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The Effects of Environmental Risk Information on Auditors' Decisions about Prospective Financial Statements

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ABSTRACT *This study tests a model of how auditors make decisions when presented with environmental risk information in the context of a task that requires their professional opinion on a company's forecasted information. Auditing provided a small-world context where declarative and procedural knowledge have been well documented in terms of the rules for analysing financial information. This research uses a conceptual modelling approach to determine auditors' perceptions of environmental risk information and the effects on their judgement and decision choices when issuing an examination report supporting forecasted financial statements. Auditors were provided with environmental risk information that they had to process and integrate in their decision-making. The results demonstrated that auditors act on unfamiliar declarative knowledge using their standard procedural knowledge. The results from eighty-four senior auditors displayed evidence that auditors' perception of environmental risk information is downplayed compare to the traditional accounting information during their judgement and decision choice phases. When confronted with conflicting information, auditors tend to place more reliance on financial rather than environmental risk information. One of the implications of this study is that auditors should be trained to handle non-traditional information, such as environmental risk.*

1. Introduction

The problem addressed in this study is how auditors process environmental risk information about companies in making decisions about whether to issue an examination report supporting management's forecasts. Environmental risk information is becoming more important in auditing and requires further research (Groot, 2001). We are motivated in studying forecasted prospective financial statement information because it is an area that continues to receive attention due to the demand for

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this service by investors and creditors (Bell and Wright, 1995). We are in an era in which consumers of financial statement information are clamouring for more timely and relevant information (e.g. consider the existence, including the attendant press releases, of the AICPA's special committee report on the information needs of investors and creditors (1993)).

Auditors use standard benchmarks to better analyse and compare a company's financial information in order to advise management on expense reduction or revenue improvement. However, auditors' perceptions of non-traditional information are not well calibrated due to a lack of benchmarks (Groot, 2001; Rodgers and Housel, 2001). For example, Slovic and MacPhillamy (1974) claimed that common information has a greater impact because it is simpler to use in comparing candidates. Further, Lipe and Salterio (2000) presented evidence that decision-makers, while making comparisons between similar situations, give common information more weight in the final decision than situation-specific unique information.

The purpose of this paper is to model the decision processes that auditors use when they are confronted with traditional and non-traditional (i.e. environmental risk factors) information in the analysis of forecasted financial statements. Further, the research tests whether perception of environmental risk information is bundled by auditors and whether this alters their analysis of forecasted financial statements. Kaplan and Norton (2001) suggested that most intangible asset valuation is bundled, and in this paper we also examined whether auditors bundle environmental risk information.

This study responds to the call by prior research (e.g. Groot, 2001; Lev, 2001; Rodgers, 2003) for future studies of accounting and auditing to examine how decision-makers integrate, utilize and measure intangible or non-traditional information. The environmental risk information presented to auditors in our study related to a firm's significantly increasing or decreasing environmental pressure, plant location costs, changes in plant security and rising insurance costs. The conceptual model presented in the following section describes auditors' perceptual processing when capturing and bundling environmental risk information as well as other processes that auditors use in rendering decisions about prospective financial statements.

The traditional decision-making models treat information as passively perceived by the auditors. The model tested in this study assumes that auditors are actively operating on the information they are presented using their perception and judgement in reaching decisions.

Conceptual Model

The conceptual model presented in this paper has shown to be useful in conceptualizing a number of different issues important to organizations (Rodgers, 1992, 1999; Culbertson and Rodgers, 1997; Rodgers and Gago, 2001). This model is particularly relevant because it clarifies critical pathways for decision-making purposes and eliminates rival alternative hypotheses (Rodgers, 1997, p. 63).

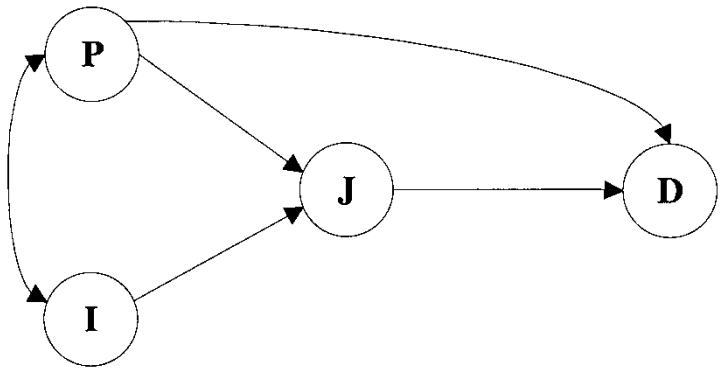

Figure 1. Decision-makers' processes diagram. P = perception; I = information; J = judgement; D = decision choice.

