the highest classification of SCA with the score of 73.78%. DA and LA classify firms to SCA group with 71.07% and 70.89% accuracy respectively.

5.4 Conclusions

The first goal of this chapter was to examine the profile of a SCA target. Based on the contribution of accounting information in the prediction of SCAs, it appears that firms with high liquidity (and consequently low profitability), low productivity levels, small in size, with high equity to assets ratio, and historical litigation background are attractive targets of SCAs. On the contrary, large firms, but with low liquidity levels and high productivity are able to avoid litigation. It is very important, that all results are robust regardless of the approach used to split the sample.

The second goal was to compare the predictive ability of five techniques. The results showed that UTADIS and SVMs classify more accurately the data of 2,072 firms by

70.72% and 68.84% not only in case of Model A (validation sample), but also as well as in Model B by 70.07% and 69.10% respectively.

Also, this chapter examined whether combining the outcome of individual models into multi-classifiers (i.e. integrated models) could lead to improved classification accuracy. MV achieves an overall accuracy of 68.84%. Finally, ROC curves were presented in the analysis. UTADIS provides the highest classification results in the prediction of SCAs.

CHAPTER 6 CORPORATE GOVERNANCE IN PREDICTION OF SCA

6.1 Introduction

In the previous chapter, five classification techniques and an integrated method were applied with an aim to compare their ability to classify firms in the two groups; SCAs and NSCAs. Also, in chapter 5 the impact of accounting information in the phenomenon of securities class action was analysed. This chapter aims to repeat the analysis, while adding qualitative variables of corporate governance at the initial dataset. Section 6.2 explains the contribution of corporate governance information in the prediction of SCA and section 6.3 discusses the classification accuracies of the techniques.

6.2 Contribution of corporate governance in the prediction of SCAs

In this section four models are being developed as shown in Table 6.1. These four models include accounting ratios and corporate governance indicators. In all the cases, the set of the accounting ratios is the same as the one used in chapter 5. Then, the corporate governance indicators are added in order to examine whether they can improve the classification accuracies.

So, the first model contains the seven accounting ratios plus the Industry CGQ (ID-CGQ) index, which is the general industry score of 24 industry groups as shown in Table 6.1. In the second model, the index IX – CGQ, which is the general index score, instead of the ID – CGQ is used. For the creation of the third and the fourth model all the four subscores of the industry and of index variable are used, respectively.

Table 6.1: The four models

Model 1	Model 2	Model 3	Model 4
ROA	ROA	ROA	ROA
NS/TA	NS/TA	NS/TA	NS/TA
CR	CR	CR	CR
Log TA	Log TA	Log TA	Log TA
E/TA	E/TA	E/TA	E/TA
G/TA	G/TA	G/TA	G/TA
PAST	PAST	PAST	PAST
ID – CGQ	IX – CGQ	BS - Industry	BS-Index
		CS - Industry	CS – Index
		TDS - Industry	TDS - Index
		AS - Industry	AS - Index

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

As shown in the Table 6.2 the NS/TA ratio and the Log TA are negatively correlated to SCAs and statistically significant at the 5% and 1% level in all four models. These results are in line with those found in section 5.2, where only accounting ratios were investigated. The ID – CGQ, the IX – CGQ, the BS-Index and the BS-Industry indicators are positively related and statistically significant at the 5% level, except from the BS-Industry and BS-Index which are significant at the 1% level.

Table 6.2: Coefficients of LA

Model 1		Model 2		Model 3		Model 4	
ROA	-0.020 (0.077)	ROA	-0.018 (0.118)	ROA	-0.019 (0.103)	ROA	-0.016 (0.158)
NS/TA	-0.384 (0.025)**	NS/TA	-0.377 (0.026)**	NS/TA	-0.385 (0.026)**	NS/TA	-0.382 (0.027)**
CR	0.137 (0.114)	CR	0.126 (0.149)	CR	0.128 (0.139)	CR	0.112 (0.216)
Log TA	-0.519 (0.007)***	Log TA	-0.392 (0.037)***	Log TA	-0.530 (0.007)***	Log TA	-0.417 (0.027)**
E/TA	-0.003 (0.618)	E/TA	-0.002 (0.800)	E/TA	-0.003 (0.585)	E/TA	0.000 (0.977)
G/TA	-1.544 (0.069)*	G/TA	-1.558 (0.067)*	G/TA	-1.607 (0.065)*	G/TA	-1.528 (0.082)*
PAST	0.546 (0.086)*	PAST	0.541 (0.090)*	PAST	0.547 (0.087)*	PAST	0.522 (0.107)
ID – CGQ	0.011 (0.026)**	IX – CGQ	0.009 (0.032)**	BS - Industry	0.268 (0.009)***	BS-Index	0.325 (0.000)***
				CS - Industry	0.019 (0.846)	CS – Index	-0.006 (0.949)
				TDS - Industry	0.032 (0.729)	TDS - Index	-0.012 (0.889)
				AS - Industry	-0.090 (0.355)	AS - Index	0.002 (0.981)

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Table 6.3 presents the results of DA and SVMs. As far as the signs of the coefficients are concerned, the results of the DA agree with those obtained from the LA except from the three subscores (CS – Industry, TDS – Industry and AS – Industry) in model 3 and the two subscores (CS – Index and TDS – Index) in model 4. On the other hand, SVMs' results show similar signs of coefficients for half of the variables.

