Commerce Division
Discussion Paper No. 91

AN EMPIRICAL ANALYSIS OF THE LIKELIHOOD OF DETECTING FRAUD IN NEW ZEALAND

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February 2001

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ISSN 1174-5045
ISBN 1-877176-68-0

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Acknowledgements

The first author acknowledges the logistic support of King Fahd University of Petroleum & Minerals, Saudi Arabia. The third and fourth authors gratefully appreciate the financial support provided by Lincoln University, New Zealand through the Fund for Excellence Scheme in 1999, and the research assistance provided by Peter Cody. We thank the auditors who generously gave of their time to participate in the study.

Abstract

The objective of this paper is to provide information on the perceived effectiveness of 56 fraud-detecting standard audit procedures normally used in stock and warehousing cycle, and to examine auditor- and audit firm-specific factors that influence the likelihood of detecting fraud in stock and warehousing cycle in New Zealand. We gathered data through a mail survey of New Zealand auditors in order to ascertain their opinion on the effectiveness of these audit procedures. The results suggest that relatively few (less than half) of the 56 standard audit procedures are perceived by our surveyed auditors as being "more effective" in detecting fraud in stock and warehousing cycle. Further, more than half of the 56 audit procedures are perceived by respondents as "moderately effective" in detecting fraud. Fifteen audit procedures are perceived as being "less effective" in detecting fraud the stock and warehousing audit cycle.

A univariate analysis reveals no significant perpetual differences among our respondents on the basis of the location of their employers in New Zealand, and the type of audit firm employing them. We employed logit regression analysis to test a model to predict the likelihood of detecting fraud in stock and warehousing cycle, given certain auditor- and audit firm-specific factors. The results of the regression analysis suggest that size of audit firm (measured by the number of employees), auditor's position tenure, and auditor's years of experience are statistically significant predictors of the likelihood of detecting fraud in stock and warehousing cycle in New Zealand. Thus, the likelihood of fraud detection in stock and warehousing increases as the auditor acquires more years of auditing experience, and with the audit firms employing more members of staff.

Key Words: Fraud detection, Stock and warehousing cycle, Audit procedures, New Zealand.

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1. Introduction and Literature Overview

Corporate fraud[1] is on the increase worldwide. The United Kingdom's Audit Commission, for example, reports that the number of frauds has increased by 38 percent since 1990 (Tyler, 1997). Fraud is not only on the increase; it is also expensive. The amount of money involved in 2,608 reported fraud cases over the last ten years, studied by the United States' (US's) Association of Certified Fraud Examiners (ACFE), totalled US$15 billion (Mitchell, 1997).

A study of fraud detection in the stock and warehousing cycle in New Zealand (NZ) context is topical. The recent collapse of Fortex Group Limited was partly due to a fraud perpetuated in the stock and warehousing cycle. The management of Fortex classified, and recorded low-value lamb ribs as high-value French lamb legs as part of its year-end stock (Macfie, 1996). The external auditors of this company are believed not to have detected this fraudulent financial reporting (although legal action against the auditors on this issue was eventually settled out of court). Losses to creditors of the company following Fortex's collapse totalled about NZ$70 million (MacLennan, 1996). A study assessing the perceived effectiveness of the audit procedures normally used in stock and warehousing cycle will be useful to NZ auditors, as a means of improving on their capacities to detect occurrences of similar incidents in their future audit engagements.

A body of literature, commonly called the "red flag" literature, evolved in an attempt to deter and detect the likelihood of fraud occurring. The red-flag literature suggests conditions under which fraud is more likely to occur (see Coopers and Lybrand, 1977; Elliott and Willingham, 1980; Romney and Albrecht, 1980; Pincus, 1989; Albrecht et al., 1995 for further discussion of, and the literature on, red flags). Although the red flag literature does provide some insight into the likelihood of fraud occurring, it has been criticised on three fronts. First, the flags are rather general and subjective, and often may be present when no fraud has occurred (see Albrecht and Romney, 1986). Second, it is difficult to operationalise the "red flags" in empirical research. For example, a lack of management integrity has been cited as a "red flag" condition, yet how does one assess such a factor? Finally, "red flags" are neither predictive nor absolute (Cottrell and Albrecht, 1994).

Recent studies researching into the likelihood of detecting fraud have examined the use of audit procedures to detect fraud in a typical audit engagement (see, for example, Moyes and Baker, 1995; Moyes, 1996; Moyes and Hasan, 1996; Moyes and Lavine, 1997). These

studies find that auditing experience of auditors and prior success of audit firms in detecting fraud are significant in detecting fraud. In the stock and warehousing cycle, the size of audit firm is associated with greater likelihood of fraud detection (Moyes and Hasan, 1996). Techniques that directly collect evidence are seen to be more effective by auditors than those that indirectly collect evidence, and test stock valuation (Moyes, 1996).

While the efficacy of the use of audit procedures to detect fraud has been tested, it is limited, in most cases, to auditors in the US. This study, therefore, extends this research issue to NZ. Specifically, the purpose of the study is three-fold: (1) To assess the degree of fraud-detecting effectiveness of 56 standard audit procedures that are applicable to stock and warehousing cycle[2]; (2) To identify any perceptual differences of auditors in NZ on the effectiveness of each of the standard fraud-detecting audit procedures on the basis of: (i) regional location (Auckland, Wellington, Christchurch, and "others"), and (ii) type of audit firm (Big-5 and non-Big-5); and (3) To investigate the relative influence of four auditor and audit firm-specific factors: (i) size of audit firm; (ii) position tenure of auditor; (iii) years of experience of auditor; and (iv) practice review experience of auditor's firm on the likelihood of detecting fraud in stock and warehousing cycle. Based on *a priori* reasoning and prior literature, we expect the four auditor- and audit firm-specific factors to have positive effects on the likelihood of detecting fraud in stock and warehousing cycle.

