

**PREDICTION OF GOING-CONCERN STATUS:
A PROBIT MODEL FOR THE AUDITORS**

by

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(ABSTRACT)

Under the going-concern concept, an entity is assumed to be a going concern when it is able and willing to continue operations in the foreseeable future. Although substantial agreement exists as to the meaning and role of the going-concern concept, it is difficult to make going-concern assessments in the course of an audit. In particular, existing auditing guidelines contained in SAS No. 34 are inadequate and existing going-concern prediction models are flawed. In view of this, the objective of the dissertation is to construct a going-concern prediction model (hereafter called the Koh model) that is based upon improved statistical techniques and methodology.

A sample of 165 companies that filed for bankruptcy during the period 1980 to 1985 and a matched sample of 165 non-bankrupt companies are used to construct and test the Koh model. Following the lead taken by the proposed SAS on going-concern assessments, a non-going concern is operationalized as a bankrupt company. For each of the sample companies, six financial ratios as specified by the proposed theory of bankruptcy are obtained. Probit analysis with the weighted exogenous sample maximum likelihood procedure is used to estimate the coefficients of the Koh model. Using the Lachenbruch U method, the hold-out accuracy rates of the Koh model are computed. They are 85.45% for non-going concerns, 100.00% for going concerns, and 99.91% overall. With these accuracy rates, the Koh model compares favorably with other going-concern prediction models suggested in the literature and the auditors.

The effects of misclassification costs of Type I and Type II errors on the Koh model are also considered. It is found that the optimal cut-off probability for the Koh model is very insensitive to varying relative misclassification costs. Coupled with its high predictive ability and stability, the Koh model can be an effective prediction model, analytical tool, and defensive device for auditors. Further, the methodology developed and employed in the dissertation can contribute to the current state-of-the-art in constructing prediction models such as going-concern or bankruptcy prediction models, takeover/acquisition prediction models, and loan default prediction models.

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Chapter 1

THE GOING-CONCERN CONCEPT AND EXTERNAL AUDITING

The going-concern concept is fundamental in the theory and practice of accounting. Accounting Principles Board (APB) Statement No. 4 [1970] recognizes it as a “basic feature of financial accounting”¹ while International Accounting Standard (IAS) No. 1 [1975] acknowledges it as a “fundamental accounting assumption.”² This view is widely reflected in the accounting literature too. For example, Grady [1965] identifies the going-concern concept as a “concept which underlies or permeates [generally] accepted accounting principles,”³ and Moonitz [1961] presents it as a “basic postulate of accounting.”⁴

Although the going-concern concept is one of the most important accounting concepts, it has surprisingly generated little elaboration and discussion. In the external

¹ American Institute of Certified Public Accountants, “Basic Concepts and Accounting Principles Underlying Financial Statements of Business Enterprises,” *Accounting Principles Board Statement No. 4* (New York: AICPA, October 1970), paragraph 25.

² International Accounting Standards Committee, “Disclosure of Accounting Policies,” *International Accounting Standard No. 1* (London: IASC, January 1975), paragraph 7.

³ Paul Grady, “Inventory of Generally Accepted Accounting Principles for Business Enterprises,” *Accounting Research Study No. 7* (New York: AICPA, 1965), p. 23.

⁴ Maurice Moonitz, “The Basic Postulates of Accounting,” *Accounting Research Study No. 1* (New York: AICPA, 1961).

auditing context, reference to the going-concern concept is rare. In the United States, auditing guidelines for assessing the going-concern status of business entities were established only in 1981 via Statement on Auditing Standards (SAS) No. 34.⁵

To date, the assessment of going-concern status in the external auditing context remains a problematic task. As will be shown in the last section of this chapter, existing auditing guidelines as embodied in SAS No. 34 are inadequate. This is so even after considering the proposed changes contained in a proposed SAS issued in February 1987 on the auditor's consideration of an entity's ability to continue existence.⁶ This proposed SAS would replace SAS No. 34, if adopted. Further, prediction models suggested in the literature to aid auditors in making going-concern assessments are flawed. These prediction models will be critically reviewed in Chapter 2.

The objective of this dissertation is to improve upon previous prediction models by constructing a weighted probit model using the current state-of-the-art in probit analysis and improved methodology. This proposed model is expected to be a significant aid to auditors when they are making going-concern assessments. Details of the proposed model will be given in Chapter 3.

This dissertation consists of six chapters. The first chapter discusses the going-concern concept in an external auditing context and the second chapter reviews existing going-concern prediction models suggested in the literature. The third chapter proposes a going-concern prediction model for the auditors and the fourth chapter discusses the construction and testing of the proposed model. The fifth chapter discusses the accuracy rates of going-concern prediction models and auditors and the application of the pro-

⁵ American Institute of Certified Public Accountants, "The Auditor's Considerations When a Question Arises About an Entity's Continued Existence," *Statement on Auditing Standards No. 34* (New York: AICPA, March 1981).

⁶ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," *Exposure Draft: Proposed Statement on Auditing Standards* (New York: AICPA, February 14, 1987).

posed model. Finally, the last chapter presents a summary of the dissertation and suggests directions for future research.

This chapter consists of three sections. The first section discusses the going-concern concept and its impact on the theory and practice of accounting. The second section highlights external auditing problems under the going-concern concept. Finally, the third section reviews existing and proposed external auditing guidelines for making going-concern assessments.

1.1 THE GOING-CONCERN CONCEPT

1.1.1 Historical Background

One of the earliest forms of business organization was the venture, which was usually organized for a particular mission and designed to effect a single and usually substantial transaction, such as a ship voyage. A venture was not expected to outlive the completion of the single transaction or to take on an independent and separate identity. Upon completion of the mission, profits for distribution would be determined and the venture would terminate. Later in the history of commerce, more permanent forms of business organization became common. Among them were proprietorships, partnerships and corporations; they were designed to effect an indefinite succession of transactions and had no predetermined limit set on their lives. These business organizations were then referred to as going concerns because continuity of business activities

was their primary characteristic.⁷ As going concerns became common, new methods of accounting became necessary.

The going-concern concept was conceived long before generally accepted accounting principles were established. In 1892, Dicksee used the “perpetual existence” concept for registered companies to justify cost valuation of permanent assets.⁸ Subsequently, Hatfield [1927] used the going-concern concept as a general principle applicable to the valuation of specific assets.⁹ As early as 1922, Paton maintained that “the existence of a distinct entity” and “the continuity of this entity” were two essential postulates of the entity theory.¹⁰ Since then, the going-concern concept has been gradually accepted as a fundamental concept in the theory and practice of accounting.

1.1.2 Definition and Nature of the Going-Concern Concept

Substantial agreement exists as to the meaning and role of the going-concern concept in the accounting literature and professional pronouncements. Although there are slight variations, the basic idea is that an entity can be assumed to continue in operation for the foreseeable future without the necessity or intention to liquidate unless there is evidence to the contrary. This view is unanimous in the accounting literature and professional pronouncements as can be seen from the selection of quotations below:

⁷ Hartwell C. Herring, III, and W. H. Steven Rowlett, “The Going Concern Assumption and Financial Statement Objectives,” *National Public Accountant* (August 1974), p. 23.

⁸ Lawrence R. Dicksee, *Auditing* (London: Gee & Co., 1892), pp. 179-184.

⁹ Henry R. Hatfield, *Accounting, Its Principles and Problems* (New York: Appleton-Century-Crofts, 1927), pp. 74-75.

¹⁰ William A. Paton, *Accounting Theory: With Special Reference to the Corporate Enterprise* (Chicago: Accounting Studies Press, 1962), pp. 472 and 478.

1. American Accounting Association [1957]:

The "going-concern" concept assumes the continuance of the general enterprise situation. In the absence of evidence to the contrary, the entity is viewed as remaining in operation indefinitely. Although it is recognized that business activities and economic conditions are changing constantly, the concept assumes that controlling environmental circumstances will persist sufficiently far into the future to permit existing plans and programs to be carried to completion.¹¹

2. Moonitz [1961]:

... a large part of accounting practice as well as theory is based on the presumption that the accounting entity will continue in operation and not be liquidated in the foreseeable future. In the absence of evidence to the contrary, the entity should be viewed as remaining in operation indefinitely. ... Indefinite continuance means that the business will not be liquidated within a span of time necessary to carry out present contractual commitments or to use up assets according to the plans and expectations presently held.¹²

3. Chambers [1966]:

A going concern is a firm ... in the ordinary course of business; that is, a firm which is not in the process of forced liquidation.¹³

4. International Accounting Standards Committee [1975]:

The enterprise is normally viewed as a going concern, that is, as continuing in operation for the foreseeable future. It is assumed that the enterprise has neither the intention nor the necessity of liquidation or of curtailing materially the scale of its operations.¹⁴

¹¹ American Accounting Association, *Accounting and Reporting Standards for Corporate Financial Statements* (Florida: AAA, 1957), p. 2.

¹² Maurice Moonitz, "The Basic Postulates of Accounting," *Accounting Research Study No. 1* (New York: AICPA, 1961), pp. 38-39.

¹³ Raymond J. Chambers, *Accounting, Evaluation and Economic Behavior* (Prentice-Hall, 1966), p. 218.

¹⁴ International Accounting Standards Committee, "Disclosure of Accounting Policies," *International Accounting Standard No. 1* (London: IASC, January 1975), paragraph 7.

From the above, the going-concern concept can be defined as consisting of the following essential components. First, the going-concern concept assumes that an entity has both the ability and intention to remain in uninterrupted existence or succession. Thus, a going concern has no intention or necessity to liquidate or curtail significantly the scale of operation. (This traditional definition of a going concern emphasizes liquidation as the critical event separating a going and non-going concern.¹⁵ However, as will be shown later in this Chapter, the current interpretation of the going-concern concept by the Auditing Standards Board (ASB) focusses on bankruptcy as the critical event instead of liquidation.)

Second, the going-concern concept applies only within a certain time-frame. That is, it does not imply permanent continuance but continuance for the foreseeable future. In the going-concern context, "the foreseeable future" has often been interpreted as the time necessary to carry out present contractual commitments, to use up assets according to plans and expectations presently held, and to permit existing plans and programs to be carried to completion.

Third, the going-concern concept is primarily a total concept. That is, it applies to an entity as a whole and does not apply to specific parts that, when put together, form the entity.¹⁶ In other words, it is not meant to be applied to individual assets or liabilities per se. Consequently, the going-concern status of an entity is usually not impaired when an entity liquidates a branch, a segment or some operations unless the survival of the entire entity is threatened by such actions.

¹⁵ This point was also emphasized by S. C. Yu in his article, "A Reexamination of the Going Concern Postulate," *International Journal of Accounting Education and Research* (Spring 1971), on p. 44 where he stated: "Practically all references to the going concern in traditional accounting convey the same theme: in the absence of evidence of liquidation, a firm is assumed to continue indefinitely."

¹⁶ S. C. Yu, "A Reexamination of the Going Concern Postulate," *International Journal of Accounting Education and Research* (Spring 1971), p. 50.

Fourth, although the going-concern concept is a fundamental feature in the theory and practice of accounting, it can be made invalid or inapplicable by evidence to the contrary. That is, when evidence contrary to the going-concern assumption is present, an entity may no longer be assumed to be a going concern.

Incorporating all the essential components above, the going-concern concept assumes that an entity is a going concern if the entity is able and willing to continue operations (so that there is uninterrupted existence and succession for the entity as a whole) within some specified time-frame (usually taken to be the “foreseeable future”) when there is no information that indicates the contrary.

1.1.3 Justification of the Going-Concern Concept

APB Statement No. 4 [1970] explains that the going-concern concept is a reasonable assumption because it corresponds to economic and business reality. In particular, several forms of enterprises continue to exist as legal entities for extended periods of time. Hence, many businesses and organized activities have continuity of existence. Also, the framework of law, custom and tradition provides a significant degree of stability and continuity. In law, for example, the institution of the corporation creates an artificial person with an indefinite life.¹⁷ Further, a fundamental force underlying economic activity is the desire of enterprises to stay in business. As such, forced liquidation is not a significant fact about businesses under normal conditions.¹⁸

¹⁷ American Institute of Certified Public Accountants, “Basic Concepts and Accounting Principles Underlying Financial Statements of Business Enterprises,” *Accounting Principles Board Statement No. 4* (New York: AICPA, October 1970), paragraph 55.

¹⁸ Thomas H. Sanders, Henry R. Hatfield, and Underhill Moore, *A Statement of Accounting Principles* (New York: American Institute of Accountants, 1938), p. 3.

Given the above, continued existence is highly probable for most business entities; because of this relative permanence of business entities, it is reasonable to assume that they are going concerns unless liquidation appears imminent. Thus, the going-concern concept actually embodies economic and business reality.

The going-concern concept can also be justified on the ground that it reduces the impact of uncertainty in accounting measurement. Specifically, uncertainty is avoided in a convenient way by assuming that an entity has an indefinite life until some major event suggests evidence to the contrary. This simplifies accounting measurement because, in the absence of any evidence which may negate the going-concern assumption, forced-sale or liquidation values and liquidation commitments are irrelevant. Also, the going-concern assumption allows the accountant to avoid the necessity of dealing with the question of estimating the remaining life of a company.¹⁹

The significance of the going-concern concept is best summarized by Paton and Littleton [1940] in *An Introduction to Corporate Accounting Standards*, where they stated that:

The assumption that the business entity has continuity of life may be largely one of convenience, since no one can confidently predict the course of events. Yet some degree of continuity is the typical experience even in the midst of insolvency, liquidation and dissolution. Business in general does not consist of an array of sporadic, short-term ventures and its accomplishments are not normally subject to the test of complete liquidation. Liquidation is not the normal expectation; continuity is. The possibility of abrupt cessation of activity cannot afford a foundation for accounting, although the accountant may on occasion be called on to report situations in which such a condition is imminent. Accounting standards must rest primarily on normal or typical conditions.²⁰

¹⁹ Joseph A. Wiseman, "The Going Concern, Its Impact on Financial Reporting," *Georgia CPA* (Spring 1975-76), p. 20.

²⁰ William A. Paton and A. C. Littleton, *An Introduction to Corporate Accounting Standards* (Florida: American Accounting Association, 1940), p. 9.

1.1.4 Impact of the Going-Concern Concept on Financial Accounting

The going-concern concept has profound effects on financial accounting. First, unless there is evidence of imminent liquidation, forced-sale or liquidation values and liquidation commitments are irrelevant in the preparation of financial statements for an entity because the entity is assumed to be a going concern. Consequently, under the going-concern concept, assets in the balance sheet include expenditures of prior years that may have little, if any, separate realizable value. Similarly, values that can be obtained from the liquidation of assets that are tied up in the entity and not separate from it are largely irrelevant, and usually may be ignored. Also, balance sheet liabilities for a going concern include certain obligations that are accounted for in terms of the entity's long-range commitments rather than the creditors' legal claims.

Second, the going-concern concept provides the basis for matching costs and revenues. In other words, the going-concern concept allows the accountant to allocate costs, or other appropriate values, over their expected lives to specific accounting periods. Unless an entity is assumed to continue operations into the foreseeable future, there is no necessity or reason to match costs and revenues by accounting periods and carry forward into some future accounting periods any costs or revenues. Further, the classification of assets and liabilities as current or long-term derives in part from acceptance of the going-concern concept.

1.1.5 Impact of the Going-Concept Concept on External Auditing

The going-concern concept has significant effects on external auditing too. In *The Philosophy of Auditing*, Mautz and Sharaf [1961] postulated that in the absence of

clear evidence to the contrary, what has held true in the past for the enterprise under examination will hold true in the future.²¹ They explained that the inclusion of the continuity or going-concern concept as an auditing postulate is necessary because the continuity postulate, together with other postulates, provides the foundation to develop a logical, integrated theory of auditing. Without the continuity or going-concern concept of accounting, auditing would be improbable, if not impossible because “unless the auditor can assume that what has held true in the past will hold true in the future for the enterprise under examination, barring any clear indications to the contrary, he has no basis for accepting or rejecting such assertions as the valuation of receivables and inventories, the economic usefulness of fixed assets, or the adequacy of internal control.”²²

Mautz and Sharaf [1961] also added that the going-concern concept provides the auditor with a guide in the performance of all his verification work; therefore, it is a protection against economic and business changes unforeseeable at the time of the verification. For example, if fixed assets were purchased to facilitate a certain type of activity which has been conducted according to plan, the auditor, in the absence of contrary evidence, can expect the activity to continue and the assets to be so used. Therefore, the acceptance of the going-concern concept as an auditing postulate places important limits on the extent of an auditor’s responsibilities and provides a basis for deducing the extent of his obligation to forecast the future and to have his work judged on the basis of hindsight.

From a practical audit standpoint, the going-concern concept affects both the evidence-gathering and reporting aspects of the auditor’s examination. When an auditor

²¹ Robert K. Mautz and Hussein A. Sharaf, *The Philosophy of Auditing* (Florida: American Accounting Association, 1961), p. 42.

²² *Ibid.*, p. 48.

discovers evidence to the contrary, he may have to conduct additional test and subsequently modify his report. Existing and proposed external auditing guidelines on the assessment of going-concern status will be discussed in the last section of this chapter.

1.2 AUDITING PROBLEMS UNDER THE GOING-CONCERN CONCEPT

Under the going-concern concept, an entity is assumed to be a going concern only in the absence of information to the contrary. Therefore, there may be circumstances under which the going-concern concept does not hold and an entity can no longer be assumed to be a going concern. Consequently, one major auditing problem is: what circumstances constitute information to the contrary and how should they be evaluated? Some circumstances that indicate that an entity is not a going concern are relatively clear-cut and they pose few problems to the external auditor. For example, an entity is definitely not a going concern when it is in receivership or liquidation. However, there are many entities that display signs of going-concern problems but they continue to operate with varied success. Under such circumstances, the going-concern status of the entity is uncertain.

Miller [1966] has classified information which may negate the going-concern assumption into two broad categories: namely, management intent and material uncertainties.²³ Management intent refers to circumstances where management, for valid business reasons, desires to limit the future life of the business entity. This happens when management (1) intends to terminate an entity that is created for a specific purpose with limited life, (2) proposes to sell all or a substantial portion of the entity's as-

²³ Rene A. Miller, "Reporting and Auditing Problems Under the 'Going-Concern' Concept," *Arthur Young Journal* (Autumn 1966), pp. 2-11.

sets, or (3) plans to sell the entire business. These circumstances warrant the auditor's examination of the entity's going-concern status.

Material uncertainties, the second category of contrary information, are more common and more difficult to deal with. They comprise uncertain circumstances that may cast doubt on an entity's continued existence and they vary in degree of materiality. Material uncertainties include (1) contingent liabilities, (2) recoverability of a specific asset, (3) involuntary conversions and related problems, and (4) continued operating losses and related problems. These circumstances also warrant the auditor's examination of the entity's going-concern status.

Unfortunately, even though circumstances that constitute contrary information may be listed, it is extremely difficult to lay down guidelines as to how these circumstances should be assessed. In a recent study of 86 listed U.K. companies that filed for bankruptcy in the period 1977 to 1983, it was found that only 21 of these companies (i.e., approximately 25%) were qualified on a going-concern basis in their last financial statements prior to bankruptcy.²⁴ In other words, in only one out of four cases did the audit report draw any attention to the fact that the failing company might not continue in operational existence for the foreseeable future. In another study, Menon and Schwartz [1986] found similar results. In particular, only 63 out of 147 U.S. bankrupt companies (i.e., less than 43%) were qualified on a going-concern basis prior to bankruptcy.²⁵ This poor field record demonstrates the difficulty of assessing an entity's going-concern status, which is the primary auditing problem arising from the going-concern concept.

²⁴ Richard J. Taffler and Meggy Tseung, "The Audit Going Concern Qualification in Practice—Exploding Some Myths," *Accountant's Magazine (Scotland)* (July 1984), pp. 263-269.

²⁵ Krishnagopal Menon and Kenneth B. Schwartz, "The Auditor's Report for Companies Facing Bankruptcy," *Journal of Commercial Bank Lending* (January 1986), pp. 42-52.

The second auditing problem under the going-concern concept arises when an entity's continued existence is in doubt. Under such circumstances, the decision of the auditor on the entity's going-concern status is very sensitive. It has been argued that to qualify or disclaim an audit opinion on the ground that an entity's continued existence is doubtful may simply add to the difficulties of the entity and so hasten its demise. In other words, the auditor's opinion may actually become a self-fulfilling prophecy.²⁶ The Union Europeenne des Experts Comptables Economiques et Financiers (UEC) Committee on Auditing explicitly recognizes this problem and recommends that auditors exercise very careful judgment because "... the serious nature of the opinion which the auditor must form ... might have [an effect] on the future viability of the enterprise, including the possibility that it may lead to a collapse."²⁷

On the other hand, if an auditor issues a "clean" report and the entity subsequently fails, creditors and investors may attempt to bring the auditor to court for performing an inadequate audit. In *F. & M. Schaefer Corp v. C. Schmidt & Sons* [SDNY (1979) 597 F. 2d 814], the fact that the auditors continued to give Schaefer a clear opinion without qualification was assumed to infer that Schaefer was not a failing firm even though such a message was not intended. It seems that the auditor is in a no-win situation—either way, he puts himself in an unenviable position. This problem has burdened the auditing profession for decades and it seems that relief may come about only through the use of objective, unambiguous and defensible audit procedures to assess the going-concern status of an entity. Unfortunately, as will be shown below, both SAS No. 34 and the proposed SAS do not contribute much toward this end.

²⁶ Accountant International Study Group, *Going Concern Problems* (New York: AICPA, 1975), paragraph 58. See also paragraphs 59-61 for counter-arguments.

²⁷ "Audit Considerations Regarding the Going Concern Basis—Draft Statement (7)," *Journal of UEC* (July 1, 1976), p. 177.

1.3 EXTERNAL AUDITING GUIDELINES

1.3.1 Statement on Auditing Standards No. 34

Prior to 1981, there was little guidance embodied in professional pronouncements that might help an auditor in assessing an entity's going-concern status when uncertainty arose. In fact, there had not been much legal guidance for the auditor either. In view of this, SAS No. 34, "The Auditor's Considerations When a Question Arises About an Entity's Continued Existence," was issued in March 1981 to lay down guidelines for the auditor when he is assessing the going-concern status of his client. These guidelines are summarized in the paragraphs below.

Under normal circumstances, when an auditor examines an entity's financial statements in accordance with generally accepted auditing standards, he does not search for evidence relating to the entity's continued existence because an entity's continuation is assumed in financial accounting.²⁸ Therefore, it is only in situations where an entity's continued existence appears to be doubtful that further investigation is necessary.

Basically, there are two types of information that may indicate that an entity's continuation is in doubt. They are often referred to as contrary information and they usually come to the auditor's attention as evidence obtained during the course of the audit engagement up to the date of the audit report.²⁹ The first type of contrary information is information that may indicate solvency problems. This includes negative trends (e.g., recurring operating losses) and other indications (e.g., default on loan). The

²⁸ American Institute of Certified Public Accountants, "The Auditor's Considerations When a Question Arises About an Entity's Continued Existence," *Statement on Auditing Standards No. 34* (New York: AICPA, March 1981), paragraph 3.

²⁹ *Ibid.*, paragraph 4.

second type of contrary information is information that may cast doubt about an entity's continued existence without necessarily suggesting potential solvency problems. This comprises internal matters (e.g., loss of key management) and external matters (e.g., legal proceedings).

Although contrary information indicates circumstances that may threaten the continued existence of an entity, its significance may be diminished by the presence of mitigating factors.³⁰ These factors can be grouped into five categories as follows: (1) asset factors (e.g., disposability of assets), (2) debt factors (e.g., availability of borrowing capacity), (3) cost factors (e.g., separability of operations producing negative cash flows), (4) equity factors (e.g., variability of dividend requirements), and (5) other factors (e.g., capability to operate at reduced levels).

In evaluating the relative importance of contrary information and mitigating factors, the auditor must consider the underlying conditions that resulted in the contrary information, the nature of the entity's business and its operating characteristics, the discussions with principal officers and the possible legal implications, if any.³¹ Also, the auditor must consider any management plans that are responsive to the observed conditions that resulted in the contrary information.³² These management plans include (1) plans to liquidate assets, (2) plans to borrow money or restructure debt, (3) plans to reduce or delay expenditures, and (4) plans to increase ownership equity. The auditor must evaluate their relevance, feasibility and impact.

In addition, the auditor should also discuss with management any forecasts, projections, budgets, or other prospective data.³³ In particular, the auditor should con-

³⁰ Ibid., paragraph 5.

³¹ Ibid., paragraph 7.

³² Ibid., paragraph 8.

³³ Ibid., paragraph 9.

sider data relating to cash flows, data that are available or that can reasonably be developed, and data that are relevant in relation to the management plans. Further, the auditor should examine the assumptions underlying the prospective data, especially assumptions that are material to the relevant forecasts or projections, uncertain or sensitive to variations, or in deviation from historical trends.

After considering the significance of the contrary information and any mitigating factors, discussing plans, prospective data, and other appropriate matters with management, and making any substantive test necessary and practicable to assess such information, factors and plans, the auditor should be in a position to decide whether or not the entity can be regarded as a going concern.³⁴

From the brief review above, it can be seen that SAS No. 34 is in effect a codification of the traditional view of the going-concern concept and the generally accepted auditing practice of assessing an entity's continued existence. SAS No. 34 is not revolutionary in any sense—it merely puts down formally what has been traditionally and generally done in practice.

1.3.2 Problems with SAS No. 34

As the title of SAS No. 34 suggests, SAS No. 34 deals only with considerations and the final decision on the going-concern status is a matter of professional judgment. In a sense, SAS No. 34 properly lays down guidelines but does not eliminate the need to exercise careful judgment. Unfortunately, SAS No. 34 only tells the auditor what items should be considered when doubt about an entity's continued existence arises, but it does not tell the auditor how these items (e.g., contrary information and mitigating

³⁴ Ibid., paragraph 11.

factors) should be evaluated. In other words, no practical and systematic method, procedure or model is suggested in SAS No. 34 and this makes the going-concern evaluation highly subjective. Consequently, given the same set of contrary information and mitigating factors, different auditors may use different evaluation techniques that may, in turn, lead to different conclusions. This lack of uniformity and certainty reduces the utility of audit reports to decision makers. Furthermore, this highly subjective approach lacks objective defense if subsequent litigation should arise.