Table 6.3: Coefficients of DA and SVMs

Model 1	DA	SVMs	**Model 2**	DA	SVMs
ROA	-0.288	0.012	ROA	-0.251	-0.054
NS/TA	-0.434	-0.169	NS/TA	-0.430	-0.161
CR	0.297	-0.173	CR	0.270	-0.147
Log TA	-0.550	-0.384	Log TA	-0.421	-0.421
E/TA	-0.078	0.376	E/TA	-0.035	0.429
G/TA	-0.318	-0.598	G/TA	-0.323	-0.504
PAST	0.296	0.516	PAST	0.294	0.765
ID – CGQ	0.383	-0.175	IX – CGQ	0.367	-0.059
Model 3	DA	SVMs	**Model 4**	DA	SVMs
ROA	-0.246	0.006	ROA	-0.204	-0.035
NS/TA	-0.415	-0.152	NS/TA	-0.383	-0.157
CR	0.273	-0.186	CR	0.200	-0.149
Log TA	-0.546	-0.481	Log TA	-0.404	-0.408
E/TA	-0.090	0.397	E/TA	0.008	0.387
G/TA	-0.310	-0.547	G/TA	-0.278	-0.489
PAST	0.283	0.289	PAST	0.253	0.708
BS - Industry	0.452	-0.168	BS-Index	0.563	0.010
CS - Industry	0.026	0.059	CS – Index	-0.005	-0.036
TDS - Industry	0.043	-0.040	TDS - Index	-0.020	-0.051
AS - Industry	-0.151	-0.009	AS - Index	-0.004	0.034

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

Table 6.4 shows the weights of the variables in the case of UTADIS and MHDIS. As far as the UTADIS results are concerned, Log TA carries the highest weight in all the models, followed by G/TA and NS/TA. The ID – CGQ indicator plays a significant role, by contributing 13.33% to the classification. Similar results are obtained from model 2 where Log TA, G/TA and IX – CGQ weight the most, contributing by

29.84%, 20.05% and 16.32% accordingly to the classification. In models 3 and 4, Log TA, G/TA, PAST, NS/TA and TDS – Industry and TDS – Index play the most significant role compared to the other variables.

Table 6.4: Weights of variables in the UTADIS and MHDIS

Model 1	UTADIS	MHDIS		**Model 2**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	0.31%	0.00%	10.33%	ROA	0.77%	11.02%	15.30%
NS/TA	17.51%	17.03%	46.81%	NS/TA	11.00%	34.07%	3.42%
CR	0.00%	0.00%	3.49%	CR	0.00%	0.00%	0.00%
Log TA	47.67%	0.00%	7.89%	Log TA	29.84%	10.99%	5.11%
E/TA	1.05%	48.83%	0.00%	E/TA	3.08%	9.63%	12.36%
G/TA	14.55%	34.14%	16.12%	G/TA	20.05%	20.55%	22.25%
PAST	5.59%	0.00%	11.14%	PAST	18.94%	10.30%	12.20%
ID – CGQ	13.33%	0.00%	4.21%	IX – CGQ	16.32%	3.44%	29.36%
Model 3	UTADIS	MHDIS		**Model 4**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	0.81%	8.95%	0.00%	ROA	0.00%	2.15%	5.84%
NS/TA	18.13%	0.00%	32.38%	NS/TA	36.87%	3.33%	36.78%
CR	0.00%	0.00%	0.00%	CR	0.00%	8.44%	0.00%
Log TA	37.91%	17.38%	23.97%	Log TA	41.10%	0.00%	41.58%
E/TA	4.77%	5.34%	29.66%	E/TA	1.82%	27.98%	0.00%
G/TA	21.39%	19.52%	0.00%	G/TA	10.69%	16.89%	6.50%
PAST	10.49%	21.11%	0.00%	PAST	6.77%	18.93%	0.00%
BS - Industry	0.09%	7.96%	0.00%	BS-Index	0.20%	9.42%	0.00%
CS - Industry	0.00%	0.03%	0.00%	CS – Index	0.00%	2.90%	0.97%
TDS - Industry	6.16%	19.27%	2.69%	TDS - Index	2.31%	8.92%	0.00%
AS - Industry	0.24%	0.44%	11.30%	AS - Index	0.24%	1.04%	8.33%

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

Almost all the variables play a significant role in the case of MHDIS model. In more detail, ROA, NS/TA, Log TA, E/TA, G/TA and PAST account collectively for the prediction. Interestingly, IX – CGQ weights 29.36% (model 2), while the ID-CGQ only 4.21% in model 1. According to models 3 and 4, the board subscore, the takeover defense subscore and the audit subscore weight the same regardless of whether the scores that relate to the industry or to the index are used. The compensation subscore does not affect the classification in either model.

Profile of SCA target firms

ID - CGQ and **IX - CGQ** are positively related to the litigation. Both contribute to the classification of firms to SCA group. As it is obvious from Table 6.4 these two indicators play a significant role weighting 13.33% and 16.32% respectively. This means that contrary to our expectations the quality of corporate governance affects positively the class actions.

BS - Industry and **BS - Index** are positively related to the litigation. UTADIS do not provide high weight for the classification of firms to SCA group. Also, MHDIS classifies firms with accuracy 9.42% in NSCA group. Firms with organized boards aligned SOX requirements (e.g. the existence of a compensation committee, the board size and board composition) are more likely to face a SCA. Ferris et al. (2007) found that board size is positively related to the SCAs. Amoah and Tang (2010) also find by proving that board meetings are positively related to the SCAs, wherever the board independence is negatively related to the litigation incidence.

CS - Industry and **CS - Index** do not weight significantly to the classification of the firms into SCA group. As for the sign of the coefficient, in some cases it is positive and in other cases it is negative. This does not allow us to gain a clear understanding as of their influence on the SCAs. It should be mentioned that existing literature is also mixed. Collins et al. (2008) found that bonus compensation is positively related to the SCAs but not statistically significant; however Ferris et al. (2007) show that the SCAs and compensation are negatively related.

TDS - Industry and **TDS - Index** contribute little to the classification according to UTADIS and MHDIS in classifying firms to SCA group. Related evidence does not

exist as this variable or even a relative one has not been used in the past. In most cases TDS - Index is negatively related to SCAs. In other words, when a firm has low controls for takeover defenses the probability to face a SCA is increased.

