Neural Network Detection of Management Fraud Using Published Financial Data

Kurt Fanning
Department of Accounting
Central Missouri State University
Warrensburg, Mo. 64093-8888

Kenneth O. Cogger
College of Business
University of Kansas
Lawrence, Ks. 66045-2003

ABSTRACT

This paper uses Artificial Neural Networks to develop a model for detecting management fraud. Although similar to the more widely investigated area of bankruptcy prediction, research has been minimal. To increase the body of knowledge on this subject, we offer an in-depth examination of important publicly available predictors of fraudulent financial statements. We test the value of these suggested variables for detection of fraudulent financial statements within a matched pairs sample. We use a self organizing Artificial Neural Network (ANN) AutoNet in conjunction with standard statistical tools to investigate the usefulness of these publicly available predictors. Our study results in a model with a high probability of detecting fraudulent financial statements on one sample. The study reinforces the validity and efficiency of AutoNet as a research tool and provides additional empirical evidence regarding the merits of suggested red flags for fraudulent financial statements.

Introduction

The use of Artificial Intelligence (AI) to detect management fraud is an unexplored area. Although similar to the well-examined area of bankruptcy prediction, research on management fraud has been minimal. To help increase the knowledge on this subject, this study offers an in-depth examination of important publicly available predictors of fraudulent financial statements (FFS). We use a self-organizing Artificial Neural Network (ANN), AutoNet, with standard statistical tools to investigate the usefulness of publicly available predictors. From this research our study develops a preliminary model with a high probability of detecting FFS using publicly available information for one sample.

Motivation

The passage of the new Federal law regarding class actions lawsuits requires auditors to report management fraud when they find it during corporate audits (Taylor 1995). Proposed new rules indicate that higher standards for the detection of management fraud are forthcoming from the Accounting Standards Board (ASB) (Cheney 1996). These actions increase the need for audit firms to detect management fraud effectively. Management fraud may be defined as "deliberate fraud committed by management that injures investors and creditors through materially misleading financial statements (Eliott and Willingham 1980)" or "intentional or reckless conduct, whether by act or omission, that leads to materially misleading financial statements" (NCFFR 1987).

Uncovering management fraud is a difficult task using normal audit procedures (Porter and Cameron 1987). First, there is a shortage of knowledge concerning the characteristics of management fraud. Second, given its infrequency, most auditors lack the experience necessary to detect it. Finally, managers are deliberately trying to deceive the auditors. Given managers who understand the limitations of an audit, standard auditing procedures may be insufficient. These limitations suggest the need for additional analytical procedures for its detection.

One source for these new analytical procedures is AI. AI in the form of ANN's has shown promise in auditing, accounting, finance, economics, and other fields (Coakley et al. 1995; Fanning et al. 1995; Fanning and Cogger 1994; Yoon et al. 1993; Smith 1993; Chester 1993; Zahedi 1993). In this study we continue this research by integrating ANN's and traditional statistical techniques (McLachlan 1992; Maddala 1991; Elliot and Kennedy 1989; Hosmer and Lemeshow 1989) to develop a robust technique for detecting management fraud. We examined management fraud by testing companies issuing FFS. Our study examines the merits of suggested variables as indicators of FFS. We also offer a preliminary model as a step toward the detection of FFS.

Artificial Neural Networks

Since proven theory is scarce regarding the detection of management fraud, ANN's are appropriate since they possess the ability to identify nonlinear patterns by learning from the data. We use AutoNet in this study. AutoNet was developed using the framework of the generalized adaptive neural network algorithm (GANNA) (Cogger 1992). Cogger (1992) explains the theory underlying GANNA and Fanning et al. (1995) and Fanning and Cogger (1994) proved its effectiveness. Like standard neural networks, GANNA uses processing elements whose parameter values are adjusted by trial and error. Unlike standard neural network approaches the network grows in complexity to solve the current problem. It does not require a priori specification of the number of layers, numbers of nodes, and other network aspects.

Instead of commonly employed sigmoidal transfer functions, AutoNet uses simple quadratic functions. When many such elements are connected in multiple layers, input-output relationships of any form can be modeled. AutoNet adds layers, as needed, in an evolutionary manner, provided each additional layer improves performance, using a squared error metric. To

protect against overspecialization, performance is measured on a validation sample within the training sample. When performance in the validation sample declines, network evolution ceases.

The strength of a GANNA processor is its speed and its self-determination of the correct network structure. An efficient use of a standard ANN such as a Backpropagation requires experienced judgment in making choices about network structure. This can be time consuming and may reduce confidence in the optimality of the chosen structure. By using a self-organizing ANN such as AutoNet, the user can have greater confidence in the result, since the architecture and parameter values are learned from training examples. Finally, since AutoNet uses a self-determined squared error metric for network formation there is no possible user induced bias.

Sample

For our study we required a sample of companies with known FFS. Obtaining such a sample presents a challenge. Rarely do audit firms provide researchers with FFS data. The auditing firms fear the risk of litigation and the possible damage from being associated with FFS. For example, when the Standing Subcommittee on Methods of Perpetration and Detection of Fraud, established after the Cohen commission in 1978, repeatedly requested non-public information regarding management fraud, none was forthcoming (Winters and Sullivan 1994; Ziegler 1980).

In 1933 and 1934 the government passed the Securities Acts of 1933 and 1934. By these acts, auditors of companies that are publicly traded are subject to requirements and penalties of the SEC. For the present study, we note that the act had two main objectives:

> (a) to provide investors with material financial and other information concerning securities offered for public sale; and (b) to **prohibit misrepresentation, deceit, and other fraudulent acts and practices** in the sale of securities generally (whether or not required to be registered).

Since the government delegates enforcement powers concerning management fraud to the SEC, we use the SEC enforcement releases to collect our sample of companies with FFS.

We note that our sample is a sub-sample of the population of companies issuing FFS. It excludes non-public companies since the SEC only has jurisdiction over publicly traded companies. In addition, the sub-sample only includes those companies where the SEC has determined the existence of management fraud. Therefore, the characteristics of companies who are successful in hiding their fraud are not in our sample. These restrictions limit the possible generalizations of the study's results.

Our study uses a matched pairs design to control for industry, fiscal year, and size. This allows the investigation of comparable companies with similar conditions. In addition, the collection of many of the variables requires the use of proxy statements, annual reports and 10-Ks. With a suggested a priori frequency of management fraud of 1 percent (Jones and Maher 1986; Murphy 1980), the analysis of a completely representative sample of companies would be an arduous task. For our study, we have a final sample of 102 FFS. If 99% of our sample were to be non-fraudulent cases, we would need detailed information on 10,098 such companies besides the 102 fraud cases for a total of 10,200 companies. Therefore, we used a matched pair design.

The SEC reports cases where it exercises its enforcement powers in the SEC's Accounting Series Releases (ASR's), Litigation Releases (Lit) and the Accounting & Auditing Series Releases (AAER's). Several prior studies show the value of the SEC enforcement releases in accounting research (Moreland 1995; Beasley 1994; Licata et al. 1993; Campbell and Parker 1992; Green 1991; Feroz et al. 1991; Loebbecke and Willingham 1988). Using the SEC releases as our source of companies issuing FFS has several advantages and disadvantages. Chief among the advantages is that it provides a measure of consistency. This eliminates difficulties in dealing with different procedures and rules defining management fraud. The chief disadvantage is our dependency on the definitions and policies of the SEC for the sample.

Another issue in use of SEC enforcements is assuming the guilt of the companies issuing FFS. These assumptions may not be entirely true. Since the details of discussions between the companies and the SEC are unavailable, it is possible that the company may view conceding as the path of least cost. This raises questions regarding the validity of considering these companies' financial statements as fraudulent. However, from inspection of the enforcement releases and the background on how the SEC pursues litigation, we feel that assuming that the companies issued FFS is reasonable.

The SEC enforces cases of FFS through section 10(b) and rule 10b-5 of the Securities act of 1934. Section 10(b) and rule 10b-5 makes it unlawful for any person to "use or employ" a "manipulative or deceptive device or contrivance" in connection with publicly traded securities. For details of the legal issues surrounding 10(b) and rule 10b-5, see Epstein and Spalding (1993) or Spellmire et al. (1993). We assume that cases involving a violation of rule 10(b) are cases of FFS. While cases involving 10(b) usually involve management fraud, not all cases mentioning 10(b) involve FFS. Several SEC enforcement releases are public announcements and do not involve a financial statement. The companies in these releases are excluded from our sample.

Unfortunately, there is no consistent pattern to the SEC enforcement releases. Therefore, our study uses two additional criteria, besides the explicit mention of 10(b), for deciding whether a SEC enforcement release includes a FFS. The two criteria are violating the anti-fraud provisions or falsifying the accounting records. A retest of our findings excluding non-10(b) companies shows no significant difference in the results.

Beside cases meeting these three criteria, there are other cases in the SEC enforcement releases that may involve companies issuing FFS. For example, many companies violate SEC rule Section 13(b)(2) that requires companies to maintain proper accounting records. Several cases

under this rule probably involve FFS. However, to maintain the integrity of our sample if the company does not meet one of our three criteria, we do not include it in the sample.

After defining the criteria, a search of the SEC dockets provides the relevant enforcement releases. Our search encompassed SEC dockets from January 8, 1980 to December 7, 1993 (Volume 19 No. 1 to volume 53 No. 17). The search included Litigation releases 8957 to 13595 (4,508 cases; 130 cases are not available due to missing SEC dockets). We note that Commerce Clearing House (CCH) publishes a service that includes the ASR's and AAER's. However, the litigation releases are not in the CCH publications. This study examines all AAER's from No. 2 to No. 505. AAER No. 1 is a summation of cases preceding 1971. Because our study uses a COMPUSTAT tape containing data for the period, 1972-1992, the cases before 1972 are not in the sample.

