

Auditing:
A Journal of Practice
& Theory
Vol. 17, No. 1
Spring 1998

An Empirical Investigation of the Relationship Between the Computerization of Accounting Systems and the Incidence and Size of Audit Differences

**Timothy B. Bell, W. Robert Knechel, Jeff L. Payne
and John J. Willingham**

SUMMARY

The decade of the 1980s saw a surge in research examining the empirical characteristics of audit differences detected in audit engagements. This paper examines the differential impact of computerization on common attributes of audit differences that have been studied in previous papers. Consistent with prior studies, the results of this study indicate that the majority of audit differences (misstatements) arise due to incorrect computations, differences in management and auditor judgment, faulty initial identification and processing of transactions, and overworked accounting personnel. Likewise, audit differences related to control attributes are usually associated with inadequately skilled personnel, improper or inadequate independent verifications, or improper documents and records; audit differences are rarely associated with inadequate controls over assets or records. This study reports additional findings that incorrect manual computations, the recording of exchange documents, incorrect application of internal controls, and inadequate internal controls are more likely to be sources of problems when information systems are computerized than when they are not. Finally, very few of the audit differences in this study were associated in any way with failures in the computerized system. This information should be useful for auditor planning in computerized environments and highlights the need to adequately consider the nature and reliability of such systems in the planning stages of an engagement.

Key Words: Audit planning, Audit difference, Fraud, Information technology.

Data Availability: Contact the authors concerning data availability.

Information technology can be viewed as a source of increased control over information and business processes or as a potential source of audit problems. Conventional wisdom suggests that data processing will generally be more reliable when automated, but also suggests some important concerns, e.g., converting of data to electronic form, limiting access to software and data, and developing new software. The purpose of this study is to provide empirical evidence about the differential impact of computerization on the causes of audit differences and the effectiveness of internal

Timothy B. Bell is with KPMG Peat Marwick; W. Robert Knechel is a Professor at the University of Florida; Jeff L. Payne is an Assistant Professor at the University of Mississippi; and John J. Willingham is retired from the University of Texas at Austin.

We acknowledge the helpful comments of the anonymous reviewers. Earlier versions of this paper benefited from comments received from participants in seminars at the University of Kansas, the University of Oklahoma and the 1996 International Symposium on Audit Research in Maastricht.

controls.¹ To facilitate audit planning, auditors obtain an understanding of internal control, make assessments of the inherent and control risks of significant financial statement assertions, and determine the nature, extent and timing of audit procedures to perform. In order to accurately assess inherent and control risk, auditors must have a good understanding of the attributes of reliable accounting systems. Available evidence suggests that audit differences will occur more frequently when an accounting system is poorly designed, overly complex, relies on manual computation, or lacks key controls. This paper examines whether extensive computerization within the accounting system has a differential impact on the association of these general attributes with the incidence and magnitude of audit differences.

Consistent with prior studies, this study reports that most audit differences arise from differences in judgment between the auditor and management, incorrect manual computations, incorrect application of internal controls, missing internal controls and breakdowns due to overworked accounting personnel. More importantly, this study reports additional findings that incorrect manual computations, improper recording of exchange documents, incorrect application of internal controls, and inadequate internal controls are *more likely* to be sources of problems when information systems are computerized. The results reported in this paper should be important to auditors who are planning engagements in a computerized environment.

The remainder of the paper is organized as follows. The next section describes the elements of inherent and control risk that are of interest in this study and the expected relationship between computerization and audit risks. The second section raises the specific research propositions to be addressed in the study. The third section describes the approach to data gathering and analysis. The results of the empirical analysis are presented in section four. Finally, a summary and discussion is presented in the last section.

RISK ASSESSMENT AND ACCOUNTING INFORMATION SYSTEMS

Auditors are required to obtain a level of understanding of internal control which is adequate for planning an engagement. As part of

this process, auditors make assessments of the inherent and control risks of significant assertions related to material account balances. These assessments have a direct impact on the planning of an audit engagement, affecting the nature, extent and timing of audit procedures performed. Professional standards provide guidance to auditors when making assessments of inherent and control risk. This guidance applies to all engagements, regardless of the extent of computerization within the accounting system.²

Auditors are increasingly concerned about the implications of information technology for assessing risk and planning the engagement. Information technology (IT) has a direct impact on control risk and may preclude the auditor from performing a purely substantive audit. This point is emphasized in Statement on Auditing Standards No. 80:

In entities where significant information is transmitted, processed, maintained, or accessed electronically, the auditor may determine that it is not practical or possible to reduce detection risk to an acceptable level by performing substantive tests for one or more financial statement assertions....In such circumstances, the auditor should perform tests of controls to gather evidential matter to use in assessing control risk, or consider the effect on his or her report. (SAS No. 80, para. 14)

Furthermore, the planning of audit tests will depend on the nature of information technology that is used in data processing:

In certain entities, some of the accounting data and corroborating evidential matter are available only in electronic form....Certain electronic evidence may exist at a certain point of time. However, such evidence may not be retrievable after a specified period of time. (SAS No. 80, para. 19)

¹ Audit differences include accounting errors and fraudulent financial reporting.

² For example, see §AU312 "Audit Risk and Materiality in Conducting an Audit"; §AU316 "Errors and Irregularities"; §AU319, "Consideration of the Internal Control Structure in a Financial Statement Audit"; and §AU326 "Evidential Matter" (as amended by SAS No. 80) of the AICPA's codification of auditing standards.

In other words, the auditor must understand how information technology affects transaction processing and factor that understanding into the planning of the engagement.

In order to accurately assess inherent and control risk, auditors must have a good understanding of the attributes which indicate whether an information system is reliable. *Systems Auditability and Control* by the Institute of Internal Auditors (1992) and *Internal Control: An Integrated Framework* by the Committee on Sponsoring Organizations of the Treadway Commission (1992) describe the risks associated with computerized information systems. The former document included an empirical examination of risks related to computerized information systems and identified "unauthorized access or changes to data and systems" and "data accuracy and integrity" as the two most critical risks related to information technology. Both of these risks can be considered to be accounting-related. Only one other accounting-related risk was identified, i.e., the "lack of available skilled human resources."³

Many control concepts are well understood by auditors in traditional information systems, e.g., the need for segregation of duties, specific authorization procedures, adequate documents and records, independent verification of transaction processing, and restricted access to assets.⁴ This understanding, however, may be lacking when applied to technology-based information systems, since controls are implemented much differently in such an environment. Practicing auditors may have inadequate *empirical* knowledge of the relationship between the accounting and data processing attributes that determine the risk of material misstatements occurring. A typical result of this incomplete understanding is that the design of audit testing tends to emphasize direct tests of account balances and to ignore the assurance that can be obtained from a reliably controlled information system, especially one based on extensive computerized procedures. Such an audit approach may be effective but may not be efficient.⁵ Furthermore, new audit methodologies are increasingly emphasizing the role of management and process controls in audit planning.⁶

Controls in a computerized environment are often perceived differently than those in a manual system. *Application controls* improve the reliability of data processing by preventing, detecting and correcting errors in individual transactions as they are processed within the system. Data entry is considered to be a common source of mistakes because it may involve manual transformation of data into electronic form (e.g., keying or scanning of data). Breakdowns in subsequent processing can be caused by hardware or software problems, improper processing by human agents or improper handling of exceptions.

³ Most of the risks addressed in *Systems Auditability and Control* (IIA 1992) dealt with the cost effectiveness, compatibility and appropriateness of computing systems.

⁴ See Arens and Loebbecke (1994, 278) for a discussion of the five basic types of control procedures included in most accounting systems. These categories have been modified by SAS No. 78 which adopted the Committee of Sponsoring Organizations of the Treadway Commission (COSO) (1992) terminology for internal controls. We retain the older terminology because it was the accepted basis for describing controls when the data was gathered.