AS - Industry and **AS - Index,** contribute to the classification of firms to SCA group, as far as MHDIS is concerned. These indices are negatively related to the litigation (except for AS – Index in case of LA and SVMs). The negative sign indicates that firms which pay high audit fees or firms with audit committee when compared with other companies in the same industry are less probable to face a SCA. Amoah and Tang (2010) found a negative relationship between audit independence and audit committee meetings with the SCA phenomenon too. Moreover, Rice et al. (2013) concluded that the audit opinion received by the Big 4 concerning the SOX 404 is negatively correlatd to the SCAs.

6.3 Discussion of classification accuracies

Looking at the performance of the first model in the validation sample MHDIS and UTADIS provide the highest accuracies in classifying firms in the SCA group (59.21% and 58.55% respectively). In the second model, MHDIS and MV achieve the highest accuracies (61.84% and 60.88%). In the third one, DA and MV classify firms with accuracy of 58.97% and 56.48% respectively, whereas in the fourth model MHDIS and UTADIS are again the best performers.

Turning to the overall accuracy, the results remain the same in the case of the first model. In the second model, UTADIS and MV classify firms with accuracy of 65.79% and 65.37% respectively, and in the third model, DA and LA classify firms with accuracy of 62.85% and 61.54%. Finally, in the fourth model UTADIS and MV provide the highest classification (62.50% and 59.39%, respectively).

Table 6.5 presents the classification accuracies of the employed techniques in both the training and the validation sample.

Table 6.5: Summary of results

	Model 1			**Model 2**		
	Accuracy of NSCA	Accuracy of SCA	Overall	Accuracy of NSCA	Accuracy of SCA	Overall
Training (%)						
LA	73.03	55.92	64.47	73.68	55.92	64.80
DA	72.37	55.92	64.15	74.30	54.60	64.45
UTADIS	74.35	61.53	67.94	74.36	61.54	67.95
MHDIS	80.76	71.79	76.28	78.20	79.48	78.84
SVMs	73.07	57.69	65.38	93.58	88.46	91.02
MV	74.02	60.45	67.23	75.26	60.87	68.06
Validation (%)						
LA	64.10	50.00	57.05	66.67	55.13	60.90
DA	65.38	51.28	58.35	67.95	52.56	60.25
UTADIS	72.36	58.55	65.46	72.37	59.21	65.79
MHDIS	61.18	59.21	60.19	57.23	61.84	59.53
SVMs	57.23	51.97	54.60	68.42	57.23	62.82
MV	64.45	58.46	61.45	69.87	60.88	65.37
	Model 3			**Model 4**		
Training (%)						
LA	68.42	59.21	63.82	70.39	61.18	65.79
DA	69.08	57.89	63.50	69.08	59.21	64.15
UTADIS	78.20	58.97	68.58	76.92	58.97	67.94
MHDIS	87.17	74.35	80.76	76.92	82.05	79.48
SVMs	92.30	72.19	82.05	75.64	58.97	67.30
MV	82.22	71.10	76.66	76.40	65.80	71.10
Validation (%)						
LA	66.67	56.41	61.54	62.82	50.00	56.41
DA	66.67	58.97	62.85	61.54	52.56	57.05
UTADIS	66.44	53.94	60.19	68.42	56.57	62.50
MHDIS	63.15	55.92	59.53	50.65	63.81	57.23
SVMs	62.50	53.28	57.89	63.15	54.60	58.88
MV	65.48	56.48	60.98	66.52	52.27	59.39

6.4 Conclusions

Considering the aim of the chapter we could sum up to three points. The first is that almost all accounting variables (ROA, NS/TA, Log TA, E/TA, G/TA as well as PAST) continue to significantly contribute to the classification according to UTADIS and MHDIS, even after we account for corporate governance indices.

The second point is that all signs of corporate governance indices are the same with those of existing literature. The BS - Industry and the BS - Index are positively related to SCAs, the AS - Industry and the AS – Index are negatively related to the SCAs, and the CS subscores results are mixed as related existing literature. It should be noted once more that TDS - Industry and TDS - Index are being introduced for the first time producing negative sign, indicating that firms with low controls of poison pills and takeover defences attract SCAs.

The third point is that according to the comparison of the predictability of the five techniques, MHDIS and MV classify more accurately the set of 460 firms to the SCA group in model 1 and in model 2. In the case of model 3 the best classifiers are DA and MV and in the model 4 MHDIS and UTADIS.

CHAPTER 7 CONCLUSIONS

7.1 Introduction

The current research had two aims. Focusing on USA enterprises over the period 2003-2011, it aimed to identify whether and up to what degree accounting and corporate governance information could contribute to the classification of firms to a class action or a non-class action group. On these grounds, the study examined the predictive power of alternative classification methods and whether the incorporation of an integrated method could increase the predictability accuracy.

In methodological terms, Discriminant Analysis, Logit Analysis, Utilités Additives Discriminantes, Multi-group Hierarchical Discrimination, Support Vector Machines and Majority Voting (MV) were selected in order to examine the predictive ability of classification accuracy using accounting and corporate governance information. As it has been explained in section 3.2 these techniques have successfully been used in the past in the area of finance.

This chapter highlights the innovation of the study, summarises major findings and explains the reasons why classification results differ among methods. It also proposes future research directions.