Since the accounting rules, asset valuations and other characteristics for financial companies are different from other companies, we excluded these companies from the current sample (Stice 1991; Dopuch et al. 1987). We can examine these finance companies in a later study. Our sample was further decreased due to lack of data, no mention of a fiscal year, only concerning violations of quarterly reporting, and a shortage of matching companies. These conditions result in a sample of 102 cases of FFS. The sample includes 73 companies from the 10(b) criteria, 24 from anti-fraud provisions and 5 under falsification. Table 1 presents the sample mortality while Tables 2 and 3 provide industry and exchange information.

MATCHING

Using a matched pair design has many benefits (Hunt and Ord 1988; Sibley and Burch 1979; Rubin 1973a, 1973b; and Cochran 1953). An important benefit is that the use of matched pairs controls for external factors. Since our study matches on more than one variable this eliminates most standard randomizing methods (Sibley and Burch 1979). However, a manual

matching process reduces the differences for the matched variables for the fraudulent and the control companies. We controlled for industry, fiscal year end and company size in an attempt to mitigate the effects of seasonal earnings patterns, unique industry characteristics, concurrent economic conditions and firm size. Previous studies such as Stice (1991), Gautschi and Jones (1987) and St. Pierre and Anderson (1982) suggest industry and size as important determinants of litigation versus auditors. Finally, using the same fiscal year attempts to control for general economic conditions.

We matched companies based on sales for the fiscal year involving the first fraudulent financial statement of the company. We correctly match at the 4 digit DNUM level for 97 pairs, 3 digit DNUM level for 4 cases and 1 case at the 2 digit level. The matched pairs at the 3 digit level involved moving up or down by one digit while the 2 digit match correctly agreed with the industry description in the fraud company's 10-K. We also checked the DNUM classification in COMPUSTAT with the companies' individual 10-Ks and Moody's industry summaries to detect any noticeable discrepancies. All summaries agreed with the DNUM classification.

Selecting a correct fiscal year for the matching processing is a difficult task. Since our intent is to develop a model that provides an early warning to auditors, we used the first year that the company has a fraud violation. For example, when a company was charged with fraud for the years 1983 to 1985, we considered 1983 the first fraud year. Since many large frauds start as smaller frauds and expand in the following years (Merchant 1987), focusing on the first year of FFS provides the most help to auditors and the financial community.

An underlying assumption of this fiscal year selection process is that in the years before the first fraud year the company did not issue FFS. This may not always be true, but for our study we assume that the SEC would have prosecuted these years if they could detect any fraudulent

activity. For example, the SEC in prosecuting the company Doughties for fiscal year 1980 and 1981 footnotes the following:

> . . . Doughties and Price Waterhouse & Co., investigators hired by Doughties, have similarly been unable to quantify or allocate overstatements made prior to 1980. Because materiality can be established only for 1980 through mid-1982, the commission limits its opinion to the audits performed for fiscal years 1980-1981.

Thus, we assume that the first year the SEC charges the company with filling FFS is the first year the firm issued FFS. We match fiscal years by maximizing the number of months that overlap between the paired companies. On average the matched pairs overlap by nine and half months with all pairs overlapping a minimum of five months. These actions should cause a control sample that reflects the best match on industry, size and fiscal year possible.

Insuring that our control group does not have FFS is important. We note that no company in the control group is the subject of a SEC enforcement, since the companies are of public record. In addition, we found no public indication of fraudulent behavior in a search of ABI Inform, WSJ Index, Scott's Forecasts, New York Times Index and the company's 10-Ks.

While the process of insuring that the control group is free of FFS is extensive, it does not guarantee that the financial statements in the control group are non-fraudulent. It only guarantees that there is no publicly available management fraud information in the listed sources. Since this only covers information known to this date, there is no guarantee that future information will not prove that members of the control group issued FFS. However, since most of the statements are were filed before 1987, we doubt that any such information exists.

Since we matched companies by sales it is important that the sales be similar between the groups. For most of the matched pairs, the ratio of sales of fraudulent firm to the matched firm is less than 2. Some companies with small or no values for sales create 11 ratios that are greater

than 4. However, we considered these valid matches when viewed in absolute dollars. Retests using a sample excluding the 11 matches shows no significant difference in the results.

Variables

The suggested variables in our study come from many sources. While being a thorough examination of possible predictors of FFS, it is not exhaustive. For example, our study omits possible information in 8-Ks (Emmanuel 1989). These are documents filed with the SEC after a significant occurrence at a company. This includes disagreements between the auditor and the company. We also omit information in newspapers and trade journals. We choose not to use these sources due to time and resource limitations.

Several companies in the sample were missing data for certain variables in COMPUSTAT. For these cases we used the companies' 10-Ks and the Moody's manuals to supply the missing variables. Where necessary, we adjusted the variables to meet COMPUSTAT's definitions. In addition, COMPUSTAT sometimes contains restated values for certain variables instead of the original values. For those instances, we used the original values from the 10-K's.

To find suggested variables, we searched prior works on the topic of management fraud. Such works as Beasley (1994), Bell et al. (1993), Blocher (1993), Bologna et al. (1993), Schilit (1993), Spellmire et al. (1993), Crain (1992), Davia et al. (1992), Arens and Loebbecke (1991), Green (1991), Stice (1991), Loebbecke et al. (1989), Palmrose (1987), Dopuch et al. (1987), Albrecht and Romney (1986), Wallace (1985), Albrecht et al. (1984) and Business Week (1975) contain suggested red flag indicators of management fraud.

There are several details to the data collection testing process that we should describe. First, many variables are from proxy statements and 10-Ks. The values used are from the best available statement closest to the relevant year. For example, while the 10-Ks and proxy statements both report security ownership, we used the 10-Ks when available since the proxy

statement is usually issued 90 days later. If security ownership was not in the 10-K or the 10-K of that year is unobtainable, then we used the proxy statement or the 10-K closest to the first year of fraud.

Second, there were several sub-standard proxy statements and 10-Ks issued by companies in our sample. The poor quality of these documents could contribute to measurement error in the values of the variables. Therefore, to minimize this problem, we confirmed data by using other sources such as Moody's and Standard and Poor's manuals.

Our next step was the reduction of the variables into a parsimonious model. The version of AutoNet used in this study was limited to a maximum of 24 variables. Therefore, it was more efficient to first test the variables with univariate tests and logistic regressions. Thus, we defer the use of AutoNet to later stages of the model building process.

Corporate Governance

Within the context of corporate governance we tested the percentage of outsiders on the board, size of the board, presence of lawyers and academics on the board, existence and structure of the committees, and having the CEO as chairperson. A strong corporate governance system is a possible effective force against management fraud. With the separation between ownership and management of modern corporations, having viable monitoring mechanisms is important (Jensen 1993; Watts and Zimmerman 1986; Fama and Jensen 1983; Jensen and Meckling 1976; Alchian and Demsetz 1972; and Berle and Means 1932). This suggests that the characteristics of the Board of Directors may be important indicators for the detection of FFS.

It has been shown that outside directors may provide better monitoring of the company operations (Himelstein et al. 1994; Beasley 1994; Jensen 1993; Vance 1983). This suggests that they discourage management fraud. Our study uses a conservative definition of outside director. Following Baysinger and Butler (1985), directors who are officers, relatives of officers or former

officers of the firm are considered inside directors for our study. Directors involved in an interlocking relationship and directors who are lawyers or other consultants that received fees are considered inside directors.

Gautschi and Jones (1987) and Eliott and Willingham (1980) argue that having a lawyer on the board of directors mitigates the chances of corporate malfeasance. An individual with a legal background provides a director working under a professional code of ethics. Such an individual should be less likely to be involved with illegal acts and irregularities. A lawyer should be more alert to violations of the law. In support of this premise, Gautschi and Jones (1987) found a negative correlation between the presence of lawyers on the Board and corporate misconduct. This suggests having a lawyer on the Board lowers the probability of a FFS. We code any director in the legal profession as a lawyer. The coding for the variable is a binary classification with instances of multiple lawyers counting as a single lawyer. However, since there were only four companies with more than one lawyer on the Board, the issue is moot.

Some argue that the presence of an academic on the Board of Directors should help mitigate corporate malfeasance (Vance 1983). Being isolated from the rigors of the corporate world, the academic members of the board may maintain a professional independence in their actions. This suggests that the presence of an academic on the Board lowers the probability of FFS. Since we coded this as a binary variable, multiple members from the academic community on the Board count as only a single instance. Since only two companies had more than one academic on their Board an investigation into the effect of multiple academics is unnecessary. The individuals from the academic community in our study were always from Universities and Colleges.

Whether the size of the Board of Directors adds to its effectiveness as a monitoring agent is a debatable one (Jensen 1993; Gautschi and Jones 1987; Chaganti et al. 1985). It may be that

the larger the board, the better the monitoring performance due to the extra experience and expertise of the additional members. One study suggests a statistically significant association between a smaller Board and company failure (Chaganti et al. 1985). The results in Beasley (1994) suggest that the Board size of the companies with non-FFS is statistically larger than the companies with FFS. However, another study finds that incidence of illegal corporate behavior is positively, not negatively, correlated to the size of the board (Gautschi and Jones 1987). Finally, another study suggests that the size of the board is irrelevant to the company's performance (Vance 1983). While the evidence is mixed, we included board size as a possible important variable.

Committees are possible important measures for the governance of companies (Korn/Ferry 1993; Kesner 1988; Harrison 1987; Braiotta and Sommer 1987). One motive for the growth of the use of committees is the attempt to signal to the investing public that directors are acting responsibly (Harrison 1987). The audit committee may be the most important committee for prevention of fraud (McMullen 1996; Beasley 1994; Vinten and Lee 1993; Verschoor 1993; Braiotta 1992; Knapp 1991; GAO 1989; Pincus 1989; Pany et al. 1981; SEC 1980). McMullen's (1996) findings suggest an association between the lack of an audit committee and likelihood of management fraud. The Treadway commission (NCFFR 1987) suggests that the number one agent for fraud prevention is the audit committee.

