Accounting for Micro and Macro Level Information Technology Investment Analysis: An Extension of the Event Studies

1. Introduction

Recent research (Im, Dow, Grover 2001, Richardson and Zmud 2002, Subramani and Walden 2001) indicated that investors are positively influenced by information technology (IT) investment announcements. A fundamental assumption is that investments in IT are presumed to be a leading indicator of future improvements in corporate performance. "This [e-commerce announcements being associated with market valuation increases], therefore, indicates a perception among investors that e-commerce initiatives announced are likely to be associated with significant future benefit streams for firms" (Subramani and Walden 2001, p. 148). However, it is also important to compare a firm's investments with industry competitors (e.g., peer companies) because "investors focus, among other factors, on a firm's performance relative to others in the industry" (Richardson and Zmud 2002).

One implication of this research is that investors perceive that investments in IT should actually result in improvements in corporate performance over time. It also follows that investors' perceptions about such initiatives should lead them to continue to invest in the firms where they believe that the investments in IT have paid off. For example, in today's market place an announcement about a firm's intention to invest in e-commerce technology would likely be met with skepticism and an inclination to wait to see if the investment would pay off over time.

Since investments in IT and the necessary worker knowledge to use the IT productively often take time to have an impact (Brynjolfsson and Hitt 1993, Brynjolfsson and Yang 1997), it follows that investors' perceptions should also be influenced by the actual over time performance of these assets. To begin exploring this inferred relationship between IT performance and investors' perception requires a more micro-level, finer-grained examination of individual investors' decision making processes when confronted with information about the performance of such assets.

One immediate problem is that investors are not provided with performance information about IT assets in the form they are accustomed to, such as that found on financial "tear-sheets" that include financial ratios, cash flow, earnings per share, etc. (McWilliams and Siegel 1997). If such information existed, the relationships among investors' perceptions, and subsequent decision making behavior, and the performance impacts of investments in IT would be easier to explain.

To extend the event studies, the current study examines the impact over time of IT performance information on investors' decision making processes. This research focus required a more micro-level multivariate analysis experimental study that modeled investors' decision processes in the context of supplemental IT performance information in the form of a ratio: return on knowledge (ROK). The ROK ratio was selected because it met two requirements: it allowed sub-corporate allocation of net income to IT and it followed the basic format of common financial ratios such as ROA, making it possible to present and discuss IT performance in a simple, familiar context for investors.

Prior event study research (Richardson and Zmud 2002) called for more fine-grained measures of the relationship between IT investments and business performance. This study's micro-level analysis complements and extends the prior macro-level event studies with the study of individual investor decision making processes (see Figure 1).

Figure 1 Complementary Macro and Micro Levels of Analysis

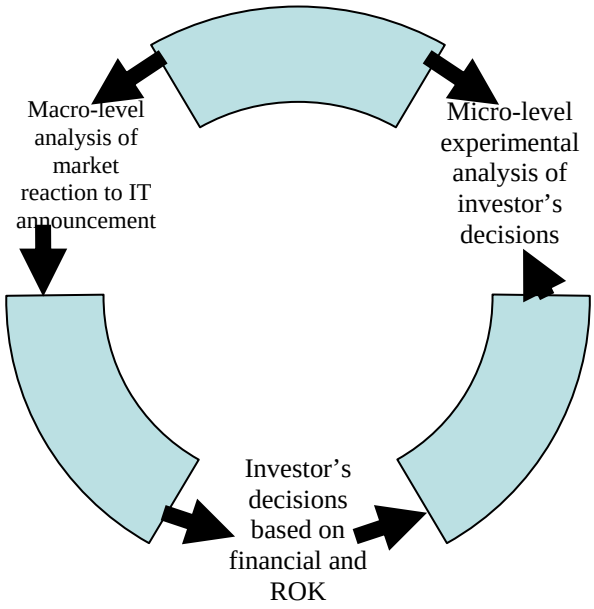


Figure 1 depicts the current macro-level market studies leading to predictions about investors' decisions, presumably resulting from IT announcements. Extending this research, there is a need for micro-level experimental studies to explain how and why individual investors make decisions.

This research examined the contention that if IT events at the macro-level represented a leading indicator of company future performance and influenced investor behavior, then the actual performance of those investments in IT over time, presented at a micro level, should also influence investor behavior. This gave the current study two focii: (1) What individual investor reactions would be when presented with fine-grained IT performance information, and (2) how individual investors would use fine-grained IT performance information in their decision making processes.

