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EVIDENTIAL EFFORT AND RISK

by

Tim Kizirian

A Dissertation Submitted to the Faculty of the

COMMITTEE ON BUSINESS ADMINISTRATION

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY
WITH A MAJOR IN MANAGEMENT

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entitled Evidential Effort and Risk

and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy (Management)

Dr. William Felix	William Felix	Date 5/19/01
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Dr. Jeff Schatzberg	Jeff Schatzberg	Date 5/20/01
		Date

Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

William Felix — Dissertation Director — 5/19/01 — Date

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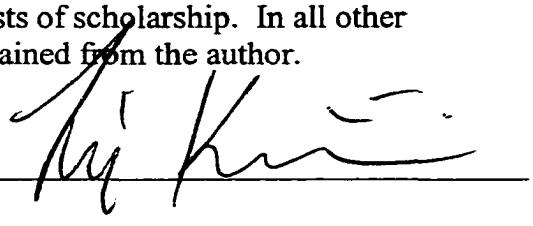
SIGNED: 

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DEDICATION

"What will it profit a man if he gains the whole world and looses his own soul?"
– Jesus Christ

To Jesus, the Author of Life.

To my mother and father, James and Lucine, who have always provided me with love and encouragement.

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ABSTRACT

There is widespread recognition in the accounting literature that properly directed audit effort is critical to an effective and efficient engagement. Auditors assess the risks of managerial misstatements and use these risks to plan audit procedures. Prior studies examining the linkage between assessed risk and audit effort report weak and conflicting results. The unobservable nature of the audit process necessitates the use of proxies to capture assessed risks and audit effort. This study utilizes proprietary audit workpaper data to obtain better measurement of assessed risks and effort. These improved measurements provide stronger evidence on whether changes in assessed risks will affect the nature, timing, and extent of audit testing. This linkage is examined first using OLS and then an instrumental variables approach to address potential simultaneity in determining the nature, timing, and extent of substantive effort. In contrast to prior research, results suggest that auditors vary the nature, timing, and extent of substantive effort in response to assessed auditee risks.

CHAPTER 1. INTRODUCTION AND OVERVIEW

This study investigates whether auditors change planned audit effort in the face of different levels of assessed auditee risk.[1] While authoritative guidance concerning the audit risk model (ARM) (SAS No. 47, 1983) requires auditors to consider auditee risks in audit testing, the existing literature has found weak or conflicting results about the link between auditee risk and planned audit effort. Authoritative bodies who have questioned the strength of this link can benefit from knowing the extent to which evidential plans are risk-adjusted.

This paper provides a descriptive analysis of evidential planning (EP). I provide evidence to improve researchers' knowledge of existing EP issues, and insights for theory and theory building. The EP literature demonstrates that auditors intend to rely on the auditing profession's guidance in developing and implementing evidential plans, but do so only moderately (e.g., Bedard 1989). Additionally, the fundamental expectation of an economically significant relationship between assessed risk and audit investment has not been established in the archival EP literature (e.g., Mock and Wright 1993, 1999). I extend prior research by using improved measurement methods and a stronger test of this relationship. I attempt to improve the EP process and direct future EP research by synthesizing theories proposed in the current literature and using relevant evidence to evaluate those theories.

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[1] Planning audit effort entails determining which accounts to focus on, as well as determining the nature, timing, and extent of evidence-gathering procedures.

Auditors face several challenges in planning audit effort, including the appropriate measurement of various auditee risk factors to produce control and inherent risk assessments that are conventionally characterized as "high," "medium," and "low." The ARM does not precisely direct the auditor in the organization and application of auditor risk knowledge, which is, often times, indistinct. Auditors look to the ARM and audit firm guidance in developing and implementing evidential planning guidance. Theorists describe the audit process as a sequential iterative process of learning. A systematic planning process is usually followed, but there is no detailed prescription in the ARM (Felix and Kinney 1982). It is essentially an audit-planning metaphor for a risk-focused approach to EP that assists auditors in the implementation of the opinion formulation process, and there is great variation in its use in practice. The elements and structure of the ARM may not reflect the knowledge base that auditors consider in making EP decisions, and it may not fully represent the auditor's reasoning and judgment. The potentially incomplete reflection of the auditor's knowledge naturally raises questions about the practicality of the ARM for both theory and practice. The ARM provides broad EP guidance and does not uniformly apply to all audit settings (e.g., auditees with different risk profiles) (Bloomfield 1995).

Evidential plans respond to broad information sets (e.g., SAS No's. 53-61) that we have yet to identify and understand. Davidson and Gist (1996) suggest that the requirement of only a surface level understanding of business processes

and related risks prevents the consistent application of the ARM. My research methods focus on certain categories of auditor effort (the nature, timing, and extent of audit testing) and risk factors that may affect that effort. Risk assessments documented in auditor workpapers are unlikely to completely reflect the auditor's estimation of the potential risk of material misstatements (Bedard et al. 2000). Bedard et al. (2000) posit that the major factors affecting EP decisions include materiality assessments, planning phase analytical procedures, and risk assessments. Additional factors include auditor training, knowledge, judgment heuristics and biases. Bedard et al. (2000) also suggest that the aggregation of the nature, timing, and extent of audit tests does not comprise an all-inclusive measure of the auditor's evidence-gathering effort. For example, effort expended on the financial statement audit may potentially be reduced due to supplementary audit evidence that is collected from consulting work such as information systems implementation, consulting, or auditing. My investigation of the critical link between risk assessments and the nature, timing, and extent of audit testing considers only a portion of the factors influencing EP decisions. Thus, my research is a first-step in the advancement of our understanding of the EP process.

Measurement problems, such as poor proxies and inaccessible data, are pervasive throughout the EP research literature and hinder prior efforts to understand and improve the EP process (Bedard et al. 2000). With such data limitations and measurement issues, it is no surprise that the current literature is partial and conflicting about whether audit effort is risk-adjusted. In addition to

uncertainties involving the identification and measurement of the appropriate auditee risks, and the associated effort, proxies for risks and effort have been based on crude and indirect surrogates. Auditors select from a menu of substantive tests – e.g., by varying the nature, timing, and extent of evidential plans - that vary in perceived audit effectiveness and efficiency. While auditors may respond to changes in auditee risks, data limitations often preclude researchers from taking into account the entire option set of effort available to auditors, and thus, from learning whether evidential plans are risk-adjusted. My data is derived directly from audit workpapers provided by a Big Five CPA firm with a hightech and biotech client base. The workpapers identify audit risk assessments as well as the related evidence-gathering procedures. My use of auditor workpaper data allows for improved measures of assessed risk and audit effort, which are appropriately disaggregated and, if documented risks fully reflect auditor knowledge, are not subject to the measurement biases pervasive in the current literature. I use extracted risk assessment and auditor effort data to examine the assessed risk-effort relation, as well as the potential for interactions between the nature, timing, and extent of testing, which is promoted by authoritative guidance.

My examination of the EP reaction to assessed risks, in a unique audit setting, provides evidence about where the professional guidance should possibly be more prescriptive. My research findings on the natural and inherent limits of the ARM, or other EP factors used by auditors, will be useful to both researchers

and practitioners. Since most of the key struggles of poor proxies and data limitations found in the literature are strongly dependent on the risk-effort relationship, I report and analyze the correlation between risk and effort.

Based upon the assumption that risk assessments fairly reflect auditors' beliefs of where potential material financial statement misstatements are more likely to occur, I hypothesize that auditors increase the nature, timing, and extent of audit testing as a response to higher risks. Thus, I empirically test the degree to which the nature, timing, and extent of audit examination are adapted to assessed auditee risks. My main results are based on regressions of various measures of effort on assessed auditee risk. Results of statistical tests support the hypothesis of a positive association between assessed risk and audit effort. These results confirm the current belief of oversight committees that, while the ARM does need updating, it is being used in practice (e.g., P.O.B. Oversight Report, Chapter 2, Section 2.14).

The remainder of this paper proceeds as follows. Chapter two summarizes the relevant issues in the current evidential planning literature as well as data limitations and issues in the choice and measurement of variables. Chapter three develops the hypothesis. Chapter four describes the proprietary data, variable measurement, and research methods. Chapters five and six present the results, discussion, and conclusions.

CHAPTER 2. PRIOR RESEARCH

This chapter reviews the empirical research in evidential planning and highlights the contribution of this study to the literature.

2.1 Lack of a widely accepted evidential planning theory

The ARM is included in Generally Accepted Auditing Standards (GAAS) as a normative model to assist auditors in the judgment processes of assessing risks and selecting an audit approach (e.g., the reliance approach). Auditors use these assessed risks to determine the mix of substantive procedures to be carried out in an audit. It is a key EP tool routinely used in the opinion formulation process (see Appendix A). While the ARM is widely accepted and utilized by practitioners, oversight boards and researchers have presented evidence suggesting it is inconsistently implemented and, at a minimum, in need of refinement (Houston et al. 1999). Critics of the ARM suggest the model in its present form is weak due to its inherent exclusion of key issues (e.g., engagement and fraud risk issues are not clearly separable from the defined constructs of inherent and control risk).[2] Furthermore, it has not been empirically demonstrated that the ARM is used as the sole basis of risk evaluation.

The auditor should be able to defend the EP decisions made in the opinion formulation process. Normative models assist in this defense and provide a basis

[2] However, SAS No. 82 does amend SAS No. 47 and reaffirm the consideration of fraud in EP.

for evidential plans.[3] Documented evidential procedures justify EP decisions by way of demonstrating that the engagement was planned for, that specific evidence was necessary to carry out a GAAS audit, and that the needed evidence was obtained (Waller and Felix 1984).

SAS No. 47 states:

> In addition to audit risk, the auditor is also exposed to loss or injury to his or her professional practice from litigation, adverse publicity, or other events arising in connection with financial statements audited and reported on.

This exposure, conventionally termed "engagement risk" or "auditor business risk," is not delineated in the construct of the ARM, which specifies, in contrast, audit risk as the risk the firm may fail to modify its opinion on materially misstated financial statements. The auditor bears engagement risk regardless of whether he has complied with professional standards and performed the audit in accordance with GAAS. Engagement risk is customarily assessed as part of the audit firm's client acceptance and continuance procedures. Not only must an auditor evaluate risks related to potential clients, he must also consider how those risks might potentially affect the audit firm. Whether auditors are influenced by engagement risk in audit stages that follow the client acceptance process, or

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[3] Auditors use normative models to plan procedures to assist in the detection of material misstatements in historical financial statements. These normative models may serve two related purposes in the study of judgment and decision-making in EP (Felix et al. 2001). One purpose is to use normative models to compare and contrast the procedural rationality of auditors' standard practices. A second use of normative models is to provide a source of rationality criteria that auditors can and should achieve. This second use allows auditors to streamline procedures set out in professional standards and thus, lessen cognitive effort. A supplemental use of such normative models is the justification of planning decisions by establishing that a logical process was followed.

whether they consider this risk in designing evidential plans, has not been considered in the literature and remains an open empirical question (Asare et al. 1994, Johnstone 2000).[4]

Although the ARM is the framework underlying most EP research, the ARM is solely an audit-planning metaphor for a risk-focused audit approach, and provides little specific or prescriptive guidance (Bell and Wright 1995).[5] The ARM is broad evidential planning guidance requiring the auditor to assess the probability of errors and use this assessment to obtain the level of evidence required to reduce audit risk to an acceptable level. Little empirical evidence exists about evidential planning practices (Houston et al. 1999; Morton and Felix 1992, 1994; Felix and Niles 1988; Kinney 1989). Although the ARM is a key EP tool that assists auditors in the implementation of the opinion formulation process, it has been criticized both in theory and in practice (Srivastava and Shafer 1992; Akresh et al. 1988; Kinney 1983). Several papers have attempted to build foundational EP models (Mock et al. 1998; Caster and Pinkus 1996; Gillett 1993; Srivastava and Shafer 1992; Bedard et al. 1991). These proposed theories carry with them several advantages over the ARM. Some of these models would require auditors to explicitly document judgments that are only implicitly made using the ARM. Other models improve the consistency of application for similar situations; in theory, these models have the potential to obtain widespread

[4] Data on engagement risk is likely available. Many audit firms have adopted mechanisms for carefully monitoring and documenting the client acceptance process (Johnstone and Bedard 2000).

acceptance. Nevertheless, audit practitioners and academic researchers have not implemented or embraced any of these proposed theories. Both theory and practice could greatly benefit from the continued exploration of alternative risk-focused planning models.

The ambiguity of the ARM may explain audit firms' tendencies to set rigid risk assessment guidelines (Bedard et al. 2000). Perhaps these guidelines attempt to achieve a level of consistency across audits that the ARM does not explicitly provide (Houston et al. 1999). If the ARM is not descriptive of the auditor's planning behavior, and if the current auditing practice is not deficient, then standard setters should search for an alternative theoretical risk assessment - evidential planning metaphor. While it is possible that auditors use the ARM, it may not be evident because their risk assessments may not be reflective of their beliefs (i.e., auditors are not proficient assessors of risks).

This theoretical ambiguity raises the question of whether the Auditing Standards Board should provide detailed prescriptions commensurate with levels of assessed risk for given accounts and assertions. This concept is considered extensively in the Public Oversight Board's Panel on Audit Effectiveness.[6] The Panel's Report acknowledges that the Auditing Standards Board may potentially

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[5] Mautz and Sharaf, in their 1961 monograph, *The Philosophy of Auditing*, developed the notion that the audit can be carried out using the scientific method (the risk-focused approach).

[6] At the request of the Securities Exchange Commission, the Public Oversight Board's Panel on Audit Effectiveness published a report and recommendations to the Auditing Standard's Board. See the Public Oversight Board's Report on Audit Effectiveness (2000). The Panel's evaluation of the audit risk model essentially supports its continuation, as enhanced and updated by the Panel's recommendations.

alter or refine the ARM to promote audit effectiveness and meet the needs of the changing auditing environment. The Auditing Standards Board is not constrained to the current audit risk model if it is incapable of being adapted to meet current auditor and auditee business conditions and risks. For example, considerable changes in technology and competition have motivated the reengineering of audit approaches. Big Five firms now promote "working smarter," and are greatly increasing their understanding of the client in the early stages of the audit to consider additional risk factors, such as the condition of the client's industry.

Although the Panel is generally satisfied with the legitimacy of the ARM, the Panel recommends that the Auditing Standards Board enhance auditing guidance and quality control standards to allow more consistent, specific, and definitive decision making – particularly with respect to the use of the ARM.[7] In addition to recommendations that standard setters better specify procedures, the Panel's Report advocates that audit firms carefully review and enhance methodologies, guidance, and training with respect to linkage decisions between risk assessments and evidential effort.

Critics of the ARM assert the model is inherently limited because its design is constrained to accommodate engagements that involve audits of historical financial statements (King and Schwartz 1998). These critics claim this financial statement audit focus impedes a more expanded concept of assurance services (Elliot 1994; Havelka et al. 1998; Blackwell et al. 1998; King and

Schwartz 1998). A more expanded concept of assurance would incorporate the supply of assurance regarding a variety of information and assertions, and would do so on a continuous basis (Elliot 1994). Bedard et al. (1999) consider the possibility of an "assurance approach" to EP rather than employing the risk model espoused in the professional standards. This assurance approach would allow auditors to gather sufficient evidence as a basis for a conclusion that the financial statements are presented fairly. Srivastava and Shafer (1992) use a belief function framework to employ such an approach to capture the linkage between assessed client risks and EP. These authors argue the ARM is deficient and limited in two areas. First, the ARM does not incorporate the structure of audit evidence. Second, the ARM does not use an appropriate framework for representing uncertainties in audit evidence.

