Fraud Risk Factors and the Likelihood of Fraudulent Financial Reporting: Evidence from Statement on Auditing Standards No. 43 in Taiwan

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Abstract

Prior research on fraud risk assessment identifies an array of factors that are related to the likelihood of fraudulent financial reporting, and mainly draws on behavioral decision theory and uses experimental designs to predict the occurrence of fraud. This study empirically examines the relation between the fraud risk factors identified in Statement on Auditing Standards No. 43 in Taiwan and the likelihood of fraudulent financial reporting. We find that Taiwanese listed firms with pressure risk factors, opportunity factors, and rationalization factors are more likely to engage in fraudulent financial reporting.

Keywords: fraud, fraud risk factors, fraudulent financial reporting, auditing standards

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I. INTRODUCTION

Recent high-profile financial failures such as Enron and WorldCom raised public concerns about the integrity of financial reporting. Although Statement on Auditing Standards (SAS) No. 99, *Consideration of Fraud in a Financial Statement Audit*, was developed before these accounting scandals, its release came in their wake.[1] To restore public confidence in the integrity of financial reporting in Taiwan after well-known accounting scandals such as Procomp Informatics, and Infodisc, and following International Standards of Auditing (ISA) 240, the Auditing Standards Board in Taiwan issued Statement on Auditing Standards No. 43 (hereafter TSAS 43) in September 2006. TSAS 43 superseded TSAS 14, which was issued in 1987.[2]

One of the primary purposes of TSAS 43 is to improve the likelihood that fraud will be detected during the financial statement audit process. Auditors are required to assess the risk of material misstatement due to fraud during their audits, which has never emphasized when TSAS 14 was issued twenty years ago. Predicting the occurrence of fraud is important because the presence of fraud often leads to costly lawsuits again audit firms (Palmrose 1987). Therefore, the current study investigates

1 In November 2002, SAS No. 99, which superseded SAS No. 82, was issued by the Auditing Standards Board of the American Institute of Certified Public Accountants (AICPA) and became effective for audits of financial statements for fiscal years beginning on or after December 15, 2002. SAS No. 99 addresses auditors' concerns regarding fulfilling their responsibility to determine if a client's financial statements are free of material misstatement due to fraud. It also provides auditors with a significant level of detail to enhance the auditor's understanding of the nature and characteristics of fraud.

2 ISA 240 establishes standards and provides guidance on the auditor's responsibility to consider fraud and error in an audit of financial statements. It requires that – when planning and performing audit procedures and evaluating and reporting the audit results – the auditor consider the risk of material misstatements in the financial statements resulting from fraud or error. TSAS 43 draws heavily on ISA 240, which became effective on or after December 15, 2004.

the relation between the fraud risk factors identified by TSAS 43 and the likelihood of fraudulent financial reporting.

Prior studies on fraud risk assessment mainly draw on behavioral decision theory such as using cues (e.g., fraud risk factors) to predict the occurrence of fraud (see Nieschwietz et al. 2000 for a literature review).[3] Unlike prior research, which generally uses an experimental design (e.g., Loebbecke et al 1989; Bell et al. 1991; Bell and Carcello 2000), the current study empirically tests the relation between a set of fraud risk factors identified by TSAS 43 and the likelihood of fraudulent financial reporting.[4] This set of fraud risk factors was originally developed from Cressey's (1953) hypothesis, which has become better known as the "fraud triangle" and then adopted by SAS No. 99 and TSAS 43.[5,6] Like SAS No. 99, TSAS 43 requires auditors to evaluate the potential presence of fraudulent behavior by assessing factors related to perceived pressure, perceived opportunity, and rationalization.

The current study uses Cressey's (1953) fraud risk theory to develop proxy variables to measure pressure, opportunity, and rationalization, because the fraud risk factors are not directly observable. Specifically, we use three variables to proxy

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3 Fewer studies empirically examine fraud related issues, such as Beasley (1996), Summers and Sweeney (1998), and Skousen and Wright (2006).

4 Compared to the U.S., the Taiwanese capital market is less developed and the average listed company size is much smaller. Furthermore, Taiwanese listed companies are characterized by family-control, group-affiliation, cross-shareholding, and less institutional ownership (Chen et al. 2007), which is different from widely dispersed ownership in the U.S. examined in studies such as Krishnan (2003). In contrast, the legal environment in U.S. is comparatively litigious, and an auditor in the U.S. faces a higher likelihood of frivolous but expensive lawsuits (Seetharaman et al. 2002). Class action suits and joint and several liability are also more common in the U.S. In the recent high-profile financial scandals in Taiwan such as Procomp Informatics and Infodisc, the CPAs involved only faced suspension of practice for at most one year.

5 SAS No. 99 and TSAS 43 identify two types of misstatements that auditors must consider: misstatements arising from fraudulent financial reporting and those arising from the misappropriation of assets. The scope of the current study is limited to misstatements related to fraudulent financial reporting.

6 One leg of the fraud triangle represents a perceived non-shareable financial need (i.e., *perceived pressure*). The second leg represents *perceived opportunity*, and the final leg stands for *rationalization*.

for each fraud risk factor, respectively. That is, analyst forecast error, negative cash flow from operations, and the percentage of directors' shareholdings pledged for loans and credits are used to proxy for the pressure risk factor. We use related party transactions, CEO duality, and the deviation between cash flow rights and control rights to proxy for the opportunity risk factor, whereas we use the frequency of earnings restatement, frequency of auditor switches, and frequency of internal auditor switches to proxy for the rationalization risk factor. Based on Cressey's (1953) fraud risk theory, we hypothesized that firms with perceived pressures, perceived opportunities, and rationalization are associated with higher likelihood of fraudulent financial reporting.

We select the sample from the Taiwan Economic Journal (TEJ) financial restatements database. Specifically, we restrict our sample to firms listed on TSEC and GTSM that are subject to financial restatements (because of alleged violations of GAAP) mandated by the Securities and Future Bureau (SFB) during 1996-2006, similar to Accounting and Auditing Enforcement Releases issued by the U.S. Securities Exchange Commissions (SEC). We also include sample firms categorized by the Securities and Futures Investor Protection Center (SFIPC) as fraudulent financial statements cases.[7] All the financial data are drawn from the TEJ database. Using a matched sample of fraud firms and non-fraud firms, similar to Bell and Carcello (2000), we empirically examine whether the proxy variables for fraud risk

7 In an effort to protect investor rights, Taiwan promulgated the Securities Investors and Futures Traders Protection Act, which became effective on January 1, 2003. The Protection Act authorizes the government to establish an institution for protecting investors. In accordance with the Protection Act, the SFIPC was established in 2003. One of its services includes filing class-action litigation or submitting cases for arbitration on behalf of twenty or more securities or futures investors victimized by the same incident. Class-action litigation or arbitration cases due to fraudulent financial statements are among one of the four major crimes specified in the Article 20 and Article 20-1 under the Securities Exchange Law. The sample firms can be retrieved from http://www.sfipc.org.tw/main.asp.

factors, categorized by pressure, opportunity, and rationalization, and identified by TSAS 43, are associated with higher likelihood of fraudulent financial reporting.

