# Do auditors' opinions, industry factors and macroeconomic factors signal financial distress? Evidence from Taiwan

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## Abstract

This study investigates the usefulness of auditors' opinions, macroeconomic factors, and industry factors in predicting bankruptcy based upon a sample of public firms in Taiwan. Auditors' opinions examined include going concern", "consistency", "contingency" (uncertainty), "long-term investment audited by other auditors" ("other auditor"), and "realized investment income based on non-audited financial statements" ("no auditor"). Macroeconomic factors assessed consist of currency (M1b) supply change ratio, 1-year depositary interest rate change ratio, and consumer price index change ratio. We also study the impact of electronic industry factor given electronic industry constitutes a vital part of Taiwan economy.

Our major empirical results are consistent with general bankruptcy literature and the unique nature of Taiwan economy. First, in addition to auditors' "going concern" opinions, "other auditor" is also found to be a significant bankruptcy predictor. Due to auditors' being lack of knowledge and tendency of sharing litigation risk, investment income audited by other auditors tend to have lower earnings quality and firms with such income items are more likely to fail. Secondly, higher currency supply and higher consumer price index are signals of better macroeconomic environment, in which the likelihood of bankruptcy is reduced. In contrast, higher interest rate imposes more burdens upon firms' cost of raising capital and therefore increases the likelihood of bankruptcy. Thirdly, since electronic firms in Taiwan have lower debt ratios and therefore survival of electronic firms are less likely to be influenced by interest rate fluctuations.

Discrete-time hazard models are developed with different combinations of financial ratios, auditors' opinions, macroeconomic factors, and industry factor. The models' overall goodness-of-fits and out of sample prediction accuracy are compared using various criteria. Overall speaking, the models in incorporation with auditors' opinions, macroeconomic factors, and industry factor perform better than the financial-ratio-only model. More importantly, not only do auditors' opinions, macroeconomic factors, and industry factor contain incremental information beyond financial ratios in predicting bankruptcy, but also they have incremental contribution beyond one another.



Key Words: Financial distress, Auditors' opinion, Discrete-time hazard model, Going concern

# Do auditors' opinions, industry factor, and macroeconomic factors signal financial distress? Evidence from Taiwan

## 1. Introduction

In U.S. economy, the number and the magnitude of bankruptcy filing have been soaring in recent years, which have caused serious wealth loss of investors and creditors. Along with the economy globalization, similar phenomenon is often observed overseas. This calls for developing bankruptcy prediction models based upon not only U.S. data but also foreign data. This study responds to the call by attempting to develop bankruptcy prediction models using Taiwan data. Bankruptcy prediction study in Taiwan economy is interesting and important because Taiwan, in addition to its strong economy, has great success in electronics industry as one of the world's largest supplier of computer monitors and a leading PC manufacturer. Through developing bankruptcy prediction models using Taiwan data, this study particularly focuses on examining the usefulness of auditors' opinions, macroeconomic factors, and industry factor in bankruptcy prediction.

U.S literature on bankruptcy prediction has been well developed since Altman (1968). Various factors have been studied for their usefulness in bankruptcy prediction, including financial accounting information, stock market information, bond rating, etc. Among these bankruptcy predictors, auditors' opinions and macroeconomic/industry factors deserve more investigation due to the following reasons. Although prior literature has examined the usefulness of auditors' opinions in bankruptcy prediction, their empirical conclusions are divergent, i.e., some studies

(e.g., Hopwood, McKeown and Mutchler 1989, Sun 2007) find auditors' opinions are valuable bankruptcy predictors, while others (e.g., Altman and McGough 1974, Koh and Killough 1990) do not. Inconsistency among studies could be due to differences in statistical modeling techniques or sample data used. This calls for additional evidence based upon more advanced statistical techniques and different sources of data, such as non-U.S. data. One part of this study examines the usefulness of auditors' opinions in predicting bankruptcy, based upon discrete-time hazard models and data from Taiwan. Specifically, five types of modified auditors' opinions are studied: "going concern", "consistency", "contingency" (uncertainty), "long-term investment audited by other auditors" ("other auditor"), and "realized investment income based on non-audited financial statements" ("no auditor"). "Going concern", "consistency", "contingency" modified opinions have been studied in prior literature (e.g., Hopwood et al. (1989), Hopwood, McKeown and Mutchler (1994), Sun, Ettredge and Srivatava (2003), Sun (2007)). However, "other auditor" and "no auditor" are novel features investigated in this study. Investment incomes are critical item in income statement in emerging markets, such as Taiwan. In developing countries, the corporate governance and investor protection systems are not as well established as in developed countries. Companies in such less developed economy often invest in their related parties whose financial statements are usually not audited

by independent auditors, and then recognize investment profits under equity method. Since the earnings quality of these non-audited financial statements is questionable, investment profits and earnings for such companies could have been overstated. Furthermore, even if a company's investment income from related parties has been audited by other auditors, risk of overstating investment income is still fairly high. Among other reasons, the company's auditor may not have sufficient knowledge to objectively evaluate the integrity of investment income. Besides, the auditor may not bother to perform a careful audit upon such items, considering the auditor can reduce its litigation risk by signing opinions which state that long term investment is audited by other auditors. Therefore, it is interesting to examine whether "no auditor" and "other auditor" have incremental contribution in predicting bankruptcy in Taiwan.

Unlike firm-specific information, industry-level factors and macroeconomic factors have been rarely studied in bankruptcy prediction literature. In fact, three categories of factors influence a firm's survival. They operate at the firm level, industry level and economy level (Everett and Watson 1998). However, prior bankruptcy prediction models are mostly based upon firm level factors (e.g., financial ratios, stock information), ignoring factors in both the industry and economy levels. In this study, we empirically examine whether the incorporation of industry level factors and macro-economy level factors can enhance the performance of bankruptcy

prediction models. As to macroeconomic factors, we examine: currency (M1b) supply change ratio, 1-year depositary interest rate change ratio, and consumer price index change ratio. Interest rate change ratio is of our special interest because one-year CD interest rate in Taiwan has experienced some dramatic fluctuations in our study period, ranging from 1.4%-9.5%. Such a large magnitude of fluctuation provides an ideal setting to examine the influence of interest rate on companies' credit risk. In regards to industry level factors, we particularly focus on electronics industry because Taiwanese market, as one of the world's leading producer for electronic products including computer monitors, semiconductors, and integrated circuits, provides an excellent setting for studying financial distress in emerging electronics industry.

Our study uses public companies traded on Taiwan stock exchanges from 1986-2005, with year 1986-2004 as the training period and year 2005 as the test period. Bankruptcy (exchangeable with term "financial distress" in the paper) is defined according to definitions provided by Balse Committee on Banking Supervision (2001). Our models are developed using discrete-time hazard model, which has been argued to perform better than static logit model (Shumway 2001). Based upon different combinations of financial ratios, auditors' opinions, industry factors, and macroeconomic factors, various bankruptcy prediction models are developed using the training sample and their prediction accuracies are compared in the test sample.

Our empirical results show that (1) auditors' opinions have incremental contribution in explaining and predicting bankruptcy. Specifically, "going-concern"

and “long-term investment audited by other auditors” (“other auditor”) have significant power. (2) Macroeconomic factors have incremental usefulness in explaining and predicting bankruptcy. In specific terms, increase currency supply and consumer price index reduce the likelihood of bankruptcy, and increase in interest rate increases the likelihood of bankruptcy. (3) Analyses on electronics industry indicate a lower effect of change in interest rate upon the likelihood of bankruptcy in electronic industry. This is primarily driven by the lower debt ratio of electronic companies. Prediction models’ performance can be improved by making the distinction between electronic companies and non-electronic companies. (4) The discrete-time hazard model, in incorporation with modified auditors’ opinions, macroeconomic factors, and electronic industry factor has the best explanatory power and prediction accuracy.

Through development of bankruptcy prediction models for Taiwan public companies, the study aims to understand the usefulness of modified auditors’ opinions, macroeconomic factors, and industry factor in prediction bankruptcy. Our study’s contribution can be summarized as follow. First, the research adds additional evidence to the stream of research confirming the incremental contribution of auditors’ opinions in signaling firms’ inability of survival, by utilizing a recent set of data from Taiwan economy. In addition to going concern opinions, “long-term investment audited by other auditors” (“other auditor”) is also useful for predicting bankruptcy of Taiwan companies. Secondly, the research finds the importance of macroeconomic factors, in particular interest rate, money supply rate, consumer price index in predicting bankruptcy. Thirdly, the research provides better understanding upon bankruptcy in electronics industry, which is a core component of Taiwan economy. Electronics industry is less affected by fluctuations in interest rate due to lower debt ratios. More interestingly, not only do auditors’ opinions, industry factor, and

macroeconomic factors have incremental value beyond financial ratios in predicting bankruptcy, but also they contain incremental information beyond one another. Findings of this study emphasize the importance of taking into account the unique economic environment in developing bankruptcy prediction model.

