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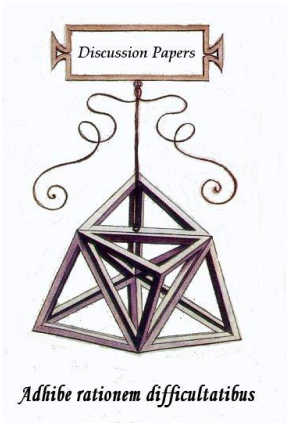

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A statistical analysis of reliability of audit opinions as bankruptcy predictors

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Discussion Paper
n. 174

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A statistical analysis of reliability of audit opinions as bankruptcy predictors

Abstract

Research measures the reliability of audit firms in predicting bankruptcy for US-listed financial institutions. Object of the analysis is the Going Concern Opinion (GCO), widely considered a bankruptcy warning signal to stakeholders. The sample is composed of 42 US-listed financial companies that filed Chapter 11 between 1998 and 2011. To highlight differences between bankrupting and healthy firms, a matching sample composed by 42 randomly picked healthy US-listed financial companies is collected. We concentrate on financial institutions, whereas the existing literature pays considerably heavier attention to the industrial sector. This research imbalance is remarkable and particularly unexpected in the wake of recent financial scandals. Literature points out two main approaches on bankruptcy prediction: 1) purely mathematical; 2) approaches based on a combination of auditor knowledge, expertise and experience. The use of data mining techniques, allow us to benefit from the best features of both approaches. Statistical tools used in the analysis are: Logit regression, Support Vector Machines and an Adaboost Meta-algorithm. Findings show a quite low reliability of GCOs in predicting bankruptcy. It is likely that auditors consider further information in supporting their audit opinions, aside from financial-economic ratios. The scant predictive ability of auditors might be due to critical relationships with distressed clients, as suggested by recent literature.

Classificazione: M42, G33
Keywords: : 1) Bankruptcy 2) Financial institutions; 3) Going Concern Opinion; 4) Data Mining.

Contents

1. Introduction

Along the time, bankruptcy prediction has been one of the target that many researches tried to accomplish. In the early seventies, several models were proposed, basing the analysis on the traditional financial ratios (Beaver, 1966, 1968; Altman, 1968).

By the time, while the information technology evolved and the need for more trustable predictions was felt by the investors, the bankruptcy prediction models progressed through the utilization of even more advanced techniques, based on data mining (Divsalar et al., 2012), intelligence modeling techniques (Demyanyk, Hasan, 2010) and artificial neural networks (Alfaro, et al. 2008).

On a parallel track, many studies rely on the relevance of the going concern opinion (GCO), through which seasoned auditors report the early warning signs of bankruptcy (see, among others, Casterella et al., 2000).

The global financial crisis, started in 2007, along with the recent financial scandals, have both brought about an increased attention paid to the auditor opinions issued on distressed clients. The GCO represents one of the most relevant judgments the auditors express, as it is even able to affect the equity markets (Blay, Geiger, North, 2011) and the investors' behavior (Menon, Williams, 2010).

Given the importance of the GCO, several papers in the literature try to explain the relationship between the GCO and bankruptcy prediction.

Lennox (1999) argues that the role of auditors is foremost to warn investors when a company is likely to go into bankruptcy. Hence, auditors are obliged to issue a "going concern qualification." Some scholars take the opposite view and conclude that the GCO, at best, offers only marginal information to stakeholders (Mutchler, Hopwood, McKeown, 1997). Still other authors gauge the reliability of auditors in issuing a GCO and they find that a high number of opinions tend to be wrong about the likelihood of bankruptcy. Actual outcomes often turn out to be quite different from what these auditors were predicting (Malgwi, Emenyonu, 2004).

Uneven results of this nature are justified by auditors who say they are only responsible for reporting the past and the present. They do not consider themselves "clairvoyant," and therefore they should not be held responsible for predicting the future of a company (Casterella, Lewis, Walker, 2000).

Investors pay an increasingly attention to the GCO, because they consider it as a preliminary bankruptcy warning signal. Investors, thus, need a transparent and credible audit opinion in order to make their decisions. They would not rely on audited financial reports if they consider that opinion as low trustable (Robertson, Houston, 2010).