Critics of Srivastava and Shafer's "Overall Audit Risk Model" claim the model's requirements to quantify subjective inputs and organize evidence independently are not realistically achievable (Gardner 1990). The proposed model achieves flexibility by employing individual auditor judgment, while at the same time retaining opportunities to standardize and use historical judgment that has proven to be trustworthy. However, this type of flexibility carries with it an incremental level of complexity and effort when compared to the ARM, and could possibly impact timely audit completion. Gardner (1990) reasons that the time constraints imposed by the model's requirements to quantify and document the

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[7] The Auditing Standard's Board is the body that promulgates GAAS.

many subjective inputs render the "Overall Audit Risk Model" unrealistic in field settings. Use of the proposed theoretical model brings with it a cognitive cost as it requires auditors to make additional decisions to apply different techniques in different audit circumstances.

While Srivastava and Shafer's proposed model displays greater flexibility and is more easily generalized across audits than the ARM, there is always a concern that the use of more flexible procedures negatively impacts the defensibility of final judgments.[8] Furthermore, research in behavioral decision theory has shown that the Bayesian formulation is not fully descriptive of auditor belief revision (Joyce 1976). However, the appeal of Bayes' Theorem as a general theory of rational choice in auditing is strong since it involves logical consequences of conditional probabilities. Early research suggests that intuitive auditor belief revision is fundamentally nonoptimal (Scott 1977; Reinhold 1967). Later research established that such nonoptimal behavior is primarily due to determinable effects such as the order in which new information is received and the manner in which it is presented (Reckers et al. 1993; Krull et al. 1993; Butt and Campbell 1989).

The EP literature lacks a rigorous theory of evidence upon which to build research expectations and interpret empirical results. The complexity in distinguishing elements of assessed risks and linking them to the related

[8] Experimental laboratory research can explore the applicability of proposed theoretical models and test claims that these models improve efficiency while maintaining comparable levels of

evidential effort is a primary shortcoming of the ARM (Kinney 1983). The difficulty in expressing substantive evidence independent from all other evidence, and the subjectivity involved in attributing a numerical value to a belief in the evidence is also cited as a drawback of the ARM (Shafer and Srivastava, 1990). Other cited imperfections of the ARM include its inability to distinguish between assessed inherent risk and control risk, as well as the evidence presented to assess these risks. The complexity involved in revising judgments for new or changed evidence is also a cited criticism (Waller and Felix 1984; Akresh et al. 1988).

2.2 Mixed results/ no results

The current literature reports conflicting results about the extent to which auditors consider and act upon risk in designing an audit. Despite the importance of evidential planning, there have been few field based studies that attempt to determine whether auditors assess risks in a manner consistent with SAS No. 47 and CPA firm policy, and then appropriately focus effort based on that risk assessment.

SAS No. 47 guidance specifies that audit program plans be designed to respond to client risk factors to aid the auditor in the identification of, and testing for, potential errors. According to the standard, the effectiveness of substantive testing should increase as the risk of material errors in the financial statements

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justifiability. These new approaches to modeling a viable EP theory suggest the need for researchers to understand the current EP behavior patterns of auditors.

increases.[9] While the auditor should design an efficient program, it should also be an effective program with respect to detecting material errors and irregularities. Whether the scope and effectiveness increase with risk is an empirical question to which this study directs itself.

There is widespread recognition in the accounting literature that properly directed audit effort is critical to an effective and efficient engagement (see Appendix B) (Mock and Wright 1993, Davidson and Gist 1996, Bedard et al. 2000). However, archival studies involving audit engagements are inconclusive and do not reveal a strong association between evidential planning and assessed risk (Bedard 1989; Mock and Wright 1993; Davidson and Gist 1996). These studies lead to questions about whether effort is appropriately adapted to the auditor's assessment of the client's occurrence risk (the multiplicative combination of inherent and control risk), which connotes potential inefficiency and ineffectiveness in audit planning.[10] The nature, timing and extent of evidential procedures, and the evaluation of the results produced by those procedures, in part determine this effectiveness.[11] The ARM's general prescription of risk factor consideration in audit program design has not been consistently documented in the prior research. For example, Houston et al. (1999)

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[9] SAS No. 47 is conventionally applied by first specifying a target amount of acceptable audit risk. After assessing inherent risk and control risk, and imputing detection risk, which is used to determine the nature and scope of substantive audit procedures. Audit procedures are designed such that detection risk, and thus audit risk, is set to an acceptably low level by setting detection risk equal to audit risk deflated by occurrence risk.

[10] Occurrence risk is a client-related risk which the auditor cannot affect – it can only be assessed.

found significant effects of client risk factors on budgeted effort while Bedard and Wright (1994) did not. O'Keefe et al. (1994a) found inherent risk was associated with budgeted effort only for certain labor categories, but certainly not uniformly related. The literature is beset with mixed results on the connection between occurrence risk and effort.

Although attempts have been made to find the determinants of audit effort, and the relative weight of those determinants, archival evidence rarely indicates whether auditors consider audit risk in determining the nature, timing, and extent of audit procedures. Key explorations of audit effort in the empirical evidential planning research stream include Mock and Wright (1993) and Davidson and Gist (1996). These studies are unable to adequately answer the question of whether assessed inherent and control risks influence the determination of audit effort, and whether this consideration is fully captured by the ARM (Wright 1986). Prior literature provides mixed results regarding the assessment or changing assessments of the risk elements established by the ARM. Prior literature has not empirically demonstrated the utilization of the ARM in designing changes in the level of audit investment that respond to changes in the assessed risk of materially misstated financials (Joyce 1976; Kaplan et al. 1985; Libby et al. 1985). While Joyce's research suggests auditors react appropriately to audit risk, he does not identify the conditions under which this reaction takes place. The results of

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[11] While the effectiveness of an audit is difficult to define precisely due to the largely unobservable audit process, audit failure (type II error), and to a lesser extent, litigation, characterize an ineffective audit (Palmrose 1988).

Houston et al. (1999) suggest that the ability of the ARM to describe auditor effort and the inclination of auditors to charge a risk premium depend upon the nature of the risks present in the audit. In the presence of varying risk of errors, the ARM adequately described EP decisions; in the presence of risk of irregularities, it did not.

Key findings of the nature, timing, and extent of audit tests are portrayed in Bedard et al. (1999). Archival studies have shown widespread use of standard audit programs and have found that nature decisions are generally not statistically related to assessed inherent or control risk. In contrast, experimental research demonstrates much greater audit plan adaptability to assessed risks (e.g., Bedard 1989). Additionally, experimental studies show that the nature of audit tests appears to be influenced by factors such as the use of analytical procedures, the auditor's level of experience, internal control quality, and a cooperative auditee (e.g., Bedard 1989; Hirst and Koonce 1996; Bedard and Wright 1994). Few studies discuss the variation in the strength of tests as a means to detect potential misstatements and thus to provide a desired level of audit assurance. In nature decisions, the manner of examination often contains a fixed and a variable component rarely considered in the literature. The fixed component stems from efficient and well-grounded auditing conventions, such as accounts receivable confirmation procedures. This further emphasizes the need in the literature to properly score and weigh nature, perhaps with an anchoring and adjustment

metric. The anchoring metric can represent the fixed form of examination and the adjustment metric can represent the variable form.

I am unaware of any studies that look at audit timing decisions as a primary variable of interest. A few studies indirectly consider changes in the timing of audit effort (e.g., Srinidhi and Vasarhelyi 1986; Wright and Bedard 2000). These studies have primarily focused on inherent risk, client characteristics, and the experience of the audit staff (Srinidhi and Vasarhelyi 1986; Wright and Bedard 2000). Srinidhi and Vasarhelyi (1986) note that inherent risk plays a role in timing decisions, but that a strong industry effect exists. Regardless, the literature to date is lacking in studies that look directly at the linkage between assessed inherent and control risks and EP timing decisions.

Archival studies have found little evidence of a relationship between assessed inherent and control risk factors and extent. Most studies find little agreement in auditor judgments involving the extent of audit effort, and few of these studies attempt to explore the reasoning behind these unexpected results (e.g., Bedard 1989; Mock and Wright 1993, 1999). Experimental and verbal protocol studies indicate that extent decisions are only mildly related to inherent and control risk assessments (Bedard 1989; Wright and Bedard 2000; Johnstone 2000).

Methodological issues such as the consideration of appropriate test variables, industry effects, and auditor reactions to initial audit evidence are also pervasive in the EP literature (Ashton 1983). Few studies look at the incremental

effects of specific decision variables on EP decisions (e.g., Akresh et al. 1988). These variables include such items as materiality in planning, experience-related differences, the opportunities for tradeoffs in audit planning, and the role of groups or audit teams. Industry focus may also affect risk assessments and the related EP decisions (Waller 1993, Jiambalvo and Waller 1984). Further, it is possible that auditors react strongly to the initial substantive evidence provided by dual-purpose tests as depicted in Morton and Felix (1994) (Ricchiute 1992; Butt and Campbell 1989). At a minimum, this dual-purpose substantive work conducted in the early stages of the audit should be considered an integral component of the evidential mix and should be employed in the risk – effort analysis. Thus, a need exists for more detailed evidence on the risk-effort relationship to consider a broader definition of effort, including dual-purpose tests.

2.3 Methodological issues, choice and measurement of variables, and data limitations

2.3.1 High- level measurement issues

The dynamic and often judgmental nature of an audit makes it difficult to pinpoint a "proper risk assessment" or a "proper focus of effort." Much of this difficulty stems from the fact that numerous aspects of audit effectiveness and quality are unobservable (e.g., appropriate staffing decisions, etc). To the extent that auditor documented risk assessments accurately reflect auditor beliefs, this paper compares and contrasts measures of risk and effort to provide insight into

current and future theory. The results from both experimental and archival studies attempting to find a relation between risk and effort are mixed, perhaps due to measurement error for the level of auditor effort and for risk assessments. The challenges of creating metrics that appropriately capture the audit investment may contribute to some of the conflict and inconsistency in the EP literature.

Archival EP studies are generally unable to capture the effectiveness of audit procedures. Linking EP decisions to audit failure is a potential means to "back into" audit effectiveness. Lawsuits arising from faulty audits and the related resolution data can potentially highlight audit failure (Palmrose 1987, 1988, 1991, 1997). Of course there is no assurance that lawsuit or resolution data are based on valid claims of audit failure. Regardless, this type of analysis requires extensive data with a time frame that is sufficient to highlight any audit failure – it is only possible with detailed longitudinal data. More precise measures of audit plan changes, particularly of audit effectiveness, are needed. Conversely, behavioral researchers are able to design experiments with seeded errors or extreme deficiencies in audit procedures to highlight ineffective EP procedures.

The difficulty in attempting to create numerical point estimates capturing the effectiveness or the strength of evidence is further compounded by the substitutability and interchangeability of evidence with respect to differing management assertions. Auditors choose from a set of substantive tests and have the ability to vary the nature, timing, or extent of those tests in addressing client

risks. One form of evidence may address multiple management assertions.[12] Auditors may also substitute various tests to respond to client conditions. Researchers are faced with the challenge of isolating and partitioning potentially strong interdependencies. To allow for the interrelated nature of audit effort, Mock and Wright (1999) account for the interdependency of audit tests across multiple assertions and accounts using a structural equation model. While SAS No. 47 indicates that EP decisions are interrelated and not mutually exclusive, most laboratory experiments and archival studies tend to focus exclusively on specific EP components, as opposed to a more holistic view of evidence.

2.3.2 Measurement of risks

To properly define, identify, and examine risk is a challenge. Researchers and practitioners are faced with the task of choosing the appropriate risk(s) for a given analysis and of determining whether and how these risks are measured and interrelated (Dusenbury et al. 2000; Waller 1993; McDaniel and Kinney 1995; Jiambalvo and Waller 1984).[13] There is uncertainty surrounding the definition and measurement of auditee business risk, as well as its implications in EP. Houston et al. (1999) point out that business risk is not explicitly reflected in the ARM and is not directly associated with the risk of undetected material misstatements. It appears that professional standards offer auditors incomplete guidance on the EP implications of auditee business risk (P.O.B. Oversight

[12] For example, an accounts receivable confirmation procedure provides evidence as to the existence and valuation assertions implied by management in the financial statements.
[13] Waller (1993) introduces the notion of "auditee risk."

Report). Thus, practitioners and researchers are uncertain about the manner in which auditee business risk is instilled into the conventional definition of occurrence risk.[14] Whether or how individual auditee business risk factors aggregate across the risk categories provided in SAS No. 47, and the manner in which they are applied in the EP process, is an empirical question.

SAS No. 47 defines control risk more precisely than inherent risk, so auditee business risk is likely accounted for in the assessment of inherent risk.[15] The lack of prescriptive guidance on defining and assessing inherent risk (SAS No. 47) may leave auditors to define inherent risk broadly to include assessed client business risk. The following excerpt from a Big Five accounting firm's internal Auditing Strategy Guidance Memorandum denotes the firm's broad interpretation of the SAS No. 47 guidance on defining and assessing inherent risk:

> "We refer to the likelihood of significant misstatements occurring, ignoring the effect of internal control, as inherent risk. Inherent risk results from the external factors, pressures, and forces brought to bear on the entity as well as from some internal factors. Inherent risk may relate to company-wide conditions or events, as well as to conditions or events specific to an audit objective, such as the nature of the account balance or class of transactions."

With ample data, research in this area could better partition and examine different classifications of risks to provide empirical evidence on precisely which risks are considered in the EP process. Using various auditee risks, several studies have attempted to proxy for inherent and control risk. Mock and Wright

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[14] Additionally, EP studies often ignore the client's business risk as a portion of the auditor's business risk.

[15] It is also possible that the internal control environment may be influenced by business risk.

(1999) surveyed for micro and macro risk factors as surrogates for inherent and control risk. Relevant non-archival studies (Bedard 1989; Wright and Bedard 2000; Johnstone 2000) utilize surveys and protocol analysis to arrive at occurrence risk surrogates. Archival EP studies also measure risk assessment primarily using surveys and protocol analysis.

In addition to uncertainties involving the identification and measurement of the appropriate auditee risks, there is uncertainty about whether risk assessments fully reflect beliefs about the areas in which potential misstatements are more likely to occur. SAS No.'s 55 and 78 indicates that when designing audit tests, control risk may at times be assessed at the maximum as a default assessment. A default assessment is permitted when the compliance testing effort required to assess control risk below the maximum for an assertion is not efficient. That is, the testing effort will exceed the potential reduction in substantive procedures gained from an assessment below the maximum. Prior research has noted the apparent tendency of auditors to default to assessing control risk at the maximum for purposes of efficiency (Waller 1993; Bloomfield 1995; Haskins and Dirsmith 1995; Lea et al. 1992; Bedard 1990).

The POB's Panel on Audit Effectiveness believes that it is not sufficient to merely indicate that inherent or control risk is high or at the maximum. Rather the auditor should be required to reasonably determine why the risk is high or at the maximum. The Panel believes that such a requirement will better prepare the auditor to select and perform the appropriate tests of controls and substantive

tests. For illustrative purposes, consider a revenue recognition risk assessment example. The auditor should note that risks are assessed as high when items such as the complexity of sales terms, potential cutoff issues, understated deferred revenue, or side agreements permitting rights of return of client product are present. By assessing risks at the maximum for purposes of efficiency, the auditor may design substantive tests without fully comprehending the client's business environment and potential weaknesses in the client's systems, balances, or assertions. In an attempt to be efficient, the auditor may omit the examination of key balances or assertions and potentially omit key audit procedures, thus bearing a higher level of detection risk than intended. Requiring the auditor to obtain a threshold level of knowledge even for risk assessments at the maximum can fine-tune auditor judgment and prevent audit failure. Documenting the reasoning behind this assessment allows the auditor to better understand the relevant business processes and risks of the auditee.