⁵ As noted above, SAS No. 80 questions whether a purely substantive approach to auditing is possible. Many auditing researchers downplay the issue of efficiency based on the argument that effectiveness is ultimately the key concern for auditors. However, there are at least two counter-arguments to this position. First, competitive pressure has caused a reduction in audit fees and audit firms are looking for ways to cut man-hours on engagements without reducing the level of assurance obtained. As a result, the substitution of low-cost procedures for high-cost procedures may be necessary to ensure long-term firm profitability. Second, a common misconception is that an auditing firm can rapidly increase the audit resources it has available. This is simply not true within a limited time period, such as a busy season, especially when considering *experienced* personnel. Therefore, most firms operate with a relatively fixed level of resources which can be brought to bear on any given engagement. Excessive use of such resources in a low-risk engagement/audit area means fewer resources are available for high-risk engagements/audit areas, i.e., efficiency breakdowns in one engagement may result in effectiveness breakdowns in others. Hackenbrack and Knechel (1997) find evidence of this efficiency/effectiveness trade-off by analyzing time usage in audit engagements for an international accounting firm. They found virtually no reduction of substantive tests when auditors indicated they were relying on internal control as a source of assurance.

⁶ Most large audit firms have significantly redesigned their audit methods in the past few years, placing heavy emphasis on analytical procedures and management controls. For example, see Knechel (1997).

General controls are designed to assure that application controls operate in the most effective manner. Some of the concerns of general controls include system development and maintenance, system security and access, database integrity, reliability of end-user computing, and contingency planning. Since system software and applications come from different sources (e.g., external vs. internal development) and get used at different levels of the organization (e.g., centralized vs. distributed vs. desktop processing), we expect that the risks of each will vary.⁷

Because of the different perspective about controls, many traditional control concepts need to be applied differently in a computerized environment. To illustrate:

- Segregation of duties: The write-off of bad debts is usually segregated under someone other than the credit manager. If a computer operator has access to receivable files, however, he may authorize credit entries for write-offs without proper authority and in spite of the appearance of segregated duties.
- Adequate documents and records: Basic principles of system design suggest that documentary evidence of a transaction should be prepared as soon as the transaction occurs (this is sometimes referred to as a boundary document). In a computerized environment, however, transaction entry and processing occur without the preparation of paper-based documents.
- Restricted access to assets: Inventory should be kept in a secure facility so as to limit the opportunity for employee theft. Such restrictions can be overcome, however, by a computer operator who can generate an authorization to have inventory moved to a less secure area.

The key point of these illustrations is that *physical* internal controls that appear to be effective can be overcome by *electronic* means, which necessitates a different approach to achieving the organization's control objectives.

Computerization also creates significant opportunities for increased control that are not available in a manual system. The computer's ability to scan all transactions, perform edit and

field checks, and compare and reconcile data across systems and sources can be used to greatly improve the reliability of information processing. Kreutzfeldt and Wallace (1986) found that better general controls led to reduced audit difference rates. Unfortunately, many auditors fail to recognize these beneficial capabilities and do not adequately factor the existence of such controls into the audit plan (Waller 1993).

Auditing firms have historically relied on special experts to assess the reliability of computerized systems. As a natural outgrowth of this philosophy, many auditors feel that they lack the expertise to adequately evaluate and test automated systems and, accordingly, plan their engagements so as to audit "around" the computer as often as possible (Ellis 1989). As accounting systems become increasingly automated, and such automation becomes virtually universal, auditors need to reconsider the appropriateness of this strategy. In order to adopt appropriate audit strategies, however, auditors need to develop a more complete understanding of the relationship between system attributes (especially IT-related controls) and the incidence of audit differences.

PRIOR RESEARCH AND STATEMENT OF RESEARCH PROPOSITIONS

Little or no empirical evidence is available addressing the relationship between computerized information systems and audit differences. In order to expand the empirical understanding of the impact of computerization on audit differences, we examine a number of internal control and system attributes and their correlation with observed audit differences in both computerized and noncomputerized environments. Prior research on general attributes of audit differences has shown a number of common patterns.⁸ For

⁷ *Systems Auditability and Control* provides extensive details on the risks of automated information systems, the design of appropriate control systems and the audit of those systems. The general discussion of general and application controls appears in Module 2, "Audit and Control Environment" (specifically, see IIA 1992, chap. 2).

⁸ See Ramage et al. (1979), Hylas and Ashton (1982), Kreutzfeldt and Wallace (1986), Roberts and Wedemeyer (1988), Wright and Ashton (1989) and Houghton and Fogarty (1991).

example, prior research has shown that audit differences are frequently caused by incompetent personnel, improper period cutoff, and errors in judgment. We also know that audit differences are frequently detected by high-level analytical procedures but that the incidence of audit differences is not well correlated with auditor assessments of inherent and/or control risk (Waller 1993). Finally, we know that small companies, companies with poor controls, companies with complex transactions and companies with low profitability are more likely to have errors in their financial statements (Kreutzfeldt and Wallace 1986). None of the prior studies have specifically addressed the impact of computerization on these error attributes, however.

For the purposes of this study, we have selected the most commonly identified error attributes in prior studies and gathered data about their relative occurrence in computerized and noncomputerized systems. Based on logical analyses of common principles of system design and internal control, we generate expectations about whether these error attributes are more or less likely to occur in a computerized system.

Causes of Audit Differences Not Expected to be Affected by Information Technology

In spite of advances in expert systems, computers are not flexible when dealing with unusual or subjective situations which may require intervention by a human decision maker. As a result, transactions which require the use of extensive judgment may be subject to essentially the same risk whether or not a system is computerized. Therefore, our first proposition is:

- P1:** Judgment errors should not be more or less frequent in computerized systems.⁹

Causes of Audit Differences Expected to be Reduced by Information Technology

Computerized information systems have a number of advantages over manual systems. Computers are able to process large quantities of data in an identical manner, subject data to built-in edit checks, automate computations and transfer data between files without error or loss.¹⁰

Houghton and Fogarty (1991) found that routine transactions have lower error rates than nonsystematic transactions. As a result, our next three propositions suggest specific causes of audit differences that should be *less* frequent in computerized systems:

- P2:** Incorrect manual computations are less frequent in computerized systems.
P3: Incorrect data in an exchange document is less frequent in computerized systems.
P4: Omission of an exchange document is less frequent in computerized systems.

Error Attributes of Internal Control Expected to be Reduced by Information Technology

Computerization can lead to increased information reliability in many situations. Internal controls in a computerized system can be highly effective because they will be executed uniformly across transactions and need not be subject to sampling constraints. Further, since they are often transparent to the user, such controls are difficult to circumvent. We have three propositions related to internal control problems that are expected to be *less* frequent when a system is computerized:

- P5:** Controls applied on a sample basis are less frequently associated with audit differences in a computerized system.
P6: Incorrect application of controls are less frequently associated with audit differences in a computerized system.
P7: Management override of controls are less frequently associated with audit differences in a computerized system.

⁹ An alternative proposition is that information technology provides better information for monitoring situations involving judgment (e.g., accounting estimates) and that audit differences may be affected by the availability of more detailed and accurate monitoring information. In this situation, computerization may either increase or decrease the rate of audit differences.

¹⁰ COSO (1992, 50) specifically discusses the potential risks associated with data exchange in information systems.

Error Attributes of Internal Control Expected to Increase With Information Technology

Internal control may also present some problems when a system is computerized. For example, controls in a computerized system may be more complex and less well understood than in a manual system. There are a multitude of contingencies that must be explicitly considered in a system and hidden interactions among components that might not be apparent or considered within the system design. Furthermore, since many of the traditional control concepts used in information systems may become less effective when electronic means of circumvention exist, commonly considered aspects of control, such as segregation of duties or control of assets, may be less effective. For example, segregation of duties may be needed within data processing (e.g., system design, programming, data maintenance and operations) as well as across more traditional dimensions in transaction processing. Finally, we expect that computerized systems will require a higher degree of competence to implement and operate than a manual system.¹¹ We state six propositions related to internal control attributes which may be associated with more frequent audit differences when a system is computerized:

- P8:** Lack of appropriate controls are more frequently associated with audit differences in computerized systems.
- P9:** Inadequate controls are more frequently associated with audit differences in computerized systems.
- P10:** Inadequate safeguard of assets is more frequently associated with audit differences in computerized systems.
- P11:** Poor segregation of duties is more frequently associated with audit differences in computerized systems.
- P12:** Problems with accounting personnel are more frequently associated with audit differences in computerized systems.
- P13:** Problems with management personnel are more frequently associated with audit differences in computerized systems.