Still other authors worry that a GCO issued on a firm would serve as a "self-fulfilling prophecy," accelerating its failure by reducing public confidence in the firm's capacity to continue as a going concern

(Carson et al. 2012; Pryor, Terza, 1998; Citron, Taffler, 1992; Merton, 1968).
An audit opinion coherent with the real business situation of the audited firm, could reduce the information asymmetry between capital demand and supply and, thus, it could improve the investors' awareness about the risks they run investing in the audited companies (Holt, DeZoort, 2009).
The choice to focus the analysis on the financial institutions is due to the fact that the existing literature on the relationship between auditing and bankruptcy prediction, pays considerably heavier attention to the industrial sector (Carson et al., 2012; Wertheim, Fowler, 2012). We believe the financial sector is even more relevant, since it involves a wider range of stakeholders. Relatively few researchers have written papers aligned with our focus on the financial sector (Kumar, Ravi, 2007; Malgwi, Emenyonu, 2004).
We conducted the study on US-listed firms because the US is still considered the premier market and financial center, and also because in US the Sarbanes Oxley Act (SOX) has a larger impact on the audit opinion than comparable laws in other countries. The US is also where frauds, scandals and collapses have the biggest resonance, thus it deserves greater attention from regulators.
The research is organized as follows. Section 2 provides an analytical literature review about GCO and the relationship between bankruptcy prediction models and GCO; section 3 defines the research design; section 4 describes the sample creation and data collection; section 5 shows statistical analysis and findings; section 6 and 7 propose conclusions and suggestions for future researches.

2. Literature review

2.1 Going concern opinion

Auditors have the responsibility to issue an audit opinion in order to assure that the financial reporting gives a true and fair view in accordance with the financial reporting framework used for the preparation and presentation of the financial statements.
If the auditor has some substantial doubts about the firm's ability to continue as a going concern, he\she has to issue a modified GCO. Such modification of opinion is called "emphasis of a matter" and it informs users about uncertainties or disagreements over accounting principles. Otherwise, if this emphasis of matter regarding the going concern is not sufficient to express the severity of the financial situation of the firm, auditor must issue a qualified opinion, indicating the reasons of this choice.
The term going concern is based on the "continuity assumptions" that an entity will continue in operations for the foreseeable future and will be able to realize assets and discharges. Modification of opinion should be useful for the stakeholders to be informed about the financial

conditions of the firm and for the management to take corrective actions, especially to prevent the failure of the firm.

The guidelines on going concern involve both accounting and auditing standards to regulate the preparation and the evaluation of the financial statements of listed companies.

The accounting standard provides a description of going concern principle in IAS 1 (Disclosure of Accounting Policies, 1975). It states that a firm has to prepare its financial statements under going concern conditions. If management has significant doubts about the ability of the entity to continue as a going concern, the uncertainties must be disclosed.

The issuance of the auditing standards related to the going concern, started in 1974 when the AICPA issued the SAS 2 and continued with SAS 34 (AICPA, 1981), SAS 59 (AICPA,1988), SAS 126 (AICPA, 2012) and ISA 570. Whereas there are no relevant differences between SAS 126 and SAS 59 (SAS 126 is just a clarity redraft of the previous standard), there are instead differences between SAS 59 and SAS 34. Some authors, indeed, argue that the SAS 59 was issued in order to reduce the investors' surprise related to the bankruptcy (Asare, 1990; Holder-Webb, Wilkins, 2000). Moreover, while SAS 34 allowed auditors to express their concerns about the continuity of the company by issuing a qualified opinion, SAS 59 allows them to issue an unqualified "modified" opinion. SAS 59 provides the following four categories of conditions/events that may raise substantial doubt about going concern:

- negative trends in financial ratios;
- indicators of possible financial difficulties;
- internal matters;
- external matters.

The guidance contained in SAS 59 leaves much to auditors' discretion, thus a huge part of the auditors' judgment is based on their perceptions and on the external events impacting their profession.

According to these considerations, auditors could commit two types of errors in modifying an audit opinion for substantial doubt about going concern: type 1 is a false positive, it occurs when the auditor issues a GCO and the firm continues in business; type 2 arises when the firm is going to fail and the auditor does not issue a GCO. As causes of the type 1 error, Kida (1980) finds the "self-fulfilling prophecy" effect and a deteriorated relationship with the client. About the type 2, the risk of lawsuit by creditors and the loss of reputation could be factors explaining the error.