We investigated whether the companies filing FFS lacked audit committees more often than the control group. Second, for those companies having audit committees, we also investigated whether the composition of the audit committee differed. Having an audit committee does not guarantee that corporate governance operates effectively. The American Law Institute (ALI) recommends that all audit committee members be "free of any significant relationship" with senior executives (Verschoor 1993). This suggests that the higher the proportion of outsiders on

the audit committees, the lower the probability of FFS. To test the relationship of outside board directors on the audit committee and FFS, we classified members of the audit committee using the same rules as outside board directors. We then compared the percentage of outside board directors of the two groups.

Another important monitoring committee is the nominating committee (Braiotta and Sommer 1987; Bacon 1981; Pany et al. 1981). Nominating committees can be a powerful tool to help monitor the composition of the Board of Directors (Braiotta and Sommer 1987). Having a separate committee responsible for the eligibility of those running for the Board, helps restore power to the Board. However, since the CEO is usually also the Chairperson and most nominees are recommendations of the Chairperson, the additional control offered by a nominating committee may be small (Mace 1986). Some critics even argue that nominating committees are a sham (Hanson 1989).

Our study tested whether the existence of a nominating committee is more highly associated with companies issuing FFS. We also tested whether companies with a nominating committee issuing FFS have a greater proportion of outside directors on their nominating committee than the control group. The mere existence of a nominating committee may be a wrong signal if the CEO and inside directors dominate the committee.

Compensation committees are another important corporate governance committee (Braiotta and Sommer 1987; Pany et al.1981). A compensation committee can be seen as a monitoring device that helps alleviate certain agency problems. Diminishing the agency problem may remove possible motivation for committing management fraud. Therefore, the existence of a compensation committee should be more associated with the control group. We also examined whether companies with a compensation committee and issued FFS have a smaller proportion of

outsiders on the compensation committee than the control group. This procedure tested whether insider control bypasses the monitoring potential of a compensation committee.

Finally, we followed upon the suggestion that the executive committee forms a major part of the corporate governance (Gautschi and Jones 1987). In contrast to the audit committee, we expected to find a positive relationship between the presence of an executive committee and FFS. The establishment of an executive committee may be an attempt by top management to insulate their activities from the other members of the Board. This is due to the increased ability of top management to conceal their activities by having all important activities take place within the executive committee. We also tested whether companies that issued FFS and have an executive committee contain a smaller proportion of outside directors than the control group. Gautschi and Jones (1987) found that as the number of outside members on the executive committee increases, the number of violations decreased.

There has been an argument made that having the Chief Executive Officer (CEO) as Chairperson of the Board diminishes the effectiveness of the Board to govern the corporation (Beasley 1994; Jensen 1993; Lipton and Lorsch 1992; Kesner and Johnston 1990; Dalton and Kesner 1987; Kesner and Dalton 1986; Nader 1984). Since the Chairperson of the Board usually controls committee assignments, having the CEO as Chairperson may decrease the effectiveness of the committees. Therefore, our study tested whether companies issuing FFS have a greater incidence of having the CEO as the Chairperson of the Board.

Auditor

In the study we examined auditor quality, auditor change, and qualification of financial reports by the auditor. Beatty (1989) and DeAngelo (1981) suggest that larger auditing firms, i.e. the Big Six, with more invested in their reputational capital have greater incentives to reduce audit

errors. Since the opportunity costs of losing the audit are a much smaller proportion of the larger firm's total revenues, they may be less willing to ignore discovered material errors.
The larger firms may have greater experience concerning the individual industries and possess greater resources, thus may be able to provide higher audit quality (Benston 1980).

As a partial validation of the reputational value of the larger firms, several studies suggest that the Initial Public Offerings (IPO's) audited by the Big Six have smaller underpricings than non-Big Six auditors (Menon and Williams 1991; Simunic and Stein 1987). The accounting literature finds that larger auditing firms command a premium in their fees suggesting that Big Six auditors provide higher quality audits (Davis and Simon 1992). To this end we examined whether companies with FFS are more likely to be associated with non-Big Six auditors.

Auditor changes (opinion shopping) may be more closely associated with companies issuing FFS (Bradley 1985). For example, if the company does not agree with the policies of its current auditor, it may seek a more flexible auditor. Stice (1991) found a strong negative association between auditor tenure and litigation. A possible explanation is that the high cost of learning the companies' business precludes an effective audit. This agrees with arguments that companies with new auditors may receive substandard audits (Knapp 1991; NCFFR 1987; St. Pierre and Anderson 1982). Such findings suggest that new auditors may have a decreased probability of finding FFS. However, there is the competing argument that long auditor tenures leads to complacency and overconfidence that diminish the effectiveness of the audit (Shockley 1981). We tested the importance of auditor changes to detection of FFS over a three and one year period. The three-year period includes the first year of the FFS and the two years before this first year. Any audit change over the three-year period counts as an audit change. The one year period covers only the first year of the FFS.

A qualification of the audit opinion is a warning signal of weakness in a company's accounting or financial condition (Lev and Thiagarajan 1993; Arens and Loebbecke 1991). It suggests that the firm lacks a clean bill of health from their auditors. Therefore, it seems likely that companies with audit qualifications may be more associated with companies with FFS than the control group. An opposing argument suggests that companies with FFS would wish to avoid the additional attention that an audit qualification would bring.

To simplify matters and avoid weighting the merits of the different types of audit reports, the model is a binary variable where the audit report is either unqualified or qualified. Therefore we merged the subject to with the qualified audit reports. Our first test looks at any qualification within a three-year period. Since more current information may provide better information, we also tested audit qualifications during the first year.

Agency Problems

Within the umbrella of agency theory we examined the issues of percentage of stock ownership by top management and compensation plans. Jensen and Meckling (1976) and Watts and Zimmerman (1986) question the effect of separation of management and ownership have had on modern corporations. When activities are costless to the individuals in management position, the individuals may take additional perks and benefits (Fama and Jensen 1983). Management fraud is possibly the ultimate theft of perks. Agency theory suggests that as management ownership increases, the chances for FFS should decrease (Beasley 1994).

The stock ownership of the directors and officers, as given in the proxy statements, provides the measure for top management's control of the company. Since the proxy statements for five pre-1979 companies (stock ownership reporting not required till after 1979) are missing values for stock ownership, we used the average values for each group for these companies. A retest excluding these companies shows no significant change in the results.

Since fraudulent behavior may be a result of the moral climate established by the leader of the firm, it is worth examining CEO stock ownership (Jensen 1993; NCFFR 1987; Clinard 1983). Agency theory suggests that aligning the interests of managers and owners increases firm value by reducing the monitoring costs required to insure that managers act in the owner's best interest. Thus, agency theory suggests that as the stock ownership by the CEO increases, the likelihood of management fraud should decrease. We consider the Chairperson of the Board the CEO when there is no mention of a CEO.

The ability of compensation plans to realign management and ownership is unclear. Some suggest that short term bonus plans may help align managers and outside owners (Waegelein 1988). Others suggest that if managers receive bonuses on near term results, the managers may be myopic in their decisions (Schilit 1993; NCFFR 1987). Zmijewski and Hagerman (1981) suggest that managers with short term incentive plans are more likely to choose accounting procedures that shift reported earnings from future to current periods. This suggests that a short term compensation plan may increase the probability of FFS.

We defined short term cash bonus plans as those that either encompasses all officers or pay only to the CEO and selected officers based on current years results. This is a binary variable. The same arguments regarding short-term cash compensation plans and FFS are also applicable to profit sharing plans. If the firm has a profit sharing plan, then the managers may be more likely to issue FFS.

One mechanism to mitigate the agency problem is a long term compensation plan. The plan, usually a stock option plan, should help control the issuing of FFS by aligning the long term interests of the managers and owners. We tested the association of long-term plans and FFS using a binary variable.

Subsidiaries

Some suggest that organizational complexity, i.e., a large number of subsidiaries, is associated with FFS (Loebbecke et al. 1989). Creating many subsidiaries may ease the creation of fictitious inventory and other accounting entries. Since the companies in our study showed little change in the number of subsidiaries, we only tested the variable over the first year of the fraud.

The existence of a foreign subsidiaries may increase the probability of FFS. The existence of a foreign subsidiary may inhibit the ability of the auditing firms. Since many companies in our sample have a Canadian or Mexican subsidiary, a company must have had more than one foreign subsidiary to be marked as having foreign operations. Using this criterion provides a better indication of companies with organizational complexity due to foreign operations.

Capital Structure

It is an open question whether a high debt structure is associated with FFS (Persons 1995). A high debt structure may increase the likelihood of FFS since it shifts the risk from equity owners and managers to debt owners. Research suggests that the potential for wealth transfers from debt holders to managers increases as leverage increases (Chow and Rice 1982; Jensen and Meckling 1976). Management may be manipulating financial statements, due to the need to meet certain debt covenants. This suggests that higher levels of debt may increase the probability of FFS. We measured this through the difference in debt levels and the ratio of debt to equity.

Operating Results

Financial distress may be a motivation for management fraud (Stice 1991; Loebbecke et al. 1989; Kinney and McDaniel 1989; Kreutzfeldt and Wallace 1986). When the company is doing poorly there is greater motivation to engage in management fraud. The results in Hamer (1983) suggests that most models predict bankruptcy with similar ability. Therefore, we used the Altman (1968, 1983) Z score to investigate the association of FFS and financial distress.

Z = 1.2(working capital/total assets) + 1.4(retained earnings/total assets) + 3.3(earnings before interest and taxes/total assets) + 0.06(market value of equity/book value of total debt) + 1.0(sales/total assets)

Loebbecke et al. (1989) suggest that the need for continued growth as a motivation for management fraud. Companies unable to achieve similar results to past performances may engage in fraudulent activities to maintain the previous trends (Stice et al. 1991). Rapid growth may also cause a decrease in the effectiveness of internal control (Stice 1991). Companies who are growing rapidly may exceed the monitoring processes ability to provide proper supervision. We measured growth as geometric sales growth for the previous two years. Many companies lack the data to consider using a longer period.