7.2 The innovation of the study

The importance of the study is highlighted by its stakeholder's implications and the categories of people this phenomenon affects. The fact that class actions, as a way of defense, combine many advantages operates as a strong motive for shareholders to go against a firm and for lawyers to undertake a group advocacy. Shareholders are the first to be affected by such an event and the first to decide whether or not to join a class to go against a company, in which they have invested their money. Investors also constitute a type of stakeholders, who have great interest on knowing in advance whether the company whose stock they possess or are about to acquire have possibility to face a security class action, in order to determine the optimum portfolio of stocks and maximize its return. Directors, managers, chief executive officers and chief financial officers work for improving the quality of the firm's control so as to

minimize the firm's total risk. Therefore, they are interested in knowing whether a material error could cause a filing in the court against their company. Lawyers, institutional investors' or pension funds' as lead plaintiffs would be interested too as they estimate the expected legal fees that come up with a security class action settlement. Policymakers try to corral security class and are interested in maintaining the prosperity of the society and protect public interest. Moreover, due to the fact that nowadays securities class action is a modern way of litigation, academics have an intense research interest learning classification techniques about their prediction.

The current study investigates the factors (financial and non-financial) that cause securities class actions. Even though there is literature that investigates this event, it is restrained to the consequences of it and its effect to the share price. The literature has failed to develop models that can predict securities class actions so far, determining the gap in literature and the innovation of the current research. It is the first time that alternative classification techniques plus an integrated method are applied in order to predict the phenomenon of security class actions, enriching the existing literature.

Focusing on the industrial sector, this study explores the predictability of the five separate classification techniques plus an integration technique, so as to value the probability that a firm will face a class action or not in the future. It is important that we utilized the largest sample size so far counting 2,072 cases from the industrial sector in the US. In addition to the above, the data collected cover a wide period of time; namely 2003-2011 which is immediately after the Sarbanes Oxley Act that took place in 2002.

Another innovation of the study is that it is the first study that uses corporate governance variables in conjunction to accounting variables, in order to develop prediction models for securities class actions. As explained in section 2.7 corporate governance information has been used in the past to determine the lawsuit, but it has never been used in developing quantitative methods for its prediction.

7.3 Research framework

The current study had three stages. In the first stage, we collected all the firms that faced at least once a security class action in the past. Initially, the total number of filings was 1,204 US firms, but due to unavailability of data the sample was reduced to 1,036 SCA which were matched by size and industry with an equal number of NSCA firms. Therefore, the final sample size was 2,072 companies operating in the US over the period 2003 – 2011.

This study used two datasets. The first consisted of 2,072 firms was used to investigate the contribution of accounting information to the prediction of securities class actions. This sample was split into two subsamples (Model A and Model B). In Model A two third of the total sample was used for training purposes and the rest for validation purposes. In Model B the training and validation sample was constructed on the basis of a cut-off point in time in such a way so as to correspond to the pre - credit and post - crisis period. The second dataset consisted of 460 firms, which were included in the first dataset. This set of firms was used in order to examine the contribution of corporate governance data in conjunction with accounting ratios to the prediction of securities class actions. The total size of firms that faced a security class action was 230 firms as in the first dataset matched by size and industry with an equal number of NSCA firms, giving us a total size of 460 firms.

The selection of variables was the next stage. Based on data availability, twelve variables, measuring productivity, leverage, liquidity, size and profitability, were used. After excluding four variables due to missing values and one more in order to avoid multicollinearity problems, the final set was reduced to seven variables, which showed high discriminatory power on univariate tests (except from variable PAST) and low correlation with each other.

In the third stage we examined the contribution of accounting variables and corporate governance indices by applying the five classification techniques. The characteristics of a possible security class action target were analyzed, creating a certain profile of a firm that could possibly attract a massive litigation lawsuit. Moreover, we applied the same classification methods with the same datasets so as to compare the predictability accuracies.

In the case of the second dataset of 460 firms (where corporate governance indices along with accounting variables were examined), an alternative construction of sample was applied too so as to check whether results differentiated. After performing the classification techniques in the new datasets, the results did not improve our understanding over the profile of security class actions firms and therefore were excluded from the analysis[25]. Moreover, we applied Majority Voting (MV) as an integration technique so as to examine whether it provided higher classification accuracies.

7.4 Summary of the findings

The choice of database and variables is commonly made on the grounds of data availability (Lara et al. 2006). Even though the current study was restricted by this fact, the findings of it are important and are summarised below.

As the first aim was is to examine the contribution of accounting information to the securities class actions the study provides important results about the profile of security class action. Firms with high liquidity and low profitability have more chances of facing a massive litigation due to the fact that the shareholders expect to be compensated by firms which have high liquidity. According to UTADIS the profitability ratio (ROA) is the fourth most significant variable in the classification of the firms and liquidity ratio (CR) is the second most significant variable. These results are in line with those of Gande and Lewis (2009) and Peng and Röell (2008). Inefficient financial management (low NS/TA ratio), drives the shareholders to form a class and go against the firm. Regarding UTADIS, this variable plays also a significant role. Against McTier and Wald (2011) and Pellegrina and Saraceno (2011), this research reveals that small size firms have increased possibility to face a security class action, compared to their larger rivals. Poulsen et al. (2010) provides supporting evidence that the logarithm of total assets and ROA are negatively related to a security class action.

Moreover, the firms which receive lawsuits are the ones that have not paid significant attention to build their goodwill and have experienced litigation activity in the past.

[25] See Appendix No 2.

Once more the results are in line with Donelson et al. (2012), Gande and Lewis (2009) and Pellegrina and Saraceno (2011). Also, the higher the firm's leverage, the higher the risk, and consequently the higher the probability of a security class action supporting results by Peng and Röell (2008) and Strahan (1998).

As far as the corporate governance indices are concerned, this study supports Ferris et al. (2007) and Amoah and Tang (2010) findings. Firms with organized boards aligned SOX requirements are more likely to face a security class action. Compensation subscores do not particularly contribute to the classification of the firms. Existing literature about relevant indexes is also mixed. Bonus compensation is positively related to the security class actions Collins et al. (2008) but Ferris et al. (2007) show that the SCAs and compensation are negatively related. Takeover defences subscores and audit subscores contribute also to the classification. When a firm has low controls for takeover defenses the probability to face a security class action is increased. Amoah and Tang (2010) found a negative relationship between audit independence and audit committee meetings with security class actions. Firms which do not follow strict audit controls have high probability to face a security class action.