## 2. Sample and Data

Balse Committee on Banking Supervision (2001) indicates that the definition of financial distress includes all events that will result in credit loss of stake-holders. Thus, this study recognizes as financial distress all such events including: equity per share less than 5 NT dollars, delisting firms, reorganization, governmental financial supports, embezzlement, negative book value of equity, termination of operation due to economic recession, chairman of board with checks bounced, firm with checks bounced, emergent collection from bank, trading intermitted by stock exchanges due to insolvency.

The sample employed in this study is Taiwan public listed companies as of July 2006. Financial industry is excluded due to its different industrial nature. We also exclude firms with insufficient data. Our study period spans from 1987 to July of 2006, with 1987-2004 as training period, and 2005- July of 2006 as test period. Our training sample consists of 187 bankrupt firms (3,084 firm-year observations), and 1,475 nonbankrupt firms (14,047 firm-year observations). Our test sample is composed of 28 bankrupt firms (56 firm-year observations), and 1,486 nonbankrupt

firms (2,843 firm-year observations) (See Panel A of Table 2). Panel B of Table 2 provides sample distribution among types of bankruptcy and Table 2-3 presents sample distribution by industry. Eleven types of bankruptcies are studied in this paper, with "the firm has checks bounced" (32%) and "The firm receives financial supports from the government" as the most frequent types (31%). The bankrupt firms are from various industries, heavily concentrating in electronics industry.

Information used to predict bankruptcy (including financial ratios and auditors' opinions, macroeconomic factors) is for one year prior to the event year. Company bankruptcy event and predictor information is obtained from various sources including Taiwan economic journal, [including basic company data for public listed companies, financial data for public listed companies, auditors opinions database, and macroeconomic database.

## 3. Methodology

### 3.1. Discrete-time hazard model

We use discrete hazard model to analyze the prediction ability of auditors' opinions, macroeconomic variables, and industry variables. Model parameters are estimated using maximum likelihood functions. The significance of individual variable is examined using Wald statistics. The overall goodness-of-fit for models are evaluated based upon likelihood ratio. Following prior literature (Sun 2007), Vuong test (1989) is employed to compare the overall fits of different models.

Shumway (2001) advocates the use of discrete-time hazard model for bankruptcy prediction. The concept of discrete-time hazard model originates from survival model that is widely used in biological medication field. It was not until recent years that social science researchers started using it for analyzing variables' effect upon survival (e.g., Lancaster 1990). Cox and Oakes (1984) calculate hazard rate to estimate the likelihood of survival and survival time.

Shumway (2001) defines firm age, $T \in \{1, 2, 3, ..., t\}$, as the period that starts from the inception date of a firm to the date of bankruptcy filing or the end of sample period. The probability mass function of bankruptcy is $f(t, x; \theta)$, which $x$ represents the vector of explained variable and $\theta$ represents the vector of parameter. Equations (3) and (4) represent respectively the two most important functions of hazard model, survival function and hazard function.

Survival function: $S(t, x; \theta) = 1 - \sum_{j<t} f(j, x; \theta)$ (3)

Equation (3) represents the probability of survival up to time t.

Hazard function: $\phi(t, x; \theta) = \frac{f(t, x; \theta)}{S(t, x; \theta)}$ (4)

Equation (4) represents the probability of bankruptcy at time t conditional on surviving to t.

The likelihood function of the hazard model is expressed as:

$$L = \prod_{i=1}^{n} \phi(t_i, x_i; \theta)^{y_i} S(t_i, x_i; \theta), \quad (5)$$

where $y_i$ is a dummy variable, which is set to 1 only in the year in which a bankruptcy filing occurred. Shumway (2001) indicates that multi-period Logit model is estimated with the data from each firm year as if it were a separate observation. The likelihood function of the multi-period Logit model can be written as:

$$L = \prod_{i=1}^{n}(F(t_{i,}x_i;\theta)^{y_i} \prod_{j<t_i}[1-F(j,x_i;\theta)]) \quad (6)$$

The cumulative density function, $F(t,x;\theta)$, has a value between 0 and 1. $F(t,x;\theta)$ can also be written as hazard function, $\phi(t,x;\theta)$. Replacing $F(t,x;\theta)$ with the hazard function, $\phi(t,x;\theta)$ in equation (6), the likelihood function is written as

$$L = \prod_{i=1}^{n}(\phi(t_{i,}x_i;\theta)^{y_i} \prod_{j<t_i}[1-\phi(j,x_i;\theta)]) \quad (7)$$

According to Cox and Oakes (1984), survival function of discrete-time hazard model satisfies

$$S(t,x;\theta) = \prod_{j<t_i}[1-\phi(j,x_i;\theta)] \quad (8)$$

Substituting equation (8) into equation (5) verifies that the likelihood function of a multi-period logit model is equivalent to that of a discrete-time hazard model. Different from single-period logit model, the multi-period logit model (discrete-time hazard model) incorporates time-varying covariates by making *x* depend on time, and therefore provides more consistent and unbiased parameters estimation (Shumway 2001).

We define hazard function as logit function, defined as:

$$\phi(t,\, x;\, \theta) = \frac{e^{\left(\alpha+\beta_1 g(t)+\beta_2' x\right)}}{1+e^{\left(\alpha+\beta_1 g(t)+\beta_2' x\right)}}, \qquad \theta = (\alpha, \beta_1, \beta_2'), \tag{9}$$

Where, $g(t)$ represents the natural log of firm age, that is, $g(t) = \ln(t)$. This belongs to a type of accelerated failure-time models (Lancaster 1990). Parameter $\theta$ is estimated using maximum likelihood methods (MLE). $x$ is set of bankruptcy (financial distress) predictors. employed in this study include financial ratios, auditors' opinions, macroeconomic factors, and industry factors. Next we turn to discuss these variables.

**3.2. Variables**

Financial ratio variables consist of the nine financial ratios used in Ohlson (1980): firm size (Natural log of (Total Assets/ GNP Implicit Price Deflator Index); working capital divided by total asset; current liabilities divided by current asset; total liabilities divided by total asset; a dummy variable that equals to one if total liability exceeds total asset, 0 otherwise; return on assets; a dummy variable that equals one if net income was negative for the last two years, zero otherwise; change in net income ((net income in current year minus net income last year)/sum of absolute values of two years' net income); funds (net income and depreciation expense) divided by total liabilities.

In regards to auditors' opinions, in addition to going concern, consistency, and contingency[1], which have been studied in prior literature (e.g., Hopwood, McKeown and Mutchler 1989), we also include auditor's opinions of investment profits recognized by non-audited financial statements ("non-audited investment") and long term investment audited by other auditors ("other auditor").

As to macroeconomic factors, we examine: currency (M1b) supply change ratio, 1-year depositary interest rate change ratio, consumer price index change ratio. We expect a positive association between interest rate change and the likelihood of bankruptcy, given that increase in interest rate will increase the cost of capital. Increase in consumer price index is a sign of higher consumer demand and stronger economy, in which bankruptcy is less likely to occur. Therefore we expect a negative association between consumer price index and the likelihood of bankruptcy. As currency (M1b) supply increases, interest rate will accordingly decrease which reduces cost of capital and reduces the likelihood of bankruptcy. Therefore, a negative relation is expected between current supply change rate and the likelihood of bankruptcy.

In regards to industry level factors, we particularly focus on electronics industry. As reflected in Panel A of Table 1, electronic companies represent 50.46%

1 Contingency includes modified auditors' opinions due to insufficient debt allowances which result in uncertain collection of account receivables, contingent liabilities for post period events, lawsuit which is progressing, and going concern doubt for long term investment companies.

of all listing firms, which indicates the importance of electronic industry in Taiwan. We further observe that, from 1987 to 2005, the earnings fluctuation of electronic stocks is greater than that of the overall publicly listed companies, as reflected by the higher standard variations of gross profits, operating incomes, pre-tax incomes, and earnings per share of electronic stocks. Because of its higher earnings risk (fluctuations) and the associated higher default risk, Taiwan electronic industry has lower loan ratios than the market average. As shown in Table 1-2, the ratio of long term debts to total assets and the ratio of total debts (both long term and short term) to total assets of Taiwan electronic companies are respectively 0.065976 (compared to 0.089073 for all public firms) and 0.200685 (compared to 0.271736 for all public firms). Having the lower debt ratio, electronic companies' financial conditions are expected to be less sensitive to interest fluctuations. To test this expectation, we include the interaction term of an industry dummy variable for electronic industry ($ELE_i$＝1if firm i belongs to electronic industry, 0 otherwise) and one-year depositary interest rate change ratio. We expect a negative coefficient for this interaction term.

### 3.3 Prediction Accuracy

#### 3.3.1.Type I and Type II errors

To predict bankruptcy status for the test period, we employ the coefficients estimated using the training period sample under the maximum likelihood functions.