Persons (1995) suggests that fraud companies may be less likely to generate the same sales to total assets as non-fraud companies. We tested this using the ratio of sales to total assets.

Personnel

There are several possible personnel variables that may be associated with FFS; CEO turnover, CFO turnover, instances where the CEO is also the treasurer, and family relationships. If top management suspects that the CEO is engaging in fraudulent behavior, they may ask him to resign. The CEO may decide to leave before the discovery of the fraud. In these instances, turnover at CEO level may help predict FFS. We measured the CEO turnover as binary variable over a 1 year and a 3-year period with multiple changes counting as a single change.

The same arguments also apply to Chief Financial Officer (CFO) turnover (Business Week 1975). The CFO may have perpetrated the fraudulent behavior and the company removed the CFO hoping that their motive goes unnoticed. Also, the CFO may leave if the CFO feels that the company may discover the fraud. We measured CFO turnover by any change to the Chief Financial Officer, Vice-President of Finance or Treasurer over 1 year and 3 years. This is a binary

variable with multiple changes in CFO, including changes in both the treasurer and the CFO (when they are different) counting as a single change.

A fundamental rule of internal control is the principle of separation of duties (Arens and Loebbecke 1991). There has long been an association between the failure to segregate duties and management fraud (Albrecht et al. 1984). Two of the most important positions at the companies for preventing FFS are the CEO and CFO. Therefore, having the CEO serve as the CFO may be strongly associated with FFS. For our study, we measured the separation of duties as the proportion of companies where the CEO is also the CFO, V.P. of Finance, or Treasurer.

The SEC also requires the disclosure of any family relationships between the directors and officers. Relationships between officers and directors may aid fraudulent behavior since it increases the possibility of collusion. This is a binary variable with multiple relationships counting as only a single instance of a relationship.

Litigation

The SEC requires companies filing 10-Ks with SEC to disclose any involvement with litigation during the past year. Litigation may be a warning sign that the company may be issuing FFS (Business Week 1975). We tested whether companies engaging in fraudulent behavior are more likely to be involved in litigation. We measured this by the existence of any litigation over the three periods including and before the first fraud year. This is a binary variable with multiple litigations in the different years still counting as only one case of litigation.

Since not all three years of 10-Ks are available for all companies, the litigation variable only measures the years available. Another problem is the self reporting process for litigation in the 10-Ks. If a company engages in FFS there is no guarantee that the company is also reporting its litigation on the 10-K correctly, although such an omission is illegal and moreover, detectable by the SEC.

Accounting Choices

We examined the relationship between a company's choice in inventory valuation methods and type of depreciation, and FFS. Managers involved in fraudulent activities may attempt to disguise their actions through accounting choices. By selecting different valuation methods, management can increase or decrease stated values for various variables (Dhaliwal et al. 1982; Salamon and Smith 1979). Management's selection of inventory valuation method can significantly affect its financial statements (Zmijewski and Hagerman 1981). The selection of LIFO in times of rising prices reduces earnings, while using FIFO creates higher earnings. If the managers are engaging in fraud, they may wish to report higher earnings to forestall stockholder investigations into their actions. For our study, prices were generally rising and the choice of LIFO leads to more conservative estimates of earnings (Lev and Thiagarajan 1993). Therefore, companies with FFS may be less likely to choose LIFO during our study period. We used the primary method of inventory valuation during company's first fraud year for the variable. The variable is binary. Several companies do not have inventory but since this is primarily a result of the type of industry, the matched pair design controls for this factor.

Depreciation method is another accounting choice that can increase or decrease earnings. By choosing straight line depreciation over accelerated methods the manager can increase earnings in the current period. Similar to the inventory choice, individuals may attempt to increase earnings to mask their irregularities. Dhaliwal et al. (1982) suggest that manager controlled companies are more likely to choose the straight line depreciation due to its effect on earnings. However, Niehaus (1989) did not find any such relationship. This is a binary variable where the company used either an accelerated depreciation method or straight line.

Financial Statement Accounts and Ratios

There are certain financial statement variables that are more likely to be subject to manipulation by management. These accounts include sales, accounts receivable, allowance for doubtful accounts and inventory (Schilit 1993; Green 1991; Loebbecke et al. 1989; Wright and Ashton 1989; Hylas and Ashton 1982). The subjective nature of the judgments involved with these accounts makes them more difficult to audit. In some instances we used the natural log transformation for the account variables in an attempt to induce normality and stabilize variances (Neter et al. 1996).

Persons (1995), Schilit (1993), Stice (1991), Green (1991), Feroz et al. (1991) and Simunic (1980) suggest that management may manipulate accounts receivable. The fraudulent activity of recording sales before it is earned may show as an additional accounts receivable. We tested this by comparing the account and the ratios of accounts receivable to sales (Green 1991; Daroca and Holder 1985) and accounts receivable to total assets (Stice 1991).

Persons (1995), Spellmire et al. (1993), Schilit (1993), Crain (1992), Stice (1991), and Simunic (1980) also suggest that management may manipulate inventories. The company may not match the corresponding cost of goods sold (COGS). This increases gross margin, net income and strengthens the balance sheet. Another type of manipulation involves the process of reporting inventory at lower of cost or market. The company may choose not to record the right amount of obsolete inventory. Therefore, we tested whether companies with FFS are more likely to have a higher proportion of inventory, the ratio of inventory to sales and the ratio of inventory to total assets. We also investigated whether companies issuing FFS may have a higher gross margin percentage than the control group.

As a contra-asset account whose value uses management's judgment, the allowance for doubtful accounts is also subject to manipulation (Schilit 1993; Green 1991). To test this variable, our study tested the difference between the balances in allowance for doubtful accounts

for the two groups. We first tested the ratio of allowance for doubtful accounts to sales and then the ratio of allowance for doubtful accounts to accounts receivable.

We examined several possible financial statement red flag variables, such as net property plant and equipment, total assets, retained earnings, working capital, the ratio of property, plant and equipment to total assets and sales to total assets for their ability to predict FFS. The ratio of sales to total assets was significant predicator in prior research (Persons 1995). We also investigated possible red flag variables from the income statement including sales, cost of goods sold, earnings before interest and taxes, extraordinary items and the ratios of return on sales and , return on equity.

Trend Analysis

Trend analysis has been successful in finding material irregularities and errors (Blocker 1993; Green 1991; McKee 1989; Knechel 1986; Blocher and Willingham 1985). These works established that auditors and analysts often use a 10 % change as a threshold for a material change in accounts or ratios (Green 1991; Loebbecke and Steinbart 1987; Kinney 1987). We tested whether a greater than 10% change in the accounts receivable and gross margin are indicators of FFS. We recorded a trend variable if the company's accounts receivable or gross margin percentage exceeds 110% of the previous years value.

Results of the Univariate Testing

We used those variables significant at 25% level on the univariate tests for further model development. The univariate tests suggest several variables may be helpful in detecting FFS. We report the results of univariate tests in tables 4-8 to provide evidence about the statistical significance of the variables. Since diagnostic tests showed that the variables are not normally distributed, the reported non-parametric tests are more appropriate (Siegal 1956). We used the Wilcoxon sign rank test for continuous variables and chi-squared tests for dichotomous

variables. T-tests results are similar in direction and magnitude to the reported non-parametric tests.

In the corporate governance area (Table 4), Board size, percentage of outsiders on the board, the existence of an audit committee, the existence of a compensation committee and the CEO also being the Chairperson significant variables (Table 4). The high number of variables from corporate governance suggests that a failure in this area is highly associated with FFS. These results agree with results in prior research (Beasley 1994).

The academic or legal variables seem not to be associated with FFS. Perhaps more precise knowledge of the backgrounds of the board of directors than that obtainable from proxy statements could change the results. Neither the executive nor nominating committee variable proves significant. Very few firms in our study even had these committees. Since these have grown in popularity perhaps reexamination of these variables using more recent data may produce different results. The tests on the percentage of outsiders on the four committees suggest no statistical significance. With the Board of Directors consisting of only 4 to 6 members, it was not usual for the only outside members on the board to be the audit and compensating committees. This may explain the lack of difference between the two groups in our study.

The use of a non-Big Six auditor is the only statistically significant variable relating to the auditor (Table 5). It is surprising that the auditor variables provide little information. It appears that using the audit report to predict FFS is not an important option. The only agency variable that is statistically significant is the presence of a profit sharing plant. The results suggest that having a profit sharing plan is more closely associated with the companies with non-FFS. Perhaps suggesting that a profit sharing plan helps mitigate certain agency problems. The other compensation plan variables were not significant. Given the agency viewpoint, it is surprising that

there may be no difference in the stock ownership of the two groups. There is always the possibility that our use of shares owned by all directors and officers is not a correct proxy for management ownership. Using a more refined measurement, Beasley (1994) did find a relationship between companies with non-FFS and management that has a greater stock ownership. Thus, the agency variables may be more useful in a different form.

There is no statistically significant difference regarding the number or type of subsidiaries. A company's geometric growth over a three-year period is statistically significant (Table 6). Only the change of the CFO over a 3-year period is statistically significant for the personnel change variables. As expected, the combination of the CEO and CFO position is statistically significant with the fraud sample having a greater number of instances. The choice of using LIFO for inventory valuation is statistically significant supporting the suggestion that companies with FFS choose LIFO less often. There is no statistically significant difference regarding having family within the organization. Our controlling for the size matches companies where family relationships are not usual. This suggests that having a family member varies with size. The depreciation method variable was not statistically significantly. Most companies used straight line with those using an accelerated depreciation method being in certain industries. Thus controlling for industry suggests that the choice of a depreciation method varied with industry.