In short, the challenges of quantifying risk factors and relating them to audit effort stem from a core difficulty of capturing auditor's risk assessment beliefs. The EP research has utilized tools such as Likert scales, protocol analysis, probability analysis and client-firm and client-industry characteristics to gauge and calibrate risk assessments. In their protocol analysis, Bedard and Wright (2000) obtain a weak risk-effort relation that is consistent with prior research. In their study, risk factors were not strongly associated with differences in the extent of testing. Several possible reasons were proposed for the weak link

between risk factors and planning decisions such as auditor's lack of risk-recognition, differences in interpretation of risks, or perhaps a difficulty in adapting the audit plan. The lack of risk recognition refers to the difficulty auditors face in highlighting and connecting auditee risk factors to potentially risky assertions in the financial statements. Compounding this risk-recognition problem is the challenge faced by auditors to uniformly translate underlying client risk characteristics into inherent and control risk. The Bedard and Wright (2000) study highlights the importance of adjusting evidential plans based on these underlying risk factors.

2.3.3 Thinking outside of the risk-focused approach

The risk-focused approach is the primary means of highlighting areas where the risk of potential misstatements in the financial statements appears to be the highest. It is possible, however, that environmental factors other than assessed risks significantly impact EP decisions. Examples of environmental factors highlighted in the current literature include anchoring effects, litigation effects, the implementation of decision aids, expert systems, and the standardization of audit programs (Eining et al. 1997). Prior research has also noted the potential for correlated omitted variables in the determination of audit effort – variables auditors consider as they determine the nature, timing, and extent of audit effort in addition to the items delineated in the ARM (Johnstone 2000).

Dimensions of audit task settings are also important to understanding EP decisions. Several studies have looked into possible anchoring by auditors on prior year's EP decisions (Kowalczyk and Wolfe 1998; Butler 1986; Kinney and Uecker 1982). Anchoring effects may hamper the auditor's ability to adapt to varying client risk factors and, if significant, are a key dynamic that should be controlled for in the designs of behavioral laboratory experiments. Auditor's EP decisions may also vary due to the difficulty involved with the identification and inclusion of fraud and business risk judgments.

2.3.4 Extent proxies are varied while nature and timing are effectively ignored

Extent is the most frequently studied component of all the planning decisions, with research dating back to the 1970s (Bedard et al. 2000). Many approaches have been used to proxy for the extent of substantive tests (Mock and Wright 1993; Bedard 1989). These items include total audit hours, the change in audit hours from prior year, number of personnel hours by staff category, and the number of population items sampled.

However, in accordance with GAAS, the *aggregate* procedures enveloped by the nature, timing, and extent of effort are used to achieve specific audit objectives and reduce detection risk to an acceptable level. The third GAAS Standard of Fieldwork states that sufficient competent evidential matter is to be obtained to allow a reasonable basis for an opinion on the fairness of the financial statements under audit. Evidence that is sufficient and appropriate to meet one or

more audit objectives is considered to be competent and effective audit evidence. The sufficiency of audit evidence relates, in part, to the extent of the audit procedures performed while appropriateness relates to the nature and timing of the audit procedures (SAS No. 47).[16]

The EP literature has tended to limit measures of auditor effort to the extent of testing (also termed as the amount or scope of testing (Bedard et al. 2000)), with little consideration given to the nature and timing of testing. My research approach will consider and examine the potential association between assessed risks and the nature, timing, and extent of audit procedures. While it is understood that auditors usually have the option to vary the nature, timing, and extent of testing, whether auditors adapt and modify the nature and timing, along with the extent of audit tests, to mitigate changes in risk is an empirical question. Prior archival literature has emphasized the "extent" variable, effectively minimizing the possibility that the nature and timing of audit tests can change drastically – especially for high-risk clients. This dismissal of key variants is due to a lack of data or reasonable proxies for the nature and timing of audit procedures. Accordingly, archival EP research measures audit effort primarily as the extent of audit testing. Both Bedard and Wright (1994) and Houston et al. (1999), which are experimental studies, find evidence that auditors adjust the

[16] The difficulty or expense required to test a particular item is not in itself a valid basis for omitting a needed audit procedure. If there is reasonable doubt about one or more assertions, the data-granting assurances firm will obtain audit evidence to remove such doubt. If the firm is unable to obtain audit evidence, an unqualified opinion will not be expressed.

nature of testing with changes in risk. For example, an adjustment of the nature of tests - via an adjustment of the type of testing - to vary the strength of the evidence, *ceteris paribus*, may conceivably produce a more effective evidential program. Mock and Wright (1993, 1999) measure the nature of audit tests using several different metrics.[17] In general they find little association between assessed risks and planned tests, concluding that evidential plans were not highly risk-adjusted.

SAS No. 47 states that as the risk of significant misstatements decreases, substantive procedures may be modified by altering the audit timing and performing more substantive procedures in advance of year-end.[18] Auditors may perform audit procedures to obtain audit evidence before, during or after the period covered by the financial statements. Performing audit procedures before the period-end allows the consideration of significant matters that may affect the year-end financial statements and the opportunity to change audit plans, if necessary. When audit procedures are performed before the period-end, there is a potentially increased risk that the auditor will not detect significant misstatements that may exist after the procedures are performed. Selecting additional audit procedures to cover the remaining period reduces this potential increased audit risk. Interim audit procedures (i.e., procedures performed before the period-end)

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[17] Mock and Wright (1999) measure the change in the nature of audit tests as the percentage of common test procedures. Mock and Wright (1993) proxy for the nature of audit tests using the number of planned substantive tests. The 1999 study finds that changes in common tests relate to the variation in a number of risks. The 1993 study finds extensive reliance on standardized audit programs and thus, little variation in the adjustment of the nature of audit tests, as measured.

are selected in a manner to provide a reasonable basis for extending the audit conclusions to the period-end.

Substantive audit procedures are applied to cover the remaining unaudited period on which the auditor will report. Comparing and investigating information at the balance sheet date with comparative information at the interim date helps to identify amounts that appear unusual. Additionally, analytical procedures or tests of details, or a combination of both, may provide a reasonable basis for extending to the balance sheet date the audit conclusions for the financial statement assertions that were tested directly or indirectly at the interim date.

The management of audit timing involves both audit effectiveness and cost efficiencies. If internal control is assessed as ineffective and will not be relied upon, it is ordinarily most efficient and effective to conduct all substantive work at the balance sheet date. For example, applying principal substantive procedures to the details of accounts at an interim date may not minimize overall audit costs if internal control does not effectively permit the auditor to limit the extent of required substantive audit procedures required to cover the period remaining to year-end. When the auditee's internal controls are assessed as effective and reliable, conducting substantive work at interim potentially minimizes the overall cost of the audit. The auditor takes into account the costs of the audit procedures necessary to cover the period remaining to year-end, and the cost of reliance on the related effective internal controls.

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[18] SAS No.'s 55 and 78 also outline criteria for strong internal controls.

If misstatements are found in account balances at interim dates, the auditor considers whether to modify the planned nature, timing or extent of substantive audit procedures in the remaining period or whether to perform additional auditing procedures at the balance sheet date. In making this decision, the auditor considers the implications of the nature and cause of misstatements detected at the interim date, the relationship to other parts of the audit, the corrections subsequently recorded by the entity and the results of auditing procedures covering the remaining period.

Based on the *ex ante* assumption that auditors are operationalizing the risk-focused approach embedded in the ARM, the expectation that auditors will exhibit modification and interchange among all available methods of audit effort appears reasonable. The weak ability of archival literature to demonstrate a strong relation between assessed risk and effort is no great surprise as it appears to focus on measurement of auditor effort as the extent of substantive testing. Modification of the nature and timing of tests may occur when risks vary. It is possible that as risks change, auditors conduct more effective tests (by manipulating the nature of the examination) and carry out more tests closer to year-end, as suggested by SAS No. 47. Statistically significant positive associations between the nature of audit testing and inherent and control risks are found in the experimental literature (e.g., Bedard 1989). Both Joyce (1976) and Bedard and Mock (1992) report a correlation in audit risk judgments and the nature of evidence. My research will take into consideration that auditors may opt

to vary the nature, timing, and extent of testing to effectively and efficiently provide a given level of assurance.

2.3.5 Challenges for future research

Based on the preceding summary of the EP research, we know that auditors may select from a menu of substantive tests in response to assessed risks – e.g., by varying the nature, timing, and extent of evidential plans - that vary in perceived audit effectiveness and efficiency. What we know suggests that future studies should follow up on the inconsistent relationship between assessed risks and evidential nature, timing, and extent decisions. Most archival EP studies acknowledge the need to consider the potential for the substitutability of the nature, timing, and extent of audit effort, but usually lack the relevant data. Methodological improvements in the EP literature will be essential to account for the substitutability and interchangeability of various measures of effort in response to assessed risks. Assessed risk and effort proxied have been inconsistently estimated, presenting researchers with challenges in understanding and interpreting the related literature. The design and use of more precise tests with finer measures in areas where the expectation of changes in risks is high has the potential to contribute to the EP literature.

2.3.6 Data issues and limitations

Evidence on the audit planning process and the degree to which the behavior of auditors follows authoritative guidelines will contribute to our understanding of EP. More direct evidence (such as auditor workpaper data) that

will enable point estimates to be more precise and superior to metrics of the past may assist in solving conflicts in the literature involving the assessed risk-effort relation, and provide insight into theory building.[19] Houston et al. (1999) sum up the problems stemming from the measurement and data-limitation difficulties faced by EP researchers:

> [These limitations] force archival researchers to infer risk assessments from the data and/or elicit them after completion of the audit – in some cases from auditors who did not make the actual audit planning judgments. In addition, archival studies must rely upon relatively crude proxies for inherent and control risk (e.g., categorical variables coded as 0, 1) that are unlikely to reflect the level of risks in specific audit contexts.

Researchers agree that the difficulty in detecting relationships between occurrence risk and audit investment, which is pervasive in the archival research, is partially caused by insufficient access to direct and timely measures of risk and effort (Hackenbrack and Knechel 1997; O'Keefe et al. 1994b; Mock and Wright 1993; Bedard 1989). Mock and Wright (1999) conclude that the weak association between changes in client risks and program planning can be better examined by sampling clients with diverse assessed risk profiles; they suggest the need for richer data to test and extend their hypothesis. In addition to the simple requirement for variability that will promote learning (Cook and Campbell 1979), they suggest that auditees in a high-growth environment may exhibit more shifts in assessed inherent and control risk. The limited scope and unexpected weak

[19] Srivastava and Shafer (1990) acknowledge the difficulty faced by the auditor of attributing a numerical value to a belief in evidence, especially in situations where no generally accepted statistical measures exist or where there is uncertainty about the evidence.

usage of the ARM in the Mock and Wright (1993, 1999) studies may have resulted from drawing risk and effort data from two mature industries.

The primary question raised by Mock and Wright (1993, 1999) is whether evidential planning is adaptive to changes in client risk. The authors note that future research should primarily address this issue by selecting a sample of engagements in an industry where client risks are known to be constantly changing (i.e., high technology as opposed to the mature manufacturing and merchandising industries of prior research). With such data it appears reasonable to expect more extensive revisions in evidential planning. More specifically, the audit areas that are highlighted as having greater risk potential should receive greater scrutiny (more effort) by auditors. Mock and Wright (1999) purport that one may reasonably expect to identify a positive association between client risks and planned effort in a sample of firms where risk is constantly shifting.

Although field data is costly to obtain, it enables the study of decisions made in a natural environment. Using actual workpaper data as opposed to survey or experimental data, I can conduct more direct and powerful tests on the relation between assessed risk and effort. Further, my data provide an opportunity to interpret and explain ambiguous results in prior archival studies that have been unable to find a strong influence of auditor's risk assessments on evidential effort.

The high-growth environment in which this study's high technology and biotechnology firms operate is volatile, and business risks are constantly changing. Thus, revisions in evidential planning may reasonably be expected

based on changes in inherent and control risk assessments (a straightforward use of the ARM). Based on the predictions of prior research, the relation between risk and effort is expected be more evident in this study.

2.4 The human impact on evidential planning

That the auditor is human also potentially confounds the researcher's ability to clearly see a relation between assessed audit risk and effort. The primary implication of human behavior patterns and bounded rationality is the potential that assessed risks do not capture all evidence knowledge (Simon 1979). Empirical research suggests that auditors are not proficient at assessing and/or documenting risks, potentially due to their tendency to make decisions using instinct or intuition, and their susceptibility to behavioral biases (e.g., recency biases, confirmation proneness, etc.). Whether auditors are convinced of their own risk assessments, and act on them, is an empirical question (Felix et al. 2001).

Auditor's attempt to understand and assess risks to plan the audit. The assessed risks may not reflect the entire auditor information set. Empirical research demonstrates that auditors are not proficient assessors of risks. This potential lack of proficiency may be due to imprecise guidance on risk assessment, or the programmed manner (based on heuristics) in which auditors may assess risks. Auditors also make decisions using a combination of instinct or intuition, and formal analysis. Many decisions made using intuition are efficient when based upon experience, and are not expressly prohibited by current

guidance (SAS No. 47). There is often a greater cost associated with making a decision using a more formal analysis.[20] The psychology literature informs us that most decision-makers generally prefer to make decisions using intuition, even when a more formal analysis is shown to be superior (e.g., Horwich 1982).[21]

Decision-making factors such as risk, uncertainty, and information form the basis of auditing. The opinion formulation process is a complex sequential decision process used by auditors to reach an opinion on the financial statements; it encompasses an ordered interdependent set of tasks for evidence planning, collection, and evaluation (Felix and Kinney 1982; Shields et al. 1987). Horwich (1982) identifies four sources of complexity - all four of which are present in EP decision-making - which usually make formal analysis attractive. The four factors noted are (1) a large number of factors to consider, (2) more than one decision-maker, (3) multiple attributes, and (4) uncertainty.

Characteristics of the auditor as a decision-maker such as knowledge, ability, experience, and preferences factor into the EP decision-making process. Further, properties of cognition such as perception, memory, attention, and effects of experience may be reasonably expected to influence EP decisions. Research has predicted a recency effect in situations where evidence is mixed and conflicting (Messier et al. 1987).

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[20] Quantitative methods of analysis do not eliminate judgment. Rather, they allow it to be applied more easily.

[21] Research that builds on the notions of information and auditor preferences has the potential to provide an understanding of both the limitations and benefits of a more formal EP theory.

One of the principal psychological human information processing (HIP) issues related to EP research is the auditor's search for information about assertions. The general findings of studies in this area suggest that auditors have a propensity to seek confirming evidence over disconfirming evidence. This tendency has been termed "confirmation proneness" or "confirmation bias" (Peecher 1998; McMillan and White 1993). Auditors also appear to weight confirming evidence more heavily than disconfirming evidence. This suggests that the assertion's form may influence both the type of evidence pursued and the related importance of that evidence to the arrangement of evidential plans.

Thus, the evidence gathering response to assessed risks is not consistent. Whether auditors are convinced of the accuracy of their own risk assessments may contribute to the inconsistent findings of an assessed risk-effort relation. Auditors have second order uncertainty about a precise measure of their beliefs, which is costly, if not impossible to eliminate through analysis (Felix et al. 2001, Waller 1994). Norms, evidence, and surrogates for evidence should be identified, interpreted, and acted upon.[22] Since the auditor is human and is thus constrained rationally (Simon 1979), we cannot be certain that presented evidence, such as risk evidence, is appropriately impounded and acted upon. The auditor's scope of memory, knowledge and intelligence are limited. Therefore, we cannot be

[22] The auditor evaluates evidence. Evaluation inherently involves comparison, judgment and opinion. Comparison requires an expected state of affairs (norms) and an observed state of affairs (evidence). The auditor perceives the norms and the evidence, interprets them (in an iterative versus a purely sequential manner), and draws inferences from them. Thus, the opinion

certain, *ex ante*, whether risk assessments affect beliefs about the areas in which potential misstatements are more likely to occur. Decision making characteristics and HIP issues may also contribute to the inconsistent evidence gathering response to assessed risk found in the current literature. There is a need in the literature for evidence that will clarify whether auditor's actions are consistent with their risk assessments (Morton and Felix 1992, 1994; Felix and Niles 1988; Houston et al. 1999; Kinney 1989). An examination of the relation between the nature, timing, and extent of audit effort (the planned evidence mix) and auditor-estimated risk will contribute to our understanding of auditor belief modification.