Supplementary Analysis

For each of the expected effects discussed above we will also examine the impact of fraudulent transactions, account classification and company size on the results. Due to the basic nature of most fraudulent transactions, we expect that there will be differences in the attributes of audit differences caused by fraud (see SAS No. 82). Also, different industries have different key processes that are computerized, therefore, based on results reported in prior studies (e.g., Kreutzfeldt and Wallace 1986; Bell and Knechel 1994; Maletta and Wright 1996), we expect to observe differences across accounts as a result of differences in levels of computerization. Finally, we expect to see differences across companies of different sizes because smaller companies are less likely to have extensive, sophisticated and integrated computerization within their information system and are less able to afford the resources and talent needed to utilize computerized systems effectively and efficiently.

SURVEY INSTRUMENT AND SAMPLE DESCRIPTION

A detailed questionnaire was developed to gather information on the relationship between IT system attributes and the incidence of audit differences. Part I of the survey requested general engagement information such as audit gauge (planning materiality), extent of system computerization, complexity of the computer environment, and whether reliance was placed on IT and/or other controls.

In Part II, respondents were asked to identify the audit differences detected in the course of the engagement and to answer a series of questions for each audit difference (see table 4). Audit differences were defined to include accounting errors (unintentional misstatements) and fraud (intentional misstatements). Respondents were instructed to include immaterial audit differences,

¹¹ See *Systems Auditability and Control*, (IIA 1992, Module 9, 9-4). While computerized systems are often designed to alleviate errors by the lowest level employee (e.g., clerks or salespeople), the systems must still be designed and operated at a level that requires substantial competence at higher personnel levels.

but entries made by the auditor at the request of the client (e.g., tax provision entries) were omitted. The questions for each audit difference were derived from a detailed examination of the five basic types of control procedures and the two broad classes of IT controls.¹²

The survey instrument was pretested on a small number of engagements by members of the research team in consultation with the audit team. Subsequently, surveys were mailed directly to respondents. In all cases, the survey was completed by either the manager or senior on the engagement. In order to provide quality assurance over survey responses, computer audit specialists from the office that conducted the audit were required to review the completed surveys for accuracy.

A target sample of 385 audit engagements for fiscal 1988 were randomly selected from a large international accounting firm's U.S. client database. The target population included both public and private entities (including not-for-profit entities). For those engagements where the client was a consolidation or combination of separate entities, respondents were asked to select the one entity whose operations and industry best represented the consolidated group. Responses were received for 358 engagements. Eighty-two of these responses were eliminated because they were not full-scope audits. Thirty-four financial institutions were also eliminated due to the unique nature of their operations and account structures, yielding a final sample of 242 full-scope audit engagements. On average, the survey instrument took six hours to complete.

Table 1 reports the industry composition of the final sample of 242 engagements. In total, 2,221 audit differences were reported for the sample of 242 engagements. Table 2 categorizes the 2,221 audit differences by account group. The largest concentrations of audit differences relate to inventory (351), accrued liabilities (348) and accounts receivable (236). Almost 15 percent of the 2,221 audit differences were reclassification entries. Also, 5.87 percent (11.38 percent) of the audit differences were larger than gauge (50 percent of gauge) and 5.77 percent of the audit differences were considered to be fraudulent.

Table 3 presents the mean and median of the magnitudes of the audit differences classified by account (negative amounts reflect credit amounts). The magnitude of each of the audit differences was also divided by gauge for the engagement to obtain a measure of the misstatement's significance relative to the size of the company.¹³ Table 3 also presents the percentage of audit differences which were income *reducing*. Summary totals are presented for assets, liabilities/equity and net income. Looking at these aggregates, we see that the mean impact on assets is a net credit of \$105,158, which represents 8.9 percent of gauge, with 55 percent of the

¹² The five types of control procedures are (1) segregation of duties, (2) authorization procedures, (3) adequate documents and records, (4) independent verification, and (5) limited access. The two categories of EDP control are general controls and application controls.

¹³ Gauge is defined as a floating percentage of assets or revenues, whichever is larger. The percentage used to compute gauge depends on the level of assets and revenues.

TABLE 1
Classification of Survey Engagements by Industry

Industry	Surveys		Audit Differences	
	Number	% of Total	Number	% of Total
Agriculture	10	4.1	104	4.7
High Technology	16	6.6	205	9.2
Manufacturing	65	26.9	714	32.1
Merchandising	31	12.8	476	21.4
Real Estate	11	4.5	83	3.7
Other	109	45.0	639	28.8
Totals	242	100.0	2,221	100.0

TABLE 2
Audit Differences Classified by Account Group

<u>Account Group</u>	<u>Number of Audit Differences</u>	<u>% of Total Differences</u>
Cash	53	2.39
Marketable Securities	4	0.18
Accounts Receivable	236	10.63
Inventory	351	15.89
Other Current Assets	106	4.77
Land	5	0.23
Depreciable Assets	161	7.25
Intangible Assets	12	0.54
Investments	27	1.22
Other Assets	106	4.77
Accounts Payable	160	7.25
Accruals	348	15.67
Long-Term Liabilities	6	0.27
Other Liabilities	102	4.59
Deferred Taxes	5	0.23
Retained Earnings	29	1.31
Other Equity	7	0.32
Reclassification Entries	326	14.68
Other	177	7.83
Total	2,221	100.00

entries being income reducing. For liabilities and equity, the mean effect is a net debit of \$69,296 but, when scaled by gauge, we see a net credit of 28.1 percent with 67.2 percent of the entries being income reducing.¹⁴ Finally, 74.2 percent of the adjustments to income reduce net income, with a mean net debit of \$89,392 representing 47.7 percent of gauge.

RESULTS

We first present our primary results related to the differential impact of computerization on the attributes of audit differences. We then present supplemental analyses examining fraudulent transactions, account classification, and company size differences. We examine both the rate at which audit differences occur and the magnitude of the audit differences relative to gauge. Audit difference rates are based on the frequency of error causes and internal control attributes relative to the population of all observed audit differences. Audit difference magnitudes are standardized by dividing the raw audit difference by gauge. The average audit

difference magnitude is computed relative to audit differences having a specific attribute, not relative to all audit differences.

Primary Propositions: Analysis of Aggregate Audit Difference Rates

Table 4 summarizes our results related to our 13 primary propositions.¹⁵ We report t-statistics to test differences between computerized and noncomputerized systems. The tests of audit difference rates are one-sided because our propositions are directional, but the

¹⁴ The fact that the unscaled errors average to a net debit while the errors scaled by gauge average to a net credit suggests that the debit errors occur when gauge is large. The scaling process then has the effect of discounting the debit entries relative to the credit entries, resulting in a shift in the sign of the average error.

¹⁵ The percentages in tables 4-7 do not add to 100 percent because more than one attribute of interest may be present in any given audit difference. The survey totals in tables 4-7 will exceed 242 as each survey could provide more than one input when responses are separated by computerization, audit difference classification, account and company size.

TABLE 3
Summary Statistics for Audit Difference Magnitudes by Account

<u>Account</u>	<u>N^a</u>	<u>Mean: Debit (Credit)</u>	<u>Median: Debit (Credit)</u>	<u>Mean Relative to Gauge</u>	<u>% of Items Decreasing Income^b</u>
Assets:					
Cash	109	14,119	1,643	1.9%	39.4
Receivables	337	(51,902)	(3,250)	2.0	63.0
Allowance for Bad Debts	38	(14,165)	(12,869)	-5.1	75.9
Inventory	401	(9,846)	(800)	-10.9	57.1
Prepaid Assets	64	(17,618)	56	-8.4	47.3
Land	19	(44,405)	(1,232)	-12.4	58.1
Plant Assets	171	6,350	4,925	10.3	40.9
Accumulated Depreciation	82	16,516	(619)	5.1	63.5
Investments	53	91,606	6,000	25.3	41.3
Intangibles	22	(279,758)	(1,770)	38.2	54.0
Total Across Engagements ^c	242	(105,158)	0	8.9	55.0
Liabilities/Equity:					
Accounts Payable	264	19,619	(4,537)	-13.3	67.4
Accrued Liabilities	323	(9,151)	(1,391)	-17.5	59.8
Other Liabilities	76	(15,386)	(338)	-2.5	60.3
Debt	41	(36,792)	(3,329)	44.3	60.6
Deferred credits	85	118,161	(2,632)	7.1	61.3
Equity	84	72,300	(355)	14.2	53.6
Retained Earnings	76	(12,046)	1,632	26.7	39.7
Total Across Engagements	242	69,296	(2,778)	-28.1	67.2
Net Income:					
Sales	147	21,810	3,000	-11.3	62.5
Cost of Goods Sold	362	38,123	2,710	21.3	63.3
Depreciation Expense	65	14,410	2,328	33.0	78.5
Other Expenses	743	(2,602)	1,393	1.3	60.6
Other Income	134	(11,948)	(1,099)	0.2	38.2
Other Profit and Loss	159	13,487	1,000	3.5	62.9
Total Across Engagements	242	89,392	8,591	47.7	74.2

^a Sample size is the number of lines in all adjusting entries in which each type of account appears. For engagement total, sample size is 242 (the number of completed surveys).