The multivariate analyses of fraud-risk factors indicate that all the pressure proxy variables (i.e., analyst forecast errors, negative cash flow from operations, and percentage of directors' shareholdings pledged for loans and credits) are associated with a higher likelihood of fraudulent financial reporting, suggesting that firms with financial pressures are more likely to engage in fraudulent financial reporting. We also find that firms with more related party transactions (one proxy for opportunity) are associated with higher likelihood of fraudulent financial reporting. Finally, we find that firms with a higher frequency of earnings restatements, firms with auditor switches, and firms with internal auditor switches are more likely to engage in fraudulent financial reporting.

The remainder of this paper is organized as follows. The next section presents the related research and the development of the hypotheses, followed by the research design and sample selection in Section III. Section IV discusses the empirical test results and additional analyses, and section V concludes.

II. RELATED RESEARCH AND DEVELOPMENT OF HYPOTHESES

Prior research on fraud risk assessment mainly draws on behavioral decision theory (see Nieschwietz et al. 2000 for a literature review) to examine a number of potential fraud risk factors to predict a future event (e.g., fraud). For example, Loebbecke et al. (1989) examined a model, based on *conditions* in the entity and managerial *motivation* and managerial *attitude* and developed by Loebbecke and Willingham (1988), to assess the likelihood of material management fraud, and reported that at least one risk factors was present in all three model components (i.e.,

conditions, motivation, and attitude). Bell et al. (1991) expanded Loebbecke et al. (1989) to include a non-fraud sample to test Loebbecke and Willingham's (1988) model, and illustrated the best model where the three components contained only those risk factors from their original mapped sets that could correctly (i.e., 74 percent) classify the occurrence of fraud. Following Bell et al.'s (1991) approach of including a non-fraud sample, Bell and Carcello (2000) developed and tested a logistic model to estimate the likelihood of fraudulent financial reporting for an audit client, conditioned on the presence or absence of a set of fraud risk factors. Bell and Carcello (2000) then demonstrated a model with better classification power to effectively discriminate fraudulent financial reporting, and includes fraud risk factors such as rapid growth, weak control environment, and management that lied to the auditors or was overly evasive.

Using publicly available data, Calderon and Green (1994) empirically assess fraud risk factors by using the differences between analysts' earnings forecasts and reporting earnings to predict the occurrence of fraudulent financial reporting. They developed models with relatively moderate error rates for false negatives (9.76% to 15.38%), but much higher error rates for false positives (77.76% to 88%). Beasley (1996) empirically tested the relation between various corporate governance characteristics and the incidence of fraud, and found that board composition (e.g., proportion of outside directors) is negatively associated with fraud. Based on the assumption that external information may contribute to improving fraud assessment, Summers and Sweeney (1998) reported that insider trading patterns provide incremental power in assessing fraud risk, even when allowing for some of the factors uncovered by Bell and Carcello (2000), and Loebbecke et al. (1989). Skousen and Wright (2006) identified a set of potential fraud risk factors to

construct a prediction model to identify the occurrence of fraud. They argue that their model correctly classifies fraud and non-fraud firms approximately 69.77 percent of the time, which is better performance than other fraud prediction models.

In developing our testable hypotheses, the current study is mainly based on Cressey's (1953) framework and the fraud risk factors identified by TSAS 43. Based on a series of interviews about 200 incarcerated inmates who has been convicted of embezzlement at prisons in the Midwest, Cressey's (1953) developed this hypothesis:

> *Trusted persons become trust violators when they conceive of themselves as having a financial problem which is non-shareable, are aware this problem can be secretly resolved by violation of the position of financial trust, and are able to apply to their own conduct in that situation verbalizations which enable them to adjust their conceptions of themselves as trusted persons with their conceptions of themselves as users of the entrusted funds or property.*

The hypothesis has become known as the "fraud triangle", which includes a perceived non-shareable financial need (i.e., incentive/pressure), a perceived opportunity, and rationalization. In Cressey's view, all three elements must be present for a trust violation to occur. Like SAS No. 99, TSAS 43 lists the examples of fraud risk factors in the appendix. The major difference between TSAS 43 and TSAS 14 lies in clarifying the auditor's responsibility to consider the risk of material misstatements in the financial statements due to fraud during the audit process.

Fraud Risk Factor Proxies for Pressure

Under Cressey's (1953) framework, one leg of the fraud triangle represents a perceived non-shareable financial need, which arose from situations that could be divided into six basic categories: (1) violation of ascribed obligations, (2) problems resulting from personal failure, (3) business reversals, (4) physical isolation, (5)

status gaining, and (6) employer-employee relations. In a practitioner's view, Albrecht et al. (2006, 33) divided pressures into four types: (1) financial pressures, (2) vice pressures, (3) work-related pressures, and (4) other pressures, where approximately 95 percent of all frauds involve either financial or vice-related pressures. However, the current study focuses on empirical tests using pressure as an independent variable and its association with the likelihood of fraudulent financial reporting. We follow TSAS 43 and use three proxies (i.e., analyst's forecast error, negative cash flow from operations, and percentage of directors' shareholdings pledged for loans and credits) to measure pressure, which is described below.

TSAS 43 suggests that "excessive pressure exists for management to meet the requirements or expectation of third parties due to the following: such as profitability or trend level expectations of investment analysts, institutional investors etc." Top management focusing on thresholds for earnings is likely to influence the perceptions of financial statement users (e.g., investors) concerned with the firm's performance. One of the earnings thresholds used by top management is to meet analyst's consensus earnings forecast (DeGeorge et al. 1999). Since analyst earnings forecast revisions can be used to reflect information about the persistence of earnings (Barth and Hutton 2004), we use analyst forecast errors, measured by the difference between earnings per share based on analysts' forecasts and actual earnings per share, to capture external pressures faced by top management. We expect a positive relation between analyst forecast errors and the likelihood of fraudulent financial reporting, because the greater the expected gap between analysts' earnings forecasts and actual earnings, the higher the external pressures faced by management, and thus the more likely the presence of fraudulent financial reporting.

H1a: Firms with higher analyst earnings forecast errors will be more likely to engage in fraudulent financial reporting.