Williams [1984] conducted personal interviews with 15 partners and owners of CPA firms on selected going-concern issues three years after the issuance of SAS No. 34.³⁵ One important finding is that while the partners agreed that solvency factors are most important, there was no agreement on the relative importance of individual solvency factors suggested in SAS No. 34. Also, there was no mention of specific audit procedures designed to examine a client's going-concern status and in fact, some partners used completely subjective evaluation methods based merely on their knowledge of the client, the industry and the economy. Thus, it is apparent that SAS No. 34 does not provide clear and adequate guidelines as to how auditors should evaluate the going-concern status of an audit client. It is apparent also that unless a general evaluation model is developed, there can be no uniformity or objectivity in auditors' decisions on the going-concern status of business entities.

Another problem with SAS No. 34 is that some of the suggested guidelines are too general and ambiguous. For example, in the consideration of management plans, SAS No. 34 suggests that the auditor look into the apparent feasibility of plans, the possible direct and indirect effects, and the data that can reasonably be developed.³⁶

³⁵ H. James Williams, "Practitioners' Perspectives on Going-Concern Issues," *The CPA Journal* (December 1984), pp. 12-19.

³⁶ American Institute of Certified Public Accountants, "The Auditor's Considerations When a

Unfortunately, SAS No. 34 does not suggest any criteria or methods to evaluate the apparent feasibility of plans, nor does it indicate what constitutes possible direct and indirect effects and data that can reasonably be developed. Thus, while still being “guided” by SAS 34, different auditors can do different things and reach different conclusions. In fact, it is also conceivable that auditors can apply the same procedures and guidelines and still reach different conclusions. Therefore, there is a need for SAS No. 34 to be more specific and less ambiguous; otherwise, it can never serve as a good, practical and consistent guide.

1.3.3 The Proposed Statement on Auditing Standards

In February 1987, a proposed Statement on Auditing Standards, “The Auditor’s Consideration of an Entity’s Ability to Continue in Existence,” was issued as an Exposure Draft. This proposed SAS would replace SAS No. 34, if adopted. The proposed SAS differs significantly from SAS No. 34 in the following aspects: (1) the definition of a going concern, (2) the auditor’s responsibilities, and (3) the auditing and assessment procedures involved. These differences are elaborated below.

First, SAS No. 34 makes reference to the going-concern concept without stating explicitly what a going or non-going concern is. However, as discussed in the first section of this chapter, a going concern has been viewed traditionally as an entity that is expected to continue operation for the foreseeable future. In particular, the traditional accounting literature assumes liquidation to be the critical event separating a going and non-going concern. In contrast to SAS No. 34, the proposed SAS explicitly defines a going concern as an entity that is willing and able to sustain operation without entering

Question Arises About an Entity’s Continued Existence,” *Statement on Auditing Standards No. 34* (New York: AICPA, March 1981), paragraphs 8 and 9.

into bankruptcy proceedings or a similar transfer of operating control through regulatory or judicial action.³⁷ This definition represents a significant departure from the traditional going-concern concept. In particular, it links going-concern discontinuity to bankruptcy instead of liquidation. This has important implications because it suggests that bankruptcy prediction models can be used to assess the going-concern status of audit clients.

Second, SAS No. 34 suggests that assessing the going-concern status of an entity is only incidental to the performance of an external audit. In particular, it states that the auditor does not search for evidential matter relating to the entity's continued existence. Nevertheless, the auditor remain aware that auditing procedures applied primarily for other purposes may bring to his attention contrary information. SAS No. 34 merely requires that the auditor considers any such contrary information in forming an opinion on the financial statements. In contrast, the proposed SAS implies a more active auditor involvement in assessing an entity's continued existence. In fact, it states that the auditor has a responsibility to consider conditions that exist and events that have occurred prior to the completion of field work that might affect the entity's continued existence.³⁸ Further, when contrary information is present, the auditor should gather evidence to evaluate the entity's ability to continue in existence.³⁹ Thus, the proposed SAS places a greater burden on the auditor to assess a client's continued existence as compared to SAS No. 34. This enhanced responsibility is consistent with the view that the going-

³⁷ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 2.

³⁸ Ibid.

³⁹ Ibid., paragraph 3.

concern assumption is an assertion that management makes in preparing financial statements. As such, the auditor should actively verify the going-concern assertion.⁴⁰

Third, while SAS No. 34 merely suggests that auditing procedures applied primarily for other purposes may bring to light contrary information, the proposed SAS is specific as to what such auditing procedures may be. In particular, the following auditing procedures may provide evidence that casts doubt on an entity's continued existence: (1) applying analytical procedures, (2) reviewing subsequent events, (3) reviewing compliance with the terms of debt and loan agreements, (4) reading the minutes of meetings of stockholders, board of directors, and other important committees, (5) inquiring of an entity's legal counsel about litigation, claims and assessments, (6) confirming with related and third parties details of arrangements to provide or maintain financial support to those parties, and (7) obtaining written representations from management.⁴¹ Clearly, the proposed SAS expects the auditor to be more alert to the going-concern implications of the above auditing procedures. This, again, imposes a greater burden on the auditor than does SAS No. 34.

The proposed SAS also adds new guidelines on the assessment of an entity's ability to continue in existence. It appears to suggest that the auditor should evaluate the probability of the entity's ability to continue operations. This impression is given by the reference to Statement of Financial Accounting Standards (SFAS) No. 5, *Accounting for Contingencies* [1975] (which relies to some extent on probability

⁴⁰ J. Efrim Boritz and Eva R. Kralitz, "Reporting on Condition: Auditing the Going-Concern Assumption," *CA Magazine* (March 1987), pp. 67-70.

⁴¹ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 4.

estimates),⁴² and the statement about the likelihood of substantial doubt (which has probability implications).⁴³

Other than the major differences highlighted above, the proposed SAS and SAS No. 34 are similar (if not identical) in other areas such as contrary information, mitigating factors and management plans. Thus, the problems associated with SAS No. 34 will not be eliminated or mitigated even if the proposed SAS is adopted. Consequently, both SAS No. 34 and the proposed SAS are inadequate to guide auditors in making going-concern assessments.

⁴² Financial Accounting Standards Board, "Accounting for Contingency," *FASB Statement No. 5* (Connecticut: FASB, March 1975).

⁴³ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 12.

Chapter 2

A LITERATURE REVIEW OF GOING-CONCERN MODELS

As shown in Chapter 1, the assessment of going-concern status is difficult and existing external auditing guidelines are inadequate. This has led some accounting researchers to conclude that in making going-concern assessments, “the auditor is still very much on his own, having to rely virtually entirely on his subjective judgment and experience”⁴⁴ and “the tools available for formulating a qualified going concern opinion are not adequate.”⁴⁵

In view of the above, several researchers have advocated the use of objective statistical prediction models. This area of research, pioneered by Altman and McGough [1974],⁴⁶ is an outgrowth of the bankruptcy prediction literature. It is based on the idea that firms do not fail suddenly or in an unpredictable fashion. More importantly, it is based on the premise that the probability of failure is often reflected in the firm’s finan-

⁴⁴ Pieter J. Bosch, “A Definition of the Going-Concern Concept,” *Accountancy SA* (February 1984), p. 239.

⁴⁵ Christine V. Zavgren, “The Prediction of Corporate Failure: The State of the Art,” *Journal of Accounting Literature* (1983), p. 1.

⁴⁶ Edward I. Altman and Thomas P. McGough, “Evaluation of a Company as a Going Concern,” *Journal of Accountancy* (December 1974), pp. 50-57.

cial statements and can be detected through financial ratio analysis before failure occurs. As early as the 1930's, univariate studies had been conducted to uncover ratios that are good discriminators between bankrupt and non-bankrupt firms (see, for example, Smith [1930]⁴⁷). These early studies facilitated the construction of more sophisticated univariate failure-prediction models, particularly the univariate model constructed by Beaver [1966].⁴⁸ Since then, many significant advances in the art of failure prediction have been made.

Two of the most significant advances in the art of failure prediction are the introduction of multivariate analysis to bankruptcy prediction and the application of conditional probability models resulting from advances in econometrics. The first milestone led to the application of multivariate statistical models such as multiple discriminant analysis [Altman, 1968]⁴⁹ and multiple regression analysis [Meyer and Pifer, 1970]⁵⁰ and the second milestone led to the application of conditional probability models such as logit analysis [Martin, 1977]⁵¹ and probit analysis [Casey, McGee, and Stickney, 1986].⁵²

In 1974, Altman and McGough suggested that the models and methodologies used in bankruptcy prediction research could be applied to the prediction of going-

⁴⁷ Raymond F. Smith, *A Test Analysis of Unsuccessful Industrial Companies* (Bureau of Business Research, University of Illinois, Bulletin No. 31, 1930).

⁴⁸ William H. Beaver, "Financial Ratios as Predictors of Failure," *Journal of Accounting Research* (January 1967), pp. 44-62.

⁴⁹ Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *Journal of Finance* (September 1968), pp. 589-609.

⁵⁰ Paul A. Meyer and Howard W. Pifer, "Prediction of Bank Failures," *Journal of Finance* (September, 1970), pp. 853-868.

⁵¹ Daniel Martin, "Early Warning of Bank Failure: A Logit Regression Approach," *Journal of Banking and Finance* (1977), pp. 249-276.

⁵² Cornelius Casey, Victor E. McGee, and Clyde P. Stickney, "Discriminating Between Reorganized and Liquidated Firms in Bankruptcy," *The Accounting Review* (April 1986), pp. 249-262.

concern continuity.⁵³ Since then, six studies (including Altman and McGough [1974]) have dealt with prediction models in the going-concern context. These six studies can be classified into two categories. The first category consists of going-concern studies that are concerned with predicting the going-concern status of firms. Altman and McGough [1974],⁵⁴ McKee [1976],⁵⁵ and Levitan and Knoblett [1985]⁵⁶ fall into this category. The second category consists of going-concern studies that are concerned with predicting the auditor's going-concern qualification for firms with going-concern problems. This category includes Mutchler [1985],⁵⁷ Menon and Schwartz [1987],⁵⁸ and Dopuch, Holthausen, and Leftwich [1987].⁵⁹ In general, studies in the second category are more recent and sophisticated than those in the first category.

This chapter consists of three sections. The first section discusses the three studies concerned with predicting going-concern status and the second section discusses the three studies concerned with predicting going-concern qualification. Finally, the last section highlights the problems in all the six studies.

⁵³ Edward I. Altman and Thomas P. McGough, "Evaluation of a Company as a Going Concern." *Journal of accountancy* (December 1974), pp. 50-57.

⁵⁴ Ibid.

⁵⁵ Thomas E. McKee, "Discriminant Prediction of Going Concern Status: A Model for Auditors," in *AAA Collected Papers of the Annual Meeting* (August 23-25, 1976, Sarasota, Florida), pp. 294-321.

⁵⁶ Alan S. Levitan and James A. Knoblett, "Indicators of Exceptions to the Going Concern Assumption," *Auditing: A Journal of Practice & Theory* (Fall 1985), pp. 26-39.

⁵⁷ Jane F. Mutchler, "A Multivariate Analysis of the Auditor's Going-Concern Opinion Decision," *Journal of Accounting Research* (Autumn 1985), pp. 668-682.

⁵⁸ Krishnagopal Menon and Kenneth B. Schwartz, "An Empirical Investigation of Audit Qualification Decisions in the Presence of Going Concern Uncertainties," *Contemporary Accounting Research* (Spring 1987), pp. 302-15.

⁵⁹ Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich, "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (July 1987), pp. 431-454.

2.1 PREDICTION OF GOING-CONCERN STATUS

Statistical models that predict the going-concern status of firms accurately can be very useful to the external auditors. First, such models can provide objective and unambiguous information to supplement an auditor's subjective judgment in making going-concern assessments. Second, such models are important and persuasive analytical tools that the auditor can use when discussing problems with clients and recommending changes in the financial statements. They can be defensive devices in litigation too. Third, besides using such models at the end of an audit to determine the type of audit opinion that is appropriate, the auditor can use them at the beginning of the audit. By making an initial risk assessment of the financial position of an audit client with such models, the auditor can determine the the scope of the audit and plan the necessary audit procedures.

Models that predict the going-concern status of firms accurately can be useful to investors and creditors too. Generally, investors and creditors want to avoid investing in or lending to a firm that is predicted to have a low probability of going-concern continuity.

To date, three models that predict going-concern status have been proposed in the literature. Each of these models is briefly discussed below.

2.1.1 Altman and McGough [1974]

Altman and McGough [1974]⁶⁰ extended the application of the bankruptcy prediction model developed by Altman [1968]⁶¹ to the going-concern context. Altman's 1968 model was constructed using multiple discriminant analysis to analyze 33 failed manufacturing firms that filed for bankruptcy during the period 1946 to 1965 and 33 non-failed manufacturing firms. These two samples of firms were matched in terms of industry and size. An initial set of 22 variables was considered. These variables were chosen on the basis of their popularity in the literature and their potential relevance in discriminating between failed and non-failed firms. Using stepwise procedures and his own judgment, Altman [1968] developed a five-variable discriminant model consisting of (1) working capital to total assets, (2) retained earnings to total assets, (3) earnings before interest and tax to total assets, (4) market value of equity to book value of total debt, and (5) sales to total assets. Altman [1968] validated his bankruptcy prediction model on a validation sample of 25 bankrupt firms and 66 non-bankrupt firms. All the 66 non-bankrupt firms were financially troubled firms (i.e., firms that reported losses). The accuracy rates for these bankrupt and non-bankrupt firms were 96.00% and 78.79% respectively, giving an overall accuracy rate of 83.52%.

Although Altman's [1968] model was constructed primarily to predict business failures, Altman and McGough [1974] believed that it could be used to assess the continuity of a company's operation as well.⁶² This idea was tested in 1974 with a sample of

⁶⁰ Edward I. Altman and Thomas P. McGough, "Evaluation of a Company as a Going Concern." *Journal of Accountancy* (December 1974), pp. 50-57.

⁶¹ Edward I. Altman, "Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy," *Journal of Finance* (September 1968), pp. 589-609.

⁶² Recall that going-concern discontinuity was traditionally operationalized as liquidation. Thus,

34 companies that entered bankruptcy proceedings between 1970 and 1973. It was found that the discriminant model could predict bankruptcy for these companies with an accuracy rate of 82.35% one year prior to bankruptcy. The model's accuracy rate was 57.58% two years prior to bankruptcy. In contrast, the auditors qualified their audit reports for the same sample companies on a going-concern basis only 44.12% and 21.21% of the time, respectively. Altman and McGough [1974] concluded that the model was superior in signalling going-concern problems and that it could be an effective aid to the auditor in making going-concern assessments.

Later, Altman [1982] extended the 1974 study to a larger sample of 109 failed companies that filed for bankruptcy during the period 1970 to 1982.⁶³ He found that, as in the 1974 study, his discriminant model outperformed the auditors in predicting bankruptcy. The accuracy rates for the model and auditors one and two years prior to bankruptcy were 86.24% and 73.39% (for the model), and 47.71% and 19.27% (for the auditors), respectively. Altman [1982] concluded that the discriminant model developed in 1968 to predict bankruptcy could also be used to help auditors in assessing a company's ability to continue in existence.

2.1.2 McKee [1976]

McKee [1976] constructed and tested a discriminant model for classifying going and non-going concerns based on a total sample of 50 companies judged to be going

contrary to the proposed SAS, going-concern discontinuity was perceived to be different from bankruptcy at that time.

⁶³ Edward I. Altman, "Accounting Implications of Failure Prediction Models," *Journal of Accounting, Auditing & Finance* (Fall 1982), pp. 4-19.

concerns and 50 matched companies judged to be non-going concerns.⁶⁴ The two subsamples of going and non-going concerns were matched by industrial classifications and they covered financial statements for the period 1970 to 1973. Of the 50 matched pairs, 35 matched pairs were used for model construction and the remaining 15 matched pairs were used for model validation. Unlike Altman's [1968] model, the non-going concerns used in McKee's [1976] study included not only companies that filed for bankruptcy but also companies that were (1) entering receivership, (2) undergoing reorganization where creditors either become shareholders or reduce their claims, (3) having substantial losses in four successive years, (4) having significant deficits in retained earnings for four successive years, or (5) disposing of or discontinuing a major product under adverse conditions. All non-bankrupt firms not meeting any of the previous criteria were considered going concerns.

In this study, 40 variables were initially considered. These variables were selected on a judgmental basis, with primary emphasis given to financial ratios directly related to the cash-flow model of the firm put forth by Beaver [1966]⁶⁵ and to financial ratios found to be significant in previous bankruptcy studies. These 40 initial variables were reduced to 15 financial ratios through stepwise discriminant procedures. After further stepwise selection, the final discriminant model consisted of the following seven variables: (1) quick assets to current liabilities, (2) working capital to owners' equity, (3) long-term liabilities to working capital, (4) total liabilities to total assets, (5) net sales to total assets, (6) net income before tax plus depreciation, depletion, and amortization to total liabilities, and (7) company current assets to current liabilities to industry current

⁶⁴ Thomas E. McKee, "Discriminant Prediction of Going Concern Status: A Model for Auditors," in *AAA Collected Papers of the Annual Meeting* (August 23-25, 1976, Sarasota, Florida), pp. 294-321.

⁶⁵ William H. Beaver, "Financial Ratios as Predictors of Failure," *Journal of Accounting Research* (January 1967), pp. 44-62.

assets to current liabilities. The accuracy rates for the discriminant model were 77.00% for the estimation sample (i.e., the in-sample accuracy rate) and 72.00% for the validation sample (i.e., the hold-out accuracy rate).

As an extension, McKee [1976] derived a decision rule based on three years' data and the discriminant model. Basically, the Z-scores for the three years were summed and the total was compared to a critical cut-off value to determine the classification of the companies. This decision model increased the overall accuracy rate from 72.00% to 86.67% for the validation sample. The accuracy rates for going and non-going concerns were 93.33% and 80.00%, respectively. Although McKee [1976] did not compare these results to the auditors' opinions explicitly, he concluded that his discriminant model would be of obvious benefit to the auditor in assessing the going-concern status of audit clients.

2.1.3 Levitan and Knoblett [1985]

Based on an expected high correlation between going-concern discontinuity and bankruptcy, Levitan and Knoblett [1985] used multiple discriminant analysis to construct a bankruptcy prediction model to help auditors make going-concern assessments.⁶⁶ The discriminant model was constructed with a sample of 35 bankrupt companies that filed for bankruptcy during the period 1980 to 1981 and a sample of 35 non-bankrupt companies matched on the basis of industry and size. A total of 26 variables was considered. Unlike previous studies where variables were selected primarily on the basis of judgment, this set of 26 variables was selected after considering external auditing guidelines suggested in the literature. In particular, the 26 variables were de-

⁶⁶ Alan S. Levitan and James A. Knoblett, "Indicators of Exceptions to the Going Concern Assumption," *Auditing: A Journal of Practice & Theory* (Fall 1985), pp. 26-39.

rived from the following four categories of variables identified by SAS No. 34 to be contrary information: (1) recurring operating losses, (2) working capital deficiencies, (3) negative cash flows from operations, and (4) adverse key financial ratios. Some of the variables used were dummy variables (e.g., a dummy integer representing the number of years in the past three years a particular ratio was negative) and trend variables (e.g., the slope of a particular ratio over the past three years).

The final discriminant model included the following ten variables: (1) trend variable for operating income to shareholders' equity, (2) net income to shareholders' equity, (3) dummy variable for current assets to current liabilities, (4) net worth to total debt, (5) dummy variables for cash flow, (6) quick assets to total assets, (7) trend variable for current assets to current liabilities, (8) dummy variable for net income, (9) current assets to total assets, and (10) current assets to current liabilities. The effectiveness of the discriminant model in predicting bankruptcy was tested using a split-half methodology. That is, the sample was split into two halves randomly and one half was used as an estimation sample and the other a validation sample. The overall accuracy rates of the discriminant model one and two years prior to bankruptcy were 88.50% and 67.00%, respectively.

Levitan and Knoblett [1985] also assessed the performance of auditors in qualifying bankrupt companies by examining the audit reports of the 70 sampled companies. An audit opinion was considered "correct" when a going-concern qualification was given to a bankrupt firm or when a clean opinion was given to a non-bankrupt firm. The auditors' accuracy rates one year prior to bankruptcy were 65.63% for bankrupt companies, 100.00% for non-bankrupt companies, and 83.58% overall. The corresponding accuracy rates two years prior to bankruptcy were 27.27%, 100.00%, and 64.71%, respectively. Levitan and Knoblett [1985] concluded that their discriminant model was a better indicator of a company's future prospects than the auditor's going-concern opin-

ion. Thus, the discriminant model should be useful to the auditor in assessing a company's continued existence.

2.2 PREDICTION OF GOING-CONCERN QUALIFICATION

The three prediction models reviewed above are fundamentally different from the three prediction models to be reviewed in this section. While the first three prediction models predict companies' going-concern status, the latter three prediction models predict auditors' going-concern qualification. In other words, the going-concern prediction models in the previous section are concerned with predicting the expected continuity of firms whereas the going-concern *qualification* prediction models in this section are concerned with predicting the opinions of auditors. However, both categories of models are often motivated by the same factors such as the provision of objective and unambiguous information to aid auditors in making going-concern assessments. Although the prediction of going-concern qualification may be less useful to investors and creditors in making investment and loan decisions as compared to the prediction of going-concern status, it may be more useful to researchers interested in distinguishing between audit opinions that are predictable with publicly available data and those that are unexpected or unwarranted. Such information is particularly useful in market-based accounting research where the efficiency of the market and the information content of disclosures are evaluated.

To date, three models that predict going-concern qualification have been proposed in the literature. These models are briefly reviewed below.

2.2.1 Mutchler [1985]

Mutchler [1985] used discriminant analysis to construct three different prediction models of going-concern qualification with three different sets of independent variables.⁶⁷ The models were constructed with a total sample of 119 manufacturing companies that received going-concern qualifications in their audit reports and 119 manufacturing companies that exhibited potential going-concern difficulties but did not receive going-concern qualifications. Companies that exhibited potential going-concern difficulties were defined as companies that met at least one of the following seven criteria: (1) liquidation, (2) negative net worth, (3) negative cash flow, (4) negative income from operations, (5) negative working capital, (6) current year loss, including cases where there were two and three straight loss years, and (7) current year retained earnings deficit, including cases where there were two and three straight deficit years. These criteria were determined through interviews with auditors as reported in Mutchler [1984].⁶⁸

For the first model, the independent variables used were the top six financial ratios found by Mutchler [1984] to be the six most important cues used by auditors to determine whether a problem company would receive a going-concern opinion. For the second model, the independent variables used included not only the six ratios used in the first model but also two dummy variables to capture the presence of contrary information and the presence of mitigating factors. These two dummy variables were included on the basis of guidelines suggested in SAS No. 34. Finally, for the third model, the independent variables used included all the six ratios used in the first model as well as

⁶⁷ Jane F. Mutchler, "A Multivariate Analysis of the Auditor's Going-Concern Opinion Decisions," *Journal of Accounting Research* (Autumn 1985), pp. 668-682.

⁶⁸ Jane F. Mutchler, "Auditors' Perceptions of the Going-Concern Opinion Decision," *Auditing: A Journal of Practice & Theory* (Spring 1984), pp. 17-30.

the improvement variable (defined as the difference between the current year's and the previous year's net income to ending assets) and a dummy variable to capture the nature of the audit report (i.e., whether qualified or clean) in the previous year. For all the models, data for the 238 sample companies were obtained from financial statements issued between the period March 31, 1981 to February 28, 1982.

Among the three models constructed, Mutchler [1985] found that the third model, after omitting the improvement variable, had the highest predictive ability. The following seven variables were used in this "best" model: (1) cash flow to total liabilities, (2) current assets to current liabilities, (3) net worth to total liabilities, (4) total long-term liabilities to total assets, (5) total liabilities to total assets, (6) net income before tax to net sales, and (7) dummy variable for the previous year's audit opinion. The effectiveness of this model in predicting going-concern qualification was tested on the total sample using a split-half methodology with ten different runs. The results showed that the discriminant model could predict going-concern qualification with an accuracy rate of 71.00% and non-qualification with an accuracy rate of 94.10%. The overall accuracy rate of the model was 89.90%. Apparently, the inclusion of SAS No. 34 variables such as mitigating factors, contrary information and trend do not appear to be useful in predicting going-concern qualification because these variables are not included in the "best" (i.e., most predictive) model.

Based on her findings, Mutchler [1985] concluded that for 89.90% of the companies in the sample, the going-concern qualification was redundant because it could be predicted correctly with the discriminant model.

2.2.2 Menon and Schwartz [1987]

The prediction model constructed by Menon and Schwartz [1987] differs from all the four models reviewed so far in that it used logit analysis instead of discriminant analysis.⁶⁹ This is a significant methodological improvement because logit analysis avoids many of the problems encountered in the application of discriminant analysis. (These problems will be elaborated in the next section of this chapter.)

Similar to Mutchler [1985], Menon and Schwartz [1987] were more interested in the prediction of going-concern qualification than going-concern status. Their estimation sample consisted of 89 companies, 37 of which received going-concern qualifications. All the 89 companies in the sample were bankrupt firms that filed for bankruptcy during the period 1974 to 1980.

The following seven variables were used to model the auditors' going-concern qualification decisions: (1) current assets to current liabilities, (2) change in current assets to current liabilities over the year, (3) retained earnings to total assets, (4) debt to total assets, (5) income to total assets, (6) dummy variable for recurring operating losses, and (7) cash flow from operations to total liabilities. These ratios were selected after reviewing guidelines suggested in SAS No. 34 and Carmichael [1972].⁷⁰ These guidelines suggest factors that may be useful for detecting going-concern problems. However, such guidelines are very broad and general; thus, the specific variables selected were based primarily on subjective judgment and findings in prior research.

⁶⁹ Krishnagopal Menon and Kenneth B. Schwartz, "An Empirical Investigation of Audit Qualification Decisions in the Presence of Going Concern Uncertainties," *Contemporary Accounting Research* (Spring 1987), pp. 302-315.

⁷⁰ D. R. Carmichael, "The Auditor's Reporting Obligation: The Meaning & Implementation of the Fourth Standard of Reporting," *Auditing Research Monograph No. 1* (New York: AICPA, 1972).

The effectiveness of the resulting logit model in predicting going-concern qualification was tested with two validation samples. The first validation sample consisted of 39 bankrupt companies that filed for bankruptcy during the period 1981 to 1983 and the second validation sample consisted of 46 non-bankrupt companies that were identified as being financially weak (i.e., companies that reported net loss and retained earnings deficit in 1981). For the first validation sample of 39 bankrupt companies, the accuracy rates for predicting going-concern qualification and non-qualification were 71.43% and 84.00%, respectively, giving an overall accuracy rate of 79.49%. For the second validation sample of 46 non-bankrupt companies, the corresponding accuracy rates were 100.00%, 71.43%, and 78.26%, respectively.⁷¹ Menon and Schwartz [1987] concluded that their logit model could predict going-concern qualification accurately.