^b The percentage of audit differences that are income decreasing represents the percentage of permanent accounts with credits and the percentage of nominal accounts with debits, both of which have the potential to reduce income either directly (nominal accounts) or indirectly (permanent accounts).

^c The totals per engagement represent the summation across all adjustments for a specific engagement. The percentage of income reducing net audit differences is based only on the engagements that had a *net* change in assets, liabilities or income as a result of aggregate audit differences. In some cases, aggregation across all audit differences resulted in no net change to assets (73 instances), liabilities (68 instances) or net income (52 instances).

tests of audit difference magnitudes are two-sided since our propositions do not directly address magnitudes.

First, we note that audit differences are more frequent when systems are computerized (3.580

noncomputerized/5.479 computerized). Consistent with many prior studies we see that the majority of differences were due to judgment differences between the auditor and management (P1: 24.62 percent noncomputerized/26.84 percent

TABLE 4
Aggregate Audit Difference Rates and Magnitudes

	Rate ^a	Audit Difference Rates		Audit Difference Magnitude	
		Computerized?		Computerized?	
		No	Yes	No	Yes
Total Number of Audit Differences		469	893	469	893
Total Number of Complete Surveys		131	163	131	163
Average Number of Audit Differences per Engagement		3.580	5.479**	3.580	5.479**
Causes of Audit Differences		% ^b	%	% ^c	%
P1 Did the difference occur due to differences in auditor and manager judgment?	—	24.62	26.84	27.89	32.88
P2 Did the difference occur due to an incorrect manual computation of data?	L	36.32	41.40*	30.37	24.98
P3 Did the difference occur because of incorrect data in an exchange document?	L	3.08	2.34	15.07	31.80
P4 Did the difference occur due to omission of an exchange document?	L	4.17	7.72**	161.73	18.02
Internal Control Characteristics					
P5 Did the difference go undetected because of controls applied on a sample basis?	L	4.44	8.23**	15.78	67.00
P6 Did the difference go undetected due to incorrect application of controls?	L	18.47	23.46*	40.13	36.04
P7 Did the difference occur because of management override of controls?	L	3.46	3.53	150.19	59.67
P8 Did the difference go undetected due to lack of appropriate controls?	H	24.70	23.83	55.49	20.43
P9 Did the difference go undetected because of inadequate controls given risk involved?	H	9.11	15.08**	115.32	47.80
P10 Did the difference occur because of inadequate safeguard of assets?	H	0.69	0.25	10.00	47.50
P11 Did the difference occur because of poor segregation of duties?	H	0.65	2.12*	10.33	15.28
P12 Did the difference occur because of problems with accounting personnel?	H	13.04	15.97	100.70	17.47*
P13 Did the difference occur because of problems with management personnel?	H	5.51	7.08	42.84	43.43

* Difference between computerized and noncomputerized settings significant at $p < .05$ (t = one-sided for rates, two-sided for magnitudes).

** Difference between computerized and noncomputerized settings significant at $p < .01$ (t = one-sided for rates, two-sided for magnitudes).

^a Proposed expectation that computerized applications will have higher (H) or lower (L) rates of audit differences. These expectations do not apply to audit difference magnitude.

^b Audit difference rate percentages are based on the frequency of audit difference causes and internal control characteristics relative to the population of all observed audit differences. The percentages do not add up to 100% because more than one attribute of interest may be present in any given audit difference.

^c Audit difference magnitudes are standardized by dividing the raw difference by gauge. The average audit difference is computed relative only to audit differences having a specific attribute, not relative to all differences.



computerized) and/or incorrect manual computations (P2: 36.32 percent/41.40 percent). As expected in P1, there is not a significant difference in judgment audit difference rates between computerized and noncomputerized systems. Surprisingly, two of the causes of audit differences occur more frequently in computerized systems: incorrect manual computations (P2: 36.32 percent/41.40 percent) and omission of an exchange document (P4: 4.17 percent/7.72 percent). The presence of incorrect data in an exchange document was not affected by computerization (P3). There are no significant differences in the magnitude of audit differences between computerized and noncomputerized systems.

Four internal control attributes occur at significantly higher rates in computerized systems. Consistent with our expectations, problems with control design (P9: 9.11 percent noncomputerized /15.08 percent computerized) and segregation of duties (P11: 0.65 percent/2.12 percent) are more common in computerized systems. Contrary to our propositions, problems with controls applied on a sample basis (P5: 4.44 percent/8.23 percent) and incorrect application of controls (P6: 18.47 percent/23.46 percent) are also more common in computerized systems. None of the other propositions related to internal controls are supported or contravened. The observed differential rates do not carry over to the analysis of audit difference magnitudes, but we do see that computerization is associated with smaller differences arising from problems with accounting personnel (P12: 100.70 percent/17.47 percent).

Management override is a potentially important problem in both noncomputerized and computerized systems because of the large magnitude of the resulting audit differences (150.19 percent/59.67 percent), irrespective of the low audit difference rate for such problems (3.46 percent/3.53 percent). Also of interest is the extremely low rate of problems associated with the safeguarding of assets (.69 percent/.25 percent) and the segregation of duties (.65 percent/2.12 percent). These findings may be a result of the sensitization of professionals to potential problems in these areas or it may indicate a relatively low exposure to material audit differences in those areas of internal control.

Supplemental Analysis of Audit Difference Classified as Fraud

Statement on Auditing Standards No. 82 requires the auditor to obtain reasonable assurance that material misstatements due to errors and fraud will be detected.¹⁶ Fraud is most problematic to an auditor, however, because of management's intent to deceive shareholders and/or the auditor. Consequently, the attributes of fraudulent misstatements may differ from errors and may be affected differently by information technology. Table 5 presents our analysis of audit differences classified as either errors or fraud. We report the results of Chi-squared test for differences in audit difference rates between the two categories of error. We use the Wilcoxon rank sum test for differences in audit difference magnitudes.

The average number of audit differences per engagement is greater for errors than for fraud (5.313 vs. 2.150, $p < .01$). Differences classified as fraud that occur in computerized systems are less likely to be due to incorrect manual computations (42.14 percent error/25.64 percent fraud) but more likely to be associated with management override of controls (3.06 percent/14.29 percent) and poor segregation of duties (1.72 percent/10.81 percent). The latter two results are not surprising and confirm conventional audit wisdom. Poor segregation of duties (4.71 percent/52.25 percent) and missing controls (20.07 percent/30.00 percent) also lead to larger audit differences when fraud is present. Looking at only fraudulent misstatements, we see that computerization is associated with increases in the incidence of incorrect manual computations (9.68 percent noncomputerized /25.64 percent computerized) and poor segregation of duties (0.00 percent/10.81 percent).

In summary, the implementation of information technology affects several attributes that contribute to fraudulent activity. In computerized environments fraud is less likely to be due to invalid manual processing, but is facilitated

¹⁶ At the time the data were gathered for this paper, the operable auditing standard was SAS No. 53. The differences between SAS No. 53 and SAS No. 82 do not have an impact on the results reported in this paper.