The second aim of the study was to compare alternative methods for the development of the prediction models. The classification techniques provide consistent results and that the order in which the methods provide the highest accuracies are the same for the two models (see Appendix Table E).

Undoubtedly, MHDIS, UTADIS and MV are the best classifiers in all models providing over 60% accuracy (see Appendix Table F). Interestingly in overall accuracy UTADIS and MHDIS takes the first place in all models in overall accuracy and SCA group respectively. It is obvious though that some methods are more accurate in overall classification, while others appear to classify more accurately SCAs. This proves that there is no perfect method for the prediction of firms that will face a SCA.

7.5 Differences among classification methods

The results provided by the techniques in chapters five and six proved that there are differences in classification accuracies even when the dataset is the same. In some cases LA provided higher classification accuracy than UTADIS and vice versa. This happens because each technique processes differently the information given. In other words, even though the dataset employed is the same, there are differences in the implicit criteria for solving the problem. As a result some methods are more accurate in classifying SCA firms and others are more accurate in classifying NSCA firms.

Each technique employs different algorithms for the development of a prediction model and utilise different objective functions. Even techniques that belong to the same category may provide totally different results.

For instance, UTADIS and MHDIS belong to multicriteria decision aid models group. UTADIS solves one linear programming formulation to minimize the sum of all misclassifications. MHDIS solves three mathematical programming formulations, two linear and one mixed-integer, involving 1) minimization of overall classification error, 2) minimization of the number of misclassifications, and 3) maximization of the minimum distance between the global utilities of the correctly classified banks. These techniques generate different weights affecting the utility scores, and consequently provide different classification accuracies (Doumpos and Zopounidis, 2002). SVM is a machine learning method which implements the structural risk minimization principle, which minimizes the upper bound for the generalization error rather than minimizing the training error as other techniques do (Doumpos et al., 2005). Discriminant analysis on the other hand as a multivariate statistical technique develops a linear discriminant function in order to maximize the ratio among –group to within-group variability, assuming that the variables follow a multivariate normal distribution and that the dispersion matrices of the groups are equal (Zopounidis and Doumpos, 1999). These assumptions do not apply in real world problems, like security class actions. As such DA (as well as LA) was used for comparison purposes.

7.6 Future Research

Extension of the topic of the prediction of securities class actions could be performed in the following ways.

Firstly, this study restricted itself to the use of accounting and corporate governance information mainly due to data availability (see section 1.3). A challenging task could be to include more specific corporate governance variables. Also, a set of audit specific control variables could be a promising addition in the set of variables, in order to examine their classification accuracy.

Secondly, a methodological way forward could be the employment of neural networks, rough sets, or stacked generalization models (as another integrated method) and their comparison with the methodologies used in the present study, could bring the analysis a step further.

Thirdly, the availability of a database with European firm is inevitable in the near future. Therefore, it would be interesting to run the same models and attempt to compare the results, even though firms in EU and US operate under different legal frameworks. In any case the analysis should take into account whatever differences these two legal frameworks entail.

APPENDIX

1. Federal Rules of Civil Procedure Rule 23. Class Actions

(a) PREREQUISITES. One or more members of a class may sue or be sued as representative parties on behalf of all members only if:
(1) the class is so numerous that joinder of all members is impracticable;
(2) there are questions of law or fact common to the class;
(3) the claims or defences of the representative parties are
typical of the claims or defences of the class; and
(4) the representative parties will fairly and adequately protect the interests of the class.

(b) TYPES OF CLASS ACTIONS. A class action may be maintained if Rule 23(a) is satisfied and if:
(1) Prosecuting separate actions by or against individual class members would create a risk of:
(A) Inconsistent or varying adjudications with respect to individual class members that would establish incompatible standards of conduct for the party opposing the class; or
(B) adjudications with respect to individual class members that, as a practical matter, would be dispositive of the interests of the other members not parties to the individual adjudications or would substantially impair or impede their ability to protect their interests;
(2) the party opposing the class has acted or refused to act on grounds that apply generally to the class, so that final injunctive relief or corresponding declaratory relief is appropriate respecting the class as a whole; or
(3) the court finds that the questions of law or fact common to class members predominate over any questions affecting only individual members, and that a class action is superior to other available methods for fairly and efficiently adjudicating the controversy. The matters pertinent to these findings include:
(A) the class members' interests in individually controlling the prosecution or defence of separate actions;

(B) the extent and nature of any litigation concerning the controversy already begun by or against class members;

(C) the desirability or undesirability of concentrating the litigation of the claims in the particular forum; and

(D) the likely difficulties in managing a class action.

(c) CERTIFICATION ORDER; NOTICE TO CLASS MEMBERS; JUDGMENT; ISSUES CLASSES; SUBCLASSES.

(1) Certification Order.

(A) Time to Issue. At an early practicable time after a person sues or is sued as a class representative, the court must determine by order whether to certify the action as a class action.

(B) Defining the Class; Appointing Class Counsel. An order that certifies a class action must define the class and the class claims, issues, or defences, and must appoint class counsel under Rule 23(g).

(C) Altering or Amending the Order. An order that grants or denies class certification may be altered or amended before final judgment.

(2) Notice.

(A) For (b)(1) or (b)(2) Classes. For any class certified under Rule 23(b)(1) or (b)(2), the court may direct appropriate notice to the class.

(B) For (b)(3) Classes. For any class certified under Rule 23(b)(3), the court must direct to class members the best notice that is practicable under the circumstances, including individual notice to all members who can be identified through reasonable effort. The notice must clearly and concisely state in plain, easily understood language:

(i) the nature of the action;

(ii) the definition of the class certified;

(iii) the class claims, issues, or defences;

(iv) that a class member may enter an appearance through an attorney if the member so desires;

(v) that the court will exclude from the class any member who requests exclusion;

(vi) the time and manner for requesting exclusion; and

(vii) the binding effect of a class judgment on members under Rule 23(c)(3).

