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External audit and bankruptcy prediction

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Abstract In this paper, we investigate the relationship between external auditor characteristics and the likelihood of bankruptcy. We use a sample of US public companies to analyse whether auditor attributes are associated with default. We also test whether the inclusion of such attributes in bankruptcy prediction models improves their predictive ability. We find that firms audited by industry-expert auditors, large audit firms and long-tenured auditors are less likely to default. Firms with higher audit fees are more likely to default. Our results also show that the inclusion of auditor attributes significantly increases the predictive ability of bankruptcy prediction models. This paper contributes to the literature about auditing and bankruptcy prediction. Our results suggest that the auditor attributes can provide predictive signals concerning a default risk and that an external audit can play a relevant role in early warnings of financial distress. Our study also suggests that bankruptcy prediction models can become more effective if they are complemented with audit data. Our results are of interest to market participants, auditors, regulating authorities, banks and other financial institutions that are interested in credit risk assessment.

Keywords Bankruptcy prediction · External audit · Auditor characteristics

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1 Introduction

This paper investigates the relationship between external auditor characteristics and the likelihood of bankruptcy. We supplement Ohlson's (1980) logit model for bankruptcy prediction with auditor attributes to test whether the latter are associated with default and whether the inclusion of such attributes improves the model's predictive ability.

There are several reasons for further research about external audit and bankruptcy prediction. Research has, thus far, paid little attention to the question whether external auditing helps to predict bankruptcy. Certain studies have investigated the relationships between qualified audit reports and financial failure, but have delivered conflicting results. Hopwood et al. (1989) found that bankrupt companies receive a qualified going concern opinion in the year before the default, while Lennox (1999) found that audit reports are not accurate indicators of financial failure. This stream of research only focused on qualified going concern opinions, whereas other auditor attributes can be associated with bankruptcy, especially in the years preceding the bankruptcy and the issuing of a qualified going concern opinion. Such attributes can include fees, size, tenure and industry expertise. The bankruptcy setting is particularly salient for analyses concerning auditors' activities, given the high probability of reputational risk and litigation costs that auditors can incur when reviewing insolvent or financially distressed companies (Robinson 2008; Blay and Geiger 2013).

Another reason for further research on this topic arises from the bankruptcy prediction literature. Standard, accounting-based bankruptcy prediction models only use financial ratios and studies have found that their predictive ability has dwindled in the last decades (Beaver et al. 2005, 2012). Hence, researchers argue for additional explanatory variables to be included in the models (Agarwal and Taffler 2008; Beaver et al. 2012). The decline in predictive power is attributed to factors such as the perception of investors and lenders that there is an increase in managerial discretion in fair value accounting environments (such as the US GAAP and the IAS/IFRS) (Beaver et al. 2012). An effective external audit can assure external users in an appropriate way that the financial statements are reliable and that they accurately represent the firm's performance and financial position (Bratten et al. 2013).

We analyse a sample of U.S. firms for the period 1992–2014. We supplement Ohlson's (1980) logit model for bankruptcy prediction with auditors characteristics. The model includes the most common financial ratios, which were applied in prior bankruptcy literature (Bellovary et al. 2007; Altman et al. 2015). We complement the model with the following auditor attributes: fees, size, tenure and industry expertise. To the best of our knowledge, no prior research has yet tried to supplement a standard bankruptcy prediction model with audit data to test for possible associations, as well as an increase in predictive ability. We also analyse our model's accuracy by using a table classification approach and a receiver operating characteristic (ROC) curve to assess whether auditor attributes improve the predictive ability of Ohlson's (1980) model. As a robustness check, we also control for Altman's (1968) Z-Score.

Our findings show that auditor features are significantly associated with bankruptcy. The likelihood of bankruptcy has a positive association with audit fees. Firms with long-tenured auditors, large auditors or industry expert auditors are less likely to fail. We conducted additional analyses by dividing our sample into two periods, that is before and after the implementation of the SOX regulation, which mandated tighter requirements to safeguard auditor independence and effectiveness. The results show that the auditors' features have stronger associations with the likelihood of default after the implementation of the SOX requirements.

Our paper can contribute to the auditing literature. All in all, our findings suggest that the auditors' features can signal financial distress and default risk. External investors and lenders can offer a lower cost of capital to firms that are perceived as better audited. This can decrease the likelihood of a default. Our findings also suggest that auditors can actively prevent a default. Auditors who have more resources and competence, as well as more knowledge about an industry and its firms, can review a firm's internal control system, benchmark its earnings with the industry average and effectively review cash flow forecasts and discount rates. Firms can benefit from auditing activity, for example by making timely decisions to avoid financial distress or to improve their internal control systems.

We also contribute to prior accounting-based bankruptcy studies. Prior literature encourages the use of non-financial variables to improve bankruptcy prediction (Cassar 2011; Altman et al. 2015). Non-financial variables include significant information about the firm and cover non-financial aspects such as external audits, governance mechanisms and management changes. Such variables can be relevant in determining the probability of a firm defaulting in future (Back 2005; Altman et al. 2015). Our study answers this call for research about non-financial variables by showing how auditor characteristics affect a firm's default risk. Our results show that the inclusion of external audit features increases the predictive accuracy of Ohlson's (1980) bankruptcy prediction model by reducing the misclassification of bankrupt firms as non-bankrupt firms. Our study supports the view that non-financial variables can have relevant predictive ability and makes suggestions for future research concerning firms' other non-financial features.

The existing bankruptcy literature typically uses an analysis over a short period of time based on 1-year predictions (Altman et al. 2015). Bankruptcy scholars suggest that longer time series should be used to make more robust predictions (Campbell et al. 2008) Following this suggestion, we use panel data with a long time series and we provide evidence that our model, supplemented with external audit variables, has long-term predictive accuracy.

Overall, our findings have policy implications, which regulatory authorities, investors and lenders will find interesting. Firstly, regulatory authorities can find our study useful, because it indicates that increased audit quality, which is mandated by law, brings about a more effective review of the firm's financial distress conditions and signals default risk to investors and lenders. This supports, for example, the rationale that underlies recent regulations in the European Union, which strengthen the auditors'role to issue early warns of financial distress. Secondly, our research suggests that banks, investors and financial institutions can consider external audit

measures for their credit rating systems, which are based on an estimated probability of default in future.

The remainder of the paper is structured as follows: In Sect. 2 we review the the literature and develop our hypotheses, in Sect. 3 we explain the research methodology, Sect. 4 contains the empirical findings and the paper ends with a discussion, as well as conclusions (Sect. 5).

2 Literature review and hypothesis development

The research suggests that external auditors play a key role in ensuring reliable financial reporting (Dechow et al. 2010; Bratten et al. 2013). By helping to mitigate misstatements and discretionary accruals, an effective audit plays a crucial role in providing the necessary assurance (Balsam et al. 2003). Mansi et al. (2004) suggest that auditors play an information role and an insurance role for the benefit of investors and bondholders. As information providers, auditors independently verify the financial statements, which are prepared by managers. As insurance providers, auditors can be sued in terms of security laws and indemnify users of financial reports against incorrect audits.