Many individual accounts are statistically significant (Table 7). These include Accounts receivable, Allowance for doubtful accounts, Inventory, Total assets, Debt and Earnings before interest and taxes. Given the significance of accounts receivable and inventory it is surprising that working capital is not significant. It seems that two groups have the same amount of working capital just distributed differently.

The ratios accounts receivable/sales, accounts receivable/ total assets, inventory/sales, net property, plant and equipment/total assets, debt/equity, and sales/total assets are statistically

significant (Table 8). In addition, the two trend variables are statistically significant. These results reinforce the importance of using ratio and trend analysis as analytical procedures.

In summation, the univariate tests provide valuable information regarding a large number of variables over a large sample. While some suggested variables are not statistically significant in our study, the results should be viewed cautiously. Our study examines these variables at the aggregate level on one sample and generalizations to specific cases should be made carefully. Every case of management fraud is separate and the variables not significant in the aggregate may still be useful indicators for a particular case.

Multivariate Results

Since we are interested in a parsimonious portmanteau model that auditors would find useful, the individual variables such as total assets, accounts receivable, etc. are not included in the model development. While several of these are good predictors in our study, they lack the ability to transfer to other samples. Ratios are better able to generalize and we use them in the model development. There is a high natural correlation between the ratios accounts receivables to total assets and the accounts receivables to sales. To achieve our objective of a parsimonious model, since investigating the same variables would be wasteful for auditors, we needed to select between these ratios. We selected the ratio of accounts receivables to sales since stepwise logistic regressions suggest that it has the best potential.

There were sixty-two possible variables in our study with the results of the univariate tests and elimination of the accounts receivables to total assets variable reducing this number to twenty variables. These twenty variables represent the most relevant variables for additional model development. Table 9 shows their means and standard deviations.

The next step in securing a model was the application of multivariate tests and AutoNet. The univariate results for the variables are informative but there is the question whether the

association in a univariate test is a direct association or whether there is a joint correlation with a third variable. Also, a univariate test does not allow detection of interaction effects that AutoNet or multivariate tests may find. We developed four models: (1) stepwise logistic regression; (2) stepwise linear discriminant analysis; (3) stepwise quadratic discriminant analysis and (4) AutoNet.

Since the desired result is the development of the best discriminant function for future prediction, using the entire sample of 204 companies makes the most sense. However, the results of reporting without a hold out sample are upwardly biased (Frank et al. 1965). Therefore, we used a holdout sample. Since AutoNet has an upper limit of 150 companies for its sample size, we used this as the cutoff point for the training sample. Having 150 firms in the training sample results in 74 percent of the pairs being in the training sample and 26 percent in the holdout sample. The SAS procedure for linear and quadratic discriminant analysis automatically provides the values for the training and holdout samples. For logistic regression, the holdout results are obtained by entering the variables into the Logistic model. We make a similar computation with the ANN model.

We recognize the need to incorporate the costs of misclassifications in any true model (Dopuch et al. 1987). In addition implicated in our matched pairs design is an assumption of equal a priori probabilities of FFS and non-FFS. This creates a choice-based sample bias since the population does not have equal probabilites (Palepu 1986). We choose to present the results in table 10 assuming equal costs of type 1 and type 2 errors and equal prior probabilities since these are preliminary results. Thus, the results presented in table 10 should be viewed as an indication of the merits of the various variables and AutoNet rather than a true model. Future research will address these issues.

Table 10 reports the results for the Linear, Quadratic and Logistic models using the same number of variables as selected by AutoNet. The results in table 10 report the correct classification by four methods of classification. Since we have a binary model with several binary variables, the necessary assumptions for linear and quadratic discriminant analysis are violated. However, prior research suggests that both methods are robust even where the necessary conditions do not exist (Neter et al. 1996). Logistic regression is appropriate for our sample that disproportionately samples from two populations (Maddala 1991). We used these three methods as benchmarks for the ANN results.

We trained the models on the first 75 matched pairs with the last 54 matched pairs as the holdout sample. This represents a chronological split with the training samples representing the earlier cases. The results for each method are roughly similar in the training sample but only AutoNet maintains its accuracy in the holdout sample for both Fraud and Non-fraud companies. Since there is a difference in the variables selected by the GANNA processor, we suggest this may be the reason for its success. Also, AutoNet incorporates nonlinear features that may explain its ability to generalize to the holdout sample.

The variables selected by AutoNet are the outside director, having a non Big Six auditor, the geometric growth rate, accounts receivable to sales, net plant property and equipment to total assets, debt to equity and the trend variables for accounts receivable and gross margin. The percentage of outside directors suggests that additional outside directors may provide additional oversight that helps prevent FFS. The non-Big Six auditor variable suggests that Big Six auditors may offer abilities that help prevent the issuing of FFS. Since growth is a non-linear variable, AutoNet can capture it. The growth rate in sales for the companies with FFS is less than the control companies. This suggests that companies with FFS may be facing slower growth. This may cause managers to engage in fraud.

The higher proportion of accounts receivable to sales of the companies with FFS agrees with research that suggests that accounts receivable is an asset higher with a higher degree of manipulation. The net property plant and equipment to total assets ratio is higher for non-FFS companies. The ratio of net plant property and equipment to total assets suggests that companies with FFS may not be depreciating assets as rapidly. Also, the property, plant and equipment assets are perhaps less easy to manipulate. Since the companies with FFS have higher debt to equity, additional debt may be a good indicator of FFS. The trend variables may show the fraudulent companies manipulating the underlying variables.

The models for discriminant analysis and logistic regression contained the same variables with five out of eight variables the same as AutoNet. The three different variables are the change in CFO over a 3-year period, the use of the inventory method, and the sales to total assets. These substitute for the variables growth, accounts receivable to sales and property, plant and equipment to total assets. This suggests that longer tenure at these positions may be not be helpful since the non-FFS companies had the larger change in turnover. The inventory variable supports the viewing the choice of LIFO as indicator of higher quality earnings since Non-FFS were more likely to choose it. Finally, the sales to total assets shows that companies with FFS are operating at less efficiency since they get fewer sales for the same total assets.

We offer the AutoNet model from Table 10 as our best preliminary model for detection of FFS. Its ability to predict 63 percent of the holdout sample is statistically significant at < 1 %. None of the other models had prediction accuracies much greater than 50 percent, or, randomly guessing.

Discussion

The results of our model suggest there is potential in detecting finding FFS through analysis of public documents. We suggest that ANN's offer superior ability to standard statistical

methods in detecting FFS. AutoNet offers the advantage of quickly developing models for analysis. Alternative ANN's such as Adaptive Logit Networks (Fanning et al. 1995) also offer potential for detection of FFS.

There were several publicly available variables left for future study. Such variables include within industry comparisons and long term trends. Industry standings probably would provide additional valuable information in the growth and financial distress variables. Since our examination of short term trends suggests useful variables, there may be additional information in long term trends. However, prior empirical work indicates that data beyond three years does not provide useful information (Green 1991).

Most of the suggested factors in the Loebbecke et al. (1989) model that are available to the auditor have no corresponding values in the public financial statements. For example, the personal habits of the CEO are normally not part of the public record. Therefore, testing such items as high gambling debts and prior illegal activities is impossible. There is no examination of the personal variables such as age, education, or martial status in our study. These all may prove valuable indicators.

We aggregated all industries except financial companies in our study. Research to find the variables most useful in the specific industries would be of great value. Certain variables may become useful classifiers when examined in a stratified by industry sample. We trained on a sample that covered the period 1972 to 1984. Certain conditions have changed over this time. For example, it is rare for any company not to have an audit committee in 1996. Thus, the useful of certain variables may change over time. Any additional research has the later SEC releases to find an additional more current sample.

Conclusion

As the auditing profession moves to address its responsibility to detect FFS, the results of our study should be beneficial. The study contributes to auditing literature by examining the suggested variables for the ones best able to discriminate cases of FFS. All auditors face a limited amount of time. By pinpointing variables best able to detect FFS, our study suggests certain variables to which auditors should be allocating additional audit time.

In addition, our study is one of the first to use ANN's to help detect FFS. The adding of ANN's to the analytic procedures for the detection of FFS should help develop useful models. In prior works, we showed the effectiveness of AutoNet using auditor data (Fanning et al. 1995). In this work we showed that AutoNet is also effective when using publicly available information. We lacked any relevant financial data in the first study since the companies were not identified, while for the current study, we did not have access to the auditor data. Having both types of data should provide a more effective model. We are in the process of obtaining such a complete sample. With an improved AutoNet, capable of handling a larger sample and a greater number of variables, we hope to develop a powerful analytical tool for detection of management fraud.