The circles in Figure 1 represent the theoretical constructs of perception (P), information (I), judgement (J) and decision choice (D) (Rodgers and Housel, 1987; Rodgers, 1992, 1997). In the *first phase*, perception and information affect judgement; while in the *second phase*, perception and judgement affect decision choice. Perception involves framing situations based upon experience, heuristics and informational sources. The double-ended arrow connecting perception and information in Figure 1 represents this relation. Further, information and perception are interdependent because information is dependent on how auditors, influenced by their framing, interpret it (e.g. Tversky and Kahneman, 1974).

Judgement, the next step in the decision-making process, requires more analysis of the financial information than the perceptual processes. It is in the judgement phase where analytical tools gained from auditing training are used for the interpretation of financial information (Rodgers and Housel, 1987; Rodgers, 1992, 1999). It remains to be seen how auditors' judgement will be affected by environmental risk information.

In section 2 of this paper we discuss how auditors process information in auditing engagements using forecasted statements. A description of the experiment is presented in section 3, followed by the analysis of our experimental results in section 4. The final section provides conclusions, implications and a call for future research on modelling the auditing decision-making process.

2. Theory: Modelling the Interaction of Information and Auditors' Decision Processes

The following description of the two primary phases of decision-making review how decision-makers' perception (first phase) and judgement (second phase) affect their use of various information sets in reaching auditing decisions.

First Phase: The Effect of Perception of Environmental Risk Information and Financial Statement Information on Judgement

In the current study, the first processing phase includes perception of environmental risk information and financial statement information (i.e. liquidity, profitability and risk). Research has shown that liquidity, profitability and risk are the most significant indicators for financial statement information (Lau, 1987). The conceptual model provided in this paper asserts that an auditor places weights on analysed information that are influenced by his/her perception of environmental risk information.

Perception of environmental risk information is influenced by a decision-maker's knowledge base. Perceptual framing involves encoding, where a set of facts processed by the decision-maker becomes part of his/her declarative knowledge structures (Figure 2). Declarative knowledge includes the use of information consisting of factual ratios, trends etc. (Rodgers, 2002). Decision-makers use this declarative knowledge in conjunction with their general problem-solving procedures (e.g. analogy, means–end analysis, working backwards).

Declarative knowledge was represented in the model's measurement system. The declarative knowledge, in this study, included environmental risk information, consisting of factual trends over a three-year period of time on environmental pressure, plant location costs, changes in plant security and rising

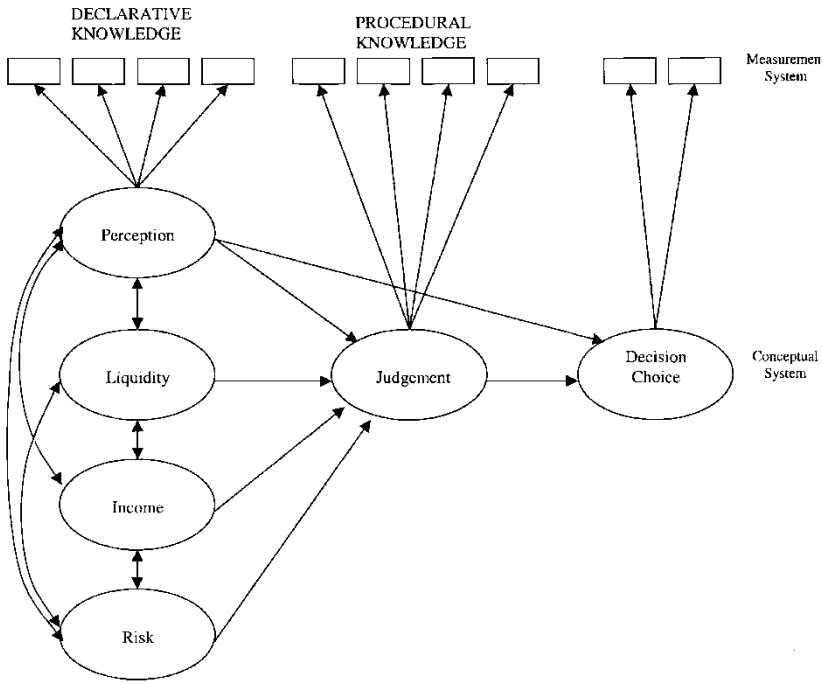

Figure 2. Auditors' modelling processes.