Based on this premise, certain studies have investigated the relationships between qualified audit reports and financial failure (Hopwood et al. 1989; Lennox 1999; Geiger et al. 2005). Users of financial reports, legislators and members of the public expect auditors to issue effective early warnings about pending client defaults in the form of qualified audit opinions (Geiger et al. 2005). Accordingly, Hopwood et al. (1989) studied a sample of U.S. companies and found that bankrupt companies are more likely to receive a qualified going concern opinion in the year before a default. Studying a UK sample, Lennox (1999) found that audit reports are not accurate indicators of financial failure, since the majority of failed companies received an audit opinion without any going concern qualification.

Geiger et al. (2005) explain that the association between bankruptcies and audit opinions can vary according to the regulative framework for auditor reporting. They find that, in 2002 and 2003, bankrupt companies are more likely to have received a qualified going concern audit opinion prior to the default than in 2000 and 2001. They explain this with reference to public opinion and pressure groups, as well as the more stringent regulation of audit firms in terms of the Sarbanes–Oxley Act (SOX 2002).

To date, the literature has not investigated whether auditor characteristics are associated with bankruptcy and whether they can be used to predict a default. External auditor characteristics can be predictive of future defaults. We focus on four key auditor attributes: fees, size, tenure and expertise.

According to the audit risk model, auditors charge higher audit fees to riskier clients, due to a higher probability of litigation and reputational risks (Hogan and Wilkins 2008). Following this assumption, certain studies found that auditors charge higher fees to firms with internal control deficiencies (Hogan and Wilkins 2008). Similarly, Hoitash et al. (2005) document that higher audit fees are charged to firms that disclosed material weaknesses. Abbott et al. (2006)

found that firms that engage in income-increasing earnings management pay higher audit fees. Geiger and Rama (2003) found that financially stressed companies pay higher audit fees. Following these studies, we hypothesise that auditors charge higher fees to companies that are more likely to go bankrupt. The higher audit fees are motivated by the higher probability of litigation and reputational risk, which are associated with financially distressed firms (Hogan and Wilkins 2008). The higher fees also relate to the additional effort it takes to review financial reports, which are closely scrutinised by investors and lenders (Geiger and Rama 2003). We formulate the following hypothesis.

H1 Audit fees are positively associated with the likelihood of bankruptcy.

The literature suggests that large auditors deliver more effective and higher-quality auditing services than small audit firms. Large auditors have more resources, more comprehensive skills and a bigger capacity to audit according to specific measurements. Large auditors can also offer non-audit services such as audits of employee benefit plans, due diligence investigations related to mergers and acquisitions, internal control reviews, as well as consultations concerning financial and tax planning (DeAngelo 1981; Palmrose 1986; Kim et al. 2003; Behn et al. 2008). Several empirical studies have therefore found that firms, which are audited by large auditors, have lower discretionary accruals (Francis et al. 1999; Kim et al. 2003) or are less likely to be involved in financial fraud (Farber 2005). Overall, financial markets perceive firms that are audited by large auditors, as having more credible earnings (Behn et al. 2008). As a result of this assurance to the market, firms, which are audited by large auditors, benefit from lower ex ante capital costs (Khurana and Raman 2004) and lower debt costs (Gul et al. 2013).

Based on the abovementioned studies, we hypothesise that large auditors are negatively associated with the likelihood of bankruptcy. There are several reasons for this hypothesis. Firstly, large auditors have the competences and skills to issue early warnings about financial distress situations and are better equipped to effectively consult on how to handle it (Geiger et al. 2005; Behn et al. 2008). Secondly, investors and external lenders perceive firms that are audited by large auditors as less risky and as having more credible financial reporting capabilities, thereby enabling these firms to benefit from lower capital costs, lower debt costs and being better able to handle financial distress situations (Khurana and Raman 2004; Gul et al. 2013). Thirdly, large auditors are better equipped to review complex measurements that require, for example, cash flow forecasts, goodwill impairment or evaluations of financial assets. Large auditors can therefore deliver superior audits concerning fair value measurements (Bratten et al. 2013). Fourthly, another argument that supports the notion of firms audited by large auditors being less likely to go bankrupt, relates to the selection of clients by the large (Big-X) auditors. Big-X auditors are more likely to select large, solvent and profitable firms that are able to pay for their premium services (Lawrence et al. 2011). Such firms can be less likely to fail ex ante. Furthermore, large auditors can avoid riskier firms to mitigate possible reputational costs related to troubled firms and bankruptcies.

Based on the abovementioned arguments, we expect that the presence of a Big-X firm can establish a prediction perspective whereby it signals a lesser likelihood of failure by bankruptcy. We formulate the following hypothesis.

H2 Firms audited by large auditors are less likely to go bankrupt.

For a long time, regulators have been concerned about the effect of audit-firm tenure on audit effectiveness (Chen et al. 2008). On the one hand, as audit-firm tenure lengthens, auditors are more likely to become familiar with the client firm's management and, consequently, more lenient about accounting and reporting decisions. On the other hand, audit-firm tenure enables an auditor to understand the client firm better and more comprehensively. According to this perspective, audit effectiveness improves as audit-firm tenure lengthens. Several empirical studies have found that audit-firm tenure does not impair independence and it does not negatively impact on financial-reporting reliability (Gul et al. 2009; Knechel and Vanstraelen 2007). For instance, Carcello and Nagy (2004a) found that financial frauds are more likely to occur in the first 3 years of an auditor's appointment. Myers et al. (2003) found that longer tenures are associated with decreased earnings management, as well as extraordinary and special items.

Mansi et al. (2004) found that audit-firm tenure is negatively associated with debt financing costs. They found that investors require lower rates of return as tenure lengthens. This association is also significant for firms with non-investment grade debt. Mansi et al. (2004) conclude that longer tenures reduce the information asymmetry between auditors and clients, thereby enabling a better audit. In turn, a better audit results in lower capital costs.

Following the abovementioned arguments, we contend that, due to lower information asymmetry and a deeper knowledge of the firm, long-tenured auditors are better able to issue early warnings to firms that are at risk of default(Mansi et al. 2004). Such early warning activities can match more effective consultancy services, for example, about debt restructuring and debt covenant negotiations. Early warnings also force managers to make timely decisions to avoid a default (for example, anticipating a turnaround, a review strategy or a debt restructuring). Due to better auditor scrutiny, investors and lenders can be more willing to help companies in financial distress. We therefore formulate the following hypothesis.

H3 Audit-firm tenure is negatively associated with the likelihood of bankruptcy.

The literature suggests that industry specialist auditors deliver more effective audits (Balsam et al. 2003; Krishnan 2003; Reichelt and Wang 2010). Industry specialist auditors create an internal database with industry-specific best practices, which they use in their audit activities (Reichelt and Wang 2010). Krishnan (2003) argues that industry experts are better able to evaluate whether a provision for warranties are reasonable and consistent with industry standards. Francis (2011) claim that auditors, which audit multiple firms within a single industry, can be in a better position to compare accruals. In this way, industry specialist

auditors can create industry-based audit practices and routines. Empirical studies found that firms, which are audited by industry specialist auditors, have lower discretionary accruals (Krishnan 2003; Reichelt and Wang 2010). Carcello and Nagy (2004b) found that industry specialisation is negatively associated with clients committing financial fraud. Industry specialist auditors can detect errors more accurately (Owhoso et al. 2002). Balsam et al. (2003) found that an auditor's industry specialisation is positively associated with the earnings response coefficient (ERC) and the predictability of future cash flows.

