

Nonprofessional Investors' Perceptions of the Efficiency and Effectiveness of XBRL-enabled Financial Statement Analysis and of Firms Providing XBRL-formatted Information

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ABSTRACT

We investigate the effects of eXtensible Business Reporting Language (XBRL) on the perceived efficiency and effectiveness of both investor financial statement analysis and of firms using XBRL-formatted financial reporting. Building on the theory of reasoned action and technology acceptance model, we expect that performing XBRL-enabled financial statement analysis will positively affect user *perceptions* of the efficiency and effectiveness of financial statement analysis and of firms providing XBRL-formatted financial information. Our research design incorporated a between-subjects experiment involving MBA student participants and the NASDAQ demo Excel Investor Analysis Tool for analyzing XBRL instance documents.

As predicted, our results indicate that participants in the XBRL-based group perceived XBRL-enabled analysis to be significantly more efficient than did participants using paper-based information. Contrary to expectations, there was no significant difference between the two groups regarding analysis effectiveness, although *all* participants agreed that XBRL improves analysis effectiveness (and efficiency) over using paper-based information. Consistent with our hypotheses, participants perceived that firms are *both* more efficient and more effective when they prepare XBRL-based information compared to paper-based information. Our results concerning the effects of XBRL usage on user perceptions complement Hodge et al.'s (2004) findings regarding the advantages derived through XBRL usage and have important implications for the SEC's current voluntary program of XBRL adoption, as well as other non-U.S. XBRL initiatives.

Key Words: XBRL, perception, theory of reasoned action, technology acceptance model, financial reporting, financial statement analysis

1. INTRODUCTION

Regulators have increased financial reporting requirements due to recent high-profile accounting scandals (e.g., Enron, WorldCom, and Xerox). The requirements of the Sarbanes-Oxley Act (2002) are the most notable in the United States. Jurisdictions in other parts of the world enacted similar legislation (see Pinsker 2005). Compliance costs are substantial with many firms and organizations, including the U.S. Securities and Exchange Commission (SEC), indicating that the requirements are overly burdensome (SEC 2005). The result is that firms are investigating numerous processes and technologies to improve their financial reporting information systems and reduce compliance costs.

Improved electronic (digital) financial reporting is one solution. Improved reporting has been of considerable interest to standard setters and accounting bodies (Debreceeny and Gray 2001). The Financial Accounting Standards Board (FASB 2000) published a study that provided initial information on various characteristics of electronic reporting, while calling for more research on the topic. Globally, the International Accounting Standards Committee (IASC) and Canadian Institute of Chartered Accountants (Trites 1999) have both published reports on Web-based reporting. Thus, it appears that academic research is needed in order to examine multiple characteristics of electronic financial reporting.

EXtensible Business Reporting Language (XBRL) is an Extensible Markup Language (XML)-derived language that is important to the business community, especially accounting. XBRL is specifically designed to facilitate the “preparation, analysis, and communication of financial statement information,” (XBRL International

2005a). Supporters believe that it is one method of improving the efficiency and effectiveness of electronic financial reporting (Bovee et al. 2002; Debreceeny et al. 2002).¹ In support of these expectations, Hodge et al. (2004) found that using XBRL significantly improved participants' (MBA students) acquisition and integration of financial statement information.

We extend Hodge et al.'s (2004) results on the practical advantages of using XBRL by investigating nonprofessional investors' perceptions of the impact of XBRL on financial statement analysis and their perceptions of firms providing XBRL-formatted information: a prerequisite for conducting analysis with XBRL-enabled tools. The theory of reasoned action (TRA) asserts that perception is a primary determinant of behavior, while technology acceptance model (TAM) research shows a positive relationship between user perceptions of information technology (IT) efficiency and effectiveness and IT use. Thus, it is important to supplement findings about the advantages of using XBRL by investigating the effects of XBRL usage on user perceptions of XBRL's capabilities.

Based on the TRA and TAM literatures, we hypothesize that users performing XBRL-enabled financial statement analysis will more positively perceive the efficiency and effectiveness of XBRL-based analyses, and firms providing financial information in the XBRL format, compared to the same perceptions from those performing paper-based analyses. Our hypotheses are tested using a between-subjects experiment involving 61 MBA student participants. The NASDAQ demo Excel Investor Analysis Tool, which is built on an XBRL instance document, is used as our XBRL proxy.