In what follows, we will review the recent event studies to demonstrate how the current study extends this research using a covariance structural modeling to confirm the efficacy of a prior cognitive decision making model to the IT investment context. The contention is that if event studies were tapping into investors' perceptions (at the macro-level) that investments in IT represented a leading indicator of company performance, then individual investors decision models (at the micro-level) should be influenced by the actual over time performance of those investments in IT. As such the current study has two foci: (1) individual investors' reaction to IT performance information and (2) how investors will use IT performance information in their decision making processes.

This led to two studies: (1) a field study with professional investors to determine if such supplemental information would have any impact on investment decisions and (2) a follow-up laboratory study to determine how influential such supplemental information would be once investors understand it as well as they understand traditional financial data.

We first tested professional investors to determine whether the supplemental IT performance information would have any impact on their decision making. The reasoning being that they would be harshest critics of, and therefore least likely to use, any new information. Therefore, if the supplemental information influenced their decision making, it would be reasonable to continue the research. The results indicated that ROK information *was* used in their decision making at the model level but was ambiguous at the individual path level. Subsequently, a second group of novice investors were educated to understand the traditional forms of financial analysis as well as IT performance analysis.

The results of the covariance structural modeling are discussed in the context of two main hypotheses designed to test the impact of supplemental IT performance information on investor decision making and to confirm the efficacy of the model used to represent their decision making processes.

1.1. Event Studies and IT Performance

Recent macro-level IT event studies (Im, Dow, and Grover 2001, Richardson and Zmud 2002, Subramani and Walden 2001) offer some insights about the relationship between investments in IT and investor reactions. This research focused on predicting the effects of IT investment announcements on shareholder returns and firm stock value.

The basic assumption of the event study approach is that when relevant influences (such as firm size, trading volume, and complementary investments in worker knowledge) can be controlled for, then the issuance of announcements concerning intentions to invest in IT and the market's reaction provide a market value estimation of the investment in IT. The goal of this research is to hold as many conditions as possible constant to isolate the relevant cases where such "events" produce the predicted results.

Subramani and Walden (2001) employed an event study methodology to determine the impact of announcements about new e-commerce initiatives on a firm's market value. The assumption was that if investors perceive that e-commerce initiatives will enhance future cash flows, then capital markets will place a higher value on firms that make unanticipated announcements about e-commerce initiatives.

The results of their study, that included a wide spectrum of firms, indicated that such unanticipated announcements do indeed result in a significant increase in the market valuation of these firms. They inferred that investors' perceptions about e-commerce initiative announcements was that such initiatives are likely to be a leading indictor of significant future cash flow streams for the firms.

A limitation of this study was the result that there was no significant difference in cumulative abnormal returns among web-based and conventional firms. Other limitations were the short duration of the study event time frame (i.e., last quarter of 1998) and the uniqueness of this particular time period—stocks in the Internet sector were particularly sensitive to speculative activity and press announcements. Further, the study asserts that unanticipated announcements may have been "merely symbolic moves by firms rather than genuine attempts to initiate e-

commerce activities" (p.152). The authors of this study suggested that it was meant to stimulate further research and debate on the use of event studies to predict the market reaction to e-commerce announcements.

Im et. al. (2001) also examined the effect of IT investment announcements on a firm's stock price. They argued that prior research had not established an unambiguous link between IT investments and a firm's performance. They sought to extend the work of Dos Santos, Peffers, and Mauer (1993) that found no improvement in firm stock value as a result of IT investment announcements, and control for its various limitations.

Their research used an event methodology over a longer time frame than the Subramani and Walden (2001) study. The research included a large sample of companies to control for a time lag effect of announcements and industry size effects. Their results indicated that smaller firms derive greater benefits from IT announcements than do larger firms. They inferred from their results that investors are beginning to identify "both the tangible and intangible benefits of IT investments" (p. 103).

Their research also extended prior production theory research (Brynjolfsson and Hitt 1993, Brynjolfsson and Yang 1997) that argued for the need to account for investments in complementary assets, such as employee knowledge and IT assets, by taking into account the learning curve time lag effects of these complementary assets on investor reaction. Otherwise, management would simply invest in IT, resulting in an automatic improvement in corporate performance. The history of IT investments is littered with too many failures to accept such a simplistic conclusion about the relationship between IT investments and subsequent corporate performance.

A limitation of this study was that general infrastructure investments might have more impact on a firm's market value than do IT investments in particular. Prior research (Dos Santos, et.al. 1993) using a more stable period (1981-8) found that there was no effect of IT investment announcements on excess returns. Other research (Richardson and Zmud, 2002) indicated that

there are two general limitations of the event studies:

"Despite our efforts to isolate the IT investment announcements, it is possible that the results are driven by other contemporaneous events not covered in the press announcement. If the IT investment announcement was anticipated and leaked to the market in advance of the formal announcement, it is difficult to determine when the market became aware of this new information."