insurance costs that the subjects obtained from the cases. A primary motivation for studying the effects of environmental risk information was to determine if it would influence the formulation of knowledge structures used in the *judgement* phase. Knowledge structures have been shown to have a profound impact on auditing decision-making (e.g. Tubbs, 1992; Nelson *et al.*, 1995).

Traditional financial statement information analysed by auditors is depicted in our model by the major concepts of liquidity, profitability and risk. The model depicts how external information and declarative knowledge are processed and often modified by procedural knowledge before a decision is made. Individuals use selective procedural knowledge that enables them to select operators in forming a useful solution. Procedural knowledge consists of stored information about if–then rules that provide situation-specific solutions in decision-making. This procedualization, where facts are turned into procedures, is represented in the measurement model in terms of the judgement concept (Vera-Munoz *et al.*, 2001; Rodgers, 2002). As indicated in the conceptual model in Figure 2, declarative knowledge, filtered by perception, can influence decision choice as well as being mediated by procedural knowledge during the judgement phase.

Therefore, to determine the effect of auditors' perception of bundled environmental risk information as well as financial information on their judgement, the following hypothesis was tested:

H1: Auditors' perceptions of environmental risk information as well as financial statement information will significantly influence their judgement.

Second Phase: The Effect of Judgement and Perception on Decision Choice

The second phase involves problem-solving analysis; therefore, the auditor should know an adequate set of operations to complete the analysis. Difficulty will result if a needed operator is not known or if an incorrect operator is used (Lewis, 1981; Waller and Felix, 1984). This indicates that auditors may experience difficulty in judging environmental risk information because they have not been trained in the use of this kind of information in rending decisions.

The judgement phase represents a culmination of information processing and knowledge acquisition.[1] To examine the effect of auditors' perception and judgement on their decision choice, we tested the second hypothesis:

H2: Auditors' perception of environmental risk information and judgement significantly influences their decision choice.

3. Method

Subjects

Subjects included eighty-four senior auditors who attended a Big Six CPA firm training school. Their mean auditing experience was three years. The results of

Frederick *et al.* (1994) and Nelson *et al.* (1995) suggest that this is sufficient time to have developed an adequate knowledge structure of general auditing analysis experience. Moreover, Hoffman *et al.* (1995) advocated that the experts (or novices) must be presented some sort of task that taps into their knowledge and skill, that reveals their reasoning and judgement processes, and that permits assessment of their performance. The senior auditors in the sample were deemed to have the knowledge and skill level required to perform the experimental task presented to them. The subjects had a relatively consistent level of prior experience (approximately three and a half years). They were deemed competent to complete the experimental tasks in that they had participated in assurance reviews involving forecasts or have covered these issues in a training seminar. Their ability to successfully complete the tasks was also assured by their respective partners based on their knowledge of the subjects' abilities to perform similar kinds of analyses.

The gender distribution of subjects was consistent with the distribution in the audit profession in the United States (approximately 60% male, 40% female). The subjects came from geographically distributed offices and were randomly selected for participation in the study.

Task

The subjects were asked to read two cases, to use the information in each of them to assess the forecasted financial statements for the company in each case, and to make a decision about whether to issue an examination report supporting the statements. Subjects took approximately one and a half hours to complete the cases. The information in each case consisted of financial statements, a management profile and a company's outlook story. Partners at a Big Five firm validated the questionnaire and approved it for use in one of their national training programmes. The management profile and outlook story described the company's past achievements and difficulties, as well as its forecasted future directions. We manipulated the management profile and outlook story to contradict the financial statements and forecasted information (2×2 design). This manipulated environmental risk information provided the subjects with the knowledge base to interact with their perception of the environmental risk information.