¹ XBRL supporters include CPA firms of all sizes (including all of the "Big 4"), technology companies (e.g., Microsoft and EDGAR Online), and numerous regulators.

Consistent with our predictions, the participants in the XBRL-based group perceived XBRL-enabled analysis to be significantly more efficient than participants in the paper-based group. Contrary to our predictions, testing revealed no definitive evidence that analysis effectiveness was perceived to be greater using XBRL-based, instead of paper-based information. However, post hoc, partial support for this prediction is provided by the fact that participants in both groups were agreeable to XBRL improving efficiency and effectiveness over paper-based information. Furthermore, as expected, results indicate that individuals perceive that firms are *both* more efficient and more effective when they prepare XBRL-based information compared to paper-based information. Our results extend Hodge et al.'s (2004) findings regarding transparency advantages derived through XBRL usage by showing how XBRL usage also affects user perceptions of both XBRL-formatted information and the firms providing this information. Since perception is known to affect behavior (per TRA and TAM), these findings have important implications for the SEC's current voluntary program of XBRL adoption, as well as other non-U.S. XBRL initiatives.

In the remainder of the paper, we review relevant literature and develop hypotheses (§2), describe our research method (§3), presents results (§4), discuss implications of our results (§5), and draw conclusions from the study, including limitations and future research (§6).

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

XBRL Background

We believe that because of its extensibility and reusability, XBRL represents a different financial reporting format from both paper-based and traditional PDF (portable

document format)-based reporting. Mason and Mitroff (1973) suggested that presentation mode was an important variable in information systems research. Further, “media choice in financial reporting is a new phenomenon brought on by the widespread use of multimedia-capable computers and financial reporting on the Internet,” (Clements and Wolfe 2000, 79). Paper-based and PDF-based reporting may not be efficient or effective enough to satisfy both financial information users’ interests (primarily stockholders and creditors) or the new legislation and regulation. The major concerns of both users and regulators are timeliness, usefulness, and effectiveness. Thus, XBRL-based reporting should have substantial benefits over paper and PDF-based formats.

Our belief regarding the benefits of XBRL-based reporting is supported by the theory of the “best fit” between characteristics of the task, the user/decision-maker, and the environment: including any information systems present (Vessey 1991). Of particular relevance to XBRL’s enhanced search capabilities, Hunton and McEwen’s (1997) results indicate that cognitive search strategies which closely fit the task improve task performance in computerized environments. XBRL provides decision makers a closer fit to the digitalized and electronic environment in which they work than do paper or PDF formats. Furthermore, XBRL’s search capabilities are much greater than those of the other two formats (Hodge et al. 2004). While our focus is on XBRL versus paper-based formats in this paper, we believe there will also be benefits over PDF-based reporting, because it is more difficult to search and there is a tendency to print PDF documents (Nielsen Norman Group 2003).

U.S. academic research on XBRL has been limited. Research has focused on the practical benefits of XBRL to analysts and other users (e.g., Hodge et al. 2004) and the

appropriateness of an XBRL taxonomy (e.g., Bovee et al. 2002). We extend the research by using the TRA and TAM literatures to examine the effects of XBRL on the perceptions on XBRL-enabled and non-enabled users. We not only investigate the effects of XBRL on perceptions of the capabilities (i.e., efficiency and effectiveness) of XBRL-enabled financial statement analysis, but also on the perceptions of firms adopting XBRL-based reporting. Our approach is therefore significant, because no prior XBRL academic research has considered *both* perceptions of nonprofessional investors. Even when mandated, research indicates that IT user perceptions can still significantly impact the usage of IT (e.g., negative perceptions can lead to suboptimal albeit required use; Davis et al. 1989). When use is voluntary, perceptions have an even larger effect on use; and at present, XBRL adoption is voluntary (XBRL International 2005b).²

We develop our hypotheses from two research literatures. First, we use the theory of reasoned action to establish the importance of perception in determining behavior. Second, since TAM applies TRA to IT, we use TAM to formulate beliefs about the effects of IT use on user perceptions. Figure 1 presents our model of the effects of IT use on user perceptions of IT and the firm providing IT, and is explained in the following sections.