Table 1
Sample Mortality

	AAER[1]	LITIGATION	TOTAL
ALL CASES	505	149	654
NO COMPANY OR FRAUD	134	0	134
SUB-TOTAL	371	149	520
DUPLICATES	192	109	301
SUB-TOTAL	179	40	219
NOT GERMANE[2]	50	14	64
SUB-TOTAL	129	26	155
NOT IN COMPUSTAT	45	6	51
SUB-TOTAL	84	20	104
NO MATCH	1	1	2
TOTAL	83	19	102

[1] Accounting and Auditing Release

[2] Includes Financial companies, No date, Pre-1972, Quarterly

Table 2
Industry Classification According to
COMPUSTAT of the Fraud Sample

4-DIGIT SUMMARY

DNUM	Number
1000	3
2000	19
3000	38
4000	5
5000	16
7000	15
8000	5
9000	1

Table 3
Exchange Listing

	New York	Amex	OTC
Fraud	14	7	81
Non-Fraud	17	15	70

Table 4
Corporate Governance Variables
All Matched Pairs (102)

Variable	(Fraud) Number[1]	(Non-Fraud) Number[1]	p-value[2]
Bosize (C)	6	7	0.003
Outdir (C)	40	45.5	0.067
Acad	23	20	0.607
Legal	33	40	0.307
Ceochair	89	83	0.264
Audcom	40	55	0.014
Execom	27	32	0.440
Compcom	39	52	0.031
Nomcom	8	11	0.470
Audout (C)	100	100	0.824
Execout (C)	33	25	0.682
Compout (C)	67	67	0.345
Nomout (C)	41.5	60	0.317

Bosize = the number of members on the Board of Directors
Outdir = the percentage of outside directors on the Board of Directors
Acad = 1 if the Board has a director who is an academic and 0 otherwise
Legal = 1 if the Board has a director who is a Lawyer and 0 otherwise
Ceochair = 1 if the CEO is also the Chairman and 0 otherwise
Audcom = 1 if the company has an audit committee and 0 otherwise
Execom = 1 if the company has an executive committee and 0 otherwise
Compcom = 1 if the company has a compensation committee and 0 otherwise
Nomcom = 1 if the company has a nominating committee and 0 otherwise
Audout = the % of outsiders on the audit committee
Execout = the % of outsiders on the executive committee
Compout = the % of outsiders on the compensation committee
Nomout = the % of outsiders on the nominating committee

(C) for continuous variables; otherwise dichotomous

[1] Median for continuous variables and number of occurrences for dichotomous variables
[2] The Wilcoxon matched pairs sign rank test for continuous variables and chi-square test for dichotomous variables. p value based on H: Fraud and Non-Fraud groups identical

Table 5
Auditor/Agency Variables
All Matched Pairs (102)

Variable	(Fraud) Number[1]	(Non-Fraud) Number[1]	p-value[2]
Audchyr1	9	7	0.602
Audch3yr	20	18	0.719
Audquyr1	18	17	0.853
Audqu3yr	22	25	0.618
NonB6	46	28	0.002
Manowner (C)	0.351	0.320	0.590
Ceoowner (C)	0.207	0.204	0.590
Ltplan	81	85	0.472
Stplan	37	42	0.472
Profit	21	32	0.054

Audchyr1 = 1 if the company changed auditor from last year and 0 otherwise
Audch3yr = 1 if the company changed auditor over the last 3 years and 0 otherwise
Audquyr1 = 1 if the company has current qualification of the audit report and 0 otherwise
Audqu3yr = 1 if the company had a qualified audit report in the past 3 years and 0 otherwise
NonB6 = 1 if the company has a non-Big Six Auditor and 0 otherwise
Manowner = the percentage of stock ownership by officers and directors
Ceoowner = the percentage of stock ownership by the CEO
Ltplan = 1 if the company has a long term compensation plan and 0 otherwise
Stplan = 1 if the company has a short term compensation plan and 0 otherwise
Profit = 1 if the company has a profit sharing plan and 0 otherwise

(C) for continuous variables; otherwise dichotomous

[1] Median for continuous variables and number of occurrences for dichotomous variables
[2] The Wilcoxon matched pairs sign rank test for continuous variables and chi-square test for dichotomous variables. p value based on H: Fraud and Non-Fraud groups identical

Table 6
Subsidiaries/Capital Structure/Operating Results/Personnel/Litigation/Accounting Choices
All Matched Pairs (102)

Variable	(Fraud) Number[1]	(Non-Fraud) Number[1]	p-value[2]
Subs (C)	2	2	0.3560
Forsub	17	19	0.7910
Z (C)	3.479	3.535	0.2050
Growth (C)	1.329	1.096	0.0006
Cfochyr1	17	17	1.0000
Cfoch3yr	25	37	0.0502
Ceochyr1	9	10	0.8100
Ceoch3yr	10	14	0.3850
Pcfo	26	13	0.0130
Lit	35	25	0.1149
Relation	34	32	0.7650
LIFO	4	11	0.0923
Depr	25	22	0.7250

Subs = the number of subsidiaries
Forsub = 1 if the company has two or more foreign subsidiaries and 0 otherwise
Z = the Altman Z score
Growth = the geometric growth rate of sales for the last three years
Cfochyr1 = 1 if the company changed their CFO from last year and 0 otherwise
Cfoch3yr = 1 if the company changed their CFO over the last 3 years and 0 otherwise
Ceochyr1 = 1 if the company changed it CEO and 0 otherwise
Ceoch3yr = 1 if the company changed its CEO in the last 3 years and 0 otherwise
Pcfo = 1 if the CEO and CFO is the same person and 0 otherwise
Lit = 1 if the company has litigation against it over the last 3 years and 0 otherwise
Relation = 1 if the company has a family relationship and 0 otherwise
LIFO = 1 if the company uses the LIFO method for inventory and 0 otherwise
Depr = 1 if the company uses an accelerated depreciation method and 0 otherwise

(C) for continuous variables; otherwise dichotomous

[1] Median for continuous variables and number of occurrences for dichotomous variables
[2] The Wilcoxon matched pairs sign rank test for continuous variables and chi-square test for dichotomous variables. p value based on H: Fraud and Non-Fraud groups identical

Table 7
Financial Statement Variables
All Matched Pairs (102)

Variable	(Fraud) Number[1]	(Non-Fraud) Number[1]	p-value[2]
Ar	3.6860	2.1950	0.0003
All	0.1100	0.0785	0.0564
Inv	2.9680	2.3100	0.0526
Ppe	3.1370	3.5983	0.4404
Lta	2.9100	2.5100	0.0087
Ltdebt	2.3500	1.7760	0.0004
Re	1.1570	0.9850	0.4040
Wc	3.9880	3.5280	0.5460
Sales	20.0600	19.2700	0.9826
Cogs	11.6880	10.4750	0.3100
Ebit	1.5470	0.9020	0.0960
Extra	0.0000	0.0000	0.9360

Ar = accounts receivable (data2)
All = allowance for doubtful accounts (number of matched pairs = 90) (data67)
Inv = inventory (data3)
Ppe = net property, plant and equipment (data8)
Lta = natural log of total assets (data6)
Ltdebt = natural log of total debt (data181)
Re = retained earnings (data36)
Wc = working capital (data179)
Sales = sales (data12)
Cogs = cost of goods sold (data41)
Ebit = earnings before interest and taxes (data178)
Extra = extraordinary items (data48)

[1] All continuous variables reporting the median as the number

[2] The Wilcoxon matched pairs sign rank test. p value is based on H: Fraud and Non-fraud groups identical

Table 8
Ratios/Trends
All Matched Pairs (102)

Variable	(Fraud) Number[1]	(Non-Fraud) Number[1]	p-value[2]
Arsales (C)	0.223	0.174	0.0001
Arta (C)	0.227	0.209	0.0380
GM (C)	0.347	0.333	0.8700
Invta (C)	0.188	0.183	0.6960
Invsales (C)	0.198	0.138	0.0230
Allar (C)	0.021	0.028	0.3280
Allsales (C)	0.005	0.005	0.8372
Ppeta (C)	0.220	0.232	0.0540
Debteq (C)	1.234	0.799	0.0030
Ros (C)	0.056	0.047	0.9480
Roe (C)	0.169	0.160	0.4360
Sata (C)	1.068	1.316	0.0005
ARE	80	57	0.0003
GME	34	17	0.0049

(C)for continuous and number of occurrences for dichotomous
[1] All continuous variables reporting the median as the number
[2] The Wilcoxon matched pairs sign rank test: p value is based on H: Fraud and Non-fraud groups identical

Arsales = accounts receivable (data2) to sales (data12)
Arta = accounts receivable (data2) to total assets (data6)
GM = (sales (data12) /sales (data12)) - (Cogs (data41)/sales (data12))
Invta = inventory (data3) to total assets (data6)
Invsales = inventory (data3) to sales (data12)
Allar = allowance for doubtful accounts (data67) to accounts receivable (data2)

Allsales = allowance for doubtful accounts (data67) to sales (data12)
Ppeta = net property, plant, and equipment (data8) to total assets (data6)
Debteq = debt (data181) to equity (data219)
Ros = nibt (data170) to sales (data12)
Roe = nibt (data170) to stockholder's equity (data216)
Sata = sales (data12) to total assets (data6)
ARE = 1 if the company's account receivable exceeds 1.10 of last years and 0 otherwise
GME = 1 if the company's gross margin % exceeds 1.10 of last years and 0 otherwise
(C) for continuous variables; otherwise dichotomous
[1] Median Wilcoxon matched pairs sign rank test for continuous variables and chi-square test for dichotomous variables. p value is based on H: Fraud and Non-fraud groups identical

Table 9
Mean Values for Final 20 Variables

Variable	Mean		Standard Deviation	
	Fraud	Non-Fraud	Fraud	Non-Fraud
Bosize	6.26	7.07	2.65	2.87
Outdir	37.07	42.56	24.82	25.28
Ceochair	0.87	0.81	0.36	0.39
Audcom	0.39	0.54	0.49	0.50
Compcom	0.38	0.51	0.49	0.50
NonB6	0.45	0.27	0.50	0.45
Profit	0.21	0.31	0.41	0.47
Z	91.31	4.52	858.52	5.63
Growth	1.55	2.08	1.04	8.78
Cfoch3yr	0.25	0.36	0.43	0.48
Pcfo	0.25	0.13	0.44	0.34
Lit	0.34	0.25	0.48	0.43
LIFO	0.04	0.11	0.20	0.31
Arsales	0.63	0.19	3.30	0.14
Invsales	0.25	0.18	0.30	0.23
Ppeta	0.25	0.29	0.20	0.21
Debteq	1.49	3.60	11.62	30.68

Sata	1.17	1.43	0.78	0.85
Are	0.78	0.56	0.41	0.50
Gme	0.33	0.17	0.47	0.37

See previous tables for variable definitions

Table 10
Prediction Accuracy (%) for model with 8 variables
Based on starting with 20 possible variables
150 firms in the training sample and 54 in holdout sample

Training

Method	Fraud	Non-fraud	Total
LDA[1]	69	71	70
QDA[1]	88	55	71
LOGIT[2]	71	68	69
ANN[3]	69	80	75

Holdout

Method	Fraud	Non-fraud	Total
LDA[1]	67	37	52
QDA[1]	78	22	50
LOGIT[2]	67	33	50
ANN[3]	66	59	63

[1] Includes the variables Outdir, NonB6, Cfoch3yr, LIFO, Debteq, Sata, Are, Gme.
[2] Includes the variables Outdir, NonB6, Cfoch3yr, LIFO, Debteq, Sata, Are, Gme.
[3] Includes the variables Outdir, NonB6, Growth, Arsales, Ppeta, Debteq, Are, Gme.