We argue that industry specialist auditors can help to reduce the likelihood of bankruptcy. Industry experts can, at an early stage, identify whether and how a firm's accruals and earnings deviate from industry trends. They can compare the accruals and earnings of similar client firms that they are auditing. Such early assessments can prompt a firm's management to make timely decisions (for example, when they anticipate a turnaround, revise a strategy or renegotiate debt), thereby reducing the likelihood of a default. Auditors with industry expertise can, at an early stage, indicate whether goodwill impairment will become necessary and they can also issue early warnings about a potential future decrease in a firm's earnings and cash flows. We therefore formulate the following hypothesis.

H4 Auditor industry specialization is negatively associated with the likelihood of bankruptcy.

Based on this association, we postulate that the inclusion of salient auditor features increases the predictive ability of bankruptcy prediction models. Financially distressed firms pay higher fees (Geiger and Rama 2003). Such fees can relate to the additional auditing effort in order to ensure that credible earnings are reported during a crucial period of the firm's life and it can also relate to an auditor's risk of possible future litigation costs related to a default by the client firm. The auditor's fees can, thus, be predictive of a firm's future default. Auditor features such as size, tenure and industry expertise can increase audit effectiveness concerning the early detection of financial distress situations. Large auditors have the skills and competences to issue early warnings and provide consultancy services. They also ensure financial reporting credibility, which can help a financially distressed firm to avoid default, thereby benefiting from lower debt costs (Khurana and Raman 2004; Gul et al. 2013). Even without a causal link, we can expect a lower likelihood of bankruptcy in firms that are audited by large auditors. Large auditors tend to select bigger and more profitable firms that are able to pay for their premium services. Such firms can be less likely to fail (Lawrence et al. 2011). Audit-firm tenure and industry expertise can, for different reasons such as a deeper company-specific understanding or industry specialization, contribute to early warnings of financial distress. Such early warnings can be useful for timely management decisions aimed at avoiding a default. All in all, these considerations lead us to the following hypothesis.

H5 The inclusion of auditor characteristics in bankruptcy prediction models increases their predictive ability.

3 Research design

3.1 Sample selection

Our empirical analysis use data, which is downloaded from the Compustat North America database. To create the sample, we downloaded the financial statement data for active and inactive U.S. firms, which are available on Compustat North America. Compustat specifically provides information about the reasons for a firm's delisting, which we used to identify bankrupt firms. Bankrupt firms are delisted firms that have entered Chapter 11 proceedings (Robinson 2008). Audit Analytics provides information about auditors. The initial sample included 230,765 company-year observations from 1992 to 2014. After matching it with Audit Analytics, we obtained our final sample of 70,959 company-year observations.

3.2 Model specification

To test our hypotheses, we used Ohlson's (1980) bankruptcy prediction model and added the audit-related independent variables.

$$\begin{aligned}\text{Bankruptcy}_{it} = {} & \beta_1 \text{AuditFees}_{it} + \beta_2 \text{Big} - \text{X}_{it} + \beta_3 \text{Tenure}_{it} + \beta_4 \text{Leader}_{it} \\ & + \beta_5 \text{Non} - \text{AuditFees}_{it} + \beta_6 \text{Auditorchange}_{it} + \beta_7 \text{GoingConcern}_{it} \\ & + \beta_8 \text{WC\_TA}_{it} + \beta_9 \text{RE\_TA}_{it} + \beta_{10} \text{Cash\_TA}_{it} + \beta_{11} \text{ROE}_{it} \\ & + \beta_{12} \text{Leverage}_{it} + \beta_{13} \text{Time}_{it} + \text{b}_{14} \text{Industry}_{it} + \varepsilon\end{aligned}.$$

Since the explanatory variables of the bankruptcy prediction equation are neither linear nor normally distributed (Ohlson 1980), we used the logistic regression (the logit model), whereby the dependent variable (Bankruptcy) is binary (1 if the firm is bankrupt and 0 otherwise).

We considered PricewaterhouseCoopers, Ernst and Young, Deloitte, KPMG and Arthur Andersen (until the latter disappeared) as the large auditing firms (Big-X) between 1992 and 2014. The Big-X variable is a dummy and assumes the value of 1 if the auditor is a Big-X auditor or 0 otherwise (Lawrence et al. 2011). We measured audit fees (AuditFees) as the natural logarithm of audit fees (Hogan and Wilkins 2008; Minutti-Meza 2013). We measured audit-firm tenure (Tenure) according to the number of fiscal years that an auditor was in charge of the audit (Myers et al. 2003; Ghosh and Moon 2005; Lim and Tan 2008). Industry expertise (Leader) is a dummy (1 for industry specialists and 0 otherwise). We identified industry specialists as the largest supplier in each industry (classified with SIC two-digit codes), as well as the second and third largest suppliers in industries in which there were readily observable differences between the second and the third largest or between the third largest and the remaining suppliers (Palmrose 1986; Balsam et al. 2003). For every year, we used client sales as the basis to compute the auditor industry share in every two-digit SIC code. We calculated

the latter according to the population of available observations from Compustat (Balsam et al. 2003).

Due to the regulators' concerns that auditors can sacrifice their independence if their clients pay high non-audit fees, we added non-audit fees (Non-AuditFees), which we measured as the natural logarithm of the non-audit fees paid to an auditor, as a control variable (Robinson 2008; Blay and Geiger 2013),. Despite these concerns, academic research found no evidence that non-audit fees are associated with less effective audits. DeFond et al. (2012) found no association between an auditor's propensity to issue a going concern opinion and the amount of non-audit fees received from the client firm. The authors claim that an auditor's market-based incentives, such as risks related to a loss of reputation and litigation costs, largely outweigh the benefits derived from compromising the auditor's independence. Other studies found no associations between non-audit services and restatements (Kinney et al. 2004; Agrawal and Chadha 2005). Recent research analysed the settings of financially distressed firms by narrowing the focus of previous studies and by testing the independence of auditors who provide non-audit services. These studies delivered conflicting results. Robinson (2008) found a positive correlation between non-audit services (for example, tax planning advisory services) and the likelihood of a going concern opinion being issued prior to bankruptcy filings, thereby concluding that non-audit services do not impair auditor independence and can, due to an information spillover effect, improve audit effectiveness in firms that perform poorly. Auditors who also provide consultancy services can, in fact, gain more knowledge about a firm, which they can use in their audit. Blay and Geiger (2013) found that non-audit fees are negatively associated with going concern opinions in financially distressed firms. We therefore thought it would be interesting to incorporate non-audit fees into our model.

We added a control for auditor change (AuditorChange). Firms with a higher risk of default can change auditors for several reasons, including reduced audit fees or audit-opinion shopping to avoid qualified going concern opinions (Davidson et al. 2004). We also added a control for a going concern opinion being issued (GoingConcern). A going concern opinion can be indicative of financial failure (Robinson 2008; Geiger et al. 2005).

The abovementioned comments send a signal to the audit-related variables that auditing is endogenous to bankruptcy. To avoid endogeneity, we use audit-related variables, which are lagged for periods of 1, 2 and 3 years, respectively. We, thus, obtained a robust estimation of how auditing affects bankruptcy. This approach is also consistent with the underlying reasoning of our hypothesis development. If an audit effectively detects financial failure at an early stage or is an overall early indicator, this can be observed in the years that precede the bankruptcy, and not so much in the year of the bankruptcy.