The emphasis on stock and warehousing cycle is of significance. First, stocks constitute a significant portion of corporate assets, both in absolute size and in proportion to all other assets on the balance sheet. Second, stocks, most often, are held in different locations that make physical control and counting difficult. Third, valuation of stocks is difficult due to such factors as obsolescence, and the need to allocate manufacturing costs to stocks. Fourth, there are several acceptable stock valuation methods. These factors make stocks more susceptible to fraud, and hence require a careful audit.

According to Arens and Loebbecke (2000), the stock and warehousing cycle comprises of two separate, but closely related systems. The first is the actual physical flow of goods, and the second is the related costs. They identify five parts of stock and warehousing cycle that must be audited: (i) acquisition and recording of raw materials, labour and overheads; (ii) internal transfer of assets and related costs; (iii) shipping of goods and recording revenues and costs; (iv) physically observing stock; and (v) pricing and compiling stock. Because fraud can occur in any of these parts of the stock and warehousing cycle, each part needs to

be audited. This paper incorporates fraud–detecting audit procedures applicable to all five parts of the cycle.

The layout of the reminder of the paper is as follows. Section 2 describes the research design and methodology employed, while Section 3 reports the results of the statistical analyses carried out on the survey data. Section 4 concludes the paper with highlights on the limitations of the underlying research, and suggestions for future research.

2. Research Design and Methodology

2.1 Sample Design and Sampling Method

Public accountants practising (auditors) in NZ serve as our target population. The target population was stratified on a regional basis (that is, Auckland, Wellington, Christchurch and "others"). It is expected that the extent of fraud occurring in different geographical areas in NZ may vary, and therefore the available audit procedures will vary in their fraud-detecting effectiveness. In particular, because Auckland is a cosmopolitan city, we expect the possibility of fraud occurring to be relatively greater in Auckland (that is, "the big city effect") than in the other regions examined. Sampling units were drawn from each regional stratum. This sampling method is preferred because it minimises the variability of population units within each regional stratum, while maximising the variability across strata.

2.2 Survey Development and Administration

We collected the data for the study through a questionnaire survey in the late 1999. The survey instrument, which consisted of a cover letter, a pre-paid envelope and a questionnaire, was first mailed to 400 stratified auditors.[3] Of these, 26 were returned to us by the postal agency as undeliverable. One hundred and ten auditors responded with usable questionnaire, representing about 29 percent response rate. Anonymity was promised to all respondents to the survey. The questionnaire consists of three parts. The first part collects demographic information about respondents. The second part solicits their opinion on the degree of effectiveness of the 56 standard fraud-detecting audit procedures applicable to stock and warehousing cycle. The respondents were asked to indicate their opinion on the degree of effectiveness of each of the 56 standard fraud-detecting audit procedures on a five-point

Likert-like response scale, which ranges from "not effective" (scored as one) to "extremely effective" (scored as five). This measurement procedure was employed for two reasons. First, it is relatively easy for respondents to use, and responses from such a scale are likely to be reliable (Anderson et al., 1983).[4] Second, the quasi interval features of the Likert scale render it appropriate for hypothesis testing of mean responses. To understand why a respondent will not indicate his/her opinion on the effectiveness of a particular audit procedure, an additional column was provided alongside each audit procedure to be ticked in case of non-applicability.

The third part of the questionnaire provides the respondents with an optional opportunity to contribute written comments on fraud-detecting techniques other than those indicated in the questionnaire that they have used in the stock and warehousing cycle.

2.3 Methodology for Data Analysis

Three main research themes were pursued in this study as follows:

Effective audit procedures

The mean response of all the respondents on each of the audit procedures was computed. This mean response on each audit procedure measures its degree of effectiveness in detecting fraud as perceived by the respondents. As a supplementary analysis, an overall mean response of 3.0365 was also computed for the 56 audit procedures based on the usable returned questionnaire. This overall mean response represent the perceived fraud-detecting effectiveness of a hypothetical average audit procedure in the stock and warehousing cycle. The overall mean response is used as a benchmark to determine the degree of effectiveness in detecting fraud for each audit procedure. Significant differences between the overall mean response and the mean response for each audit procedure were tested with parametric One-sample *t*-test, and are used to classify the audit procedures into one of three categories: "more effective", "moderately effective", and "less effective."[5] Each category represents a differing degree of effectiveness in detecting fraud in the stock and warehousing cycle. Thus, an audit procedure is classified as "more effective" if its mean response exceeds the overall mean response by a significant difference at any of the conventional levels. On the other hand, an audit procedure is classified as "less effective" if its mean response is below the overall mean response by a significant difference at any of the conventional levels. Finally, an audit

procedure is classified as "moderately effective" if its mean response when tested against the overall mean response is not statistically significant.

Perceptual differences

To determine if there are any significant perceptual differences among the respondent auditors on the effectiveness of the 56 audit procedures in detecting fraud in stock and warehousing cycle on the basis of: (i) regional location, and (ii) type of audit firm, we tested the following null hypotheses with One-way analysis of variance (ANOVA)[6] and Two-sample *t*-test respectively:

Hypothesis 1: There are no regional perceptual differences on the effectiveness of the standard audit procedures in detecting fraud in stock and warehousing cycle.

Hypothesis 2: There are no perceptual differences between Big-5 and non-Big-5 auditors on the effectiveness of the standard audit procedures in detecting fraud in stock and warehousing cycle.

Because the ANOVA is incapable of isolating which regional differences are significant, a *posteriori* Scheffe multiple-comparisons test was used to pinpoint which of the regions examined differ significantly (Siegel and Castellan, 1988).