The general limitations of the past event studies argues for new approaches that will help explain (at the micro-level) how investors actually use IT performance information in their decision making. One possible extension of the event level research would be to move away from analyzing market responses to IT events and examine the impact that IT performance-related information might have on individual investor decisions. Since "market" responses are the aggregate of millions of investor decisions, insight into whether or not IT performance-related data at the granular level creates investor bias would also provide insight into market responses at the macro level.

Biases that affect decision maker perceptions of information have been extensively documented and analyzed in work such as the large body of Nobel Prize winning research by Kahneman and Tversky (1979). Cognitive models of the role of bias in the decision-making process also exist in accounting research literature (Rodgers 1997). Therefore, we felt our line of examination would fall directly within and extend a well established nonological network of associated constructs.

For the current investment decision making context, it is critical to represent investors' use of common analysis techniques, such as return-based ratio analysis. The model (Rodgers and Housel 1987) used in the current study initially was developed expressly for the accounting-financial environment (even though it has since been used in various contexts—see Rodgers 1997) and takes into account investors' perceptual filtering of accounting-based information as well as their judgmental processes where common analysis techniques are presumed to occur. A further

advantage of this model is that it can be formulated within the context of the covariance structure modeling technique making it possible to test the decision making model at the theory, as well as individual path levels.

Because investors rely on existing financial information (e.g., tear-sheet information such are return ratios, earnings per share, cash flow, etc.), an extension of the model would be to provide investors with new, supplemental information about the performance of IT assets over time. Such performance information does not currently exist in the common accounting-based reporting information (McWilliams and Siegel 1997).

Ideally, this supplemental information would be in the same form as the traditional financial information, such as a ratio format that reflected revenue in the numerator and investment cost in the denominator. The primary problem with existing measures is that they do not provide a method for allocating revenue to IT assets within a firm (Rodgers and Housel 2001).

Some promising approaches for assessing the performance of IT assets have been developed. For example Ba, Stallert, and Whinston (2001) used an "internal markets" approach for quantifying knowledge investment decisions. Devaraj and Kohli (2003) argued that IT usage is a good surrogate for estimating its value. However, they called for future studies of IT value that would incorporate cognitive variables and their impact on corporate performance.

Schwartz and Zozaya-Gorostiza (2003) used a real options approach for helping management value IT investments representing IT acquisition benefits as a stream of stochastic cash flows noting the need isolate the impact of IT assets from other assets. However, none of these approaches provided a method for allocating revenue to IT to enable a ratio-based performance measure akin to those investors are familiar with from traditional financial analysis.

The current study addresses this problem by providing an IT performance ratio, return on knowledge (ROK) (Housel and Kanevsky 1995, Rodgers and Housel 2001). The ROK ratio follows the basic form of common financial ratios and meets the basic requirements for accounting-based metrics (Elliot 1994) and was, therefore, appropriate for the purposes of the

current study.

1.3. Traditional and Supplemental Information

In recent years, coinciding with the rise in interest in the impact of IT on firm performance, there has been concern about whether non-financial performance measures should be considered by external users for investment decisions (Amir and Lev 1996).

For instance, accounting researchers have recently advocated that financial and non-financial performance measures should be part of the information set for all intended internal and external decision makers (Amir and Lev 1996, Ittner and Larcker 1998, Mednick 1999, Boulton et al. 2000). Also, a report by the AICPA (1994) concluded that companies should disclose leading non-financial performance measures on key business processes but provided no specific guidance on what measures should be used.

In light of the demand for IT performance information, an important question is how investment decision-makers will use such information. Therefore, this study examined the use of traditional information (e.g., earnings per share and cash flow), and supplemental IT performance information (represented by the "I" in Figure 2). The ROK metric is derived from a general theory of IT productivity that has been documented elsewhere (Housel and Bell 2001, Rodgers and Housel 2001, Housel and Kanevsky 1995).

Although many companies today have developed performance measurement systems that incorporate financial and non-financial performance measures, non-financial performance measures have been primarily used for management feedback and control of operations (Rodgers and Housel, 2001). The first hypothesis is designed to test the impact of traditional financial and supplemental IT performance information on investors' decisions as well as confirm the general applicability of decision model (represented in Figure 2) to the research context.

Hypothesis 1: Investors' decisions will be influenced by traditional information (a) Earnings per Share (EPS), (b) Cash Flow, and (c) supplemental IT performance information (ROK).