The model includes the most common financial ratios, which are used in bankruptcy studies (Ohlson 1980; Bellovary et al. 2007; Altman et al. 2015). Bellovary et al. (2007) reviewed the bankruptcy studies of the 1930s and identify key financial ratios that are widely used: return on equity (ROE), working capital on total assets (WC_TA), cash on total assets (Cash_TA), retained earnings on total assets (RE_TA) and a firm's leverage (Leverage), which is measured as the financial debt

on total assets. We included these ratios, with dummies, as controls for industry and time effects.

4 Empirical results

4.1 Descriptive statistics

Table 1 reports the descriptive statistics for the external audit variables and the financial ratios,[1] which we used in our analysis. Panel A shows the descriptive statistics for non-bankrupt firms, and panel B that for bankrupt firms. Panel C reports the summary statistics for the entire sample.

The mean of auditor fees (AuditFees) is high for bankrupt firms compared to non-bankrupt firms. On average, audit-firm tenure is lower for bankrupt firms than for non-bankrupt firms. The mean values of the Big-X indicate a higher probability of large auditors auditing non-bankrupt firms than bankrupt firms. Regarding auditor industry expertise (Leader), the non-bankrupt firms showed considerably higher mean values than the bankrupt firms. The summary statistics also show that non-bankrupt firms have a higher average liquidity (WC_TA and Cash_TA) than bankrupt firms, while bankrupt firms are more leveraged (Leverage) than non-bankrupt firms.

4.2 Univariate analysis

Table 2 shows Spearman's rank correlation for dependent and independent variables.

All the explanatory variables, which we used in our analysis, are significantly correlated with the dependent variable. Auditor change is not significantly correlated with bankruptcy proxy (Bankruptcy). Particularly bankruptcy is significantly negatively associated with the external audit variables (AuditFees, Non-AuditFees, Tenure, Big-X, and Leader). These findings suggest that audit quality positively affects the likelihood of bankruptcy.

Concerning the financial ratios, the analysis shows that a lower probability of bankruptcy is associated with higher company liquidity (WC_TA, RE_TA, Cash_TA) and profitability (ROE). In contrast, higher debt is associated with a higher likelihood of a default.

4.3 Multivariate analysis

Column A in Table 3 reports the multivariate regression of our model with audit independent variables, which are lagged for 1 year. The proxy for a qualified going

[1] To avoid the influence of outliers, we winsorised all financial variables used in the analysis at the top and bottom 1%.

Table 1 Descriptive statistics

Variable	Mean	Std. dev.	Min.	Max.
Panel A: External audit variables and financial ratios for non-bankrupt firms				
AuditFees	13.073	1.560	5.991	18.779
Big-X	0.727	0.445	0	1
Leader	0.039	0.195	0	1
Tenure	11.104	5.374	1	23
Non-AuditFees	11.593	1.936	1.386	18.230
AuditChange	0.086	0.281	0	1
WC_TA	0.208	0.211	− 0.076	0.583
RE_TA	− 0.377	0.877	− 2.343	0.367
Cash_TA	0.116	0.110	0.005	0.329
ROE	0.058	0.388	− 0.660	0.962
Leverage	0.580	3.058	0.001	721.55
Panel B: External audit variables and financial ratios for bankrupt firms				
AuditFees	12.815	1.444	8.987	17.034
Non-AuditFees	11.329	1.662	5.991	17.111
Tenure	10.033	4.480	1	22
AuditChange	0.107	0.309	0	1
Big-X	0.625	0.485	0	1
Leader	0.004	0.066	0	1
WC_TA	0.129	0.179	− 0.076	0.583
RE_TA	− 0.622	0.905	− 2.343	0.367
Cash_TA	0.088	0.092	0.004	0.329
ROE	0.062	0.535	− 0.661	0.962
Leverage	0.749	0.495	0.036	5.216
Panel C: External audit variables and financial ratios for total sample				
AuditFees	13.071	1.559	5.991	18.779
Non-AuditFees	11.591	1.934	1.386	18.230
Tenure	11.096	5.369	1	23
AuditChange	0.087	0.281	0	1
Big-X	0.726	0.445	0	1
Leader	0.039	0.194	0	1
WC_TA	0.208	0.211	− 0.076	0.583
RE_TA	− 0.379	0.877	− 2.343	0.367
Cash_TA	0.116	0.110	0.004	0.329
ROE	0.058	0.390	− 0.660	0.962
Leverage	0.581	3.047	0.001	721.55

This table shows the descriptive statistics of the variables, which are included in the model. The sample covers the time period from 1 January 1992 to 31 December 2014. We calculate AuditFees as the natural logarithm of the audit fees. Big-X is the proxy for large auditing firms and we measure it as a dummy variable, which assumes the value of 1 if the auditor is a Big-X audit firm and

Table 1 (continued)

	0 otherwise. We measure Tenure according to the number of fiscal years for which the auditor was in charge of audits. Leader is measured as a dummy variable, which assumes the value of 1 for industry specialists and 0 otherwise. We measure Non-AuditFees as the natural logarithm of the non-audit fees, which is paid to an auditor
	We base the calculation of financial ratios on annual data. We calculate ROE as the net income on ordinary equity, WC_TA as working capital divided by total assets, Leverage as financial debt on total assets, RE_TA as retained earnings on total assets and Cash_TA as cash on total assets. Section 3.2 contains details about the definitions and construction of the variables

concern opinion (GoingConcern) predicts bankruptcy exactly and is discarded by the logit regression. This also happened in the regressions with audit data, which is lagged for 2 and 3 years, respectively, as reported in columns B and C of Table 3. This result suggests that bankrupt firms received a qualified going concern opinion in the years preceding the default. Hence, the issuing of a qualified going concern opinion can be considered as a first step towards bankruptcy.

Column A in Table 3 shows that audit fees (AuditFees), which are lagged for 1 year, are significantly positively associated with bankruptcy (p value < 0.05). If we lag the audit fees further, the association becomes less significant with a lower coefficient when we apply a 2-year lag (0.115 and p value < 0.10 in column B, Table 3) and not significant when we apply a 3-year lag (column C in Table 3). The findings suggest that audit fees increase as a firm gets closer to a default, which is consistent with an increase in audit risk and also with an increase in the auditors' review effort. These findings provide support for H1. Auditors charge higher fees as compensation for their risk and to pay for the additional effort in reviewing firms that approach bankruptcy.

Column A in Table 3 shows that large auditors (Big-X) are negatively associated with financial failure. The coefficient is negative and significant at the 5% level and significant when we use 1-, 2- and 3-year lagged data. These findings strongly support H2. Firms audited by large auditors are less likely to go bankrupt. Large auditors confer credibility to financial statements thereby enabling the audited firms to benefit from lower capital and debt costs. Large auditors also have a thorough set of skills and competences, which can be useful in, for example, fair value measurements such as goodwill impairment or the evaluation of financial assets. This knowledge helps to align asset value with market value and to pick up on a decline in expectations about future cash flows. The findings can also relate to a client firm's characteristics. Large auditors can select large, solvent and profitable firms, which are less likely to go bankrupt, to pay for their value-added services. This does not change the meaningfulness of the findings within a bankruptcy prediction perspective: The presence of a Big-X auditor signals a lower likelihood of failure.