Prior literature streams attempt to find out the elements affecting the decision to issue a GCO, such as financial conditions of the audited firms, litigations, turnaround initiatives, size of the audit firm (Bruynseels, Knechel, Willekens, 2013; Reynolds and Francis, 2000; Blay et al. 2011; Musvoto, Gouws, 2011; Chen, Xiumin, Xin, 2013).

Bruynseels et al. (2013) investigate the link between management's turnaround initiatives and auditors' opinion, finding that turnaround

actions are associated with a higher likelihood to receive a GCO. Reynolds et al. (2001) questioned whether the client size affects the propensity of auditors in issuing a GCO. They considered the economic dependence and the reputation protection as variables of their study, finding that the issuance of GCO by Big Five audit firms is not affected by client size. Blay et al. (2011) provide evidence that the GCO is considered as an external communication of risk, as this type of audit opinion allows stakeholders to have incremental information related to distressed firms. Musvoto et al. (2011) argue that GCO assumption is anti-measurement in nature, as it is difficult to measure the attributes of accounting phenomena under GCO assumptions. Chen et al. (2013) evaluate the link among insider trading, litigation and GCO, finding that the probability of receiving a GCO is negatively associated with the level of insider selling.

In the American context, the issuing of Sarbanes Oxley Act of 2002 (SOX) can be considered as an answer to recent accounting frauds but it did not change going concern issuing regulation (Bellovary, Giacomino, Akers, 2007). Regarding this matter, some scholars try to identify the state of the going concern decision post SOX era (Nogler, Jang, 2012).

2.2 Bankruptcy prediction models and going concern opinion

Even if the fundamentals of the bankruptcy prediction models can be found in historical contributions based on financial ratios (Beaver, 1966, 1968; Altman, 1968; Altman, Hotchkiss 2006), attempts were carried out in order to improve the effectiveness of the bankruptcy prediction, taking advantage from other, increasingly sophisticated models (Demyanyk et al., 2010).

Among them are logistic regression techniques (Logit) (Ohlson, 1980), early warning systems (Davis, Karim, 2008), artificial neural networks to forecast the main financial ratios (Celik, Karatepe, 2007) or to predict the outcome of Chapter 11 bankruptcy (Luther, 1998). Still in the succeeding years, scholars tried to identify warning bankruptcy signs among the disclosure issues, through the data-mining (Divsalar et al., 2012), text-mining (Shirata et al., 2011), multivariate analysis (Mutchler, 1985), multivariate adaptive regressions (De Andrés, 2011) and more advanced fuzzy clustering analysis (Lenard, Alam, Booth, 2000).

Most researches deal with the bankruptcy prediction carrying out the implicit assumption to find out the factors which could span the information in the financial ratios (Pinches, Mingo, Caruthers, 1973; Zavgren, 1985), determining the most critical and sensitive financial ratios which could represent an early warning against bankruptcy risk (Altman, 1968; Beaver, McNichols, Rhie, 2005).

According to a wide range of scholars, auditors could have a key role in assessing the bankruptcy risk and thus in preventing a financial collapse Hodges, Cluskey and Lin (2005) analyze whether the most common cross sectional bankrupt predictors – Altman Z-Score, cash flows and

financial ratios – along with audit opinion, observed in the three years before the bankruptcy, gave back trustable predictive information about the collapse. The results show that the audit opinion does not represent an effective warning sign for impending bankruptcy and, at the same time, neither the other predictors provide with very reliable information about the bankruptcy risk. On the same literature stream, Malgwi et al. (2004) focus on UK financial institutions considering a time lag going from 1977-78 to 1999-2000. They wonder whether it does exist an association between the bankruptcy of the banks and the preceding audit opinions. They thus use audit opinions like a proxy to evaluate the auditors' effectiveness in predicting failure. They find a high number of unqualified opinions were issued before the bankruptcy, differently from what they expected.

A similar analysis is carried out by Casterella et al. (2000). They observe that auditors do not consider themselves "clairvoyant", thus they should not be required to predict the future of a company. Furthermore, in some cases, issuing a qualified opinion might also affect the events and might lead companies to go bankrupt (Hopwood, McKeown, Mutchler, 1989).