The estimated parameters and variable data are combined to yield estimated probability of bankruptcy for each holdout firm at age t. The estimated values are compared with the optimal cutoff scores that minimize the sum of type I and type II errors in the training sample (e.g., Begley, Ming and Watts 1996). A type I error ($\alpha(P)$) occurs if the firm is bankrupt but is misclassified as non-bankrupt. A type II error ($\beta(P)$) occurs if the firm is non-bankrupt but is misclassified as bankrupt.

### 3.3.2. ROC (receiver operating characteristic)

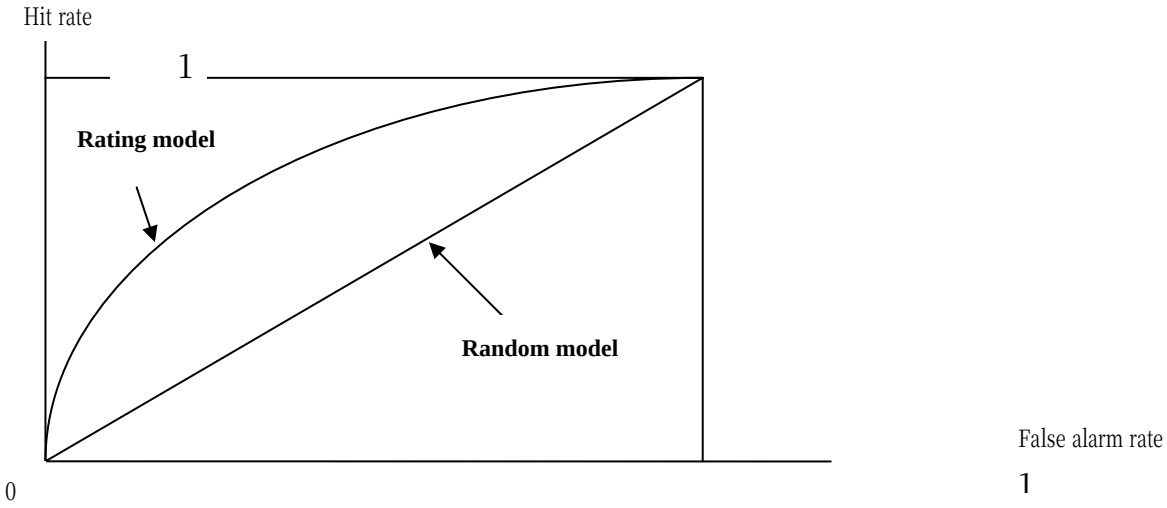
This study also refers to ROC (receiver operating characteristic) curve (e.g., Sobehart and Keenan 2001) to assess the quality of prediction models. When making prediction, the decision maker's prediction can fall into one of the following four outcomes.

| | | Actual status | |
|---|---|---|---|
| | | Bankruptcy | Non-bankruptcy |
| Predicted status | Bankruptcy | (I) | (III) |
| | Non-bankruptcy | (II) | (IV) |

I, II, III, IV represent the number of firms falling into each category

Under a selected cut-off point C, the hit rate of bankruptcy is defined as HR (C) =I/ (I+II). The false alarm rate is FAR (C) =III/ (III+IV). A ROC curve of false alarm rate versus hit rate is plotted while the cut-off C is varied, as depicted in Figure 1.

Figure 1: ROC curve




A ROC curve always goes through two points (0,0 and 1,1). 0,0 is where the predictor finds no positives (detects no bankruptcy). In this case it always gets the negative (non-bankruptcy) cases right but it gets all positive cases (bankruptcy) wrong. The second point is 1,1 where every firm is classified as bankruptcy. So the predictor gets all bankruptcy cases right but it gets all non-bankruptcy wrong. A predictor that randomly guesses has ROC which lies somewhere along the diagonal line connecting 0,0 and 1,1 (Random predictor line in Figure 1). The average area under the ROC is a convenient way of comparing prediction models (Hayden 2002). The greater the average area under curve, AUC, the better the predictability of model is. A random classifier (Random guessing line) has an area of 0.5, while and ideal one has an area of 1. We use U test of Mann-Whitney (1947) to examine if the average under curve of different models is significantly greater than 0.5.

## 4. Empirical Results

### 4.1. Estimation of Models

The descriptive statistics of variables are presented in Table 3. Out of total 20,030 observations, 7,217 firm-year observations (36.03％) receive modified auditors' opinions (Panel C of Table 3). Among various modified opinions, long term investment audited by other auditors ("other auditor") is the most frequent (46.8754%), followed by Consistency (38.0768%).

Multivariate analysis results are presented in Table 4-1 to 4-3. Twenty-seven models are developed under different combinations of financial ratios, auditors' opinions, macroeconomic factors, and electronic industry indicator. Table 4-1 shows the models with financial ratios and modified auditors' opinions. Model 1 is the financial-ratio-only model, i.e., Ohlson (1980) model with coefficients re-estimated using our data. Among the auditors' opinions studied, "going concern" and "long term investment audited by other auditors" ("other auditor") consistently exhibit significant positive associations with the likelihood of bankruptcy in Taiwan economy. The finding on "going concern" opinion is consistent with prior literature using U.S. data (e.g., Hopwood et al. 1994; Sun 2007). The empirical result on "other auditor" confirms our expectation that profits from long term investment audited by other auditors possess lower earnings quality and firms with such profits are subject to

higher risk of bankruptcy. This is an interesting finding unique to Taiwan economy. However, it is in general consistent with some U.S. literature that finds that soon-to-be bankrupt firms "cook" financial statement through earnings management to fool investors and auditors (e.g., Rosner, 2003).

Table 4-2 and 4-3 presents results for models with macroeconomic factors and electronic industry indicator. As expected, currency (M1b) supply change ratio and consumer price index change ratio have significantly negative association with the likelihood of bankruptcy. These confirm our conjecture that 1. as money supply increases, the cost of capital will go down and therefore reduce the risk of failure; 2. as consumer price index increases, the risk of failure decreases due to the prosperous economy and the increasing society consumption. Interest rate change ratio has significant positive coefficients, which is consistent with our expectation that increase in interest rate results in increase in cost of capital and therefore increases the risk of bankruptcy. Finally, the interaction term between interest rate and electronics industry dummy variable is observed to be significant negative. This confirms our expectation that due to lower debt ratio, electronic firms are less sensitive to the fluctuation in interest rate.

It is important to note that significant auditors' opinions variables (i.e., going concern, and "other auditor") remain their significance after controlling for

macroeconomic and electronic industry factors, and vice versa. This indicates that auditors opinions and macroeconomic/industry factors have incremental contribution in explaining bankruptcy beyond each other.

Next, we discuss the comparison of models' fit based upon Vuong test, results of which are presented in Table 4-4. Panel A indicates that models' with going concern and "other audit" opinions have significant incremental overall fit beyond the financial-ratio-only model (Model 1). Panel B reports that models' in incorporation with macroeconomic factors have significantly better fit than financial-ratio-only model; models with both macroeconomic factors and auditors' opinions have significantly better fit than macroeconomic-factor-only models. Panel C reports that models' taking into account the electronic industry factor have better fit than models without considering the industry factor. These comparisons suggest that 1. auditors' opinions, macroeconomic factors, and industry factor have incremental contribution in signaling bankruptcy beyond financial accounting information. 2. auditors' opinions, macroeconomic factors, and industry factor contain incremental information beyond one another for the purpose of bankruptcy prediction.

### 4.2. Out-of-sample Prediction Accuracy

#### 4.2.1. Type I and Type II errors

Table 5 presents the optimal cutoff points and the out-of-sample Type I and Type II errors for various models. From the models which consist of macroeconomic factors or industry factors presented in the middle column or the most right column, we can observe lower type I error for models which contain "other auditor" and "going concern" auditors' opinions. The models presented on the most right column of Table 5, which consist of macroeconomic factors, industry factor, and auditors' opinions, consistently exhibit lower prediction errors compared to models with auditors' opinions (see the first main column of Table 5), or the models with auditors' opinions and macroeconomic factors (see the second main column of Table 5). This observation once again strengthens the importance of distinguishing electronic industry from other industries for bankruptcy prediction in Taiwan economy. The model taking into account the auditors' opinions (going concern, "other auditor"), macroeconomic factors, and industry factor has the lowest sum of Type I and Type II errors (10.71% of Type I error, and 41.29% of Type II error, and a sum error of 52.00%).