Audit-firm tenure (Tenure) is negatively associated with the likelihood of bankruptcy. The coefficient is significant at the 10% level when we use 1-year (column A in Table 3) and 2-year (column B in Table 3) lagged data. With 3-year lagged data, the coefficient is negative and more significant (column C in Table 3). The findings also suggest that firms, which are audited by long-tenured auditors, are

Table 2 Spearman correlation analysis

	Bankruptcy	AuditFees	Non-AuditFees	Tenure	AuditChange	Big-X	Leader	WC_TA	RE_TA	Cash_TA	ROE	Leverage
Bankruptcy	1											
AuditFees	− 0.0138*	1										
Non-AufitFees	− 0.0138*	0.6662*	1									
Tenure	− 0.0166*	0.3361*	0.1348*	1								
AuditChange	− 0.0062	− 0.1357*	− 0.0983*	− 0.1009*	1							
Big-X	− 0.0197*	0.5339*	0.5072*	0.0466*	− 0.1463*	1						
Leader	− 0.0156*	0.2409*	0.2209*	0.0937*	− 0.0254*	0.1082*	1					
WC_TA	− 0.0334*	− 0.1622*	− 0.1329*	− 0.0428*	− 0.0038*	0.0359*	− 0.1148*	1				
RE_TA	− 0.0375*	0.3886*	0.3526*	0.2765*	− 0.0671*	0.2907*	0.1051*	0.0685*	1			
Cash_TA	− 0.0208*	− 0.1829*	− 0.1718*	− 0.1154*	0.0143*	− 0.0579*	− 0.0950*	0.5663*	− 0.2279 *	1		
ROE	− 0.0199*	0.1472*	0.1104*	0.1050*	− 0.0277*	0.0355	0.0606*	− 0.2029*	0.2865*	− 0.1636*	1	
Leverage	0.0471*	0.2351*	0.1830*	0.0684*	0.0101*	0.0428*	0.1098*	− 0.6038*	− 0.1308*	− 0.3937*	0.2114*	1

This table shows the Spearman rank correlation coefficients for both dependent and explanatory variables included in the analysis

All p values are two-tailed; * the coefficient is significant with p value < 0.05

Table 3 Main findings

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy
L_AuditFees	0.130**		
	(0.0587)		
L_Non-AuditFees	− 0.0292		
	(0.0434)		
L_Tenure	− 0.0196*		
	(0.0109)		
L_Auditchange	0.158		
	(0.164)		
L_BigX	− 0.327**		
	(0.147)		
L_Leader	− 3.272***		
	(0.969)		
L2_AuditFees		0.115*	
		(0.0634)	
L2_NonAuditFees		− 0.0400	
		(0.0476)	
L2_Tenure		− 0.0229*	
		(0.0124)	
L2_AuditChange		0.256	
		(0.171)	
L2_Big-X		− 0.379**	
		(0.158)	
L2_Leader		− 3.119***	
		(0.961)	
L3_AuditFees			0.0535
			(0.0692)
L3_Non-AuditFees			− 0.0146
			(0.0533)
L3_Tenure			− 0.0284**
			(0.0142)
L3_AuditChange			0.238
			(0.185)
L3_Big-X			− 0.401**
			(0.171)
L3_Leader			− 2.988***
			(0.960)
WC_TA	− 1.227***	− 1.484***	− 1.732***
	(0.332)	(0.375)	(0.435)
RE_TA	− 0.216***	− 0.149**	− 0.120
	(0.0653)	(0.0712)	(0.0805)
Cash_TA	− 2.084***	− 2.064***	− 1.672**
	(0.686)	(0.753)	(0.845)

Table 3 (continued)

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy
ROE	− 0.0972	− 0.0721	− 0.0419
	(0.140)	(0.160)	(0.177)
L_Leverage	0.0566***	0.0614***	0.0546***
	(0.0138)	(0.0143)	(0.0143)
Constant	− 4.693***	− 4.289***	− 3.342***
	(1.222)	(1.252)	(1.267)
Observations	51,686	44,712	38,489
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

This table shows the estimated coefficient, which results from the following logit model

Model 1: Bankruptcy = f (audit variables lagged for one period, financial ratio, control variables)

Model 2: Bankruptcy = f (audit variables lagged for two periods, financial ratio, control variables)

Model 3: Bankruptcy = f (audit variables lagged for three periods, financial ratio, control variables)

Robust standard errors in parentheses

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

less likely to fail, thereby supporting H3. The positive effect of tenure is stronger in the years preceding a default (see also how the coefficient grows with 2- and 3-year lagged time periods). Long tenures appear to have fewer benefits than having a large auditor or an auditor with industry expertise.

An auditor's industry expertise (Leader) was strongly negatively associated with the likelihood of bankruptcy in all the regressions (the coefficient is significant at the 1% level in all the columns in Table 3). The findings suggest that auditors with industry expertise can benchmark a firm's accruals and earnings against industry standards and therefore such auditors are able to issue an effective early warning to managers. Such early warnings can enable management to make timely decisions to avoid a default. Industry experts have best practice and audit routine databases and can detect whether or not a firm's accruals and earnings significantly deviate from industry trends.

We considered the control variables and found that the non-audit fees (NonAuditFees) have no significant associations with the likelihood of bankruptcy across the regressions (see columns A to C in Table 3). Auditor change (AuditorChange) is also not significantly associated with bankruptcy. When we use 1-, 2- and 3-year lagged data, the control variables, which relate to financial ratios, show an overall correlation coefficient in the expected direction. The findings in Table 3 (see columns A to C) show that more indebted firms are more likely to default (leverage). Firms that are more likely to fail, have less working capital (WC_TA) and less cash (Cash_TA), which is consistent with dwindling economic

activity and cash flows. They also have less retained earnings (RE_TA), which can be reduced by losses, especially in the year immediately preceding the default.

We performed several robustness checks. We re-ran our regression without Big-X or Leader to ensure that the two variables did not pick up on the same phenomenon. This test was useful, since auditors with industry expertise are also likely to be large auditors. We found that Big-X and Leader are still significant when we use 1-, 2- and 3-year lagged data (not reported). We added delisted firms, which entered Chapter 7 proceedings, to our sample and obtained the same findings (not reported).

We also repeated the analysis by including Altman's (1968) Z-score as a control variable. Following Altman's procedure (1968), we conducted an estimated multivariate discriminant analysis to define the canonical linear function,[2] which best discriminates between the bankrupt and non-bankrupt firms. We added the lagged value of the Z-score to avoid the autocorrelation problem between the dependent variable and the Z-score proxy. Since WC_TA and RE_TA are included in the Z-score calculation, we excluded these control variables from our model. The findings of this robustness check (see Table 4) are consistent with the main analysis.

4.4 Model evaluation

To test whether the inclusion of external audit variables improves the predictive validity of our bankruptcy prediction model, we assessed our model's error rate and compared it with the traditional accounting-based bankruptcy model.

The bankruptcy prediction literature identified two error types. The model can predict that a firm is not bankrupt when, in fact, it is. This error corresponds to the assignment of a high credit score to firms that default (type I error). A type II error occurs when the model misclassifies a non-bankrupt firm as a bankrupt one.