TSAS 43 also suggests that "financial stability or profitability is threatened by economic, industry, or entity operating conditions, such as: recurring negative cash flow from operations or an inability to generate cash flow from operations while reporting earnings and earnings growth," which may induce management to commit financial statement fraud. Therefore, we use negative operating cash flows to measure external pressures faced by management, and expect a positive relation between negative operating cash flows and the likelihood of fraudulent financial reporting.

H1b: Firms with negative operating cash flows will be more likely to engage in fraudulent financial reporting.

TSAS 43 also suggests that "information available indicates that management or the board of directors' personal financial situation is threatened by the entity's financial performance…" Beasley (1996) and Dunn (2004) support this argument in that top management, having a significant financial stake in a firm, may have their personal financial position threatened by the firm's financial performance. In Taiwanese listed firms, directors, supervisors, managers and large shareholders (i.e., owning at least 10 percent of a company's outstanding shares) are required to periodically report to the Securities and Futures Bureau (SFB) the percentage of their shareholdings that are pledged for loans and credits. Pledging for loans will reduce the personal funds required for shareholding. We use the stock pledge ratio, measured by the percentage of directors' and supervisors' shareholdings pledged for loans and credits, to proxy for personal financial need as suggested by this standard. If executives and directors increase their stock pledge ratio, their personal degree of

leverage will expand and the risk for their companies will also increase to a certain degree. Lee and Yeh (2004) find that firms with higher stock pledge ratios are more likely to suffer financial distress. Therefore, firms with a higher stock pledge ratio will be more likely to have fraudulent financial reporting.

H1c: Firms with a higher stock pledge ratio will be more likely to engage in fraudulent financial reporting.

Fraud Risk Factor Proxies for Opportunity

According to the fraud triangle model described in Cressey (1953), the presence of a non-shareable financial problem (i.e., incentive/pressure), by itself, will not lead to committing fraud. Although the non-shareable financial problem creates the motive for the perpetrator to commit fraud, the perpetrator must also perceive that he or she has an opportunity to commit fraud without being caught. We follow TSAS No. 43 and use three proxies (i.e., related party transactions, CEO duality, and deviation between control rights and cash flow rights) to measure opportunity, which is described below.

TSAS 43 suggests that "the nature of the industry or the entity's operations provides opportunities to engage in fraudulent financial reporting that can arise from the following: significant related-party transactions not in the ordinary course of business or with related entities not audited or audited by another firm." Recent high-profile accounting scandals such as WorldCom, Tyco and Adelphia raised considerable public concerns about related party transactions, because related party transactions were allegedly used to manipulate earnings, loot companies, and commit fraud (Young 2005). Using a survey of 77 internal auditors, Moyes et al. (2005) find that the existence of related party transactions is ranked the second highest of the opportunity risk factors. Using 52 audit managers to assess fraud risk

under SAS No. 99 for a hypothesized client, Wilks and Zimbelman (2004) find that the risk factor "significant related party transactions" ranks the third most important out of the six opportunity risk factors evaluated. However, in a literature review of related party transactions, Gordon et al. (2007) conclude that survey research suggests that the presence of related party transactions alone does not appear to significantly increase external auditors' client risk assessments. Like Ming and Wong (2003), we use the level of related party sales to measure the related party transaction opportunity risk factor. We expect that firms with higher level of related party sales will be more likely to engage in fraudulent financial reporting.

H2a: Firms with a higher level of related party sales will be more likely to engage in fraudulent financial reporting.

TSAS 43 suggests that there is an increased risk where "there is ineffective monitoring of management as a result of the domination of management by a single person or small group without compensating controls." Firms with ineffective monitoring (e.g., CEO duality) will promote CEO entrenchment, and result in a potential conflict of interest situation that reduces shareholder wealth (Jensen and Meckling 1976). Since the CEO in such a case will in fact be monitoring his own decisions and activities, CEO domination will reduce the board's effectiveness to provide oversight over managerial decisions and activities (Vance 1983). Moreover, domination by the CEO may lead to recording important transactions that are not in the best interest of the entity, since these decisions may not be reviewed.

These arguments suggest that a weak internal control mechanism in a firm, as a result of CEO domination, is likely to have a negative impact on the reliability of the firm's financial reporting. Dechow et al. (1996) provide evidence that firms subject to SEC enforcement actions resulting from earnings manipulations are more likely

to have an insider dominated board and are more likely to have CEO duality. Their results are consistent with the argument that firms with CEO-dominated boards or insider dominated boards are more likely to be associated with lower levels of monitoring and/or weaker internal control systems. Agrawal and Chadha (2005) argue that CEO-dominated firms are more likely to have earnings restatements, but they did not find a significant relation between CEO duality and restatements. We use CEO duality to proxy for the ineffective monitoring concerns raised by TSAS 43, and expect that firms with CEO duality will be more likely to engage in fraudulent financial reporting.

H2b: Firms with CEO and board chairman duality will be more likely to engage in fraudulent financial reporting.

TSAS 43 suggests an increased risk where "there is a complex or unstable organization structure, as evidenced by difficulty in determining the organization or individuals that have controlling interest in the entity." Prior studies suggest that family-control is a dominant characteristic in Taiwanese listed companies (Claessens et al. 2000; Yeh et al. 2001). The agency problem in such companies in an emerging economy is caused by the expropriation of minority shareholders as well as creditors by the controlling shareholders (Shleifer and Vishny 1997), which may be due to the deviation between control rights and cash flow rights, and a lack of strong legal protection of minority investors. The concentrated ownership creates incentives for controlling shareholders to manage earnings to camouflage their self-serving behaviors, which increases the likelihood of fraudulent financial reporting.

Lee and Yeh (2004) further demonstrate that firms with a higher deviation in control away from the cash flow rights are more likely to suffer financial distress. Following LaPorta et al. (2002), we use the ratio of cash flow rights to control rights

to proxy for the opportunity risk factor. We expect that firms with a higher ratio of cash flow rights to control rights will be more likely to engage in fraudulent financial reporting, because a higher control-ownership wedge facilitates managerial opportunism in financial reporting (Kim and Yi 2006; Chen et al. 2007).

H2c: Firms with higher ratio of cash flow rights to control rights will be more likely to engage in fraudulent financial reporting.

Fraud Risk Factor Proxies for Rationalization

The third and final factor in the fraud triangle under Cressey's (1953) framework is rationalization. Cressey (1953) pointed out that rationalization is not an *ex post facto* means of justifying a theft act, but a necessary element of the crime before it occurs. That is to say, rationalization is a part of the motivation for the fraud. Cressey (1953) found that the fraud perpetrators generally rationalized their crimes by viewing them as essentially noncriminal, as justified, or as part of a generally irresponsibility for which they were not completely accountable. We follow TSAS 43 and use the frequency of earnings restatement, frequency of auditor switches, and frequency of internal auditor switches to proxy for the rationalization risk factor, which is described below.