Previous studies (e.g., Ittner and Larcker 1998) have indicated that investors rely upon indicators such as earnings and cash flow. Hence, we use EPS as a proxy for earnings and operating cash flow as a proxy for cash flow. Since any non-traditional information derived from IT performance metrics would be new for investors, a second study was conducted so that investors could be educated to understand the IT performance metric, i.e., ROK, as well as the traditional financial metrics. The focus of the second experiment was to determine whether investors would respond differently to supplemental IT performance information, if they had been educated to understand it.

This led to the second hypothesis and its sub-hypotheses.

Hypothesis 2: Educating investors about traditional financial information and supplemental IT performance information (i.e., ROK) will influence their decisions.

Hypothesis 2a: Once investors are educated about IT performance (ROK) information, the information will have a significant impact on their decision choices.

Hypothesis 2b: The direction of investor's decisions will follow the ROK information trend direction even in the presence of contradictory traditional financial information.

1.4. Modeling Investors' Decision Making

The decision modeling approach employed in this study assumes that information inputs pass through the cognitive filters of perception and judgment before decisions are made. The work of Kahneman and Tversky (1979) has demonstrated that the way people perceive information is influenced by cognitive filters such as decision heuristics.

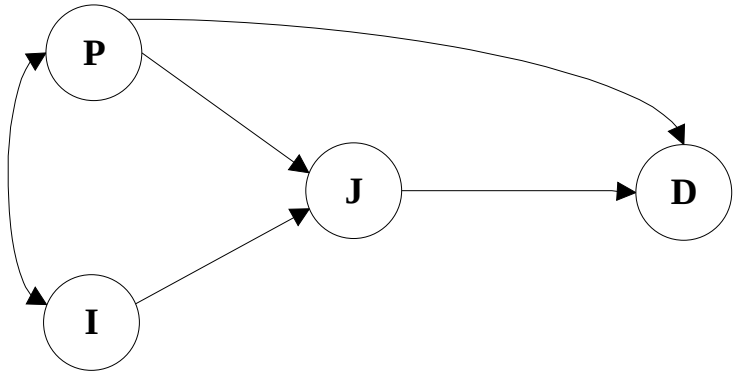
Russo, Meloy, and Wilks (2000) found that pre-decisional information acquisition had a significant impact on the decision making process. They found that professionals, even under pressure to be accountable for their decisions, tended to distort new information to support whichever alternative they a priori preferred. Although neither line of research tested their assumptions about cognitive decision processes at the theory, the results support the assumption that decision making is affected by the filters of perception and judgment.

Rodgers and Housel (1987) and Rodgers (1997) found that by using a covariance structural modeling approach, it was possible to test a theory of cognitive decision making at the theory level as well as individual path levels. Rodgers (1997) reported on the wide range of the successful application of this decision model to a variety of business and social contexts. This model was selected in the current study to represent the decision processes of investors.

The model (Figure 2) assumes that decision makers process information subjectively because there is an interdependency between information and perception in which information becomes what it is perceived to be. Information, as perceived, affects judgment since it is retrieved from memory prior to the use of judgment in reaching a decision (Rodgers and Housel 2001). In other words, before an individual makes a decision, he encodes information, as perceived, and develops a representation for the problem, i.e. a judgment. Judgment formation calls upon a prior framework of the decision maker's insights, skills, and relationships (i.e., uses perceptual framing) (Rodgers and Housel 1987).

Judgment, contextually enriched by information, as perceived, has a direct impact on decision choice and loads it with perceptual errors, biases, and context-dependent heuristics of which decision makers are largely unaware (Thompson, Gentner, and Lowenstein 2000, Rodgers 1992).

Figure 2 Decision Process Model



where P = perception, I = information, J = judgment, and D = decision choice.

The model depicts perception as implicitly or explicitly driving path dependence in later stages of processing. That is, what you already know biases what you are likely to learn next. This can also be viewed as the interdependency between perception and information in the model.

Investors' ability to understand and represent supplemental IT performance information is structured and constrained by their existing domain experience (Zhang and Markman 2001). The "I" in the process model represents traditional tear sheet and supplemental IT performance information. The ease with which investors can transform their existing domain structures (P) to accommodate the new, supplemental information will largely determine how they perceive a company's productivity/profitability (Sloman, Love, and Ahn 1998).

2. Research Design

2.1 Experiment 1: Professional Investors

The purposes of this study were to confirm that the decision model was appropriate for the current research context as well as to whether professional investors would include supplemental IT performance information in their decision making (Hypothesis 1).