However, there is a rich literature supporting the role of the GCO in predicting the failure of a company. Hopwood, McKeown and Mutchler (1994) find that audit opinions have not a lower ability in predicting bankruptcy respect to financial ratio-based models, as it was expected.

Mutchler et al. (1997) examine whether auditors issuing GCO on soon-to-be bankrupt companies are influenced by contrary information (e.g. the default on debt) and by mitigating factors that offset such contrary information. Results suggest the existence of a significant correlation between GCO decisions and the probability of bankruptcy. By using three variables to indicate the debt-status of the companies observed – payment, covenant defaults, cured defaults – their study represents the next step in the research of Chen and Church (1992) who analyze the correlation between GCO and a single debt-status variable only. In turn, the analysis of Mutchler et al. (1997) is taken up and extended by Foster, Ward and Woodroof (1998), who analyze the usefulness of debt default and GCO in the bankruptcy risk assessment. They find that loan default and loan covenant violations explain the bankruptcy at the time of the last annual report issued before the violation happened.

According to Lennox (1999), one of the roles of the auditors is precisely to warn investors when a company is likely to go bankrupt. He underlines that if there are possibilities that a company ceases to trade in the foreseeable future, then the auditors must give a GCO.

Moreover, Bryan, Tiras and Wheatley (2005) consider that if the role of the GCO is to anticipate the signal of a possible bankruptcy, then the stakeholders should have the possibility to defend against the risk to have losses, carrying out timely actions.

3. Research design

In this research we measures the reliability of audit firms in predicting bankruptcy for US-listed financial institutions. Our main assumption is that a worsening of the traditional accounting ratios may lead to a high probability of receiving a GCO and a high probability of filing for Chapter 11.
On the basis of the controversial findings about the reliability of the auditors in predicting bankruptcy and in accordance with the literature review, we formulate our research questions as follows:
RQ1: Which ratios are mostly correlated with the issuance of a GCO?
RQ2: Are financial ratios useful in predicting the risk of bankruptcy?
RQ3: Is the audit opinion helpful in predicting the risk of bankruptcy?

4. Sample selection and data collection

As first step, we collected all the 996 US-listed companies that filed for Chapter 11 between 2002 and 2011 from the Edgar SEC database. Companies file for Chapter 11 when they, or their creditors, ask for protection under the bankruptcy laws of the United States in order to restructure the financial conditions. We consider the Chapter 11 as a proxy of bankruptcy. From the website of all 996 companies, we detected the sector and excluded those outside the financial sector. This skimming produced a list of 60 financial US-listed firms (Table 1).

Table 1: Distribution of US-listed firms that filed for Chapter 11 in the sample period (2002-2011)

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
All firms[1]	252	161	75	67	77	44	72	132	64	52	996
Financial firms (FF)[2]	6	8	3	4	4	4	6	17	6	2	60
% of FF out of all firms[3]	2,4%	5%	4%	6%	5,2%	9,1%	8,4%	12,9%	9,4%	3,8%	3,8%

For each company, using Thomson Reuters Datastream, we extracted the audit opinions and the classical accounting performance ratios used for financial statement analysis, excluding firms with missed values. We ended up with a list of 42 companies.
We then divided financial ratios into three categories, depending on the financial statement document to which they refer: statement of cash flow, balance sheet and income statement (Table 2 - a detailed description is reported in the Appendix). The Edgar SEC database

[1] All US-listed firms that filed for Chapter 11 in the sample time-period distributed per year.
[2] All US-listed financial firms that filed for Chapter 11 in the sample time-period distributed per year.
[3] Percentage of US-listed financial firms that filed for Chapter 11 in the sample period over all US-listed firms that filed for Chapter 11 in the sample time-period.

provided us with the type of qualified audit opinion issued during the sample time-period (e.g., going concern or others). The table below classifies the collected data and show their composition (Table 3). From the extraction achieved on the Edgar SEC database we found that 10 firms out of 42 received a qualified audit opinion, for a total number of 21 qualified audit opinions. All of them were GCOs. For each of the 10 firms analysed, we collected the year(s) of receiving GCO, the year of filing for Chapter 11 and the time lag calculated as the difference between the year of filing for Chapter 11 and the last audit report (Table 4).