2.2.3 Dopuch, Holthausen, and Leftwich [1987]

Dopuch, Holthausen, and Leftwich [1987] constructed models to predict audit qualifications for four types of contingencies—namely; going concern, litigation, asset realization and multiple uncertainties.⁷² For the present purpose, only the going-concern qualification prediction model is of interest. This model was constructed using probit analysis with a weighted procedure to eliminate the bias in the coefficient estimates caused by choice-based sampling. (A more elaborate discussion of the choice-based sample bias will be presented in the next section and Chapter 3.)

⁷¹ Menon and Schwartz [1987] did not provide the accuracy rates when they discussed the validation results. All the accuracy rates given above were computed from the “raw” data presented in Tables 5 and 6 of their paper.

⁷² Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich, “Predicting Audit Qualifications with Financial and Market Variables,” *The Accounting Review* (July 1987), pp. 431-454.

The going-concern qualification prediction model was constructed using an estimation sample of 27 firms with going-concern qualifications during the period 1969 to 1976 and 346 firms with clean audit opinions during the same period. No matching of industry or size between the qualified and non-qualified firms was attempted. The following nine variables were used to construct the model: (1) change in total liabilities to total assets over the year, (2) change in receivables to total assets over the year, (3) change in inventory to total assets over the year, (4) total assets, (5) dummy variable for the availability of income to shareholders, (6) dummy variable for the period of listing in the New York Stock Exchange or the American Stock Exchange, (7) change in beta over the year, (8) change in the residual standard deviation from the market model regression over the year, and (9) difference between common stock returns and an equally weighted industry index. These variables were selected primarily on the basis of judgment and consistency with the findings of previous research.

The effectiveness of the probit model in predicting going-concern qualification was tested on a validation sample consisting of 12 firms with going-concern qualifications and 95 firms with clean audit opinions during the period 1977 to 1980. Assuming equal misclassification costs of predicting qualification and non-qualification incorrectly, the accuracy rate for predicting going-concern qualification was only 33.30%. The accuracy rate for predicting clean audit opinions was 99.90%, giving an overall accuracy rate of 92.43%.⁷³ These accuracy rates were the highest among the four models constructed for predicting going-concern, litigation, asset realization, and multiple uncertainties qualifications. Dopuch, Holthausen, and Leftwich [1987] concluded that their

⁷³ Dopuch, Holthausen, and Leftwich [1987] reported different accuracy rates for different estimated misclassification costs. For simplicity and ease of comparison with other going-concern models, only the accurate rates for equal misclassification costs of predicting qualification and non-qualification incorrectly are given here.

probit model could predict audit qualifications of contingencies (including the going-concern qualification) accurately.

2.3 PROBLEMS WITH THE SUGGESTED GOING-CONCERN MODELS

The idea that objective prediction models can be constructed to aid auditors in making going-concern assessments is appealing. However, there are major problems with all the six studies reviewed in the previous two sections that may seriously diminish the usefulness of these going-concern models. These problems are discussed below.

2.3.1 Problems with the Application of Discriminant Analysis

Four of the six research studies in the going-concern area (namely; Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985]) used multiple discriminant analysis to construct prediction models. However, discriminant analysis requires restrictive assumptions that are often violated, leading to invalid results. For example, although discriminant analysis assumes that the independent variables are multivariate normal, deviations from multivariate normality are generally observed in practice. In fact, non-multivariate normality is the rule rather than the exception as far as financial ratios are concerned. McLeay [1986] reported that financial ratios are not even univariate normal.⁷⁴

When the normality assumption is violated, the test of significance and the estimated error rates are biased. Although Gilbert [1968] reported that discriminant analysis

⁷⁴ Stuart McLeay, "Student's t and the Distribution of Financial Ratios," *Journal of Business Finance & Accounting* (Summer 1986), pp. 209-222.

may be robust to normality violations,⁷⁵ Lachenbruch, Sneeringer, and Revo [1973] found that non-multivariate normality can affect the results of discriminant analysis seriously.⁷⁶ In particular, the estimated error rates for the individual groups can be significantly distorted even though the overall estimated error rate may not be significantly affected. Thus, the discriminant results in Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985] may be invalid.

Another important assumption in the application of linear discriminant analysis is that the variance-covariance matrices are equal across all groups. Violation of this assumption affects the significance test for the differences in group means as well as the appropriate form of the classification rules. In general, quadratic instead of linear classification rules should be used if the dispersions of the groups are unequal [Eisenbeis, 1977].⁷⁷ In the bankruptcy prediction context, it was found that the financial ratios of bankrupt firms and non-bankrupt firms do not have equal dispersions [Richardson and Davidson, 1983].⁷⁸ Similar findings can be expected for going and non-going concerns as well as firms that have going-concern qualifications and those that do not. Further, Diamond [1976]⁷⁹ and Altman, Haldeman, and Narayanan [1977]⁸⁰ reported that quad-

⁷⁵ Ethel S. Gilbert, "On Discrimination Using Qualitative Variables," *Journal of the American Statistical Association* (December 1968), pp. 1399-1412.

⁷⁶ Peter A. Lachenbruch, C. Sneeringer, and L. T. Revo, "Robustness of the Linear and Quadratic Discriminant Function to Certain Types of Non-Normality," *Communication in Statistics* (1973), pp.39-56.

⁷⁷ Robert A. Eisenbeis, "Pitfalls in the Application of Discriminant Analysis in Business, Finance, and Economics," *Journal of Finance* (June 1977), pp. 875-900.

⁷⁸ Frederick M. Richardson, and Lewis F. Davidson, "An Exploration into Bankruptcy Discriminant Model Sensitivity," *Journal of Business Finance & Accounting* (Summer 1983), pp. 195-207.

⁷⁹ Harold S. Diamond, Jr, "Pattern Recognition and the Detection of Corporate Failure," (Unpublished Ph.D. Dissertation, New York University, 1976).

⁸⁰ Edward I. Altman, R. G. Haldeman, and P. Narayanan, "Zeta Analysis," *Journal of Banking and Finance* (June 1977), pp. 29-54.

atic classification rules are statistically more appropriate than linear classification rules in the construction of bankruptcy prediction models. Thus, it might not be appropriate for Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985] to use linear discriminant analysis to construct their models. In particular, the larger the sample size, the closer the groups, and the more the number of variables, the greater will be the differences between linear and quadratic results [Marks and Dunn, 1974].⁸¹

Besides restrictive assumptions, discriminant analysis also suffers from two other serious shortcomings. First, while discriminant analysis may be appropriate for classifying observations into groups when the assumptions are met, it is not appropriate for generating probabilities. In other words, even though discriminant analysis can predict a firm as a going or non-going concern, it cannot generate the probability of a firm being a going or non-going concern in an accurate or appropriate manner. Most attempts to use discriminant analysis to generate probabilities involve the subjective assessment of the probability associated with a particular discriminant score. However, as shown by Martin [1977], such procedures are inferior in generating probabilities as compared to the very naive procedure of setting the probabilities of observations being in the various groups equal to their prior probabilities in the population.⁸² Further, the probabilities generated through discriminant analysis may be inaccurate, even though the classification accuracy may be high.⁸³

⁸¹ Sidney Marks and Olive Jean Dunn, "Discriminant Functions when Covariance Matrices are Unequal," *Journal of the American Statistical Association* (June 1974), pp. 555-559.

⁸² Daniel Martin, "Earning Warnings of Bank Failure," *Journal of Banking and Finance* (1977), pp. 249-67.

⁸³ As discussed in the first chapter, the proposed SAS suggests that the auditor make an assessment of the probability of going-concern continuity when he formulates his audit opinion for his client. In view of the poor performance in generating probabilities, discriminant analysis is clearly not an appropriate statistical method to use in the construction of going-concern prediction models.

Second, unlike the coefficients in the classical linear regression model, the coefficients in the discriminant model are not unique [Eisenbeis, 1977].⁸⁴ In fact, only the *ratios* of the discriminant coefficients are unique because discriminant coefficients are determined only up to a factor of proportionality. Consequently, there is no test for the absolute value or significance of a particular coefficient. The only appropriate test is whether the ratio of two coefficients is equal to some constant. However, most of these tests assume equal variance-covariance matrices across the groups, which as discussed above, is often violated. Thus, it is difficult to assess the significance of and hence, interpret the coefficients in the discriminant models of Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985].

2.3.2 Problems with the Operational Definitions of a Going Concern

A going concern is a firm that is expected to remain in operation for the foreseeable future. Although this definition forms the core of the going-concern concept, it is not operational. In particular, the level of future operations and the expected life of the firm are undefined [McKee, 1986].⁸⁵ Thus, to operationalize the going-concern concept, the traditional definition of a going concern emphasizes liquidation as the critical event separating a going and non-going concern. However, in the proposed SAS, a going concern is defined as an entity that is willing and able to sustain operation without entering into bankruptcy proceedings or a similar transfer of operating control through

⁸⁴ Robert A. Eisenbeis, "Pitfalls in the Application of Discriminant Analysis in Business, Finance, and Economics," *Journal of Finance* (June 1977), pp. 883-85.

⁸⁵ Thomas E. McKee, "Why Can't Accountants Deal with Uncertainty about Enterprise Continuity?" *Management Accounting* (July 1986), pp. 24-29.

regulatory or judicial action.⁸⁶ This current interpretation redefines going-concern discontinuity as bankruptcy instead of liquidation. This definition will be used by external auditors if the proposed SAS is adopted.

Altman and McGough [1974] and Levitan and Knoblett [1985] expected bankruptcy and going-concern discontinuity to be highly correlated and equated non-going concerns with bankrupt firms. In view of the definition in the proposed SAS, this is appropriate. However, Altman and McGough [1974] and Levitan and Knoblett [1985] did not have authoritative support for their definitions at the time their studies were conducted. Consequently, they made some reservations about using bankruptcy prediction models to assess going-concern discontinuity by stating that bankruptcy and going-concern discontinuity might not be equivalent. Menon and Schwartz [1987] also assumed bankruptcy to be a going-concern exception "since bankruptcy filing clearly threatens a company's survival chances."⁸⁷ As a result, they selected a sample of only bankrupt firms (representing companies with going-concern problems) to construct their logit model. Dopuch, Holthausen, and Leftwich [1987] made no attempt to operationalize a going concern. This is not surprising because their study focussed on audit qualifications and not going-concern status per se.

McKee [1976] extended Altman and McGough's [1974] operational definition of a going concern by defining a non-going concern as a firm: (1) undergoing bankruptcy, (2) entering receivership, (3) undergoing a reorganization where creditors either become shareholders or reduce their claims, (4) having substantial losses in four successive years, (5) having a significant deficit in retained earnings for four successive years, or (6) dis-

⁸⁶ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 2.

⁸⁷ Krishnagopal Menon and Kenneth B. Schwartz, "An Empirical Investigation of Audit Qualification Decision in the Presence of Going Concern Uncertainties," *Contemporary Accounting Research* (Spring 1987), p. 304.

posing of or discontinuing a major product under adverse conditions. The relationship between items (1) to (3) and going-concern discontinuity is consistent with the definition of a going concern in the proposed SAS. However, for the remaining parts of the definition, there are no clear links between going-concern discontinuity and items (4) to (6). For example, it has not been established that a firm having substantial losses in four successive years will not remain in operation for the foreseeable future or will file for bankruptcy. Further, setting “four years” as the cut-off point between going and non-going concerns is subjective and arbitrary. As such, McKee’s operational definition of a going concern is flawed.

Mutchler [1985] did not actually provide an operational definition of a going concern but instead defined a “company that exhibited potential going-concern difficulties” or “problem” company as a firm meeting one or more of the following criteria: (1) liquidation, (2) negative net worth, (3) negative cash flow, (4) negative income from operations, (5) negative working capital, (6) current year loss (including cases where there are two or three straight loss years), and (7) current year retained earnings deficit (including cases where there are two or three straight deficit years). As in McKee’s [1976] definition, there are no clear links between going-concern discontinuity and the suggested criteria for “problem” companies, except in the case of liquidation (i.e., criterion 1). It is clear that a firm in liquidation is not expected to remain in operation for the foreseeable future (and thus, a non-going concern) but the links between factors such as negative working capital and negative current income and going-concern discontinuity have not been established. In fact, firms can have negative income from operations and negative working capital and yet continue to operate with success. This is especially so for firms suffering temporary setbacks or firms with good long-run prospects but low current liquidity. As such, Mutchler’s [1985] operational definition of “problem” companies cannot be extended to non-going concerns. It is also not con-

sistent with the definition of a going concern given in the proposed SAS that focusses on bankruptcy as the critical event separating a going concern from a non-going concern.

When the operational definition of a going concern does not correspond to the going-concern concept, models constructed on the operational definition can have several serious limitations. First, the sample will not be dichotomized into going and non-going concerns correctly. That is, companies that are classified as going concerns in the sample may actually be non-going concerns and vice versa. Thus, the sample data used to construct or test the prediction model lack validity. Second, the model resulting from incorrect sample dichotomization (and hence, invalid data) will not predict what it purports to predict. In statistical terms, inappropriate operational definitions lead to an initial misclassification of samples in a non-random manner. The result is that the “apparent error rates are considerably affected” and hence “should not be trusted” [Lachenbruch, 1974].⁸⁸ This criticism is particularly relevant to the prediction model constructed by McKee [1976] because of the way going concerns are defined in his study.

2.3.3 Problems with Choice-Based Sample Designs

With most estimation techniques, there is an implicit assumption that exogenous random sampling designs are used. That is, an observation is randomly drawn and the dependent and independent variables are observed. However, this is not the case with the construction of all the six going-concern models reviewed above. For these prediction models, the samples were drawn based on the knowledge of the dependent variable (i.e., going or non-going concern, or qualified or non-qualified audit opinion). Under

⁸⁸ Peter A. Lachenbruch, “Discriminant Analysis When the Initial Samples are Misclassified II: Non-Random Misclassification Models,” *Technometrics* (August 1974), p. 424.

such sampling designs, the probability of an observation entering the sample depends on the attributes of the dependent variable. This violates the random sampling design assumption and leads to a choice-based sample bias of both the parameter and probability estimates.⁸⁹

Zmijewski [1984] showed that this bias decreases as the sample selection probability approaches the population probability.⁹⁰ However, except for Menon and Schwartz [1987] and Dopuch, Holthausen, and Leftwich [1987], all the other four studies reviewed used matched sample designs. Consequently, non-going concerns and companies with going-concern qualifications were oversampled in these studies because their sample probabilities (0.5) were much larger than their population probabilities. In particular, there is no doubt that the proportion of non-going concerns and qualified audit opinions in real life is extremely small and certainly much less than 0.5. The result of this is an understatement of classification and prediction error rates in the oversampled group (i.e. the non-going concerns and going-concern qualifications). By assuming equiprobability, the matched sample design “magnifies” the effects of the choice-based sample bias. These effects can be minimized if sample probabilities reflecting population probabilities are used. Further, they can be eliminated if appropriate weighted procedures (to be discussed in Chapter 3) are applied.

Of the six studies reviewed, only Dopuch, Holthausen, and Leftwich [1987] considered choice-based sample bias explicitly and used weighted procedures to eliminate it. Although similar procedures are also available in discriminant analysis through the use of prior probabilities to account for the relative occurrences of observations in the dif-

⁸⁹ See, for example, Charles F. Manski and Steven R. Lerman, “The Estimation of Choice Probabilities from Choice Based Samples,” *Econometrica* (November 1977), pp. 1977-88.

⁹⁰ Mark E. Zmijewski, “Methodological Issues Related to the Estimation of Financial Distress Prediction Models,” *Journal of Accounting Research* (Supplement 1984), pp. 59-86.

ferent groups, they were not used by Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985]. Instead, group memberships were assumed to be equi-probable. However, unless membership in the groups is equally likely (which it is not), the estimated error rates under such an assumption will bear little relationship to what one might expect in the population. More importantly, the effectiveness of the classification is misleading when incorrect prior probabilities are chosen. Thus, the results of discriminant models in the above studies (as well as the logit model in Menon and Schwartz [1987]) are questionable.

2.3.4 Problems with the Selection of Independent Variables

In reviewing the bankruptcy prediction literature, Zavgren [1983] concluded that the lack of knowledge concerning the variables that are relevant for distinguishing between failing and non-failing firms is a serious impediment to the development of a scientific approach to the bankruptcy problem.⁹¹ This criticism can also be extended to the going-concern prediction literature, where the selection of independent variables for going-concern models is based neither on sound theoretical justification nor valid empirical evidence. Instead, independent variables are often selected on the basis of criteria such as: (1) popularity in the literature, (2) potential relevance, (3) consistency with the findings of previous research, (4) suggested "guidelines" in the literature, and (5) subjective judgment.

The above criteria used by the six going-concern studies to select independent variables are problematic. First, financial ratios that are most popular in the literature may not be the most important for model construction because no theoretical or em-

⁹¹ Christine V. Zavgren, "The Prediction of Corporate Failure: The State of the Art," *Journal of Accounting Literature* (1983), p. 2.

pirical rationale exists to indicate that popular ratios provide an adequate model.⁹² Second, potential relevance to going-concern prediction is not an appropriate (or even valid) criterion for variables selection because potential relevance does not lead to a unique set of variables. In particular, it does not discriminate between two or more potentially relevant variables and almost any existing or even new financial ratio can be potentially relevant. Third, consistency with previous findings is a meaningless criterion if previous findings are not supported by theory or empirical evidence. In the going-concern context, “previous findings” often refer to the variables selected in some previous studies where the variables selection procedures are just as arbitrary and subjective. Fourth, while “guidelines” for variables selection exist in the literature (e.g., SAS No. 34), these “guidelines” are very general and they do not specify the particular financial ratios to use in the prediction models. Ultimately, the researcher has to select a set of ratios from all possible ratios that fall within the “guidelines.” Fifth, the use of subjective judgment to select variables is problematic because variables selected under such a criterion are often arbitrary and not supported by sound theory or empirical evidence. Further, they vary from researcher to researcher, making it difficult (if not impossible) to integrate or evaluate research findings.

Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] attempted to overcome some of the problems by using statistical techniques. Basically, they started with some large set of initial variables and then selected a reduced set of “significant” variables using stepwise multiple discriminant analysis procedures. However, the use of stepwise procedures is problematic too. In particular, the final “significant” variables are selected on the basis of improving the discriminating power of the discriminant model. This power relates to the characteristics of the particular

⁹² Ibid., p. 9.

sample and not to any rationale regarding the actual importance of some particular characteristics in general.⁹³ Thus, the results are sample-specific. Also, the variables selected often depend on the order in which they are selected so that different final variables can be selected even with the same sample and the final set of variables may not actually be the best (i.e., most predictive). Further, as Edmister [1972] pointed out, other models of almost the same predictive power are possible using the variables excluded because they are highly correlated with those selected.⁹⁴ Thus, while the variables selected through stepwise procedures have predictive ability, they do not provide unique information.

Incidentally, although all the six models reviewed above are constructed to aid auditors, some of the variables used are more suited for academic research than for practical application. For example, one of the variables used by Dopuch, Holthausen, and Leftwich [1987] is the change in the residual standard deviation from the market model regression. This variable is defined as the difference between the residual standard deviation of the market model regression measured over 260 trading days prior to the fiscal year end and 260 trading days prior to the previous fiscal year end, where the market model regression is based on the equally weighted market index.⁹⁵ Even if the auditor understands what this variable means, it is doubtful that such data are readily available to him.

⁹³ Ibid., p. 17.

⁹⁴ Robert O. Edmister, "An Empirical Test of Financial Ratio Analysis for Small Business Prediction," *Journal of Financial and Quantitative Analysis* (March 1972), p. 1487.

⁹⁵ Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich, "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (July 1987), p. 436.

2.3.5 Problems with Predicting Going-Concern Qualification

While Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] are concerned with predicting going-concern status, Mutchler [1985], Menon and Schwartz [1987], and Dopuch, Holthausen, Leftwich [1987] are concerned with predicting going-concern qualification. Clearly, the prediction of going-concern status is directly related to the auditor's assessment of going-concern continuity. However, the prediction of going-concern qualification is of limited usefulness to auditors making going-concern assessments because of the following problems.

First, in the construction of models that predict going-concern qualification, there is an implicit assumption that all qualified and non-qualified audit opinions for the sample of firms are correct. Otherwise, it is meaningless to predict audit opinions on the basis of data (i.e., previous opinions) which may be incorrect in the first place. However, from the data supplied by Menon and Schwartz [1987], this implicit assumption is clearly not valid. In particular, out of a total of 89 bankrupt firms that were used to construct the prediction model, only 37 (i.e., 41.57%) received going-concern qualifications.⁹⁶ According to the proposed SAS, all bankrupt firms should be qualified on a going-concern basis. Consequently, with incorrect dependent variables, problems associated with an initial misclassification of samples in a non-random manner (i.e., incorrect predictions and invalid estimated accuracy rates) are expected when going-concern qualification prediction models are used to predict going-concern status.⁹⁷

Second, in view of the violation of the implicit assumption of correct audit opinions in the sample, the models constructed by Mutchler [1985], Menon and

⁹⁶ As discussed in Chapter 1, Taffler and Tsueng [1984] and Menon and Schwartz [1986] also reported similar results.

⁹⁷ See also the last paragraph of Section 2.3.2.

Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] can only predict audit opinions as they *would* be issued by auditors included in their samples (whether or not such opinions are appropriate) and not as they *should* be issued on the basis of the financial condition of the firms. Clearly, such model predictions are not appropriate for assessing the going-concern status of firms in forming going-concern opinions. Put simply, going-concern qualification prediction models can only increase the understanding of the auditor's going-concern opinion formulation process but will not give guidance to going-concern assessments.

Third, models that predict going-concern qualification accurately may not predict going-concern status accurately. For example, the model constructed by Menon and Schwartz [1987] predicted going-concern qualification and non-qualification on a validation sample with accuracy rates of 71.43% and 84.00%, respectively. However, the same model predicted bankruptcy (i.e., going-concern discontinuity) and non-bankruptcy (i.e., going-concern continuity) with accuracy rates of only 35.90% and 54.33%, respectively.⁹⁸ Thus, it is doubtful that models that predict going-concern qualification will be useful to auditors in making going-concern assessments.

2.3.6 Problems with Model Testing and Validation

All the six studies reviewed attempted to test or validate the prediction models constructed. However, some of the testing and validation procedures used were inadequate. Altman and McGough [1974] tested their discriminant model on a sample of 34 firms all of which were bankrupt. Thus, they could only assess the error rate of predicting the going-concern status incorrectly for a sample of non-going concerns (i.e.,

⁹⁸ These accuracy rates were computed using data reported in Menon and Schwartz [1987]. They were based on a cutoff probability between bankrupt and non-bankrupt firms of 0.5.

Type I error). However, both Type I and Type II errors are costly to the auditor.⁹⁹ In particular, Type I errors may result in the auditor being sued for not providing early warning signals of distress to investors and creditors (as expected by the society in general and the proposed SAS in particular), and Type II errors may result in the auditor losing clients for unwarranted qualifications. Type II errors may also result in the misclassified firm actually becoming bankrupt (i.e, the self-fulfilling prophecy). Without the knowledge of both types of errors, the effectiveness of the discriminant model suggested by Altman and McGough [1974] cannot be assessed adequately. It is also difficult to assess the effectiveness of McKee's [1976] model because although McKee [1976] concluded that his discriminant model is of obvious benefit to auditors in making going-concern assessments, he did not compare the accuracy rates of his model to those of auditors (which were not computed). Thus, it is not clear whether his model can benefit or guide auditors.

Finally, except for Dopuch, Holthausen, and Leftwich [1987], all the other five going-concern studies reviewed in this chapter tested their models in a biased manner. Specifically, the proportions of going and non-going concerns and qualified and non-qualified audit opinions in the validation samples do not reflect their actual proportions in the respective populations. Consequently, the reported accuracy rates of the prediction models do not reflect that actual accuracy rates that are expected when the models are applied in real life.

⁹⁹ Type I error refers to the error of predicting going-concern status for a non-going concern and Type II error refers to the error of predicting non-going-concern status for a going concern.

Chapter 3

A PROPOSED GOING-CONCERN PREDICTION MODEL

The previous chapter reviewed the going-concern models suggested by Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], Mutchler [1985], Menon and Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] and concluded that their usefulness to auditors in making going-concern assessments may be seriously diminished because of one or more of the following: (1) problems with the application of discriminant analysis, (2) problems with the operational definitions of a going concern, (3) problems with choice-based sample designs, (4) problems with the selection of independent variables, (5) problems with predicting going-concern qualification, and (6) problems with model testing and validation.

Thus, while the idea that objective prediction models can be constructed to aid auditors in making going-concern assessments is appealing, all the six going-concern models suggested in the literature are limited for this purpose. What is needed is a going-concern prediction model that overcomes or avoids the six problems identified above. The objective of this dissertation is to construct a going-concern prediction model that is based upon improved statistical techniques and methodology. The im-

proved model proposed is expected to be an appropriate and significant aid to auditors in making going-concern assessments.

This chapter consists of two sections. The first section addresses the six problems identified in the six previous going-concern studies by proposing solutions to eliminate them. The second section integrates the solutions proposed in the first section and discusses the methodology to be used in constructing and testing the proposed going-concern prediction model. For ease of reference, the proposed going-concern prediction model will be referred to as the Koh model.

3.1 PROPOSED SOLUTIONS TO IDENTIFIED PROBLEMS

3.1.1 Problems Associated with Discriminant Analysis

Discriminant analysis requires very restrictive assumptions, including multivariate normality of the independent variables and equal covariances across all groups. However, these assumptions are often violated in the going-concern context, where the independent variables are mostly financial ratios that do not have equal normal dispersions across the dependent variables (i.e, going and non-going concerns, and qualified and non-qualified audit opinions). This results in bias in both the test of significance and the estimated error rates as well as inappropriate linear classification rules. Further, discriminant analysis does not generate accurate probabilities and unique discriminant coefficients. In view of these problems and limitations, discriminant analysis is not an appropriate statistical technique for constructing going-concern models.

One way to eliminate the problems associated with the application of discriminant analysis is to use another statistical technique that requires less restrictive

assumptions, generates accurate probabilities, and provides unique coefficients. Probit analysis satisfies these requirements.

To see how probit analysis is superior to discriminant analysis in constructing going-concern prediction models, consider first the linear probability model.