We evaluated the accuracy of our model by using both a table classification approach and a receiver operating characteristic (ROC) curve approach. We used the table classification approach to assess whether our external audit indicators improved the predictive ability of the bankruptcy prediction model and reduced type I errors, which are costlier than a type II errors (Lee et al. 2002). We began by running Ohlson's (1980) model, as well as Ohlson's (1980) model supplemented with auditor characteristics. Next, we defined the classification matrix. Table 5 shows our estimated models' predictive ability.

The sensitivity of a model describes the probability that the model will, given a specified probability (cut-off point) when it is bankrupt, classify a firm as bankrupt. The specificity of a model refers to the probability that the model classifies a firm as non-bankrupt when it is non-bankrupt. Since our panel sample was unbalanced, we adjusted the cut-off point as a percentage of the bankruptcy firm-year observations scaled according to the total firm-year observations in the sample. We used a cut-off point of 0.017 to calibrate the accuracy. In order to better compare our

[2] The discriminant linear function is: $0.51\frac{Working\ capital}{Total\ assets} + 0.30\frac{Retainded\ earnings}{total\ assets} + 0.3\frac{Sales}{Total\ assets} + 0.88\frac{EBIT}{Total\ assets}$ $+0.15\ Market\ to\ book\ value$.

Table 4 Robustness checks

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy	Model 4 Bankruptcy
AuditFees	0.117*			
	(0.0681)			
Non-AuditFees	− 0.0698			
	(0.0464)			
Tenure	− 0.0368***			
	(0.0122)			
Auditchange	− 0.0973			
	(0.204)			
BigX	− 0.520***			
	(0.150)			
Leader	− 2.358***			
	(0.695)			
L_zscore	− 0.00144			
	(0.000949)			
L_AuditFees		0.0891		
		(0.0731)		
L_Non-AuditFees		− 0.0682		
		(0.0494)		
L_Tenure		− 0.0409***		
		(0.0134)		
L_Auditchange		− 0.0648		
		(0.214)		
L_BigX		− 0.430***		
		(0.158)		
L_Leader		− 2.978***		
		(0.969)		
L2_zscore		− 0.00124		
		(0.000923)		
L2_AuditFees			0.0714	
			(0.0795)	
L2_NonAuditFees			− 0.0613	
			(0.0546)	
L2_Tenure			− 0.0487***	
			(0.0155)	
L2_AuditChange			0.0145	
			(0.223)	
L2_Big-X			− 0.460***	
			(0.169)	
L2_Leader			− 2.806***	
			(0.964)	
L3_zscore			− 0.00147	
			(0.00104)	
L3_AuditFees				0.0264
				(0.0871)

Table 4 (continued)

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy	Model 4 Bankruptcy
L3_Non-AuditFees				− 0.0483
				(0.0596)
L3_Tenure				− 0.0552***
				(0.0180)
L3_AuditChange				0.0219
				(0.237)
L3_Big-X				− 0.410**
				(0.184)
L3_Leader				− 2.690***
				(0.961)
L4_zscore				− 0.00182
				(0.00126)
Cash_TA	− 2.524***	− 2.700***	− 3.272***	− 3.536***
	(0.653)	(0.692)	(0.756)	(0.805)
ROE	0.0674	− 0.124	− 0.232	− 0.367*
	(0.167)	(0.180)	(0.192)	(0.214)
Constant	− 4.029***	− 2.815**	− 2.544*	− 1.874
	(0.921)	(1.308)	(1.361)	(1.388)
Observations	36,579	32,636	28,472	24,721
Industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
PctCorr	95.35	95.43	95.45	95.70
Sensitivity	19.09	19.16	18.39	19
Specificity	96.09	96.16	96.16	96.39
AUC	0.708	0.714	0.723	0.732

This table describes the logistic regression coefficients, which are obtained by regressing the bankruptcy score for audit quality proxies (AufitFees, Big-X, Tenure, Leader and Non-AuditFees), Cash_TA, as well as the lagged value of the Z-score (L_zscore). The calculation of all the variables are based on annual data. Zscore is measured by conducting a multivariate discriminant analysis, which provides the canonical discriminant function. Section 3 contains details about the definition and construction of the variables.The last 4 rows of Table 6 illustrate the predictive ability of the estimated models. Pctcorr is the correct classification rate. Sensitivity describes the probability of the model classifying a firm as bankrupt when it is bankrupt. Specificity is the probability that the model classifies a firm as non-bankrupt when it is non-bankrupt. AUC is the value of the area under the ROC curve. This table describes the findings of the following models

Model 1: Bankruptcy = f (audit variables, z-score lagged for one period, financial ratio)

Model 2: Bankruptcy = f (audit variables lagged for one period, z-score lagged for two periods, financial ratio lagged for one period)

Model 3: Bankruptcy = f (audit variables lagged for two periods, z-score lagged for three periods, financial ratio lagged for two periods)

Model 4: Bankruptcy = f (audit variables lagged for three periods, z-score lagged for four periods, financial ratio lagged for three periods)

Robust standard errors in parentheses

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

models' predictive power, we excluded the firms for which the audit proxies were not available.

The classification tables show that the model with audit proxies provided a higher sensitivity rate (lower type I errors) than the models without them. The results specifically provide evidence that the bankruptcy model, which includes the audit indicators, is the best model in terms of sensitivity (71.90%) and specificity (59.39%), thereby indicating that it is particularly suitable for identifying bankrupt firms. Our findings also show that the model, which includes external audit variables, provides a higher overall classification rate (59.48%) than models without audit proxies.

These findings support hypothesis 5, namely that the inclusion of the external audit indicators improves the bankruptcy prediction model's predictive power.

We also tested our models by using an ROC approach. The ROC curve assessed the model's performance over the entire range of possible cut-off points, thereby measuring the trade-off between type I and type II errors (Graph 1 and Graph 2).

The value of the area under the ROC curve (AUC) can be between 0 and 1, where an AUC of 1 corresponds to a perfect model. The AUC for the bankruptcy prediction model, which includes an external audit proxy (0.7271), is higher than the AUC for the model that only includes a financial ratio (0.7114). These results are consistent with the reported findings.

4.5 Further investigations

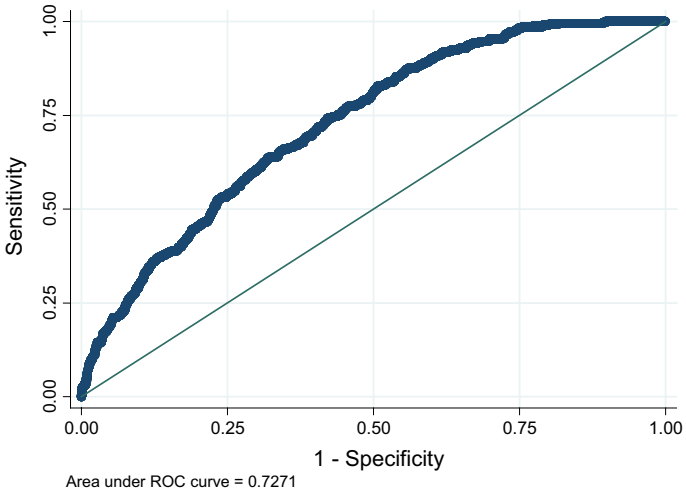
Table 6 shows the results of a further analysis, which we conducted by decomposing auditor change into change types (Davidson et al. 2004). The analysis divides auditor change into changes (1) from a Big-X to a non-Big-X auditor, (2) from a non-Big-X to a Big-X auditor and (3) from a non-Big-X to another non-Big-X auditor (excluding—to avoid collinearity—the change from a Big-X auditor to another Big-X auditor, which is less interesting). These changes can have different origins. The change from a Big-X to a non-Big-X auditor can signal a desire to reduce fees and/or seek a less effective audit, which can be the case for a financially distressed firm.