### 4.2.2. Probability Rankings

Following Shumway (2001), we divide our test sample into ten groups based upon their predicted probability of bankruptcies using our models. Then we present the percentage of bankrupt firms classified into each group in Table 6. Results show

that the most accurate model is the model with macroeconomic factors, going concern, and "other auditor" opinions. This model accurately predicts 60.71% of all 28 bankruptcies in the highest bankruptcy probability decile and 89.27% of bankrupt firms in the five highest probability deciles (above-median decile). Further, models with auditors' opinions or/and macroeconomic factors predict more bankruptcies in the highest probability decile compared to models without these factors. This once again suggests the importance of auditors' opinions and macroeconomic factors in signaling failure.

**4.2.3. ROC**

The results of ROC curve and Mann-Whitney U test are shown in Table 7. All models developed in this study have AUC (Area Under Curve) larger than 0.5, which indicate that all models perform better than a random model. In general, models with auditors' opinions, and/or macroeconomic and industry factor have larger AUC compared to those without these factors. In particular, the model with going concern opinions, macroeconomic factors, and industry factor has the largest AUV (0.8228), which corresponds to the best model quality. Finally, the models with macroeconomic and industry factors have smaller 95% confidence interval compared to those without these factors.

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Table 1 Descriptive statistics of earnings and debts items for Taiwanese listing firms and electronics firms from 1986 to 2005

Panel A: Descriptive statistics of earnings items

| Electronics Firms | Gross Operating Margin | Operating Income | Pre-tax Income | Earnings per Share (EPS) |
|---|---|---|---|---|
| Mean | 732,824 | 342,382 | 379,668 | 2.0271 |
| Median | 156,986 | 44,727 | 43,588 | 1.4800 |
| Standard Deviation | 4,102,553 | 2,876,436 | 3,103,379 | 4.9624 |
| Minimum | -8,569,601 | -12,000,000 | -19,000,000 | -78.3600 |
| Maximum | 115,000,000 | 93,013,824 | 93,819,423 | 171.3900 |
| Observations | 9,126 | 9,126 | 9,126 | 9,126 |
| Listing Firms | Gross Operating Margin | Operating Income | Pre-tax Income | Earnings per Share (EPS) |
| Mean | 723,372 | 321,796 | 362,161 | 1.7045 |
| Median | 192,269 | 60,204 | 58,745 | 1.2500 |
| Standard Deviation | 3,307,590 | 2,332,785 | 2,617,667 | 4.5385 |
| Minimum | -8,569,601 | -12,000,000 | -19,000,000 | -258.6200 |
| Maximum | 115,000,000 | 93,013,824 | 93,819,423 | 171.3900 |
| Observations | 18,731 | 18,731 | 18,731 | 18,731 |

Panel B: Descriptive statistics of debts items

| | Listing firms | Electronics firms |
|---|---|---|
| Long-term debt/Asset | 0.089073 | 0.065976 |
| Long-term and short-term debt /Asset | 0.271736 | 0.200685 |

Table 2 Sample distribution of stress and non-stress firms

Panel A: Sample distribution

| Period | Stress | | Non-stress | | Total | |
|---|---|---|---|---|---|---|
| | firm | observation | firm | observation | firm | observation |
| 1987-2004 | 187 | 3,084 | 1,475 | 14,047 | 1,662 | 17,131 |
| 2005-2006.7.30 | 28 | 56 | 1,486 | 2,843 | 1,514 | 2,899 |
| Total | | 3,140 | | 16,890 | | 20,030 |

Panel B: Financial distress distribution

| Definitions of financial distress | Firm Number |
|---|---|
| Equity per share of the firm is less than 5 NT dollars. | 14 |
| The firm suffers delisting, but equity per share is more than 5 NT dollar. | 13 |
| The firm suffers insolvency reorganization. | 23 |
| The firm receives financial supports from the government. | 66 |
| The managers embezzle the firm's property. | 17 |
| The equity book value of the firm is negative | 2 |
| The firm terminates operation because of economic recession. | 2 |
| The chairman of the board of directors in the firm has checks bounced | 3 |
| The firm has checks bounced | 69 |
| The firm suffers emergent collection from the bank | 4 |
| The firm is intermitted trading by stock exchange due to insolvency | 2 |
| Total | 215 |

Panel C: Sample distribution by Industry

| Industry | Firm number | Industry | Firm number |
|---|---|---|---|
| Cement | 1 | Rubber | 1 |
| Food | 15 | Automobile | 4 |
| Plastics | 7 | Electronics | 67 |
| Textile | 22 | Construction | 31 |
| Electrical apparatus | 7 | Transportation | 3 |
| Wire and cable | 3 | Tourism | 2 |
| Chemicals | 7 | Retailing | 4 |
| Glass and ceramic | 5 | Conglomerate | 1 |
| Paper production | 1 | Other | 12 |
| Steel | 22 | | |
| | | Total | 215 |

Table 3 Descriptive statistics of variable in discrete-time hazard models

Panel A: Descriptive statistics of variable in discrete-time hazard models

| | Mean | Median | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Currency (M1b) supply change ratio | 10.3966 | 9.2700 | 8.1314 | -6.6500 | 51.4100 |
| Consumer price index change ratio (Base year=2001) | 1.5951 | 1.6600 | 1.6682 | -1.6900 | 4.6200 |
| Labor productivity index manufacturing change ratio | 0.0352 | 0.0520 | 0.0830 | -0.2154 | 0.1245 |
| 1-year depositary interest rate change ratio | 0.9564 | 0.9375 | 0.2960 | 0.3600 | 1.9000 |
| Natural logarithm of age | 2.6275 | 2.7726 | 0.8241 | 0.0000 | 4.0943 |
| Current liability divided by current asset | 1.1021 | 0.6723 | 8.1255 | 0.0001 | 625.0000 |
| Total liabilities divided by total asset | 0.5076 | 0.4466 | 1.7411 | 0.0000 | 153.8050 |
| Working capital divided by total asset | 0.1623 | 0.1612 | 0.3388 | -23.0300 | 1.0000 |
| Net income divided by total assets | 0.0331 | 0.0415 | 0.2696 | -22.2421 | 17.7999 |
| Natural logarithm of total assets divided by consumer price levels (Base year=2001) | 1.8265 | 1.8281 | 0.1287 | 0.08048 | 2.1622 |
| Funds provided by operations divided by total liability | 0.2153 | 0.1559 | 3.2849 | -35.3495 | 97.1641 |
| Net income change divided by average net income ( $(NI_t - NI_{t-1})/(\lvert NI_t \rvert + \lvert NI_{t-1} \rvert)$ , where $NI_t$ is net income for year t. | 0.0763 | 0.0950 | 0.5709 | -1.0000 | 1.0000 |

Panel B: Proportion of dummy variable of 20,030 observations

| | Electronics Firms | Total liability exceeds total assets | Net income was negative for the last two years |
|---|---|---|---|
| Proportion of dummy variable of 20,030 observations | 50.4593% | 1.5327% | 11.7624% |

Panel C: Proportion of CPA opinion of 20,030 observations

| | Going concern | Consistency | Non-audit | Other CPA | Contingency | Total |
|---|---|---|---|---|---|---|
| Proportion of CPA opinion of 20,030 observations | 2.9406% | 13.7194% | 0.9286% | 16.8896% | 0.7439% | 35.2221% |
| Proportion of CPA opinion of 7,217 observations which received qualified opinions | 8.1613% | 38.0768% | 2.5772% | 46.8754% | 2.0646% | 97.7553%[a] |

[a] Because there are other kinds of auditor opinions in Taiwanese firms, the sum of proportion is less than 100%.

Non-audit: Investment income recognized by un-audit financial statement
Other auditor: Long-term investment audited by other auditor

4-1 Results of discrete-time hazard models

| Model | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | Financial ratio | Financial ratio and going concern opinion | Financial ratio and consistency opinion | Financial ratio and non-audit opinion |
| Natural logarithm of age | 0.182414 (3.118614)* | 0.108893 (1.016948) | 0.18944 (3.345070)* | 0.181380 (3.078123)* |
| Current liability divided by current asset | -0.051506 (1.538942) | -0.091064 (2.446895) | -0.0527 (1.582099) | -0.051345 (1.526254) |
| Total liabilities divided by total asset | 0.024534 (0.341273) | 0.019738 (0.153841) | 0.024288 (0.335980) | 0.024692 (0.346991) |
| Working capital divided by total asset | -1.231778 (15.043605)*** | -1.052162 (10.141226)*** | -1.23273 (15.003978)*** | -1.233047 (15.042311)*** |
| Net income divided by total assets | -0.037645 (5.708034)** | -0.037719 (4.866634)** | -0.03768 (5.718009)** | -0.037612 (5.681702)** |
| Natural logarithm of total assets divided by consumer price levels | 7.701212 (77.984338)*** | 7.567061 (71.592310)*** | 7.704564 (78.122537)*** | 7.692468 (77.744106)*** |
| Total liability exceeds total assets | -1.944206 (5.162421)** | -2.431717 (10.644265)*** | -1.94353 (5.209720)** | -1.964092 (5.239604)** |
| Funds provided by operations divided by total liability | -0.015045 (1.865554) | -0.014078 (1.555270) | -0.01502 (1.853524) | -0.015018 (1.848039) |
| Net income was negative for the last two years | 1.746833 (121.034031)*** | 1.420163 (65.411672)*** | 1.735529 (118.818145)*** | 1.745156 (120.629610)*** |
| Net income change divided by average net income | -1.021994 (51.545648)*** | -0.986610 (48.203815)*** | -1.01781 (51.218437)*** | -1.022845 (51.588348)*** |
| Going Concern | | 1.558577 (44.405910)*** | | |
| Consistency | | | -0.22804 (0.879299) | |
| Non-audit | | | | 0.197241 (0.104342) |
| Constant | -19.711030 (149.352973)*** | -19.257150 (135.505272)*** | -19.7035 (149.364786)*** | -19.693675 (149.001819)*** |
| Likelihood ratio (Chi-square) | 324.007653*** | 363.394185*** | 324.934905*** | 324.106635*** |
| Degree of freedom | 10 | 11 | 11 | 11 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
(Wald statistics in parentheses)