This human implication in EP involving risk evaluation, as well as the related evidential planning implications, has been a primary focus of audit decision-making research. The extant experimental literature provides supporting evidence that, in general, the practicing auditor's evidential effort will be focused to reflect the auditor's beliefs concerning where misstatements are more likely to be observed.

Beginning with Ashton (1974), experimental research has examined the implications of different control system characteristics on planning decisions relating to the nature, timing, and extent of substantive tests (Joyce and Libby 1982; Ashton 1983). Libby et al. (1985) examined whether risk assessments affect beliefs about the areas in which potential financial statement misstatements are more likely to occur. In an experiment, the ARM was used to generate

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formulation process involves a dynamic set of evaluation procedures to obtain and create inputs

hypotheses concerning the effect that internal control evaluation exerts on audit planning decisions. The generated hypotheses were compared to the behavior of a group of experienced auditors who completed a set of highly realistic case studies. The subjects' decisions were consistent with the predictions developed from the ARM. Risk assessments did appear to affect beliefs about the areas in which potential misstatements are more likely to occur. Although the results of the related research vary with the different control system attributes (or with changes in these attributes), the general results of EP laboratory experiments are consistent with that of Libby et al. (1985), demonstrating a risk-effort relation.

Experimental research is better able to control for human behavior issues that potentially cloud our ability to see an assessed risk-effort relation. By conducting well-designed laboratory experiments researchers can better account for the fact that the ARM does not hold the complete set of auditor considerations in EP. The current experimental literature supports the notion that the practicing auditor's evidential effort will be focused to reflect the auditor's beliefs of where misstatements are more likely to be observed. Access to direct workpaper evidence would potentially enable archival researchers to better measure auditor's beliefs. Such data access may facilitate the detection of an assessed risk-effort relation in the archival literature.

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for comparison in order to arrive at one of several possible conclusions or actions.

CHAPTER 3. HYPOTHESIS DEVELOPMENT

The EP literature provides conflicting expectations about a relation between assessed risk and audit effort. However, the chief rationale for the risk-focused approach is the promotion of a direct relation between risk and effort. This rationale is that the information that supports the audit risk assessments – primarily inherent risk and control risk – will direct procedures or other tests of details sufficient to reduce audit risk to an acceptably low level for the audit objective under review. This leads one to expect a direct relation between risk and effort in both the archival and experimental EP literature.

The ARM is the primary theoretical model used by auditors in implementing a risk-focused approach to auditing. The purpose of this approach is to minimize the risk that the auditor unknowingly issues an unqualified audit opinion on financial statements that are materially misstated. The auditor will use professional judgment to determine the nature, timing and extent of substantive audit procedures to obtain sufficient, appropriate audit evidence upon which to base an opinion. It is not cost-effective for the auditor to test most available evidence. Further, the auditor is able to obtain persuasive rather than conclusive audit evidence that the financial statements are free of material misstatements. The risk-focused approach espoused in the ARM provides the auditor with a framework to manage audit risk. It facilitates the opinion formulation process by assisting auditors in determining an amount of evidence that will minimize audit

risk to a predetermined, acceptable level. Because the auditor is persuaded by examining some, rather than all, of the information available, there is always a risk that he may unknowingly issue a report expressing an unqualified audit opinion on financial statements that are materially misstated.

Relevant EP studies suggest that, in general, many factors potentially confound the researcher's ability to find a relation between assessed audit risk and effort. It is unclear whether the inherent risk assessment includes auditor-assessed fraud risk and auditee business risk risks (P.O.B. Oversight Report 2000).[23] Additionally, research has demonstrated that there is variability in the measurement and interrelation of inherent and control risk factors by auditors (Dusenbury et al. 2000; Waller 1993; McDaniel and Kinney 1995; Jiambalvo and Waller 1984). The difficulty in partitioning and examining different classifications of risks confounds the EP researcher's ability to better understand the EP process. In short, poorly defined risks are assessed by auditors who exhibit great variability in the assessment and documentation of their beliefs. The general unavailability of auditor workpaper data inhibits the EP researchers' ability to measure auditor beliefs.

I focus my analysis on the more risky revenue cycle portion of the audit. Examination of a more risky audit area provides a more powerful setting to study the assessed risk-effort relation implicit in the risk-focused approach. The revenue portion of the audit is considered by the data-granting firm to be a

significant account consistent among the two industry classes represented in my data set (hightech and biotech).[24] Since the revenue area has a higher risk profile and is considered to be significant for all my sampled firms, I focus my analysis on the revenue recognition section of the sample audits.[25]

Several sources corroborate the significance of the revenue cycle to the audit. The 1999 COSO Report noted that either premature revenue recognition or recognition of fictitious revenue occurred in approximately half of the cases of misstated financial statements reported in the Security and Exchange Commission's AAER's issued between 1987 and 1997. Similarly, a substantial portion of litigation against audit firms reported to the SECPS's Quality Control Inquiry Committee involves revenue recognition issues. The Panel on Audit Effectiveness also indicated many potential risks in the area of revenue recognition, citing revenue recognition issues in 70% of the 96 AAER cases reviewed.

Since I have matched data on assessed risk and effort measures for the revenue portion of the sampled audits, my focus of analysis is at the revenue

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[23] In a recent ASB Risk Assessments Task Force proposed revision, the Key Risk subgroup found much practitioner confusion regarding the definition of significant business risks.

[24] There are a number of criteria that the data granting firm considers in the determination of whether an account or cycle to be considered "significant." Generally speaking, an account or cycle will be considered significant if it is considered to be critical to the prevention of audit failure, or if its review will significantly decrease audit firm risk. Whether an account or cycle is considered to be significant is a judgment call by the partner of the audit engagement; however, significant accounts are usually considered to be key to the viability of the auditee's business. Accounts or cycles displaying circumstances that indicate an increased risk of errors and irregularities – i.e., a risk of significant misstatements - are considered to be significant.

[25] For firms operating in the hightech industry, revenue recognition, receivables, accruals, and inventory are significant accounts or cycles. The significant accounts or cycles for biotech firms

cycle-level. The data contain inherent and control risk assessments at various levels (i.e., the financial statement, account, and assertion levels). Nature, timing, and extent measures of effort are available only at the revenue cycle level. Focusing on matched data at the revenue cycle level will provide the greatest likelihood of finding a relation between assessed risk and effort.

Theoretically, an aggregate risk assessment will affect an aggregate level of effort. The risk-focused approach to auditing attempts to identify and focus effort on the highest-risk areas of the audit. Being that different audit areas (e.g., property, plant and equipment and the revenue account) are likely to require a different mix of audit procedures, aggregated risk and effort data is difficult to obtain.[26] While my assessed risk and effort measures are consistent with authoritative guidance and the guidelines set by the data-granting assurances firm, they are not the only possible measures available. I attempt to capture auditor effort using the nature, timing, and extent of substantive testing – the three conventional components of effort that may respond to variation in assessed risks. I attempt to capture auditor risk beliefs using documented risk assessments characterized as "high," "medium," and "low." In practice, auditors use a product of inherent and control risks in determining the nature, timing, and extent of testing. Since inherent and control risks are apt to be utilized in combination

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are revenue recognition (primarily contract review), equity and inventory. The significant cycle considered by the firm to be common to hightech and biotech firms is revenue recognition.

[26] Surveys or protocol analyses using practitioner experts are potential means to arrive at aggregate measures of assessed risk and effort.

(Graham 1985; Messier and Austen 2000), I use a product of inherent and control risk as an aggregate measure of assessed auditee risk.

Consistent with the risk-focused approach promoted in authoritative auditing guidance, I treat measures of auditor effort (nature, timing, and extent of testing) as dependent variables, and assessed auditee risk as the independent variable. The dependent variables represent audit evidence, and the independent variable represents detection risk. Detection risk is the risk that the auditor's substantive procedures will fail to detect significant misstatements, leading auditors to erroneously conclude that material errors do not exist. SAS No. 47 states that there is a direct relationship between the risk of significant misstatements and the amount of substantive audit procedures.[27] The greater the assessed risk of significant misstatements, the more audit assurance is required from substantive audit procedures. Detection risk is typically imputed after assessing inherent and control risk, and after specifying a target amount of acceptable audit risk. Evidence-gathering procedures are designed such that detection risk, and thus audit risk, is reduced to an acceptably low level.[28] Since the guidance of the practicing office sets a minimum target level of acceptable audit risk, this risk is constant across audit observations.

Based on the assumption that auditors are implementing a risk-focused approach, I hypothesize that changes in assessed risks will positively affect the

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[27] Substantive audit procedures are selected to achieve audit objectives that obtain audit evidence to whether financial statement assertions are free of significant misstatements.

individual measures of audit effort (i.e., the nature, timing, and extent of substantive effort).

Hypothesis: Changes in assessed risks will affect the nature, timing, and extent of audit testing.

[28] Auditor's detection risk is equivalent to the acceptable level of audit risk deflated by occurrence risk. Theoretically, it is the only risk that the auditor can influence via examination.

CHAPTER 4. PROPRIETARY DATA AND RESEARCH METHODS

4.1 Proprietary data

A single Big Five accounting firm provides the financial statement audit workpaper data upon which this study is based. Specifically, a practice office of the firm granted access to its archived audit workpaper records. Using a random number generator, sample audits were randomly selected from the archived workpapers. The archives contained audit files from audits conducted from 1992 to 1999. The practicing office's client base consists primarily of public and private high tech and biotech clients. The data consist of mostly medium and small sized audits with few large audits. The accounting firm provided one year of audit data for 78 clients. Each of the 78 firm-year observations include, among other variables, materiality and the auditor's documented inherent and control risk assessments by assertion and account. Each observation includes a complete audit program for all accounts and assertions, listing the evidential gathering effort for the entire year's engagement, including all tests of controls. A detailed budget is provided, breaking out budgeted and actual hours and charges by staff level.[29]

The audit-observation years span from 1996 to 1999. Two of the sample audits are from the year 1999, 40 are from 1998, 32 are from 1997 and four are from 1996. Of the two industries represented in the sample, 34 (44%)

[29] It is possible that these data are different from similar data in other Big Five firms. However, Due to the homogeneity of the audit processes, I have no reason to believe that these data are

observations are audits of biotech firms and 44 (56%) observations are audits of hightech firms. The audit firm has been auditing these clients for an average of six years. The data set does not contain any first-year audits.[30]

4.2 Variable measurement

4.2.1 Risk

Since my risk assessments are extracted directly from auditor workpapers, they are not subject to potential measurement biases. The following risk measures are used in this study:

Risk Measure	**Symbol**	**Definition**
Inherent Risk	IR	Auditor assessed inherent risk at the financial statement level
Control Risk	CR	Auditor assessed control risk at the financial statement level
Revenue Inherent Risk	REVIR	Auditor assessed revenue cycle inherent risk
Revenue Control Risk	REVCR	Auditor assessed revenue cycle control risk
Multiplicative Combination of Revenue Risk	REVMC	The multiplicative combination of revenue cycle inherent and control risks (REVIR*REVCR)

systematically different from similar data in any other Big Five firm (Arnett and Danos 1979; Waller 1993).

[30] First year audits would potentially display less anchoring on prior year working papers.

The data-granting assurances firm measures and documents all risk assessments as "low," "medium," or "high." Consistent with the audit firm's methodology, I provide a ranked metric for assessed risk, using 0 for low risk, 1 for medium, or 2 for high. Consistent with the Public Oversight Board's Panel's recommendations that it is not sufficient to merely indicate that inherent or control risk is high or at the maximum, the data-granting firm's audit practice requires all risk assessments to be tested and reflective of perceived audit risk. For example, these auditors may not document control risk as at the maximum (i.e., high risk) for purposes of efficiency and do no further work. Rather, the auditors are required by audit firm policy to reasonably determine and document why the risk is high or at the maximum.

4.2.2 Nature

I measure the dependent variable NATURE using the following classes of evidence strength and persuasiveness: outside, outside/inside, inside, and auditor-created. I rank audit procedures listed in the revenue cycle audit program according to these classes of evidence strength. Using a ranked metric, outside, outside/inside, inside, and auditor-created evidence take on the values of 3, 2, 1, and 0, respectively. "Outside" evidence is obtained, inspected, or observed completely outside of the influence of management. This is considered to be the strongest form of evidence. An example of outside evidence is a cash confirmation sent directly from a bank to the auditor. "Outside/inside" evidence originated from a third party outside of the influence of management but has the

potential to be manipulated by management. An example of outside/inside evidence is a bank statement sent to the auditee. This bank statement, if presented by the auditee to the auditor as evidence of a cash amount, originated from the bank but passed through the hands of the auditee, and thus had the potential to be manipulated by the auditee. Accordingly, this type of evidence is not as strong as outside evidence. "Inside" evidence is obtained directly from the auditee. An example of inside evidence is an auditee-created record stating that a certain amount of cash exists in the bank. This form of evidence is weaker than outside/inside evidence. "Auditor created" evidence is based on estimations made by the auditor using only internal data. An example of auditor created evidence is an analytical procedure used by the auditor to roughly estimate the amount of cash obtained by the auditee. The auditor carries out this analytical procedure drawing on current year *unaudited* financial statements (i.e., inside evidence) presented by the auditee. I rank this as the weakest form of evidence. Technically, it is an estimation based on inside information. If however an analytical procedure involved "outside" data, such as industry data, I rank that procedure as outside/inside evidence.

This metric of evidence strength is founded upon certain key characteristics of reputable and valid evidence. These characteristics include levels of objectivity and neutrality, investigative scrutiny, consistency and agreement, and manner of archiving (Salterio and Koonce 1997; Moeckel and Plumlee 1989). Typically, audit evidence is persuasive rather than convincing.

Both the individual assertions in financial statements and the overall proposition that the financial statements as a whole are fairly presented are of such a nature that even an experienced auditor is seldom convinced beyond all doubt with respect to all aspects of the statements being audited. While my NATURE metric is an attempt to capture the validity of evidence, my manner of ranking and categorizing of evidence may potentially render it a noisy measure. Ranking NATURE using a rigid scaling method erroneously implies that the related information content of evidence is provided in fixed strata.[31] My ranked metric for NATURE is a reasonable simplification of the data-granting firm's more complete and sophisitcated audit planning guidance and interpretation of SAS No. 47.[32]

4.2.3 Timing

My data set does not contain audits that changed the proximity of the year-end engagement relative to the auditee's fiscal year-end. Accordingly, I measure TIMING as the proportion of substantive testing hours conducted at the auditee's fiscal year-end to total audit substantive testing. Total audit substantive testing includes interim or "mid year" work or as joint tests conducted during internal controls evaluation. If, for a given audit, 100 percent of the substantive work was conducted at the auditee's fiscal year-end, then the observation receives a score of 100 for audit timing. If, for a given audit, 60 percent of substantive hours were

[31] Future research should consider having a panel of expert's rank the substantive tests outlined in the audit programs.
[32] My framing of the data-granting firm's guidance ignores the importance of auditor logic.

conducted at the fiscal year-end, and 40 percent during interim work, then the observation receives a score of 60.

4.2.4 Extent

I use several different measures of the extent of audit testing.