Two cases had financial statement information that was clearly defined and internally consistent with management profiles and outlook stories while the other two were less clear and less consistent. Cases 2 and 3 were consistent, whereas cases 1 and 4 were not. The financial statement information in cases 1 and 3 were considered '*good*', whereas cases 2 and 4 were not. Companies considered having 'good' financial statements had positive net income, whereas companies with 'bad' financial statements had net losses on the income statement. Each subject was randomly assigned two cases: one of the former and one of the latter. That is, every other person was given the same case.

Total sample size equals 167 responses (84 auditors × 2 cases = 168 minus 1 incomplete case).

The financial information for the cases was based on annual reports from the paper industry for three years and consisted of ratios, an income statement, a balance sheet and a statement of cash flow for each case. After the subjects read each case, they used an interval scale to indicate: (1) the usefulness of non-traditional information about the company; (2) the judgement he or she used to assemble procedural knowledge in evaluating liquidity, profitability, risk and the overall performance of the company, each rated separately; (3) decisions about whether or not to issue an examination report supporting the forecasted financial statements, and whether to extend hours for testing. The following discusses the operationalizations of perception, information, judgement and decision choice.

Perception of Environmental Risk Information

This factor was assessed with events occurring outside of the realm of financial information, consisting of factual trends over a three-year period of time on environmental pressure, plant location costs, changes in plant security and rising insurance costs on their forecast analysis. Specifically, subjects were asked to determine the informational usefulness of these facts.

Information

Current ratio, net margin ratio and debt/equity ratio represented the three major independent concepts of a company's liquidity, profitability and risk. These ratios were selected because a number of studies point out their significance as indicators of a company's financial health (Van Horne, 1980).

Judgement

This factor was assessed by the subjects' evaluations of a company's liquidity, profitability, risk and its overall performance over a three-year period of time, and represented their procedural knowledge. Auditors survey such information to review the likelihood that such trends will continue as forecasted by management. They analysed this information using basic financial analysis as depicted under standard auditing guidelines. For example, if accounts receivables are trending upwards, it is reasonable to assume that revenues are trending upwards as well.

The auditor's evaluations represent procedural knowledge that is formed through a variety of learning mechanisms such as composition and proceduralization (Anderson, 1987). Judgement represents the unobserved concept that reflects procedural knowledge.

Decision Choice

This factor reflects two conditions regarding (1) a subject's decision about whether to issue an examination report supporting the forecasted financial statements, and (2) whether to extend hours for testing. The latter condition enhances structuring of the auditing decision. In other words, it allows a degree of 'realism' by enabling an auditor to modify his/her decision.

Model Equations

Following are the first- and second-phase structural model equations. The first phase represents the effects of perception and information (i.e. liquidity, profitability and risk) on judgement (y_1); and the second-phase equation that represents the effects of perception and judgement on decision choice (y_2). The structural equations are:

$$y_1 = \gamma_1 x_1 + \gamma_2 x_2 + \gamma_3 x_3 + \gamma_4 x_4 + \varepsilon \quad (1)$$

$$y_2 = \gamma_5 x_1 + \beta_1 y_1 + \varepsilon \quad (2)$$

Interpreted in the context of a multiple regression equation, equation (1) indicates that γ_1 value for the effect of perception on y_1, is the effect of perception after 'having controlled for γ_2 (liquidity), γ_3 (profitability) and γ_4 (risk) variables in the equation'. Equation (2) shows the γ_5 value for the effect of perception on y_2 after having controlled for β_1 (judgement).

Procedure

x_1 (equations (1) and (2)) represents auditors' perception of environmental risk information. This latent variable is measured by their assessment of the importance of the following four indicators:

1. environmental pressure;
2. plant location costs;
3. changes in plant security; and
4. rising insurance costs.

x_2, x_3 and x_4 (equation (1)) represent financial statement information in terms of liquidity, profitability and risk of a company, respectively. x_2 is measured by the current ratio, x_3 by the net margin ratio and x_4 by the debt/equity ratio.

y_1 (equations (1) and (2)) is auditors' judgement. This latent variable is measured by four procedural knowledge indicators, which represent auditors' analysis and evaluation of a company's

- forecasted liquidity;
- forecasted profitability;

- forecasted leverage; and
- overall performance.

y_2 (equation (2)) is auditors' decision choices, a latent variable that is measured by two indicators:

- issuing the examination report; and
- extending hours for testing.