4-1 Results of discrete-time hazard models (continued)

| Model | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| | Financial ratio and other opinion | Financial ratio and contingency opinion | Financial ratio, going concern, consistency and contingency opinion | Financial ratio, going concern, and other CPA opinion | Financial ratio and five opinions[2] |
| Natural logarithm of age | 0.125460 (1.1413273) | 0.175705 (2.878770) * | 0.111292 (1.051363) | 0.065494 (0.357102) | 0.065690 (0.354751) |
| Current liability divided by current asset | -0.052200 (1.500518) | -0.054221 (1.705902) | -0.091611 (2.474947) | -0.094167 (2.413627) | -0.094112 (2.406785) |
| Total liabilities divided by total asset | 0.023439 0.325669) | 0.024274 (0.326319) | 0.019649 (0.153257) | 0.019733 (0.168222) | 0.019913 (0.172717) |
| Working capital divided by total asset | -1.231169 (15.090696) *** | -1.234728 (14.959268) *** | -1.055127 (10.163479) *** | -1.054946 (9.820861) | -1.055541 (9.782524) *** |
| Net income divided by total assets | -0.035020 (4.721322) ** | -0.037518 (5.665174) ** | -0.037693 (4.869948) ** | -0.035428 (4.159307) *** | -0.035400 (4.148435) ** |
| Natural logarithm of total assets divided by consumer price levels | 7.177632 (64.978989) *** | 7.670892 (77.180422) *** | 7.558508 (71.333864) *** | 7.118403 (61.022406) ** | 7.107628 (60.688009) *** |
| Total liability exceeds total assets | -1.867860 (4.954963) ** | -1.953927 (5.206822) ** | -2.434236 (10.703424) *** | -2.351140 (10.143698) *** | -2.365687 (10.268242) *** |
| Funds provided by operations divided by total liability | -0.014122 (1.546782) | -0.014969 (1.842968) | -0.014043 (1.542659) | -0.013322 (1.328697) ** | -0.013278 (1.310026) |
| Net income was negative for the last two years | 1.657932 (105.467017) *** | 1.736548 (118.648426) *** | 1.410997 (64.121522) *** | 1.354427 (58.278101) *** | 1.348640 (57.399808) *** |
| Net income change divided by average net income | -1.007843 (50.832242) *** | -1.019393 (51.361531) *** | -0.983526 (47.972361) *** | -0.979740 (48.129063) *** | -0.978939 (48.009286) *** |
| Going Concern | | | 1.541925 (42.947302) *** | 1.504272 (40.618613) *** | 1.494183 (39.695810) *** |
| Consistency | | | -0.141192 (0.330423) | | -0.069339 (0.078313) |
| Non-audit | | | | | 0.208287 (0.108426) |
| Other auditor | 0.590828 (12.806813) *** | | | 0.516312 (9.465751) ** | 0.514377 (9.224773) *** |
| contingency | | 0.366571 (0.637880) | 0.152377 (0.103178) | | 0.090583 (0.035760) |
| Constant | -18.690235 (129.278572) *** | -19.634031 (147.563520) *** | -19.226998 (134.764247) *** | -18.396272 (119.539540) *** | -18.368651 (118.856200) *** |
| Likelihood ratio (Chi-square) | 336.262332*** | 324.596424*** | 363.836280*** | 372.485334*** | 372.726336*** |
| Degree of freedom | 11 | 11 | 13 | 12 | 15 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
(Wald statistics in parentheses)

[2]Auditors' opinions examined include going concern", "consistency", "contingency" (uncertainty), "long-term investment audited by other auditors" ("other auditor"), and "realized investment income based on non-audited financial statements" ("no auditor").

4-2 Results of macroeconomics discrete-time hazard models

| Model | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| | Financial ratio and macroeconomics | Financial ratio, macroeconomics and going concern opinion | Financial ratio, macroeconomics and consistency opinion | Financial ratio, macroeconomics and non-audit opinion |
| Natural logarithm of age | 0.183821<br>(3.171166) * | 0.114098<br>(1.123534) | 0.186505<br>(3.247631) * | 0.182551<br>(3.122266) * |
| Current liability divided by current asset | -0.045156<br>(1.165517) | -0.087423<br>(2.267740) | -0.045702<br>(1.182156) | -0.044953<br>(1.152444) |
| Total liabilities divided by total asset | 0.014540<br>(0.132764) | 0.010606<br>(0.051892) | 0.014491<br>(0.132118) | 0.014694<br>(0.135704) |
| Working capital divided by total asset | -1.259559<br>(15.038353) *** | -1.067729<br>(10.402241) *** | -1.259324<br>(14.997623) *** | -1.261439<br>(15.057577) *** |
| Net income divided by total assets | -0.035428<br>(4.950278) ** | -0.035834<br>(4.390773) ** | -0.035473<br>(4.964725) ** | -0.035378<br>(4.908462) ** |
| Natural logarithm of total assets divided by consumer price levels | 7.421922<br>(72.798600) *** | 7.347305<br>(67.746716) *** | 7.428010<br>(72.895106) *** | 7.408316<br>(72.474902) *** |
| Total liability exceeds total assets | -1.990838<br>(5.343132) ** | -2.425847<br>(10.314515) | -1.990053<br>(5.358157) ** | -2.014581<br>(5.445825) ** |
| Funds provided by operations divided by total liability | -0.014658<br>(1.693435) | -0.013795<br>(1.451349) *** | -0.014656<br>(1.691812) | -0.014613<br>(1.664495) |
| Net income was negative for the last two years | 1.689177<br>(106.759696)*** | 1.394547<br>(60.531760) *** | 1.686818<br>(106.285353)*** | 1.686058<br>(106.068409)*** |
| Net income change divided by average net income | -0.993696<br>(47.352319) *** | -0.969607<br>(45.024724) *** | -0.991004<br>(47.011445) *** | -0.994483<br>(47.366867) *** |
| Going Concern | | 1.498585<br>(40.101201) *** | | |
| Consistency | | | -0.087738<br>(0.126315) | |
| Non-audit | | | | 0.256492<br>(0.173759) |
| Currency (M1b) supply change ratio | -0.038210<br>(8.750777) *** | -0.033774<br>(6.791344) *** | -0.038094<br>(8.755950) *** | -0.038272<br>(8.795290) *** |
| Consumer price index change ratio | -0.361848<br>(25.750269) *** | -0.338505<br>(21.811066) *** | -0.358566<br>(24.819469) *** | -0.362382<br>(25.830537) *** |
| 1-year depositary interest rate change ratio | 1.623217<br>(21.471829) *** | 1.692610<br>(23.361397) *** | 1.616973<br>(21.250171) *** | 1.618633<br>(21.351223) *** |
| 1-year depositary interest rate change ratio × Electronics dummy variable | | | | |
| Constant | -19.770090<br>(143.078895)*** | -19.574595<br>(133.145110)*** | -19.776131<br>(143.151632)*** | -19.737917<br>(142.555471)*** |
| Likelihood ratio (Chi-square) | 358.963884*** | 394.773288*** | 359.092653*** | 359.126491*** |
| Degree of freedom | 13 | 14 | 14 | 14 |