Extent Measure	**Symbol**	**Definition**
Revenue Substantive Hours	SUBREVDPT	Total number of hours spent on revenue-specific substantive tests, including substantive tests from dual-purpose tests, deflated by total audit hours
Total Audit Hours	THS	Total audit hours
Number of Tests per Revenue Audit Program	NOFTESTS	Number of audit tests for the revenue section deflated by total auditee equity

Mock and Wright (1999) measure the extent of substantive testing using the total number of audit hours expended. Their measure is clouded by the inability to distinguish substantive testing hours from hours expended to plan the audit and test related internal controls.[33] My metric will consider *all* total or revenue substantive testing conducted during the audit, including interim substantive work as well as joint substantive tests conducted during internal controls evaluation. For purposes of consistency across audit observations, I

[33] Bedard (1989) ranked extent as increases or decreases in total hours from prior year.

deflate total substantive hours by total audit hours.[34]

[34] I ran additional empirical tests using an extent measure that was deflated by auditee equity. The results of such empirical tests did not vary greatly from tests using the present measure of EXTENT. The unique financial structures of many biotech and hightech firms (e.g., start-up firms, loss firms, or biotech firms without a saleable FDA approved product) render deflation of audit hours by equity to be more desirable than assets or sales. Assets or sales amounts are often non-existent or widely varied due to the level of FDA approval or technological feasibility.

4.3 Research methods

I first examine descriptive statistics for the full sample as well as subsamples partitioned on profitability and industry. These descriptive statistics will include univariate tests for mean differences using independent samples t-tests.[35]

The effect of assessed risks on the nature, timing, and extent of substantive effort may be modeled using three basic ordinary least squares (OLS) regressions. I initially model the basic linkage decision using the following three equations:

$$NATURE_i = \alpha + \beta_{1i}REVMC + \varepsilon \quad (1)$$
$$TIMING_i = \alpha + \beta_{1i}REVMC + \varepsilon \quad (2)$$
$$SUBREVDPT_i = \alpha + \beta_{1i}REVMC + \varepsilon \quad (3)$$

where REVMC represents the multiplicative combination of the assessed revenue cycle-level inherent and control risks. The variables NATURE, TIMING, and SUBREVDPT represent the nature, timing, and extent of substantive audit testing at the revenue cycle-level. The causal form of the first three regressions is implicit in the risk-focused approach, and is consistent with the conventional models presented in the current literature. This functional form assumes that audit effort is dependent upon assessed risk. I use the OLS models, as a first pass, to test for the expected positive relation between assessed risks and the nature, timing, and extent of effort. The models represented in Equations (1) through (3) are adequate to look at the independent risk-effort relations between REVMC and NATURE, TIMING, and SUBREVDPT, leaving the tradeoff between the three

effort measures for later tests. To achieve maximum audit efficiency, however, auditors may vary the mixture of evidence to reduce detection risk to an acceptably low level.

The fourth model attempts to isolate the incremental effect of the assessed risk on the nature, timing, and extent of auditor effort, using a reverse linkage model. This model reverses the traditional relationship between assessed risk and effort, controlling for potential tradeoffs between the nature, timing, and extent of substantive effort. While the use of this model obviously ignores any causal linkages, I expect to learn about the incremental relation between assessed risk and each individual measure of effort.

$$REVMC_i = \alpha + \beta_{1i}NATURE + \beta_{2i}TIMING + \beta_{3i}SUBREVDPT + \varepsilon \quad (4)$$

In addition to reacting to assessed auditee risks, it is possible that auditors consider tradeoffs with other types of effort when making EP decisions (Bedard 1989). Specifically, auditors may vary the nature, timing, and extent of substantive tests simultaneously, in response to assessed risks. The auditor's nature, timing, and extent decisions may interrelate depending upon the auditor's desired levels of efficiency and effectiveness. Consider the following example in the revenue cycle.[36] Auditors may vary the nature of examination by confirming revenue contract agreements with third parties (usually customers), or they may

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[35] I use the independent groups t-test where $t = X_1\text{-}X_2/SE_{X1\text{-}X2}$.

[36] Revenue cycle audit procedures are primarily designed to provide assurance to the existence, occurrence, and completeness assertions implicit in the financial statements.

perform routine sales cutoff tests.[37] For high-dollar items, revenue contract confirmation procedures provide stronger evidence to the existence of revenue, but are more expensive to perform than sales cutoff tests. While cutoff procedures are primarily designed to provide evidence that revenue is recorded in the proper accounting period, they also make clear the existence of revenue. Auditors may vary the extent of substantive tests performed by changing the number of revenue agreements confirmed, or by changing the amount of sampled sales transactions to verify the date and terms of shipment. Manipulation of revenue is more likely to occur close to year-end. Thus, the revenue audit has strong timing implications as the sales cutoff test usually is made close to year-end to address the potential for revenue shifting. Holding constant the level of assessed revenue cycle risk, the auditor may choose to move audit timing closer to year-end to conduct more revenue cutoff procedures, or may choose to confirm more revenue contract agreements at an interim date. The variation in the assessed level of auditee risks will likely affect the auditor's perception of the most efficient and effective mixture of these evidential options.

Although auditing standards suggest that EP decisions are interrelated (SAS No. 47), prior studies typically evaluate these decisions independently, ignoring potential interdependencies. Expectation and intuition suggest that auditors' EP decisions embrace the complex interdependencies among the nature, timing, and/or extent of testing. The complexity inherent in these EP decisions,

[37] The sales cutoff test is designed to obtain reasonable assurance that sales, and the related

however, is certain to cause poor auditor self-insight, which decreases the likelihood that experimental studies will uncover these interdependencies.[38] Archival studies, which are in the best position to uncover such complex interdependencies, are generally hindered by insufficient access to direct and timely measures of assessed risk and effort. Further, data inaccessibility has altogether precluded prior archival research from considering the timing of substantive effort. Unlike prior research, my data makes available archival measures of the nature, timing, and extent of substantive effort. This data availability presents a new challenge of accurately capturing the potential interdependencies in the assessed risk-effort relation. To appropriately consider the substitutability and interchangeability of substantive evidence, I employ an instrumental variables method of analysis using two-stage least squares (2SLS). Ordinary regression analysis is based on several assumptions. A key assumption is that the independent variables are in fact statistically independent of the unobserved error component of the model. If this assumption is not true, that is, if the regressant varies systematically with the error term, then ordinary regression will produce inconsistent results and the parameter estimates will be biased. NATURE, TIMING, and SUBREVDPT might individually fail to be pure independent variables because they are dependent variables in a larger simultaneous system. As an example, it is possible that the extent of audit testing

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accounts receivable are recorded in the accounting period in which the goods are shipped.

is not only affected by the assessed audit risk, but also by the nature and timing of audit tests. This might occur if auditors perceive a tradeoff between SUBREVDPT and NATURE. For this reason, the problem of dependent regressors is often called simultaneous equation bias. Since using the OLS estimation method to estimate these equations may produce biased estimates, I simultaneously run the following set of models:

$$NATURE_i = \alpha + \beta_{1i}REVMC + \beta_{2i}TIMING + \beta_{3i}SUBREVDPT + \varepsilon \quad (5)$$
$$TIMING_i = \alpha + \beta_{1i}REVMC + \beta_{2i}NATURE + \beta_{3i}SUBREVDPT + \varepsilon$$
$$SUBREVDPT_i = \alpha + \beta_{1i}\ REVMC + \beta_{2i}TIMING + \beta_{3i}NATURE + \varepsilon$$

By imposing a linearity assumption on the parameters in these models, I consider the expected relationship between assessed risks and each of the three measures of substantive effort. To provide evidence of whether the behavior in the risk-effort relationship systematically changes as the assessed risk levels change, I plot the dependent and independent variables (plots are not included). Separate scatterplots of REVMC and NATURE, TIMING, and SUBREVDPT suggest that the assumption of linearity is appropriate. Although the assumptions implicit in the OLS methodology are quite robust to a variety of classes of data, the variables as defined (REVMC is dichotomous, NATURE is ranked, TIMING and SUBREVDPT are proportions) potentially reduce variability. Imposing a linear assumption will likely provide the most conservative coefficient estimates.

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[38] Auditors assess risks based on rules of thumb as well as in a programmed manner. Decisions are made using a complex combination of instinct, intuition, and/or formal analysis. The unraveling of this unobservable and complex decision-making process is a challenge.

CHAPTER 5. RESULTS

Table 1 presents descriptive and summary statistics for the variables of interest. Panels B-F of Table 1 presents summary statistics for the full sample, as well as the biotech, hightech, profit, and loss subsamples. Panel A of Table 1 presents descriptive mean values for the full sample as well as partitions on biotech and hightech industries, and on profit and loss firms. Key auditee financial variables (equity, total assets, revenue, and net income) are included in the table. When partitioned on profitability, 60% (47 firms) of the observed client-firms experienced a net loss for their fiscal year. The mean net income and net loss for the entire sample is $44.36M and ($27.65M).[39] Comparisons of assessed risk and effort values for the loss and profit firms in Panel A of Table 1 reveal core differences in the auditor treatment of clients based on profitability. As pointed out in Appendix A, higher risk firms are more likely to be audited under the substantive approach, and low risk firms under the reliance approach. The independent groups t-test indicates that loss firms display significantly larger values than profit firms for NATURE (1.71 vs. 1.60) and TIMING (85.94 vs. 79.81) suggesting that the substantive audit approach may be taken with the loss firms, and the reliance approach with profit firms. This notion is not supported by EXTENT, which holds the same value for both profit and loss firms (.73). As

[39] The average net income for the ten profitable biotech firms in the biotech subsample is $5.69M. The average net loss for the 24 loss biotech firms in the biotech subsample is ($12.77M). The

previously discussed, my metric for the nature of audit examination, NATURE attempts to rank substantive tests based on the validity and independence of its underlying evidence. NATURE provides different results from those found by Mock and Wright (1993), who use the number of audit program tests as a measure of the nature of audit examination. Mock and Wright's (1993) metric, for example, would consider an audit program containing 10 procedural steps to have half the evidence strength of an audit program containing 20 procedural steps. The use of their measure of the nature of audit tests provides values that are not significantly different at the .05 level for profit and loss firms (7.71 vs. 7.13).

Mock and Wright (1993, 1999) conclude that the weak assessed risk-effort relation found in the literature can be better examined by sampling clients with diverse assessed risk profiles. Panel B of Table 1 indicates that the standard deviations for all measures of assessed risk are larger than .65. While these values seem to indicate that my risk measures have variability, this level of variability is not comparable to levels in the prior archival literature as proxies used in prior studies do not have direct measures for inherent and control risks. My assessed risk metrics are consistent with the data-granting firm's methodology, while the prior literature's proxies are split out using "micro" and "macro" risk factors. It is interesting to note that the mean values for IR and CR are identical for the full sample, with a value of .51. This unvaried relationship also holds for biotech (.67) and hightech (.38) subsamples. The loss and profit

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average net income for the 21 profitable hightech firms in the hightech subsample is $62.78M.

firm subsamples provide different IR and CR numbers. REVIR and REVCR provide differential values for the full sample and for the industry and profitability subsamples. These findings provide conflicting evidence to the notion of auditor uncertainty surrounding the definition and measurement of inherent and control risks (e.g., Waller 1993; McDaniel and Kinney 1995; Jiambalvo and Waller 1984; P.O.B. Oversight Report 2000). Specifically, inherent and control risks at the revenue cycle level appear to be assessed independently, while the financial statement level risks do not seem to support the notion of independent assessment. Although inherent and control risks are defined quite differently in authoritative pronouncements, it is possible that many of the same fundamental risks and attributes are being considered in the assessment of inherent and control risk at the financial statement level (Waller 1993).[40] Messier and Austen (2000) observe that researchers and practitioners have criticized the ARM because its multiplicative form suggests interdependence between inherent and control risks (e.g., Cushing and Loebbecke 1983; Kinney 1989).[41] My finding of minimal variability between IR and CR, but substantial variability between REVIR and REVCR provides conflicting results to this notion of potential interdependence.

The average net loss for the 23 loss hightech firms in the hightech subsample is ($43.17M).

[40] Waller (1993) finds evidence to suggest that a knowledge-based dependency exists between inherent and control risk. Waller 1993 points out that an association between inherent and control risk is likely due to an overlap in the pervasive and specific risk factors used to assess those risks.

[41] Using an experimental approach, Messier and Austen (2000) test for dependencies in the risk components of the ARM. Their findings are consistent with Waller's (1993) notion of a knowledge-based dependency between inherent and control risk assessments.

The independent groups t-test indicates that inherent risk and control risk are significantly larger for loss firms (.68 and .61) than for profit firms (.26 and .35). Similarly, REVMC is significantly larger for loss firms (.62) than for profitable firms (.27). The higher risk assessments for loss firms provide evidence to support the notion that auditors assess auditee risk higher for unprofitable firms. These findings are consistent with research claiming that auditors generally consider the probability of the occurrence of fraud to be greater for firms in a financial loss position (Zimbelman 1997). Palmrose (1991) presents circumstantial evidence of an increase in business risk to the auditor when the auditee is in a loss position.[42] It is possible that increases in bankruptcy and fraud risks, due to the loss position of the auditee, are accommodated by inherent and control risks.[43]

Table 2 provides results of simple regressions of effort measures on assessed risks. As discussed previously, potential tradeoffs and interactions exist between the effort variables. These simple regressions are presented as an initial examination of the assessed risk-effort relationship. Panel A reviews the assessed risk-effort relation using NATURE as a dependent variable, and REVIR, REVCR, and REVMC as the independent variables. Panel B uses TIMING as a dependent variable, and Panel C uses SUBREVDPT. All of the regressions produce

[42] In her sample, 31% of litigation cases alleging audit failure involved auditees in a financially distressed position.

[43] SAS No. 59 notes that it will generally be unnecessary to design specific procedures to evaluate going concern, as audit procedures designed to meet other audit objectives should be sufficient.

statistically significant and positive coefficients, suggesting a strong relation between measures of assessed risk and the constructed measures of effort.

Table 3 presents results using the basic reverse linkage model for the full sample and for profit and loss firms.[44] In the full sample results, coefficients for TIMING and SUBREVDPT are statistically significant, but the coefficient for NATURE is not. Results for the profit firm subsample indicate that coefficients for all effort measures are significant.[45] The non-significance of NATURE in the full sample appears to be driven by the loss firms. Results for the loss firm subsample indicate that the coefficient for NATURE is not statistically significant. To investigate whether REVIR or REVCR may be driving this non-significance in the loss firm subsample, I conduct additional reverse linkage regressions (not listed in Table 3), separately using REVIR and REVCR as dependent variables. Results for these regressions indicate a non-significant coefficient for the NATURE variable when REVCR is the dependent variable but not when REVIR is the dependent variable. This result seems consistent with the notion that auditors believe loss firms to have a higher probability of irregularities (e.g., risk of fraud), as well as a higher probability of bankruptcy risk, and that these risks are subsumed by inherent risk (Houston et al. 1999).

SAS No. 82 highlights negative earnings as one of many factors that indicate a greater risk of fraudulent financial reporting.

[44] Since I analyze categorical variables, I run multinomial logit models to add evidence of linearity between the measures (models are not included). Results using multinomial logit models are consistent with results using OLS models. Pearson correlation coefficients between the nature, timing, and extent measures are greater than .50, indicating possible multicolinearity or simultaneity problem. The instrumental variables approach (2SLS) I employ will address this potential simultaneity problem.