Subjects. In this experiment, 25 professional investors (from several very large investment banks and brokerage houses) served as subjects in the context of recommending stock for a

company's telecommunications portfolio. The repeated measures design of the study resulted in 100 independent responses. They were approximately 75% male and 25% female with all having at least an undergraduate degree. The subjects had been serving in their current roles for more than 5 years and had a range of experience in their job categories of approximately 10 years.

Procedures. They were required to evaluate four different telecommunication companies as potential investment opportunities. Subjects were provided company information including traditional financial (including cash-flow information) and non-traditional, i.e., ROK, information in four case studies (see example case in Appendix).

Two of the four companies were treated as positive trending earnings firms, and the other two were treated as negative earnings trending firms. The order of presentation of these four companies was random across all subjects. The following company data for a three-year period was provided: accounting information, ratios, cash flow information, and ROK information.

Total sample size (responses) based on repeated measures across the four company cases was 100. The cases and the measurement instruments were delivered to the investors at their places of employment. The subjects' responses were recorded on an interval scale. The scale properties follow the assumption of normality in the following way: equal intervals where the distances between the numbers are of a known constant size.

For one of the two positive-profit trending companies, ROK information was showing an increasingly positive trend for the three-year period. For the other positive-profit trending company, the ROK information was showing an increasingly negative trend for the same three-year period. Likewise, for one of the negative-profit trending companies, the ROK information was increasingly positive over the three-year period, for the other negative-profit trending company, the ROK information was increasingly negative over the three-year period.

This experiment was designed to determine whether the ROK information influenced subjects' perceptions and judgments in reaching an investment decision. The subjects' average time of completion of the four company case analyses and responses was one hour.

The subjects were instructed to compare the importance of various information items in forming their decisions about whether a company should receive an investment amount of $1,000,000. ROK was explicitly defined as a ratio that measures the revenue attributable to knowledge assets divided by the cost to use the knowledge assets (including IT). ROK was offered as supplemental information about the performance of the four companies' people and IT.

Independent and Dependent Variables. The independent variables were financial and non-financial performance information and metrics (I) and the subjects' perceptions of the companies' economic and management performance (P). The dependent variables were the subjects' judgments (J) and decision choices (D), where "J" was the subjects' current analysis of company financial performance (liquidity, profitability, and leverage) and IT performance (ROK).

Model Equations. As shown in Figure 2, there are two stages in the decision making process. The first stage of the decision making process represents the effects of subjects' perceptions of factors affecting the Internet infrastructure telecommunication market space and the effect of this information on their judgment. The second stage represents the effects of perception and judgment on decision choice. These effects can be formulated in the following two structural model equations:

1. $\eta_1 = \beta_1\xi_1 + \beta_2\xi_2 + \beta_3\xi_3 + \beta_4\xi_4 + \zeta_1$

2. $\eta_2 = \beta_5\xi_1 + \beta_6\eta_1 + \zeta_2$

Interpreted in the context of a multiple regression equation, Equation 1 indicates that β_1 value for the effect of perception on η_1 is the effect of perception after having controlled for β_2 (EPS), β_3 (cashflow), and β_4 (ROK) variables in the equation. Equation 2 shows the β_5 value for the effect of perception on η_2 after having controlled for β_6 (judgment). ζ represents the residual of the structural equation.

Independent variables are defined below:

ξ_1 represents subjects' economic and management perception. This latent variable is measured by the following four indicators:

1. Telecommunications technology is improving business and society;
2. Telecommunications industry will be a growth area in the future;
3. Management's performance has positively affected the value of the company;
4. Management's ability has positively affected this company's P/E.

ξ_2, ξ_3, and ξ_4 are measured in terms of EPS, cash flow, and ROK of a company, respectively. ξ_2 is measured by EPS ratio. ξ_3 is measured by operating cash flow. ξ_4 is measured by the ratio of knowledge asset performance in core company operations.

η_1 (in Equations 1 and 2) represents subjects' judgments. This latent variable is measured by five indicators, which represent firm's: (1) liquidity; (2) profitability; (3) riskiness; (4) projected information; and (5) ROK.

η_2 (in Equation 2) represents subjects' decision choices of (a) approval/ disapproval of stock and (b) conditions placed on approval of stock.

2.2. Results

Model Tests. The chi-square test disclosed moderate discrepancies between the observed correlation matrix and that implied by the professional investors' model (χ^2=223, where degrees of freedom=69). Yet, the normal fit index (NFI), the incremental fit index (IFI), and the comparative fit index (CFI) values surpassed the threshold of 0.80 for acceptable fit (Bentler and Bonett, 1980). Individual parameter estimates further corroborated the application of this theoretical model to the current research context. The theory level results of the covariance structure model confirmed hypotheses three and four demonstrating the efficacy of using this model to represent investor decision making.