TSAS 43 suggests that "risk factors reflective of attitudes/rationalizations by board members, management, or employees, that allow them to engage in fraudulent financial reporting, may not be susceptible to observation by the auditor….For example, auditors may become aware of the following information that may indicate a risk factor: management failing to correct known reportable conditions on a timely basis." A recent increase in the frequency of earnings restatements, such as Enron, WorldCom, and Waste Management, has raised significant concerns about the quality of financial reporting, and suggest earnings restatements have become the

extreme makeovers of financial reporting. We use the frequency of quarterly (mandatory and voluntary) earnings restatements within the past two years for a specific event year to capture this managerial rationale that management may fail to correct any wrongdoing that was previously requested by the auditor or by regulators such as SFB.[8] Since earnings restatement reflects a loss of quality in financial reporting, we expect that firms with an earnings restatement will be more likely to engage in fraudulent financial reporting.

H3a: Firms with an earnings restatement will be more likely to engage in fraudulent financial reporting.

TSAS 43 suggests that "auditors may become aware of the following information that may indicate a risk factor: the relationship between management and the current or predecessor auditor is strained, such as frequent disputes with the current or predecessor auditor on accounting, auditing, or reporting matters." Sorenson et al. (1983) suggest that a client may use auditor switches to lower the likelihood of detection of fraudulent financial reporting. Loebbecke et al. (1989) document that 36 percent of their fraud sample was perpetrated in the first two years of an auditor's tenure. We use the frequency of auditor switches during our sample period to capture this rationalization risk factor, and expect that auditor switches are related to the likelihood of fraudulent financial reporting.

H3b: Firms with auditor switch will be more likely to engage in fraudulent financial reporting.

We also use the frequency of internal auditor switches during our sample period to capture this rationalization risk factor, because internal audit is among the most common ways that fraud is detected, based on 2004 Report to the Nation on

8 For example, if 1997 is the event year that a sample firm is recognized as a fraud firm, then the variable RST is the total number of quarterly earnings restatements, including mandatory and voluntary restatements, for the years 1995 and 1996.

Occupational Fraud and Abuse conducted by the Association of Certified Fraud Examiners. We also expect that firms with internal auditor switches during our sample period will be more likely to engage in fraudulent financial reporting.

H3c: Firms with an internal auditor switch will be more likely to engage in fraudulent financial reporting.

III. RESEARCH DESIGN AND SAMPLE SELECTION

Regression Models

We use the following logistic regression model to test the relation between fraud risk factors suggested in TSAS 43 and the likelihood of fraudulent financial reporting.

$$FRAUD = \alpha + \beta_1 AFE + \beta_2 NCFO + \beta_3 PLEDGE + \beta_4 RPTS + \beta_5 CEO + \beta_6 DEV + \beta_7 RST + \beta_8 \triangle CPA + \beta_9 \triangle IAUD + \beta_{10} SIZE + \varepsilon \quad (1)$$

where:

FRAUD	= indicator variable coded 1 if the firm is subject to a financial restatement mandated by the SFB or the firm is categorized by SFIPC as a fraudulent financial statement case, and 0 otherwise.
AFE	= the difference between earnings per share based on analysts' forecast and actual earnings per share.
NCFO	= indicator variable coded 1if the firm has negative operating cash flows for the past two years, and 0 otherwise.
PLEDGE	= the percentage of directors' and supervisors' shareholdings that are pledged for loans and credits.
RPTS	= sales to related party, scaled by total assets.
CEO	= indicator variable coded 1 if the firm's CEO and board chairman are the same person, and 0 otherwise.
DEV	= ratio of cash flow rights to control rights
RST	= number of quarterly (mandatory and voluntary) earnings restatements within the past **two** years for a given event firm-year that a sample firm is defined as a fraud firm.
△CPA	= number of auditor switches for a given event firm-year.[9]
△IAUD	= number of internal auditor switches for the past three years for a given event year.
SIZE	= Ln(assets).

9 We compare a firm's incumbent auditor and audit firm with its prior year's list of auditor and audit firm to identify the number of auditor switches for a given event firm-year. There are six companies (company codes are 1230, 1458, 1602, 2538, 5207, and 8705) that incurred 2 auditor switches during a given firm-year, and the others incurred one or no auditor switches during a given firm-year. Our definition of auditor changes excludes auditor changes resulting from CPA firm mergers.

ε = error term.

The dependent variable, FRAUD, is a dummy variable proxy indicating whether the firm has engaged in fraudulent financial reporting. Hypothesis 1 predicts that firms with pressure risk factors are more likely to engage in fraudulent financial reporting. We expect the coefficients on analyst forecast errors (AFE), negative operating cash flows (NCFO), and stock pledge ratio (PLEDGE) to be positively associated with the likelihood of fraudulent financial reporting.

Hypothesis 2 predicts that firms with opportunity risk factors are more likely to engage in fraudulent financial reporting. We expect the coefficients on sales to related parties (RPTS), CEO duality (CEO), and deviation between cash flow rights and control rights (DEV) to be positively associated with the likelihood of fraudulent financial reporting.

Hypothesis 3 predicts that firms with rationalization risk factors are more likely to engage in fraudulent financial reporting. Therefore, we expect the coefficients on earnings restatement frequency (RST), frequency of auditor switches (△CPA), and frequency of internal auditor switches (△IAUD) to be positively associated with the likelihood of fraudulent financial reporting. We control for the effect of firm size (SIZE) and expect the coefficient to be negative, because larger firms have stronger internal control systems than smaller firms (O'Reilly et al. 1998).

For testing our hypotheses, we first use three models to test the association between the specific fraud risk factor proxies (i.e., pressures, opportunities, and rationalizations) and the likelihood of fraudulent financial reporting. Then we use the full model regression which includes all three risk factor proxies and the control variable for firm size to test our hypotheses.

Sample Selection

The initial sample for this study is from two resources that include firms potentially engaged in fraudulent financial reporting. First, we select our sample from the Taiwan Economic Journal (TEJ) financial restatements database. Specifically, we restrict our sample to firms listed in TSEC and GTSM which were subject to financial restatements initiated by the Securities and Future Bureau (SFB) during 1996-2006. The mandatory restatements are alleged violations of Generally Accepted Accounting Principles and Generally Accepted Auditing Standards, similar to Accounting and Auditing Enforcement Releases issued by the U.S. Securities Exchange Commissions (SEC). In addition, we also select our sample from the fraudulent financial statements cases categorized by the Securities and Futures Investor Protection Center (SFIPC).