Table 2: Set of financial ratios used in the analysis

Statement of cash flow ratios	**Balance sheet ratios**	**Income statement ratios**
Cash flow/sales (CFS)	Convertible debt/total assets (CD)	Net income available to common (NIAC)
Increase decrease in cash and short term investments (IDCSTI)	Short term debts and current portion of long term debt/total assets (STD)	EBIT
	Total debts/total assets (TD)	Net sales or revenues (NS)
	Total shareholder equity/total asset (TSE)	Operating income (OI)
	Decrease in investments (DI)	Equity in earnings (EE)
	Increase in investments (II)	ROA
	Discontinued operations/total assets (DO)	ROI
	Long term borrowings/total assets (LTB)	ROS
	Long term debts/total assets (LTD)	ROE
	Net debts/total assets (ND)	
	Other liabilities/total assets (OL)	
	Reduction in long term debts (RLTD)	

The remaining 32 firms received an unqualified opinion. In order to validate the results of our analysis, we built a matching sample composed of 42 randomly picked US-listed financial companies that did not file for Chapter 11, namely healthy firms.

For each of them, we carried out the same procedure followed for Chapter 11 filing firms descripted above. Among the matching sample, we found 2 firms that received a qualified opinion in the 2002-2011 time-period considered (for a total of 3 modified audit opinions) and all of them were GCOs. The remaining firms had unqualified opinions.

Table 3: The sample			
Total US financial firms	Financial firms filing for Chapter 11	Financial firms with no data available	Net number of financial firms filing for Chapter 11
996	60	18	**42**

Table 4: Details on financial firms receiving GCO(s)				
Firms filing for Chapter 11, receiving GCO	Y_GCO	Y_Chapter 11	Y_Audit Opinion	Time lag
1	2003	2005	2003	2
2	2009, 2010, 2011	2011	2011	0
3	2004	2009	2009	0
4	1999, 2000	2002	2000	2
5	2000, 2001	2003	2001	2
6	2001	2002	2001	1
7	2004	2010	2009	1
8	2001, 2003	2005	2003	2
9	2001, 2002, 2003, 2004, 2006, 2007	2008	2007	1
10	2000, 2001	2003	2001	2

Where:
Y_GCO: year of receiving GCO.
Y_Chapter 11: year of filing for Chapter 11.
Y_ Audit Opinion: year of the last audit opinion received.
Time Lag: difference between Y_Chapter 11 and Y_Audit Opinion.

5. Statistical analysis and findings

The statistical analysis is composed of the following four steps:
- data preprocessing;
- Logit regression analysis;
- Support Vector Machine analysis;
- Adaboost meta-classifier.

5.1 Data Preprocessing

As stated above, the sample is composed of 42 bankrupted firms and 42 healthy firms. For each of them, we considered 23 financial ratios. Being $N = 84$ the total amount of firms and $M = 23$ the total amount of financial ratios considered, we denote with $x_{i,j}$, $i = 1, ..., N$ and $j = 1, ...,$

M the j-th financial ratio related to i-th firm and with T_i, *i = 1, ..., N* the last year of available data for i-th firm. For each firm, we considered a time lag of four years, that is, for each $x_{i,j}$, we built x^t_i, j for $t_i = T_{i-3}, ..., T_i$. Last available year T_i for healthy firms is assigned with a one-to-one criteria, that is, we replicated T_i *i = 1, ..., 42* related to bankrupted firms and assigned each of them to a randomly picked healthy firm (Nicolaou 2004)
Resulting data are combined in a matrix A composed by *N* rows and *Mx4* columns.

5.2 Logit regression analysis

To answer the RQ1:

Which ratios are most relevant for the issuance of the GCO?

we used Logit regressions (Greene, 2003). Logit regressions allow us to highlight which financial ratios are more correlated to Going Concern issuance. To avoid problems related to the strong multicollinearity of our data, we used a naïve multiple Logit regression approach (Fraser, Hite, 1990). We regressed each column of matrix A versus a labels vector $y^{GC} \in R^N$. Each element of y^{GC} is denoted as $y_{i,t}$. $y_{i,\ t} \in \{0, 1\}$ where 0 indicates that i-th firm did not receive a GCO at time t, and 1 indicates that i-th firm received a GCO at time t.
Table 5 shows which financial ratios are correlated to labels vector. Statistical significance is evaluated with a Z test (Sprinthall, Fisk 1990) and *, ** and *** indicate, respectively, a level of significance equal to 0.05, 0.025 and 0.01. Signs of regression coefficients βs are coherent with expectancies, and this could confirm goodness of our analysis.