Confirmed Model for Professional Investors. The interdependency between perception and information in Figure 2 was tested to determine if EPS, cash flow and ROK information influenced subjects' perceptions. Table 1 indicates that professional investors' perception was statistically interdependent with cash flow and ROK information ($p<0.10$). This implies that in professional investors' first stage of processing investment information that sources, such as ROK, are identified and considered for later processing.

Table 1 Perception and Information Interactional Effects

	PERCEPTION
EARNINGS PER SHARE	0.09
CASH FLOW	0.17**
KNOWLEDGE VALUE ADDED	0.17**

**p< .10

Table 2 illustrates that in Equation 1, perception, EPS, cash flow and ROK information all have a significant ($p< .05$) effect on judgment. Of note here is that even though EPS was not considered to covary significantly with perception, its effect on judgment indicates parallel processing. In addition, perception did not have a significant ($p< .05$) direct effect on decision choice in Equation 2. However, judgment had a significant ($p< .05$) effect on decision choice. It appeared that the professional investors' reliance on traditional financial, cash flow, and supplemental IT performance information was evident.

Table 2 Causal Model Parameters (Investment Bankers)

Regression Weights

γ_{JP}	0.08*
γ_{JE}	0.18*
γ_{JC}	1.05*
γ_{JK}	0.77*
γ_{DP}	0.09
β_{DJ}	1.47*

[1]Where ***P***-Perception, ***E***-Projected Price Earnings Ratio, ***C***-Cash Flow, ***K***-Knowledge value added, ***J***-Judgment, ***D***-Decision Choice.[i]

*$p < .05$

R^2 is a rough measure of the amount of variance in the outcome variable that is explained by the two equations. The R^2 for the first equation for the professional investor model was 0.62. We attribute this high level of variance accounted for to the supplemental IT performance information (i.e.,ROK) and ξ_1 (i.e. perceptions of management and economic information). For the second equation, R^2 for the professionals was 0.16, which indicates unfamiliarity with the use and integration of supplemental IT performance information in their judgments.

The results of the first experiment confirmed that the use of the cognitive decision model was appropriate for the current research context. They also indicated that the potentially most skeptical of investors, i.e., the professionals, included supplemental IT performance information in their decision making processes. The results indicated that there was sufficient reason to pursue a follow-up experiment to discover whether educating investors about traditional and supplemental IT performance information would significantly affect their decision making.

2.3. Experiment 2

Experiment 2 was undertaken to examine the effect of education with traditional and non-traditional information on novice (i.e., accounting students) investors. Given that the first experiment indicated that investors would use supplemental IT performance information (i.e.,

ROK) even though it was novel, we reasoned that eventually investors would have to be educated about the the information as well as traditional financial information. Using novice investors helped avoid possible contamination resulting (Russo et. al. 2000) from professional investors having learned and used traditional financial information prior to learning about the IT performance information.

Subjects. One hundred and ninety-seven business students taking senior level accounting class were the subjects in the second experiment. There were a total of 396 usable responses from the repeated measures design (all usable responses came from students completing the pre and post education phases of the experiment). They ranged in age from 19 to 24 years and were approximately 50% male and 50% female. Most had very limited experience as investors.

Procedures. Participants received five years of annual financial information, five years of financial ratios, earning estimates for the coming two years, and the three most recent years return on knowledge (ROK) information for one company. The participants were split in two groups. Both groups received the same financial information with upward traditional financial trends for five consecutive years for the same company. The three year ROK information, on the other hand, was exactly reversed between the groups. ROK for the first group showed upward trend over three years and ROK information for the second group showed downward trend for the same three years.