Auditor- and audit firm-specific factors

To investigate the relative influence of: (i) size of audit firm; (ii) position tenure of auditor; (iii) years of experience of auditor; and (iv) practice review experience of auditor's firm on the likelihood of detecting fraud in stock and warehousing cycle, we estimated the following logit regression model:

$$Fraudec_j = \alpha + \beta_1 Size_j + \beta_2 Post_j + \beta_3 Exp_j + \beta_4 \Pr ac_j + \varepsilon_j \qquad (1)$$

Where, $Fraudec_j$ = dichotomous variable which is coded 1 if auditor *j* has detected fraud in the stock and warehousing cycle, and 0 otherwise;

α = the constant term of the equation to be estimated;

β_1 = the coefficient of independent variable to be estimated from the data, where $1 \le i \le 4$;

$Size_j$ = the size of audit firm where auditor *j* works;

$Post_j$	=	the position tenure of auditor *j*;
Exp_j	=	the years of experience of auditor *j*;
$Prac_j$	=	the practice review experience of auditor *j*'s firm; and
ε	=	the stochastic disturbance term for auditor *j*.

3. Analysis of the Survey Data

Analysis of the survey data is organised under four major headings. The first details the demographic characteristics of our respondents. The second is about the perceptual effectiveness of the 56 audit procedures. The third presents analysis on the perceptual differences between auditors operating in different geographical areas in NZ, and the type of audit firm. The fourth concerns auditor- and audit firm-specific factors that influence the likelihood to detect fraud in stock and warehousing cycle.

3.1 Respondents' Demographic Characteristics

As reported in Panels A and B of Table I below, about 93 percent of our respondents are members of the Institute of Chartered Accountants of New Zealand (ICANZ). Of these, 58 percent are in the ICANZ's full membership category, and 27 percent of this figure work with Big-5 audit firms. About 15 percent of our respondents are also qualified with other professional bodies such as the Institute of Chartered Accountants of England and Wales, The Institute of Internal Auditors, and the ACFE.

The number of years our respondents have been in their current positions range from four months to 26 years; with the average position tenure being about four years. In contrast, our respondents have, on average, eight years of practical experience in auditing. As reported in Panel B of Table I, there are significant differences between our respondents who are Big-5 and non-Big-5 auditors on a number of variables including the location of their firms, practice review experience, and stock and warehousing cycle fraud detection experience. The Big-5 firms have experienced significantly more practice reviews, and have detected more stock and warehousing cycle-related frauds than non-Big-5 firms. With respect to individual respondents, however, no statistically significant differences were found in stock and warehousing cycle fraud detection experience of Big-5 and non-Big-5 auditors.

Table I
Analyses of responses to demographic questions and respondents' most frequent write-in comments

Panel A: Metric variables

Response	Obs.	Mean	Std. dev.	Min.	Max.	Skewness	Kurtosis
1. No. of years in present audit firm	109	6.55	6.80	0.5	32	1.856	5.893
2. Position tenure	110	3.60	4.67	0.3	26	2.725	10.573
3. No. of years of experience in auditing	110	7.69	7.27	0.5	35	1.554	5.270
4. No. of staff of respondent's employer	110	261.12	882.32	4	8500	7.982	72.016
5. No. of years of ICANZ membership of respondents	105	5.63	7.13	0	35	2.046	6.997

Panel B: Non-metric variables

Response	Obs.	Big-5 firm	Non-Big-5 firm	t-test	
				t-value	Prob.
1. Respondents' ICANZ membership type:					
Combined	102	55	47	1.866	0.065
Full	64	30	34		
Provisional	38	25	13		
2. Respondents' membership of other professional bodies	104	55	49	0.249	0.804
3. Respondents' firms experiencing practice review before	110	55	49	-3.709	0.000
4. Respondents' firms detecting fraud in stock and warehousing cycle before	92	49	43	-2.555	0.012
5. Respondents detecting fraud in stock and warehousing cycle before	104	55	49	0.781	0.437
6. Regional location of respondents' firms:					
Combined	104	55	49	2.575	0.011
Auckland	27	16	11		
Wellington	27	18	9		
Christchurch	18	12	6		
"Others"	32	9	23		

Panel C: Analysis of write-in comments (n = 35)

Write-in comment (Some respondents made more than one comment)	No. of respondents	Proportion of total (%)
1. Alterations on stock sheets attracted attention	2	4
2. Review stock security system	4	8
3. Attendance at stocktaking	5	10
4. Random testing outside stocktaking period	2	4
5. Identify controls over physical stock count	6	12
6. Just listening to what other staff have to say	2	4
7. Review variances from standard costs	3	6
8. Compare various margins and test other relationships	4	8
9. General knowledge of and close interaction with client	3	6
10. There is no best way to detect fraud	3	6
11. Audits are not designed to detect fraud	3	6
12. Miscellaneous comments on control procedure (such as key staff taking holidays, segregation of duties, review of purchasing policies, e.t.c.)	13	26

Table II
Audit procedures evaluated as "more effective" in detecting fraud in stock and warehousing cycle by respondents (Overall mean response = 3.0365)

Audit procedure (By the order of perceived effectiveness)	Mean	Std. dev.	*t*-value
1. Review stock count procedures: [1] accounting for items in transit (in and out); [2] comparison of counts with stock records; and [3] reconciliation of differences between counts and stock records.	3.827	0.985	8.421**
2. Follow up all exceptions to make sure they are resolved.	3.764	1.013	7.568**
3. Perform compilation tests to ensure that stock sheets total schedule agrees with the physical stock counts.	3.609	0.968	6.202**
4. Verify that stock balances on stock sheets agree with perpetual records (stock subsidiary ledger).	3.591	0.980	5.936**
5. Review adequacy of physical security for the entire stock.	3.518	1.098	4.600**
6. Review major adjustments for propriety.	3.509	1.139	4.350**
7. Trace stock listed in the schedule to stock tags and the auditor's recorded counts for existence, description, and quantity.	3.482	1.081	4.319**
8. Review procedures for receiving, inspecting, and storing incoming items and for shipments out of the warehouse.	3.482	0.955	4.889**
9. Determine if access to stock area is limited to only authorised personnel.	3.418	1.035	3.867**
10. Re-count a sample of client's counts to make sure the recorded counts are accurate on the tags (also check descriptions and unit of count, such as dozen or gross).	3.400	1.167	3.267**
11. Observe the physical count of stock at all locations.	3.318	1.125	2.627**
12. Obtain written confirmation of stocks in public warehouses.	3.245	1.118	1.959*
13. Review related party transactions involving stock movements.	3.227	1.155	1.733*
14. Trace from stock tags to the stock sheets and make sure stock on tags are included.	3.209	1.032	1.753*