Tables 4 and 5 examine the risk-effort relation simultaneously, considering the potential interaction among the effort variables. The 2SLS model will estimate a relation between assessed risk and effort while addressing potential simultaneity. Based on the results of the simple and reverse linkage regressions, I expect this relation to be positive. Revenue-specific measures of assessed risk and effort are utilized.[46] Results are provided for the full sample as well as for subsamples. Table 4 indicates that when NATURE is a dependent variable, the only significant coefficient obtained is in the profit subsample, where NATURE is related to REVMC. The lack of a statistically significant relationship between assessed risk and changes in the nature of audit tests in the full sample is surprising, given the extensive audit guidance promoting a positive relation. The loss firms appear to drive this lack of a relation. The reverse linkage regression produced consistent results, indicating a significant relation between NATURE and REVMC for profit firms, but not for loss firms. When TIMING and SUBREVDPT are dependent variables, all coefficients on assessed risk are significant. When SUBREVDPT is a dependent variable, TIMING is significant for the full sample and for loss firms. In the profit firm subsample, none of the effort variables are interacted. The interaction of TIMING and SUBREVDPT in the loss firm subsample appears to be driving the relation between TIMING and SUBREVDPT in the full sample.

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[45] I conduct 2-tailed tests at the .05 level of significance.

[46] NATURE measures the nature of audit examinations in the revenue section. TIMING affects all audited accounts simultaneously. SUBREVDPT measures substantive revenue-cycle audit hours.

Specific attributes of the revenue cycle may be driving the results above. In particular, revenue shifting is a significant risk, and as a result, substantial audit effort is dedicated to revenue cutoff testing. Revenue cutoff testing is effective primarily as a year-end procedure. Accordingly, any interim cutoff testing will likely increase overall audit effort with little impact on audit effectiveness. *Ceteris paribus*, interim cutoff testing would naturally lead the auditor to expend more effort to provide a given level of assurance. Auditors may perceive management of loss firms to have a higher tendency to revenue shift than managers of profit firms, as revenue shifting is an expedient means to increase revenue in the current year.[47] Since nearly all revenue shifting takes place at the end of the auditee's fiscal year, the negative relation between TIMING and SUBREVDPT for loss firms appears reasonable.

In an effort to determine whether the unique revenue profiles of biotech firms may also be driving these results, in Table 5 the sample is partitioned into biotech and hightech firm groups. While both biotech and hightech firms are generally high risk, and as such, may reasonably be grouped together, they do differ in their revenue profiles. Panel A of Table 1 indicates the mean net income is $(7.34M) for the sample's biotech firms, as compared to $7.40M for the sample's hightech firms. Biotech firms are typically loss entities; approximately 10% of biotech firms survive. Within my sample of biotech firms, 71% (24 of the

[47] Revenue shifting may not be as pervasive for auditees who have been in a loss position from multiple years.

34 firms) are loss firms, while 52% (23 of the 44 firms) of hightech firms are loss firms. Biotech loss firms represent just over half of the loss firm subsample.

The business model for most biotech firms is to conduct research and development toward a "wonder drug" with hopes that this drug will pass a rigorous campaign of testing by the Federal Drug Administration (FDA), to ultimate approval for sale and distribution. Up to the point at which this wonder drug reaches the pharmaceutical market, the core revenue generator for biotech firms is the contractual sale to institutional investors of portions of the right to the unapproved drug. This "sale" is based on contractually set milestones that gauge the advancement of research and development toward the drug's approval. Thus, the primary biotech revenue-audit product is the assurance of achieved milestones based on revenue agreements. The examination of revenue contracts and their related research and development activities consists of relatively standardized and typical audit procedures. Further, these standardized procedures are primarily carried out at year-end so that information about the year's research and development expenditures is complete. Contract reviews will typically occur year after year, and are almost always the key revenue substantive test. Based on the standardization of revenue audit procedures for biotech firms, the non-significance of NATURE in the full sample may be driven by the biotech subsample. Biotech firms may similarly influence the non-significance of NATURE for the loss firms in Table 4. Given the unique audit timing characteristics of biotech firms, the lack of association between TIMING and

SUBREVDPT in the biotech subsample appears reasonable. While revenue agreements are key audit procedures to most hightech firms, revenue contract review procedures do not typically consume the largest portion of their revenue audit. The results for the hightech subsample indicate that NATURE decisions appear to be associated with REVMC alone. TIMING decisions are dependent on REVMC and SUBREVDPT. SUBREVDPT decisions are dependent on REVMC and TIMING. For the hightech subsample, all measures of effort are related to assessed risk. The inverse relation between TIMING and SUBREVDPT indicates that as extent decisions are decreased, the audit timing is moved closer to year-end.

Table 6 simultaneously examines the assessed risk-effort relation using a revenue-based measure for the extent of revenue-specific procedures, SUBREVREV. While SUBREVDPT identifies auditor revenue effort in terms of the auditor's overall effort, SUBREVREV identifies auditor revenue effort in terms of auditee revenue activity.[48] The primary motivation for using the new deflator is based on the likelihood that substantive revenue cycle audit effort is affected by the amount of auditee revenue. The Table 6 profit-firm results indicate that the coefficient on REVMC is significant when NATURE, TIMING, and SUBREVREV are dependent variables. NATURE and TIMING are dependent on SUBREVREV decisions. SUBREVREV is correspondingly affected by NATURE and TIMING decisions. The SUBREVREV regression

coefficients are significant for profit firms but not for loss firms, providing evidence to suggest that auditors manipulate the extent of audit testing for profitable firms, but not for loss firms. The insignificant coefficients for the SUBREVREV regression for the full sample appear to be driven by loss firms. Results for loss firms reveal very little relation between assessed risk and effort – TIMING obtains the only significant coefficient. This overall finding of an assessed risk- effort relation for profit firms, but not loss firms, provides evidence to support the findings in Houston et al. (1999) that the ARM adequately describes EP decisions in the presence of risk of errors but not irregularities.

The previously noted pervasive testing of revenue agreements in audits of biotech firms may be driving the relation between TIMING and REVMC in the loss firm subsample. The predominating insignificance of assessed risk-effort relations for loss firms may be driven by their business cycle attributes. These attributes are brought out by the revenue-based metric, SUBREVREV. The fact that these firms are showing a loss probably means that they are in the start-up phase of the business life cycle, as opposed to profit firms that are most likely in the growth or the maturity phase.[49] Revenue cycle testing may be less significant to the financial statement audit for firms in the beginning phases of the business life cycle. Thus, it is possible that there is very little variability in the revenue-

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[48] SUBREVDPT is deflated by the audit effort measure, THS.

[49] The drug discovery process takes, on average, 14 years to the final stages of FDA approval. (Orphan Drug laws have recently begun to decrease the average number of years to approval.) Likewise, to move software product to technological feasibility takes, on average 8 years. The

specific assessed risk and effort measures for loss firms in the industries I study. Further, the revenue-deflated metric, SUBREVREV, may provide a less meaningful metric in cases where few biotech milestone agreements exist, or where milestones will not reasonably be attained within the audit period. Similarly, revenue based metrics may be less meaningful for hightech firms whose products have not yet achieved technological feasibility. Audit procedures for startup biotech and hightech firms are relatively simple and standardized, consisting primarily of auditor inquiry about when the revenue cycle will, in essence, show variability and become significant to the audit.

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assurances firm has been auditing its loss clients for an average of five years, providing circumstantial evidence that these loss firms are in the start-up phase of the business life cycle.

CHAPTER 6. CONCLUSION

The auditor plays a monitoring role supporting efficient contracting and improves the reliability and credibility of the financial reporting process (Independence Standards Board Exposure Draft ED 00-2). Generally Accepted Auditing Standards facilitate the provision of a minimum level of audit assurance. The risk-focused auditing approach implicit in these standards promotes a linkage between assessed auditee risks and audit effort. My workpaper evidence enables more direct measures of assessed risk and audit effort that are finer and superior to proxies used in the prior literature. I find that all of the assessed risks are generally related to audit effort. While the assessed risk-effort relation holds, it does not do so consistently. Industry and profitability characteristics of the auditee appear to affect the auditor's use of the nature, timing, and extent of substantive testing. That is, it appears that auditors fine-tune their efforts based on specific auditee characteristics.

I study the assessed risk-effort relation because properly directed audit effort is critical to an effective and efficient audit (Mock and Wright 1993, Davidson and Gist 1996, Bedard et al. 2000). While auditors need to be cost-conscious, they should also effectively identify material misstatements (e.g., SAS No's. 53-61). An appropriate evidential focus is achieved by concentrating auditor effort on the management assertions with the highest levels of assessed risk. The audit risk model is the primary audit-planning tool used in practice.

However, contrary to the risk-focused approach espoused in the model, audit programs do not appear to be risk-adjusted (Bedard 1989; Mock and Wright 1993; Davidson and Gist 1996).

Prior studies focus on the extent of testing, and tend to have poor proxies for the nature and timing of substantive effort. These studies find a weak relation between assessed risk and proxies for effort. I contribute to the literature by providing evidence that auditors will vary the nature and timing of substantive effort in response to assessed risks. The challenges of creating metrics that appropriately capture auditor-assessed risk and audit investment decisions may contribute to the inconsistency and weak results in the prior literature. Unlike prior studies that use survey data gathered long after the completion of an audit, my study uses assessed risk designations and effort measures directly from auditor workpapers. I find results despite qualitative workpaper measures developed by auditors (e.g., assessed risk measures ranked as "low," "medium," and "high"), suggesting that the assessed risk-effort relation is quite powerful. While most of my measures are based on qualitative data, they capture the underlying auditor behavior more precisely than proxies used in the past.

Prior research has been forced to utilize noisy proxies in an attempt to capture the nature, timing, and extent of substantive tests. Prior archival studies have not found nature decisions made by auditors to be statistically related to assessed risks, potentially due to noisy proxies such as this. The timing of audit testing has not been studied in the prior literature due to the inaccessibility of

workpaper data. My measure of nature attempts to capture the validity and independence of audit evidence. I find an association between nature decisions and assessed risks. I also find auditor's timing decisions to be significantly related to assessed risks. My measure of extent is able to isolate all relevant substantive testing conducted during the audit. I find auditor's extent decisions to be significantly related to assessed risks.

To address the fact that auditors may vary the nature, timing, and extent of substantive tests simultaneously, I employ an instrumental variables approach (2SLS). The results from the 2SLS model indicate that, to some extent, auditors interrelate the nature, timing, and extent of testing in making evidential planning decisions. Thus, researchers should consider modeling nature, timing, and extent decisions *simultaneously*, unlike prior studies that may have had only a partial view of the assessed risk-effort relation due to data inaccessibility.

Several factors may potentially limit the generalizability of my results. First, my data is drawn from one specific office of one Big Five firm. While this reduces generalizablity, it reduces the variability in risk assessments due to the homogeneity of the training. Since professional audit standards require auditor training and quality control mechanisms to be in place for all audit firms, I argue that this increases the generalizability of my results. Second, the client firms from which this data is drawn are quite different from firms within the mature manufacturing industries examined in prior studies. I study high-risk firms representing two young industries with unique business environments. Third, I

focus my analysis on the more risky revenue cycle portion of the audit. While this is a narrow focus, an examination of this more risky audit area potentially provides a more powerful setting to study the assessed risk-effort relation implicit in the risk-focused approach.

Another potential limitation of this study is the lack of consideration of crossover effort from substantive procedures performed in other areas of the audit. For example, cash confirmations from banks often provide strong evidence of the existence of current year revenue for biotech firms. Future research that considers the effects of crossover substantive effort will contribute to our understanding of the evidential planning process.

The Public Oversight Board's Panel on Audit Effectiveness suggests that standard setters need to develop more definitive authoritative guidance linking risk assessments to the nature, timing and extent of substantive tests. The Panel's evaluation of *the* audit risk model supports the continuation of *an* audit risk model. My results suggest the need for auditee characteristics to be included in that model. This study finds that auditors follow a risk-focused approach to evidential planning, however, auditee business characteristics appear to affect auditor's evidential planning decisions. The Public Oversight Board acknowledges that the elements of the audit risk model may not represent a complete set of auditor considerations, reasoning, and judgment in evidential planning decisions. My reverse linkage model produces r-squared values of

approximately 70%, suggesting that while the audit risk model is used by auditors, it does not incorporate all of the auditors evidential planning criteria.

This dissertation examines the assessed risk-effort relation for the revenue cycle portion of the audit. My workpapers contain data on other portions of the audit as well. There are likely to be differences in the assessed risk-effort relation in audit areas deemed to be less risky than the revenue cycle portion of the audit. Future work that examines this relation in less risky audit areas will be useful in solidifying whether auditors adjust effort in the face of changing risks. Future work may also build on the detailed workpaper data on audit pricing, assessed risks of fraud and bankruptcy, and level of reliance on the external audit function. I plan to study the association between auditor's assertion level risk assessments and the related rate of detected misstatements. This research will essentially follow up on the work of Waller (1993).

APPENDIX A

The conventional definition of auditing as an objective examination of management's financial statements does not describe the audit process in a sophisticated manner because it does not consider the opinion formulation process as a whole.[50] The opinion formulation process is a complex sequential decision process used by auditors to reach an opinion on the financial statements; it encompasses an ordered interdependent set of tasks for evidence planning, collection, and evaluation (Felix and Kinney 1982; Solomon and Shields 1995).

Felix and Kinney (1982) depict a general outline of the auditor's opinion formulation process, beginning with input procedures that are designed to enable the auditor to develop normative expectations of management's assertions and to estimate an approximate audit strategy based on those expectations.[51]

The auditor's opinion formulation process begins with obtaining an overall understanding of the auditee. A sufficient analysis and understanding of

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[50] There are several primary concepts in auditing including but not limited to evidence, due audit care, fair presentation, independence, expectations, ethical conduct, responsibility and punishment (Schandl 1978). Although this list is not complete, it does include items that occupy an important position in the structure of auditing theory. This paper will focus on a small portion in the area of evidence.

[51] To accomplish this first step, the auditor achieves an adequate understanding of the nature of the client's business, its organization, and its operating characteristics through both qualitative and quantitative evidence. Such business evidence includes the type of business, types of products and services, capital structure, related parties, geographic and production considerations, as well as compensation methods. The auditor also considers matters such as economic conditions, government regulations, financial trends, changes in technology, and competitive conditions within the industry. This understanding is used to form an assessment of inherent risk. Interestingly, SAS do not specify the depth of knowledge necessary or require the auditor to perform any activities or procedures to assess inherent risk (SAS No. 22, 47). SAS No. 47 merely notes that the auditor needs to obtain an understanding of inherent risk. Moreover, it does not

the client's industry and business process is necessary to adequately plan the audit engagement.[52] After becoming oriented with the nature of the client's business, the auditor makes a preliminary evaluation of the internal control environment, system, and procedures.[53] Compliance tests of pertinent controls may then be performed.[54] If at this time the auditor is able to assess that control risk is below maximum, then the auditor may opt to decrease substantive procedures if reliance on internal controls appears to be cost effective.[55] Engagement conditions in which the auditor has assessed control risk at "below maximum" may allow the auditor to choose the reliance approach to auditing. In such audit circumstances where controls are in operation, pertain to the assertion at issue, and are likely to prevent and detect material misstatements, the auditor may choose to test and rely on those controls as a means to adequately reduce the cost of substantive tests. This understanding of internal controls, in conjunction with an adequate

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specify the depth of knowledge or activities and procedures necessary to assess inherent risk below the maximum, as in the case of control risk.

[52] Risk assessment alone is not sufficient to plan and execute an audit. An adequate understanding of the client is necessary to plan the audit engagement, particularly pertaining to the auditor's responsibility to assess the risk of fraud (See SAS No. 82).

[53] The control environment includes such factors as an informed and astute board of directors and audit committee. It encompasses a management team that fosters an appropriate attitude and awareness toward control issues such as the presence of appropriate personnel policies and organizational structure, with the proper assignment of authority. It also includes the presence of an internal audit function. The control system consists of the methods and records that are set up to record transactions. Control procedures provide reasonable assurance that the internal control structure's objectives will be met. They include transactions executed in accordance with management's authority and transactions that are properly recorded. They include procedures to provide reasonable assurance that access to assets is limited to appropriate personnel and that periodic comparison of physical assets to recorded assets is conducted. Segregation of duties is also a control procedure.