3.1.1.1 Linear Probability Model

The linear probability model is the simplest of a class of models referred to as conditional probability models. Such models estimate the probability of the occurrence of an outcome (e.g., going-concern or non-going-concern status) conditional on the attribute vector or independent variables (e.g., a set of financial ratios). In the going-concern context, the linear probability model can be expressed in the following regression form:

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

where $Y_i = 0$ if firm i is a non-going concern
 $= 1$ if firm i is a going concern
 α, β = unknown model parameters
 X_i = a set of financial ratios for firm i
 ε_i = error term for firm i

As in the classical linear regression model, the linear probability model assumes that X_i is fixed (or, if random, independent of ε_i) and ε_i is random and independently distributed with mean 0.

As shown by Pindyck and Rubinfeld [1981], Y_i can be interpreted as the conditional probability that firm i will continue as a going-concern given its financial ratios

(i.e., Prob $[(Y_i = 1) | X_i]$).¹⁰⁰ The estimated value of Y_i , computed from the estimated model parameters $\hat{\alpha}$ and $\hat{\beta}$ (i.e., \hat{Y}_i) is an estimate of this conditional probability. However, the linear probability model has an inherent flaw in that the values of \hat{Y}_i are not bounded between 0 and 1. This makes them meaningless as estimates of probabilities.

3.1.1.2 Probit Analysis

Probit analysis overcomes the boundary problem identified above by transforming the linear probability model in such a way that \hat{Y}_i will be bounded within the [0, 1] interval for all values of X_i . This is done by using the cumulative normal probability function and a theoretical index (Z) in the following way:

$$Z_i = \hat{\alpha} + \hat{\beta}X_i$$

$$Y_i = N(Z_i)$$

where Z_i = theoretical index for firm i

$N(\cdot)$ = cumulative normal probability function

Basically, probit analysis assumes that there exists a theoretical index Z_i that is determined by X_i . This is similar to the relationship between Y_i and X_i in the linear probability model. Further, the index Z_i is assumed to be a continuous variable that is random and normally distributed so that \hat{Y}_i (the estimated conditional probability) is bounded between 0 and 1.¹⁰¹ Details about probit analysis can be found in Appendix C.

¹⁰⁰ Robert S. Pindyck and Daniel L. Rubinfeld, *Econometric Models & Economic Forecasts*, (New York: McGraw-Hill, 1981), p. 275.

¹⁰¹ The theoretical index, Z , defined in this manner is also called the normal standard deviate in statistics.

In the present going-concern context, these two assumptions are reasonable. First, the theoretical index (Z_i) can be thought of as a measure of the financial condition of a firm, which is closely related to the firm's financial ratios. Also, when this measure of financial condition falls below some threshold level (\bar{Z}_i), the firm becomes a non-going concern; otherwise, the firm remains a going concern. Thus, Z_i is related to X_i as well as the the probability of going-concern continuity, as assumed in the above specification of the probit model. Second, since the financial condition of a firm depends on many factors, it is reasonable to assume that Z_i is normally distributed via the central limit theorem. Thus, the probit model transforms Z_i 's into conditional probabilities via the cumulative normal probability function.

Besides the two assumptions above and some "usual" classical regression assumptions (such as, random and independent error terms), probit analysis does not require restrictive assumptions such as multivariate normality in X and equal covariances across Y . Further, probit models are specified so as to yield conditional probabilities and unique coefficients. As such, probit analysis avoids the problems associated with the application of discriminant analysis and is appropriate in the construction of going-concern prediction models.

3.1.2 Problems with Operational Definitions

The definition of a going concern as a firm that is expected to remain in operation for the foreseeable future is too general to be operational. Therefore, alternative operational definitions are necessary. However, inappropriate operational definitions of a going concern can lead to invalid sample data, incorrect predictions, and biased estimated error rates.

One way to ensure that the operational definition of a going concern is appropriate is to look to authoritative auditing guidelines. While SAS No. 34 does not define what a going concern is, the proposed SAS defines a going concern as an entity that is willing and able to sustain operation without entering into bankruptcy proceedings or a similar transfer of operating control through regulatory or judicial action. External auditors will use this operational definition if the proposed SAS is adopted, which appears likely. Since the primary objective of the Koh model is to aid auditors in making going-concern assessments in accordance with generally accepted auditing procedures, it is appropriate to follow the lead taken by the proposed SAS and operationalize going concerns as non-bankrupt firms and non-going concerns as bankrupt firms. This avoids inappropriate operational definitions of a going concern.

3.1.3 Problems with Choice-Based Sample Designs

Without adjustment procedures, choice-based sample designs result in biased parameter and probability estimates in the construction of going-concern prediction models. To minimize the effects of choice-based sample bias, the sample proportions of going and non-going concerns (or qualified and non-qualified audit opinions) should reflect those of the population. However, this means that matched sample designs cannot be used because going and non-going concerns (or qualified and non-qualified audit opinions) do not occur in equal proportions in real life. Consequently, very large random samples are needed to obtain information on the rare occurrences (i.e., non-going concerns and going-concern qualifications) if the effects of choice-based sample bias are to be minimized through this approach.

A better solution to the choice-based sample bias problem is to use an adjustment procedure such as the weighted exogenous sample maximum likelihood (WESML)

procedure.¹⁰² This procedure eliminates choice-based sample bias even when matched sample designs are used. As shown in Appendix C, under the assumption of random exogenous sampling, probit model parameters are estimated by maximizing the log-likelihood function (L) as shown below:

$$L = \Sigma(Y) \ln[N(X'\beta)] + \Sigma(1 - Y) \ln[1 - N(X'\beta)]$$

However, the equation above assumes that the sample proportions of the different groups reflect those of the population. When this is not the case, the WESML procedure can be used to adjust for the differences between sample and population proportions by maximizing the weighted log-likelihood function (L^*) as follows:

$$L^* = \left[\frac{P}{S}\right]\Sigma(Y) \ln[N(X'\beta)] + \left[\frac{(1 - P)}{(1 - S)}\right]\Sigma(1 - Y) \ln[1 - N(X'\beta)]$$

where P = the proportion of non-going concerns in the population
 S = the proportion of non-going concerns in the sample
 = 0.5 for matched samples

Comparing the two equations for L and L^* above, it is clear that as S approaches P , L^* reduces to L . Thus, the further the sample proportions from the population proportions, the more distorted the model results will be. This holds whether discriminant analysis or probit analysis is used to construct the going-concern models.

By using the WESML procedure, the matched sample design can be used to control for industrial and size effects. At the same time, problems with choice-based sample bias are eliminated.

¹⁰² The use of WESML to eliminate choice-based sample bias in the construction of bankruptcy prediction models is first advocated by Zmijewski [1984]. It is subsequently used by Dopuch, Holthausen, and Leftwich [1987] to construct models to predict audit qualifications. Details of the WESML procedure can be found in Manski and Lerman [1977].

3.1.4 Problems with Variables Selection

As discussed in the previous chapter, independent variables selected on the basis of criteria such as popularity in the literature, potential relevance, consistency with previous research, suggested guidelines in the literature, and subjective judgment are problematic. It is no surprise that Casey, McGee, and Stickney [1986] concluded that one of the greatest limitations of previous research in bankruptcy prediction is the lack of a well-accepted theory to guide the selection of independent variables.¹⁰³ This criticism applies to the construction of going-concern models as well.

Problems with the selection of independent variables in the six going-concern studies reviewed in Chapter 2 can be avoided by selecting variables on the basis of a sound theoretical base. In the context of constructing going-concern prediction models, a sound theoretical base amounts to a sound theory of bankruptcy since non-going concerns are operationalized as bankrupt firms. Although some attempts have been made to formulate theoretical models of bankruptcy, no adequate theoretical model exists to guide the selection of independent variables in the construction of going-concern models. A review of these theoretical models of bankruptcy is provided by Scott [1981]¹⁰⁴ and is summarized below.

¹⁰³ Cornelius Casey, Victor E. McGee and Clyde P. Stickney, "Discriminating Between Reorganized and Liquidated Firms in Bankruptcy," *The Accounting Review* (April 1986), p. 252.

¹⁰⁴ James Scott, "The Probability of Bankruptcy: A Comparison of Empirical Predictions and Theoretical Models," *Journal of Banking and Finance* (September 1981), pp. 317-344.

3.1.4.1 Theoretical Models of Bankruptcy

The gambler's ruin model of bankruptcy, first proposed by Wilcox [1971], assumes that a firm has a given amount of capital, K , and changes in K , denoted Z , are random.¹⁰⁵ Also, positive cash flows from the firm's operations increases K and losses require the firm to liquidate its assets. When K becomes negative, the firm is declared bankrupt. Under these assumptions, a firm will become bankrupt if:

$$K + Z < 0$$

The gambler's ruin model based on simple scenarios analogous to that described above is well developed in the theory of probability for games of risk. Formulas for computing the probability of ultimate ruin (i.e., bankruptcy in the present context) exist. However, as pointed out by Scott [1981], attempts to apply the gamblers' ruin model to bankruptcy prediction have been disappointing.¹⁰⁶ In particular, bankruptcy predictions were grossly inaccurate and estimated probabilities of bankruptcy were implausibly low (e.g., the riskiest bank in the study by Santomero and Vinso [1977] had a probability of bankruptcy estimated at only 0.0000003).¹⁰⁷

Scott [1981] concluded that the gambler's ruin model of bankruptcy is too simplistic and inappropriate to explain the bankruptcy phenomenon and proposed a series

¹⁰⁵ Jarrod W. Wilcox, "A Gambler's Ruin Prediction of Business Failure Using Accounting Data," *Sloan Management Review* (Spring 1971), pp. 1-11.

¹⁰⁶ James Scott, "The Probability of Bankruptcy: A Comparison of Empirical Predictions and Theoretical Models," *Journal of Banking and Finance* (September 1981), pp. 323-24.

¹⁰⁷ Anthony M. Santomero and Joseph D. Vinso, "Estimating the Probability of Failure for Commercial Banks and the Banking System," *Journal of Banking and Finance* (September 1977), pp. 182-205.

of bankruptcy models under different sets of assumptions instead.¹⁰⁸ Scott's [1981] basic model assumes that a firm has a potentially infinite life and can meet losses by either selling debt or equity. Further, it assumes that a firm remains solvent as long as stockholders' wealth, as measured in terms of market value, is positive. Under these assumptions, bankruptcy occurs when:

$$S + X < 0$$

where S = market value of equity
 X = earnings

Scott [1981] extended the basic model of bankruptcy by introducing assumptions about the firm's floatation costs of raising external funds, taxes, investments, and debt payments. For example, by incorporating floatation costs (c) and investments (I), Scott's [1981] model of bankruptcy proposes that bankruptcy occurs when:

$$S + (1 + c)(X - I) < 0 \quad \text{if } X < I$$

or $S + X - I < 0 \quad \text{if } X > I$

Although the attempts of Wilcox [1971] and Scott [1981] to formulate theoretical models of bankruptcy are commendable, they fall short of being able to guide the selection of independent variables in the construction of going-concern prediction models. In particular, these models are very general and do not lead to unique financial ratios. For example, as Scott [1981] pointed out, the earnings variable, X , in his model is not uniquely defined and in fact, can be surrogated by numerous financial ratios.¹⁰⁹ Further,

¹⁰⁸ James Scott, "The Probability of Bankruptcy: A Comparison of Empirical Predictions and Theoretical Models," *Journal of Banking and Finance* (September 1981), pp. 317-24.

¹⁰⁹ *Ibid.*, p. 331.

the suggested theoretical models of bankruptcy focus only on some limited aspects of the firm, such as its earnings and market value. In view of this, a more specific and comprehensive theoretical model of bankruptcy is proposed to guide the selection of independent variables for the Koh model.

3.1.4.2 *A Proposed Theory of Bankruptcy*

The theory of bankruptcy proposed here is based on the financial crisis model put forth by Hudson [1986].¹¹⁰ Basically, Hudson [1986] summarized the conditions representing a financial crisis as follows:

$$C < TR + Br$$

$$C + P < TR + B(1 + r)$$

$$C + L < TR + B(1 + r)$$

where C = cash assets

TR = trade creditors

B = bank loan outstanding in the previous period

r = risk-free rate of interest

P = present expected value of future earnings

L = present expected liquidation value

The three conditions above represent the liquidity crisis, profitability crisis, and net worth crisis, respectively. The proposed theory of bankruptcy is based on the idea that involuntary bankruptcy results from these three crises. The role and significance of each of these crises in the proposed theory of bankruptcy is discussed below.

¹¹⁰ John Hudson, "An Analysis of Company Liquidations," *Applied Economics* (1986), pp. 219-235.

Liquidity Crisis: Generally, liquidity refers to the ability to discharge liabilities as they become due. Thus, a liquidity crisis arises when a firm is unable to discharge its maturing liabilities. There are two types of liquidity crises. Short-term liquidity crisis refers to the situation where a firm is unable to discharge its short-term liabilities. In accounting, short-term liabilities are usually represented by current liabilities that are payable within one year from the balance sheet date. Also, in the short-term, only quick assets are readily available for use in discharging short-term liabilities. Therefore, a short-term liquidity crisis exists when:

$$QA < CL$$

$$\rightarrow \frac{QA}{CL} < 1$$

where QA = quick assets
 CL = current liabilities

That is, a short-term liquidity crisis exists when a firm's quick assets to current liabilities is less than 1.

In contrast to short-term liquidity crisis, long-term liquidity crisis refers to the situation where a firm is unable to discharge its total liabilities in the long-term. In the long-term, the resources available to a firm for discharging its liabilities are the present value of its future cash flows, which can be represented by the market value of the firm's equity. Thus, a long-term liquidity crisis exists when:

$$MV < TL$$

$$\rightarrow MV - TL < 0$$

where MV = market value of equity
 TL = total liabilities

Standardizing by using total assets (TA), $MV - TL < 0$ becomes:

$$\frac{MV}{TA} - \frac{TL}{TA} < 0$$

That is, a long-term liquidity crisis exists when the difference between a firm's market value of equity to total assets and total liabilities to total assets is negative.

Profitability Crisis: Generally, profitability refers to the ability to generate earnings. Thus, a profitability crisis arises when a firm is unable to generate sufficient earnings. Both liquidity and profitability are crucial to the survival of a firm because a firm that is unable to discharge its liabilities or earn sufficient profits is not expected to survive in the long-term.

As in the case of liquidity, there are two types of profitability crises. Short-term profitability crisis refers to the situation where the earnings generated by a firm is insufficient to cover its interest payments. In other words, a short-term profitability crisis exists when:

$$EBIT < IP$$

$$\rightarrow \frac{EBIT}{IP} < 1$$

where $EBIT$ = earnings before interest and tax
 IP = interest payments

That is, a short-term profitability crisis exists when a firm's earnings before interest and tax to interest payments is less than 1.

On the other hand, long-term profitability crisis refers to the situation where the net income generated by a firm is insufficient to provide a return on investment (i.e., net income to total assets) is that is greater than or equal to the return required by investors. For the present purpose, the return required by investors is assumed to be some arbitrary number, k . This simplifies the analysis without any loss of generality. Accordingly, a long-term profitability crisis exists when:

$$\frac{NI}{TA} < k$$

where NI = net income
 TA = total assets
 k = required rate of return

That is, a long-term profitability crisis exists when a firm's net income to total assets is less than the return required by investors.

Net Worth Crisis: Generally, the net worth of a firm refers to the difference between total assets and total liabilities, or shareholders' equity, which comprises mainly common stock and retained earnings. The net worth crisis refers to the situation where the shareholders' equity is negative. In other words, a net worth crisis exists when:

$$CS + RE < 0$$

where CS = common stock
 RE = retained earnings

Standardizing by using total assets (TA), $CS + RE < 0$ becomes:

$$\frac{CS}{TA} + \frac{RE}{TA} < 0$$

That is, a net worth crisis exists when the sum of a firms' common stock to total assets and retained earnings to total assets is negative.

Probability of Continuity: Combining all the above, the probability of continuity (i.e. non-bankruptcy) can be written as:¹¹¹

Prob (Continuity) = Function (Liquidity Crisis, Profitability Crisis, Net Worth Crisis)

$$\text{i.e., } P(C) = f \left(\frac{QA}{CL}, \frac{MV}{TA}, \frac{TL}{TA}, \frac{EBIT}{IP}, \frac{NI}{TA}, \frac{RE}{TA} \right)$$

$$\text{where } \frac{\partial P(C)}{\partial(QA/CL)} > 0, \frac{\partial P(C)}{\partial(MV/TA)} > 0, \frac{\partial P(C)}{\partial(TL/TA)} < 0,$$

$$\frac{\partial P(C)}{\partial(EBIT/IP)} > 0, \frac{\partial P(C)}{\partial(NI/TA)} > 0, \frac{\partial P(C)}{\partial(RE/TA)} > 0.$$

The theory of bankruptcy proposed above provides justification for selecting the following independent variables for the construction of the Koh model: (1) quick assets to current liabilities, (2) market value of equity to total assets, (3) total liabilities to total assets, (4) interest payments to earnings before interest and tax,¹¹² (5) net income to total

¹¹¹

$\frac{CS}{TA}$ is omitted because it is captured by $\frac{TL}{TA}$ and $\frac{RE}{TA}$, as shown by the accounting identity below:

$$E = TA - TL$$

$$CS + RE = TA - TL$$

$$CS = TA - TL - RE$$

$$CS/TA = 1 - TL/TA - RE/TA$$

¹¹² Interest payments to earnings before interest and tax is used instead of earnings before interest

assets, and (6) retained earnings to total assets. Thus, by using the proposed theory of bankruptcy, the problems associated with the selection of independent variables through arbitrary and subjective means are avoided.

3.1.5 Problems with Predicting Audit Qualification

As shown in the previous chapter, it is problematic to use going-concern qualification prediction models to predict going-concern status. In particular, predictions of going-concern qualification do not give accurate and appropriate indications of going-concern status. Consequently, they cannot guide auditors in making going-concern assessments; only predictions of going-concern status are useful to the auditors for such a purpose. Therefore, to avoid the problems associated with predicting going-concern qualification, the Koh model is constructed to predict going-concern status and not going-concern qualification.

3.1.6 Problems with Model Testing and Validation

Except for Dopuch, Holthausen, and Leftwich [1987], all the other five going-concern studies reviewed in the previous chapter did not test or validate their models adequately or appropriately. In particular, Altman and McGough [1974] did not assess Type II errors and McKee [1976] did not compare the accuracy rates of his model to those of the auditors. Further, accuracy rates that were reported in all the five studies were based on biased validation samples (i.e., validation samples that do not reflect the

and tax to interest payments (as specified in the proposed theory of bankruptcy) to avoid computational problems when companies have low or no interest payments. It is more common for companies to have zero interest payments than zero earnings before interest and tax.

actual proportions of the various groups in the respective populations). Thus, the accuracy rates reported in these going-concern studies do not reflect the effectiveness of the models in real life.

To overcome these problems, the Koh model is evaluated on the basis of Type I and Type II errors on a validation sample that adjusts for the relative occurrence of going and non-going concerns in real life in the computation of the overall accuracy rate. Further, the accuracy rates of the Koh model are compared to those of other going-concern models and the auditors before the expected benefit of the Koh model to auditors in making going-concern assessments is evaluated.

3.2 METHODOLOGY

This section discusses the methodology that is used in the construction and testing of the Koh model. It integrates and incorporates the proposed solutions to the identified problems discussed in the previous section. The following two aspects are discussed below: (1) sample selection, variables selection, and data sources, and (2) model construction and testing.

3.2.1 Sample Selection, Variables Selection, and Data Sources

The sample that is used to construct and test the Koh model consists of going and non-going concerns (i.e., non-bankrupt and bankrupt companies, respectively) that are found on the COMPUSTAT tapes. Non-going concerns are defined as non-financial companies that are reported in the *Predicast's F & S Index of Corporate Changes* to have

filed for bankruptcy during the period 1980 to 1985.¹¹³ To control for industry and size, each non-going concern is matched with a going concern on the basis of industrial classification code (as provided by the COMPUSTAT tapes) and total assets. In the matching process, only companies that have not filed for bankruptcy and are not in the process of liquidation as at June 30, 1987, are included as going concerns.

For each non-going concern, the date on which bankruptcy is filed (i.e, the bankruptcy date) is obtained from either the *Predicast's F & S Index of Corporate Changes* or the *Moody's Industrial and OTC Manuals*. For these non-going concerns, data obtained from the financial statements within one year prior to the bankruptcy date are used to construct the Koh model. Where such one-year prior financial statements are not available, the last available financial statements prior to the bankruptcy date are used, provided they are not more than two years prior to the bankruptcy date.¹¹⁴ For going concerns, data obtained from the financial statements issued within the same fiscal years as those of the matched non-going concerns are used.¹¹⁵

For each company in the sample, the following data are obtained from the COMPUSTAT tapes: (1) quick assets to current liabilities, (2) market value of equity

¹¹³ Financial companies (e.g., banks, savings and loans institutions, and insurance companies) are excluded from the dissertation because the characteristics of these companies are very different from those of non-financial companies. In particular, financial companies operate in closely regulated environments and follow specialized financial reporting practices. Further, the capital structures (and hence financial ratios) of financial companies are very different from those of non-financial companies.

¹¹⁴ The fact that no financial statements are issued by a bankrupt company one year prior to the bankruptcy date can be interpreted as an indication of financial distress. In such a case, it is reasonable to use two-year prior financial statements as they represent financial statements issued one year prior to the first sign of financial distress. A similar argument to use financial statements that are more than two years prior to the bankruptcy date is less convincing and thus not considered. In any case, out of the 165 non-going concerns in the sample, only 27 sets of two-year prior financial statements are used.

¹¹⁵ Fiscal years are used to match the financial statements of going and non-going concerns instead of calendar years because the COMPUSTAT tapes record data by fiscal years. A fiscal year in the COMPUSTAT tapes begins on June 1 and ends on May 31. For example, the fiscal year 1985 begins on June 1, 1985 and ends on May 31, 1986.

to total assets, (3) total liabilities to total assets, (4) interest payments to earnings before interest and tax, (5) net income to total assets, and (6) retained earnings to total assets, and (7) auditor's opinion.

The first six items are the independent variables to be used in the construction of the Koh model. As discussed in the previous section, these independent variables are selected on the basis of the proposed theory of bankruptcy. The last item (auditor's opinion) is needed to compare the performance of the Koh model to that of the auditors.

All the sample data needed to construct and test the Koh model are first obtained from the COMPUSTAT tapes. In cases where data are missing from the COMPUSTAT tapes, secondary data sources are used. These include the *Moody's Industrial and OTC Manuals* and *10-K Reports*. It is important to ensure that data observations are complete to avoid bias induced by non-randomly distributed missing data.¹¹⁶ It is also important to validate the data generated by the COMPUSTAT tapes to ensure that they are correct. This is done by randomly checking some selected tape data against data reported in the *Moody's Industrial and OTC Manuals* and *10-K Reports*. At the end of the data collection process, no missing data exist and the sample data are considered to be highly accurate.

3.2.2 Model Construction and Testing

To construct the Koh model, probit analysis is used to analyze the sample data obtained through the procedures described above. The WESML procedure is used to

¹¹⁶ Since this bias is eliminated by using a complete data set to construct the Koh model, it is not elaborated on here. However, a discussion of the effects of incomplete data bias can be found in Mark E. Zmijewski, "Methodological Issues Related to the Estimation of Financial Distress Prediction Models." *Journal of Accounting Research* (Supplement 1984), pp. 59-86.

eliminate the choice-based sample bias and estimate the model parameters. The Koh model can be written as:

$$Y_i = N(X_i'\beta)$$

where Y_i = Prob ($Y_i = 1 | X_i$)
 i.e., the conditional probability of firm i being a going concern given its financial ratios
 = 0 if firm i is a non-going concern
 = 1 if firm i is a going concern
 $N(.)$ = cumulative normal probability function
 X_i = financial ratios of firm i
 i.e, quick assets to current liabilities, market value of equity to total assets, total liabilities to total assets, interest payments to earnings before interest and tax, net income to total assets, and retained earnings to total assets for firm i
 β = model parameters (including the model constant) to be estimated by maximizing the weighted log-likelihood function

As discussed in the previous section, the weighted log-likelihood function to be maximized under the WESML procedure is:

$$L^* = \left[\frac{P}{S}\right]\sum(Y) \ln[N(X'\beta)] + \left[\frac{(1 - P)}{(1 - S)}\right]\sum(1 - Y) \ln[1 - N(X'\beta)]$$

where P = the proportion of non-going concerns in the population
 = the percentage of COMPUSTAT companies that filed for
 bankruptcy during the period 1980 to 1985
 = 0.6% or 0.006
 S = the proportion of non-going concerns in the sample
 = 0.5 for matched samples

After estimating the model parameters, the estimated value of Y_i , denoted \hat{Y}_i , estimates the conditional probability of firm i being a going concern given its financial ratios. A comparison of this estimated probability to some pre-determined cut-off probability is needed to classify the firm as a going or non-going concern. A more elaborate discussion of this is given in the next two chapters.

To test the predictive power of the Koh model in discriminating between going and non-going concerns, the Lachenbruch U method is used.¹¹⁷ That is, a probit model is first constructed using $n-1$ (i.e., all except one) firms and the performance of the model is then judged on its correctness in predicting the classification of the held-out firm. This process is repeated for each of the firms in the sample. This method has the advantage of producing more efficient estimates of error rates, as compared to other hold-out methods [Lachenbruch and Mickey, 1968].¹¹⁸

The Lachenbruch U method generates the misclassification rates for both Type I and Type II errors for the Koh model. These estimated error rates are compared to those of Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] to assess the relative performance of all these models in predicting going-concern status. It is not meaningful to compare the Koh model with models constructed by Mutchler

¹¹⁷ Peter A. Lachenbruch, "An Almost Unbiased Method of Obtaining Confidence Intervals for the Probability of Misclassification in Discriminant Analysis," *Biometrics* (December 1967), pp. 639-645.

¹¹⁸ Peter A. Lachenbruch and M. Ray Mickey, "Estimation of Error Rates in Discriminant Analysis," *Technometrics* (February 1968), pp. 1-11.

[1985], Menon and Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] because they are fundamentally different and hence not comparable. In particular, while the Koh model predicts going-concern status, the other three models predict going-concern qualification.

In the comparison of the Koh model with the other three models that predict going-concern status, care must be taken in interpreting the results because, as discussed in the previous chapter, the error rates in the three discriminant models are biased. In evaluating the effectiveness of these going-concern prediction models, weighting procedures that reflect real life proportions of going and non-going concerns are used to compute the overall accuracy rates.