References

Albrecht, S., K. Howe, and M. Romney. 1984. *Deterring Fraud: The Internal Auditor's Perspective.* Institute of Internal Auditors.

_____, and M. Romney. 1986. Red-Flagging Management: a Validation. *Advances in Accounting.* 323-333.

Alchian, A. and H. Demsetz. 1972. Production, Information Costs, and Economic Organization. *American Economic Review.* December:777-795.

Altman, E. 1968. Financial Ratios, Discriminant Analysis, and the Prediction of Corporate Bankruptcy. *Journal of Finance*. September:589-609.

_____. 1983. *Corporate Financial Distress: A Complete Guide to Predicting, Avoiding, and Dealing with Bankruptcy*. John Wiley & Sons. New York.

_____. 1988. Analytical Procedures. *Statement on Auditing Standards No. 56.* New York: Auditing Standards Board.

Arens A. and J. Loebbecke. 1991. *Auditing: An Integrated Approach. 5th edition.* Prentice Hall.

Bacon, J. 1981. *Corporate Directorship Practices: The Nominating Committee and the Director Selection Process.* The Conference Board. New York.

Baysinger, B. and H. Butler. 1985. Corporate Governance and the Board of Directors: Performance Effects of Changes in Board Composition. *Journal of Law, Economics and Organization.* 1. Fall:101-124.

Beasley, M. 1994. An Empirical Examination of the Relation Between Corporate Governance and Management Fraud. *Working Paper*. North Carolina State University.

Beatty, R. 1989. Auditor Reputation and the Pricing of Initial Public Offerings. *The Accounting Review.* 64. 4. October:693-709.

Bell, T., S. Szykowny, and J. Willingham. 1993. Assessing the Likelihood of Fraudulent Financial Reporting: A Cascaded Logic Approach. *Working Paper, KPMG Peat Marwick.* Montvale N.J.

Benston 1980. The Market for Public Accounting Services: Demand, Supply and Regulation. *The Accounting Journal.* Winter:2-46.

Berle A. and Means G. 1932. *The Modern Corporation and Private Property.* Harcourt & Brace. New York.

Blocher, E. 1993. *The Role of Analytical Procedures in Detecting Management Fraud.* Institute in Management Accountants. New Jersey.

_____, and J. Willingham. 1985. Analytical Review: A Guide to Evaluating Financial Statements. *McGraw-Hill.* New York.

Bologna, G., R. Lindquist, and J. Wells. 1993. *The Accountant's Handbook of Fraud and Commercial Crime.* John Wiley & Sons. New York.

Braiotta, L. 1992. Preventing Fraudulent Reporting: Auditing for Honesty. *ABA Journal.* May:76-79.

_____, and A. Sommer Jr. 1987. *The Essential Guide to Effective Corporate Board Committees.* Prentice-Hall. Englewood Cliffs. New Jersey.

Business Week. 1975. The Touche Ross Manual for Spotting Fraud. *Business Week.* February 17:52.

Campbell, D. and L. Parker. 1992. SEC Communications to the Independent Auditors: An Analysis of Enforcement Actions. *Journal of Accounting and Public Policy.* 11. 297-330.

Chaganti R., V. Mahajan, and S. Sharma. 1985. Corporate Board Size, Composition and Corporate Failures in the Retailing in Retailing Industry. *Journal of Management Studies.* 22. 4. July:400-417.

Chester, M. 1993. *Neural Networks: A Tutorial.* PTR Prentice-Hall. New York.

Clinard, M. 1983. *Corporate Ethics and Crime.* Sage Publications . Beverly Hills. Ca.

Cheney, Glenn. 1996. Auditing Standards Board Pushes CPAs to Dig for Fraud. Accounting Today. April 8-21. 14,17.

Chow, C. and S. Rice. 1982. Qualified Audit Opinions and Share Prices-An Investigation. *Auditing: A Journal of Practice & Theory.* 1. Winter:35-53.

Coakley, J., L. Gammill, and C. Brown. 1995. *Artificial Neural Networks in Accounting and Finance.* Working paper. Oregon State University.

Cochran, W. 1953. Matching in Analytical Studies. *American Journal of Public Health.* 43. June:684-691.

Cogger, K. 1992. A Learning Paradigm for Neural Network Architecture. *Euro XII/TIMS XXXI Joint International Conference, Helsinki*. June. Working Paper No.237, School of Business, University of Kansas, Lawrence, KS, 66045.

Crain, M. 1992. Financial Statement Fraud. *Florida CPA Today.* October:34-36.

Dalton, D. and I. Kesner. 1987. Composition and CEO Duality in Board of Directors: An International Perspective. *Journal of International Business.* 18. 3. Fall:33-42.

Daroca, F. and W. Holder. 1985. The Use of Analytical Procedures in Review and Audit Engagements. *Auditing: A Journal of Practice & Theory. 4.* Spring:80-92.

Davia, H, P. Coggins, J. Wideman, and J. Kastantin. 1992. *Management Accountant's Guide to Fraud Discovery and Control.* John Wiley & Sons. New York.

Davis, L. and D. Simon. 1992. The Impact of SEC Disciplinary Actions on Audit Fees. *Auditing: A Journal of Practice & Theory.* 11. Spring:58-68.

DeAngelo, L. 1981. Auditor Size and Auditor Quality. *Journal of Accounting and Economics.* 3. 2. 183-199.

Dhaliwal, D., G. Salamon and E. Smith. 1982. The Effect of Owner Versus Management Control on the Choice of Accounting Methods. *Journal of Accounting and Economics.* 4. July:41-53.

Dopuch, N., R. Holthausen, and R. Leftwich. 1987. Predicting Audit Qualifications with Financial and Market Variables. *The Accounting Review.* 62. July:431-454.

Dopuch, N. and D. Simunic. 1980. The Nature of Competition in the Auditing Profession: A Descriptive and Normative View. In *Regulation and the Accounting Profession.* Van Nos Reinhold. New York.

Elliot, J. and D. Kennedy. 1988. Estimation and Prediction of Categorical Models in Accounting Research. *Journal of Accounting Literature.* 7. 202-242.

Elliott, R. and J. Willingham. 1980. *Management Fraud: Detection and Deterrence.* Petrocelli. New York.

Epstein, M. and A. Spalding Jr. 1993. *The Accountant's Guide to Legal Liability and Ethics.* Richard D. Irwin. New York.

Emmanuel, C. 1989. Limiting Exposure to Fraudulent Financial Reporting. *Journal of Commercial Bank Lending.* September:16-27.

Fama, E. and M. Jensen. 1983. Separation of Ownership and Control. *Journal of Law & Economics.* 26. 301-325.

Fanning, K., K. Cogger and R. Srivastava. 1995. Detection of Management Fraud: A Neural Network Approach. *International Journal of Intelligent Systems in Accounting, Finance & Management.* Volume 4. Number 2. June. 113-126.

Fanning, K. and K. Cogger. 1994. A Comparative Analysis of Artificial Neural Networks Using Financial Distress Prediction. *International Journal of Intelligent Systems in Accounting, Finance & Management.* Volume 3. Number 4. December. 241-252.

Feroz, E., K. Park, and V. Pastena. 1991. The Financial and Market Effects of the SEC's Accounting and Auditing Enforcements Releases. *Journal of Accounting Research.* 29. Supplement:107-142.

Frank, R., W. Massy, and D. Morrison. 1965. Bias in Multiple Discriminant Analysis. *Journal of Marketing Research.* 2. August:250-268.

Gautschi III F. and T. Jones. 1987. Illegal Corporate Behavior and Corporate Board Structure. In *Corporate Social Performance and Policy*. 9. 93-106.

General Accounting Office. 1989. *CPA Audit Quality-Status of Actions to Improve Auditing and Financial Reporting of Public Companies.* General Accounting Office.

Green, B. 1991. *Identifying Management Irregularities Through Preliminary Analytical Procedures.* Unpublished Doctoral Dissertation. Kent State University.

Hamer, M. 1983. Failure Prediction: Sensitivity of Classification Accuracy to Alternative Statistical Methods and Variable Sets. *Journal of Accounting and Public Policy*. 2. 4. 289-307.

Hanson, D. 1989. Hearing before the Subcommittee on Telecommunications and Finance of the Committee on Energy and Commerce. *House of Representatives.* August 2.

Harrison, J. 1987. Strategic Use of Corporate Board Committees. *California Management Review.* Fall:109-125.

Himelstein L., S. Baker, R. Glover, and S. Baker. 1994. Boardrooms: The Ties that Blind. *Business Week.* May 2:112-114.

Hosmer, D. and S. Lemeshow. 1989. *Applied Logistic Regression.* John Wiley & Sons. New York.

Hunt, H. and J. Ord. 1988. Matched Pairs Discrimination: Methodology and An Investigation of Corporate Accounting Policies. *Decision Sciences.* 19. Spring:373-382.

Hylas, R. and R. Ashton. 1982. Audit Detection of Financial Statement Errors. *The Accounting Review.* 57. October:751-765.

Jensen, M. 1993. The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems. *The Journal of Finance.* 48. 3. July:831-880.

_____ and W. Meckling. 1976. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics.* 3. October:305-360.

Jones, J. and M. Maher. 1986. *Fraudulent Financial Reporting.* Paper Presented at the Alabama Research Convocation.