Note: * = Significant at the 10% level (two-tail test).
** = Significant at the 1% level (two-tail test).

3.2 Effective Audit Procedures

The results gathered from the survey provide information on the respondents' perception of the relative effectiveness of the 56 standard audit procedures. The perceived effectiveness of the survey respondents on each audit procedure is summarized in Tables II, III and IV. The first column of these tables presents the full text of each audit procedure. The second through fourth columns represent the mean response, standard deviation, and *t*-test statistic for each audit procedure.

Our respondents perceive 25 percent (14 of 56) of the standard audit procedures as being "more effective" than the average audit procedure in detecting fraud in stock and warehousing cycle. Table II presents the auditors' responses for each of the 14 "more

effective" audit procedures in the stock and warehousing cycle. The mean response of the 110 respondents for each of the 14 "more effective" audit procedures is greater than the overall mean response of 3.0365 which represents the effectiveness of an average audit procedure in detecting fraud in the stock and warehousing cycle. The 14 "more effective" audit procedures are, generally, used to collect direct audit evidence in a typical audit engagement. This suggests that they should be applied in the planning stage of an audit. As suggested by Moyes (1996), early indication of possible fraud during the planning stage of an audit would allow auditors to re-plan more effectively, and maximise audit time and resources. Twelve of the 14 "more effective" audit procedures were also perceived by US auditors as such (see Moyes, 1996).

Table III
Audit procedures evaluated as "moderately effective" in detecting fraud in stock and warehousing cycle by respondents (Overall mean response = 3.0365)

Audit procedure (By the order of perceived effectiveness)	Mean	Std. dev.	*t*-value†
1. Test pricing by tracing unit costs from vendors' invoices to the perpetual stock records.	3.218	1.160	1.642
2. Perform purchases cut-off test to ensure that goods in transit on F.O.B. shipping point basis are recorded as purchases and included in stock.	3.154	1.110	1.115
3. Trace shipments to sales records, stock records, and bills of lading (shipping documents).	3.145	1.074	1.064
4. Identify slow-moving, obsolete, or damaged items within the stock.	3.136	1.062	0.986
5. Trace balances of stock-listing schedules to the general ledger.	3.127	1.110	0.858
6. Record client's counts for subsequent testing.	3.118	1.115	0.768
7. Perform analytical procedures by computing ratios and comparing them with previous year's.	3.109	1.176	0.647
8. Verify pricing by locating the appropriate and sufficient invoices to account for the entire quantity of stock for the particular item being tested, especially for FIFO valuation method.	3.091	1.146	0.498
9. Review warehouse records for duplicate locations for the same items.	3.091	1.019	0.560
10. Review policies regarding stock returns.	3.082	1.059	0.448
11. Tour warehouse facilities and become familiar with storage, marking, and location procedures.	3.054	1.012	0.187
12. Observe that damaged or obsolete goods are valued at net realizable value.	3.054	1.099	0.172
13. Review the last shipping document used at year-end and make sure the stock for that item was excluded from the physical count.	3.027	1.281	-0.076
14. Trace stock tags identified as non- owned during the physical observation to the stock-listing schedule to make sure that they have not been included.	3.018	1.149	-0.167
15. Enquire about stocks in other locations, on consignment or on sale or return basis.	3.009	1.096	-0.262

Table III (Contd.): Audit procedures evaluated as "moderately effective" in detecting fraud in stock and warehousing cycle by respondents (Overall mean response = 3.0365)

Audit procedure (By the order of perceived effectiveness)	Mean	Std. dev.	*t*-value†
16. Account for all used and unused tags to make sure none are lost, added or intentionally omitted (record tag numbers for those used and unused for subsequent follow-up).	2.991	1.145	-0.418
17. Trace shipments to sales daybooks.	2.982	1.165	-0.492
18. Compare current stock levels and values with previous year's and evaluate.	2.954	1.078	-0.797
19. Review the last shipping document used at year-end to make sure the stock for that item was excluded from the physical count.	2.945	1.240	-0.770
20. If a standard cost system is used, determine if the valuation method is efficient and useful by reviewing and analysing the variances.	2.936	1.034	-1.016
21. Discuss with client management the stock and warehousing cycle.	2.936	1.144	-0.919
22. Examine shipping area for stock set aside for shipment, but not counted.	2.918	1.068	-1.162
23. Draw flow chart of internal control system and compare with written policies.	2.900	1.180	-1.213
24. Determine whether costs should be included in the valuation of a particular item of purchased stock such as freight, storage, discounts, and other costs and compare the findings with the prior year's audit working papers to make sure the valuation methods are consistent.	2.891	1.136	-1.344
25. Examine stock descriptions on the tags and compare to the actual stock for raw materials, work in progress, and finished goods.	2.882	1.081	-1.500
26. Compare the classification of raw materials, work in progress, and finished goods by comparing the description on stock tags and the auditor's recorded test counts to the stock-listing schedule.	2.873	1.158	-1.483
27. Examine receiving area for stock that should be included in the physical count.	2.864	1.121	-1.618

Note: † = None of the *t*-values is statistically significant at the conventional levels.