[Insert Table 1]

Table 1 provides details about the sample selection process and sample characteristics. Our sample period starts in year 1996 and ends in year 2006, the latest data available from the TEJ financial restatement database. As reported in Panel A of Table 1, we begin our sample selection with 123 firms subject to mandatory restatements initiated by SFB during the sample period. We exclude 37 firms with duplicate quarterly or annual earnings within the same sample year. We further exclude 12 firms in the financial services and insurance industries. We also delete 3 firms with incomplete financial data. In addition, we add 26 firms that are categorized by SFIPC as fraudulent financial reporting cases. The final sample combining these two data sources is 97 firm-year observations.

Panel B of Table 1 provides the sample distribution by Taiwan Economic Journal (TEJ) industry code for fraud and non-fraud firms listed on the TSEC and

GTSM. The fraud firms are scattered across a wide range of industries, and the electronics industry has the largest number of fraud firms for both the TSEC and GTSM during the sample period. Following Bell and Carcello (2000), for each fraud firm we obtain 5 non-fraud firms that have the same 2-digit TEJ industry code, the same securities market, and the closest capitalization, except for industries that have less than 5 matched firms or incomplete financial data.

Table 2 presents the descriptive statistics for the 97 fraud sample firms and the matched 467 non-fraud sample firms with univariate tests. For the incentive proxies, analysts forecast errors (AFE), on average, are 3.99 (0.61) percent for fraud (non-fraud) firms. The difference in analysts forecast errors between fraud and non-fraud firms is statistically significant at the 1% level, suggesting that fraud firms are associated with higher analyst forecast errors. On average, 24.7 (11.1) percent of fraud (non-fraud) firms reports negative cash flow from operations (NCFO) for the sample year. The difference in NCFO between fraud and non-fraud firms is statistically significant at the 1% level, indicating that fraud firms are more likely to report negative cash flow from operations than non-fraud firms. The percentage of directors' and supervisors' shareholdings pledged for loans and credits (PLEDGE) is 38.6 (20.5) percent for fraud (non-fraud) firms. The difference in PLEDGE between fraud and non-fraud firms is also statistically significant at the 1% level, suggesting fraud firms are associated with higher PLEDGE ratios.

[Insert Table 2]

For the opportunities proxies, fraud (non-fraud) firms have 18.2 (12.9) percent of sales to related parties (RPTS). The difference in RPTS between fraud and non-fraud firms is statistically significant at the 5% level, indicating that fraud firms have higher sales to related parties. However, the difference in CEO duality (CEO)

between fraud firms and non-fraud firms is not statistically significant. As to control-ownership wedge (DEV), fraud firms have a marginally higher ratio of cash flow rights to control rights than non-fraud firms.

For the rationalization proxies, fraud (non-fraud) firms, on average, have 1.9 (0.2) quarterly earnings restatements within the past two years for a specific event year (RST). The difference in RST between fraud and non-fraud firms is statistically significant at the 1% level, suggesting that fraud firms are more likely to have more financial restatements than non-fraud firms. As to the frequency of auditor (internal auditor) switches, fraud firms are more likely to have auditor (internal auditor) switches than non-fraud firms. After the financial restatements, fraud firms and non-fraud firms are similar in size, measured by total assets.

Table 3 presents the Pearson correlation matrix for the dependent and independent variables. Analyst earnings forecast errors (AFE), negative operating cash flows (NCFO), stock pledge ratios (PLEDGE), sales to related parties (RPTS), frequency of financial restatements (RST), frequency of auditor switches (△CPA), and frequency of internal auditor switches (△IAUD) are significantly and positively correlated with the likelihood of fraudulent financial reporting (FRAUD), which is consistent with the related hypotheses.

[Insert Table 3]

The formal tests are based on multivariate regression analyses. Other correlation coefficients between variables are small and all VIFs are all between 1 and 2. Therefore, the regression models are relatively free from multicollinearity problems.

IV. EMPIRICAL RESULTS AND ADDITIONAL ANALYSES

Regression Results

Tests of the research hypotheses using the presence of fraudulent financial reporting as the dependent variable are reported in Table 4. Hypothesis 1 predicts that firms with pressure risk factors are more likely to engage in fraudulent financial reporting, whereas hypothesis 2 predicts that firms with opportunity risk factors are more likely to engage in fraudulent financial reporting. Hypothesis 3 predicts that firms with rationalization risk factors are more likely to engage in fraudulent financial reporting.

Models 1 to 3 regress the presence of fraudulent financial reporting (FRAUD) on fraud risk factor proxies (i.e., pressure, opportunity, and rationalization) by using a 564 sample observations composed of 97 fraud firms and matched 467 non-fraud firms. In model 1 of Table 4, the coefficients on AFE, NCFO, and PLEDGE are significantly positive, suggesting that firms with pressure risk factors are more likely to engage in fraudulent financial reporting. In model 2 of Table 4, the coefficient on RPTS is significantly positive, indicating that firms with sales to related parties are more likely to engage in fraudulent financial reporting. In model 3, the coefficients on RST, △CPA, and △IAUD are significantly positive, suggesting that firms with rationalization risk factors are more likely to engage in fraudulent financial reporting.

When we use the full regression model 4 that includes all three risk factor proxies and the control variable for firm size to test our hypotheses 1 to 3, the results for each research variable are consistent with the results in model 1 to model 3. For the control variable, the coefficient on firm size (SIZE) is significantly negative, suggesting that smaller firms are more likely to engage in fraudulent financial reporting.

[Insert Table 4]

In sum, our findings demonstrate the importance of fraud risk factors (i.e., pressure, opportunity, and rationalization) used in identifying the likelihood of fraudulent financial reporting. Our results corroborate fraud risk factors identified in TSAS 43 to predict the likelihood of fraudulent financial reporting in Taiwan.

Assessment of Model Performance

Although we used the results from the univariate analyses to construct the final logistic model (i.e., model 4 of Table 4) that achieved the highest level of classification accuracy, it is necessary to evaluate model performance. We first use the Jackknife method to assess classification accuracy, since our sample size is lower than 1000, which Efron (1983) argued is required for an error rate that is close to the true error rate. The Jackknife method attempts to examine results repeatedly without redoing the same test with a new sample, which has been demonstrated to produce more conservative and less biased estimates of true population characteristics (Crask and Perreault 1977).

Given the best model (i.e., model 4) presented in Table 4 to examine the probability of predicting fraudulent financial reporting, we use the Jackknife method to assess the classification accuracy for *our fraud and non-fraud sample* at every cutoff point between 0.05 to 0.95 (scaled in increments of 0.05), and we consider additional cutoff points in the two tails of the distribution, as reported in Table 5. The cutoff points represent the predicted probability of fraud that is derived from using the logistic regression model. Our maximum classificatory accuracy based on the combined fraud and non-fraud sample is at the cutoff value of 0.15. For example, using a cutoff value of 0.10, 81.4 percent of all fraud observations and 66.8 percent of all nonfraud observations are correctly classified.