[Insert Figure 1 about here]

Theory of Reasoned Action and Importance of Perception

The theory of reasoned action (TRA) starts with two assumptions about individuals in order to model the relationship among perceptions, attitudes, intentions,

² The SEC initiated a voluntary program in February 2005 of using XBRL for EDGAR reporting. The program commenced in April 2005 and only a handful of companies have currently joined the program. EDGAR, the Electronic Data Gathering, Analysis, and Retrieval system, performs automated collection,

and behaviors: (1) individuals are rational with the ability to process and use available information, and (2) they use the information they have processed to arrive at reasonable decisions about behavior (Ajzen and Fishbein 1980; Fishbein and Ajzen 1975).³ When individuals perceive objects they gather information, which consist of bundles of attributes. An individual's attitude toward an object is determined by an evaluative response toward the object's attributes. Perceptions, as the information source for rational decision-making, strongly influence attitudes. TRA completes its model by asserting that attitudes affect intentions, which in turn affect behavior. Intentions, according to TRA, are the best predictors of behavior. Thus, TRA holds that behavior is made as a rational decision by individuals consistent with their intentions, the content of which is derived from perceptions.⁴ Empirical support has been found for TRA's predictions (e.g., Armitage and Connor 2001; Sheppard et al. 1988).

Technology Acceptance Model and XBRL

The technology acceptance model (TAM) is an adaptation of TRA applied to the acceptance and adoption of new IT (Bagozzi et al. 1992; Davis et al. 1989). TAM is diagrammed in Subfigure A of Figure 1. It postulates that when users are provided new IT to assist them in performing assigned tasks, their perceptions of the IT's potential effectiveness and efficiency relative to task performance significantly influence their attitudes toward adopting or accepting the IT (Agarwal 2000; Bagozzi et al. 1992; Davis et al. 1989). Perceived usefulness is the degree to which a person believes that using a

validation, indexing, acceptance, and forwarding of submissions by companies and others who are required by law to file forms with the U.S. Securities and Exchange Commission.

³ Theory of Planned Behavior extends TRA to include control beliefs and perceptions of control beliefs (Ajzen 1991). Since these variables do not apply to the situation we are investigating, we use TRA as the more parsimonious of the two models and because TAM was developed from TRA.

particular system would enhance his or her job performance (i.e., effectiveness), while perceived ease-of-use is the degree to which a person believes that using a particular system would be free from effort (i.e., efficiency; Davis 1989). Thus, consistent with TRA, TAM holds that perceptions about IT affect attitudes about IT, which affect the intentions to accept and actually use IT. The numerous studies testing TAM have resulted in an accumulation of evidence supporting its modeling of how user perceptions of IT usefulness and ease of use affect user attitudes toward IT adoption or acceptance (e.g. Adams et al. 1992; Al-Gahtani 2001; Davis et al. 1989; Hendrickson et al. 1993; Segars and Grover 1993; Subramanian 1994; and Szajna 1994).

TRA and TAM research has firmly established the critical role user perceptions play in determining IT acceptance and use. In fact, Davis (1993) states that perceived usefulness is the most influential determinant of IT acceptance. Contrary to the IT implementation literature, the effects of user perceptions and attitudes on IT acceptance and use cannot be eliminated by simply mandating IT usage (Gelinas et al. 2005; Hayes 2004).

These findings have important implications for XBRL. Specifically, while Hodge et al.'s (2004) results indicate that XBRL-enabled users (MBA students) were better than non-XBRL users at acquiring and integrating financial statement information, their study did not examine whether their XBRL users had more positive perceptions and attitudes than did their non-XBRL users about their respective IT. It is crucial to investigate the perceptions of XBRL users in order to form expectations about the diffusion of XBRL use in the business community, since TRA and TAM research has established a strong

⁴ According to TRA, intentions consist of attitudes and subjective norms (i.e., beliefs that others think one should or should not perform a certain behavior). Since behavior is not a dependent variable in our study,

causal link from user perceptions of IT to IT use. As noted above, even mandated use of XBRL is unlikely to be fully effective if XBRL users have negative perceptions of XBRL usage.

In order to investigate user perceptions of XBRL, we extend TAM by explicitly including initial IT use among the external factors affecting user perceptions (see Figure 1). Although the primary focus of TAM research has been the effects of internal factors (i.e., perceptions) on acceptance of a new IT, the literature recognizes that some initial use of the new IT (i.e., prior to acceptance) is required for users to form rational perceptions of IT (consistent with TRA's view of user rationality; Davis et al. 1989). Accordingly, we do not replicate the research design used in prior TAM studies of testing whether positive perceptions of IT efficiency and effectiveness lead to increased IT use. We accept that TAM research has established this relationship and build on it in. We examine causal links antecedent to those established effects of perception on IT use, namely, the effects of IT use (i.e., initial use) on user perceptions, which in turn affects IT adoption, acceptance, and use. Specifically, we test the effects of XBRL-enabled and non- XBRL-enabled use on user (MBA students as nonprofessional investors) perceptions. By examining the effects of XBRL use in this manner, we complement Hodge et al.'s (2004) results on the practical advantages gained by using XBRL with results on the effects of XBRL use on user perceptions: a critical factor in determining the extent to which the advantages of XBRL usage will be realized in practice.