4-2 Results of macroeconomics discrete-time hazard models (continued)

| Model | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|
| | Financial ratio, macroeconomics and other opinion | Financial ratio, macroeconomics and contingency opinion | Financial ratio, macroeconomics going concern, consistency and contingency opinion | Financial ratio, macroeconomics going concern, and other CPA opinion | Financial ratio, macroeconomics and five opinions |
| Natural logarithm of age | 0.135350 (1.647597) | 0.176895 (2.921049) * | 0.112480 (1.080306) | 0.073338 (0.449346) | 0.070114 (0.405681) |
| Current liability divided by current asset | -0.046249 (1.163437) | -0.047290 (1.285086) | -0.087069 (2.263331) | -0.090930 (2.273500) | -0.090185 (2.242134) |
| Total liabilities divided by total asset | 0.013733 (0.124329) | 0.014331 (0.125648) | 0.010639 (0.052198) | 0.010326 (0.052950) | 0.010541 (0.055333) |
| Working capital divided by total asset | -1.243852 (14.898628) *** | -1.262890 (15.001757) *** | -1.068273 (10.422504) *** | -1.059398 (10.011670) *** | -1.058643 (9.990370) *** |
| Net income divided by total assets | -0.033772 (4.363176) ** | -0.035292 (4.905841) ** | -0.035801 (4.384423) ** | -0.034310 (3.930130) ** | -0.034233 (3.896171) ** |
| Natural logarithm of total assets divided by consumer price levels | 7.063147 (63.275218) *** | 7.389767 (71.957176) *** | 7.338375 (67.422725) **** | 7.022567 (59.582118) *** | 7.003209 (59.072042) *** |
| Total liability exceeds total assets | -1.901858 (5.049441) ** | -2.010973 (5.427954) ** | -2.428689 (10.340097) ** | -2.346856 (9.875022) *** | -2.359758 (9.959929) *** |
| Funds provided by operations divided by total liability | -0.013928 (1.460226) | -0.014577 (1.671551) | -0.013770 (1.444422) | -0.013156 (1.269059) | -0.013103 (1.246758) |
| Net income was negative for the last two years | 1.644830 (99.982287) *** | 1.676630 (104.108051) *** | 1.391016 (59.873674) *** | 1.359523 (57.149364) *** | 1.356502 (56.507969) *** |
| Net income change divided by average net income | -0.990244 (47.520498) *** | -0.991491 (47.239998) *** | -0.968889 (44.871342) *** | -0.970096 (45.553551) *** | -0.971571 (45.520097) *** |
| Going Concern | | | 1.491389 (39.124446) *** | 1.478374 (38.634338) *** | 1.474364 (37.881577) *** |
| Consistency | | | -0.012033 (0.002319) | | 0.034304 (0.018559) |
| Non-audit | | | | | 0.218492 (0.119731) |
| Other auditor | 0.475239 (7.447135) *** | | | 0.437991 (6.159946) ** | 0.442809 (6.216635) ** |
| Contingency | | 0.378409 (0.665565) | 0.124396 (0.066374) | | 0.055389 (0.012907) |
| Currency (M1b) supply change ratio | -0.035429 (7.611727) *** | -0.038403 (8.840330) *** | -0.033859 (6.824531) *** | -0.031500 (5.960767) ** | -0.031612 (5.988054) ** |
| Consumer price index change ratio | -0.325530 (19.361385) *** | -0.362212 (25.782889) *** | -0.338177 (21.389803) *** | -0.304921 (16.556881) *** | -0.306464 (16.475022) *** |
| 1-year depositary interest rate change ratio | 1.671454 (22.166331) *** | 1.618505 (21.297221) *** | 1.687945 (23.075372) *** | 1.731543 (23.903192) *** | 1.730553 (23.703845) *** |
| Likelihood ratio (Chi-square) | -19.181083 (130.666256) *** | -19.682850 (141.091470) *** | -19.547692 (132.229074) *** | -19.043804 (122.568856) *** | -19.003384 (121.598910) *** |
| Degree of freedom | 366.245523 *** 14 | 359.578252 *** 14 | 394.840555 *** 16 | 400.797623 *** 15 | 400.950983 *** 18 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
(Wald statistics in parentheses)

4-3 Results of macroeconomics and industry discrete-time hazard models

| Model | 19 | 20 | 21 | 22 |
|---|---|---|---|---|
| | Financial ratio, macroeconomics and industry | Financial ratio, macroeconomics, industry and going concern opinion | Financial ratio, macroeconomics, industry and consistency opinion | Financial ratio, macroeconomics, industry and non-audit opinion |
| Natural logarithm of age | 0.065067 | 0.026424 | 0.067567 | 0.064110 |
| | (0.330552) | (0.050823) | (0.355051) | (0.320661) |
| Current liability divided by current asset | -0.046951 | -0.088911 | -0.047547 | -0.046758 |
| | (1.180494) | (2.294055) | (1.197795) | (1.167782) |
| Total liabilities divided by total asset | 0.014458 | 0.010323 | 0.014406 | 0.014624 |
| | (0.132570) | (0.048847) | (0.131870) | (0.135908) |
| Working capital divided by total asset | -1.205608 | -1.041001 | -1.205411 | -1.207375 |
| | (13.921490) *** | (9.798141) *** | (13.879897) *** | (13.936390) *** |
| Net income divided by total assets | -0.035204 | -0.035554 | -0.035253 | -0.035158 |
| | (4.787520) ** | (4.290410) ** | (4.802169) ** | (4.749143) ** |
| Natural logarithm of total assets divided by consumer price levels | 7.288229 | 7.232474 | 7.294724 | 7.275632 |
| | (68.370583) *** | (64.241995) *** | (68.469581) **** | (68.081215) *** |
| Total liability exceeds total assets | -1.935965 | -2.392735 | -1.935317 | -1.959421 |
| | (5.395998) ** | (10.294523) *** | (5.411494) ** | (5.495213) ** |
| Funds provided by operations divided by total liability | -0.014327 | -0.013556 | -0.014325 | -0.014286 |
| | (1.551663) | (1.361149) | (1.549938) | (1.526648) |
| Net income was negative for the last two years | 1.679963 | 1.393261 | 1.677341 | 1.676826 |
| | (105.075077)*** | (60.278986) *** | (104.552182)*** | (104.370583)*** |
| Net income change divided by average net income | -0.981885 | -0.958900 | -0.978900 | -0.982645 |
| | (45.930979) *** | (43.785222) *** | (45.554667) *** | (45.945901) *** |
| Going Concern | | 1.445392 | | |
| | | (36.939147) *** | | |
| Consistency | | | -0.091442 | |
| | | | (0.137047) | |
| Non-audit | | | | 0.248015 |
| | | | | (0.161894) |
| Currency (M1b) supply change ratio | -0.038744 | -0.034454 | -0.038649 | -0.038794 |
| | (9.038709) *** | (7.092806) *** | (9.059140) *** | (9.077633) *** |
| Consumer price index change ratio | -0.368199*** | -0.344388 | -0.364913 | -0.368663 |
| | (27.560995) *** | (23.127653) *** | (26.591998) *** | (27.632273) *** |
| 1-year depositary interest rate change ratio | 1.651943 | 1.710267 | 1.645649 | 1.648209 |
| | (23.184649) *** | (24.575943) *** | (22.952352) *** | (23.080012) *** |
| 1-year depositary interest rate change ratio× Electronics dummy variable | -0.547758 | -0.412661 | -0.548423 | -0.546967 |
| | (5.365368) ** | (3.030291) * | (5.375042) ** | (5.353996) ** |
| Constant | -19.041714 | -18.989795 | -19.046939 | -19.013325 |
| | (126.886702)*** | (119.726824)*** | (126.938265) | (126.476845)*** |
| Likelihood ratio (Chi-square) | 364.691104*** | 397.953852*** | 364.890919*** | 364.843001*** |
| Degree of freedom | 14 | 15 | 15 | 15 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
(Wald statistics in parentheses)

4-3 Results of macroeconomics and industry discrete-time hazard models (Continued)