TABLE 5
Audit Difference Rates and Magnitudes by Classification

	Sig. ^a	Difference Classification			
		Error		Fraud	
		Computerized?		Computerized?	
		No	Yes	No	Yes
Total Number of Audit Differences		436	850	33	43
Total Number of Complete Surveys		126	160	15	20
Average Number of Audit Differences per Engagement	0.007	3.460	5.313**	2.200	2.150
		Audit Difference Rates ^b			
		Rate ^c	%	%	%
Causes of Audit Differences					
P1 Did the difference occur due to differences in auditor and manager judgment?	ns	—	24.65	27.26	24.24
P2 Did the difference occur due to an incorrect manual computation of data?	0.041	L	38.31	42.14	9.68
P3 Did the difference occur because of incorrect data in an exchange document?	ns	L	3.33	2.44	
P4 Did the difference occur due to omission of an exchange document?	ns	L	4.50	7.95**	0.27
Internal Control Characteristics					
P5 Did the difference go undetected because of controls applied on a sample basis?	ns	L	4.23	8.51**	7.41
P6 Did the difference go undetected due to incorrect application of controls?	ns	L	18.32	23.44*	20.83
P7 Did the difference occur because of management override of controls?	0.001	L	1.62	3.06*	28.13
P8 Did the difference go undetected due to lack of appropriate controls?	ns	H	23.86	26.69	37.04
P9 Did the difference go undetected because of inadequate controls given risk involved?	ns	H	8.44	15.19**	18.52
P10 Did the difference occur because of inadequate safeguard of assets?	ns	H	0.74	0.26	
P11 Did the difference occur because of poor segregation of duties?	0.001	H	0.70	1.72*	
P12 Did the difference occur because of problems with accounting personnel?	ns	H	13.35	15.96	9.09
P13 Did the difference occur because of problems with management personnel?	ns	H	5.91	7.27	2.70

(Continued on next page)



TABLE 5 (Continued)

	Audit Difference Magnitudes ^d			
	%	%	%	%
Causes of Audit Differences				
Did the difference occur due to differences in auditor and manager judgment?	ns	24.26	33.02	75.50
Did the difference occur due to an incorrect manual computation of data?	ns	30.34	24.79	32.00
Did the difference occur because of incorrect data in an exchange document?	ns	15.07	31.80	
Did the difference occur due to omission of an exchange document?	ns	161.74	17.46	
Internal Control Characteristics				
Did the difference go undetected because of controls applied on a sample basis?	ns	16.88	67.00	
Did the difference go undetected due to incorrect application of controls?	ns	42.54	36.12	6.40
Did the difference occur because of management override of controls?	ns	260.43	55.52	64.44
Did the difference go undetected due to lack of appropriate controls?	0.048	52.73	20.07	81.40
Did the difference go undetected because of inadequate controls given risk involved?	ns	110.91	48.71	143.60
Did the difference occur because of inadequate safeguard of assets?	ns	10.00	47.50	
Did the difference occur because of poor segregation of duties?	0.007	10.33	4.71	52.25
Did the difference occur because of problems with accounting personnel?	ns	94.28	17.59*	222.67
Did the difference occur because of problems with management personnel?	ns	42.84	40.80	

* Difference between computerized and noncomputerized settings significant at $p < .05$ (t = one-sided for rates, two-sided for magnitudes).

** Difference between computerized and noncomputerized settings significant at $p < .01$ (t = one-sided for rates, two-sided for magnitudes).

^a Significance based on the Chi-square test for audit difference frequency between account classification and the Kruskal-Wallis test for differences in error magnitude.

^b Audit difference rate percentages are based on the frequency of audit difference causes and internal control characteristics relative to the population of all observed audit differences. The percentages do not add up to 100% because more than one attribute of interest may be present in any given audit difference.

^c Proposed expectations that computerized applications will have higher (H) or lower (L) rates of audit differences. These expectations do not apply to audit difference magnitude.

^d Audit difference magnitudes are standardized by dividing the raw difference by gauge. The average audit difference is computed relative only to audit differences having a specific attribute, not relative to all differences.



by poor segregation of functional responsibilities and management override of controls.

Supplemental Analysis by Account Group

The five most frequently occurring types of audit differences (classified by account balance) were accounts receivable (236), inventory (351), other current assets (106), fixed assets (161) and accounts payable and accruals (508). The audit difference rates and magnitudes obtained for these accounts are presented in table 6. This analysis explicitly recognizes that a company could be computerized for one area but not for another. Only companies which had a misstatement in a given account area are included in this analysis.¹⁷

The average number of audit differences, classified by computerization, is significantly different across accounts (accounts receivable 2.375/inventory 2.906/other current assets 2.188/fixed assets 1.808/accounts payable and accruals 3.424, $p < .01$).¹⁸ For accounts payable and accruals, 428 (84.3 percent) of the observed differences were in a computerized environment; for inventory the comparable count is 279 (79.5 percent); and for fixed assets it is 94 (58.4 percent). In contrast, a smaller proportion of differences occur in a computerized environment for receivables (57, 24.2 percent) and other current assets (35, 33.0 percent).

In order to examine the differential impact of technology, we compared the incidence of audit differences across computerized subsystems for different accounts (i.e., comparison across the "yes" columns and reporting the resulting nonparametric tests). There are significant differences in the frequency of (1) judgment errors ($p < .01$) and (2) omission of exchange documents ($p < .01$) across accounts in a computerized environment. The difference attributable to judgment errors is based on the relatively less frequent audit differences found in other current assets (16.13 percent) while the difference associated with omission of exchange documents is attributable to the less frequent audit differences found in inventory (3.34 percent) and fixed assets (5.44 percent).

Turning to control attributes, we see that significant differences across accounts arise

due to the frequency of problems with either accounting ($p < .01$) or management personnel ($p = .011$), with the latter also resulting in a significant impact on audit difference magnitudes ($p = .034$). The across-account effect for accounting personnel is attributable to the low incidence of audit differences in inventory (8.92 percent) and the high incidence in receivables (32.08 percent). The across-account effects for management personnel is attributable to the high incidence in receivables (19.61 percent) and other current assets (17.86 percent) and larger magnitudes in inventory (38.33 percent) and payables (65.24 percent).

The impact of error causes and control attributes *within* specific accounts can be examined by comparing the yes/no columns for each account in table 6:

Accounts Receivable: Computerization is associated with an *increase* in the frequency of computational errors (24.85 percent noncomputerized/43.14 percent computerized). This result is somewhat surprising because avoidance of these types of problems is often cited as an advantage of computerized processing. As would be expected, technology-based systems are also associated with higher incidence of audit differences related to accounting personnel (14.94 percent/32.08 percent) and management personnel (6.43 percent/19.61 percent).

Inventory: Computerization is associated with more frequent judgment errors (12.85 percent/33.70 percent) in inventory which also tend to be larger (11.11 percent/26.47

¹⁷ In order to prepare table 6, each adjustment was assigned to a single balance-sheet account area based on its predominant impact. The sample counts reported in table 6 for each account differ from those in table 3, which was based on the number of actual entries to each account and includes entries to nominal accounts. Audit differences affecting accounts payable were separately coded from accrual differences in the survey. These are combined for the purpose of the analysis presented in table 6 since both accounts are essentially disbursement-related and transactions in either account are typically processed in a similar manner, i.e., within the same accounting subsystem.

¹⁸ We use the Chi-square test to test audit difference frequencies across accounts and the Kruskal-Wallis test for audit difference magnitudes.

TABLE 6
Audit Difference Rates and Magnitudes by Accounting Subsystem

	Sig. ^a	Accounts Receivable Computerized?		Inventory Computerized?		Other Current Assets Computerized?		Fixed Assets Computerized?		Accounts Payable/Accruals Computerized?	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
		Rate ^c		%		%		%		%	
Total Number of Audit Differences		179	57	72	279	71	35	67	94	80	428
Total Number of Complete Surveys		82	24	24	96	40	16	35	52	21	125
Average Number of Audit Differences per Engagement	0.001	2.183	2.375	3.000	2.906	1.775	2.188	1.914	1.808	3.810	3.424
Audit Difference Rates^b											
		Rate ^c	%	%	%	%	%	%	%	%	%
Causes of Audit Differences		—	31.28	33.33	12.85	33.70**	15.94	16.13	25.40	28.26	26.92
P1 Did the difference occur due to differences in auditor and manager judgment?	0.006										
P2 Did the difference occur due to incorrect manual computation of data?	ns	L	24.85	43.14**	54.93	45.96	45.96	35.48	45.16	35.56	32.89
P3 Did the difference occur because of incorrect data in an exchange document?	ns	L	2.84	3.92	1.39	2.97	5.88	3.23	1.59	4.40	4.00
P4 Did the difference occur due to omission of an exchange document?	0.008	L	8.00	11.76	2.78	3.34	7.14*	5.44*	4.00	10.60**	
Internal Control Characteristics											
P5 Did the difference go undetected because of controls applied on a sample basis?	ns	L	6.21	4.08	4.83	11.60*	4.62	8.00	3.92	6.82	6.88*

(Continued on next page)

TABLE 6 (Continued)