Kesner, I. 1988. Directors' Characteristics and Committee Membership: An Investigation of Type, Occupation, Tenure, and Gender. *Academy of Management Journal.* 31.1. March:66-84.

_____, and I. Dalton. 1986. Board of Directors and the Checks and (IM)Balances of Corporate Governance. *Business Horizons.* 29. 5. September/October:17-23.

_____, and R. Johnson. 1990. An Investigation of the Relationship Between Board Composition and Stockholder Suits. *Strategic Management Journal.* 11. May/June:327-336.

Kinney, W. Jr. 1987. Attention Directing Analytical Review Using Accounting Ratios: A Case Study. *Auditing: A Journal of Practice and Theory.* Fall:59-73.

_____, and L. McDaniel. 1989. Characteristics of Firms Correcting Previously Reported Quarterly Earnings. *Journal of Accounting and Economics.* 11. 71-91.

Knapp, M. 1991. Factors that Audit Committee Members use as Surrogates for Audit Quality. *Auditing: A Journal of Practice & Theory.* 10. Spring:35-52.

Knechel, R. 1986. A Simulation Study of the Relative Effectiveness of Alternative Analytical Review Techniques. *Decision Sciences.* Summer:376-394.

Korn/Ferry International. 1993. *Board of Directors, Twentieth Annual Study.* Korn/Ferry International.

Kreutzfeldt, R. and W. Wallace. 1986. Error Characteristics in Audit Populations: Their Profile and Relationship to Environment Factors. *Auditing: A Journal of Practice & Theory.* 6. Fall:20-43.

Lev B. and S. Thiagarajan. 1993. Fundamental Information Analysis. *Journal of Accounting Research.* 31. 2. Autumn:190-215.

Licata, M., T. Rollins, and W. Bremser. 1993. Keep the SEC From Your Door. *Corporate Controller.* 5. January/February:50-53.

Lipton, M. and J. Lorsch. 1992. A Modest Proposal for Improved Corporate Governance. *Business Lawyer.* 48. 59-77.

Loebbecke, J., M. Eining. and J. Willingham. 1989. Auditor's Experience with Material Irregularities: Frequency, Nature, and Detectability. *Auditing: A Journal of Practice & Theory.* Fall:1-28.

_____, and P. Steinbart. 1987. An Investigation of the Use of Preliminary Analytical Review to Provide Substantive Audit Evidence. *Auditing: A Journal of Practice & Theory.* Spring:74-89.

_____, and J. Willingham. 1988. Review of SEC Accounting and Auditing Enforcement Releases. Unpublished Working Paper.

Mace, M. 1986. *Directors: Myth and Reality.* Harvard Business School Press, Boston, MA.

Maddala, G. 1991. A Perspective on the Use of Limited-Dependent and Qualitative Variables Models in Accounting Research. *The Accounting Review.* 66. October:788-807.

McLachlan, G. 1976. A Comparison for Selecting Variables for the Linear Discriminant Function. *Biometrics.* 32. September:529-534.

McMullen, D. 1996. Audit Committee Performance: An Investigation of the Consequences Associated with Audit Committees. In *Auditing: A Journal of Practice & Theory.* Spring:87-103.

Menon, K. and D. Williams. 1991. Auditor Credibility and Initial Public Offerings. *The Accounting Review.* 66. 2. April:313-332.

Merchant, K. 1987. *Fraudulent and Questionable Financial Reporting: A Corporate Perspective.* Financial Executives Research Foundation. New Jersey.

Moreland, K. 1995. Criticisms of Auditors and the Association Between Earnings and Returns of Client Firms. *Auditing: A Journal of Practice and Theory.* 14. 1. Spring: 94-104.

Murphy, H. 1980. Discussant's Response to Auditing Implications Derived from a Review of Cases and Articles Related to Fraud. In *Proceedings of the 1980 Touche Ross/University of Kansas Symposium on Auditing Problems.* 120-126.

Nader, R. 1984. Reforming Corporate Governance. *California Management Review.* 26. 4. Summer:126-132.

National Commission of Fraudulent Financial Reporting (NCFFR). 1987. *Report of the National Commission on Fraudulent Financial Reporting: The Role of the SEC.* October. NCFFR. New York.

Neter, J., M. Kutter, C. Nachtscheim, and W. Wasserman. 1996. Applied Linear Statistical Models. Irwin. Chicago.

Niehaus, G. 1989. Ownership Structure and Inventory Method Choice. *The Accounting Review*. 64. April:269-284.

Palepu, K. 1986. Predicting Takeover Targets: A Methodological and Empirical Analysis. Journal of Accounting and Economics. 8. March:3-35.

Palmrose, Z. 1987. Litigation and Independent Auditors: The Role of Business Failures and Management Fraud. *Auditing: A Journal of Practice and Theory.* 6. 2:90-102.

Pany, K., P. Reckers, and J. Schultz, Jr. 1981. The SEC and Corporate Governance: An Evolving Role for Board of Directors. *Arizona Business.* 28. 9. December:9-15.

Persons, O. 1995. Using Financial Statement Data to Identify Factors Associated with Fraudulent Financing Reporting. Journal of Applied Business Research. 11. 3. Summer:38-46.

Pincus, K., W. Holder, and T. Mock. 1988. The SEC and Fraudulent Financial Reporting. *Research in Accounting Regulation.* 2. 167-185.

Porter, B., and A. Cameron. 1987. Company Fraud-What Price the Auditor? *Accountant's Journal.* December. 44-47.

Rouse, R. 1985. Fraud Detection and Opinion Shopping. *The Ohio CPA Journal.* Summer:41-42.

Rubin, D. 1973a. Matching to Remove Bias in Observational Studies. *Biometrics.* 29. March:159-183.

_____. 1973b. The Use of Matched Sampling and Regression Adjustment to Remove Bias in Observational Studies. *Biometrics.* 29. March:185-203.

Salamon G. and E. Smith. 1979. The Effect of the Separation of Ownership from Control on Accounting Policy Decisions. *The Accounting Review.* October:707-723.

Schilit, H. 1993. *Financial Shenanigans: How to Detect Accounting Gimmicks & Fraud in Financial Reports.* McGraw-Hill. New York.

Securities and Exchange Commission. 1980. *Staff Report on Corporate Accountability.* U.S. Government Printing Office. Washington, D. C.

Shockley, R. 1981. Perceptions of Auditor Independence: An Empirical Analysis. *The Accounting Review.* October:785-800.

Sibley, A. and E. Burch, E. 1979. Optimal Selection of Matched Pairs from Large Data Bases. *Decision Sciences.* 10. January:62-70.

Siegal, S. 1956. Nonparametric Statistics: for the Behavioral Science. McGraw-Hill.

Simunic, D. 1980. The Pricing of Audit Services: Theory and Evidence. *Journal of Accounting Research.* 18. Spring:161-190.

Simunic, D. and M. Stein. 1987. *Product Differentiation in Auditing: Auditor Choice in the Market for Unseasoned New Issues.* The Canadian Certified General Accountants' Research Foundation. Vancouver, B.C.

Smith, M. 1993. *Neural Networks For Statistical Modeling.* Van Nostrand Reinhold. New York.

Spellmire, G., W. Baliga, and D. Winiarski. 1993. *Accountants' Legal Liability: Prevention and Defense.* Harcourt Brace Jovanovich. New York.

St. Pierre, K. and J. Anderson. 1982. An Analysis of Audit Failures Based on Documented Legal Cases. *Journal of Accounting, Auditing & Finance.* Spring:229-247.

Standard's and Poor. *Register of Corporations, Directors and Executives.* Standard and Poors. New York.

Stice, J. 1991. Using Financial and Market Information to Identify Pre-engagement Market Factors Associated with Lawsuits Against Auditors. *The Accounting Review.* 66. 3:516-533.

_____, S. Albrecht, and L. Brown. 1991. Lessons to be Learned-ZZZZBEST, Regina, and Lincoln Savings. *The CPA Journal.* April:52-53.

Taylor, J. 1995. Congress Sends Business a Christmas Gift. *Wall Street Journal.* December 26. A2.

Vance, S. 1983. *Corporate Leadership.* McGraw-Hill. New York.

Verschoor., C. 1993. Benchmarking the Audit Committee. *Journal of Accountancy.* 176. 3. September:59-64.

Vinten, G. and C. Lee. 1993. Audit Committees and Corporate Control. *Managerial Auditing Journal.* 8. 3. 11-24.

Waegelein, J. 1988. The Association Between the Adoption of Short-Term Bonus Plans and Corporate Expenditures. *Journal of Accounting and Public Policy.* 7. 43-63.

Wallace, W. 1985. Are Outside Directors Put on Boards Just for Show. *Wall Street Journal.* January 21:22.

Watts, R. and J. Zimmerman. 1986. *Positive Accounting Theory.* Prentice-Hall. New York.

Winters, A. and J. Sullivan. 1994. Accounting for Fraud: Perception Vs. Reality. In *Proceedings of the 1994 Deliotte and Touche/University of Kansas Symposium on Auditing Problems.*

Wright, A. and R. Ashton. 1989. Identifying Audit Adjustments with Attention-Directing Procedures. *The Accounting Review.* 64. 4. October:79-83.

Yoon Y., G. Swales Jr.,and T. Margavio. 1993. A Comparison of Discriminant Analysis Versus Artificial Neural Networks. *Journal of Operational Research Society.* 44. 1:51-60.

Zahedi, F. 1993. *Intelligent Systems for Business: Expert Systems with Neural Networks.* Belmont, Ca. Wadsworth.

Ziegler, D. 1980. A Look at the Record on Auditor Detection of Management Fraud. In *Proceedings of the 1980 Touche Ross/University of Kansas Symposium on Auditing Problems.* 87-92.

Zmijewski. M. and R. Hagerman. 1981. An Income Strategy Approach to the Positive Theory of Accounting Standard Setting/Choice. *Journal of Accounting And Economics.* 3. August:129-149.