(3) Judgment. Whether or not favourable to the class, the judgment in a class action must:

(A) for any class certified under Rule 23(b)(1) or (b)(2), include and describe those whom the court finds to be class members; and

(B) for any class certified under Rule 23(b)(3), include and specify or describe those to whom the Rule 23(c)(2) notice was directed, who have not requested exclusion, and whom the court finds to be class members.

(4) Particular Issues. When appropriate, an action may be brought or maintained as a class action with respect to particular issues.

(5) Subclasses. When appropriate, a class may be divided into subclasses that are each treated as a class under this rule.

(d) CONDUCTING THE ACTION.

(1) In General. In conducting an action under this rule, the court may issue orders that:

(A) determine the course of proceedings or prescribe measures to prevent undue repetition or complication in presenting evidence or argument; (B) require—to protect class members and fairly conduct the action—giving appropriate notice to some or all class members of:

(i) any step in the action;

(ii) the proposed extent of the judgment; or

(iii) the members' opportunity to signify whether they consider the representation fair and adequate, to intervene and present claims or defences, or to otherwise come into the action;

(C) impose conditions on the representative parties or on interveners;

(D) require that the pleadings be amended to eliminate

allegations about representation of absent persons and that the action proceed accordingly; or

(E) deal with similar procedural matters.

(2) Combining and Amending Orders. An order under Rule 23(d)(1) may be altered or amended from time to time and may be combined with an order under Rule 16.

(e) SETTLEMENT, VOLUNTARY DISMISSAL, OR COMPROMISE. The claims, issues, or defences of a certified class may be settled, voluntarily dismissed, or

compromised only with the court's approval. The following procedures apply to a proposed settlement, voluntary dismissal, or compromise:

(1) The court must direct notice in a reasonable manner to all class members who would be bound by the proposal.

(2) If the proposal would bind class members, the court may
approve it only after a hearing and on finding that it is fair,
reasonable, and adequate.

(3) The parties seeking approval must file a statement identifying any agreement made in connection with the proposal.

(4) If the class action was previously certified under Rule 23(b)(3), the court may refuse to approve a settlement unless it affords a new opportunity to request exclusion to individual class members who had an earlier opportunity to request exclusion but did not do so.

(5) Any class member may object to the proposal if it requires court approval under this subdivision (e); the objection may be withdrawn only with the court's approval.

(f) APPEALS. A court of appeals may permit an appeal from an order granting or denying class-action certification under this rule if a petition for permission to appeal is filed with the c rule if a petition for permission to appeal is filed with the circuit clerk within 14 days after the order is entered. An appeal does not stay proceedings in the district court unless the district judge or the court of appeals so orders.

(g) CLASS COUNSEL.

(1) Appointing Class Counsel. Unless a statute provides otherwise, a court that certifies a class must appoint class counsel. In appointing class counsel, the court:

(A) must consider:

(i) the work counsel has done in identifying or investigating potential claims in the action;

(ii) counsel's experience in handling class actions, other complex litigation, and the types of claims asserted in the action;

(iii) counsel's knowledge of the applicable law; and(iv) the resources that counsel will commit to representing the class;

(B) may consider any other matter pertinent to counsel's ability to fairly and adequately represent the interests of the class;

(C) may order potential class counsel to provide information on any subject pertinent to the appointment and to propose terms for attorney's fees and non-taxable costs;
(D) may include in the appointing order provisions about the award of attorney's fees or non-taxable costs under Rule 23(h); and
(E) may make further orders in connection with the appointment.
(2) Standard for Appointing Class Counsel. When one applicant seeks appointment as class counsel, the court may appoint that applicant only if the applicant is adequate under Rule 23(g)(1) and (4). If more than one adequate applicant seeks appointment, the court must appoint the applicant best able to represent the interests of the class.
(3) Interim Counsel. The court may designate interim counsel to act on behalf of a putative class before determining whether to certify the action as a class action.
(4) Duty of Class Counsel. Class counsel must fairly and adequately represent the interests of the class.

(h) ATTORNEY'S FEES AND NONTAXABLE COSTS. In a certified class action, the court may award reasonable attorney's fees and non-taxable costs that are authorized by law or by the parties' agreement. The following procedures apply:
(1) A claim for an award must be made by motion under Rule 54(d)(2), subject to the provisions of this subdivision (h), at a time the court sets. Notice of the motion must be served on all parties and, for motions by class counsel, directed to class members in a reasonable manner.
(2) A class member, or a party from whom payment is sought, may object to the motion.
(3) The court may hold a hearing and must find the facts and state its legal conclusions under Rule 52(a).
(4) The court may refer issues related to the amount of the award to a special master or a magistrate judge, as provided in Rule 54(d)(2)(D).
(As amended Feb. 28, 1966, eff. July 1, 1966; Mar. 2, 1987, eff. Aug. 1, 1987; Apr. 24, 1998, eff. Dec. 1, 1998; Mar. 27, 2003, eff. Dec. 1, 2003; Apr. 30, 2007, eff. Dec. 1, 2007; Mar. 26, 2009, eff. Dec. 1, 2009.)