5.3 Support Vector Machine analysis

In order to deepen the RQ1 we performed an analysis using SVMs.
SVM is a popular classification tool initially proposed by Cortes and Vapnik (1995). For n-dimensional data belonging to two different classes, in its easier formulation, an SVM builds a hyperplane which maximizes the distance between the two classes. Vectors closest to the hyperplane are called Support Vectors. Using Scikit-Learn, we built a support vector machine for each feature of the sample assessed as statistically significant by Logit regression, namely for the 14 financial ratios showed in Table 5.
SVMs are trained using as label vectors y^{GC} defined above and $y^{BR} \in$ RN . As for y^{GC}, each element of y^{BR} is denoted with $y^{BR}_{i,\ t}$. $y^{BR}_{i,\ t} \in \{0,$ 1} where 0 indicates that i-th firm did not go bankrupt at time T, and 1 indicates that *i-th* firm went bankrupt at time *T*.
We denoted with SVMGC the set of SVMs generated using y^{GC} as label vector and with SVM^{BR} the set of SVMs generated using y^{BR} as label vector.

Table 5: Logit regression results			
Financial Ratios significant for Going Concern	p-value	β	Std error
Cash Flow Sales T-3	***	-1.02972483	0.33266128
Cash Flow Sales T	***	-1.46053943	0.27517565
Net Income Available To Common T	***	-0.82577326	0.25009811
Operating Income T-2	***	-1.03995088	0.34864458
Operating Income T-1	**	-0.66209752	0.27696253
ROE T-3	***	-0.85516301	0.32234961
ROA net income total asset T	**	-0.57712023	0.23119814
ROI ebit total asset T	**	-0.57496468	0.23105093
ROS T	***	-1.74405296	0.3020313
Short Term Debts / Total Assets T	**	0.60696131	0.25856189
Total Debts / Total Assets T	**	0.57593395	0.23112596
Total Shareholder Equity / Total Assets T	**	-0.57565295	0.23111892
Net Debts / Total Assets T	**	0.57465455	0.23104341
Other Liabilities / Total Assets T	**	0.57536804	0.23111189

Both SVM^{GC} and SVM^{BR} are trained on the whole sample (42 healthy and 42 non-healthy firms).
Since the generated SVMs are unidimensional, the support vectors are reduced to scalars. The mean of support vectors generated by each SVM $\in SVM^{GC}$, denoted with SVM^{GC}_j for $j = 1, ..., 14$, can be interpreted as the threshold value used by the auditors to issue a GCO; whereas the mean of support vectors generated by each SVM $\in$ SVMBR, denoted with SVM^{BR}_j for $j = 1, ..., 14$, can be interpreted as the threshold value under (above) which a firm will go (will not go) bankrupt.
The distances between SVM^{GC}_j and SVM^{BR}_j for $j = 1, ..., 14$, are normalized between 0 and 1, where a value close to 0 means low distance whereas a value close to 1 indicates a great distance. Table 6 shows that such a distance is always very close to 0.

5.4 Adaboost meta-classifier

To answer our RQ2:

Are financial ratios useful in predicting the risk of bankruptcy?

we appeal to an Adaboost meta-algorithm.
Adaboost has been first proposed by Freund and Schapire (1995) and is widely considered one of the best statistical classifier (Wu et al., 2008). The main idea behind Adaboost is to combine multiple classifiers, called weak learners, in a unique classifier through their weighted linear combination.