Internal Control Characteristics	Sig. ^a	Rate ^c	Accounts						Account Groups						
			Receivable Computerized?		Inventory Computerized?		Other Current Assets Computerized?		Fixed Assets Computerized?		Accounts Payable/Accruals Computerized?				
			No	Yes	No	Yes	No	Yes	No	Yes	No	Yes			
Audit Difference Rates ^b															
			%	%	%	%	%	%	%	%	%	%	%	%	%
P6 Did the difference go undetected due to incorrect application of controls?	ns	L	18.35	26.00	25.00	23.28	24.24	34.62	13.46	25.58*	11.43	21.98**			
P7 Did the difference occur because of management override of controls?	ns	L	3.93	9.80	1.43	3.72	4.35	7.41	1.52	3.26	5.00	2.42			
P8 Did the difference go undetected due to lack of appropriate controls?	ns	H	26.22	20.41	33.33	19.52*	19.70	21.43	25.45	19.54	16.42	28.10*			
P9 Did the difference go undetected because of inadequate controls given risk involved?	ns	H	12.42	20.00	14.29	15.20	9.09	22.22	3.85	10.23	14.96**				
P10 Did the difference occur because of inadequate safeguard of assets?	ns	H	0.57		1.54	0.77			1.75						
P11 Did the difference occur because of poor segregation of duties?	ns	H			2.78	3.73			1.49			1.94			
P12 Did the difference occur because of problems with accounting personnel?	0.001	H	14.94	32.08**	4.17	8.92	17.91	21.88	8.96	17.39	16.25	17.72			
P13 Did the difference occur because of problems with management personnel?	0.011	H	6.43	19.61*	4.35	3.36	5.88	17.86	3.03	3.30	6.25	8.05			
Audit Difference Magnitudes ^d															
			%	%	%	%	%	%	%	%	%	%	%	%	
Causes of Audit Differences			36.80	47.35	11.11	26.47*	15.27	22.80	29.88	52.77	16.43	31.60*			
Did the difference occur due to differences in auditor and manager judgment?	ns														
Did the difference occur due to an incorrect manual computation of data?	ns		58.45	21.23	31.10	39.04	8.43	7.64	25.61	18.78	11.96	16.79			
Did the difference occur because of incorrect data in an exchange document?	ns		9.40	5.50	10.00	62.00	24.75		15.00	8.00	13.33	19.40			
Did the difference occur due to omission of exchange document?	0.020		213.29	6.33	11.67	19.89		0.50		43.20	19.67	17.16			

(Continued on next page)



TABLE 6 (Continued)

	Sig. ^a	Account Groups											
		Accounts Receivable Computerized?		Inventory Computerized?		Other Current Assets Computerized?		Fixed Assets Computerized?		Accounts Payable/Accruals Computerized?			
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes		
Internal Control Characteristics													
Did the difference go undetected because of controls applied on a sample basis?	ns	23.10	16.00	5.00	131.62	3.00	0.50	14.50	9.00	17.35			
Did the difference go undetected due to incorrect application of controls?	ns	76.76	16.31	3.93	82.47	10.06	8.67	61.14	10.64	17.00	16.64		
Did the difference occur because of management override of controls?	ns	261.29	53.80	100.00	49.80	139.67	71.50	12.00	73.00	10.75	66.10		
Did the difference go undetected due to lack of appropriate controls?	ns	108.70	24.60	15.91	22.41	15.69	19.67	16.07	15.65	27.45	19.96		
Did the difference go undetected because of inadequate controls given risk involved?	0.024	196.40	3.50	22.22	105.71	21.67	8.50	4.50	9.78	27.11			
Did the difference occur because of inadequate safeguard of assets?	ns	25.00		3.00	47.50			2.00					
Did the difference occur because of poor segregation of duties?	ns			8.00	6.30			15.00			26.50		
Did the difference occur because of problems with accounting personnel?	ns	162.08	21.53	13.00	16.33	33.42	7.29	122.67	9.88	50.15	19.53		
Did the difference occur because of problems with management personnel?	0.034	18.55	5.70	15.00	38.33	42.75	6.40	138.00	6.33	75.00	65.24		

* Difference between computerized and noncomputerized settings significant at $p < .05$ (t = one-sided for rates, two-sided for magnitudes).

** Difference between computerized and noncomputerized settings significant at $p < .01$ (t = one-sided for rates, two-sided for magnitudes).

^a Significance based on the Chi-square test for audit difference frequency between account classification and the Kruskal-Wallis test for differences in error magnitude.
^b Audit difference rate percentages are based on the frequency of audit difference causes and internal control characteristics relative to the population of all observed audit differences. The percentages do not add up to 100% because more than one attribute of interest may be present in any given audit difference.
^c Proposed expectations that computerized applications will have higher (H) or lower (L) rates of audit differences. These expectations do not apply to audit difference magnitude.
^d Audit difference magnitudes are standardized by dividing the raw difference by gauge. The average audit difference is computed relative only to audit differences having a specific attribute, not relative to all differences.



percent). This result is somewhat surprising but may indicate that inventory levels can be monitored more effectively using information technology, providing more timely evidence concerning inventory shrinkage or valuation problems. Computerization of inventory accounting is also associated with a significantly lower rate of audit differences due to missing controls (33.33 percent/19.52 percent), but more frequent problems due to controls performed on a test basis (4.83 percent/11.60 percent).

Other current assets: The only attribute that indicates a difference between computerized and noncomputerized environments for other current assets is problems due to the omission of exchange documents, which are more frequent in computerized systems (0.00 percent/7.14 percent).

Fixed Assets: Computerization is associated with a higher incidence of audit differences due to omitted exchange documents (0.00 percent/5.44 percent) and the incorrect application of existing internal controls (13.46 percent/25.58 percent). Audit difference magnitudes are not significantly affected by computerization.

Accounts Payable and Accruals: Omitted exchange documents (4.00 percent/10.60 percent) are more common in computerized systems as are problems from controls being applied on a test basis (0.00 percent/6.88 percent), controls being incorrectly applied (11.43 percent/21.98 percent), controls being poorly designed (16.42 percent/28.10 percent) and assets being inadequately safeguarded (0.00 percent/14.96 percent). However, none of these increased frequencies result in a significant difference in the magnitude of audit differences. Only differences in judgment between the auditor and management exhibit significantly different magnitudes (16.43 percent/31.60 percent).

The results from the analysis by account area can be summarized as follows: The implementation of information technology does not automatically assure that records and transactions will be processed more accurately. Effec-

tive implementation of information technology requires adequate staffing and training of personnel. The mere process of computerization probably highlights and magnifies control problems that may have existed prior to computerization, especially related to personnel. As a result, control failures or processing errors that were not previously understood may become more salient. Although the incidence of certain types of misstatements may increase when systems are computerized, the magnitude of those misstatements is not larger than in manual systems, and are often smaller. Also, information technology may allow better monitoring of transactions, increasing the likelihood that an existing error will be quickly detected.

Supplemental Analysis by Company Size

The size of a company may impact the extent and sophistication of its internal controls and information technology. Table 7 presents the audit difference rates segregated by size of company (as measured by gauge). Three categories are defined for the purposes of table 7: less than \$250,000 (small), between \$250,000 and \$500,000 (moderate) and over \$500,000 (large). The incidence of audit differences per engagement increases significantly in a computerized environment as the client gets larger (4.714 small/5.750 moderate/7.724 large). Furthermore, the incidence of audit differences within computerized environments are significantly higher than noncomputerized environments for small (3.478 noncomputerized/4.714 computerized) and moderate (2.917/5.750) companies, but not large companies.

A significant difference in the rate of incorrect manual computations was observed across company sizes ($p < .01$).¹⁹ This difference is attributable to large companies which have a higher incidence of incorrect computations in computerized systems (51.60 percent large vs. 36.48 percent small/41.40 percent moderate). When we look at the magnitude of audit differences, we see that incorrect computations result in significantly larger audit differences in *small* companies (39.53

¹⁹ We use the Chi-square test on audit difference frequencies (rates) and the Kruskal-Wallis test on audit difference magnitudes.