Finally, since the Koh model is constructed to aid auditors in making going-concern assessments, it is appropriate to compare the performance of the Koh model in predicting going-concern status with that of the auditors. The auditors' accuracy rates are computed on the basis of their audit opinions. An audit opinion is considered "correct" if a going-concern qualification is given to a bankrupt company or if no going-concern qualification is given to a non-bankrupt company. Admittedly, the auditors' accuracy rates computed in this manner may be downward biased because auditors may not modify their reports even if they have detected going-concern problems. The fear of losing a client or adding to the client's demise (i.e. the self-fulfilling prophecy) may reduce the auditors' propensity to qualify [Kida, 1980].¹¹⁹ However, this downward bias in the auditors' accuracy rate may not be serious because of mitigating factors such as the fear of lawsuits for not issuing going-concern qualifications to warn investors and creditors of companies in financial distress. Further, since the auditors

¹¹⁹ Thomas Kida, "An Investigation into Auditors' Continuity and Related Qualification Judgments," *Journal of Accounting Research* (Autumn 1980), pp. 506-523.

possess more information than the Koh model uses, there is an inherent upward bias in the auditors' accuracy rates that mitigates the downward bias found by Kida [1980].

After assessing the accuracy rates of the Koh model and comparing them to those of other similar models and the auditors, the usefulness of the Koh model to auditors in making going-concern assessments can be evaluated.

To summarize, this dissertation proposes a going-concern prediction model (the Koh model) that is constructed with probit analysis using the WESML procedure on a matched sample of going and non-going concerns, defined as non-bankrupt and bankrupt firms, respectively. This model predicts going-concern status by evaluating six financial ratios that are specified by the proposed theory of bankruptcy as relating to the probability of bankruptcy (and hence, going-concern discontinuity). The Koh model is expected to outperform similar models in the literature and the auditors in assessing the going-concern status of companies in realistic settings because it is constructed using the current state-of-the-art in probit analysis and improved methodology that eliminate or avoid the major problems with all the going-concern models suggested in the literature to date. This expectation is verified by comparing the accuracy rates of the Koh model to those of other going-concern models and to those of auditors. Details of the sample data, model construction, and model testing are given in the next two chapters.

Chapter 4

CONSTRUCTION AND VALIDATION OF THE KOH MODEL

This chapter consists of three sections. The first section discusses the characteristics of the sample data and the second section discusses the construction of the Koh model. Finally, the third section presents the accuracy rates of the Koh model and the comparison results of the Koh model with models constructed by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985].

4.1 SAMPLE DATA

A survey of the *Predicast's F & S Index of Corporate Changes* yields a total of 165 non-financial COMPUSTAT companies that filed for bankruptcy during the period 1980 to 1985. These companies comprise the sample of non-going concerns that is used in the construction of the Koh model. As discussed in the previous chapter, each non-going concern is matched with a going concern (i.e., a non-bankrupt company) on the basis of industry, size, and fiscal year. Thus, from the sample of 165 non-going concerns, another sample of 165 going concerns is generated. In total, the estimation sample

consists of 330 companies. (The lists of going and non-going concerns used in the construction of the Koh model are given in Appendices B and A, respectively.)

The sample of 330 companies used in this dissertation is larger than the samples used in the six going-concern studies reviewed in Chapter 2. The highest number of bankrupt companies used in the six previous going-concern studies is 89 (see Menon and Schwartz [1987]), as compared to 165 used in this dissertation. Generally, larger samples lead to more accurate models and better external validity. In other words, larger samples result in more stable and more predictive prediction models that can be more generally applied to companies outside the sample.

For each of the 330 sample companies, the following financial ratios are computed from the COMPUSTAT tapes:¹²⁰

- (1) quick assets to current liabilities (QACL),
- (2) market value of equity to total assets (MVTA),
- (3) total liabilities to total assets (TLTA),
- (4) interest payments to earnings before interest and tax (IEBT),
- (5) net income to total assets (NITA), and
- (6) retained earnings to total assets (RETA).

(Henceforth, for ease of reference, the six financial ratios listed above will be referred to by their abbreviated forms.)

The financial ratios above are selected on the basis of the proposed theory of bankruptcy and comprise the set of independent variables to be used in the construction of the Koh model. Descriptive statistics of these financial ratios for all the sample companies, non-going concerns only, and going concerns only are presented in Table 1.

¹²⁰ As discussed in the previous chapter, all missing data in the COMPUSTAT tapes are eliminated by using secondary data sources such as the *Moody's Industrial and OTC Manuals* and *10-K Reports*. The final data set has no missing data. This avoids any bias induced by non-randomly distributed missing data.

Table 1. DESCRIPTIVE STATISTICS OF FINANCIAL RATIOS

Descriptive Statistics	All Companies	Non-Going Concerns	Going Concerns
1. QACL			
Mean	1.439	0.531	2.346
Standard Deviation	3.317	0.402	4.500
Skewness	9.409	1.875	6.995
Kurtosis	112.513	5.367	60.577
2. MVTA			
Mean	1.049	0.769	1.331
Standard Deviation	2.791	2.048	3.357
Skewness	8.433	5.779	8.308
Kurtosis	92.724	38.838	82.132
3. TLTA			
Mean	0.696	0.927	0.464
Standard Deviation	0.341	0.302	0.187
Skewness	1.008	1.624	-0.441
Kurtosis	2.363	3.425	-0.581
4. IEBT			
Mean	-0.824	-1.810	0.162
Standard Deviation	26.792	37.914	0.733
Skewness	-16.988	-12.020	-2.959
Kurtosis	304.210	152.188	24.493
5. NITA			
Mean	-0.225	-0.506	0.055
Standard Deviation	1.723	2.406	0.105
Skewness	-16.896	-12.180	-2.953
Kurtosis	298.630	153.294	23.864
6. RETA			
Mean	-0.409	-1.040	0.223
Standard Deviation	4.892	6.863	0.331
Skewness	-17.184	-12.284	-2.963
Kurtosis	305.487	155.021	17.165

Table 1 reveals some interesting characteristics about the sample data. First, the six financial ratios selected as independent variables are not normally distributed. In particular, since normal distributions are symmetrical and unimodal, they have skewness indices of zero and kurtosis indices of three. As can be seen from Table 1, however, the descriptive statistics associated with the six financial ratios selected show that these financial ratios have non-zero skewness indices and kurtosis indices that are much larger than three. For example, the financial ratio RETA for non-going concerns has a skewness index of -12.284 and a kurtosis index of 155.021 and the financial ratio MVTA for going concerns has a skewness index of 8.308 and a kurtosis index of 82.132. Therefore, the selected financial ratios are not univariate normal and hence, not multivariate normal.¹²¹ Thus, the multivariate normality assumption required by discriminant analysis is violated.

Second, the sample data display characteristics that are consistent with the proposed theory of bankruptcy. In particular, the proposed theory of bankruptcy suggests that:¹²²

$$\frac{\partial P(C)}{\partial(QACL)} > 0, \frac{\partial P(C)}{\partial(MVTA)} > 0, \frac{\partial P(C)}{\partial(TLTA)} < 0,$$

$$\frac{\partial P(C)}{\partial(IEBT)} < 0, \frac{\partial P(C)}{\partial(NITA)} > 0, \frac{\partial P(C)}{\partial(RETA)} > 0.$$

where the numerators are the probabilities of going-concern continuity and the denominators the respective independent variables (i.e, financial ratios).

¹²¹ Univariate normality is a necessary but not sufficient condition of multivariate normality. Thus, financial ratios that are not univariate normal cannot be multivariate normal. As discussed in Chapter 2, McLeay [1986] also found that financial ratios in general are not normally distributed.

¹²² See Sections 3.1.4.2 and 3.2.2 of Chapter 3.

As indicated above, the proposed theory of bankruptcy predicts that as compared to going concerns, non-going concerns have higher levels of TLTA, IEBT, and lower levels of QACL, MVTA, NITA, and RETA. As shown in Table 1, the means of five financial ratios (namely, TLTA, QACL, MVTA, NITA, and RETA) for going and non-going concerns generally exhibit such relationships. For example, the non-going concerns have mean QACL of 0.531, which is lower than that of the going concerns (2.346), and mean TLTA of 0.927, which is higher than that of the going concerns (0.464). The only exception in the sample data is the financial ratio IEBT. While the proposed theory of bankruptcy predicts that non-going concerns have higher levels of IEBT as compared to going concerns, the sample data indicate otherwise. This non-conformance of empirical observation to theory is probably due to the fact that earnings before interest and tax can be both positive and negative although the proposed theory of bankruptcy is formulated only in terms of positive IEBT. Thus, when IEBT is confounded by both positive and negative signs, no conclusive statement about the expected relative levels of IEBT for going and non-going concerns can be made. In any case, the sample data generally conform to the proposed theory of bankruptcy.

To test the relationships predicted by the proposed model of bankruptcy more rigorously, the Mann-Whitney U test is used to assess the statistical significance of the differences in the means of the six financial ratios between the going and non-going concerns.¹²³ The results of Mann-Whitney U test are presented in Table 2.

As can be seen from Table 2, all the six financial ratios for the going and non-going concerns are significantly different at a significance level of 0.00. Further, they are different in the directions predicted by the proposed theory of bankruptcy (except for

¹²³ In view of the “perverse” distributions of the financial ratios, the non-parametric Mann-Whitney U test is deemed more appropriate than the parametric t test.

Table 2. RESULTS OF THE MANN-WHITNEY U TEST

Ratio	Mean Rank		Z-Value	Significance
	Non-Going Concerns	Going Concerns		
QACL	101.24	229.76	-12.2353	0.0000
MVTA	131.89	199.11	-6.3993	0.0000
TLTA	239.13	91.87	-14.0204	0.0000
IEBT	132.71	198.29	-6.2447	0.0000
NITA	92.88	238.12	-13.8340	0.0000
RETA	100.46	230.54	-12.3853	0.0000

IEBT).¹²⁴ That is, non-going concerns have higher levels of TLTA but lower levels of QACL, MVTA, NITA, and RETA, as compared to going concerns. Thus, the proposed theory of bankruptcy is consistent with empirical evidence. Incidentally, the statistically significant results also imply that the six selected financial ratios possess high discriminating power in distinguishing between going and non-going concerns because the financial ratios are significantly different between the two groups.

To examine the characteristics of the sample data further, the variance-covariance matrices for both going and non-going concerns are computed. These matrices are presented in Table 3.

It is obvious from Table 3 that going and non-going concerns do not have equal covariances. For example, for going concerns, the variances for QACL and RETA are 20.2480 and 0.0110, respectively, but for non-going concerns, the corresponding variances are 0.1615 and 47.1009, respectively. In fact, pairwise comparisons of the variance-covariances matrices indicate clearly that going and non-going concerns have very different dispersions for the six financial ratios selected. Thus, both the multivariate normality and equal covariances assumptions are violated by the sample data. Consequently, discriminant analysis is not an appropriate statistical technique to use in the construction of the Koh model. However, probit analysis is still appropriate because it requires less restrictive assumptions.

4.2 CONSTRUCTION OF THE KOH MODEL

The Koh model is constructed on the basis of the 330 observations whose summary characteristics are described in the section above. These 330 observations are

¹²⁴ As mentioned above, when IEBT takes on both positive and negative values, the relative magnitude of IEBT between going and non-going concerns is indeterminate.

Table 3. VARIANCE-COVARIANCE MATRICES

A. Variance-Covariance Matrix for Going Concerns

	QACL	MVTA	TLTA	IEBT	NITA	RETA
QACL	20.2480					
MVTA	1.2666	11.2682				
TLTA	-0.3913	-0.1776	0.0350			
IEBT	-0.1084	-0.1601	0.0132	0.5372		
NITA	-0.0731	-0.1422	0.0015	0.0072	0.0110	
RETA	-0.1078	-0.5222	-0.0085	-0.0051	-0.0198	0.1096

B. Variance-Covariance Matrix for Non-Going Concerns

	QACL	MVTA	TLTA	IEBT	NITA	RETA
QACL	0.1615					
MVTA	-0.0211	4.1949				
TLTA	-0.0411	0.0350	0.0910			
IEBT	1.3747	-1.8080	-0.1607	1437.4680		
NITA	0.0957	-3.3432	-0.2028	-0.7216	5.7874	
RETA	0.2305	-10.3196	-0.4568	-0.9292	16.2954	47.1009

equally divided into 165 going concerns and 165 non-going concerns and each observation consists of six financial ratios. Based on these sample data, the WESML procedure in probit analysis is used to estimate the model parameters for the Koh model. Given the rate of bankruptcy among COMPUSTAT companies during the period 1980 to 1985, a 0.6% chance of going-concern discontinuity is used in the estimation procedures. Probit analysis yields the following going-concern prediction model:

$$Y_i = N(Z_i)$$

$$Z_i = 9.8967 + 0.7979 \times QACL + 0.5569 \times MVTA - 12.0050 \times TLTA \\ - 0.0054 \times IEBT + 16.6764 \times NITA + 0.8644 \times RETA$$

where Y_i = conditional probability of going-concern continuity
 $N(.)$ = cumulative normal probability function
 Z_i = theoretical index or normal standard deviate
 $QACL$ = quick assets to current liabilities
 $MVTA$ = market value of equity to total assets
 $TLTA$ = total liabilities to total assets
 $IEBT$ = interests payments to earnings before interest and tax
 $NITA$ = net income to total assets
 $RETA$ = retained earnings to total assets

The above going-concern prediction model comprises the core of the Koh model. Details about using the Koh model to predict the going-concern status of a company are deferred until the next section and Chapter 5. The following paragraphs discuss the characteristics of the Koh model.

The overall significance level of the Koh model is 0.0000 (to four decimal places), indicating a very good fit.¹²⁵ In other words, the Koh model predicts the going-concern status of the sample companies significantly better than a naive model that classifies the

¹²⁵ The χ^2 -statistic for the Koh model is 452.71 with six degrees of freedom.

observations as going or non-going concerns on the basis of their prior probabilities, which are 0.994 for going concerns and 0.006 for non-going concerns.

The in-sample accuracy rates of the Koh model are 87.27% for non-going concerns, 100.00% for going concerns, and 99.92% overall. This corresponds to the misclassification of 21 non-going concerns, 0 going concern, and 21 companies overall, respectively. Table 4 presents the details.

The overall accuracy rate of the Koh model is computed as a weighted average of the individual accuracy rates for going and non-going concerns. The weights used are derived from the relative occurrence of going and non-going concerns, which is 0.994 to 0.006. With this computation procedure, a classification rule that predicts *all* companies as going concerns has an overall accuracy rate of 99.40%. This reflects the real life situation experienced by auditors given that going-concern discontinuity occurs only about 0.6% of the time. This observation has two important implications. First, it highlights the problem of using equally weighted procedures to compute overall accuracy rates, as in McKee [1976] and Levitan and Knoblett [1985]. These equally weighted overall accuracy rates do not reflect real life experience and are misleading. Second, given that 99.40% of all companies are going concerns, the 100.00% accuracy rate for predicting going concerns is not surprising since it is more important to predict a very common occurrence (i.e., going-concern continuity) correctly than to predict a very rare occurrence (i.e., going-concern discontinuity) correctly. This, of course, ignores misclassification costs as shown below.

As discussed above, the Koh model is very conservative in the sense that it attempts to predict all going concerns correctly at the expense of non-going concerns in view of the fact that their relative occurrence is 0.994 to 0.006. However, this very conservative model may not be optimal when the misclassification cost of predicting a non-going concern incorrectly as a going concern (i.e., Type I error) is very much higher

Table 4. IN-SAMPLE CLASSIFICATION RESULTS

Actual Status	Number of Cases	Predicted Status		Accuracy Rate
		Non-Going	Going	
Non-Going	165	144	21	87.27%
Going	165	0	165	100.00%
Overall Accuracy Rate				99.92%

than the misclassification cost of predicting a going concern incorrectly as a non-going concern (i.e., Type II error). Under such circumstances, it is very costly to predict a very rare occurrence (i.e., going-concern discontinuity) incorrectly and thus, it may not be appropriate to attempt to predict all going concerns correctly at the expense of non-going concerns. Misclassification costs will be considered explicitly in Chapter 5.

All the accuracy rates presented above are in-sample accuracy rates. In other words, the accuracy rates are computed on the basis of the estimation sample. Since the same 330 sample companies are also used to construct the Koh model, the in-sample accuracy rates are upward biased. Thus, the in-sample accuracy rates provide only a biased indication of the predictive ability of the Koh model. Consequently, hold-out accuracy rates need to be computed before the predictive ability of the Koh model can be assessed. The hold-out accuracy rates for the Koh model, as computed via the Lachenbruch U method, are presented in the next section.

As discussed in Chapter 2, although discriminant coefficients are not uniquely determined, probit coefficients are. Thus, as can be seen from the Koh model, NITA (with a coefficient of 16.6764) has the greatest impact on the conditional probability of going-concern continuity and TLTA (with a coefficient of -12.0050) follows close behind. These findings correspond to the layman's view that bankrupt companies are generally companies that incur losses and have excessive debts. All the other financial ratios (with coefficients ranging from -0.0054 to 0.8644) have considerably less impact on the conditional probability of going-concern continuity. In particular, IEBT (with a coefficient of only -0.0054) has the least impact.¹²⁶ As expected, the signs of the coefficients are consistent with the proposed theory of bankruptcy. While QACL, MVTA, NITA, and RETA have positive coefficients, TLTA and IEBT have negative coefficients, as sug-

¹²⁶ This is not surprising in view of the confounding effects caused by the presence of both positive and negative IEBT's as discussed in the previous section.

gested by the proposed theory of bankruptcy (see Section 3.1.4.2). Thus, the Koh model and the proposed theory of bankruptcy are mutually supportive.

To have a crude indication of the predictive ability of multiple discriminant analysis relative to probit analysis, a discriminant model is constructed using the same financial ratios as independent variables and the same weights as prior probabilities. The resulting discriminant model has in-sample accuracy rates of only 6.67% for non-going concerns, 100.00% for going concerns, and 99.44% overall. While the difference between the in-sample overall accuracy rates of the Koh model and the discriminant model is small (99.92% vs 99.44%), 111 out of 165 non-going concerns are misclassified as going concerns by the discriminant model, as compared to only 21 misclassifications by the Koh model. Thus, even if the violation of assumptions is ignored, the discriminant model still performs significantly worse than the Koh model. This conclusion holds even in the case where the prior probabilities and weights for going and non-going concerns are assumed to be equal.¹²⁷ (Recall that this is the assumption made by Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985] when they constructed their discriminant models.) Differences between the unweighted and weighted discriminant models and probit models are highlighted in Table 5.

Table 5 reveals an interesting observation—the discriminant models are the same regardless of the prior probabilities used (i.e., the unweighted and weighted discriminant models are identical). This is so because different prior probabilities only result in different optimal cut-off discriminant scores between the groups but do not affect the coefficients in the resulting discriminant models. In contrast, the use of different weights

¹²⁷ Clearly, when equal prior probabilities and weights are used, there is no priority to classify one group correctly at the expense of the other group. Hence, the accuracy rates for going and non-going concerns are about the same (compare the unweighted and weighted accuracy rates in Table 5).

Table 5. COMPARISON OF DISCRIMINANT AND PROBIT MODELS

1. Coefficients of the Models

	Unweighted		Weighted	
	Discriminant	Probit	Discriminant	Probit
Constant	2.7784	6.8030	2.7784	9.8967
QACL	0.0106	0.9196	0.0106	0.7979
MVTA	-0.0042	0.4893	-0.0042	0.5569
TLTA	-4.0361	-11.4826	-4.0361	-12.0050
IEBT	0.0010	-0.0083	0.0010	-0.0054
NITA	-0.1688	13.4272	-0.1688	16.6764
RETA	0.0465	1.1750	0.0465	0.8644

2. In-Sample Accuracy Rates of the Models

	Non-Going Concern	Going Concern	Overall
Unweighted			
Discriminant	81.21%	92.12%	92.06%
Probit	93.94%	95.76%	95.75%
Weighted			
Discriminant	6.67%	100.00%	99.44%
Probit	87.27%	100.00%	99.92%

lead to different coefficients in the resulting probit models. As can be seen from Table 5, the probit models outperform the discriminant models in every cell.

4.3 PREDICTIVE ABILITY OF THE KOH MODEL

As discussed in the previous section, the in-sample accuracy rates of the Koh model are upward biased because the validation sample that is used to compute the in-sample accuracy rates is also the estimation sample that is used to construct the Koh model. Thus, to assess the predictive ability of the Koh model in a more appropriate manner, the hold-out accuracy rates are computed. Since the Lachenbruch U method is the most efficient among all hold-out methods, it is used to compute the hold-out accuracy rates of the Koh model.

The Lachenbruch U method consists of the following steps. First, one sample company among the 330 sample companies is held out and a probit model is constructed on the remaining 329 sample companies using the WESML procedure. Second, the resulting probit model is used to compute the conditional probability of going-concern continuity for the held-out company. Third, the above procedure is repeated for every sample company. For the Koh model, the Lachenbruch U method generates 330 probit models and 330 conditional probabilities since there are 330 sample observations. The means and standard deviations of the 330 sets of coefficients resulting from the Lachenbruch U method are given in Table 6 and the frequency distributions of the estimated normal standard deviates and conditional probabilities are given in Table 7.

As expected, the means of the 330 sets of coefficients are close to the coefficients in the Koh model. Further, Table 6 shows that the probit coefficients resulting from the Lachenbruch U method are rather stable. This implies that the Koh model is also a stable going-concern prediction model. In particular, the coefficients of the Koh model

Table 6. MEANS AND STANDARD DEVIATIONS OF COEFFICIENTS

Coefficients	Mean	Standard Deviation
Constant	9.900	0.093
QACL	0.799	0.026
MVTA	0.556	0.031
TLTA	-12.009	0.121
IEBT	-0.006	0.010
NITA	16.688	0.199
RETA	0.865	0.035

are not influenced by any specific sample company. Instead, they reflect the general characteristics of going and non-going concerns.

As shown in Table 7, the Koh model predicts that all the 165 going concerns in the sample have probabilities of going-concern continuity equal to or greater than 0.9405. In contrast, the Koh model predicts that only 59 out of the 165 non-going concerns in the sample have probabilities of going-concern continuity greater than 0.1000. These results show that the Koh model has great discriminating power in predicting going and non-going concerns.

Probit analysis generates conditional probabilities but does not dictate what the cut-off probability between the groups (i.e., going and non-going concerns) should be.¹²⁸ Therefore, to use the Koh model to predict the going-concern status of a company, a cut-off probability between going and non-going concerns must be determined. Given that only about six out of 1000 (i.e., 0.6% of) COMPUSTAT companies are non-going concerns, it is more important to predict the very common occurrence of going-concern status correctly than to predict the very rare occurrence of non-going-concern status correctly.¹²⁹ On this basis, the optimal cut-off probability for the Koh model is determined by minimizing the number of misclassifications of non-going concerns as going concerns, given that all going concerns are correctly classified. Admittedly, this results in a very conservative going-concern prediction model. However, it is not inappropriate given the relative occurrence of going and non-going concerns. (The use of less con-

¹²⁸ In contrast, discriminant analysis computes an optimal Z-score to classify the observations into groups given the prior probabilities and sample data.

¹²⁹ For example, given 100 000 companies, a 1% error rate of predicting both going and non-going concerns incorrectly will result in 994 going concerns being misclassified as non-going concerns but only 6 non-going concerns being misclassified as going concerns. Thus, it makes sense to minimize the error rate of classifying going concerns incorrectly as non-going concerns given the relative occurrence of going and non-going concerns. This, of course, ignores misclassification costs, which will be considered in the next chapter.

Table 7. FREQUENCY DISTRIBUTIONS OF THE HOLD-OUT RESULTS

Estimated Conditional Probability (i.e. \hat{Y})	Estimated Standard Normal Deviate (i.e. \hat{Z})	Frequency	
		Non-Going	Going
0.0000 to 0.0999	$-\infty$ to -1.2815	106	-
0.1000 to 0.1999	-1.2816 to -0.8415	4	-
0.2000 to 0.2999	-0.8416 to -0.5243	6	-
0.3000 to 0.3999	-0.5244 to -0.2532	4	-
0.4000 to 0.4999	-0.2533 to -0.0001	3	-
0.5000 to 0.5999	0.0000 to 0.2532	4	-
0.6000 to 0.6999	0.2533 to 0.5243	5	-
0.7000 to 0.7999	0.5244 to 0.8415	4	-
0.8000 to 0.8999	0.8416 to 1.2815	5	-
0.9000 to 0.9404	1.2816 to 1.5585	0	-
0.9405 to 1.0000	1.5586 to $+\infty$	24	165
Total		165	165

servative cut-off probabilities to predict going-concern status is discussed in the next chapter, where misclassification costs are considered explicitly.)

With the optimization procedure described above, the optimal cut-off probability for the Koh model is 0.9405 (see Table 7). This corresponds to an optimal cut-off normal standard deviate of 1.5586. In other words, all companies that have estimated conditional probabilities equal to or greater than 0.9405 (i.e., $\hat{Y} \geq 0.9405$) or estimated normal standard deviates equal or greater than 1.5586 (i.e., $\hat{Z} \geq 1.5586$) are predicted as going concerns and all companies with lower estimated conditional probabilities or normal standard deviates are predicted as non-going concerns. Given this, the Koh model can be expressed as follows:

$$\begin{aligned} \text{Koh Model: } Z \geq 1.5586 &\rightarrow \text{going concern} \\ Z < 1.5586 &\rightarrow \text{non-going concern} \end{aligned}$$

$$\begin{aligned} \text{where } Z = &9.8967 + 0.7979 \times QACL + 0.5569 \times MVTA - 12.0050 \times TLTA \\ &- 0.0054 \times IEBT + 16.6764 \times NITA + 0.8644 \times RETA \end{aligned}$$

The complete specification of the Koh model is given in Table 8.

The hold-out accuracy rates and classification results of the Koh model are presented in Table 9. As discussed earlier, these results are derived from the Lachenbruch U method. As can be seen from Table 9, the hold-out accuracy rates of the Koh model are 85.45% for non-going concerns, 100.00% for going concerns, and 99.91% overall. This corresponds to the misclassification of 24 non-going concerns, 0 going concern, and 24 companies overall, respectively. These results are similar to the in-sample results (see Table 4). However, as expected, the hold-out accuracy rates are lower than the in-sample accuracy rates since the latter are upward biased because the estimation sample is used to validate the model. In particular, the in-sample accuracy rates are 87.27% for non-going concerns and 99.92% overall, both of which are higher than the correspond-

Table 8. SPECIFICATION OF THE KOH MODEL

$$Y_i = N(Z_i)$$

$$\text{where } Z_i = 9.8967 + 0.7979 \times QACL_i + 0.5569 \times MVTA_i - 12.0050 \times TLTA_i \\ - 0.0054 \times IEBT_i + 16.6764 \times NITA_i + 0.8644 \times RETA_i$$

Key:

- Y_i = conditional probability of going-concern continuity for firm i
- $N(.)$ = cumulative normal probability function
- Z_i = normal standard deviate for firm i
- $QACL_i$ = quick assets to current liabilities for firm i
- $MVTA_i$ = market value of equity to total assets for firm i
- $TLTA_i$ = total liabilities to total assets for firm i
- $IEBT_i$ = interest payments to earnings before interest and tax for firm i
- $NITA_i$ = net income to total assets for firm i
- $RETA_i$ = retained earnings to total assets for firm i

Prediction Rule:

- $Y_i \geq 0.9405$ or $Z_i \geq 1.5586$ → firm i is a going concern
- $Y_i < 0.9405$ or $Z_i < 1.5586$ → firm i is a non-going concern

ing hold-out accuracy rates (i.e., 85.45% and 99.91%, respectively). However, both the hold-out and in-sample accuracy rates for going concerns are identical at 100.00%. This is expected given the way the optimal cut-off conditional probability is determined.