[54] For more guidance, see SAS No .55 and SAS No. 78.

[55] Like control risk, the inherent risk assessment is crucial in this evidential planning judgment. SAS No. 47 indicates that inherent risk should be assessed at the maximum in designing audit tests

understanding of the client's business and risks, determines the level of evidence consumption.[56] The substantive audit evidence is obtained, aggregated, and subjectively evaluated. While this opinion formulation process is presented as sequential, it is also iterative. The extent of iteration is determined to achieve maximum efficiency and effectiveness in the engagement. An audit opinion is formed and communicated.[57]

The resulting depiction in Felix and Kinney (1984) (see Figure 1) illustrates the component parts of the audit process as a series of interrelated judgments. The audit is not static or constrainable to an algorithm. Thus, it demands constant reevaluation and judgment based on all existing evidence in light of new and changing circumstances. While GAAS does call for auditors to consider numerous specific topics such as the requirement to assess the risk of fraud, GAAS also abound in imprecise appeals for the careful exercise of auditor judgment.

Felix and Kinney (1982) identify that a step in the auditor's logic process is the tactical planning for the collection of evidence. In this preliminary step, the auditor designs a package of audit procedures (e.g., by conducting tests of controls and substantive tests) that is expected to be efficient and effective and to

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when the effort required to assess inherent risk below the maximum for an assertion will exceed the potential reduction in substantive procedures gained from such an assessment.

[56] Manipulating the nature, timing and extent of substantive evidential procedures can vary evidence consumption.

[57] The audit process is carried out such that the financial statements present the truth, reasonably, in all material respects, and in appropriate statutory form. Effectively, the audit process (also termed an evaluation or audit inquiry) concludes when the auditor reaches an opinion on the likelihood of material financial misstatement.

collect sufficient and competent evidence to support the audit opinion. The auditor is not required to conduct tests of controls if controls will not be relied upon (i.e., under the purely substantive approach to auditing). In this case, the auditor will simply document in the workpapers the understanding of the internal control structure as well as the conclusion of the understanding of the internal control structure -- to execute the audit under the substantive approach. Contrary to the reliance approach, the auditor is not required to document the basis of the decision to perform under the substantive approach.

The auditor's tactical plan is preliminary since it may be modified as the auditor learns more about auditee risk. It is also in this tactical planning stage in which the auditor considers the alternative tests of controls and the different categories of substantive tests as well as the tradeoffs between these tests to arrive at the most economically resourceful means to an appropriate opinion. The mix of tests of controls and substantive tests is a matter of auditor judgment (SAS No. 47, 1983). The Public Oversight Board's Report on Audit Effectiveness (2000) indicates that the mix of tests of controls and substantive tests in their sample of audits varies widely among auditors, supporting that the evidence mix is subjective. The Report also notes that testing and relying on specific controls appears to be more common on larger audit engagements. Assessing control risk below the maximum level and relying on controls to reduce detailed substantive audit tests appear to be less common for small and medium-sized client entities.

In high-risk, high-profile areas, detailed tests appear to be conducted more often than relying on controls.

Based on the auditor's understanding of the client and assessment of various risks, as supported by the appropriate tests of controls, the auditor determines the categories and strengths of substantive evidence needed to support the audit opinion. This relationship between assessed auditee risk and the blend of substantive procedures is referred to as "linkage."

As depicted in Figure 2a, tests and evaluation of internal accounting controls and substantive tests of transactions and balances customarily follow the preliminary tactical planning stage.

The primary reason for the auditor's performance and consideration of risk assessments is to provide a basis for determining the nature, timing and extent of substantive tests. The auditor performs these substantive tests to attain the "reasonable assurance" required by GAAS concerning the reliability of the assertions that are rooted in the financial statements. The collection of linkage decisions is significant and challenging, requiring substantial amounts of judgment.[58] Holding all else constant, the higher the auditor-assessed risks, the more the auditor should focus on increasing the persuasiveness of the audit evidence (e.g., improving the nature of the substantive tests), increasing the extent of the substantive tests, and moving the performance of the substantive

[58] Linkage decisions should be made and reviewed by experienced personnel with the appropriate level of knowledge and skills. See the P.O.B. Report on Audit Effectiveness (2000).

procedures closer to the balance sheet date.[59] While the auditor is permitted to exercise substantial judgment in the linkage process, auditors must perform some amount of substantive tests of material account balances and transaction classes. In addition to determining the nature, timing, and extent of audit procedures, the auditor should also consider the various risk assessments in the assignment of staff as well as the appropriate level of supervision.

Schandl (1978) describes the evidential process by suggesting that auditors determine the audit opinion by obtaining and judging evidence in accordance with an established evidence model. Using such a model, the auditor concludes that the evidence (or the surrogates for evidence) is true, partially true (true with modifications), not true, or indeterminable due to non-existent evidence.[60] This paper focuses on the specific component of linkage in the evidential process, specifically, whether auditors appropriately focus effort based on their assertion-level risk assessments. It is important to note, however, that the relation between risk assessment and evidential planning is merely one of several critical links in the opinion formulation process. The contemporary approach to gathering evidence is to identify and focus on the highest-risk areas of the audit. Over time, auditors have adapted to the use of this risk-focused approach; it has

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[59] For example, if internal controls over the sales cycle are assessed as strong, the auditor may confirm a limited number of accounts receivable balances at interim and conduct fewer substantive tests at year-end; the auditor may rely on the client's internal control procedures. On the other hand, if controls are weak, the auditor may confirm a larger number of accounts receivable balances, and do so at year-end. Also, SAS No. 39, *Audit Sampling,* provides additional guidance on linking risk assessments to sample sizes in conditions in which sampling is applied.

become a practice norm and is presently considered by CPA firms to be the most efficient and effective means by which to plan and conduct audits (Huss et al., 2000).[61] This adaptation to the risk approach is a manifestation of the constraint that auditors cannot fully test every assertion that management makes in the financial statements. This logical, effective and efficient risk-focused evidence process contains two desirable properties. First, evidence resulting from a risk-focused approach will be more effective as to whether a significant assertion by management in the financial statements contains misstatements. This first benefit can be termed an evidential property. The second benefit is a planning property. Performance of a risk-focused approach in conjunction with a greater knowledge of the clients business (stemming from the auditors focus on core business areas and risks) may lead to a more efficient audit planning process.

The relationship between current and/or prior risk assessments and decisions about audit procedures is a key link in the audit risk model. According to GAAS, the expectation of a positive association between inherent and control risk assessments and initial sample sizes appears reasonable. This association, however, has not been statistically robust, as prior archival and experimental studies have found low or moderate effects for auditee risks on audit plans (Mock and Wright, 1999).

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[60] In this latter case, of course, the audit process ends because there is no evidence from which to pass a judgment or form an opinion.

[61] See Davidson and Gist (1996) for a related discussion.

In addition to utilizing the risk-focused approach, however, auditors also decompose audit processes into subtasks to achieve audit efficiency. Most auditing firms decompose the overall tasks into planning and evaluation phases (Felix and Kinney, 1982).[62] The audit is credited as a complex task that cannot be performed holistically and requires decomposition into subtasks (Waller and Felix, 1984). Felix and Kinney (1982) and Felix et al. (2000 w/p) note that the auditor's opinion formulation process decomposes and archives various auditee activities and characteristics for purposes of evidence collection and evaluation.

The audit evidence process may be described as a logical iterative sequence in the selection and processing of audit evidence. Iteration in the area of evidential planning may occur in any of the audit process steps outlined in Figure 2b. Evidence, which is gathered at different stages of the audit, continuously determines the need for additional evidence and continuously informs the auditor on the reliability of the assertions that are embedded in the financial statements. Auditor's evidence decisions are iterative, in that initial evidence collection may prompt additional evidence collection. Recognizing the option of extended testing may affect initial evidence decisions as well. Initial evidence may also be deemed to be sufficient to provide reasonable assurance that the assertions under audit are free of material error. Interestingly, Morton and Felix (1994) suggest that more general early audit evidence is more useful in forming beliefs than in

[62] In the planning phase, auditor's assessments about the risk of material misstatements in the financial statements inform planned test decisions that utilize the nature, timing and extent of evidence.

providing evidential support. Perhaps the early audit evidence is weighted more heavily. Behavioral accounting research has the potential to provide a deeper understanding in this area of evidential planning.

Felix and Kinney (1982) depict the audit tasks as sequential -- evidence is discovered and evaluated at different evidential points in the audit. While the iterative nature of the audit is acknowledged in the current literature, the significance of the chronological trait of the audit appears to be under-explored in the literature. The expectation of a positive association between the control and inherent risk assessment and initial sample size appears to be warranted, yet low or moderate association between auditee risk and audit plans is found in the current literature (Mock and Wright, 1999). In accordance with authoritative pronouncements, it appears appropriate to expect a statistically significant positive association between assessed risks and effort solely when effort is allowed to be broadly defined and the evidence pool is not limited to year end substantive tests as in the extant evidential planning literature.[63] Research in evidential planning should consider all partitions of evidence, thus affirming that the audit is both chronological and iterative. The extant research strives to find a correlation between assessed risk and primarily year-end substantive effort, often ignoring the substantive benefits received from interim audit work as well as dual-purpose compliance tests. Ignoring the chronological, sequential convention of auditing may account for the lack of statistical significance in evidential planning

studies.[64] Thus, there is a need to consider interim effort numbers as well as effort from dual-purpose tests – that is, more detailed evidence on the risk-effort relationship – to have an appropriate understanding of effort, broadly defined. A broader definition of effort should include substantive effort stemming from the completion of dual-purpose audit tests. Whether auditors react strongly to the initial substantive evidence such as evidence provided by dual-purpose tests is an empirical question (Morton and Felix 1994).

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[63] SAS No. 47 is merely a metaphor for the risk-approach to auditing. The SAS primarily provides guidelines to assist the auditor in the judgment decision process.

[64] Mock and Wright (1993, 1999) were unable to consider interim effort or dual-purpose compliance work due to a lack of archival data.

APPENDIX B

Auditors have incentives and competitive pressures to design effective and efficient audits. While audits need to be cost-conscious they should also effectively identify material misstatements. In testing management's assertions during a financial statement audit, the proper focus of audit procedures is critical. A proper focus is achieved primarily by both understanding the client and by concentrating auditor effort on those management assertions deemed to be most risky. Given the importance of planning and executing a competitive yet thorough audit, one would expect to observe a focus of effort in evidential plans that reflects the auditors beliefs about where misstatements are more likely to occur.

Although both effectiveness and efficiency of an audit engagement are difficult to observe, the extant auditing literature refers to effectiveness as providing the appropriate audit opinion and to efficiency as determining the appropriate opinion with the least amount of audit effort. The incentives and competitive pressures to design effective and efficient audits are numerous and pervasive. In theory, there is a real level of assurance that auditors must achieve (O'Keefe et al. 1994b). Thus, audits must be designed to be effective. The severe level of punishment (legal and reputation damages) resulting from a type II error (audit failure) encourages audit effectiveness (Palmrose 1988).

Audits must also be designed to be efficient. Efficiency in auditing means that evidence is being used in the most beneficial and useful manner possible. Efficiency is in the best interest of society and the accounting profession. The Big Five accounting firms seek continuous improvement in planning and executing audits. O'Keefe et al. (1994a) looks at the cross sectional relation between a single Big Five firm's use of different grades of professional labor and various client characteristics.[65] The authors note that efficiencies in the production of the audit provided an audit firm with pricing flexibility – that is, a competitive edge.

Studies on evidential planning at the firm level also support research on audit markets (Mock and Wright 1999). Research has attempted to understand the supply of, and demand for, audit services through studies involving audit fees, level of competition and quality. To improve our understanding of the market for audit services, it is useful to obtain evidence on the degree to which audit effort is driven by client risk.

[65] The sample consisted of 935 California school district audits. The authors noted that audit quality increases with the audit firm's industry-specific knowledge. An audit firm with greater industry-specific knowledge was assumed to be more efficient.

Figure 1. Felix and Kinney (1982) Overview

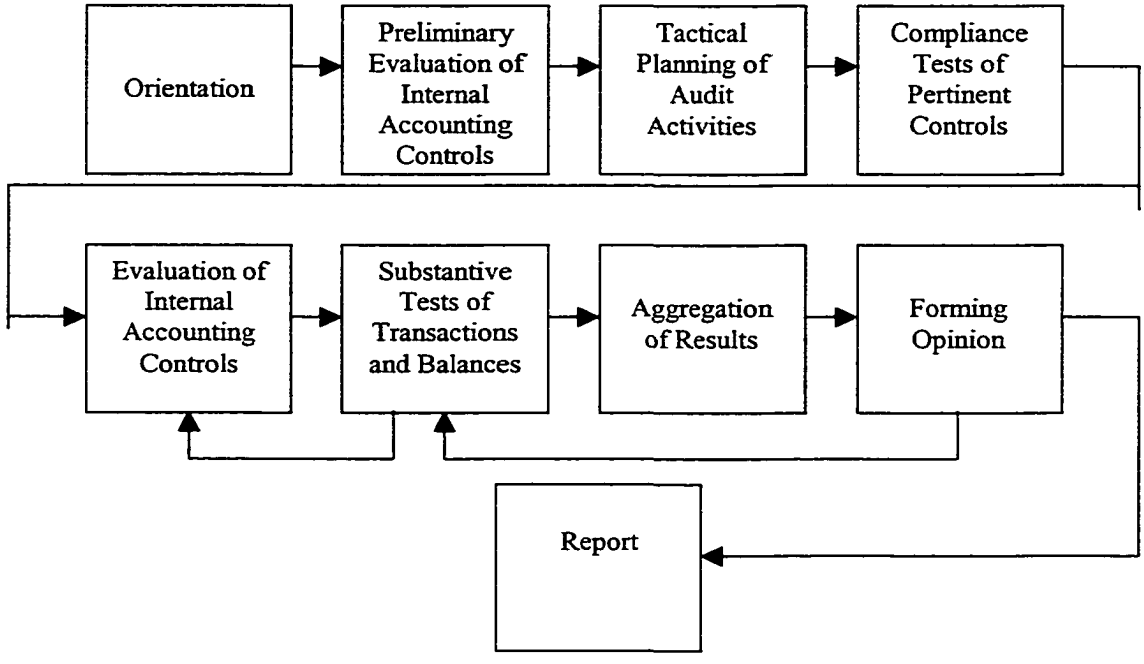

Figure 2a. Pro-forma Felix and Kinney Overview

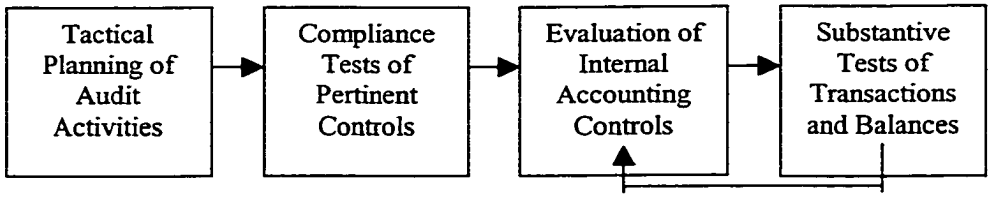

Figure 2b. Tactical Planning of Audit Activities

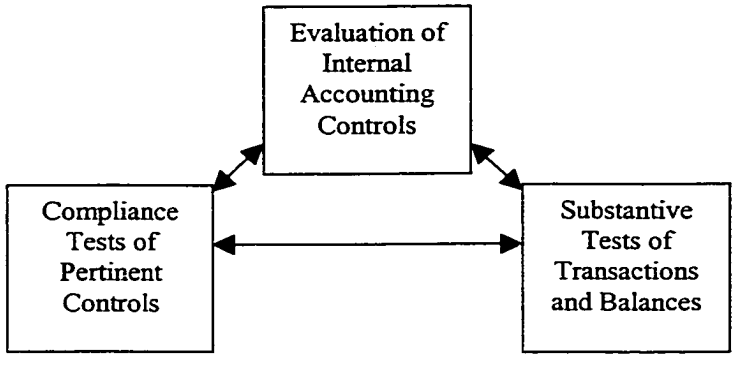

Table 1
Descriptive Statistics

Panel A: Mean Comparisons

Variable	Full Sample (n=78)	Biotech Firms (n=34)	Hightech Firms (n=44)	Loss Firms (n=47)	Profit Firms (n=31)
EQUITY	$171.23 M	$28.87 M	$281.23 M	$129.17 M	$235.00 M
TA	301.18	42.46	501.11	244.99	386.42
REV	339.57	17.71	588.28	218.17	523.64
NI	.97	-7.34	7.40	-27.65	44.36
PM	2.30	.50	3.70	1.66	3.29
IR	.51	.67	.38	.68	.26
CR	.51	.67	.38	.61	.35
REVIR	.53	.71	.38	.66	.32
REVCR	.44	.62	.29	.57	.23
REVMC	.48	.66	.34	.62	.27
NATURE	1.66	1.72	1.62	1.71	1.60
NOFTESTS	7.35	5.70	8.63	7.13	7.71
TIMING	83.50	89.02	79.22	85.94	79.81
SUBREVDPT	.08	.09	.07	.09	.07
EXTENT	.73	.74	.72	.73	.73
THS	1292.95	442.02	1950.48	1094.83	1593.32