Accordingly, we predict in our first two hypotheses that XBRL-enabled users will have stronger positive perceptions of their IT's efficiency (H1) and effectiveness (H2) than that of users of the paper-based IT, consistent with the superior capabilities of the

we do not discuss subjective norms.

former. Based on TRA's and TAM's underlying assumption that individuals rationally process information about an object's attributes, we expect user perceptions to fairly reflect the relative capabilities of the two technologies (i.e., XBRL and paper).

H1: Perceived User/Investor Efficiency

Investors using XBRL-based information should enjoy efficiency gains since XBRL-based tools allow investors to gather, integrate, and compare firm data more rapidly, and therefore, at a lower cost, compared to using paper-based data. The ability to more quickly and accurately make comparisons should improve individual efficiency when analyzing firm information. Thus, to the extent that actual IT usage (i.e., experiencing IT capabilities first-hand) rationally influences user perceptions, we hypothesize that XBRL-based users will form more positive perceptions (compared to non-aided users) of XBRL-enabled financial statement analysis efficiency.

H1: XBRL-based investors will have a stronger perception of the efficiency of XBRL-enabled financial statement analysis than will paper-based investors.

H2: Perceived User/Investor Effectiveness

Hodge et al. (2004) showed that investors benefit from the ability to easily review, compare, and integrate data from multiple firms. Since XBRL financial data is more easily searchable and retrievable, use of an XBRL-enabled tool should lead to greater effectiveness. Consistent with this expectation, Hodge et al.'s study provides experimental support for XBRL improving two aspects of effectiveness: the ability to better acquire and the ability to better integrate financial information. Parallel to H1, to the degree to which IT usage influences user perceptions, we hypothesize that XBRL-

based users will form more positive perceptions (compared to non-aided users) of XBRL-enabled financial statement analysis effectiveness.

H2: XBRL-based investors will have a stronger perception of the effectiveness of XBRL-enabled financial statement analysis than will paper-based investors.

In our third and fourth hypotheses, we extend TRA and TAM in relation to XBRL by investigating the effects of users' perceptions of firms providing their financial information in XBRL format (relative to a paper-based format). TRA's assumption that perception influences behavior is not limited to IT (as in TAM). Thus, firms providing stakeholders with XBRL-formatted financial information should be interested in the impact such statements have on stakeholders' perceptions of the firms since such perceptions, from whatever source, will influence stakeholders' behavior toward them. Consistent with this expectation, TRA has been extensively applied to customer behavior (Sheppard et al. 1988). Also, anecdotal evidence about "halo effects" and "brand name effects" suggest that attitudes users form about XBRL may carry over to the firms providing XBRL-formatted financial information. Nonetheless, H3 and H4 have less theoretical grounding than do H1 and H2 and are therefore more exploratory in nature.

H3: Perceived Firm Efficiency

Efficiency is the extent of resources required to achieve the desired objective (Brenner et al. 2002). We predict that XBRL, or more specifically, technologies based on XBRL, will reduce the resources required to prepare and analyze financial reports. Thus, based on TRA's assumption that experiences rationally influence perceptions and intentions, we hypothesize that XBRL-based investors will form larger positive

efficiency perceptions (compared to paper-based investors) of firms that provide their financial information via XBRL.

H3: XBRL-based investors will have a stronger perception of the efficiency of firms supporting XBRL-enabled financial statement analysis than will paper-based investors.

H4: Perceived Firm Effectiveness

Effectiveness is the extent to which a technology produces desired objectives (Brenner et al. 2002; Yuthas and Eining 1995). From a firm perspective, the objective of XBRL is to reduce data redundancy, and therefore, improve reporting consistency and reduce errors (Hodge et al. 2004). As mentioned earlier, XBRL allows firms to store financial statement data in a single location, but use the data for multiple purposes. Not only does this reduce report preparation time, but it also reduces the likelihood of errors and inconsistent data (i.e., it makes the data relatively more accurate). XBRL-enabled users should be able to more strongly perceive this effect, given their own experiences.