From the results presented above, it can be concluded that the Koh model has very high predictive power in predicting going-concern and non-going-concern status. In particular, the overall accuracy rate of the Koh model in making going-concern assessments in real life (where the relative occurrence of going and non-going concerns is 99.4% to 0.6%) is expected to be around 99.91%. Since this dissertation attempts to improve upon the going-concern prediction models suggested by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985], it is appropriate to compare the accuracy rates of the Koh model to those of these models.¹³⁰ Results of this comparison are presented in Table 10.¹³¹ The overall accuracy rates in Table 10 are computed with weights of 0.994 and 0.006 for going and non-going concerns, respectively. These weights reflect the relative occurrence of going and non-going concerns that auditors can expect in real life.¹³²

¹³⁰ As pointed out earlier, the going-concern qualification prediction models constructed by Mutchler [1985], Menon and Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] are fundamentally different from the Koh model and thus not comparable. In particular, they predict going-concern qualification instead of going-concern status.

¹³¹ Altman [1968] reported an in-sample accuracy rate of 96.97% for non-bankrupt firms in the original model. This rate is used in the comparison because, as pointed out earlier, Altman and McGough [1974] did not report Type II errors in their study. The use of in-sample accuracy rates will bias the results for Altman and McGough [1974] upward. In other words, the "actual" accuracy rates for the model constructed by Altman and McGough [1974] are probably lower than those used in Table 10. Further, Levitan and Knoblett [1985] only reported an equally weighted overall accuracy rate of 88.50% without breaking it down into individual accuracy rates for going and non-going concerns. To derive these individual accuracy rates, the pattern observed among the in-sample accuracy rates is applied to the hold-out accuracy rates.

¹³² As noted in the previous section, it is not meaningful to compute equally weighted overall accuracy rates for going-concern prediction models because going and non-going concerns do not occur in equal proportions in real life.

Table 9. CLASSIFICATION RESULTS OF THE KOH MODEL

Actual Status	Number of Cases	Predicted Status		Accuracy Rate
		Non-Going	Going	
Non-Going	165	141	24	85.45%
Going	165	0	165	100.00%
Overall Accuracy Rate				99.91%

Table 10. COMPARISON OF GOING-CONCERN PREDICTION MODELS

Going-Concern Prediction Model	Classification Accuracy Rates		
	Non-Going Concerns	Going Concerns	Overall
Altman and McGough [1974]	82.35%	96.97%	96.88%
McKee [1976]	80.00%	93.33%	93.25%
Levitan and Knoblett [1985]	83.50%	93.50%	93.44%
Koh [1987]	85.45%	100.00%	99.91%

As can be seen from Table 10, the Koh model outperforms all the other 3 going-concern prediction models in every cell. In particular, the next best model is that constructed by Altman and McGough [1974] with accuracy rates of 82.35% for non-going concerns, 96.97% for going concerns, and 96.88% overall. The corresponding accuracy rates for the Koh model are 85.45%, 100.00%, and 99.91%, respectively. Incidentally, the going-concern prediction model constructed by McKee [1976] has the lowest overall accuracy rate of only 93.25%, which is worse than the overall accuracy rate of a naive prediction rule that predicts *all* companies as going concerns. Given that only 0.6% of all companies are non-going concerns, such a naive prediction rules will predict going-concern status correctly 99.40% of the time. In fact, the models constructed by Altman and McGough [1974] and Levitan and Knoblett [1985] also perform worse than this naive model in terms of overall accuracy rates.

As pointed out earlier, the comparison above must be interpreted with care because the results of the other three going-concern prediction models are biased in view of the problems identified in Chapter 2. In particular, it may be difficult to evaluate the results of the other going-concern prediction models because of problems resulting from the inappropriate use of discriminant analysis, inappropriate operational definitions, absence of procedures to adjust for unequal prior probabilities, and inadequate model testing and validation.¹³³ Despite these problems, the results of the crude comparison show that the performance of the Koh model is the best among the going-concern models. In particular, the overall accuracy rate of the Koh model is 99.91%. The individual accuracy rates for going and non-going concerns are 100.00% and 85.45%, respectively. However, before advocating the use of the Koh model in making

¹³³ Details of the problems with previous going-concern prediction models are given in Section 2.3.

going-concern assessments, the performance of the Koh model should be compared to that of the auditors. The results of this comparison are presented in the next chapter.

Chapter 5

APPLICATION OF THE KOH MODEL

The construction and validation of the Koh model are discussed in the previous chapter. The Koh model has accuracy rates of 85.45% for non-going concerns, 100.00% for going concerns, and 99.91% overall. With these accuracy rates, the model compares favorably with the going-concern prediction models developed earlier by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985].

The primary objective of this dissertation is to construct a going-concern prediction model to aid auditors in making going-concern assessments. Before advocating the use of the Koh model for such a purpose, it is appropriate to compare the accuracy rates of the Koh model to those of auditors. It is only after such a comparison that the usefulness of the Koh model to auditors in making going-concern assessments can be evaluated.

This chapter consists of three sections. The first section compares the accuracy rates of the auditors to those of going-concern prediction models in general and the Koh model in particular. The second section considers the effects of misclassification costs on the Koh model. Recall that the optimal cut-off probability for the Koh model is determined by minimizing the number of misclassifications of non-going concerns as

going concerns, given that all going concerns are correctly classified. Although this results in a very conservative going-concern prediction model, it is not inappropriate given that going concerns occur very much more frequently than non-going concerns. In fact, their relative occurrence is 0.994 to 0.006. This makes it more important to predict going concerns (which occur very frequently) correctly than non-going concerns (which occur very rarely) correctly. However, less conservative going-concern prediction models may be more appropriate when misclassification costs are considered in the determination of the optimal cut-off probability. This is illustrated in the second section. Finally, the third section discusses the usefulness and limitations of the Koh model. Limitations relating to the methodology used in the construction of the Koh model are highlighted in Chapter 6 where directions for future research are also suggested.

5.1 COMPARISON OF ACCURACY RATES

The auditor's accuracy rates are computed on the basis of their audit opinions for the 330 sample companies. An audit opinion is considered "correct" if a going-concern qualification is given to a non-going concern or if no going-concern qualification is given to a going concern.¹³⁴ Admittedly, the auditors' accuracy rates in making going-concern assessments computed in this manner may be downward biased because auditors may not modify their reports even if they have detected going-concern problems. In particular, it has been argued that the fear of losing audit clients, the risk of facing lawsuits, and the possibility of adding to the client's demise (i.e., the self-fulfilling prophecy) may reduce the auditors' propensity to qualify (see, for example Kida

¹³⁴ In the dissertation, non-going concerns are operationalized as bankrupt companies.

[1980]).¹³⁵ However, this downward bias is not expected to be serious because of the following mitigating factors.

First, it is not clear that the fear of losing audit clients or the risk of facing lawsuits will cause auditors not to issue going-concern qualifications when going-concern problems are detected. While it is true that auditors who give unwarranted going-concern qualifications may lose clients or risk lawsuits, it is also true that auditors who do not give going-concern qualifications when they are appropriate may lose clients and risk lawsuits too. Thus, there is no a priori reason to believe that the fear of losing audit clients and the risk of lawsuits will cause auditors to be more conservative and not less conservative. In fact, it appears that the risk of lawsuits is greater when auditors do not issue qualified reports when they are appropriate than when auditors issue unwarranted qualifications. This arises from the fact that the losses incurred by investing in and lending to companies that go bankrupt are usually heavier than the losses incurred by not investing in or lending to companies that do not go bankrupt. Consequently, investors and creditors are more likely to take legal actions when companies with unqualified audit opinions go bankrupt than when companies with qualified audit opinions survive. Further, society expects the auditor to give early warnings of financial distress. Thus, auditors may actually have higher propensity to qualify than is commonly believed.

Second, although a going-concern qualification may hasten the demise of a distressed firm, it may also lead to actions that can save the distressed firm from its demise. For example, a going-concern qualification may highlight the need to reduce expenses and secure additional funds immediately, which management may otherwise postpone until it is too late. Therefore, the self-fulfilling prophecy alone is not adequate to support

¹³⁵ Thomas Kida, "An Investigation into Auditors' Continuity and Related Qualification Judgments," *Journal of Accounting Research* (Autumn 1980), pp. 506-523.

the argument that auditors may not issue going-concern qualifications even when they have detected going-concern problems.

Third, the comparison of accuracy rates among auditors and going-concern prediction models is always biased in favor of the auditors for a number of reasons. While the accuracy rates of the models are computed on the basis of model predictions, which are usually based on a few financial ratios from the financial statements at the balance sheet dates, the accuracy rates of the auditors are computed from audit opinions, which are often issued after balance sheet dates after considering many more factors than just a few financial ratios. In other words, auditors have access to more information in making going-concern assessments than going-concern models have in making going-concern predictions. Thus, it can be argued that the auditors' accuracy rates computed on the basis of audit opinions are actually upward biased and not downward biased.

Nevertheless, Kida [1980] found that the auditors' accuracy rates in making going-concern assessments computed on the basis of audit opinions are biased estimates of the auditors' ability in predicting going-concern status. In particular, the estimated accuracy rates are downward biased because the auditors may not qualify their audit opinions even when they have detected going-concern problems. Nonetheless, in view of the discussion above, this downward bias is not expected to be serious. Thus, it is considered appropriate to compute the auditors' accuracy rates in making going-concern assessments on the basis of their audit opinions.

The audit opinions for the sample of 330 companies are obtained from the COMPUSTAT tapes, the *Moody's Industrial and OTC Manuals*, and the *10-K Reports*. From these three sources, the 330 audit opinions obtained are classified into the following categories: (1) unqualified, (2) qualified on going-concern basis, (3) qualified on other bases, and (4) no opinion. All audit opinions that contain the auditors' expression of doubt or caution regarding the continuity of the companies being audited are classi-

fied as audit opinions qualified on a going-concern basis. Audit opinions qualified on other bases, such as litigation and material uncertainty without reference to going-concern uncertainty, are classified as audit opinions qualified on other bases. The “unqualified” category includes all clean, standard audit reports and the “no opinion” category includes all situations where the auditors are not able to issue any audit opinions or where no audit reports are found (i.e., no external audits are being conducted). The breakdown of the different categories of audit opinions for going and non-going concerns is presented in Table 11.

As can be seen from Table 11, out of 165 going concerns, 162 (i.e., 98.18%) received unqualified audit opinions and 3 (i.e., 1.82%) received audit opinions qualified on other non-going-concern bases. Therefore, the auditors’ accuracy rate for going concerns is 100.00% since none of the 165 going concerns received going-concern qualifications. For the non-going concerns, 5 companies have no audit opinions and these companies are omitted in the computation of the auditors’ accuracy rates. Of the remaining 160 non-going concerns, 54 (i.e., 33.75%) received unqualified audit opinions, 87 (i.e., 54.37%) received audit opinions qualified on a going-concern basis, and 19 (i.e., 11.88%) received audit opinions qualified on other bases. In other words, the auditors’ accuracy rates for non-going concerns is only 54.37%.¹³⁶ The above results give an overall accuracy rate of 99.73% for the auditors.¹³⁷ Details of the auditors’ classification results are given in Table 12.

¹³⁶ This result is similar to the findings of Menon and Schwartz [1986] and Levitan and Knoblett [1985]. In particular, Menon and Schwartz [1986] found that auditors have an accuracy rate of 42.86% for non-going concerns and Levitan and Knoblett [1985] found that auditors have accuracy rates of 65.63% for non-going concerns, 100.00% for going concerns, and 99.79% overall.

¹³⁷ As in the computation of overall accuracy rates for going-concern prediction models, the overall accuracy rate for auditors is computed on the basis of weights of 0.994 for going concerns and 0.006 for non-going concerns.

Table 11. BREAKDOWN OF AUDIT OPINIONS

Audit Opinion	Going Concerns	Non-Going Concerns
Unqualified	162 (98.18%)	54 (33.75%)
Qualified		
Going-Concern Basis	0 (0.00%)	87 (54.37%)
Other Bases	3 (1.82%)	19 (11.88%)
Total	165 (100.00%)	160 (100.00%)
No Opinion	0	5
Total	165	165

Table 12. CLASSIFICATION RESULTS OF THE AUDITORS

Actual Status	Number of Cases	Predicted Status		Accuracy Rate
		Non-Going	Going	
Non-Going	160	87	73	54.37%
Going	165	0	165	100.00%
Overall Accuracy Rate				99.73%

To see if going-concern prediction models in general and the Koh model in particular outperform the auditors in making going-concern assessments, the accuracy rates of the Koh model and the going-concern prediction models constructed by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] are compared to those of the auditors. Results of this comparison are presented in Table 13.

As can be seen from Table 13, the auditors in the sample outperform the going-concern prediction models constructed by Altman and McGough [1974], McKee [1976] and Levitan and Knoblett [1985] in terms of overall accuracy rates. In particular, the overall accuracy rates for the auditors and the models constructed by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] are 99.73%, 96.88%, 93.25% and 93.44%, respectively. In other words, although the three previous going-concern prediction models are constructed to aid auditors, none of them actually outperform the present sample of auditors. In fact, none of these models has an overall accuracy rate higher than that of a naive model that predicts all companies as going concerns. (Such as naive model has an overall accuracy rate of 99.40% since going concerns occur 99.40% of the time.) This is so despite the fact that the overall accuracy rate of Altman and McGough [1974] is upward biased because the accuracy rate for going concerns is based on the original sample and not a hold-out sample.

As predicted, the Koh model outperforms all the other going-concern models as well as the auditors. In particular, while the auditors have accuracy rates of 54.37% for non-going concerns, 100.00% for going concerns, and 99.73% overall, the corresponding accuracy rates for the Koh model are 85.45%, 100.00%, and 99.91%, respectively. Although the overall accuracy rates of the Koh model and the auditors are close (99.91% vs 99.73%), the Koh model outperforms the auditors in predicting non-going concerns (85.45% vs 54.37%). In view of the performance of the Koh model, there is reason to advocate the use of the Koh model by auditors when they are making going-concern

Table 13. COMPARISON OF ACCURACY RATES OF AUDITORS AND MODELS

Going-Concern Prediction model	Classification Accuracy Rates		
	Non-Going Concerns	Going Concerns	Overall
Altman and McGough [1974]	82.35%	96.97%	96.88%
McKee [1976]	80.00%	93.33%	93.25%
Levitan and Knoblett [1985]	83.50%	93.50%	93.44%
Koh [1987]	85.45%	100.00%	99.91%
Auditors	54.37%	100.00%	99.73%

assessments. However, the Koh model as specified in Table 8 may not be applicable to all situations. Instead, modifications may be necessary when misclassification costs are considered explicitly. This is illustrated in the next section.

5.2 CONSIDERATION OF MISCLASSIFICATION COSTS

As pointed out in Chapter 4, the Koh model is a very conservative going-concern prediction model because the optimal cut-off probability is determined by minimizing the number of misclassifications of non-going concerns as going concerns, given that all going concerns are correctly classified. This is not inappropriate given that the relative occurrence of going and non-going concerns among COMPUSTAT companies is 0.994 to 0.006. In other words, since going concerns occur much more frequently than non-going concerns, it is more important to predict the status of going concerns correctly than to predict the status of non-going concerns correctly. Hence, a very conservative procedure is used to determine the optimal cut-off probability of the Koh model in Chapter 4.

There is another justification for recommending a very conservative going-concern prediction model for auditors. Basically, the model used by auditors should reflect the risk attitudes of auditors. In other words, going-concern models that predict going-concern status in a very conservative manner are appropriate only for auditors who make going-concern assessments in a very conservative manner. Thus, the Koh model is appropriate only for very conservative auditors. From Tables 11 and 12, it is clear that auditors are generally very conservative in making going-concern assessments. In particular, the auditors in the sample issued no going-concern qualification to all the 165 going concerns in the sample and they issued no going-concern qualification to 73 (i.e., 45.63%) of the 165 non-going concerns in the sample. Thus, the auditors have a

low propensity to qualify.¹³⁸ Also, their accuracy rate for going concerns is 100.00%. This is identical to the corresponding accuracy rate for going concerns for the Koh model. This observation implies that both the auditors and the Koh model are very conservative because going-concern qualifications are given or predicted only in situations where going-concern continuity is clearly in doubt. Therefore, it is appropriate to determine the optimal cut-off probability for the Koh model in a very conservative manner because it results in a very conservative going-concern prediction model for very conservative auditors. In other words, the Koh model is consistent with the risk attitudes of auditors.

Although the Koh model is appropriate for auditors in general, there is no reason to preclude the use of less conservative going-concern prediction models by some auditors. In fact, less conservative models may be more appropriate when the misclassification costs of misclassifying non-going concerns as going concerns (i.e., Type I errors) are very much higher than the misclassification costs of misclassifying going concerns as non-going concerns (i.e., Type II errors). Under such circumstances, while non-going concerns occur very rarely, the misclassifications of these rare occurrences are very costly. Therefore, it may not be optimal to determine the cut-off probability in such a way that the model classifies all going concerns correctly at the expense of non-going concerns.

Up to this point, misclassification costs have been ignored. When they are considered explicitly, the procedure to be used to determine the optimal cut-off probability differs significantly from that used so far. Specifically, when misclassification costs are considered explicitly, the optimal cut-off probability for the Koh model is no longer that probability that minimizes the misclassifications of non-going concerns, given that all

¹³⁸ This finding is consistent with the findings of Kida [1980] and Menon and Schwartz [1986].

going concerns are classified correctly. Instead, the optimal cut-off probability is that probability that minimizes the expected misclassification costs of using the Koh model.

The expected misclassification costs of using the Koh model can be derived from the formula put forth by Dopuch, Holthausen, and Leftwich [1987].¹³⁹ In the present context, the expected misclassification costs of using the Koh model can be expressed as follows:

$$EC = (P_N)(P_I)(C_I) + (P_G)(P_{II})(C_{II})$$

where EC = expected misclassification costs of using the Koh model

P_N = prior probability of non-going concerns

= 0.006

P_G = prior probability of going concerns

= 0.994

P_I = conditional probability of Type I errors

= (number of Type I errors given a particular cut-off probability)/(number of non-going concerns)

= (number of Type I errors)/165

P_{II} = conditional probability of Type II errors

= (number of Type II errors)/165

C_I = misclassification cost of a Type I error

C_{II} = misclassification cost of a Type II error

In the above formula, only C_I and C_{II} are unknown parameters. Generally, the misclassification costs of predicting the going-concern status of audit clients incorrectly are not known because the expected consequences of incorrect audit opinions usually involve the loss of reputation, the loss of existing and potential clients, and the risk of

¹³⁹ Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich, "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (July 1987), pp. 444-5. Basically, the expected misclassification costs are simply the sum of the products of the misclassification costs of Type I and Type II errors and the prior probabilities of Type I and Type II errors, respectively.

lawsuits, which are largely intangible and unmeasurable. Therefore, C_I and C_{II} can only be speculated but not measured to any satisfactory degree of accuracy. To determine the optimal cut-off probability for the Koh model when misclassification costs are considered, C_I and C_{II} are not measured. Instead, the expected misclassification costs of using the Koh model are computed under alternative assumptions about the relative misclassification costs of Type I and Type II errors (i.e., $C_I:C_{II}$). This procedure is illustrated below.

Given the values of P_G , P_N , P_I , and P_{II} , EC can be expressed as follows:

$$EC = (0.006)(N_I/165)(C_I) + (0.994)(N_{II}/165)(C_{II})$$

where N_I = number of Type I errors
 N_{II} = number of Type II errors

That is,

$$EC = 0.00003636(N_I \times C_I) + 0.00602424(N_{II} \times C_{II})$$

Since only the relative expected misclassification costs for different cut-off probabilities are important (for each given $C_I:C_{II}$), EC can be simplified as follows:

$$EC = 0.03636(N_I \times C_I) + 6.02424(N_{II} \times C_{II})$$

From the above formula, it is clear that because going concerns occur more frequently than non-going concerns, misclassifying going concerns (i.e., N_{II}) contributes more to EC than misclassifying non-going concerns (i.e., N_I) when misclassification costs (i.e., C_I and C_{II}) are ignored. Thus, given the results presented in Chapter 4 for the Koh model, the optimal cut-off probability without misclassification costs is that cut-off

probability that minimizes N_I , given that N_{II} is 0. However, this procedure may not be optimal when C_I and C_{II} are considered explicitly.

Suppose that $C_I:C_{II}$ is 1:1. That is, the misclassification cost of a Type I error is same as that of a Type II error. In this case,

$$EC = 0.03636N_I + 6.02424N_{II}$$

Different cut-off probabilities will lead to different N_I 's and N_{II} 's and hence, different EC 's.¹⁴⁰ The different EC 's for the Koh model under different cut-off probabilities and the corresponding normal standard deviates are presented in Table 14. This table illustrates the determination of the optimal cut-off probability when $C_I:C_{II}$ is 1:1.

As can be seen from Table 14, when the misclassification cost of a Type I error is equal to the misclassification cost of a Type II error, the optimal cut-off probability and the corresponding optimal cut-off normal standard deviate are 0.9405 and 1.5586, respectively. (These optimal cut-off values are identical to those specified by the Koh model in Chapter 4.) With this optimal cut-off probability, the expected misclassification costs of using the Koh model is 0.87264.¹⁴¹ All other cut-off probabilities lead to higher EC 's when $C_I:C_{II}$ is 1:1. Thus, when $C_I:C_{II}$ is 1:1, the Koh model as specified in Table 8 of Chapter 4 is appropriate. This specification of the Koh model uses an optimal cut-off probability of 0.9405 in its prediction rule. However, this specification of the

¹⁴⁰ As pointed out in Chapter 4, the Koh model generates conditional probabilities for the observations but not the going-concern status. The going-concern status of the observations is determined by comparing the generated conditional probabilities to the cut-off probability. Thus, different cut-off probabilities lead to different numbers of Type I and Type II errors.

¹⁴¹ In this dissertation, the expected misclassification costs of using the Koh model are computed only for the purpose of determining the optimal cut-off probability. They do not have units and are not interpretable unless actual values of C_I and C_{II} are used. In other words, only when the actual values of C_I and C_{II} are available, the actual expected misclassification costs of using the Koh model can be computed in terms of dollar amounts.

Table 14. DETERMINATION OF OPTIMAL CUT-OFF PROBABILITY

Cut-off Probability	Normal Standard Deviate	N_I	N_{II}	EC
0.9405	1.5586	24	0	0.87264
0.9445	1.6021	24	1	6.89628
0.9465	1.6100	23	2	12.88476
0.9475	1.6240	22	2	12.84840
0.9545	1.6889	22	3	18.87264

Koh model may not be optimal for other values of C_I and C_{II} . In particular, different relative misclassification costs may lead to different optimal cut-off values.

Accordingly, the optimal cut-off probabilities (denoted Y), corresponding optimal cut-off normal standard deviates (denoted Z) and expected misclassification costs for using the Koh model are computed for $C_I:C_{II}$ ranging from 1:1 to 180:1. The results are summarized in Table 15.

As can be seen from Table 15, the Koh model is very insensitive to varying relative misclassification costs. In particular, for $C_I:C_{II}$ ranging from 1:1 to 160:1, the optimal cut-off probability (Y) and the corresponding optimal cut-off normal standard deviate (Z) for the Koh model remain at 0.9405 and 1.5586, respectively.¹⁴² In other words, it is only when the misclassification cost of a Type I error is more than 160 times that of a Type II error that a different Y and Z need to be determined. For example, when $C_I:C_{II}$ is 180:1, Y and Z are 0.9475 and 1.6240, respectively.¹⁴³ Given that $C_I:C_{II}$ is not expected to exceed 160:1 frequently, the Koh model as presented in Chapter 4 is expected to be optimal for practically all auditors when making going-concern assessments under practically all circumstances.¹⁴⁴ Coupled with the high predictive ability and stability of the Koh model (see Chapter 4 and Section 5.1), the Koh model can indeed be a significant and effective aid to auditors.

The usefulness and limitations of the Koh model to auditors are discussed below.

¹⁴² This statement also applies when $C_I:C_{II}$ is less than 1:1 (e.g., $C_I:C_{II} = 1:20, 1:100, 1:500, \dots$ etc.).

¹⁴³ For $C_I:C_{II}$ greater than 160:1, only the optimal cut-off probabilities change but the coefficients of the Koh model remains the same.

¹⁴⁴ For $C_I:C_{II}$ to be greater than 160:1, a misclassification cost of \$10 000 for a Type II error requires a misclassification cost of more than \$1 600 000 for a Type I error. This ratio of misclassification costs is highly unlikely.

Table 15. SUMMARY OF OPTIMAL CUT-OFF PROBABILITIES

$C_I:C_{II}$	Y	Z	N_I	N_{II}	EC
1:1	0.9405	1.5586	24	0	0.8726
10:1	0.9405	1.5586	24	0	8.7264
20:1	0.9405	1.5586	24	0	17.4528
30:1	0.9405	1.5586	24	0	26.1792
40:1	0.9405	1.5586	24	0	34.9056
50:1	0.9405	1.5586	24	0	43.6320
60:1	0.9405	1.5586	24	0	52.3584
70:1	0.9405	1.5586	24	0	61.0848
80:1	0.9405	1.5586	24	0	69.8112
90:1	0.9405	1.5586	24	0	78.5376
100:1	0.9405	1.5586	24	0	87.2640
120:1	0.9405	1.5586	24	0	104.7168
140:1	0.9405	1.5586	24	0	122.1696
160:1	0.9405	1.5586	24	0	139.6224
180:1	0.9475	1.6240	22	2	156.0341

5.3 USEFULNESS AND LIMITATIONS OF THE KOH MODEL

From Chapter 4 and the first two sections of this chapter, it can be concluded that the Koh model is highly predictive, very stable, and applicable to most situations. In particular, the Koh model has an overall accuracy rate of 99.91% and coefficients that vary only slightly across different estimation samples (see Tables 9 and 6, respectively). Further, the Koh model as specified in Table 8 is applicable to all cases where the misclassification cost of a Type I error is not more than 160 times that of a Type II error. Such cases are expected to be the rule rather than exception. Even if $C_I:C_{II}$ is more than 160:1, the Koh model can still be used; however, a different optimal cut-off probability between going and non-going concerns needs to be computed.