Variable Definitions

EQUITY	= Client firm equity
TA	= Client firm total assets
REV	= Client firm revenue
NI	= Client firm reported net income or loss
PM	= Planning materiality set by auditor deflated by total client firm equity
IR	= Auditor assessed inherent risk
CR	= Auditor assessed control risk
REVIR	= Auditor assessed revenue cycle inherent risk
REVCR	= Auditor assessed revenue cycle control risk
REVMC	= Multiplicative combination of REVIR and REVCR
NATURE	= Average nature of revenue cycle audit tests
NOFTESTS	= Number of audit tests for the revenue section deflated by total client firm equity
TIMING	= Timing of audit procedures; a score of 100 translates to all substantive work conducted at year end
SUBREVDPT	= Total hours spent substantively auditing the revenue cycle including substantive tests from dual-purpose tests. This variable is deflated by total audit hours.
EXTENT	= Total substantive audit procedures deflated by total audit hours
THS	= Total audit hours deflated by the total client firm equity

Table 1
Descriptive Statistics (continued)

Panel B: Full Sample Statistics, N=78

Variable	Mean	Std Dev	Minimum	Maximum
EQUITY	$171.23 M	$371.17 M		
TA	301.18	708.59		
REV	339.57	1054.96		
NI	.97	72.10		
PM	2.30	5.13	.02	26.00
IR	.51	.69	0	2
CR	.51	.69	0	2
REVIR	.53	.68	0	2
REVCR	.44	.66	0	2
REVMC	.48	.65	0	4
NATURE	1.66	.33	1	2.20
NOFTESTS	7.35	3.32	3	16
TIMING	83.50	14.35	35	100
SUBREVDPT	.08	.04	.01	.22
EXTENT	.73	.07	.48	.87
THS	1292.95	2735.88	65	17000

Note: To keep the identities of the audit firm's clients confidential, the maximum and minimum values of financial statement variables are not delineated.

Table 1
Descriptive Statistics (continued)

Panel C: Biotech Sample Statistics, n=34

Variable	Mean	Std Dev	Minimum	Maximum
EQUITY	$28.87 M	$39.18 M		
TA	42.46	45.28		
REV	17.71	23.39		
NI	-7.34	14.10		
PM	.50	.37	.02	1.50
IR	.67	.72	0	2
CR	.67	.76	0	2
REVIR	.71	.72	0	2
REVCR	.62	.74	0	2
REVMC	.66	.70	0	4
NATURE	1.72	.32	1.16	2.20
NOFTESTS	5.70	2.18	3	13
TIMING	89.02	11.07	65	100
SUBREVDPT	.09	.04	.02	.17
EXTENT	.74	.06	.61	.85
THS	442.02	384.57	65	2180

Panel D: Hightech Sample Statistics, n=44

Variable	Mean	Std Dev	Minimum	Maximum
EQUITY	$281.23 M	$465.97 M		
TA	501.11	896.50		
REV	588.28	1359.16		
NI	7.40	95.19		
PM	3.70	6.52	.06	26.00
IR	.38	.65	0	2
CR	.38	.61	0	2
REVIR	.38	.62	0	2
REVCR	.29	.55	0	2
REVMC	.34	.57	0	4
NATURE	1.62	.34	1	2.20
NOFTESTS	8.63	3.51	4	16
TIMING	79.22	15.23	35	100
SUBREVDPT	.07	.05	.01	.22
EXTENT	.72	.07	.48	.87
THS	1950.48	3503.57	130	17000

Note: To keep the identities of the audit firm's clients confidential, the maximum and minimum values of financial statement variables are not delineated.

Table 1
Descriptive Statistics (continued)

Panel E: Loss Firms Sample Statistics, n=47

Variable	Mean	Std Dev	Minimum	Maximum
EQUITY	$129.17 M	$353.73 M		
TA	244.99	722.64		
REV	218.17	744.49		
NI	-27.65	51.80		
PM	1.66	4.16	.02	26.00
IR	.68	.78	0	2
CR	.61	.74	0	2
REVIR	.66	.73	0	2
REVCR	.57	.71	0	2
REVMC	.62	.70	0	4
NATURE	1.71	.35	1	2.20
NOFTESTS	7.13	3.10	3	16
TIMING	85.94	14.40	35	100
SUBREVDPT	.09	.05	.01	.22
EXTENT	.73	.06	.61	.85
THS	1094.83	2520.09	65	16778

Panel F: Profitable Firms Sample Statistics, n=31

Variable	Mean	Std Dev	Minimum	Maximum
EQUITY	$235.00 M	$393.44 M		
TA	386.42	689.62		
REV	523.64	1370.66		
NI	44.36	77.48		
PM	3.29	6.28	.12	25
IR	.26	.44	0	1
CR	.35	.61	0	2
REVIR	.32	.54	0	2
REVCR	.23	.49	0	2
REVMC	.27	.50	0	4
NATURE	1.60	.30	1.10	2.20
NOFTESTS	7.71	3.66	3	16
TIMING	79.81	13.70	60	100
SUBREVDPT	.07	.03	.01	.16
EXTENT	.73	.09	.48	.87
THS	1593.32	3052.68	110	17000

Note: To keep the identities of the audit firm's clients confidential, the maximum and minimum values of financial statement variables are not delineated.

Table 2
Regression Results: Simple Regressions Using Revenue Risk Measures as Independent Variables
Partitioned by NATURE, TIMING, and SUBREVDPT
(n = 78)
See Notes A and B

Panel A: Dependent Variable: NATURE

Independent Variable	Predicted Relation	Estimated Coefficients	t-value	p-value	R^2
REVIR	+	.31	7.00	.0000	.38
REVCR	+	.25	4.92	.0000	.23
REVMC	+	.30	6.17	.0000	.33

Panel B: Dependent Variable: TIMING

Independent Variable	Predicted Relation	Estimated Coefficients	t-value	p-value	R^2
REVIR	+	15.84	9.84	.0000	.55
REVCR	+	14.89	8.10	.0000	.46
REVMC	+	16.38	9.53	.0000	.54

Panel C: Dependent Variable: SUBREVDPT

Independent Variable	Predicted Relation	Estimated Coefficients	t-value	p-value	R^2
REVIR	+	.052	10.13	.0000	.57
REVCR	+	.056	11.40	.0000	.63
REVMC	+	.060	11.64	.0000	.64

A: Variable definitions are listed at the end of the table.
B: Each line reports the results of a separate simple regression of the form $y = a + bx + e$.

Table 2 (continued)

VARIABLE DEFINITIONS:

REVIR	= Auditor assessed revenue cycle inherent risk
REVCR	= Auditor assessed revenue cycle control risk
REVMC	= Multiplicative combination of REVIR and REVCR
NATURE	= Average nature of revenue cycle audit tests
TIMING	= Timing of audit procedures
SUBREVDPT	= Total hours spent substantively auditing the revenue cycle including substantive tests from dual-purpose tests. This variable is deflated by total audit hours.
R^2	= Adjusted R^2

Table 3
Regression Results Using Various Risk Measures
Basic Reverse Linkage Model
Full Sample and Partitions by Profitability

$$REVMC_i = \alpha + \beta_{1i}NATURE + \beta_{2i}TIMING + \beta_{3i}SUBREVDPT + \varepsilon$$

Panel A: Full Sample (n = 78) Dependent Variable: REVMC

Independent Variable	Predicted Relation	Estimated Coefficients	p-value	R^2 =.70
NATURE	+	.22	.1525	
TIMING	+	.01	.0011	
SUBREVDPT	+	7.28	.0000	

Panel B: Loss Firms (n = 47) Dependent Variable: REVMC

Independent Variable	Predicted Relation	Estimated Coefficients	p-value	R^2 = .66
NATURE	+	.18	.3532	
TIMING	+	.02	.0140	
SUBREVDPT	+	7.48	.0000	

Panel C: Profit Firms (n = 31) Dependent Variable: REVMC

Independent Variable	Predicted Relation	Estimated Coefficients	p-value	R^2 = .74
NATURE	+	.52	.0605	
TIMING	+	.01	.0881	
SUBREVDPT	+	5.08	.0133	

REVMC = The multiplicative combination of IR and CR
NATURE = Average nature of revenue cycle audit tests
TIMING = Timing of audit procedures; a score of 100 translates to all substantive work conducted at year end
SUBREVDPT = Total hours spent substantively auditing the revenue cycle including substantive tests from dual-purpose tests. This variable is deflated by total audit hours.
R^2 = Adjusted R^2

Table 4
Regression Results Using: Two Stage Least Squares (2SLS)
Risk Measure: REVMC

Simultaneously run:

$$NATURE_i = \alpha + \beta_{1i}REVMC + \beta_{2i}TIMING + \beta_{3i}SUBREVDPT + \varepsilon$$
$$TIMING_i = \alpha + \beta_{1i}\ REVMC + \beta_{2i}NATURE + \beta_{3i}SUBREVDPT + \varepsilon$$
$$SUBREVDPT_i = \alpha + \beta_{1i}\ REVMC + \beta_{2i}TIMING + \beta_{3i}NATURE + \varepsilon$$

Panel A: *Full Sample (n = 78)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	4.55	.1525				-	-.06	.2323	-	-33.09	.1909
TIMING	+	71.47	.0011	-	-15.71	.2323				-	-520.03	.0185
SUBREVDPT	+	.14	.0000	-	-.03	.1901	-	-.01	.0185			

Panel B: *Loss Firms (n = 47)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	5.43	.3532				-	-.08	.4165	-	-40.58	.3813
TIMING	+	66.04	.0140	-	-12.17	.4165				-	-493.96	.0801
SUBREVDPT	+	.14	.0000	-	-.03	.3813	-	-.01	.0801			

Table 4 (continued)

Panel C: *Profit Firms (n = 31)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	1.92	.0605				-	-.02	.2848	-	-9.74	.2113
TIMING	+	109.81	.0881	-	-57.29	.2848				-	-557.79	.1991
SUBREVDPT	+	.20	.0133	-	-.10	.2113	-	-.01	.1991			

REVMC = The multiplicative combination of IR and CR
NATURE = Average nature of revenue cycle audit tests
TIMING = Timing of audit procedures; a score of 100 translates to all substantive work conducted at year end
SUBREVDPT = Total hours spent substantively auditing the revenue cycle including substantive tests from dual-purpose tests. This variable is deflated by total audit hours.

Table 5
Regression Results: Two Stage Least Squares (2SLS)
Risk Measure: REVMC
Breakout by Industry

Simultaneously run:

$$NATURE_i = \alpha + \beta_{1i}\, REVMC + \beta_{2i} TIMING + \beta_{3i} SUBREVDPT + \varepsilon$$
$$TIMING_i = \alpha + \beta_{1i}\, REVMC + \beta_{2i} NATURE + \beta_{3i} SUBREVDPT + \varepsilon$$
$$SUBREVDPT_i = \alpha + \beta_{1i} REVMC + \beta_{2i} TIMING + \beta_{3i} NATURE + \varepsilon$$

Panel A: *Full Sample (n = 78)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	4.55	.1525				-	-.06	.2323	-	-33.09	.1909
TIMING	+	71.47	.0011	-	-15.71	.2323				-	-520.03	.0185
SUBREVDPT	+	.14	.0000	-	-.03	.1901	-	-.01	.0185			

Panel B: *Biotech Firms (n = 34)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	-5.08	.5552				-	.10	.5290	-	56.54	.5358
TIMING	+	50.52	.0684	-	9.94	.5290				-	-561.95	.1643
SUBREVDPT	+	.09	.0005	-	-.02	.5358	-	-.01	.1643			

Table 5 (continued)

Panel C: *Hightech Firms (n = 44)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVDPT		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	3.54	.0750				-	-.04	.1674	-	-20.71	.1151
TIMING	+	79.28	.0034	-	-22.43	.1674				-	-464.38	.0389
SUBREVDPT	+	.17	.0000	-	-.05	.1151	-	-.01	.0389			

REVMC = The multiplicative combination of IR and CR
NATURE = Average nature of revenue cycle audit tests
TIMING = Timing of audit procedures; a score of 100 translates to all substantive work conducted at year end
SUBREVDPT = Total hours spent substantively auditing the revenue cycle including substantive tests from dual-purpose tests. This variable is deflated by total audit hours.

Table 6
Regression Results: Two Stage Least Squares (2SLS)
Risk Measure: REVMC
Extent Measure: SUBREVREV

Simultaneously run:

$$NATURE_i = \alpha + \beta_{1i}\, REVMC + \beta_{2i} TIMING + \beta_{3i} SUBREVREV + \varepsilon$$
$$TIMING_i = \alpha + \beta_{1i}\, REVMC + \beta_{2i} NATURE + \beta_{3i} SUBREVREV + \varepsilon$$
$$SUBREVREV_i = \alpha + \beta_{1i}\, REVMC + \beta_{2i} TIMING + \beta_{3i} NATURE + \varepsilon$$

Panel A: *Full Sample (n = 78)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVREV		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	2.80	.0550				-	-.06	.0998	-	-2.23	.2691
TIMING	+	46.29	.0000	-	-16.51	.0998				-	-36.60	.1984
SUBREVREV	+	1.26	.1008	-	-.45	.2691	-	-.03	.1984			

Panel B: *Loss Firms (n = 47)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVREV		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	10.76	.7049				-	-.20	.7073	-	-19.24	.7258
TIMING	+	53.15	.0148	-	-4.94	.7073				-	-95.05	.1889
SUBREVREV	+	.56	.1015	-	-.05	.7258	-	-.01	.1889			

Table 6 (continued)

Panel C: *Profit Firms (n = 31)*

Dependent Variable	REVMC			NATURE			TIMING			SUBREVREV		
	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value	Pred	Coeff	p-value
NATURE	+	1.11	.0014				-	-.01	.1691	-	-.03	.0497
TIMING	+	76.76	.0606	-	-69.28	.1691				-	-2.16	.0489
SUBREVREV	+	35.56	.0133	-	-.10	.0497	-	-.01	.0489			

REVMC = The multiplicative combination of IR and CR
NATURE = Average nature of revenue cycle audit tests
TIMING = Timing of audit procedures; a score of 100 translates to all substantive work conducted at year end
SUBREVREV = Total hours spent substantively auditing the revenue cycle, including substantive tests from dual-purpose tests, deflated by total auditee revenue

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