[Insert Table 5]

We also separate risk categories into "low-risk (0.01<probability of fraud<0.05)", "middle-risk (0.05<probability of fraud<0.10)", "high-risk (0.10<probability of fraud<0.20)", and "very-high-risk (probability of fraud >0.20)". The fraud (non-fraud) sample for the 4 groups are 7 (127), 11 (185), 18 (92), and 61(63), respectively. The combined high- and very-high risk categories capture 79 of the 97 fraud sample (81.5 percent) and include only 155 of the 467 non-fraud samples (33.2 percent). The combined low- and middle-risk categories capture 18 of the 97 fraud sample (18.5 percent) and include only 312 of the 467 non-fraud samples (66.8 percent).

For a robustness check, we also partition our 564 firm-year observations randomly into an estimation sample and a holdout sample to further examine model classification accuracy. The estimation sample contained 49 fraud cases and 233 non-fraud cases, whereas the holdout sample contained 48 fraud cases and 234 non-fraud cases.

Table 6 reports the logistic regression results based on the estimation sample. The overall model evaluation, goodness-of-fit statistics, and overall correction prediction are generally similar to those reported in Table 4. The variables that proxy for Pressures, Opportunities, and Rationalizations remain significant, consistent with the results reported in Table 4. However, the coefficient on SIZE becomes insignificant.

[Insert Table 6]

We also use Jackknife method to assess the classification accuracy for *our estimation and holdout sample* at every cutoff point between 0.05 to 0.95 (scaled in increments of 0.05), and we consider additional cutoff points in the two tails of the distribution, which is presented in Table 7. The maximum classificatory accuracy

based on the combined fraud and non-fraud firms for the estimation sample is also at the cutoff point of 0.15, suggesting that the logistic model (i.e., model 4 in Table 4) is robust across our estimation sample.

[Insert Table 7]

To test the potential effect of sample size on the best model (i.e., model 4 in Table 4) used to predict the likelihood of fraudulent financial reporting, we used the model computed from the logistic regression model demonstrated in Table 6 on the estimation sample to divide the holdout sample (i.e., 48 fraud firms and 234 non-fraud firms) into 4 different risk categories. That is, the "low-risk (0.01<probability of fraud<0.05)", "middle-risk (0.05<probability of fraud<0.10)", "high-risk (0.10<probability of fraud<0.20)", and "very-high-risk (probability of fraud >0.20)". The fraud (non-fraud) firms for the holdout sample in the 4 groups are 3 (81), 6 (60), 4 (43), and 35(49), respectively. The results suggest that the combined high- and very-high risk categories correctly classify 39 of the 48 fraud sample (81.2 percent) and correctly classify 141 of the 234 non-fraud samples (60.2 percent). Our additional analyses further corroborate the "best" model used in the current study.

V. CONCLUSION

Prior studies on fraud risk assessment identify an array of factors that are related to the likelihood of fraudulent financial reporting in various settings. These studies mainly draw on behavioral decision theory such as using cues (e.g., fraud risk factors) and use an experimental design to predict occurrence of fraud (Nieschwietz et al. 2000). The current study empirically tests the relation between a set of fraud risk factors identified by Statement on Auditing Standards No. 43 in Taiwan and the likelihood of fraudulent financial reporting, because recent

high-profile financial failures such as Enron and WorldCom in the U.S., and Procomp Informatics and Infodisc in Taiwan triggered Taiwan's Auditing Standard Board to issue SAS No. 43 to restore public confidence about the integrity of financial reporting and improve the likelihood that fraud will be detected during audit process.

We use Cressey's (1953) fraud risk theory to posit that firms present with perceived pressures, perceived opportunities, and rationalizations are associated with higher likelihood of fraudulent financial reporting. We use fraud risk factors identified by Taiwan's SAS 43 to develop proxy variables to measure pressure, opportunity, and rationalization. We select the sample firms from TEJ's financial restatements database restricted to those mandated by the Securities and Future Bureau (SFB) during 1996-2006, and from the fraudulent financial statements cases categorized by Securities and Futures Investor Protection Center (SFIPC).

Using a matched sample of fraud firms and non-fraud firms similar to Bell and Carcello (2000), we find that all the pressure proxy variables (i.e., analyst forecast errors, negative cash flow from operations, and percentage of directors' shareholdings pledged for loans and credits) are associated with higher likelihood of fraudulent financial reporting, suggesting that Taiwanese listed firms with financial pressures are more likely to engage in fraudulent financial reporting. We also find that firms with more related party transactions (one proxy for opportunity) are associated with higher likelihood of fraudulent financial reporting. Finally, we find that firms with higher frequency of earnings restatements, firms with auditor switches, and firms with internal auditor switches are more likely to engage in fraudulent financial reporting.

To assess model performance, we first use the Jackknife method to assess

classification accuracy for our fraud and non-fraud sample, and then partition our 564 firm-year observations randomly into an estimation sample and holdout sample to further examine model classificatory accuracy. Our maximum classificatory accuracy based on the combined fraud and non-fraud firms (and for the estimation samples) is at the cutoff value of 0.15. The logistic regression results using the estimation sample are generally consistent with the results using the full sample of observations.

In sum, our empirical findings demonstrate the importance of fraud risk factors identified in TSAS No. 43 (i.e., pressures, opportunities, and rationalizations) used to predict the likelihood of fraudulent financial reporting in Taiwan. Combined with the additional logistic regression results and the model classificatory accuracy for our fraud and non-fraud samples, our model performs quite well in differentiating fraud and non-fraud firms.

This study is subject to a number of limitations. First, since fraud is usually difficult to detect and fraud risk factors are not directly observable, this study can only use proxy variables to measure pressure, opportunity, and rationalization identified in TSAS 43. For finalizing the best model to predict the likelihood of fraudulent financial reporting, we drop fraud risk factors such as sales growth as identified in prior studies (e.g., Beasley 1996; Bell and Carcello 2000; Summers and Sweeney 1998). Second, since the distribution of fraudulent financial reporting differs for small and large firms (e.g., Eilifsen et al. 2000), and our sample is limited to listed firms in TSEC and GTSM, our results may not be generalized to small firms in Taiwan.