In contrast, a change from a non-Big-X to a Big-X auditor can signal a desire to obtain more credible financial reporting, which can benefit a company that runs

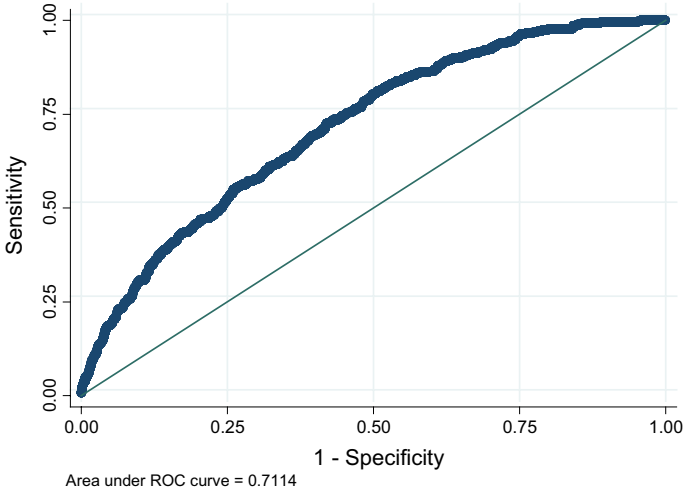
Table 5 Classification tables

	Ohlson's (1980) model (%)	Ohlson's (1980) model supplemented with auditor charateristics (%)
Sensitivity	70.13	71.90
Specificity	58.77	59.39
Correctly classified	58.86	59.48

This table illustrates our estimated models' predictive ability. A model's sensitivity describes the likelihood of the model classifying a firm as bankrupt, given a specified probability (cut-off point) when it is bankrupt. Its specificity is the likelihood that the model classifies a firm as non-bankrupt when it is non-bankrupt



Graph 1 ROC curve with auditor characteristics



Graph 2 ROC curve without auditor characteristics

the risk of a default. A change from a non-Big-X to another non-Big-X auditor can signal audit opinion shopping (Davidson et al. 2004). We did not find significant results, with the exception of a negative association between the change from a Big-X to a non-Big-X auditor and the likelihood of financial failure (see column A in Table 6). This finding suggests that financially distressed firms prefer to retain a large auditor, since the benefits of higher financial reporting credibility and lower capital costs can outweigh the economic advantages of paying reduced fees.

Table 6 Further investigations

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy
L_AuditFees	0.144**		
	(0.0595)		
L_Non-AuditFees	− 0.0299		
	(0.0437)		
L_Tenure	− 0.0194*		
	(0.0109)		
L_NonBigtoBig	0.453		
	(0.422)		
L_BigtoNonBig	− 0.717*		
	(0.425)		
L_NonBigtoNonBig	− 0.184		
	(0.396)		
L_Big-X	− 0.436***		
	(0.153)		
L_Leader	− 3.287***		
	(0.969)		
L2_AuditFees		0.129**	
		(0.0643)	
L2_Non-AuditFees		− 0.0410	
		(0.0480)	
L2_Tenure		− 0.0230*	
		(0.0124)	
L2_NonBigtoBig		0.641	
		(0.425)	
L2_BigtoNonBig		− 0.598	
		(0.427)	
L2_NonBigtoNonBig		0.0515	
		(0.401)	
L2_Big-X		− 0.487***	
		(0.164)	
L2_Leader		− 3.129***	
		(0.962)	
L3_AuditFees			0.0650
			(0.0702)
L3_Non-AuditFees			− 0.0149
			(0.0538)
L3_Tenure			− 0.0281**
			(0.0142)
L3_NonBigtoBig			0.599
			(0.468)
L3_BigtoNonBig			− 0.462
			(0.429)

Table 6 (continued)

Variables	Model 1 Bankruptcy	Model 2 Bankruptcy	Model 3 Bankruptcy
L3_NonBigtoNonBig			− 0.0863
			(0.473)
L3_Big-X			− 0.504***
			(0.178)
L3_Leader			− 2.997***
			(0.960)
WC_TA	− 1.201***	− 1.462***	− 1.713***
	(0.333)	(0.376)	(0.436)
RE_TA	− 0.214***	− 0.144**	− 0.115
	(0.0652)	(0.0706)	(0.0804)
Cash_TA	− 2.073***	− 2.037***	− 1.650*
	(0.687)	(0.753)	(0.848)
ROE	− 0.0998	− 0.0705	− 0.0406
	(0.140)	(0.160)	(0.178)
L_Leverage	0.0564***	0.0606***	0.0540***
	(0.0138)	(0.0142)	(0.0143)
Constant	− 4.797***	− 4.383***	− 3.432***
	(1.226)	(1.257)	(1.271)
Observations	51,686	44,712	38,489
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

This table illustrates the estimated coefficient, which is obtained by decomposing auditor change into change types. The analysis divides auditor change into changes from a Big-X to a non-Big-X auditor (BigtoNonBig), from a non-Big-X to a Big-X auditor(NonBigtoBig) and from a non-Big-X to another non-Big-X auditor (NonBigtoNonBig). This table describes the findings of the following models -

Model 1: Bankruptcy = f (audit variables lagged for one period, divided audit variables lagged for one period, financial ratio, control variables)

Model 2: Bankruptcy = f (audit variables lagged for two periods, divided audit variables lagged for two periods, financial ratio, control variables)

Model 3: Bankruptcy = f (audit variables lagged for three periods, divided audit variables lagged for three periods, financial ratio, control variables)

Robust standard errors in parentheses

***$p < 0.01$; **$p < 0.05$; *$p < 0.1$

We also explore the effect of the Sarbanes–Oxley Act (SOX), which was issued in July 2002. The SOX was fully implemented in 2004 and included several key provisions for the auditor activity. The SOX established the Public Company Accounting Oversight Board (PCAOB), which independently oversees firms that provide audit services. The PCAOB issued specific procedures, policies and quality control

mechanisms concerning audit activity. The SOX implemented more stringent conditions to ensure auditor independence in respect of the new requirement of auditor approval, more frequent audit partner rotation, as well as auditor reporting requirements and limitations for non-audit consulting activities. In terms of Section 404(b), an auditor must do a preliminary assessment to establish the adequacy of the client firm's internal controls over financial reporting, which must be disclosed to third parties.

The findings show that, in the pre-SOX period, industry specialization was the audit feature that had more impact on the probability of default (not reported). In the post-SOX period, several auditor characteristics display stronger and more significant associations with bankruptcy compared to the pre-SOX period and the full sample.