Data Analysis

A one-way repeated measure analysis of variance (1×4) design was used to determine if significant differences exist in the auditor's *decisions* about whether to issue an assurance letter supporting the forecasted financial statements issued by the company. The most important advantage of using this repeated-measure design is to assess auditors' decisions with regards to the four cases ranging from consistent to inconsistent information.

Maximum likelihood (MLH) was used to estimate the conceptual and measurement systems implemented by the program LISREL (Joreskog and Sorbom, 1993). A major strength of LISREL is its latent-variables approach to covariance structural model testing, whereby multiple indicators of each factor are obtained. Multiple indicators improve construct validity of measurements and reduce measurement errors (Rodgers, 1992, 1997).

LISREL also allows the following amenities for model testing: full information (e.g. MLH) estimation, statistical assessments of model fit and indications for improving the model, and relaxation of classical regression assumptions (i.e. no error term correlations, no measurement error).[2]

This analysis interpreted the comparative fit index (CFI; Bentler, 1990), which estimates a population measure of model fit. Bentler's (1990) study acknowledged the CFI to have less sampling variability than the NFI or IFI. Unlike the IFI, the CFI never exceeds 1 and avoids the NFI's small sample underestimation of model fit. These three fit indices are nonetheless asymptotically equivalent (Bentler, 1990). Finally, causal estimates tested the models' free parameters, which verified how well the auditors' models satisfy parameter restrictions (James *et al.*, 1982).[3]

4. Results

Using the repeated measure analysis of variance design (Table 1), it was concluded that significant differences exist in the mean decisions among the case companies ($F(3, 117) = 10.840$, $p < 0.001$). A t-test revealed that the auditors' decisions were not influenced by whether a company's financial statement was considered 'good' or 'bad' ($p < 0.05$). Based on these results, it appears that auditors are partially influenced by the conflicting information between the

Table 1. Repeated measures analysis test

Dependent variable means[a]			
Case 1 Inconsistent information	Case 2 Consistent information	Case 3 Consistent information	Case 4 Inconsistent information
1.050	1.125	1.475	1.500

Univariate repeated measures analysis within subjects					
Source	SS	DF	MS	F	P
Decision	6.525	3	2.175	10.840	0.001
Error	23.475	117	0.201		

[a]1 = issue an assurance letter; 2 = do not issue an assurance letter.

financial statement information and the environmental risk information. This inconsistency of information may have contributed to ambiguity in the auditors' decision-making process.

The chi-square test disclosed moderate discrepancies between the observed correlation matrix and that implied by the auditors' model ($\chi^2 = 105$, degrees of freedom = 55). Yet, the NFI, IFI and CFI values surpassed the 0.90 threshold for acceptable fit (Bentler and Bonett, 1980). Individual parameter estimates reported in Table 2 further corroborated this interpretation.

The measurement system parameters of Table 2 represent factor loadings. The factor loadings are the standardized regression weights for predicting observed variables from latent constructs. To identify the variance of the latent variables, the first indicator loading was set on its latent variable equal to one. It should be noted that most of the factor loadings are high and consistent for each of the latent variables under investigation. As a consequence, it can be concluded that the model assessed the theoretical constructs hypothesized to exist at the level of latent factors with a reasonable degree of precision and that the observed variables are adequate indicators of these factors. Table 3 reports the correlation matrix, means and standard deviations of the model.

The details associated with the causal model parameters of Table 2 can be understood in the context of the following notation. Each causal parameter estimate contains a subscript consisting of two letters. These designations are derived from the first letters of the respective factor names communicated by the parameters (γ_{JP}: Perception of environmental risk information; γ_{JL}: Liquidity; γ_{JR}: Riskiness or leverage; γ_{JI}: Income or profitability; *J*: Judgement, *D*: Decision choice). The subscripts associated with regression weights (directional arrows in the figures) are ordered so that the second subscript signifies the antecedent variable (or 'cause'), while the first refers to the dependent variable.