2. Results of an alternative set of accounting and corporate governance data

Table A: The eight alternative models

Model 1	**Model 2**	**Model 3**	**Model 4**
ROA	ROA	ROA	ROA
NS/TA	NS/TA	NS/TA	NS/TA
CR	CR	CR	CR
Log TA	Log TA	Log TA	Log TA
E/TA	E/TA	E/TA	E/TA
G/TA	G/TA	G/TA	G/TA
PAST	PAST	PAST	PAST
BS - Industry	CS - Industry	TDS - Industry	AS - Industry
Model 5	**Model 6**	**Model 7**	**Model 8**
ROA	ROA	ROA	ROA
NS/TA	NS/TA	NS/TA	NS/TA
CR	CR	CR	CR
Log TA	Log TA	Log TA	Log TA
E/TA	E/TA	E/TA	E/TA
G/TA	G/TA	G/TA	G/TA
PAST	PAST	PAST	PAST
BS-Index	CS – Index	TDS - Index	AS - Index

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

Table B: Coefficients of LA

	Model 1		**Model 2**		**Model 3**		**Model 4**
ROA	-0.019 (0.103)	ROA	-0.019 (0.090)*	ROA	-0.019 (0.095)*	ROA	-0.019 (0.096)*
NS/TA	-0.385** (0.026)	NS/TA	-0.374** (0.029)	NS/TA	-0.367** (0.031)	NS/TA	-0.367** (0.031)
CR	0.133 (0.128)	CR	0.135 (0.110)	CR	0.135 (0.114)	CR	0.132 (0.119)
Log TA	-0.549*** (0.005)	Log TA	-0.437** (0.020)	Log TA	-0.428** (0.023)	Log TA	-0.418** (0.026)
E/TA	-0.003 (0.594)	E/TA	-0.004 (0.547)	E/TA	-0.004 (0.551)	E/TA	-0.004 (0.543)
G/TA	-1.468* (0.085)	G/TA	-1.381 (0.101)	G/TA	-1.320 (0.118)	G/TA	-1.364 (0.105)
PAST	0.534* (0.094)	PAST	0.555* (0.080)	PAST	0.551* (0.083)	PAST	0.559* (0.079)
BS - Industry	0.255** (0.010)	CS - Industry	0.069 (0.455)	TDS - Industry	-0.005 (0.954)	AS - Industry	-0.046 (0.623)
	Model 5		**Model 6**		**Model 7**		**Model 8**
ROA	-0.016 (0.155)	ROA	-0.019* (0.097)	ROA	-0.019* (0.096)	ROA	-0.019* (0.095)
NS/TA	-0.382** (0.026)	NS/TA	-0.371** (0.029)	NS/TA	-0.367** (0.031)	NS/TA	-0.364** (0.032)
CR	0.112 (0.211)	CR	0.133 (0.117)	CR	0.135 (0.114)	CR	0.140 (0.106)
Log TA	-0.416** (0.028)	Log TA	-0.424** (0.023)	Log TA	-0.427** (0.022)	Log TA	-0.423** (0.023)
E/TA	0.000 (0.972)	E/TA	-0.003 (0.569)	E/TA	-0.004 (0.555)	E/TA	-0.003 (0.573)
G/TA	-1.551* (0.072)	G/TA	-1.371 (0.104)	G/TA	-1.317 (0.119)	G/TA	-1.283 (0.126)
PAST	0.520 (0.107)	PAST	0.552* (0.082)	PAST	0.551* (0.083)	PAST	0.531* (0.095)
BS-Index	0.325*** (0.000)	CS – Index	0.036 (0.683)	TDS-Index	-0.007 (0.938)	AS - Index	0.073 (0.422)

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

*Significant at p<0.10, **Significant at p<0.05, ***Significant at p<0.01

Table C: Coefficients of DA and SVMs

Model 1	DA	SVMs	**Model 2**	DA	SVMs
ROA	0.253	-0.254	ROA	0.286	-0.306
NS/TA	0.420	-0.282	NS/TA	0.442	-0.276
CR	-0.279	0.251	CR	-0.329	0.291
Log TA	0.568	-0.649	Log TA	0.491	-0.532
E/TA	0.086	-0.089	E/TA	0.116	-0.023
G/TA	0.291	-0.124	G/TA	0.296	-0.182
PAST	-0.282	0.576	PAST	-0.312	0.731
BS - Industry	-0.431	0.191	CS - Industry	-0.122	0.021
Model 3	DA	SVMs	**Model 4**	DA	SVMs
ROA	0.284	-0.308	ROA	0.280	-0.293
NS/TA	0.441	-0.295	NS/TA	0.438	-0.278
CR	-0.324	0.284	CR	-0.321	0.296
Log TA	0.490	-0.520	Log TA	0.476	-0.520
E/TA	0.117	-0.027	E/TA	0.120	-0.035
G/TA	0.286	-0.166	G/TA	0.294	-0.176
PAST	-0.312	0.624	PAST	-0.314	0.552
TDS - Industry	0.020	0.031	AS - Industry	0.079	-0.058
Model 5	DA	SVMs	**Model 6**	DA	SVMs
ROA	0.205	-0.229	ROA	0.280	-0.311
NS/TA	0.384	-0.250	NS/TA	0.444	-0.278
CR	-0.201	0.126	CR	-0.323	0.294
Log TA	0.403	-0.396	Log TA	0.481	-0.531
E/TA	-0.006	0.020	E/TA	0.111	-0.024
G/TA	0.281	-0.130	G/TA	0.297	-0.168
PAST	-0.252	0.452	PAST	-0.312	0.698
BS - Index	-0.562	0.342	CS - Index	-0.071	-0.004
Model 7	DA	SVMs	**Model 8**	DA	SVMs
ROA	0.283	-0.318	ROA	0.284	-0.274
NS/TA	0.440	-0.281	NS/TA	0.436	-0.292
CR	-0.324	0.294	CR	-0.330	0.283
Log TA	0.487	-0.533	Log TA	0.480	-0.534
E/TA	0.116	-0.025	E/TA	0.109	-0.049
G/TA	0.286	-0.162	G/TA	0.278	-0.151
PAST	-0.312	0.712	PAST	-0.302	0.678
TDS - Index	0.016	0.011	AS - Index	-0.143	0.036

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with

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Table D: Weights of variables in the UTADIS and MHDIS