H4: XBRL-based investors will have a stronger perception of the effectiveness of firms supporting XBRL-enabled financial statement analysis than will paper-based investors.

3. METHOD

Participants

Sixty-four MBA students at a medium-sized public university represented proxies for the nonprofessional investors. There were no significant differences in age, number of accounting courses taken, years of work experience, prior XBRL knowledge and experience, semester of experiment, gender, or undergraduate degree obtained between conditions.⁵ Additionally, self-efficacy beliefs were measured in a manner similar to

⁵ Using seven-point Likert scales where 1 was 'low' and 7 was 'high,' mean (standard deviation) participants' perceived XBRL knowledge and experience before the course were 1.49 (1.22) and 1.44

Hunton and Beeler (1997) using three items summed into a single index (Cronbach's alpha (0.89)). However, it too was not significant between conditions (p -value = 0.83). Three participants were dropped for not completing the instrument.⁶ Thus, there were 61 usable responses (41 in the XBRL-based condition and 20 in the paper-based condition).⁷

Many of the MBA students had a professional work history, as evidenced by the average age of 28 years (standard deviation 4.61) and work experience (mean = 6.04 years, standard deviation = 4.85) demographics. MBA students have been used in recent investment studies (e.g., Bloomfield and Libby 1996; Bloomfield et al. 1999; Hirst et al. 1999; Maines and McDaniel 2000), with similar cell sizes (Koonce et al. 2005), and were empirically shown as appropriate proxies for nonprofessional investors in the literature (Elliott et al. 2004).⁸ Although MBA students may be deficient in this situation-specific skill set, they are not deficient in their decision-making skills (Schurr and Ozanne 1985).

Two questions on the post-test questionnaire inquired as to the task difficulty. The first question was phrased, "Overall, how would you rate the difficulty of the company analysis task you had to do? (1 = not difficult, 4 = somewhat difficult, and 7 =

(1.20), respectively. Thus, it can be inferred that the participants were novice users of XBRL and did not bring preconceived biases (regarding XBRL) into the experiment.

⁶ There is no significant change in the results when the three participants who did not complete the instrument are included in the analysis.

⁷ The disparity in sample size between conditions was due to the experiment being conducted across two semesters. Two MBA sections were being taught in the first semester; therefore, it was plausible to split the conditions by section. However, since only one section was taught the second semester, the Instructor (one of the authors of this paper) could not plausibly split the class into the two conditions. Further, all participants were required to sign an honor pledge indicating they would not discuss the exam and questionnaire (i.e., the research instrument) with anyone other than the Instructor. All participants were made aware that first time violators of the honor pledge typically received suspensions, while second time offenders were expelled from the University.

⁸ The MBA students used were completing a graduate financial accounting class. Elliott et al. (2004) indicated that MBA students are appropriate proxies for investors if they have sufficient knowledge of the task materials. Under this condition, we deemed the MBA students used as appropriate, given their classroom instruction completed at the time of the study (the experiment was conducted at the end of the course) and the fact that most were scheduled to graduate later in the year.

extremely difficult).” The second question was reverse-scored, posed as a statement and said, “I thought the task (analyzing companies) was very easy. (1 = strongly disagree, 4 = not sure, and 7 = strongly agree).” The two items were summed into a single index (Cronbach’s alpha (0.80)) and analyzed. The mean (standard deviation) of the two groups were 9.05 (2.76) for the group using the Excel Investor Tool created in XBRL and 9.25 (2.49) for the group performing the task using all paper-based information, indicating a slight tendency toward the “more difficult” half of the scale. An ANOVA revealed no difference between groups (F-statistic = 0.08, p -value = 0.79). Thus, even though the XBRL-based participants were novice users of the NASDAQ Excel Investor Tool, they did not perceive the task to be any more difficult than the paper-based group.

Procedures

Study participants came from one of the author’s MBA classes. Earlier in the course, *all* student participants completed a group financial statement analysis case using paper-based annual reports. Additionally, prior to participating in the experiment all of the participants had: received instructions to independently read about XBRL (in order to form their own opinions); been given a brief XBRL description; been instructed how to use the Excel Investor’s Assistant Tool (through demonstrations). No attempts at XBRL advocacy, however, were made by the instructor in order to ensure independent opinions of the student participants.