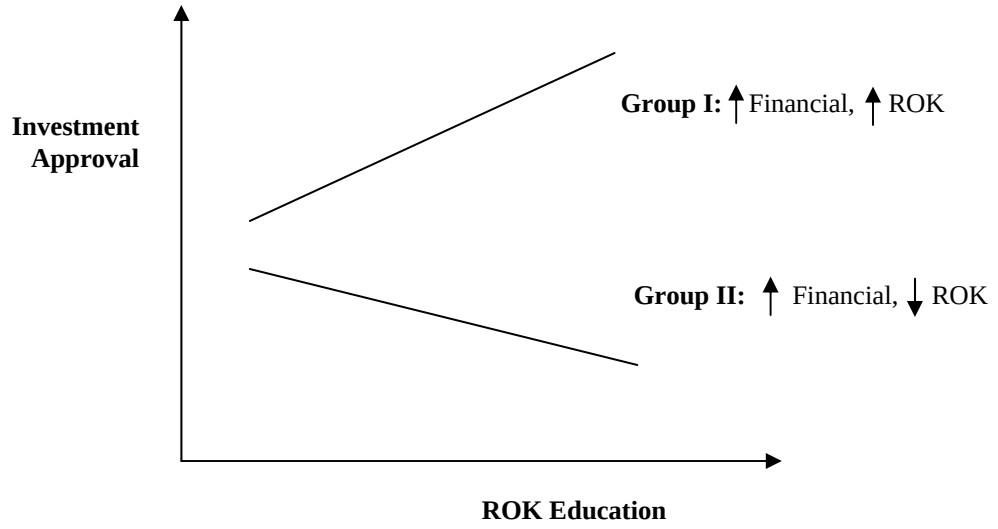
We received a total of 396 usable responses. One hundred ninety-six (196) usable responses came from the pre-education stage, 85 from Group I (with one unusable, i.e., incomplete response) and 112 from Group II; 200 came from the post-education stage, 84 from Group I and 116 (with four unusable, i.e., they had not participated in the pre-education phase) from Group II. Participants were asked to review the information and decide to invest or not to invest in the company. They were give approximately 30 minutes to review the case, complete the questionnaire and make their investment decision. The participants received education over a

period of 2 months about traditional financial information as well as ROK information during a senior level required class on financial accounting. The specific test case company information was not referred to or discussed during the two month education period. Following the education, the same participant groups once again were given approximately 30 minutes to review the same test company case, complete the questionnaire and make their investment decision.

2.4. Results

The results indicated that education about ROK information significantly impacted individuals' investment decisions. We compared pre- and post-education responses of individuals to test the main effects of ROK awareness on their investment decisions. We hypothesized that education about ROK would make a significant difference in individuals' investment decisions (Hypothesis 2a). We further hypothesized that the direction of significance would change based on the ROK information provided such that upward trend in ROK information will positively influence investment decisions while downward trend in ROK information will negatively influence investment decisions (Hypothesis 2b). The hypothesized relationship is shown in Figure 4.

Figure 4 Hypothesized Main Effects



We expected individual investors to use ROK information when were educated about it. In the pre-education stage both groups were expected to base their investment decisions solely on financial information. After the ROK education, however, we expected individuals' investment decisions to be influenced by ROK information. The ROK information received by Group I had upward trend affirming positive ROK ratios, hence we expected more individuals to approve investment in the post-education stage for Group I. On the other hand, the ROK information received by Group II was trending downward indicating negative return on knowledge investments, hence we expected individuals in Group II to decline investment.

An Analysis of Variance (ANOVA) test supported our hypothesis that ROK education makes a difference in individual investment decisions. Education had a significant impact on Group I at $\alpha = .068$ and Group II was significant at $\alpha = .067$. The results show significant differences supporting Hypothesis 2a.

Individuals' investment decisions were collected using an interval scale to indicate "Approval" and "Not Approval" (see Appendix). Individuals were asked to mark their responses in an interval scale that is 110 centimeters long. The response score is recorded as the distance of their mark measured from the end point on the left. The "Approved" scale was coded from 0 to 110, and the "Not Approved" scale was coded from 111 to 220. This scale shows a lower score for "Approved" responses and a higher score for "Not Approved" responses. Consequently a higher mean score indicates more "Not Approved" responses and a lower mean score indicates more "Approved" responses.

Mean comparison confirmed our hypothesized direction. For Group I the information provided had an upward trend for both financial and ROK information (Case A), therefore we expected more individuals to respond with "Approved" for the companies: we expected the mean of Case A respondents for post-education (GroupID = 30) to be lower than for pre-education (GroupID = 10), $\mu_{30} < \mu_{10.}$

On the other hand, Group II received upward trend for financials and downward trend for ROK information (Case B), therefore we expected more individuals to respond with "Not Approved" for the company: we expected the mean of Case B respondents for post-education (GroupID = 31) to be higher than for pre-education (GroupID = 11), $\mu_{31} > \mu_{11.}$ Mean analysis results of responses confirmed the direction of our hypothesis that ROK education influences individuals' investment decisions. As shown in Case A, when the ROK information has upward trend, individuals are more inclined to favor investment confirming Hypothesis 2b. Case B confirms that downward trend in ROK information negatively influences individuals' investment decisions, providing further support for Hypothesis 2b.