Model 1	UTADIS	MHDIS		**Model 2**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	19.94%	2.50%	42.06%	ROA	20.15%	45.54%	14.45%
NS/TA	2.67%	44.60%	2.19%	NS/TA	2.61%	29.67%	6.21%
CR	2.86%	4.55%	0.00%	CR	2.83%	7.00%	0.07%
Log TA	2.31%	9.86%	36.10%	Log TA	2.26%	0.01%	41.28%
E/TA	0.67%	3.82%	6.38%	E/TA	0.71%	0.00%	12.69%
G/TA	0.43%	33.92%	0.43%	G/TA	0.43%	17.78%	17.38%
PAST	1.02%	0.39%	12.85%	PAST	1.05%	0.00%	5.45%
BS - Industry	70.10%	0.36%	0.00%	CS - Industry	69.95%	0.00%	2.47%
Model 3	UTADIS	MHDIS		**Model 4**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	22.75%	0.14%	60.81%	ROA	20.09%	46.33%	0.88%
NS/TA	3.30%	2.71%	37.47%	NS/TA	3.12%	0.68%	40.45%
CR	2.72%	6.37%	0.01%	CR	2.53%	3.91%	3.64%
Log TA	2.30%	40.06%	0.00%	Log TA	3.24%	42.45%	8.30%
E/TA	1.37%	10.62%	1.45%	E/TA	1.37%	6.64%	3.48%
G/TA	0.75%	33.74%	0.00%	G/TA	0.77%	0.00%	36.12%
PAST	0.88%	3.18%	0.00%	PAST	1.02%	0.00%	5.97%
TDS - Industry	65.92%	3.19%	0.25%	AS - Industry	67.86%	0.00%	1.16%
Model 5	UTADIS	MHDIS		**Model 6**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	19.94%	4.27%	38.79%	ROA	19.94%	54.95%	0.54%
NS/TA	2.67%	1.17%	47.11%	NS/TA	2.67%	40.50%	3.72%
CR	2.86%	0.27%	4.50%	CR	2.86%	0.00%	4.56%
Log TA	2.31%	54.77%	0.00%	Log TA	2.31%	0.14%	44.43%
E/TA	0.67%	0.00%	9.32%	E/TA	0.67%	0.00%	10.79%
G/TA	0.43%	32.81%	0.11%	G/TA	0.43%	0.00%	34.02%
PAST	1.02%	6.71%	0.00%	PAST	1.02%	4.41%	0.00%
BS-Index	70.10%	0.00%	0.18%	CS - Index	70.10%	0.00%	1.94%
Model 7	UTADIS	MHDIS		**Model 8**	UTADIS	MHDIS	
		NSCA	SCA			NSCA	SCA
ROA	20.40%	10.80%	31.84%	ROA	19.94%	25.87%	12.20%

NS/TA	2.73%	0.00%	46.25%	NS/TA	2.67%	6.92%	33.20%
CR	2.80%	0.01%	5.08%	CR	2.86%	7.91%	0.11%
Log TA	2.25%	36.20%	10.09%	Log TA	2.31%	45.19%	0.00%
E/TA	0.85%	9.45%	0.00%	E/TA	0.67%	2.87%	6.11%
G/TA	0.45%	34.71%	1.00%	G/TA	0.43%	3.03%	34.04%
PAST	70.04%	0.00%	5.28%	PAST	1.02%	6.10%	2.93%
TDS-Index	0.47%	8.81%	0.47%	AS - Index	70.10%	2.12%	11.41%

Notes: ROA: Profit & Loss for the Period/Total Assets, NS/TA: Net Sales/Total Assets, CR: Current Assets/Current Liabilities, Log TA: Total Current Assets, Long Term Receivables, Investments in Unconsolidated Companies, Other Investments, Net Property, Plant and Equipment and Other Assets, including Intangibles, E/TA: Shareholders' Funds/Total Assets, G/TA: The excess of Cost over Equity of an acquired company. The item is a component of Total Intangible Assets, PAST: The number of SCA that each company has faced in the past, IX – CGQ: General index score that is made of comparison peer group based on stock exchange index were the firm is traded, ID – CGQ: General industry score that is made of comparison peer group based on the S&P "GICS" of 24 industry groups, BS-Index: Board composition, Nominating committee composition, etc compared with other companies in the same index, BS – Industry: Board composition, Nominating committee composition, etc, compared with other companies in the same industry, CS – Index: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same index, CS – Industry: Cost of option plans, Option repricing permitted, Shareholder approval of option plans, etc, compared with other companies in the same industry, TDS – Index: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same index, TDS – Industry: Poison pill adoption, Poison pill – shareholder approval, etc, compared with other companies in the same industry, AS – Index: Audit committee, Audit fees, etc, compared with other companies in the same index, AS – Industry: Audit committee, Audit fees, etc, compared with other companies in the same industry.

3. Summary Results

Table E: Accounting information[26]

Overall accuracy			
Model A	%	Model B	%
UTADIS	70.72	UTADIS	70.07
SVMs	68.84	SVMs	69.10
MV	68.84	LA	67.30
SCA group			
MHDIS	57.97	MHDIS	56.45
DA	55.70	DA	54.50
LA	54.80	LA	53.80

Table F: Corporate governance information

Overall accuracy							
Model 1	%	Model 2	%	Model 3	%	Model 4	%
UTADIS	65.45	UTADIS	65.79	DA	62.85	UTADIS	62.50
MV	61.45	MV	65.37	LA	61.54	MV	59.39
MHDIS	60.19	SVMs	62.82	MV	60.98	SVMs	58.88
SCA group							
MHDIS	59.21	MHDIS	61.84	DA	58.97	MHDIS	63.81
UTADIS	58.55	MV	60.88	MV	56.48	UTADIS	56.57
MV	58.46	UTADIS	59.21	LA	56.41	SVMs	54.60

[26] Tables E and F show the three highest classifications for each case presenting by this way the best classification techniques.

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