| Model | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|
| | Financial ratio, macroeconomics, industry and other opinion | Financial ratio, macroeconomics, industry and contingency opinion | Financial ratio, macroeconomics, industry, going concern, consistency and contingency opinion | Financial ratio, macroeconomics, industry, going concern, and other CPA opinion | Financial ratio, macroeconomics, industry and five opinions |
| Natural logarithm of age | 0.000672 (0.000034) | 0.060262 (0.282695) | 0.025584 (0.047317) | -0.028748 (0.057792) | -0.031340 (0.068129) |
| Current liability divided by current asset | -0.048488 (1.177382) | -0.048427 (1.272032) | -0.088634 (2.288379) | -0.092918 (2.305464) | -0.092301 (2.273957) |
| Total liabilities divided by total asset | 0.013733 (0.126423) | 0.014284 (0.126768) | 0.010349 (0.049114) | 0.010116 (0.050838) | 0.010344 (0.053379) |
| Working capital divided by total asset | -1.180606 (13.529782) *** | -1.208451 (13.913790) *** | -1.041450 (9.811922) *** | -1.026260 (9.240973) *** | -1.025288 (9.207522) *** |
| Net income divided by total assets | -0.033397 (4.155653) ** | -0.035079 (4.4747591) ** | -0.035532 (4.286095) ** | -0.033887 (3.792748) * | -0.033819 (3.760303) * |
| Natural logarithm of total assets divided by consumer price levels | 6.884688 (58.286126) *** | 7.259685 (67.643749) *** | 7.226011 (63.985009) *** | 6.867138 (55.477354) *** | 6.850049 (55.042110) **** |
| Total liability exceeds total assets | -1.835802 (5.068705) ** | -1.952407 (5.470042) ** | -2.394762 (10.314464) *** | -2.304720 (9.816228) ** | -2.317611 (9.889102) *** |
| Funds provided by operations divided by total liability | -0.013486 (1.297301) | -0.014257 (1.533920) | -0.013536 (1.355917) | -0.012825 (1.159983) | -0.012777 (1.139988) |
| Net income was negative for the last two years | 1.629956 (97.483349) *** | 1.668359 (102.519434) *** | 1.390201 (59.640031) *** | 1.354924 (56.589658) *** | 1.352741 (56.000409) *** |
| Net income change divided by average net income | -0.975576 (45.817972) *** | -0.980013 (45.844472) *** | -0.958132 (43.617155) *** | -0.957023 (44.074161) *** | -0.958645 (44.041495) *** |
| Going Concern | | | 1.439430 (36.118986) *** | 1.417468 (35.158182) *** | 1.415099 (34.587224) *** |
| Consistency | | | -0.016014 (0.004106) | | 0.034716 (0.018995) |
| Non-audit | | | | | 0.229845 (0.131962) |
| Other auditor | 0.514103 (8.537807) *** | | | 0.469797 (6.964665) *** | 0.475462 (7.034690) *** |
| Contingency | | 0.334224 (0.521930) | 0.099250 (0.042491) | | 0.019454 (0.001601) |
| Currency (M1b) supply change ratio | -0.035830 (7.836023) *** | -0.038912 (9.117610) *** | -0.034518 (7.121679) *** | -0.032119 (6.229748) ** | -0.032185 (6.240727) ** |
| Consumer price index change ratio | -0.329797 (20.570729) *** | -0.368443 (27.570462) *** | -0.343889 (22.670293) *** | -0.309317 (17.4938531) *** | -0.310720 (17.397549) *** |
| 1-year depositary interest rate change ratio | 1.702723 (24.058519) *** | 1.647775 (23.011142) *** | 1.706140 (24.301133) *** | 1.751335 (25.268987) *** | 1.751784 (25.110078) *** |
| 1-year depositary interest rate change ratio× Electronics dummy variable | -0.600040 (6.342165) ** | -0.542364 (5.250553) ** | -0.411605 (3.011055) * | -0.464144 (3.765346) * | -0.463921 (3.760456) * |
| Constant | -18.322888 (113.223215) *** | -18.969968 (125.392741) *** | -18.970184 (119080382) *** | -18.337637 (107.810940) *** | -18.305325 (107.147077) *** |
| Likelihood ratio (Chi-square) | 373.042882*** | 365.177261*** | 397.999802*** | 404.767765*** | 404.915515*** |
| Degree of freedom | 15 | 15 | 17 | 16 | 19 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
(Wald statistics in parentheses)

4-4 Results of Vuong test

Panel A: Discrete-time hazard models

| Model | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | Financial ratio | Financial ratio and going concern opinion | Financial ratio and consistency opinion | Financial ratio and non-audit opinion |
| Incremental Chi-square above model 1 | | 39.386532*** | 0.927252 | 0.098982 |
| | | (1df) | (1df) | (1df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Panel A: Discrete-time hazard models (continued)

| Model | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| | Financial ratio and other opinion | Financial ratio and contingency opinion | Financial ratio, going concern, consistency and contingency opinion | Financial ratio, going concern, and other CPA opinion | Financial ratio and five opinions[3] |
| Incremental Chi-square above model 1 | 12.254679*** | 0.588771 | 39.828627*** | 48.477681*** | 48.718693*** |
| | (1df) | (1df) | (3df) | (2df) | (5df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Panel B: Macroeconomics discrete-time hazard models

| Model | 10 | 11 | 12 | 13 |
|---|---|---|---|---|
| | Financial ratio and macroeconomics | Financial ratio, macroeconomics and going concern opinion | Financial ratio, macroeconomics and going concern opinion | Financial ratio, macroeconomics and non-audit opinion |
| Incremental Chi-square above model 1 | 34.956231*** | 70.765635*** | 35.085000*** | 35.118838*** |
| | (3df) | (4df) | (4df) | (4df) |
| Incremental Chi-square above model 10 | | 35.809404*** | 0.128769 | 0.162607 |
| | | (1df) | (1df) | (1df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

[3]Auditors' opinions examined include going concern", "consistency", "contingency" (uncertainty), "long-term investment audited by other auditors" ("other auditor"), and "realized investment income based on non-audited financial statements" ("no auditor").

Panel B: Macroeconomics discrete-time hazard models (continued)

| Model | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|
| | Financial ratio, macroeconomics, and other opinion | Financial ratio, macroeconomics, and contingency opinion | Financial ratio, macroeconomics, going concern, consistency and contingency opinion | Financial ratio, macroeconomics, going concern, and other CPA opinion | Financial ratio, macroeconomics, and five opinions |
| Incremental Chi-square above model 1 | 42.237870*** (4df) | 35.570599*** (4df) | 70.832902*** (6df) | 76.789970*** (5df) | 76.943330*** (5df) |
| Incremental Chi-square above model 10 | 7.281639*** (1df) | 0.614368 (1df) | 35.876671*** (3df) | 41.833739*** (2df) | 41.987099*** (5df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Panel C: Macroeconomics and industry discrete-time hazard models

| Model | 19 | 20 | 21 | 22 |
|---|---|---|---|---|
| | Financial ratio, macroeconomics and industry | Financial ratio, macroeconomics, industry and going concern opinion | Financial ratio, macroeconomics, industry and going concern opinion | Financial ratio, macroeconomics, industry and non-audit opinion |
| Incremental Chi-square above model 1 | 40.683451*** (4df) | 73.946199*** (5df) | 40.883266*** (5df) | 40.835348*** (5df) |
| Incremental Chi-square above model 10 | 5.727220** (1df) | 38.989968*** (2df) | 5.927035 (2df)* | 5.879117 (2df)* |
| Incremental Chi-square above model 19 | | 33.262748*** (1df) | 0.139815 (1df) | 0.151897 (1df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Panel C: Macroeconomics and industry discrete-time hazard models (continued)

| Model | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|
| | Financial ratio, macroeconomics, industry and other opinion | Financial ratio, macroeconomics, industry and contingency opinion | Financial ratio, macroeconomics, industry, going concern, consistency and contingency opinion | Financial ratio, macroeconomics, industry, going concern, and other CPA opinion | Financial ratio, macroeconomics, industry and five opinions |
| Incremental Chi-square above model 1 | 49.035229*** (5df) | 41.169608*** (5df) | 73.992149 (7df) | 80.760112*** (6df) | 80.907862*** (9df) |
| Incremental Chi-square above model 10 | 14.078998*** (2df) | 6.213377** (2df) | 39.035918*** (4df) | 45.803881*** (3df) | 45.951631*** (6df) |
| Incremental Chi-square above model 19 | 8.351778*** (1df) | 0.486157 (1df) | 33.308698*** (3df) | 40.076661*** (2df) | 40.224411*** (5df) |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

Table Results of type I and type II error

| | Discrete-time hazard models | | | | Macroeconomics discrete-time hazard models | | | | Macroeconomics and industry discrete-time hazard models | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Model** | Cut-off point | Type I error (%) | Type II error (%) | Sum of type I and type II error (%) | Cut-off point | Type I error (%) | Type II error (%) | Sum of type I and type II error (%) | Cut-off point | Type I error (%) | Type II error (%) | Sum of type I and type II error (%) |
| Financial ratio | 0.010 | 28.571429 | 33.808290 | 62.379719 | 0.012 | 14.285714 | 48.931347 | 63.217061 | 0.015 | 21.428571 | 33.711140 | 55.139711 |
| Financial ratio and going concern opinion | 0.010 | 28.571429 | 32.448187 | 61.019616 | 0.012 | 10.714286 | 51.651554 | 62.365840 | 0.014 | 17.857143 | 38.730570 | 56.587713 |
| Financial ratio and consistency opinion | 0.010 | 28.571429 | 32.901554 | 61.472983 | 0.012 | 14.285714 | 48.866580 | 63.152294 | 0.008 | 7.142857 | 53.141192 | 60.284049 |
| Financial ratio and non-audit opinion | 0.010 | 28.571429 | 33.711140 | 62.282569 | 0.012 | 14.285714 | 48.801813 | 63.087527 | 0.015 | 21.428571 | 33.646373 | 55.074944 |
| Financial ratio and other opinion | 0.015 | 39.285714 | 25.680052 | 64.965766 | 0.011 | 3.571429 | 56.055699 | 59.627128 | 0.013 | 14.285714 | 40.867876 | 55.153590 |
| Financial ratio and contingency opinion | 0.010 | 28.571429 | 33.775907 | 62.347336 | 0.012 | 14.285714 | 48.898964 | 63.184678 | 0.015 | 21.428571 | 33.711140 | 55.139711 |
| Financial ratio and five opinions | 0.013 | 35.714286 | 27.072539 | 62.786825 | 0.011 | 7.142857 | 58.905440 | 66.048297 | 0.013 | 10.714286 | 44.073834 | 54.788120 |
| Financial ratio, going concern, consistency and contingency opinion | 0.010 | 28.571429 | 32.253886 | 60.825315 | 0.012 | 10.714286 | 51.522021 | 62.236307 | 0.015 | 21.428571 | 36.139896 | 57.568467 |
| Financial ratio, going concern, and other CPA opinion | 0.013 | 35.714286 | 27.461140 | 63.175426 | 0.010 | 3.571429 | 62.370466 | 65.941895 | 0.014 | 10.714286 | 41.288860 | 52.003146 |