Interaction effects between the groups further strengthen our hypothesis that ROK education influences individuals' investment decisions (see Table 3)

Table 3 ANOVA Result for Interaction Effects			
Interaction Cells		**Group I (Upward ROK Trend)**	
		Pre-education	**Post-education**
Group II (Downward ROK Trend)	**Pre-education**	**Case C** α = .347 Not significant	**Case D** α = .004 significant
	Post-education	**Case E** α = .008 significant	**Case F** α = .000 significant

Case C compares responses for the two groups in the pre-education stage. The financial information received by both groups is the same, therefore we expected no differences in the investment decisions between the two groups regardless of the differing ROK information received by the two groups. The reasoning was that in the absence of ROK knowledge, individuals will base their investment decisions solely on financial information and disregard the ROK information. An ANOVA test indicated no significant difference between the two groups, α = .347, further confirming Hypothesis 2—that the differences observed are due to ROK education: when investors are not educated about new IT performance information, they rely solely on traditional financial information.

Case D compares pre-education responses for Group II and post-education responses for Group I. Group I received ROK information with upward trend. ANOVA results evidenced a significant difference between the groups, α = .004 supporting Hypothesis 2a. The direction of significance is confirmed by the lower mean (more approval) for post-education respondents in Group I (GroupID = 30) than for pre-education respondents in Group II (GroupID = 11) .

Similarly, Case E compares pre-education responses for Group I and post-education responses for Group II. Group II received downward trend in ROK information. In this case we expected the negative ROK trend information to result in negative approval responses because of the influence of education about ROK information. The ANOVA results indicated a significant difference for Case E, α = .008, providing further support for Hypothesis 2a. The direction of significance is confirmed by a higher mean (less approval) for post-education respondents in Group II (GroupID = 31) than for pre-education respondents in Group I (GroupID = 10).

Finally, Case F compares post-education responses between the groups. In this case both groups were educated about ROK and therefore should have had no differences in their awareness about ROK information. However, the ROK information received by the two groups was different, upward trend in ROK information for Group I and downward trend in ROK information for Group II. As a result, we expected ROK education to influence more Group I respondents to approve investment in the company and more Group II respondents to decline investment in the company. The ANOVA results indicated a significant difference between the groups, α = .000 further supporting Hypothesis 2b that the direction of ROK trend impacts individual's investment decisions. The direction of significance is confirmed by the mean analysis with higher mean (indicating more Not Approved) for post-education respondents in Group II (GroupID = 31) than for post-education respondents in Group I (GroupID = 30). This provided further support that an upward ROK trend positively influenced individuals' investment decisions while a downward ROK trend had a negative effect.

3. Conclusions

Research has indicated that successful investments in IT is a leading indicator of competitive advantage and organizational success. This is a central underlying assumption of the macro-level event studies. On the micro-level of individual investor decision making, research has been hindered by the lack of IT performance information presented in a form that is consistent with

investors experience with traditional financial information. The current study addressed this issue by introducing supplemental IT performance information for investors to review before reaching their decisions

The results of the current micro-level study support and extend the prior event study findings by offering an explanation of how investors might take into account supplemental IT performance information in their decision making processes. Taken together, the two levels of analysis offer a potentially richer explanation of investors' behavior with regard to IT investments than either approach singly.

This study's results highlighted how investors' cognitive processing of traditional and supplemental information can influence decision making. The process modeling perspective used in this paper confirmed that different pathways are dependent on investors' perception and judgment about information and are not simply a reflection of purely rational decision makers' passive processing of information.

The results indicated that when investors assume that IT performance is trending positively they tend to invest and when trending negatively, they tend to avoid investing. On the surface, this result appears to be obvious until we take into account the fact that investors appear to ignore the same supplemental IT performance information when they have no education about it. The fact that the professional investors were influenced by the supplemental information may indicate that they intuitively recognize the potential of this kind of information as a leading indicator of future overall company performance. This interpretation of the results for experiment 1 would support the implications of the event studies. However, it is the results from experiment 2 that begin to offer a more comprehensive explanation of the way that investors are likely to use such IT performance information in their decision making: once they have been educated about it.

The study also opens a debate on which kinds of supplemental information about IT performance will best suit the needs of investors. There may be other kinds of IT performance measures (e.g., impact of IT on strategic options) that can be formulated to meet the basic

requirements of financial accounting and that will also influence individual investors' decision making.

This line of research offers the opportunity for IT researchers to play a more prominent role in the investment arena and subsequently directly in management resource allocation decision making as well. We hope that the current study will lead to future research at the micro-level designed to offer more comprehensive explanations of investor decision making in the context of IT performance information.

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