Our respondents evaluated 27 (48 percent) audit procedures as being "moderately effective" in detecting fraud in stock and warehousing cycle. The 27 "moderately effective" audit procedures are presented in Table III. The mean response of each of these 27 "moderately effective" audit procedures are not statistically significant when tested against with the overall mean response of 3.0365, which represents the average effectiveness of an audit procedure to detect fraud in stock and warehousing cycle. The 27 "moderately effective" audit procedures are generally used to verify the accuracy and dependability of a client company's accounting records. Thus, the 27 "moderately effective" audit procedures are substantive procedures used to prove the stock figure as genuine, accurate, and complete. Auditors use these "moderately effective" audit procedures to confirm management's financial statement assertions about the stock and manufacturing costs, as the manufacturing costs are the basis for calculating the cost of stock. Compared with the results reported by Moyes (1996), about 70 percent of these "moderately effective" audit procedures (19 of 27)

were perceived by US auditors as having "average" effectiveness in detecting fraud in the stock and warehousing cycle.

Table IV
Audit procedures evaluated as "less effective" in detecting fraud in stock and warehousing cycle by respondents (Overall mean response = 3.0365)

Audit procedure (By the order of perceived effectiveness)	Mean	Std. dev.	*t*-value
1. Observe that non-owned goods are either identified or segregated.	2.864	1.062	-1.707*
2. Check the additions of the stock sheets for raw materials, work in progress, and finished goods.	2.836	1.088	-1.929*
3. Extend the physical stock counts times the price on selected items on the stock summaries.	2.809	1.062	-2.246**
4. Account for the direct material costs, direct labour costs, and overhead costs involved in the valuation of manufactured stocks.	2.809	1.079	-2.210**
5. In pricing stock, consider whether historical or replacement cost is lower.	2.773	1.254	-2.207**
6. Compare current manufacturing costs with previous year's.	2.764	1.074	-2.664***
7. Review contracts with suppliers and customers and enquire of management about the possibility of the inclusion of consigned or other non-owned stock, or of owned that is not included.	2.736	0.983	-3.202***
8. Compare unit costs of stock determined either with FIFO, LIFO or AVCO valuation methods with previous year's.	2.736	1.201	-2.620**
9. Compare the count of larger items stated on the tags to the counts in the prior year and the perpetual stock records.	2.727	1.108	-2.927***
10. Evaluate whether the percentage of completion recorded on the tags for work in progress is reasonable.	2.591	1.016	-4.598***
11. Compare extended stock value with previous year's.	2.536	1.089	-4.815***
12. Test direct labour costs by comparing with labour payroll and union contracts.	2.536	1.217	-4.311***
13. Send confirmations to lenders for pertinent details about warehouse receipts pledged as collateral for liabilities.	2.482	1.359	-4.279***
14. Test number of hours needed to manufacture the product by comparing with engineering specifications.	2.409	1.214	-5.421***
15. Examine financial statements for: [1] proper separate disclosure of raw materials, work in progress and finished goods; [2] proper description of the stock costing method; [3] inclusion of significant sales and purchase commitments; and [4] proper description of pledged stock.	2.327	1.257	-5.918***

Note: * = Significant at the 10% level (two-tail test).
** = Significant at the 5% level (two-tail test).
*** = Significant at the 1% level (two-tail test).

Table IV above presents the remaining 15 audit procedures evaluated by NZ auditors as having "less" effectiveness in detecting fraud in stock and warehousing cycle. The mean response from the 110 respondents for each of the 15 "less effective" audit procedures is smaller than the 3.0365 overall mean, which represents the average effectiveness of an audit procedure in detecting fraud in stock and warehousing cycle. These audit procedures appear

to be those used in collecting audit evidence in an indirect way. They should not exclusively be used in an audit, especially if fraud is suspected. Rather, they should be used to complement those procedures perceived by our respondents as having either of "more" or "average" effectiveness in detecting fraud. Most of the 15 "less effective" fraud-detecting audit procedures are analytical procedures. This result contradicts the general expectation that analytical procedures are useful in indicating client companies that are in severe financial difficulties – situation where managements are more likely to commit fraud. The plausible reason for this result is that evidence gathered with analytical procedures is less objective.

Write-in comments

As stated earlier, respondents were given an opportunity to write in audit procedures other than those in the survey questionnaire that they have used to detect fraud in stock and warehousing cycle. Of the respondents, 35 (32 percent) provided write-in comments. Comments made by these respondents are summarised in Panel C of Table I. The most frequent comments deal with control procedures such as ensuring that key staff take holidays when due, and ensuring that there is proper segregation of compatible duties. Other frequent comments mentioned include identifying controls over physical stock count, and attending stocktaking.

Perceptual Differences

Panels A and B of Table V respectively report the results of the statistical tests performed to determine if there are any perceptual differences between our respondents on the effectiveness of the 56 standard audit procedures in detecting fraud in stock and warehousing cycle on the basis of: (i) the geographical area in NZ where respondents' employers are located, and (ii) the type of audit firm that employs our respondent auditors.