Table 6: Distances between SVM^{GC} and SVM^{BR}	
Cash Flow Sales T-3	0.000600252
Cash Flow Sales T	0.0003689
Net Income Available To Common T	1.21E-0(
Operating Income T-2	1.24E-0(
Operating Income T-1	1.14E-0(
ROE T-3	0.0006160
ROA Net Income / Total Asset T	3.98174E-(
ROI Ebit / Total Asset T	4.3159E-(
ROS T	0.000469
Short Term Debts / Total Assets T	0.0002268
Total Debts / Total Assets T	0.0001659
Total Shareholder Equity / Total Assets T	4.85188E-(
Net Debts / Total Assets T	0.0001678
Other Liabilities / Total Assets T	6.79433E-(

We trained Mx4 SVMs, one for each feature of the dataset, on 50% of the sample using as label vector y^{BR}. SVMs built are used as weak learners in the Adaboost. Adaboost is trained on the same subsample used to train SVMs.
The predictive capability of Adaboost is tested on the 50% of the sample not used to train the algorithm.

Table 7: Auditors and Adaboost performances comparison[4]		
Section 1		
Auditors Global Performance	0,538	
Adaboost Global Performance	0,75	
Section 2		
	Chapter 11	**Non-Chapter 11**
GCOs according to *auditors*	0.095	0.012[1]
Unqualified according to *auditors*	0.905[2]	0.988
Section 3		
	Chapter 11	**Non-Chapter 11**
GCOs according to *Adaboost*	0.619	0.125[1]
Unqualified according to *Adaboost*	0.381[2]	0.875

[1]Error type 1
[2]Error type 2

Results show that Adaboost is able to correctly classify 75% of submitted examples. Table 7 shows results in greater detail and proposes a comparison of Adaboost's with auditors' bankrupt predictive capability.

[4] the elaboration in table 7 is referred to the 4 years preceding the issuance of the GCO.

Defining Global Performance as the ratio of correctly classified instances over the total amount of instances submitted, Adaboost outperforms auditors (75% versus 53.8%).
More in detail, auditors perform better on healthy firms, wrongly classifying about 1% of instances versus a 12.5% error rate of Adaboost classifier (error type 1). About firms which filed for Chapter 11, Adaboost strongly outperforms auditors. Its error rate (error type 2) is much lower than that of the auditors (38.1% versus 90.5%). It is important to underline that results could be influenced by sample size and composition.
In order to answer our RQ3:

Is the audit opinion helpful in predicting the risk of bankruptcy?

In addition to the above mentioned global analysis (on both samples), we now focus our attention on the only Chapter 11 filing firms that received a GCO. By means of such an analysis, we can observe that only 10 out of 42 firms (24%) received at least a GCO (table 4).
Interestingly, 8 firms out of 10 received a GCO just one or a few years before the filing for Chapter 11; the remaining 2 firms received a GCO quite far from the filing for Chapter 11 . Only for 6 firms the auditors perceived a pervasive and systematic risk of bankruptcy, issuing GCOs for more than one year .
Moreover, on the 76% (32 firms out of 42) of Chapter 11 filing firms, the audit firms commit the error of type 2, as they did not issue a GCO for them.
Other considerations could arise looking at table 6. The distance between SVM^{GC}_j and SVM^{BR}_j for each significant ratio, is always very close to 0. This means that for those ratios, the threshold values used by auditors are close to the threshold values useful to predict the risk of bankruptcy.

6. Conclusions

The present study reveals some interesting findings regarding the reliability of audit opinions as bankruptcy predictors. The percentage of Chapter 11 filing firms that received at least a GCO by audit firms is quite low (24%) and this evidence suggests that the reliability of auditors in predicting bankruptcy is quite low. In order to deepen this evidence and to answer our research questions, we carried out some further investigations using statistical methods.
Regarding the RQ1 we found out, through a Logit regression model, which are the ratios deemed relevant by auditors for issuing or not a GCO. The financial ratios mostly correlated to the issuance of a GCO are: cash flow/sales, short term debts/total assets, total debts/total assets, net debts/total assets, other liabilities/total assets, total shareholder equity/total assets, net income available to common, operating income, ROE, ROA, ROI and ROS.