Table 6 Forecast accuracy for out-sample firms

Panel A: Discrete-time hazard models

| Group | Financial ratio | Financial ratio and going concern opinion | Financial ratio and consistency opinion | Financial ratio and non-audit opinion | Financial ratio and other opinion | Financial ratio and contingency opinion | Financial ratio and five opinions | Financial ratio, going concern, consistency and contingency opinion | Financial ratio, going concern, and other CPA opinion |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% | 0.00% | 3.57% | 0.00% | 3.57% |
| 2 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 3.57% | 0.00% |
| 3 | 0.00% | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 4 | 10.71% | 7.14% | 7.14% | 10.71% | 7.14% | 10.71% | 7.14% | 7.14% | 7.14% |
| 5 | 7.14% | 3.57% | 7.14% | 7.14% | 14.29% | 7.14% | 10.71% | 3.57% | 10.71% |
| 6 | 7.14% | 10.71% | 7.14% | 7.14% | 7.14% | 7.14% | 3.57% | 10.71% | 3.57% |
| 7 | 7.14% | 7.14% | 3.57% | 7.14% | 7.14% | 7.14% | 7.14% | 3.57% | 7.14% |
| 8 | 7.14% | 7.14% | 10.71% | 7.14% | 10.71% | 7.14% | 7.14% | 10.71% | 7.14% |
| 9 | 25.00% | 7.14% | 21.43% | 28.57% | 3.57% | 25.00% | 7.14% | 7.14% | 7.14% |
| 10 | 35.71% | 53.57% | 39.29% | 32.14% | 50.00% | 35.71% | 53.57% | 53.57% | 53.57% |

Panel B: Macroeconomics discrete-time hazard models

| Group | Financial ratio and macro-economics | Financial ratio and macro-economics going concern opinion | Financial ratio, macro-economics and consistency opinion | Financial ratio, macro-economics and non-audit opinion | Financial ratio, macro-economics and other opinion | Financial ratio, macro-economics and contingency opinion | Financial ratio, macro-economics and five opinions | Financial ratio, macro-economics, going concern, consistency and contingency opinion | Financial ratio, macro-economics, going concern, and other CPA opinion |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 2 | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% | 0.00% | 3.57% | 3.57% | 3.57% |
| 3 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 4 | 7.14% | 0.00% | 3.57% | 7.14% | 3.57% | 7.14% | 3.57% | 0.00% | 0.00% |
| 5 | 3.57% | 7.14% | 7.14% | 3.57% | 7.14% | 7.14% | 3.57% | 7.14% | 7.14% |
| 6 | 10.71% | 3.57% | 10.71% | 10.71% | 14.29% | 7.14% | 10.71% | 3.57% | 10.71% |
| 7 | 3.57% | 10.71% | 3.57% | 3.57% | 10.71% | 3.57% | 7.14% | 10.71% | 7.14% |
| 8 | 14.29% | 14.29% | 14.29% | 14.29% | 7.14% | 14.29% | 10.71% | 14.29% | 10.71% |
| 9 | 14.29% | 7.14% | 14.29% | 14.29% | 7.14% | 14.29% | 0.00% | 7.14% | 0.00% |
| 10 | 46.43% | 53.57% | 46.43% | 46.43% | 50.00% | 46.43% | 60.71% | 53.57% | 60.71% |

Panel C: Macroeconomics and industry discrete-time hazard models

| Group | Financial ratio, macro-economics, and industry | Financial ratio and macro-economics, industry going concern opinion | Financial ratio, macro-economics, industry and consistency opinion | Financial ratio, macro-economics, industry and non-audit opinion | Financial ratio, macro-economics, industry and other opinion | Financial ratio, macro-economics, industry and contingency opinion | Financial ratio, macro-economics, industry and five opinions | Financial ratio, macro-economics, industry, going concern, consistency and contingency opinion | Financial ratio, macro-economics, industry, going concern, and other CPA opinion |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% |
| 2 | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% | 0.00% | 3.57% | 3.57% | 3.57% |
| 3 | 3.57% | 0.00% | 3.57% | 3.57% | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% |
| 4 | 3.57% | 0.00% | 3.57% | 3.57% | 3.57% | 3.57% | 0.00% | 0.00% | 0.00% |
| 5 | 0.00% | 0.00% | 0.00% | 0.00% | 3.57% | 0.00% | 0.00% | 0.00% | 0.00% |
| 6 | 7.14% | 10.71% | 7.14% | 7.14% | 7.14% | 7.14% | 10.71% | 14.29% | 10.71% |
| 7 | 14.29% | 14.29% | 14.29% | 14.29% | 17.86% | 14.29% | 17.86% | 10.71% | 21.43% |
| 8 | 10.71% | 10.71% | 7.14% | 10.71% | 7.14% | 10.71% | 7.14% | 10.71% | 3.57% |
| 9 | 25.00% | 7.14% | 28.57% | 25.00% | 25.00% | 21.43% | 10.71% | 7.14% | 10.71% |
| 10 | 35.71% | 53.57% | 35.71% | 35.71% | 35.71% | 39.29% | 50.00% | 53.57% | 50.00% |

Table 7 Results of area under curve (AUC)

| Model | Discrete-time hazard models | | | | Macroeconomics discrete-time hazard models | | | | Macroeconomics and industry discrete-time hazard models | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AUC | Standard deviation | 95% confidence interval | | AUC | Standard deviation | 95% confidence interval | | AUC | Standard deviation | 95% confidence interval | |
| | | | Upper Bound | Lower Bound | | | Upper Bound | Lower Bound | | | Upper Bound | Lower Bound |
| Financial ratio | 0.774403*** | 0.041545 | 0.692977 | 0.855830 | 0.802022*** | 0.037146 | 0.729217 | 0.874826 | 0.799882*** | 0.035790 | 0.729735 | 0.870029 |
| Financial ratio and going concern opinion | 0.791497*** | 0.047236 | 0.698916 | 0.884078 | 0.820295*** | 0.041975 | 0.738026 | 0.902565 | 0.822759*** | 0.038966 | 0.746387 | 0.899130 |
| Financial ratio and consistency opinion | 0.777098*** | 0.041810 | 0.695152 | 0.859043 | 0.802345*** | 0.037340 | 0.729161 | 0.875530 | 0.800310*** | 0.036136 | 0.729485 | 0.871135 |
| Financial ratio and non-audit opinion | 0.773860*** | 0.041725 | 0.692081 | 0.855638 | 0.801351*** | 0.037379 | 0.728090 | 0.874612 | 0.799281*** | 0.036061 | 0.728602 | 0.869960 |
| Financial ratio and other opinion | 0.764596*** | 0.042120 | 0.682042 | 0.847150 | 0.795221 | 0.037479 | 0.721763 | 0.868680 | 0.793544*** | 0.034484 | 0.725957 | 0.861132 |
| Financial ratio and contingency opinion | 0.774901*** | 0.041875 | 0.692828 | 0.856973 | 0.801894*** | 0.037568 | 0.728263 | 0.875526 | 0.800819*** | 0.036094 | 0.730075 | 0.871563 |
| Financial ratio and five opinions | 0.784303*** | 0.048976 | 0.688312 | 0.880295 | 0.812118*** | 0.043789 | 0.726294 | 0.897942 | 0.817346*** | 0.040043 | 0.738863 | 0.895829 |
| Financial ratio, going concern, consistency and contingency opinion | 0.793255*** | 0.047116 | 0.700909 | 0.885601 | 0.820075*** | 0.042020 | 0.737719 | 0.902432 | 0.822770*** | 0.039039 | 0.746255 | 0.899285 |
| Financial ratio, going concern, and other CPA opinion | 0.783401*** | 0.049055 | 0.687255 | 0.879547 | 0.813425*** | 0.043526 | 0.728115 | 0.898736 | 0.818075*** | 0.039969 | 0.739737 | 0.896412 |

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level