Regional perceptual differences

In most cases, our respondents do agree on the degree of effectiveness of the 56 standard audit procedures used in stock and warehousing audit cycle, except for those six instances reported in Panels A of Table V. Thus, hypothesis 1 can be rejected in 50 of the cases investigated. Of the six cases in which our respondents differ in their perception, a *posteriori* Scheffe multiple-comparisons test indicates that auditors practising in Wellington, and those practising outside the three major centres in NZ, categorised as "others" in this study for statistical purposes, differ significantly on the effectiveness of two audit procedures in detecting fraud.[7]

Table V
Auditors' perceptual differences on the effectiveness of audit procedures in detecting fraud in stock and warehousing cycle

Panel A: By area of location: Auckland v. Wellington v. Christchurch v. "Others" **(n=110)**

Audit procedure	Anova test		Kruskal-Wallis test	
	F-statistic	**Prob.**	**Chi-squared**	**Prob.**
1. Review contracts with suppliers and customers and enquire from management about the possibility of the inclusion of consigned or other non-owned stock, or of owned that is not included.	2.95	0.034††	7.153	0.067
2. Examine receiving area for stock that should be included in the physical count.	2.28	0.084	7.557	0.056
3. Observe that non-owned goods are either identified or segregated.	2.29	0.083	6.078	0.108†
4. Verify pricing by locating the appropriate and sufficient invoices to account for the entire quantity of stock for the particular item being tested, especially for FIFO valuation method.	3.84	0.012†††	12.162	0.007
5. In pricing stock, consider whether historical or replacement cost is lower.	2.36	0.0759	6.949	0.0736
6. Check the additions of the stock-listing schedules for raw materials, work in progress, and finished goods.	2.14	0.0997	7.085	0.0692

Panel B: By auditor-type: Big-5 v. non-Big-5 **(n=104)**

Audit procedure	t-test		Mann-Whitney test	
	t-value	**Prob.**	**Z-statistic**	**Prob.**
1. Enquire about stocks in other locations, on consignment or on sale or return basis.	1.780	0.075	1.796	0.072
2. Trace balances of stock-listing schedules to the general ledger.	-1.927	0.057	-1.787	0.074
3. Identify slow-moving, obsolete, or damaged items within the stock.	1.758	0.082	1.656	0.098
4. Review major adjustments for propriety.	1.615	0.110†	2.262	0.024
5. Review related party transactions involving stock movements.	2.445	0.016	2.188	0.029

Note: † = Not significant at any of the conventional levels.

†† = Scheffe multiple-comparisons test shows that auditors located in Wellington and those in other areas in New Zealand (categorised as "others" for statistical purposes) differ significantly on this audit procedure at the 10% level.

††† = Scheffe multiple-comparisons test shows that auditors located in Wellington and those in other areas in New Zealand (categorised as "others" for statistical purposes) differ significantly on this audit procedure at the 5% level.

Type of audit firm perceptual differences

Again, our statistical test suggests that there are no significant perceptual differences between Big-5 and non-Big-5 auditors on the effectiveness of the 56 standard audit procedures, except in five instances. Panel B of Table V presents these audit procedures, which our respondents differ on the basis of the type of audit firm employing them. Thus, hypothesis 2 is not substantiated in 51 cases.[8] This result is surprising given that the two types of auditors significantly differ on a number of demographic characteristics examined in this study, and reported in Panel B of Table I. This result raises concern about the economic rent enjoyed by Big-5 audit firms. If Big-5 firms do not significantly differ from non-Big-5 counterparts in their use of audit procedures to detect fraud, why should the Big-5 audit firms enjoy economic rent? Presumably, they enjoy economic rent because of their reputation, and are perceived as having greater ability to pay damages.

Auditor- and Audit Firm-specific Factors

We report the results of the logit regression analysis in Table VI. To avoid the consequences of multicollinearity because of the high correlation between the auditor's years of experience in auditing, and auditor's position tenure variables[9], two logit regression models (Models A and B) were fitted to the data. Model A includes all variables except for auditor's years of experience in auditing, while Model B includes all variables except for auditor's position tenure. Panel B of Table VI presents the correlation matrix of the auditor- and audit firm-specific factors investigated, while the results of the Models A and B[10] are reported in Panels C and D of Table VI respectively.

Table VI
Results of Logit Regression

Model: $Fraudec_j = \alpha + \beta_1 Size_j + \beta_2 Post_j + \beta_3 Exp_j + \beta_4 \Pr ac_j + \varepsilon_j$

Panel A: Descriptive statistics of auditor- and audit firm-specific factors

Variable	Notation in model	Obs.	Mean	Std.Dev.	Min.	Max
No. of employees	$Size_j$	110	261.13	882.32	4	8500
Position tenure (years)	$Post_j$	110	3.60	4.67	.3	26
Years of experience	Exp_j	110	7.69	7.27	.5	35
Practice review	$Prac_j$	110	.75	.43	0	1

Panel B: Pearson correlation matrix of auditor- and audit firm-specific factors

Variable	No. of employees	Position tenure	Years of experience	Practice review
No. of employees	1.0000	-0.0371	0.0062	-0.0819
Position tenure (years)	-0.0371	1.0000	0.7997*	0.0956
Years of experience	1.0062	0.7997*	1.0000	0.0883
Practice review	-0.0819	0.0956	-0.0819	1.0000

Panel C: Model A (All variables included except for auditor's years of experience)

Logit estimates	Number of observation	=	110
	Wald Chi-squared(3)	=	15.26
	Prob. > Chi-squared	=	0.0016
Log likelihood = -48.058963	Pseudo R-squared	=	0.1039

$Fraudec_j$	Robust Coefficient	Std. Err.	z	P> | z |	[95% Conf. Interval]	
$Size_j$ (+)	.0003806	.000171	2.226	0.026	.0000454	.0007158
$Post_j$ (+)	.1345041	.0418246	3.216	0.001	.0565694	.2164788
$Prac_j$ (+)	.3647092	.6383185	0.571	0.568	-.8863721	1.61579
Constant (?)	-2.428866	.5750908	-4.223	0.000	-3.556024	-1.301709

Panel D: Model B (All variables included except for auditor's position tenure)

Logit estimates	Number of observation	=	110
	Wald Chi-squared(3)	=	15.87
	Prob.>Chi-squared	=	0.0012
Log likelihood = -46.827845	Pseudo R-squared	=	0.1268

$Fraudec_j$	Robust Coefficient	Std. Err.	z	P> | z |	[95% Conf. Interval]	
$Size_j$ (+)	.000358	.0001672	2.141	0.032	.0000302	.0006857
Exp_j (+)	.1040997	.0315567	3.299	0.001	.0422498	1.659497
$Prac_j$ (+)	.3691132	.643012	0.574	0.566	-.8911671	1.629393
Constant (?)	-2.799416	.6243265	-4.484	0.000	-4.023073	-1.575758

Note: * = Significant at the 1% level (two-tail test).