About the RQ2, an Adaboost meta-classifier shows that financial ratios could be useful in warning the risk of bankruptcy. Adaboost, analyzing the financial ratios, is able to properly classify 75% of firms.
These results allow us to better answer our RQ3, even if the reliability of audit opinions in predicting the risk of bankruptcy seems to be quite low, due to an high rate of error type 2 (76% only considering Chapter 11 firms and 46.2% considering both Chapter 11 and non-Chapter 11 firms), the results from SVM show that auditors take into consideration the right threshold values for each ratio. These evidences highlight that auditors are reluctant to issue GCO, maybe to avoid self-fulfilling prophecy problems or to comply with the management plans for the future. The partial failure of the auditors in predicting the risk of bankruptcy could be due to the further information the auditors rely on, aside from financial and economic ratios, in supporting their audit opinion. The scant predictive ability of auditors might also be due to critical relationships with distressed clients, as suggested by some recent literature streams, or to the kind of responsibility that auditors feel to hold.
We are aware that a systemic analysis of annual report ratios and external factors such as financial crisis and regulations, is necessary to better validate our results. We consider necessary, as well, that professional associations and academics clarify whether the external auditors have or not the responsibility to forecast the success or the failure of the management's business plans and to proper predict the risk of bankruptcy, especially for listed firms. Stakeholders rely on auditor's opinion in performing their economic decision making process and thus, when auditors fail to highlight a warning signal, strong concerns about the effectiveness of the audit opinion do arise.
Some limitations of our study could arise from the features of the sample, even if it represents the universe of US financial listed firms which filed for Chapter 11 between 2002 and 2011.

7. Suggestions for future researches

Further interesting researches could arise from our analysis. An interesting step forward could be attempted splitting the results for Big4 and non-Big 4. The behavior of audit firms in issuing GCO could result different according to the size of the audit firm and the reliability of their opinions as bankruptcy predictors could be different as well.
Because the risk of bankruptcy is an interesting matter for all the developed world, an attractive research could be carried out extending the sample to other countries. The comparison could allow to find out if auditors have the same predictive capabilities in each part of the world and if factors do exist that could affect the predictive capability of auditors (e.g. a more stringent regulation).

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Appendix

Ratio[5]	**Description**
Cash flow/sales	The sum of net income and all non-cash charges or credits/net sales or revenues
Increase decrease in cash and short term investments	The change in cash and short term investments from one year to the next. This item is available only when the statement of changes in financial position is based on cash and short term investments
Convertible debt/total assets	The total amount of a company's long term debt which can be converted into common or preferred stock at a set rate and at a set date
Short term debts and current portion of long term debt/total assets	Portion of debt payable within one year including current portion of long term debt and sinking fund requirements of preferred stock or debentures
Total debts/total assets	All interest bearing and capitalized lease obligations. It is the sum of long and short term debt
Total liabilities/total assets	All short and long term obligations expected to be satisfied by the company
Total shareholder equity/total asset	The sum of preferred stock and common shareholders' equity
Decrease in investments	The investments sold during the accounting period of the company
Increase in investments	The investments bought during the accounting period of the company
Discontinued operations/total assets	The earnings of a division or segment of business that the company wants to discontinue or dispose of in the near future. Discontinued operations is treated as an extraordinary charge or credit when the per share amount includes disposal
Long term borrowings/total assets	The amount received by the company from the issuance of long term debt, (convertible and non-convertible), increase in capitalized lease obligations, and debt acquired from acquisitions
Long term debts/total assets	All interest bearing financial obligations, excluding amounts due within one year. It is shown net of premium or discount
Net debts/total assets	Total debt minus cash. Cash represents cash & due from banks for Banks, cash for insurance companies and cash & Short term investments for all other industries
Other liabilities/total assets	All other liabilities of the bank besides total deposits, short and long term debt, provision for risks and charges and deferred taxes

[5] All ratios and its measurement are taken from Datastream Thompson Reuters.

Reduction in long term debts	Funds used to reduce long term debt, capitalized lease obligations and includes decrease in debt from the conversion of debentures into common stock
Net income available to common	The net income the company uses to calculate its earnings per share. It is before extraordinary items
EBIT	The earnings of a company before interest expense and income taxes. It is calculated by taking the pre-tax income and adding back interest expense on debt and subtracting interest capitalized
Net sales or revenues	Gross sales and other operating revenue less discounts, returns and allowances
Operating income	The difference between sales and total operating expenses
Equity in earnings	Portion of the earnings or losses of a subsidiary whose financial accounts are not consolidated with the controlling company's assets
ROA	Return on asset
ROS	Return on sales
ROI	Return on investment
ROE	Return on equity