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TABLE 1
Sample Selection and Sample Distribution

Panel A: Sample Selection Criteria		
Mandatory restatements issued by the SFB (Firm-years), 1996-2006		123
Less:		
Firms with duplicate quarterly or annual earnings restatements within the same sample year	37	
Firms in financial service and insurance industries	12	
Firms with incomplete financial data	3	(52)
Add: Fraudulent financial reporting cases categorized by SFIPC		26
Full Sample		97

Panel B: TEJ Codes Distribution and Market Classification												
Industry (code)	Fraud Firms						Non-Fraud Firms					
	TSEC		GTSM		Total		TSEC		GTSM		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
Cement (11)	1	1.0	0	0.0	1	1.0	5	1.1	0	0.0	5	1.1
Food (12)	9	9.3	1	1.0	10	10.3	45	9.6	1	0.2	46	9.9
Plastics (13)	4	4.1	1	1.0	5	5.2	23	4.9	0	0.0	23	4.9
Textile (14)	9	9.3	0	0.0	9	9.3	45	9.6	0	0.0	45	9.6
Electric& Machinery (15)	5	5.2	0	0.0	5	5.2	25	5.4	0	0.0	25	5.4
Appliance & Cable(16)	3	3.1	0	0.0	3	3.1	15	3.2	0	0.0	15	3.2
Chemicals (17)	1	1.0	0	0.0	1	1.0	5	1.1	0	0.0	5	1.1
Steel (20)	7	7.2	0	0.0	7	7.2	30	6.4	0	0.0	30	6.4
Rubber (21)	2	2.1	0	0.0	2	2.1	10	2.1	0	0.0	10	2.1
Automobiles (22)	2	2.1	0	0.0	2	2.1	6	1.3	0	0.0	6	1.3
Electronics(23)	28	28.9	7	7.2	35	36.1	140	30.0	35	7.5	175	37.5
Construction(25)	8	8.2	1	1.0	9	9.3	40	8.6	5	1.1	45	9.6
Transportation(26)	2	2.1	0	0.0	2	2.1	10	2.1	0	0.0	10	2.1
Tourism (27)	1	1.0	0	0.0	1	1.0	5	1.1	0	0.0	5	1.1
Merchandise (29)	1	1.0	1	1.0	2	2.1	5	1.1	2	0.4	7	1.5
Others (99)	3	3.1	0	0.0	3	3.1	15	3.2	0	0.0	15	3.2
Total	86	88.7	11	11.3	97	100	424	90.8	43	9.2	467	100

TABLE 2
Descriptive Statistics for Risk Factors from TSAS No. 43

Risk Factors from TSAS No. 43		Fraud (N = 97)	Nonfraud (N = 467)	Z Value Wilcoxon Test Median Test
Incentives / Pressures				
AFE	Mean	3.9909	0.6143	4.4185***
	Median	0.9600	0.3121	3.0244***
NCFO	Mean	0.2500	0.1100	3.5677***
	Median	0.0000	0.0000	3.5638***
PLEDGE	Mean	0.3860	0.2052	4.5284***
	Median	0.3005	0.0977	3.2330***
Opportunities				
RPTS	Mean	0.1816	0.1285	1.7757**
	Median	0.0700	0.0400	1.8710**
CEO	Mean	0.2900	0.2400	0.9650
	Median	0.0000	0.0000	0.9655
DEV	Mean	0.8300	0.8100	1.5327*
	Median	0.9800	0.9300	1.8952**
Rationalizations				
RST	Mean	1.1900	0.2000	5.1749***
	Median	0.0000	0.0000	4.7504***
△CPA	Mean	0.1900	0.0150	7.1152***
	Median	0.0000	0.0000	7.1096***
△IAUD	Mean	0.1600	0.0685	2.8672***
	Median	0.0000	0.0000	2.8777***
Control Variable				
SIZE	Mean	9.8062	9.7982	0.3078
	Median	9.7890	9.8093	-0.1115

*, **, *** Significant at p-value < .10, .05, .01, respectively.

FRAUD = indicator variable coded 1 if the firm is subject to financial restatements mandated by the SFB or the firm is categorized by SFIPC as a fraudulent financial statement case, and 0 otherwise.
AFE = the difference between earnings per share based on analysts' forecast and actual earnings per share.
NCFO = indicator variable coded 1if the firm has negative operating cash flows for the past two years, and 0 otherwise.
PLEDGE = the percentage of directors' and supervisors' shareholdings that are pledged for loans and credits.
RPTS = sales to related parties, scaled by total assets.
CEO = indicator variable coded 1 if the firm's CEO and board chairman are the same person, and 0 otherwise.
DEV = ratio of cash flow rights to control rights
RST = number of quarterly (mandatory and voluntary) earnings restatements within the past two years for a given event firm-year that a sample firm is defined as a fraud firm.
△CPA = number of auditor switches at the event year.
△IAUD = number of internal auditor switches for the past three years.
SIZE = Ln(assets) after the financial restatements.

TABLE 3
Correlation matrix for dependent and independent variables (n=564)

	FRAUD	AFE	NCFO	PLEDGE	RPTS	CEO	DEV	RST	△CPA	△IAUD	SIZE
FRAUD	1										
AFE	0.186	1									
	0.000										
NCFO	0.150	0.057	1								
	0.000	0.174									
PLEDGE	0.191	0.002	0.113	1							
	0.000	0.971	0.007								
RPTS	0.075	0.017	-0.057	-0.048	1						
	0.076	0.685	0.174	0.255							
CEO	0.041	0.083	0.036	-0.095	0.092	1					
	0.335	0.049	0.394	0.024	0.028						
DEV	0.065	0.078	0.049	0.173	-0.143	0.130	1				
	0.125	0.063	0.246	0.000	0.001	0.002					
RST	0.218	0.073	0.087	-0.015	0.074	0.118	0.056	1			
	0.000	0.083	0.038	0.727	0.077	0.005	0.183				
△CPA	0.300	0.120	0.021	0.096	-0.013	0.102	0.039	0.056	1		
	0.000	0.004	0.625	0.023	0.751	0.015	0.356	0.185			
△IAUD	0.121	-0.033	0.026	0.002	0.033	0.022	-0.034	0.105	0.139	1	
	0.004	0.440	0.545	0.965	0.437	0.601	0.427	0.013	0.001		
SIZE	0.013	0.004	0.009	0.265	0.090	-0.141	-0.099	0.096	-0.044	-0.051	1
	0.751	0.932	0.840	0.000	0.032	0.001	0.018	0.023	0.302	0.228	

The variables are defined in Table 2.