TABLE 7
Audit Difference Rates and Magnitudes by Company Size

	Sig. ^a	Company Size					
		Small Less than \$250,000		Moderate \$250,000 to \$500,000		Large Greater than \$500,000	
		Computerized? No	Yes	Computerized? No	Yes	Computerized? No	Yes
Total Number of Audit Differences		313	462	70	207	86	224
Total Number of Complete Surveys		90	98	24	36	17	29
Average Number of Audit Differences per Engagement	0.022	3.478	4.714*	2.917	5.750**	5.059	7.724
		Audit Difference Rates^b					
		Rate ^c		%		%	
Causes of Audit Differences							
P1 Did the difference occur due to differences in auditor and manager judgment?	ns	—	21.78	21.96	32.86	27.80	27.90
P2 Did the difference occur due to an incorrect manual computation of data?	0.001	L	36.79	36.48	37.31	41.40	33.75
P3 Did the difference occur because of incorrect data in an exchange document?	ns	L	3.25	1.78	2.86	4.28	2.63
P4 Did the difference occur due to omission of an exchange document?	ns	L	3.87	8.81**	7.25	6.67	2.63
Internal Control Characteristics							
P5 Did the difference go undetected because of controls applied on a sample basis?	0.001	L	6.39	11.65**	1.45	4.55	4.46*
P6 Did the difference go undetected due to incorrect application of controls?	0.041	L	20.07	21.00	6.45	21.69**	22.85
P7 Did the difference occur because of management override of controls?	ns	L	2.27	3.33	4.35	3.95	6.98

(Continued on next page)

TABLE 7 (Continued)

	Sig ^a	Company Size						
		Small Less than \$250,000		Moderate \$250,000 to \$500,000		Large Greater than \$500,000		
		Computerized? No	Yes	Computerized? No	Yes	Computerized? No	Yes	
Audit Difference Rates^b								
		Rate ^c	%	%	%	%	%	
P8	0.021	H	22.78	21.09	27.54	31.49	29.58	22.71
P9	ns	H	5.58	15.83**	13.24	12.50	18.84	15.76
P10	ns	H	1.06	0.24		0.56		
P11	ns	H	0.33	2.49**	1.43	3.33	1.18	0.45
P12	0.001	H	10.78	11.63	17.14	26.46	17.86	15.77
P13	0.041	H	7.92	8.50	1.52	2.81		7.62**
Audit Difference Magnitudes^d								
			%	%	%	%	%	%
Causes of Audit Differences								
Did the difference occur due to differences in auditor and manager judgment?	0.001		29.02	37.41	36.17	23.27	16.87	31.86*
Did the difference occur due to an incorrect manual computation of data?	0.028		25.25	39.53	75.36	10.02	9.59	13.15
Did the difference occur because of incorrect data in an exchange document?	ns		17.30	63.88	13.50	11.13	5.50	9.00
Did the difference occur due to omission of an exchange document?	ns		153.42	19.68	244.00	25.67	6.00	6.71

(Continued on next page)

Total Number of Audit Differences



TABLE 7 (Continued)

	Sig ^a	Company Size						Audit Difference Rates ^b
		Small Less than \$250,000		Moderate \$250,000 to \$500,000		Large Greater than \$500,000		
		Computerized? No	Yes	Computerized? No	Yes	Computerized? No	Yes	
Total Number of Audit Differences								
Internal Control Characteristics								
Did the difference go undetected because of controls applied on a sample basis?	ns	15.71	88.02	17.00	7.38		7.89	
Did the difference go undetected due to incorrect application of controls?	ns	45.89	59.78	5.25	14.61	29.01	14.81	
Did the difference occur because of management override of controls?	0.014	157.29	74.47	413.00	86.71	10.33	8.25	
Did the difference go undetected due to lack of appropriate controls?	ns	21.63	26.11	192.63	13.07	34.62	18.66	
Did the difference go undetected because of inadequate controls given risk involved?	ns	13.53	75.88	398.56	16.14	36.69	11.66	
Did the difference occur because of inadequate safeguard of assets?	ns	10.00	26.00		69.00			
Did the difference occur because of poor segregation of duties?	ns	15.00	24.36	16.00	1.00		1.00	
Did the difference occur because of problems with accounting personnel?	0.004	78.39	23.62*	246.00	15.76	33.53	10.77	
Did the difference occur because of problems with management personnel?	0.017	44.13	63.61	12.00	7.40		8.94	

* Difference between computerized and noncomputerized settings significant at $p < .05$ (t = one-sided for rates, two-sided for magnitudes).

** Difference between computerized and noncomputerized settings significant at $p < .01$ (t = one-sided for rates, two-sided for magnitudes).

(Continued on next page)



TABLE 7 (Continued)

- a Significance based on the Chi-square test for audit difference frequency between account classification and the Kruskal-Wallis test for differences in error magnitude.
- b Audit difference rate percentages are based on the frequency of audit difference causes and internal control characteristics relative to the population of all observed audit differences. The percentages do not add up to 100% because more than one attribute of interest may be present in any given audit difference.
- c Proposed expectations that computerized applications will have higher (H) or lower (L) rates of audit differences. These expectations do not apply to audit difference magnitude.
- d Audit difference magnitudes are standardized by dividing the raw difference by gauge. The average audit difference is computed relative only to audit differences having a specific attribute, not relative to all differences.

percent small vs. 10.02 percent moderate/13.15 percent large). We also observe that large companies have larger audit differences due to disagreements between the auditor and management when systems are computerized (16.87 percent noncomputerized/31.86 percent computerized). This difference is also significant across the three size groups (37.41 percent small/23.27 percent moderate/31.86 percent large) and may imply that computerized systems provide better information on which to base accounting estimates than is available in noncomputerized settings.

Turning to internal control attributes, we see a number of significant differences across company size:

- small companies are more likely to have audit differences due to sample-based controls (11.65 percent small vs. 4.55 percent moderate/4.46 percent large);
- small and large companies are more likely to have audit differences due to management problems (8.50 percent small/7.62 percent large vs. 2.81 percent moderate);
- moderate-size companies are more likely to have problems with missing controls (31.49 percent moderate vs. 21.09 percent small/22.71 percent large) and accounting personnel (26.46 percent vs. 11.63 percent/15.77 percent);
- large companies are more likely to experience problems with the incorrect application of controls (29.81 percent large vs. 21.00 percent small/21.69 percent moderate).

Also of interest is the observation that there is a significant effect across size on difference magnitudes for the three attributes that are "personnel"-related: management override, accounting personnel and management personnel, all being associated with larger differences in smaller companies.

Within levels of company size, we see that computerization has its most significant impact on control attributes in small companies, i.e., computerization leads to problems with sample-based controls (6.39 percent non-computerized/11.65 percent computerized), poorly designed controls (5.58 percent/15.83 percent) and poor segrega-

tion (.33 percent/2.49 percent). For moderate companies, the impact of computerization is revealed only by a higher incidence of incorrectly applied controls (6.45 percent/21.69 percent). Finally, large companies have more frequent problems with incorrect manual computations (33.75 percent/51.60 percent), controls applied on a sample basis (0.00 percent/4.46 percent), and problems with management personnel (0.00 percent/7.62 percent). None of these observed effects for audit difference rates carry over to the magnitude of audit differences.

In summary, small firms have larger errors in the attributes affected by management and accounting personnel including disagreements with the auditor and incorrect manual processing. As firms grow, there is increased difficulty with the application of appropriate controls and the rate of problems with accounting personnel escalate. Additionally, the magnitude of differences from management override of controls remains high. Large firms continue to have difficulty with manual processing and application of controls, but the problems with the appropriateness of the controls and management and accounting personnel lessen. Of particular interest is that the magnitude of errors is smaller for large firms, especially those errors due to management override of controls.

Characteristics of IT-Related Audit Differences

Only 8.40 percent of the 1,362 audit differences analyzed in this paper were due to breakdowns or failures related to information technology.²⁰ To further understand the nature of these audit differences, we examined their attributes as they relate to general controls, controls over development and application controls. These results are reported in table 8. The percentages are computed relative to the set of data processing misstatements, not relative to all misstatements.