Table 2. Measurement and conceptual parameter estimates

	Measurement model parameters[a]	
Factor and variables	Factor loading	Error variance
Perception		
Environmental pressure	0.463[b]	0.000
Plant location costs	0.789	0.357
Changes in plant security	0.704	0.313
Rising insurance costs	0.417	0.238
Judgement		
Forecasted liquidity	0.558[b]	0.000
Forecasted profitability	0.806	0.000
Forecasted leverage	0.871	0.212
Overall performance	0.730	0.193
Decision choice		
Issue the examination report	0.545[b]	0.000
Extend hours for testing	0.555	0.246
	Causal model parameters	
	Standard weight	Critical ratio
Regression weights		
γ_{JP}	0.027	0.342
γ_{JL}	1.129	3.431[a]
γ_{JR}	0.358	3.127[a]
γ_{JI}	0.880	2.789[a]
γ_{DP}	0.063	0.479
β_{DJ}	1.056	4.052[a]
Residual variances		
Industry regulatory complexity	0.621	
Annual external audit fee paid	0.850	
Chi-square with 55 df = 105	Normed fit index = 0.92	
Incremental fit index = 0.96	Comparative fit index = 0.96	

[a]$p < 0.05$.
[b]Parameters' values fixed by scaling.
P: Perception; *L*: Liquidity; *R*: Riskiness or leverage; *I*: Income or profitability; *J*: Judgement; *D*: Decision choice. The subscripts associated with regression weights are ordered so that the first subscript signifies the antecedent variable (or 'cause'), while the second refers to the dependent variable.

Hypothesis 1 was partially supported in that the cues of $\gamma_{JL(\text{liquidity})}$, $\gamma_{JR(\text{risk})}$ and $\gamma_{JI(\text{income})}$ had a statistically significant effect on judgement ($p < 0.05$). In addition, a detailed regression analysis revealed that environmental pressure had a significant effect on decision choice ($p < 0.10$). Further, declarative knowledge indicators contributing to the perceptual construct were all significant in terms of

Table 3. Means, standard deviations and correlation matrix

	J1	*J2*	*J3*	*J4*	*DC1*	*DC2*	*M1*	*M2*	*M3*	*M4*	*LIQ*	*RIS*	*PRO*
Correlation matrix to be analysed													
J1	1.00												
J2	0.46	1.00											
J3	0.49	0.69	1.00										
J4	0.34	0.55	0.70	1.00									
DC1	−0.29	−0.38	−0.25	−0.16	1.00								
DC2	−0.22	−0.28	−0.27	−0.17	0.30	1.00							
M1	−0.02	−0.12	−0.05	−0.02	0.13	−0.02	1.00						
M2	0.03	−0.05	0.08	0.09	0.01	−0.01	0.36	1.00					
M3	0.04	0.01	−0.02	−0.03	0.05	0.04	0.34	0.55	1.00				
M4	0.04	−0.03	−0.05	0.04	0.05	−0.08	0.20	0.33	0.29	1.00			
LIQ	0.45	0.56	0.42	0.32	−0.31	−0.33	−0.04	0.01	0.05	0.03	1.00		
RIS	−0.41	−0.59	−0.44	−0.37	0.33	0.26	0.02	0.01	0.02	0.03	−0.81	1.00	
PRO	0.47	0.54	0.39	0.28	−0.30	−0.27	−0.05	0.03	0.05	0.04	0.98	−0.81	1.00
Means													
M1	*M2*	*M3*	*M4*	*J1*	*J2*	*J3*	*J4*	*DC1*	*DC2*	*LIQ*	*RIS*	*PRO*	
48.934	62.371	60.066	62.593	57.838	56.216	50.647	47.874	76.746	118.323	1.697	1.113	0.093	
Standard deviations													
M1	*M2*	*M3*	*M4*	*J1*	*J2*	*J3*	*J4*	*DC1*	*DC2*	*LIQ*	*RIS*	*PRO*	
21.554	18.886	21.423	20.546	14.758	19.873	18.167	19.785	52.949	55.532	0.182	0.572	0.047	

M1 = recent management changes affecting employee training; *M2* = recent management turnover; *M3* = management's experience with the company's product lines, management slow payment of their debts to vendors. *J1* to *J4* represent the analysis of the company's forecasted liquidity, profitability, leverage and overall performance, respectively. *DC1* and *DC2* represent approval of the forecasted report and extending hours for more testing. *LIQ* = the current ratio; *RIS* = the debt/equity ratio; *PRO* = the net margin ratio.

their weights in relation to the conceptual system (Table 2). However, when considered as a perception of bundled environmental risk information (i.e. environmental pressure, plant location costs, changes in plant security taken together) auditors appeared not to weight these items the same way they measure financial information.