TABLE 4
Logistic Regression of likelihood of fraud on Fraud Risk Factors:
A matched sample of fraud and non-fraud firms
(n=564)

$Fraud = \beta_0 + \beta_1 AFE + \beta_2 NCFO + \beta_3 PLEDGE + \beta_4 RPTS + \beta_5 CEO + \beta_6 DEV + \beta_7 RST + \beta_8 \triangle CPA + \beta_9 \triangle IAUD + \beta_{10} SIZE + \varepsilon$

Variable	Expected Sign	Model 1		Model 2		Model 3		Model 4	
		Coefficient	Wald χ^2	Coefficient	Wald χ^2	Coefficient	Wald χ^2	Coefficient	Wald χ^2
Intercept		0.5477	0.0282	-2.8095	0.9680	-1.0361	0.1131	3.3351	0.8101
Incentives									
AFE	+	0.2838	28.3506***					0.2875	26.9421***
NCFO	+	0.5846	3.2881*					0.6686	3.5782*
PLEDGE	+	1.8126	18.8582***					2.1453	19.8002***
Opportunities									
RPTS	+			1.1318	5.2128**			1.5754	5.9550**
CEO	+			0.1564	0.5817			-0.1646	0.2436
DEV	-			0.3445	0.6086			-0.5730	1.1539
Attitudes									
RST	+					0.5336	20.2609***	0.5988	21.5385***
△CPA	+					2.5033	27.1958***	2.3824	17.6178***
△IAUD	+					0.5049	2.7430*	0.7288	4.8648**
Control Var.									
SIZE	-	-0.3200	0.9082	0.0755	0.0697	-0.1039	0.1091	-0.6444	2.9113*
LR index		87.9438 (p <.0001)		6.1245 (p =0.1900)		74.6069 (p <.0001)		160.6524 (p <.0001)	
Pseudo R^2		0.1474		0.0108		0.1239		0.2479	
Concordant		73.9%		57.2%		66.2%		84.7%	
Discordant		25.4%		40.6%		28.2%		4.9%	

*, **, *** Significant at p-value < .10, .05, .01, respectively.
The variables are defined in Table 2.

Table 5
Classificatory Accuracy by Jackknife Method

Probability level	Fraud		Nonfraud	
	Correct	%	Correct	%
1.00	0	0.00	467	100.00
0.99	7	7.22	467	100.00
0.98	11	11.34	466	99.79
0.97	12	12.37	466	99.79
0.96	12	12.37	466	99.79
0.95	13	13.40	465	99.57
0.90	19	19.59	465	99.57
0.85	22	22.68	465	99.57
0.80	24	24.74	463	99.14
0.75	25	25.77	462	98.93
0.70	30	30.93	461	98.72
0.65	32	32.99	458	98.07
0.60	34	35.05	458	98.07
0.55	34	35.05	458	98.07
0.50	37	38.14	455	97.43
0.45	39	40.21	451	96.57
0.40	42	43.30	445	95.29
0.35	46	47.42	438	93.79
0.30	48	49.48	437	93.58
0.25	54	55.67	424	90.79
0.20	61	62.89	404	86.51
0.15	69	71.13	376	80.51
0.10	79	81.44	312	66.81
0.09	81	83.51	288	61.67
0.08	83	85.57	266	56.96
0.07	86	88.66	233	49.89
0.06	88	90.72	183	39.19
0.05	90	92.78	127	27.19
0.04	94	96.91	66	14.13
0.03	95	97.94	28	6.00
0.02	97	100.00	3	0.64
0.01	97	100.00	0	0.00
0.00	97	100.00	0	0.00

Table 6
Logistic Regression of likelihood of fraud on Fraud Risk Factors:
Estimation Sample [a]

Chi-Square for Model	= 84.7419
p-value	= <.0001
Pseudo R^2	= .26
Concordant	= 85.8%
Discordant	= 13.9%

Variable [b]	Parameter Estimate	Standard Error	Wald Chi-square	*p*-value
Intercept	-0.0621	5.0169	0.0002	0.9901
AFE	0.3440	0.0880	15.2854	<.0001
NCFO	1.2461	0.4831	6.6546	0.0099
PLEDGE	2.3917	0.6904	12.0017	0.0005
RPT	1.8805	1.0439	3.2452	0.0716
CEO	-0.1633	0.4813	0.1151	0.7345
DEVR	-1.0813	0.7679	1.9828	0.1591
RESTATE	0.5114	0.2257	5.1356	0.0234
△CPA	2.3974	0.7755	9.5575	0.0020
△INCPA	1.1758	0.4387	7.1821	0.0074
SIZE	-0.2796	0.5051	0.3064	0.5799

		Model Predictions [c]	
		Fraud	Nonfraud
Actual	Fraud	35	14
	Nonfraud	28	205

a. Estimated on 49 frauds and 233 nonfraud samples.
b. The variables are defined in Table 2.
c. Based on prior probabilities and cut-off level is 0.2. Accuracy classification rate = (35 + 205) / 282 = 85.1 %.

Table 7
Classification Accuracy of Estimation Sample and Holdout Sample

Predicted Probability of Fraud from Model[c]	Estimation Sample [a]		Holdout Sample [b]	
	Percentage of Observations Correctly Classified		Percentage of Observations Correctly Classified	
	Fraud	Nonfraud	Fraud	Nonfraud
1.00	0.00	100.00	0.00	100.00
0.99	6.12	100.00	6.25	100.00
0.98	6.12	100.00	10.42	99.57
0.97	8.16	100.00	14.58	99.57
0.96	8.16	100.00	18.75	99.57
0.95	8.16	100.00	22.92	99.57
0.90	14.29	100.00	27.08	99.15
0.85	18.37	98.71	29.17	99.15
0.80	24.49	98.71	31.25	99.15
0.75	26.53	98.71	31.25	99.15
0.70	28.57	97.85	33.33	98.29
0.65	32.65	97.42	33.33	98.29
0.60	32.65	97.00	35.42	98.29
0.55	36.73	96.14	35.42	97.44
0.50	38.78	94.42	41.67	97.44
0.45	38.78	93.99	41.67	97.01
0.40	40.82	93.56	41.67	96.58
0.35	46.94	92.70	47.92	95.73
0.30	48.98	91.42	50.00	93.59
0.25	51.02	88.84	52.08	91.03
0.20	61.22	87.12	56.25	86.32
0.15	73.47	81.12	60.42	80.34
0.10	81.63	68.24	66.67	68.80
0.09	83.67	63.09	77.08	63.25
0.08	83.67	60.09	81.25	56.84
0.07	85.71	50.64	87.50	50.00
0.06	87.76	42.49	87.50	38.03
0.05	93.88	36.05	87.50	25.64
0.04	95.92	24.89	91.67	13.68
0.03	95.92	14.16	100.00	5.56
0.02	97.96	4.29	100.00	0.85
0.01	100.00	0.00	100.00	0.00
0.00	100.00	0.00	100.00	0.00

a Estimated on 49 frauds and 233 nonfraud samples.
b Estimated on 48 frauds and 234 nonfraud samples.
c The cutoff points represent the predicted probabilities of fraud that are derived from the application of the logistic regression model.