The findings also shows that, after the implementation of SOX, audit-firm tenure has a negative higher coefficient and is more significant than in the pre-SOX period and the full sample. The negative association between audit-firm tenure and the probability of default is still highly significant when we use 2- and 3-year lagged data. This result can suggest that, in the post-SOX period, longer tenures enable better audits to a wider extent. This is consistent with the SOX requirement related to the auditors' annual review of their client firms' internal control systems over financial reporting and also leads to an overall deepening of their knowledge about the firms (Myers et al. 2003; Manry et al. 2008). In the post-SOX period, firms that are audited by large auditors are significantly less likely to default. The negative association between auditor size and the likelihood of bankruptcy is significant, also when we use 2- and 3-year lagged data. These findings suggest that the Big-X effect is more pronounced in the post-SOX period. In the post-SOX period, Arthur Andersen ceased to exist and PriceWaterhouse merged with Cooper&Lybrand. The number of large auditors decreased and the average audit quality of large auditors possibly improved. Our analysis also finds that bankrupt firms are always not audited by industry experts and the industry specialization proxy is thus omitted in the regression. The findings suggest that industry leadership is important to auditors in both the pre- and post-SOX periods.

All in all, the additional analyses concerning the pre- and post-SOX periods suggest that more stringent regulation of the audit activity can improve audit quality. In fact, SOX rules impose more stringent control over audit activity, as well as stricter rules on auditors' independence and additional audit tasks (that is, the review of the firm's internal controls over financial reporting). Improved audit quality can result in the auditor playing a more relevant role during the review of conditions related to a firm's financial distress and also in the assurance given to investors and lenders. Auditor attributes thus assume a more significant signalling role in predicting a default.

The caveat to this study is that, due to the limited availability of Audit Analytics data in the 1990s, the pre-SOX period contains less observations than the post-SOX period.

5 Discussion and conclusions

In this paper, we explore the association between auditor characteristics and the likelihood of bankruptcy. We supplement Ohlson's (1980) bankruptcy prediction model with auditor fees, size, tenure and industry specialization. Our analyses provide evidence that auditor characteristics are predictive signals of financial default. Our findings also suggest that auditor attributes can be applied to increase the predictive ability of default prediction models, which are used in academic research and in practice.

Our paper contributes in several ways to audit-related literature. Prior research about auditing and financial distress only focused on qualified going concern opinions. We show that, in the years preceding a default, several auditor characteristics are associated with bankruptcy. Our findings suggest that firms, which are audited by large auditors, are less likely to default. Big-X auditors are probably more likely to select solvent client firms who are able to pay for their services in the long term. Large auditors are also better equipped with knowledge and competences to deliver quality audits (Bratten et al. 2013). External investors and lenders perceive firms, which are audited by large auditors, as having more credible earnings and as being less risky. For this reason, such firms benefit from lower borrowing costs and also from investors who expect lower returns. They are also less likely to commit a default (Khurana and Raman 2004; Gul et al. 2013).

Our paper contributes to the academic debate about audit-firm tenure by suggesting that tenure does not impair independence and that it does not imply lower financial reporting reliability (Gul et al. 2009; Knechel and Vanstraelen 2007). Our findings support the view that investors and lenders perceive long-tenured auditors as being more effective, due to their deeper knowledge of the firm. For this reason, firms with long-tenured auditors can benefit from a lower cost of capital and they are less likely to default (Mansi et al. 2004).

Our research provides evidence that auditor industry specialization is associated with a lower likelihood of bankruptcy. The auditing literature claims that industry specialization results in higher financial reporting reliability, lower earnings management and less financial frauds (Reichelt and Wang 2010). Industry expert auditors can benchmark accruals, earnings, cash flow projections and discount rates according to industry averages. This activity ensures that reliable financial statements are prepared while knowledge is simultaneously it transferred to the audited firm. This knowledge can prompt management to make timely decisions, thereby helping firms to prevent financial distress and improve their internal control systems. Auditor activity can be useful, for example, for turnaround strategies or debt restructuring, as well as reviews of cash flow forecasts and debt contracts (Geiger et al. 2005).

Our paper also contributes to studies about bankruptcy prediction. We responded to a call for the inclusion of additional non-financial explanatory variables in bankruptcy prediction models (Altman et al. 2015) to show that external audits have financial default predictive power. We also show that the inclusion of auditor attributes enhances the predictive accuracy of Ohlson's prediction model. The results

indicate that our model has strong predictive power and can accurately discriminate—over a long period of time—between bankrupt firms and solvent firms. Thus, other non-financial information about a firm can effectively complement the financial ratios, which are commonly used(Altman et al. 2015; Back 2005).

Overall, our findings have practical implications and can be of interest to banks and financial institutions. Banks and financial institutions (such as rating agencies, investment funds and pension funds) use bankruptcy prediction models—which closely follow those known in the scientific literature—for their credit ratings. The entire lending and investment strategy is based on such ratings. Therefore, an improvement in the predictive ability of credit rating and bankruptcy forecasts enhances the proper allocation of financial resources and reduces the costs of misclassifying bankrupt firms as solvent firms (type I errors), which result in investment losses and an increase in the banks' non-performing loans. The reduction of type I errors is a key objective for banks, since these are much costlier than type II errors (solvent firms misclassified as firms that default).

The European banking system is particularly interested in the results of this project, because huge credit rating systems are routinely used for the daily financing operations that concern private firms. The advantage of a proper allocation of financial resources and the reduction of non-performing loans yield benefits for the overall economy and the financial markets.

Our research also has implications for authorities interested in auditing regulation. After dividing our sample into a pre-SOX and a post-SOX period, we show that more stringent regulations for auditors significantly increase the impact that an audit has on the likelihood of default. The SOX requirements, coupled with PCAOB supervision, produce higher audit quality (Bratten et al. 2013). Improved audit quality can result in a more relevant role for the auditor during reviews of conditions related to a firm's financial distress and in the assurance given to investors and lenders. Our study supports the European Union's recent regulations for a new approach to business failure and insolvency (EU 2014). The European Union 2014/135/EU recommendation formally tasks the auditor to issue early warnings of potential financial distress situations. The auditors must immediately communicate all the indicators of financial distress to the firm's management and also to the relevant authorities (for example, the tax authorities and financial market regulatory authorities). This directive prompts the auditor to play an active role in the prevention of financial defaults.

Our study also supports the notion that regulatory activities, supervision by authorities and the development of auditing standards are crucial to the work of auditors. The development of auditing standards, coupled with the evolution of accounting rules, also plays a crucial role in preventing audit activities from being determined in a negotiation between the auditor and its client firm, as was the case in the pre-SOX years.

This study has certain limitations. We used a U.S. sample. It can be worthwhile to replicate the study in an IAS/IFRS accounting environment and in other bankruptcy law settings (for example, continental European settings). Another limitation, which this study shares with all the studies about accounting-based bankruptcy prediction models, is that we do not pay attention to earnings management (Agarwal

and Taffler 2008). Firms that engage in earnings management, have distorted financial ratios. Future research can investigate whether earnings management influences bankruptcy prediction and whether an external audit plays a moderating role. We acknowledge that audit fees can be indicative of other conditions besides the risk of financial default, for example, the firm's internal control weaknesses, and that it can, therefore, be an imperfect proxy. However, the audit fees proxy for the overall audit risk includes the default risk. Finally, we do not investigate whether the use of highly subjective fair value measurements improves or impairs the ability of accounting-based bankruptcy prediction models. Future research can investigate this topic. Future research can also investigate—in depth—how the rotation of audit partners can influence the likelihood of bankruptcy.

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