These results indicated that at the conceptual system level, the perceptual effects measuring bundled environmental risk information did not influence how auditors evaluated and judged information. That is, auditors tended to rely on the financial statement information to help them gauge whether or not forecasted financial statements were acceptable. The first phase of the model that represented the effects of perception and information (i.e. liquidity, income and riskiness) on judgement, reported a robust $R^2 = 0.38$.

Hypothesis 2 was partially supported since auditors' judgement had a significant influence on their decision choices. That is, in the second phase β_{DJ} had a statistically significant effect on decision choice ($p < 0.05$). The second phase which represents effects of perception of environmental risk information and judgement on decision choice reported an $R^2 = 0.15$.

For the judgement construct, the procedural knowledge indicators (i.e. forecasted liquidity, profitability, riskiness and overall performance) were significant in loading on the judgement factor (Table 2).

5. Conclusions

The two-stage model described in this paper explored a conceptual system that provided a means of analysing the pathways that lead to auditors' decisions. This study's results concur with prior research by Lipe and Salterio (2000) that found that decision-makers, while making comparisons between similar situations (business units or companies) give financial information more weight in the final decision than situation-specific unique information. In addition, the results of the current study concur with Lipe and Salterio (2000) in finding that unique, non-traditional, environmental information is outweighed by common financial ratio information. However, the current study's results extended Lipe and Salterio (2000) in suggesting that when auditors are confronted with a case (i.e. case 4) where the financials are bad but the story is good, they appeared to be more perplexed by the ambiguity and more hesitant to render an opinion. In other words, pure reliance on financial analysis may not always be the case in audit decisions about forecasts.

The results indicated that auditors process traditional financial information, such as profitability, liquidity and leverage, directly in their judgement processes. This finding makes sense in light of the fact that auditors receive education and training that would allow them to analyse this traditional financial information and also have experience using financial statements.

However, it is also noteworthy that the results indicated that auditors process the non-traditional, environmental risk information through their perceptual

filters but did not submit it to judgement processes for analysis prior to reaching a decision. The problem appears to lie in the fact that they have no training or analytic tools for processing this information in reaching audit decisions.[4]

Several methods for analysing such non-traditional information may provide avenues for training auditors. For example, the balance scorecard (Kaplan and Norton, 2001) provides a methodology for identifying non-traditional information with financial information in units other than currency. Tillquist and Rodgers (2003) demonstrated that dependency network diagrams (DND) have great potential for measuring and valuing bundled intangible assets. Future research is needed to determine which methods are most promising and what impact such non-traditional measures would have on auditors' decision-making processes in analysing forecasted financial statements.

Although environmental risk information is valued by other sources outside accounting, there also is a need for auditors to include this information in reaching their decisions. Since auditors form one of the major accrediting sources for information, it follows that acceptable non-traditional information could improve the reliability of forecasts. Further, since creditors and investors increasingly gauge their decisions from numerous sources of information, auditors with an improved understanding of non-traditional information can play a major role in supporting the financial markets.

The current research represents a first step in laying the groundwork for the inclusion of non-traditional information in supplemental schedules of the financial statements. 'Good' measures alone are not enough since they are passive indicators; it is also necessary to determine how auditors will actively use the information in making auditing decisions. The finding that auditors used their procedural knowledge during judgement processes provided another way to examine what governs or promotes certain actions or decisions.

6. Limitations

Like all research, this study is subject to limitations. Perhaps the most serious limitations of this study revolve around the sample size and subjects selection. Our attempt to ensure external validity presented some serious challenges in obtaining commitment from the professional auditors in our sample to give us the time necessary to complete the study. Our sample size was less than ideal for our experimental design. A serious limitation of this research study was that the sample size consisted of eighty-four subjects. At present, the suggested absolute minimum ratio is five individuals for every variable or, in the current study, to use a minimum of 100 individuals (Rodgers, 1992).

Statistical criticisms are also at issue with structural model equations, such as the one used in the current study, when the sample size is less than ideal. That is, the overall χ^2 model goodness-of-fit index may be biased by sample size. There is no uniform consensus regarding the use of a non-statistical goodness-of-fit index.