The results of Model A indicate that auditor's position tenure, and the size of audit firm are significant at the conventional levels of 1% and 5% respectively. The results of an estimate of Model B indicate that the auditor's years of experience in auditing, and the size of audit firm variables are statistically significant at 1% and 5% levels respectively. The coefficient on the practice review experience of auditor's firm variable is statistically insignificant in both models. Apparently, the size of audit firm, measured by number of employees, plays a significant role in the likelihood of fraud detection. More employees represent a larger pool of accumulated expertise pertaining to fraud especially in dealing with stock. Hence, the larger the audit firm, the more likely the application of stock and warehousing audit procedures in an audit engagement will locate fraud involving stock. In both models, the coefficients on auditor's position tenure, auditor's years of experience, and the size of audit firm are all of the excepted signs; suggesting that these variables positively influence the likelihood to detect fraud in stock and warehousing cycle in NZ.

Overall, the results of the regression analysis suggest that size of audit firm, measured by the number of employees, auditor's position tenure, and auditor's years of experience in auditing are significant predictors of the likelihood of detecting fraud in stock and warehousing cycle in NZ. The Wald Chi-squared statistic, which is comparable to the *F*-statistic of a multiple regression, tests the hypothesis that all the parameters in the Equation (1) are simultaneously equal to zero. This null hypothesis is not substantiated, as the Wald Chi-squared statistic of the two models is statistically significant at the 1% level. However, the Pseudo *R*-squared, which is comparable to the *R*-squared measure in a multiple regression, does not indicate a better fit of the data in both models. We examined the sensitivity of the results of both models to other specifications, and find the results reported in Panels C and D of Table VI to be quite robust.[11]

4. Conclusions and Limitations

The major purpose of this study is to explore the degree of effectiveness of 56 standard audit procedures normally applied in the stock and warehousing cycle as perceived by auditors in NZ. Further, it investigates the relative influence of the size of audit firm, auditor's position tenure, auditor's years of experience in auditing, and practice review experience of auditor's firm on the likelihood of detecting fraud in stock and warehousing cycle.

The analysis of the usable questionnaire returned by the surveyed auditors indicates that relatively few (less than half) of the 56 standard audit procedures are perceived by our respondents as being "more effective" than average audit procedure in detecting fraud in stock and warehousing cycle in NZ. On the other hand, they evaluated more than half of these procedures as "moderately effective", and 15 as "less effective" in detecting fraud likely to be perpetuated in the stock and warehousing cycle in NZ.

A univariate analysis reveals no statistically significant perceptual differences on the effectiveness of the 56 standard audit procedures evaluated by our respondent auditors on the basis of the geographical location of their employers in NZ, and the type of audit firm (Big-5 versus Non-Big-5) that employs them.

In addition, a logit regression analysis suggest that the size of audit firm, auditor's position tenure, and auditor's years of experience increase the possibility of detecting fraud that has been perpetuated in the stock and warehousing cycle. However, practice review experience of auditor's firm was found to make statistically insignificant contribution to the likelihood of detecting fraud in stock and warehousing cycle in NZ.

The results reported here should be considered in the light of the following limitations of the underlying research. First, the 56 audit procedures evaluated by our respondents in this study do not represent all the available audit procedures to detect fraud in stock and warehousing cycle. They are limited to those found in a typical auditing textbook. However, to include all available audit procedures relevant in this transaction cycle would have been impossible. Second, the respondent auditors are assumed to be experts in understanding and applying all these audit procedures. Their perception of the effectiveness of the audit procedures may be affected by the fact that they do not suffer any economic loss. Third, responses to

questionnaire by individuals may not always reflect practice. Given the above limitations, caution should be exercised in making generalizations based on the results.

In conclusion, the likelihood of fraud detection in stock and warehousing increases as the auditor acquires more years of auditing experience, and as the audit firm employs more number of staff. Exploring the nature of these relationships, either in other transaction cycles or the same transaction cycle in other countries may be interesting areas for future research.

NOTES

1. For the purpose of this study, fraud is defined as "an intentional deception, misappropriation of a company's assets or the manipulation of its financial data to the advantage of the perpetrator" (Levy, 1985, p. 78). It also includes an array of irregularities and illegal acts characterised by intentional misstatements or omissions of amounts or disclosures in accounting records or financial statements; intentional false accounting or misapplication of accounting principles relating to amounts, classification, manner of presentation or disclosure; and misappropriation of assets (American Institute of Certified Public Accountants [AICPA], 1997).

2. Although functional activities of companies are inter-twined, auditors often view them as highly integrated sets of five cycles known as *transaction cycles*. The auditing literature provides typical examples of the five transaction cycles: (i) purchase and payment cycle; (ii) stock and warehousing cycle; (iii) sales and collection cycle; (iv) payroll and personnel cycle; and (v) capital acquisition cycle. This study focuses exclusively on the detection of fraud in the functional activity of stock and warehousing cycle.

3. The survey instrument was revised following a pilot testing on 100 auditors. Of the 33 auditors who responded to the pilot, only 26 were usable. The revised survey instrument was mailed to our stratified sampling units. A copy of the survey instrument is available, on request, from the first author.