Since the Koh model is basically a going-concern prediction model, the primary use of the Koh model is to aid auditors in making going-concern assessments. The Koh model is both inexpensive and easy to use. Input to the model (i.e., QACL, MVTA, TLTA, IEBT, NITA, and RETA) can be obtained readily from financial statements and classification can be made simply by calculating the probability of going-concern continuity with the model coefficients and comparing it to the optimal cut-off probability. Together with the results of other audit procedures, the auditor's observations, and discussions with management, the predicted going-concern status can help the auditor form his opinion.

The Koh model is also objective and unambiguous. It does not depend on subjective judgment, the probability of going-concern continuity is determined statistically, and the prediction rule is clear. Thus, it overcomes some of the shortcomings in SAS No. 34 and the proposed SAS. At the very least, the Koh model can supplement the very general and ambiguous guidelines for making going-concern assessments laid down by SAS No. 34 and the proposed SAS. Further, it provides auditors with guidelines not

only as to the information that should be evaluated but also the way in which it should be assessed. In other words, the Koh model specifies the appropriate financial ratios to consider and specifies the manner in which to assess them quantitatively and optimally. (Incidentally, the Koh model is expected to be more useful to auditors if the proposed SAS is adopted because the proposed guidelines call for an affirmative responsibility to assess the continuity of audit clients and an implied procedure to assess the probability of going-concern continuity, which can be computed by the Koh model.)

Besides being a going-concern prediction model, the Koh model might be an important and persuasive analytical tool that auditors can use when discussing problems with clients and recommending changes in the financial statements. Management is likely to respond more readily when the auditor's opinion is supported by some objective tool. The Koh model could also be a defensive device in the case of litigation. More often than not, results obtained from objective and unambiguous models make better defense than mere subjective judgments. This is so especially for going-concern assessments because they involve "consequences and implications that are too grave for relying solely on the mere judgment and experience of individual members of the professional."¹⁴⁵ Therefore, the courts might define "audit responsibilities that may require auditors to go beyond the procedures outlined in SAS No. 34."¹⁴⁶

In addition, besides using the Koh model at the end of the audit to determine the type of audit opinion that is appropriate, the auditor can also use the Koh model at the beginning of the audit. By making an initial risk assessment of the financial position of an audit client with the model, the auditor can determine the scope of the audit and

¹⁴⁵ Pieter J. Bosch, "A Definition of the Going-Concern Concept," *Accountancy SA* (February 1984), p. 240.

¹⁴⁶ J. Efrim Boritz and Eva R. Kralitz, "Reporting on Condition: Auditing the Going-Concern Assumption," *CA Magazine* (March 1984), p. 68.

plan the necessary audit procedures. In fact, when the continuity of a company is in doubt, the proposed SAS requires that the auditor actively investigate the going-concern status of the company. Thus, the Koh model can be a preliminary evaluation tool.

Although the Koh model can be an effective prediction model, analytical tool, and defensive device to the auditor, it is not without limitations. Most important, the Koh model cannot and should not replace professional judgment—it only provides the auditor with objective information for assessing the going-concern status of companies. Ultimately, the auditor must form his own opinion. Further, many potentially relevant items such as management ability and future plans are not formally incorporated into the Koh model. Nonetheless, they should be examined by the auditor as suggested by SAS No. 34 and the proposed SAS. Despite these limitations, the Koh model can be an effective aid for auditors.

Besides limitations in the application of the Koh model, there are also limitations in the methodology employed in the construction of the Koh model. These limitations are highlighted in the last section of the next chapter.

Chapter 6

SUMMARY AND DIRECTIONS FOR FUTURE RESEARCH

In the concluding chapter of the dissertation, it is appropriate to review the main conclusions and results of the previous five chapters and suggest directions for future research. Accordingly, this chapter consists of two sections. The first section summarizes the previous five chapters and the second section highlights the main contributions and limitations of the dissertation and suggests possible extensions and improvements.

6.1 SUMMARY OF DISSERTATION

6.1.1 The Going-Concern Concept and External Auditing

The going-concern concept is fundamental in the theory and practice of accounting. It assumes that an entity is a going concern if it is able and willing to continue operations in the foreseeable future and there is no information that indicates the contrary.¹⁴⁷ The going-concern concept can be justified on two grounds. First, it corre-

¹⁴⁷ Maurice Moonitz, "The Basic Postulates of Accounting," *Accounting Research Study No. 1* (New York: AICPA, 1961), pp. 38-39.

sponds to economic and business reality,¹⁴⁸ and second, it reduces the impact of uncertainty in accounting measurement.¹⁴⁹

In external auditing, the going-concern concept plays a significant role. As pointed out by Mautz and Sharaf [1961], the going-concern concept provides the foundation to develop a logical, integrated theory of auditing. Without it, auditing would be improbable, if not impossible because unless the auditor can assume that what has held true in the past will hold true in the future for the entity under examination, there is no basis for verifying management assertions, including the financial statements.¹⁵⁰

From a practical audit standpoint, the going-concern concept affects both the evidence-gathering and reporting aspects of the audit. When an auditor discovers evidence to the contrary, he may have to conduct additional tests and subsequently modify his audit report.

Although substantial agreement exists as to the meaning and role of the going-concern concept, it is difficult to make going-concern assessments in the course of an audit. In particular, while circumstances that constitute contrary information may be listed, it is extremely difficult to lay down guidelines as to how these circumstances should be assessed. Thus, it is not surprising that Menon and Schwartz [1986] found that only 42.86% of the auditors in his sample assessed the going-concern status of 147 bankrupt companies correctly.¹⁵¹

¹⁴⁸ American Institute of Certified Public Accountants, "Basic Concepts and Accounting Principles Underlying Financial Statements of Business Enterprises," *Accounting Principles Board Statement No. 4* (New York:AICPA, October 1970), paragraph 55.

¹⁴⁹ Joseph A. Wiseman, "The Going Concern, Its Impact on Financial Reporting," *Georgia CPA* (Spring 1975-76), pp. 20-26.

¹⁵⁰ Robert K. Mautz, and Hussein A. Sharaf, *The Philosophy of Auditing* (Florida: American Accounting Association, 1961), pp. 42 and 48.

¹⁵¹ Krishnagopal Menon and Kenneth B. Schwartz, "The Auditor's Report for Companies Facing Bankruptcy," *Journal of Commercial Bank Lending* (January 1986), pp. 42-52.

At present, guidelines for the auditor when he is assessing the going-concern status of his clients are contained in SAS No. 34.¹⁵² Basically, these guidelines call for the consideration of contrary information, mitigating factors, and management plans. However, SAS No. 34 is inadequate because it does not tell the auditor how contrary information, mitigating factors, and management plans should be evaluated. Further, the guidelines are too general and ambiguous to be useful. In fact, Williams [1984] found that despite SAS No. 34, the audit partners in his study used completely subjective evaluation methods in making going-concern assessments.¹⁵³

In February 1987, a proposed SAS that specifies the auditor's considerations of an entity's ability to continue in existence was issued.¹⁵⁴ This proposed SAS would replace SAS No. 34, if adopted. Although the proposed SAS is more specific in defining the auditor's responsibilities in making going-concern assessments, it still does not provide adequate guidelines. Thus, there are no adequate external auditing guidelines at present to guide auditors in making going-concern assessments.

In view of the difficulty in assessing going-concern status and the inadequacy in existing external auditing guidelines, several researchers have advocated the use of objective statistical prediction models. To date, six going-concern prediction models have been suggested in the literature. Three of these models deal with the prediction of going-concern status and the remaining three deal with the prediction of going-concern qualification. The going-concern models constructed by Altman and McGough

¹⁵² American Institute of Certified Public Accountants, "The Auditor's Considerations When a Question Arises About an Entity's Continued Existence," *Statement on Auditing Standards No. 34* (New York: AICPA, March 1981).

¹⁵³ H. James Williams, "Practitioners' Perspectives on Going-Concern Issues," *CPA Journal* (December 1984), pp. 12-19.

¹⁵⁴ American Institute of Certified Public Accountants, "The Auditor's Considerations of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987).

[1974],¹⁵⁵ McKee [1976],¹⁵⁶ and Levitan and Knoblett [1985]¹⁵⁷ fall into the first category and the going-concern models constructed by Mutchler [1985],¹⁵⁸ Menon and Schwartz [1987],¹⁵⁹ and Dopuch, Holthausen, and Leftwich [1987]¹⁶⁰ fall into the second category. A summary of these six going-concern studies is provided in Appendix D.

6.1.2 Problems with Existing Going-Concern Models

Although the idea that objective prediction models can be constructed to aid auditors in making going-concern assessments is appealing, there are major problems with all the six going-concern models mentioned above. These problems are enumerated below.

First, Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985] used multiple discriminant analysis to construct their going-concern models. However, discriminant analysis requires restrictive assumptions such as multivariate normality and equal covariances, which are often violated. When these assumptions are violated, tests of significance and estimated error rates are biased and

¹⁵⁵ Edward I. Altman and Thomas P. McGough, "Evaluation of a Company as a Going Concern," *Journal of Accountancy* (December 1974), pp. 50-57.

¹⁵⁶ Thomas E. McKee, "Discriminant Prediction of Going Concern Status: A Model for Auditors," in *AAA Collected Papers of the Annual Meeting* (August 23-25, 1976, Sarasota, Florida), pp. 294-321.

¹⁵⁷ Alan S. Levitan and James A. Knoblett, "Indicators of Exceptions to the Going Concern Assumption," *Auditing: A Journal of Practice & Theory* (Fall 1985), pp. 26-39.

¹⁵⁸ Jane F. Mutchler, "A Multivariate Analysis of the Auditor's Going-Concern Opinion Decision," *Journal of Accounting Research* (Autumn 1985), pp. 668-682.

¹⁵⁹ Krishnagopal Menon and Kenneth B. Schwartz, "An Empirical Investigation of Audit Qualification Decisions in the Presence of Going Concern Uncertainties," *Contemporary Accounting Research* (Spring 1987), pp. 302-15.

¹⁶⁰ Nicholas Dopuch, Robert W. Holthausen, and Richard W. Leftwich, "Predicting Audit Qualifications with Financial and Market Variables," *The Accounting Review* (July 1987), pp. 431-54.

linear classification rules may be inappropriate. Further, discriminant analysis does not generate accurate conditional probabilities and unique discriminant coefficients.

Second, the operational definitions of a going concern used by McKee [1976] and Mutchler [1985] are flawed because they do not correspond to the going-concern concept. When the operational definition of a going concern does not correspond to the going-concern concept, models constructed on the operational definition do not predict what they purport to predict. Further, the estimated error rates are incorrect.

Third, all the six going-concern studies used choice-based sample designs, which lead to choice-based sample bias of both the parameter and probability estimates. Except for Dopuch, Holthausen, and Leftwich [1987], none of the other five studies use weighted procedures to eliminate or mitigate this bias. In fact, Altman and McGough [1974], McKee [1976], Levitan and Knoblett [1985], and Mutchler [1985] used matched sample designs, which magnify the effects of choice-based sample bias. As a result, the estimated error rates bear little relationship to what one might expect in the population.

Fourth, the selection of independent variables for the six going-concern models is not based on sound theoretical justification or valid empirical evidence. Instead, independent variables are often selected on the basis of criteria such as popularity in the literature, potential relevance, consistency with previous research, suggested "guidelines" in the literature, and subjective judgment. Even the statistical stepwise procedures used by Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985] are not appropriate for model construction although such procedures may be appropriate for variables reduction. As a result, the independent variables used in the six going-concern models cannot be justified theoretically or empirically.

Fifth, the going-concern qualification prediction models constructed by Mutchler [1985], Menon and Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] are not useful to auditors for making going-concern assessments. These models can only

predict audit opinions as they would be issued by the auditors included in their samples (whether or not such opinions are appropriate) and not as they should be issued on the basis of the financial condition of the firms. Also, models that predict going-concern qualifications accurately may not predict going-concern status accurately.

Sixth, some of the going-concern prediction models are not tested and validated adequately. For example, Altman and McGough [1974] did not report Type II errors and McKee [1976] did not compare the accuracy rates of his model to those of auditors. Further, except for Dopuch, Holthausen, and Leftwich [1987], all the other five going-concern studies tested their models in a biased manner. Specifically, the characteristics of the validation samples are not representative of those of the respective populations. Consequently, the reported accuracy rates do not reflect the actual accuracy rates that can be expected when the models are used in real life.

6.1.3 A Proposed Going-Concern Prediction Model

In view of the problems identified above, the objective of the dissertation is to construct a going-concern prediction model that is based upon improved statistical techniques and methodology. In particular, the dissertation attempts to improve upon the previous going-concern models suggested in the literature by eliminating or mitigating the problems identified above. The proposed solutions to these problems are presented below.

First, to eliminate the problems associated with the application of discriminant analysis, it is appropriate to use some other statistical technique that requires less restrictive assumptions, generates accurate probabilities, and provides unique coefficients. Probit analysis satisfies these requirements.

Second, one way to ensure that the operational definition of a going concern is appropriate is to look at authoritative auditing guidelines. While SAS No. 34 does not define what is going concern is, the proposed SAS defines a going concern as an entity that is willing and able to sustain operation without entering into bankruptcy proceedings or a similar transfer of operating control through regulatory or judicial action.¹⁶¹ As such, it is appropriate to follow the lead taken by the proposed SAS and operationalize going concerns as non-bankrupt firms and non-going concerns as bankrupt firms.

Third, a solution to the choice-based sample bias problem is to use the weighted exogenous sample maximum likelihood (WESML) procedure. This procedure eliminates choice-based sample bias even when matched sample designs are used. Thus, by using the WESML procedure, the matched sample design can be used to control for industrial and size effects. At the same time, problems with choice-based sample bias can be eliminated.

Fourth, problems with the selection of independent variables can be avoided by selecting variables on the basis of a sound theoretical base. In the context of constructing going-concern prediction models, a sound theoretical base amounts to a sound theory of bankruptcy given that non-going concerns are operationalized as bankrupt firms. Such a theory provides justification for selecting independent variables and avoid the problems associated with the selection of independent variables through arbitrary and subjective means.

¹⁶¹ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 2.

Fifth, since it is problematic to use going-concern qualification prediction models to predict going-concern status, it is appropriate to construct a going-concern model that predicts going-concern status and not going-concern qualification.

Sixth, to evaluate the proposed going-concern prediction model adequately, it is necessary to report the Type I and Type II errors of the model on a validation sample that adjusts for the relative occurrence of going and non-going concerns in real life. Further, the accuracy rates of the proposed going-concern prediction model (i.e., the Koh model) should be compared to those of other going-concern models and to those of the auditors.

Accordingly, the dissertation attempts to incorporate all the above proposed solutions in the construction of the Koh model. The methodology used to construct and test the Koh model can be summarized as follows.

The sample that is used to construct and test the Koh model consists of going and non-going concerns operationalized as non-bankrupt and bankrupt companies, respectively. Each non-going concern is matched with a going concern on the basis of industrial classification code and total assets. For each company in the sample, the independent variables as specified by the proposed theory of bankruptcy are obtained.

To construct the Koh model, probit analysis is used to analyze the sample data. The WESML procedure is used to eliminate the choice-based sample bias and estimate the model parameters. To test the predictive power of the Koh model in discriminating between going and non-going concerns, the Lachenbruch U method is used to generate hold-out accuracy rates for the Koh model.¹⁶² Finally, the accuracy rates of the Koh

¹⁶² Peter A. Lachenbruch, "An Almost Unbiased Method of Obtaining Confidence Intervals for the Probability of Misclassification in Discriminant Analysis," *Biometrics* (December 1967), pp. 639-45.

model is compared to those of other going-concern prediction models and to those of the auditors.

6.1.4 Construction and Test of the Koh Model

A survey of the *Predicast's F & S Index of Corporate Changes* yields a total of 165 non-financial COMPUSTAT companies that filed for bankruptcy during the period 1980 to 1985. These companies comprise the sample of non-going concerns that is used to construct the Koh model. Each of these non-going concerns is matched with a non-bankrupt company to yield a sample of 165 going concerns. In total, the estimation sample consists of 330 companies.

For each of the 330 sample companies, the following six financial ratios are computed: (1) quick assets to current liabilities (QACL), (2) market value of equity to total assets (MVTA), (3) total liabilities to total assets (TLTA), (4) interest payments to earnings before interest and tax (IEBT), (5) net income to total assets (NITA), and (6) retained earnings to total assets (RETA). These financial ratios are selected on the basis of the proposed theory of bankruptcy and comprise the set of independent variables to be used in the construction of the Koh model.

Descriptive statistics of the sample data show that the sample data have characteristics that are consistent with the proposed theory of bankruptcy. Further, results of the Mann-Whitney U test show that all the six financial ratios for the going and non-going concerns in the sample are significantly different at a significance level of 0.0000 (to four decimal places). Thus, the selected independent variables have high discriminating power in distinguishing between going and non-going concerns.

Probit analysis yields the following going-concern prediction model:¹⁶³

$$Y_i = N(Z_i)$$

$$Z_i = 9.8967 + 0.7979 \times QACL + 0.5569 \times MVTA - 12.0050 \times TLTA \\ - 0.0054 \times IEBT + 0.8644 \times RETA + 16.6764 \times NITA$$

where Y_i = conditional probability of continuity for firm i

$N(.)$ = cumulative normal distribution function

Z_i = normal standard deviate for firm i

The above going-concern prediction model comprises the core of the Koh model.

The overall significance level of the Koh model is 0.0000 (to four decimal places), indicating a very good fit. The in-sample accuracy rates are 87.27% for non-going concerns, 100.00% for going concerns, and 99.92% overall.¹⁶⁴ This corresponds to the misclassification of 21 non-going concerns, 0 going concern, and 21 companies overall, respectively.

Results of the Lachenbruch U method indicate that the coefficients of the Koh model are rather stable. Using an optimal cut-off probability of 0.9405 (or an optimal cut-off normal standard deviate of 1.5886), the hold-out accuracy rates of the Koh model are 85.45% for non-going concerns, 100.00% for going concerns, and 99.91% overall. This corresponds to the misclassification of 24 non-going concerns, 0 going concern, and 24 companies overall, respectively. On the basis of these accuracy rates, the Koh model compares favorably with the going-concern prediction models constructed by

¹⁶³ Based on the rate of bankruptcy among COMPUSTAT companies during the period 1980 to 1985, a 0.6% chance of going-concern discontinuity is used in the WESML procedure to estimate the model parameters.

¹⁶⁴ All overall accuracy rates reported in the dissertation are computed on the basis of weights of 0.994 for going concern and 0.006 for non-going concerns. These weights represent the relative occurrence of going and non-going concerns expected in real life.

Altman and McGough [1974], McKee [1976], and Levitan and Knoblett [1985].¹⁶⁵ In particular, the best model (next to the Koh model) is that constructed by Altman and McGough [1974] with accuracy rates of 82.35% for non-going concerns, 96.97% for going concerns, and 96.88% overall.¹⁶⁶

The accuracy rates for the auditors in the sample are computed on the basis of their audit opinions. An audit opinion is considered "correct" if a going-concern qualification is given to a non-going concern (i.e., a bankrupt company) or if no going-concern qualification is given to a going concern (i.e., a non-bankrupt company). Out of the 165 going concerns in the sample, 162 (i.e., 98.18%) received unqualified audit opinions and 3 (i.e., 1.82%) received qualified audit opinions. However, none of these qualifications are related to going-concern continuity. Therefore, the auditors' accuracy rate for going concerns is 100.00% since none of the 165 going concerns received going-concern qualifications. For the non-going concerns, 5 companies have no audit opinions and these companies are omitted in the computation of the auditors' accuracy rates. Of the remaining 160 non-going concerns, 54 (i.e., 33.75%) received unqualified audit opinions, 87 (i.e., 54.37%) received audit opinions qualified on a going-concern basis, and 19 (i.e., 11.88%) received audit opinions qualified on a other bases. In other words, the auditor's accuracy rates for non-going concerns is only 54.37%. These results give an overall accuracy rate of 99.73% for the auditors.

With an overall accuracy rate of 99.73%, the auditors outperform the going-concern prediction models constructed by Altman and McGough [1974], McKee [1976],

¹⁶⁵ The going-concern models constructed by Mutchler [1985], Menon and Schwartz [1987], and Dopuch, Holthausen, and Leftwich [1987] predict going-concern qualification instead of going-concern status. As such, they are fundamentally different from the Koh model and hence, not comparable.

¹⁶⁶ Incidentally, the accuracy rates for Altman and McGough [1974] are upward biased because the accuracy rate for going concerns is based on the estimation sample and not the validation sample. Thus, the hold-out accuracy rates for Altman and McGough [1974] are actually lower than those reported in the dissertation.

and Levitan and Knoblett [1985], but not the Koh model. Although the overall accuracy rates of the Koh model and the auditors are close (99.91% vs 99.73%), the Koh model outperforms the auditors in predicting non-going concerns (85.45% vs 54.37%). Both the Koh model and the auditors have accuracy rates of 100.00% for going concerns. Thus, in view of these results, the Koh model can be an effective aid to auditors in making going-concern assessments.

As an extension, the effects of misclassification costs on the Koh model are also considered. When misclassification costs are considered explicitly, the optimal cut-off probability for the Koh model is no longer that probability that minimizes the misclassifications of non-going concerns, given that all going concerns are classified correctly.¹⁶⁷ Instead, the optimal cut-off probability is that probability that minimizes the expected misclassification costs of using the Koh model.

The results show that the Koh model is very insensitive to varying relative misclassification costs. It is only when the misclassification cost of a Type I error is more than 160 times than of a Type II error that a different optimal cut-off probability needs to be determined. In all other cases, the Koh model as presented in Chapter 4 applies. With its high predictive ability and stability, and its general applicability, the Koh model can be an effective prediction model, analytical tool, and defensive device to the auditor. However, the Koh model cannot and should not replace the professional judgment that is required in the course of an audit and in the opinion formulation process.

¹⁶⁷ Ignoring misclassification costs, such a procedure is appropriate in view of the very low probability of going-concern discontinuity.

6.2 DIRECTIONS FOR FUTURE RESEARCH

Before suggesting directions for future research, it is appropriate to review the major contributions and limitations of the dissertation. This is done in the paragraphs below.

6.2.1 Contributions and Limitations

The dissertation contributes to the existing going-concern literature in two ways. First, it presents the Koh model as an effective prediction model, analytical tool, and defensive device that auditors can use. Results indicate that the Koh model outperforms the auditors as well as all existing going-concern prediction models in making going-concern assessments. Thus, the Koh model can supplement existing external auditing guidelines on the assessment of going-concern status and enhance the auditor's ability to make going-concern assessments.

Second, the dissertation presents an improved methodology for constructing going-concern prediction models.¹⁶⁸ As can be seen from the previous section, in the process of reviewing previous going-concern prediction models, several problems are identified. These include problems with (1) the application of discriminant analysis, (2) the operational definitions of a going concern, (3) choice-based sample designs, (4) the selection of independent variables, (5) predicting going-concern qualification, and (6) model testing and validation. To overcome these problems, the following corresponding solutions are proposed: (1) the use of probit analysis for model construction, (2) the

¹⁶⁸ The methodology developed and employed in the dissertation can also be used to construct other types of prediction models, including bankruptcy prediction models, takeover/acquisition prediction models, and loan default prediction models.

reference to authoritative auditing guidelines for an appropriate operational definition of a going concern, (3) the use of the WESML procedure for parameters estimation, (4) the reliance on the proposed theory of bankruptcy for variables selection, (5) the prediction of going-concern status instead of going-concern qualification, and (6) the computation of Type I and Type II errors using the Lachenbruch U method and the comparison of the model's accuracy rates to those of other going-concern models and to those of auditors.

The proposed solutions enumerated above are considered and incorporated into the methodology used to construct the Koh model. This methodology is based on improved statistical techniques and contributes to the current state-of-the-art in constructing prediction models.

Despite the contributions discussed above, there are some limitations to the dissertation. First, the Koh model is constructed with and validated on COMPUSTAT companies only. Although the underlying characteristics of going and non-going concerns may be the same whether they are COMPUSTAT companies or not, the effectiveness of the Koh model has not been tested on non-COMPUSTAT companies. In the event that the Koh model is effective only for COMPUSTAT companies but not non-COMPUSTAT companies, another going-concern prediction model will be appropriate for non-COMPUSTAT companies.

Second, the independent variables in the Koh model are selected on the basis of the proposed theory of bankruptcy, which incorporates only six financial ratios. There are other factors that are suggested by SAS No. 34 and the proposed SAS that can affect the probability of going-concern continuity. Although these factors (such as the trends of key financial ratios, mitigating factors, and management plans) are not speci-

fied by the Koh model, they should be considered by the auditor when he is making going-concern assessments.¹⁶⁹

Third, as discussed in the previous chapter, the misclassification costs of Type I and Type II errors are largely unknown and cannot be measured to any satisfactory degree of accuracy. As such, the expected misclassification costs of using the Koh model can only be interpreted in relative terms but not absolute terms. In other words, the expected misclassification costs of using the Koh model can only be measured on an ordinal scale.¹⁷⁰

6.2.2 Future Directions

The limitations identified above provide possible directions for future research. For example, the first limitation highlights the possibility of constructing different going-concern prediction models for different subpopulations of companies. Clearly, if the Koh model is not effective for predicting the going-concern status of non-COMPUSTAT companies, another going-concern prediction model will be necessary. Such a model can be constructed using the methodology suggested in the dissertation. Further, different going-concern prediction models can also be constructed for different industries. It is possible that going and non-going concerns in different industries have different underlying characteristics. Consequently, different optimal cut-off probabilities and model coefficients may be necessary for assessing the going-concern status of companies in different industries. In other words, different going-concern pre-

¹⁶⁹ Besides microeconomic factors, macroeconomic factors such as interest rates and inflation rates can also affect going-concern continuity.

¹⁷⁰ Despite this limitation, the expected misclassification costs computed in Chapter 5 still provide guidance in determining the optimal cut-off probability for the Koh model.

diction models may be appropriate for different industries. However, it may be difficult to construct different going-concern prediction models for different subpopulations of companies because of limited sample data that are available for model construction and validation.