For general controls, problems with the hiring and training of IT personnel and poor IT/

²⁰ The reader should recall that the sample of companies used in this survey only included those that had moderate to extensive computerization as judged by the external auditor.

user segregation created audit differences at a rate significantly higher than zero (13.21 percent and 5.00 percent, respectively) but only the former problem resulted in difference magnitudes that were also significant (58.50 percent of gauge). For controls over development, we see frequent

or larger differences due to purchased software (12.74 percent frequency), internally developed software (22.86 percent frequency/24.00 percent magnitude), improper use of microcomputer software (20.71 percent/8.92 percent), unreliable user-developed software (22.86 percent/27.29 percent),

TABLE 8
Aggregate Audit Difference Rates and Magnitudes
Computerized Applications Only

	Audit Difference Rate	Audit Difference Magnitude ^b
Total Number of Audit Differences	893	893
Total Number of Complete Surveys	163	163
Average Number of Audit Differences per Engagement	5.479	5.479
Was the difference attributable to the client's computer system?	8.40**a	24.93**
IT General Controls		
Did the difference occur because of overworked IT personnel?	3.33	40.00
Did the difference occur because of incompetent IT personnel?	13.21**	58.50*
Did the difference occur because of poor segregation among IT personnel?	1.67	26.00
Did the difference occur because of poor IT/information user segregation?	5.00*	6.67
Did the difference occur because of poor system documentation?	3.21	106.50
Did the difference occur because of inadequate access controls?		
IT Development		
Did the difference occur due to problems with the implementation of purchased software?	12.74**	30.88
Did the difference occur due to problems implementing internally developed software?	22.86**	24.00*
Did the difference occur due to problems implementing microcomputer applications?	20.71**	8.92*
Did the difference occur due to problems implementing end user applications?	22.86**	27.29*
Did the difference occur due to inadequate/improper design specifications?		
Did the difference occur due to incorrect program coding?	4.88*	76.67
Did the difference occur due to improper/incorrect program changes?	20.71**	40.08*
IT Application		
Did the difference occur due to data entry errors?	62.86**	17.96**
Did the difference occur due to improper computer processing?	28.21**	27.61*
Did the difference occur due to improper/incorrect handling of an exception report?	19.40**	35.42*
Did the difference occur because of hardware failure?	1.55	54.00
Did the difference occur because of incorrect program used in processing?		

* Percentage is significantly different from zero at $p < .05$.

** Percentage is significantly different from zero at $p < .01$.

^a This item is presented as a percentage of the total audit differences detected, the remaining items are calculated relative to this percentage. For example, the first item was .28% of total audit differences and 3.33% of audit differences in computer applications.

^b This item is presented as a percentage of audit gauge for audit differences detected.

and inadequate testing of program changes (20.71 percent/40.08 percent). For application controls, we observe frequent data entry errors (62.86 percent/17.96 percent), errors during computer processing (28.21 percent/27.61 percent) and improper handling of exception reports (19.40 percent/35.42 percent).

The overall pattern of the aggregate results indicates that data entry errors are the most common source of IT-related misstatements, while problems with general controls are not a common cause of misstatements. As a group, problems with technology development are also a frequent source of misstatements. In regard to audit difference magnitudes, problems with personnel, program changes and exception reports result in the largest misstatements. These results are somewhat contrary to the survey results reported by the Institute of Internal Auditors (1992) in *Systems Auditability and Control*, which suggested that problems related to systems access and program changes would be more frequent and severe.

SUMMARY AND DISCUSSION

The results reported in this paper are subject to the same limitations that affect all studies of actual audit differences. First, the results are based only on discovered errors. The possibility exists that the population of undiscovered errors possesses attributes that are significantly different from those described in this paper. However, given the number of engagements and audit differences included in the analysis, the sample could be expected to be fairly representative. Second, much of the data used in this paper was obtained by soliciting *ex post* judgments from the auditors who performed the actual audits. The judgments concerning risks and the presence of selected attributes may be flawed due to inaccurate recollections or due to *ex post* rationalization of decisions made during the course of the engagement. Third, the data was gathered from audit engagements in 1989. Information technology has obviously changed significantly since that time period. However, we believe that the results in this paper are interesting because they pertain to general error attributes, not specific system attributes. Fur-

thermore, most of our comparisons are made across computerized and noncomputerized systems and would be less sensitive to the form of the actual technology used in the computerized system. Knowing that computerization increases some types of problems while reducing others is important to audit planning regardless of the nature of the actual technology.

A number of questions were asked as part of the motivation for this study. In spite of the limitations mentioned above, the results reported in the preceding sections provide partial answers to many of these questions. These answers can assist auditors in the planning of audit engagements by providing empirical evidence to highlight situations where audit differences are more or less likely to occur, along with the relative size of the audit differences.

First, as has been shown in prior studies, the majority of audit differences (misstatements) arise due to:

- incorrect computations,
- differences in management and auditor judgment, and
- faulty initial identification and processing of transactions.²¹

Second, audit differences, if they relate to control attributes, are usually associated with:

- inadequately skilled personnel,
- improper or inadequate independent verifications, or
- improper documents and records.

Audit differences are rarely associated with inadequate controls over assets or records. Third, this study isolates the following areas that are more likely to be sources of problems when information systems are computerized than when they are not:

- incorrect manual computations,
- the recording of exchange documents,
- incorrect application of internal controls, and
- inadequate internal controls.

²¹ Note that the faulty identification of transactions would include cutoff errors of various types.

Fourth, IT-related audit differences are relatively rare, even in account areas that are heavily computerized. Errors in preparing data entry are a frequent problem, however.

The most important point observed in this paper should be reiterated—the nature of audit differences discovered can be affected by the computerization of an accounting information system. Statement on Auditing Standards No. 80 has focused attention of the profession on information technology and audit evidence. We

noted very few audit differences in this study that were directly attributed to problems or failures of information technology. Taken in its entirety, the results presented in this paper should provide some useful insights for auditors planning engagements in computerized environments. It highlights the need to adequately consider the nature and reliability of computerized systems in the planning stages of an engagement. To not do so risks inefficient, and possibly ineffective, performance of the audit.

REFERENCES

- American Institute of Certified Public Accountants (AICPA). 1997. *Statements on Auditing Standards*. New York, NY: AICPA.
- Arens, A. A., and J. K. Loebbecke. 1994. *Auditing: An Integrated Approach*. Sixth Edition. Upper Saddle River, NJ: Prentice Hall.
- Auditing Standards Board. 1996. *Amendment to statement on auditing standards No. 31, evidential matter*. SAS No. 80. New York, NY: American Institute of Certified Public Accountants.
- . 1997. *Consideration of fraud in a financial statement audit*. SAS No. 82. New York, NY: American Institute of Certified Public Accountants.
- Bell, T., and W. R. Knechel. 1994. Empirical analysis of errors discovered in audits of property and casualty insurers. *Auditing: A Journal of Practice & Theory* (Spring): 84–100.
- Committee of Sponsoring Organizations of the Treadway Commission (COSO). 1992. *Internal Control: An Integrated Framework*. Jersey City, NJ: AICPA.
- Ellis, L. P. 1989. Only audit around the computer?—No! *The National Public Accountant* (May): 14.
- Hackenbrack, K., and W. R. Knechel. 1997. Resource allocation decisions in audit engagements. *Contemporary Accounting Research* (forthcoming).
- Houghton, C. W., and J. A. Fogarty. 1991. Inherent risk. *Auditing: A Journal of Practice & Theory* (Spring): 1–21.
- Hylas, R. E., and R. H. Ashton. 1982. Audit detection of financial statement errors. *The Accounting Review* (October): 751–765.
- Institute of Internal Auditors Research Foundation (IIA). 1992. *System Auditability and Control*. Altamonte Springs, FL: IIA.
- Knechel, W. R. 1997. *Auditing: Text and Cases*. Cincinnati, OH: SouthWestern Publishing.
- Kreutzfeldt, R. W., and W. A. Wallace. 1986. Error characteristics in audit populations: Their profile and relationship to environmental factors. *Auditing: A Journal of Practice & Theory* (Fall): 20–43.
- Maletta, M., and A. Wright. 1996. Audit evidence planning: An examination of industry error characteristics. *Auditing: A Journal of Practice & Theory* (Spring): 71–86.
- Ramage, J. G., A. M. Krieger, and L. L. Spero. 1979. An empirical study of error characteristics in audit populations. *Journal of Accounting Research* (Supplement): 72–102.
- Roberts, D. M., and P. D. Wedemeyer. 1988. Assessing the likelihood of financial statement errors using a discriminant model. *Journal of Accounting Literature* (7): 133–145.
- Waller, W. S. 1993. Auditors assessment of inherent and control risk in field settings. *The Accounting Review* (October): 783–803.
- Wright, A., and R. H. Ashton. 1989. Identifying audit adjustments with attention directing procedures. *The Accounting Review* (October): 710–728.