Another source of concern surrounded task validity issues. A limitation to the generalizability of this paper's results is that in the experimental setting the subjects may not have developed the same forecast assumptions from the presented data. This might have introduced a source of uncontrolled variability. It is possible that they performed the task using different assumptions, which would have contributed to measurement error. Some of our participants may have been relative novices in performing an assurance task such as analysing forecasted statements, and they may not have had the business experience in the paper industry from which we developed our case materials.

The pressure on the professional participants' time prohibited the use of a lengthy instrument that would have included substantially more industry information, both financial and non-financial. This might have introduced a source of uncontrolled variability. The over-representation of financial compared to environmental information and the lack of information source identification may have introduced sources of uncontrolled bias per the work of Tversky and Kahneman (1974). This made the task less representative of the kind of information processing that auditors typically engage in during their real-world work activities.

Although our measurement model met rigorous testing requirements, it is possible that the auditors' responses differed relative to the various groups of measures. Future research should investigate whether the results of this study are replicable and generalizable to other types of assurance tasks and decision-making situations.

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Notes

1. Judgement enables decision-makers to refine their operational skills, which influences their decision choices. For example, decision-makers are known to use two strategies consisting of 'decomposition' and 'conversion'. Decomposition allows individuals to reduce a problem into subsets by drawing on their existing knowledge to make inferences, add constraints and determine a small set of variables. This process enables the problem to be 'converted' into one that may be solved by specifying actions addressing the perceived causes. Judgement can be viewed as a multifaceted process that includes knowledge and information acquisition, as well as the effects of perception. The weighting and configuring of these inputs are unknown. Research has documented that these inputs are necessary in order for decision-makers to render useful and intelligent decisions.

2. There is considerable controversy over fit statistics; therefore, we interpreted several measures of model fit. In addition to the familiar chi-square significance test, we used several comparative goodness-of-fit indices that assessed our model validity along a more interpretable 0–1 (or approximate 0–1) scale (Bentler, 1990). To appraise model adequacy more fully, we computed both normed and non-normed fit measures to compensate for their susceptibility to different sample-size artefacts. For normed indices, sample size inflates the means of the models' sampling distributions. For non-normed indices, sample size influences their calculated values, but has only a meagre effect on their sampling distribution. Hence, we examined Bentler and Bonett's (1980) normed fit index (NFI) and incremental fit index (IFI). The NFI's values are bounded by 0 and 1, whereas IFI's values may exceed 1. Also, the IFI offsets the NFI's small-sample bias to approximate better the asymptotic NFI (Mulaik *et al.*, 1989). Simulation work indicates that the NFI and IFI more closely estimate true model fit and display less sampling variability than their counterparts derived from ratios of chi-squares to degrees of freedom.
3. Similar to Rodgers (1992), we assume that the indicators of the dependent and independent constructs measure the unobserved variables of theoretical interest with error. A confirmatory common factor analysis model is used to relate each indicator to an unobservable latent variable; or $\mathbf{Y} = \mathbf{\Lambda}_y \boldsymbol{\eta} + \boldsymbol{\varepsilon}$ and $\mathbf{X} = \mathbf{\Lambda}_x \boldsymbol{\xi} + \boldsymbol{\delta}$, where $\mathbf{Y}$ and $\mathbf{X}$ are vectors of indicators, $\mathbf{\Lambda}_y$ and $\mathbf{\Lambda}_x$ are matrices of factor loadings that represent the degree of association between the indicators and the vectors of latent variables $\boldsymbol{\eta}$ and $\boldsymbol{\xi}$, and $\boldsymbol{\varepsilon}$ and $\boldsymbol{\delta}$ are vectors of indicators specificity and random error (or 'measurement error'). We further assume that $\mathbf{E}(\boldsymbol{\eta}\boldsymbol{\varepsilon}') = 0$ and $\mathbf{E}(\boldsymbol{\xi}\boldsymbol{\delta}') = 0$; the matrices $\boldsymbol{\varepsilon}\boldsymbol{\varepsilon}'$ and $\boldsymbol{\delta}\boldsymbol{\delta}'$ are diagonal.
4. 'Expertise' has not been depicted into a simple classification. Hoffman *et al.* (1995) advocated that since expertise is a developmental process we cannot possibly learn what we need to know, either about expertise or about knowledge elicitation, by studying only experts. Senior auditors' work is part of the developmental process of auditing expertise, which we believe can shed additional light in the area of decision-making.

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