The second limitation highlights the importance of improving the proposed theory of bankruptcy by incorporating a more comprehensive list of factors that can affect going-concern continuity. Going-concern prediction models and bankruptcy prediction models in general can be improved by selecting independent variables on the basis of improved theories of bankruptcy. However, it may be difficult to improve upon the proposed theory of bankruptcy significantly because that will require an understanding of the bankruptcy phenomenon far beyond what is known today. Further, new ways must be found to capture qualitative information (such as management plans) in quantitative terms. Nevertheless, understanding the bankruptcy phenomenon and formulating improved theories of bankruptcy are issues that need to be addressed in future research.

The third limitation calls for future research into the misclassification costs of Type I and Type II errors. It will be useful to know the misclassification costs that are actually incurred by auditors in real life so that the expected consequences of using going-concern prediction models can be assessed. Also, if the misclassification costs of Type I and Type II errors can be determined, researchers can better select the optimal cut-off probabilities that minimize the expected misclassification costs of using the models. However, as pointed out earlier, it may be difficult to determine the misclassification costs of Type I and Type II errors because consequences such as the loss of reputation or goodwill and the loss of potential audit clients are intangible and difficult, if not impossible, to measure.

Finally, the usefulness of going-concern prediction models in general can be extended through future research. For example, recall that the Koh model is constructed with and validated on sample data only one year prior to the date of bankruptcy. Thus, the effectiveness of Koh model in predicting the going-concern status of companies one year into the future is evaluated adequately but the effectiveness of the Koh model in predicting the going-concern status of companies more than one year into the future is unknown. Incidentally, this is not a serious shortcoming given the guidelines contained in the proposed SAS. According to the proposed SAS, the auditor is required to obtain evidence that indicates the ability of the company to continue in existence only for a reasonable period of time, where a "reasonable period of time would usually be up to a year beyond the date of the financial statements."¹⁷¹ Thus, the auditor needs only to assess the going-concern continuity of his clients up to one year beyond the balance sheet dates.

Nevertheless, it may be useful to know how far in advance the Koh model in particular and going-concern models in general can predict the going-concern status of companies effectively. Such information is useful to management, investors, creditors, regulatory agencies, and others who are interested in the long-term financial condition of companies. In view of this, an immediate extension of the dissertation is to evaluate the effectiveness of the Koh model in predicting the going-concern status of companies more than one year prior to the date of bankruptcy. Further, different going-concern prediction models can be constructed with sample data from different base years by using the methodology employed in the dissertation. This approach may highlight the changing characteristics of non-going concerns as they approach bankruptcy and it may

¹⁷¹ American Institute of Certified Public Accountants, "The Auditor's Consideration of an Entity's Ability to Continue in Existence," Exposure Draft: Proposed Statement on Auditing Standards (New York: AICPA, February 14, 1987), paragraph 9.

also increase the understanding of the bankruptcy phenomenon. Further, it may lead to better predictions of going-concern continuity. Most important, this approach may extend the usefulness of going-concern prediction models in general to uses other than the assessment of going-concern status. For example, management and shareholders can use these models to evaluate the long-term financial position of their companies.

To summarize, directions for future research include: (1) the construction of going-concern prediction models for subpopulations of companies, (2) the formulation of improved theories of bankruptcy, (3) the determination of misclassification costs of Type I and Type II errors, and (4) the extension of going-concern prediction models to cover other situations and longer time periods.

From the above discussion, it can be concluded that although a substantial amount of research has been done in the area of going-concern prediction in the past, more awaits to be done in the future. The extensions and improvements suggested above provide some directions for future research.

To conclude, the primary objective of this dissertation is to construct a going-concern prediction model that is useful to auditors when making going-concern assessments. Given its predictive ability and stability, and general applicability, the Koh model presented in the dissertation should serve this purpose well. Further, the methodology developed and employed in the dissertation should contribute to the current state-of-the-art in constructing going-concern prediction models. In fact, it might also be useful in the construction of other prediction models such as takeover/acquisition prediction models and loan default prediction models.

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Appendix A

LISTS OF NON-GOING CONCERNS

	COMPANY NAME	BANKRUPTCY DATE
1.	ADVENT CORP	3/79
2.	AIR CHAPARRAL INC	12/82
3.	AIR FLORIDA SYSTEM INC	12/83
4.	AIRLIFT INTERNATIONAL INC	6/80
5.	ALLIED TECHNOLOGY INC	6/79
6.	ALTEC CORP	9/82
7.	AMAREX INC	4/81
8.	AMERICAN PACIFIC INTERNATIONAL INC	12/79
9.	AMERICAN RESERVE GROUP INC	9/79
10.	AMFESCO INDUSTRIES INC	6/85
11.	AMFOOD INDUSTRIES INC	9/85
12.	ANGLO ENERGY INC	9/83
13.	AUTO-TRAIN CORP	12/79
14.	BARCLAY INDUSTRIES	7/81
15.	BEEHIVE INTERNATIONAL	9/84
16.	BEKER INDUSTRIES	12/84
17.	BELLANCA AIRCRAFT CORP	9/79
18.	BENNETT PETROLEUM CORP	9/81
19.	BERRY INDUSTRIES CORP	12/83
20.	BERVEN CARPETS CORP	12/81
21.	BOBBIE BROOKS INC	4/80
22.	BRANCH INDS	12/83
23.	BRANIFF INTERNATIONAL CORP	12/81
24.	BRODY (B.) SEATING CO	8/79
25.	BUTTES GAS & OIL CO	12/84
26.	CHARTER CO	12/83
27.	CODI CORP	12/80
28.	COLUMBIA DATA PRODUCTS INC	12/83

29.	COMMODORE CORP	6/84
30.	COMMODORE RESOURCES CORP	3/82
31.	COMPUTER COMMUNICATIONS INC	6/80
32.	COMPUTER DEPOT INC	1/84
33.	COMPUTER DEVICES INC	12/82
34.	CONESCO INDUSTRIES LTD	12/84
35.	CONTINENTAL AIRLINES CORP	12/82
36.	CONTINENTAL STEEL CORP	12/84
37.	COOK UNITED INC	1/83
38.	COOPER-JARRETT INC	12/80
39.	CROMPTON CO INC	9/83
40.	CYCLOTRON CORP	12/82
41.	DAIG CORP	9/80
42.	DALCO PETROLEUM CORP	5/81
43.	DANT & RUSSELL INC	8/82
44.	DATATRON INC	6/84
45.	DENELCOR INC	12/84
46.	DESTRON INC	12/81
47.	DRECO ENERGY SERVICES LTD	8/81
48.	EMONS INDUSTRIES INC	6/83
49.	EMPIRE OIL & GAS CO	8/81
50.	ENERGY SOURCES INC	10/81
51.	ENTERPRISE TECHNOLOGIES INC	9/83
52.	EVANS PRODUCTS CO	12/84
53.	FSC CORP	12/80
54.	FAMILY ENTERTAINMENT CNTRS	12/83
55.	FLANIGAN'S ENTERPRISES INC	9/85
56.	GAMBLE-SKOGMO	1/83
57.	GAMEX INDUSTRIES INC	6/81
58.	GENERAL AIRCRAFT CORP	12/82
59.	GENERAL HOBBIES	12/81
60.	GENERAL TERMINAL CORP	6/82
61.	GEOPHYSICAL SYSTEMS CORP	12/82
62.	GILMAN SERVICES INC	12/80
63.	GOOD (L.S.) CO	1/79
64.	GULF ENERGY CORP	4/82
65.	HRT INDUSTRIES INC	1/81
66.	HILLER AVIATION INC	8/83
67.	HORN & HARDART BAKING CO	9/80
68.	INFORMATION DISPLAYS INC	12/83
69.	INVESCO INTERNATIONAL CORP	12/81
70.	KDT INDUSTRIES INC	1/81
71.	K-TEL INTERNATIONAL	6/84
72.	KELLY JOHNSTON ENTERPRISES	3/84
73.	KENILWORTH SYSTEMS CORP	12/81
74.	KOSS CORP	6/84
75.	LAFAYETTE RADIO ELECTRONIC CORP	6/79
76.	LAZARE KAPLAN INTERNATIONAL	5/82
77.	LIONEL CORP	12/81
78.	LOVELADY (IKE) INC	10/84
79.	LYNNWEAR CORP	11/79

80.	MGF OIL CORP	12/83
81.	MAGIC CIRCLE ENERGY CORP	12/84
82.	MAGNUSON COMPUTER SYSTEM INC	12/81
83.	MARION CORP	1/82
84.	MAXON INDUSTRIES INC	5/80
85.	MAYS (J.W.) INC	7/81
86.	MCLOUTH STEEL CORP	12/80
87.	MED-PAK CORP	5/79
88.	MEGO INTERNATIONAL	2/80
89.	MESTA MACHINE CO	12/81
90.	MID-AMERICAN LINES INC	12/81
91.	MILLER SHOE INDUSTRIES INC	1/83
92.	NATIONAL BUSINESS COMMUNICATION	2/84
93.	NATIONAL PARAGON CORP	3/84
94.	NATIONAL SHOES INC	1/79
95.	NISUS VIDEO INC	6/85
96.	NORTH AMERICAN CAR CORP	12/83
97.	NUCLEAR SYSTEMS INC	7/82
98.	NUCORP ENERGY INC	12/81
99.	OCEAN AIRWAYS	5/79
100.	OILTECH INC	11/82
101.	OMNI EXPLORATION INC	9/82
102.	OPELIKA MFG CORP	9/84
103.	PACIFIC EXPRESS HOLDING INC	12/82
104.	PAIUTE OIL & MINING CORP	12/83
105.	PARTNERS OIL CO	12/81
106.	PATHCOM INC	12/80
107.	PENINSULA RESOURCES CORP	12/82
108.	PEOPLES RESTAURANTS INC	6/84
109.	PHOENIX STEEL CORP	12/82
110.	PIZZA ENTERTAINMENT CENTERS	9/83
111.	PIZZA TIME THEATRE INC	12/83
112.	PLASTILINE INC	6/82
113.	POLORON PRODUCTS INC	11/79
114.	PROVINCETOWN-BOSTON AIRLINES INC	12/84
115.	PUBCO CORP	12/81
116.	PYRO-MAGNETICS CORP	12/81
117.	RPS PRODUCTS INC	6/81
118.	RANDAL DATA SYSTEMS INC	10/79
119.	RATH PACKING CO	9/83
120.	READING INDUSTRIES	12/80
121.	ROBERTS & PORTER INC	12/82
122.	ROBINS (A.H.) CO	12/84
123.	ROBINTECH INC	6/82
124.	ROBLIN INDUSTRIES	12/84
125.	RODAC CORP	6/81
126.	RONCO TELEPRODUCTS INC	6/83
127.	SPW CORP	10/84
128.	SALANT CORP	11/84
129.	SAMBO'S RESTAURANTS	12/80
130.	SATELCO INC	12/84

131.	SAXON INDUSTRIES	12/80
132.	SCHAAK ELECTRONICS INC	5/83
133.	SEATRAN LINES	6/80
134.	SENECA OIL CO	12/83
135.	SOLID STATE TECHNOLOGY	6/81
136.	SOLOMON (SAM) INC	1/79
137.	SOUTHERN BIOTECH INC	3/81
138.	SPIRAL METAL INC	3/81
139.	STANDARD METALS	12/83
140.	STEELMET INC	11/82
141.	STEVCOKNIT INC	1/80
142.	STORAGE TECHNOLOGY CORP	12/83
143.	SYKES DATATRONICS INC	2/84
144.	TACOMA BOATBUILDING INC	12/84
145.	TEXAS GENERAL RESOURCES INC	12/82
146.	TEXSCAN CORP	4/84
147.	THRESHOLD TECHNOLOGY	6/82
148.	TIDWELL INDUSTRIES	12/84
149.	TOBIN PACKING CO INC	10/80
150.	TOWNER PETROLEUM CO	12/83
151.	TRANSCONTINENTAL ENERGY CORP	12/83
152.	UNR INDUSTRIES INC	12/81
153.	UNIMET CORP	12/83
154.	UNITED GROCERS INC	9/80
155.	VECTOR GRAPHIC INC	6/85
156.	VICTOR TECHNOLOGIES INC	12/82
157.	VIDEO-TO-GO INC	11/81
158.	WATERMAN MARINE CORP	12/82
159.	WHEELING-PITTSBURGH STEEL	12/84
160.	WICKES COS INC	1/81
161.	WILSON FOODS CORP	7/82
162.	WILSON FREIGHT CO	12/79
163.	WRIGHT AIR LINES INC	12/83
164.	XRG INTERNATIONAL INC	4/82
165.	XENEREX CORP	12/84

Appendix B

LISTS OF MATCHED GOING CONCERNS

COMPANY NAME

1. AUDIOTRONICS CORP
2. COMAIR INC
3. ALASKA AIRGROUP INC
4. AIR WISCONSIN INC
5. ELECTROSPACE SYSTEMS INC
6. WELLS-GARDNER ELECTRONICS
7. TRICENTROL PLACE
8. CALLON PETROLEUM CO
9. WESSEX CORP
10. HYDE ATHLETIC IND INC
11. ELMERS RESTAURANTS INC
12. ATWOOD OCEANICS
13. CAPITAL PROPERTIES INC
14. WOLF (HOWARD B) INC
15. DELTA DATA SYSTEMS CORP
16. MISSISSIPPI CHEMICAL CORP
17. OEA INC
18. UNIVERSAL FUELS CO
19. SEIS PROS INC
20. NANTUCKET IND INC
21. GARAN INC
22. ARNOLD IND
23. USAIR GROUP
24. TRIANGLE HOME PRODUCTS INC
25. SABINE CORP
26. NATIONAL INTERGROUP INC
27. RIPLEY CO INC
28. STRATUS COMPUTER INC
29. LIBERTY HOMES

30. BRODIE EXPLORATION CORP
31. MICOM SYSTEMS INC
32. COMPUTONE SYSTEMS INC
33. ZENTEC CORP
34. P & F INDUSTRIES INC
35. KML ROYAL DUTCH AIRLINES
36. PROLER INTERNATIONAL CORP
37. PIC'N SAVE CORP
38. LYNDEN INC
39. DIXIE YARNS INC
30. LASERMETRICS INC
41. STAODYNAMICS INC
42. GETTY PETROLEUM CORP
43. FRANTZ MANUFACTURING CO
44. SPEED-O-PRINT BUSINESS MACHINES
45. ENCORE COMPUTER CORP
46. A L D INC
47. WEATHERFORD INTERNATIONAL
48. AIRBORNE FREIGHT CORP
49. SOUTH TEXAS DRILLING & EXPLORATION
50. BARUCH-FOSTER CORP
51. IPM TECHNOLOGY INC
52. LOWE'S COS
53. PACIFIC RESOURCES INC
54. FUDDRUCKERS INC
55. THREE D DEPARTMENTS INC
56. STOP & SHOP COS
57. SONIC DEVELOPMENT CORP
58. GENERAL METALCRAFT INC
59. BSN CORP
60. LANE TELECOMMUNICATIONS INC
61. DAWSON GEOPHYSICAL CO
62. DURR-FILLAUER MEDICAL
63. CROWLEY MILNER & CO
64. ENERGY RESERVE INC
65. ROSE'S STORES INC
66. KREISLER MANUFACTURING CORP
67. JERRY'S INC
68. DICOMED CORP
69. GENERAL EXPLORATION
70. AMES DEPARTMENT STORES INC
71. VESTRON INC
72. JB'S RESTAURANTS INC
73. ROBINSON HALPERN CO
74. MARANTZ INC
75. TANDYCRAFTS INC
76. DESIGNCRAFT IND
77. GENERAL HOST CORP
78. GEORESOURCES INC
79. RAVEN IND INC
80. ENSOURCE INC

81. CHAPMAN ENERGY INC
82. ELECTRONIC ASSOCIATES INC
83. NUMAC OIL & GAS LTD
84. TRANSACT INTERNATIONAL INC
85. FAMILY DOLLAR STORES
86. CYCLOPS CORP
87. ENVIRONMENTAL TECTONICS CORP
88. HASBRO INC
89. MONARCH MACHINE TOOL CO
90. FALLS CITY INDUSTRIES INC
91. GREEN (DANIEL) CO
92. DECOR CORP
93. TRANS-INDUSTRIES INC
94. EVANS INC
95. EXTEK MICROSYSTEMS INC
96. COLT INDUSTRIES INC
97. CIRCON CORP
98. SANTA FE NATURAL RESOURCES
99. PASSPORT TRAVEL INC
100. Z & Z FASHIONS INC
101. KIMBARK OIL & GAS CO
102. CONCORD FABRICS INC
103. ROYALE AIRLINES INC
104. CREDO PETROLEUM CORP
105. BEARD CO
106. SCIENTIFIC RADIO SYSTEMS INC
107. BONRAY DRILLING CORP
108. MCFADDIN VENTURES INC
109. VALLEY INDUSTRIES
110. FAST FOOD OPERATORS INC
111. BOB EVANS FARMS
112. THETFORD CORP
113. MODULINE INTERNATIONAL INC
114. SIMMONS AIRLINES INC
115. VERNON CO
116. DEXON INC
117. S & M CO
118. C3 INC
119. CAGLE'S INC
120. ARMADA CORP
121. CRAIG CORP
122. NOVO INDUSTRIES A/S
123. PANTASOTE INC
124. FRIEDMAN INDUSTRIES
125. BOSTON DIGITAL CORP
126. VALLEN CORP
127. APOGEE ENTERPRISES INC
128. CINTAS CORP
129. VALHI INC
130. CONESTOGA TELEPHONE & TELEG
131. JAMES RIVER CORP OF VIRGINIA

132. WHEREHOUSE ENTERTAINMENT INC
133. GOTAAS-LARSEN SHIPPING CORP
134. LACANA MINING CORP
135. CSP INC
136. OSHMAN'S SPORTING GOODS
137. NMS PHARMACEUTICALS INC
138. ACS INDUSTRIES INC
139. CENTURY GEOPHYSICAL CORP
140. CONSOLIDATED FIBRES INC
141. ADAMS MILLIS
142. WANG LABORATORIES
143. AST RESEARCH INC
144. TODD SHIPYARDS CORP
145. MAYNARD OIL CO
146. REGENCY ELECTRONICS INC
147. AMPOWER TECHNOLOGIES INC
148. OAKWOOD HOMES
149. SUNSTAR FOODS INC
150. MCO RESOURCES INC
151. UNIT CORP
152. KEYSTONE CONS INDUSTRIES INC
153. JLG INDUSTRIES INC
154. PRO-FAC COOPERATIVE INC
155. SULCUS COMPUTER CORP
156. SCI SYSTEMS INC
157. BISHOP GRAPHICS INC
158. MIDLAND ENTERPRISES INC
159. TUBOS DE ACERO DE MEXICO
160. PAYLESS CASHWAYS INC
161. FEDERAL CO
162. CAROLINA FREIGHT CORP
163. COMMAND AIRWAYS INC
164. FLAMEMASTER CORP
165. ROYAL GOLD CORP

Appendix C

PROBIT ANALYSIS

Probit analysis assumes that there is an underlying theoretical index Z defined by the following regression relationship:

$$Z_i = X_i'\beta + \varepsilon_i \quad [1]$$

where Z_i = theoretical index for observation i
 X_i = independent variables for observation i
 β = unknown model parameters
 ε_i = error term for observation i

In real life, Z is not observable. Instead, what is observed is a dummy variable Y defined as follows:

$$\begin{aligned} Y &= 1 && \text{if } Z_i > 0 \\ Y &= 0 && \text{otherwise} \end{aligned} \quad [2]$$

From equations [1] and [2], it is clear that:

$$\begin{aligned} \text{Prob}(Y_i = 1) &= \text{Prob}(\varepsilon_i > -X_i\beta) \\ &= 1 - F(-X_i\beta) \end{aligned} \quad [3]$$

where F = cumulative distribution function for ϵ

As can be seen from the above, the observed values of Y are merely realizations of a binomial process with probabilities defined by equation [3]. These observed values of Y vary from trial to trial depending on X_i . Hence, the likelihood function (LF) of observing Y_i 's can be expressed as follows:

$$LF = \prod_{Y_i=0} F(-X'_i\beta) \prod_{Y_i=1} [1 - F(-X'_i\beta)] \quad [4]$$

The functional form of F in equation [4] depends on the cumulative distribution of ϵ in equation [1]. Probit analysis assumes that ϵ_i is normally distributed with mean 0 and variance σ^2 . That is,

$$F(-X'_i\beta) = \int_{-\infty}^{-X'_i\beta/\sigma} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{t^2}{2}\right) dt \quad [5]$$

From equations [4] and [5], it can be seen that β and σ can only be estimated jointly as $\left(\frac{\beta}{\sigma}\right)$, but not as β and σ separately. Consequently, for simplicity, it can be assumed that $\sigma = 1$. Substituting equation [5] into equation [4], the likelihood function becomes:

$$LF = \prod_{i=1}^n [N(X'_i\beta)]^{Y_i} [1 - N(X'_i\beta)]^{1 - Y_i} \quad [6]$$

where $N(\cdot)$ = cumulative normal probability function

Thus, the log-likelihood function (L) of observing Y_i 's can be expressed as follows:

$$L = \Sigma(Y) \ln[N(X'_i\beta)] + \Sigma(1 - Y) \ln[1 - N(X'_i\beta)] \quad [7]$$

The unknown parameters for the probit model can be estimated by maximizing L above. More details about probit analysis can be found in Maddala [1983].¹⁷²

¹⁷² G. S. Maddala, *Limited-Dependent and Qualitative Variables in Econometrics* (Cambridge: Cambridge University Press, 1983).

Appendix D

GOING-CONCERN MODELS

I. MODELS THAT PREDICT GOING-CONCERN STATUS

1. Altman and McGough [1974]

Statistical Technique:

Stepwise multiple discriminant analysis.

Estimation Sample:

33 manufacturing firms that filed for bankruptcy during the period 1946 to 1965 and 33 matched non-bankrupt manufacturing firms.

Final Variables:

(1) working capital to total assets, (2) retained earnings to total assets, (3) earnings before interest and tax to total assets, (4) market value of equity to book value of total debts, and (5) sales to total assets.

Validation Sample:

34 firms that filed for bankruptcy during the period 1970 to 1973.

Accuracy Rates:

Overall accuracy rates of 82.35% one year prior to bankruptcy and 57.58% two years prior to bankruptcy.

2. McKee [1976]

Statistical Technique:

Stepwise multiple discriminant analysis.

Estimation Sample:

35 companies judged to be going concerns during the period 1970 to 1973 and 35 matched companies judged to be non-going concerns.

Final Variables:

(1) quick assets to current liabilities, (2) working capital to owners' equity, (3) long-term liabilities to working capital, (4) total liabilities to total assets, (5) net sales to total assets, (6) net income before tax plus depreciation, depletion, and amortization to total liabilities, and (7) company current assets to current liabilities to industry current assets to current liabilities.

Validation Sample:

15 companies judged to be going concerns during the period 1970 to 1973 and 15 matched companies judged to be non-going concerns.

Accuracy Rates:

93.33% for going concerns and 80.00% for non-going concerns, giving an equally-weighted overall accuracy rate of 86.67%.

3. Levitan and Knoblett [1985]

Statistical Technique:

Stepwise multiple discriminant analysis.

Estimation Sample:

35 companies that filed for bankruptcy during the period 1980 to 1981 and 35 matched non-bankrupt companies.

Final Variables:

(1) trend variable for operating income to shareholders' equity, (2) net income to shareholders' equity, (3) dummy variable for current assets to current liabilities, (4) net worth to total debt, (5) dummy variable for cash flow, (6) quick assets to total assets, (7) trend variable for current assets to current liabilities, (8) dummy variable for net income, (9) current assets to total assets, and (10) current assets to current liabilities.

Validation Sample:

Same as the estimation sample—a split-half methodology is used.

Accuracy Rates:

Overall accuracy rates of 88.50% one year prior to bankruptcy and 67.00% two years prior to bankruptcy.

II. MODELS THAT PREDICT GOING-CONCERN QUALIFICATION

1. Mutchler [1985]

Statistical Technique:

Multiple discriminant analysis.

Estimation Sample:

119 manufacturing companies that received going-concern qualifications and 119 manufacturing companies that exhibited potential going-concern difficulties but did not receive going-concern qualifications during the period 1981 to 1982.

Final Variables:

(1) cash flow to total liabilities, (2) current assets to current liabilities, (3) net worth to total liabilities, (4) total long-term liabilities to total assets, (5) total liabilities to total assets (6) net income before tax to net sales, and (7) dummy variable for the previous year's audit opinion.

Validation Sample:

Same as the estimation sample—a split-half methodology is used.

Accuracy Rates:

71.00% for going-concern qualifications and 94.10% for non-qualifications, giving an overall accuracy rate of 89.90%.

2. Menon and Schwartz [1987]

Statistical Technique:

Logit analysis.

Estimation Sample:

89 companies that filed for bankruptcy during the period 1974 to 1980, 37 of which received going-concern qualifications.

Final Variables:

(1) current assets to current liabilities, (2) changes in current assets to current liabilities over the year, (3) retained earnings to total assets, (4) debt to total assets, (5) income to total assets, (6) dummy variable for recurring operating losses, and (7) cash flow from operations to total liabilities.

Validation Sample:

39 companies that filed for bankruptcy during the period 1981 to 1983 and 46 non-bankrupt companies that reported net loss and retained earnings deficit in 1981.

Accuracy Rates:

(1) Bankrupt companies: 71.43% and 84.00% for predicting going-concern qualifications and non-qualifications, respectively, giving an overall accuracy rate of 79.49%.

(2) Non-bankrupt companies: 100.00% and 71.43% for predicting going-concern qualifications and non-qualifications, respectively, giving an overall accuracy rate of 78.26%.

3. Dopuch, Holthausen, and Leftwich [1987]

Statistical Technique:

Probit analysis with weighted procedures.

Estimation Sample:

27 firms with going-concern qualifications and 346 firms with clean audit opinions during the period 1969 to 1976.

Final Variables:

(1) changes in total liabilities to total assets over the year, (2) change in receivables to total assets over the year, (3) changes in inventory to total assets over the year, (4) total assets, (5) dummy variable for the availability of income to

shareholders, (6) dummy variable for the period of listing in the stock exchange, (7) change in beta over the year, (8) change in the residual standard deviation from the market model regression over the year, and (9) difference between common stock returns and the equally weighted industry index.

Validation Sample:

12 firms with going-concern qualifications and 95 firms with clean audit opinions during the period 1977 to 1980.

Accuracy Rates:

33.30% for going-concern qualifications, 99.90% for non-qualifications, giving an overall accuracy rate of 92.43%.

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