4. A concern in mailed survey research is that of non-response bias. To assess the potential effect of non-response bias, a procedure recommended by Oppenheim (1992) was used. Thus, the respondents were divided into two categories: early and late respondents, and then, the two categories were compared on nine demographic characteristics. The results of our test of non-response bias suggest that there are no significant differences between early and late respondents on these demographic characteristics.

5. This classification procedure facilitates discussion of our results.

6. Because the assumption of equal variance is not supported by the data, the non-parametric counterpart, Kruskal-Wallis test, was also employed. Gaito (1980, p. 567) emphasises the importance of this requirement for an ANOVA test.

7. For brevity, the result of this supplementary analysis is not reported here.

8. In another analysis, the type of audit firm variable was found not to be statistically significant. In this analysis, the type of audit firm was included in Equation (1) as a categorical variable where it was coded one if it is a Big-5 audit firm, and zero otherwise.

9. As reported in Panel B of Table VI, the pairwise Pearson product-moment correlation coefficient for these variables is 0.80. This suggests a serious multicollinearity problem (Gujarati, 1995). Simultaneous inclusion of these variables in Equation (1) results in changes in the signs of some of the parameter estimates.

10. Because the estimated residuals of the models were serially correlated, logit models with *robust* standard errors were run. Standard errors of parameter estimates of a model with serially correlated residuals are biased, and predictions based on the estimates are inefficient (Koutsoyiannis, 1977).

11. We estimated a probit specification of Equation (1) for both Models A and B. The results in each case are qualitatively similar to the logit results, and in the interests of brevity, are not reported here. Note that the difference between logit and probit regressions is about the assumption of the distribution of the independent variables. The probit regression requires that the independent variables be normally distributed (Maddala, 1991).

References

Albrecht, W. S. and Romney, M. (1986) Red-flagging management fraud: A validation, in Schwartz, B. N., Reckers, P. and Wright, A. (Eds.) *Advances in Accounting*, Vol. 3, pp. 323-333. Greenwich, Connecticut: JAI Press.

Albrecht, W. S., Wernz, G. W. and Williams, T. L. (1995) *Fraud, Bringing Light to the Dark Side of Business*, Homewood, Illinois: Richard D. Irwin, Inc.

American Institute of Certified Public Accountants [AICPA] (1997) *Statement on Auditing Standards No. 82: Consideration of Fraud in a Financial Statement Audit*, New York: AICPA.

Anderson, A. B., Basilevshy, A. and Hum, D. P. J. (1983) Measurement theory and techniques, in Rossi, P. H., Wright, J. D. and Anderson, A. B. (Eds.) *Handbook of Survey Research*, San Diego, California: Academic Press.

Arens, A. A. and Loebbecke, J. K. (2000) *Auditing: An Integrated Approach*, Eighth (International) Edition, New Jersey: Prentice Hall.

Coopers and Lybrand (1977) Red-flags for fraud, *CPA Journal*, August, pp. 76-77.

Cottrell, D. M. and Albrecht, W. S. (1994) Recognising the symptoms of employee fraud, *Health Care Financial Management*, May, pp. 19-25.

Elliott, R. K. and Willingham, J. J. (1980) *Management Fraud: Detection and Deterrence*, New York: Petroceli Books.

Gaito, J. (1980) Measurement scales and statistics: Resurgence of an old misconception, *Psychological Bulletin*, Vol. 87, No. 3, pp. 564-567.

Gujarati, D. N. (1995) *Basic Econometrics*, Third Edition, London: McGraw-Hill.

Institute of Chartered Accountants of England and Wales (1995) *Statement of Auditing Standard No. 110, Fraud and Error*, London: Auditing Standards Board.

Koutsoyiannis, A. (1977) *Theory of Econometrics*, Second Edition, London: Macmillan.

Levy, M. M. (1985) Financial Fraud: Schemes and Indicia, *Journal of Accountancy*, Vol. 160, No. 2, August, pp. 78-87.

Macfie, R. (1996) Entrepreneur on trial, *Independent*, February 16, p. 4.

MacLennan, C. (1996) The fall of Fortex, *North and South*, June.

Maddala, G. S. (1991) A perspective on the use of limited-dependent and qualitative variables models in accounting research, *Accounting Review*, Vol. 66, No. 4, October, pp. 788-807.

Mitchell, S. H. (1997) Management fraud trends, *Secured Lender*, pp. 104-108.

Moyes, G. D. and Baker, R. (1995) How effective are audit techniques in detecting fraud? *Internal Auditing*, Vol. 10, No. 4, Spring, pp. 32-40.

Moyes, G. D. (1996) Audit techniques and inventory fraud detection in accounting information systems, *Review of Accounting Information Systems*, Vol. 1, No. 1, Winter, pp. 63-76.

Moyes, G. D. and Hasan, I. (1996) An empirical analysis of fraud detection likelihood, *Managerial Auditing Journal*, Vol. 11, No. 3, pp. 41-46.

Moyes, G. D. and Lavine, M. K. (1997) Which audit techniques work in detecting fraud?, *Corporate Controller*, Vol. 10, No. 6, September/October, pp. 43-47.

Oppenheim, A. N. (1992) *Questionnaire Design, Interviewing and Attitude Measurement*, New Edition, London and Washington: Pinter Publishing Limited.

Pincus, K. (1989) The efficacy of a red flags questionnaire for assessing the possibility of fraud, *Accounting, Organisations and Society*, Vo. 14, Nos. 1/2, pp. 153-163.

Romney, M. B. and Albrecht, W. S. (1980) Auditors and the detection of fraud, *The Journal of Accountancy*, May, pp. 63-69.

Siegel, S. and Castellan, N. J. Jr. (1988) *Nonparametric Statistics for the Behavioral Sciences*, Second Edition, New York: McGraw-Hill Book Company.

Tyler, G. (1997) Corporate fraud: Buy into the fraud squad, *Supply Management*, July 31, pp. 18-21.