The research instrument was in the form of a take-home final and questionnaire. Since this was an important part of the students’ course grade (i.e., 20% of the final grade), it was expected all students would take it seriously, although, there were no post-test questions measuring this concept. Both experimental conditions were assigned to

analyze two companies: Applied Micro Circuits Corporation (AMCC) and Maxim Integrated Products, Inc. (MXIM). Specifically, participants were to analyze the two companies over the years 2000 and 2001 (the experiment took place in fall 2002 and spring 2003) and choose one company as the “better” investment choice. Participants orally indicated that they had no prior knowledge or experience with either company, eliminating a potential bias in their analysis.

All participants received identical paper-based information containing background information for each company (obtained from the annual reports) and select segment data, as well as the post-test questionnaire together with the take-home test. Although the test was required, completing the post-test questionnaire was voluntary. Participants were instructed to answer the questionnaire according to their test experiences.⁹ All participants had a week (i.e., until the next class) to complete the test and fill out the questionnaire.

One group (henceforth, the XBRL-based group) was assigned to analyze the firms using the NASDAQ’s Excel Investor Analysis tool (www.NASDAQ.com/xbrl; see Appendix A for task description). The tool was a joint project between the NASDAQ stock exchange, PricewaterhouseCoopers, and Microsoft. It used point-and-click technology so no programming or coding was necessary. It contained links to both companies’ financial statements, selected footnotes, and auditor reports constructed using an XBRL instance document (which was explained to all participants during the instructor’s demonstrations) and could perform some basic analysis functions such as providing charts and graphs. The other group (henceforth, the paper-based group) was

given the identical information provided in the Excel tool, but on paper (see Appendix B for the task description).¹⁰

Variables

Dependent variables were measured in the post-test questionnaire using seven-point Likert scales, where 1 = ‘strongly agree’, 4 = ‘not sure’, and 7 = ‘strongly disagree.’ The dependent variable for H1 (perceived investor efficiency) was phrased, “I believe that using XBRL to analyze a company’s annual report information would be more efficient than using a paper version of the annual report.”¹¹ The dependent variable for H2 (perceived investor effectiveness) was phrased the same as H1 except for substituting the word “effective” for “efficient.” The dependent variable for H3 (perceived firm efficiency) was phrased, “I believe that using XBRL to report a company’s financial information would make a company more efficient.” Finally, the dependent variable for H4 (perceived firm effectiveness) was phrased the same as H3 except for substituting the word “effective” for “efficient.”

The independent variable, “format,” consisted of two groups: XBRL-based and paper-based. Participants were randomly assigned to these groups. Of all covariates tested (see “Participants” section), only the current degree being sought was significant

⁹ Participants were asked post hoc about their perceived relationship between the questionnaire and the task (i.e., test). All participants indicated that since the test was being graded and the questionnaire was not, they did not even look at the questionnaire until after completing the test.

¹⁰ The information was consistent with the financial statement analysis case the student participants performed earlier in the semester.

¹¹ Given the content and terminology used throughout the semester, this phrase is synonymous with “financial statement analysis.”

across conditions and, thus, used as a covariate in the analysis.¹² The experiment was conducted incorporating a between-subjects design.

4. RESULTS

Manipulation Check

A manipulation check was necessary to ensure that the participants understood the source of the information they received (i.e., either paper-based or by using an XBRL-enabled investment tool). The question appeared in the post-test questionnaire and was phrased, “I was asked to analyze companies using XBRL-based company information on the computer. (1 = strongly disagree, 4 = not sure, and 7 = strongly agree).” The mean (standard deviation) for the XBRL-based group was 6.58 (1.11). A *t*-test indicated the mean was significantly higher than the midpoint (p -value < 0.01). Therefore, the XBRL-based participants appeared to understand they were using XBRL in their task.

The mean (standard deviation) for the paper-based group was 2.93 (2.34). A *t*-test showed the mean was significantly lower than the midpoint (p -value = 0.05). Thus, the paper-based group appeared to understand that they were *not* using XBRL in their task. Given these results, the manipulation was considered successful.¹³

Hypothesis 1

Hypothesis 1 examines the perceived efficiency of using XBRL in financial statement analysis. The hypothesis predicts that investors using XBRL-based information

¹² Although all participants were graduate students, four participants were not pursuing an MBA. Their demographics, however, were quite similar to the MBA student participants.

¹³ The Kolmogorov-Smirnov with Lilliefors's Correction and Shapiro-Wilk test were significant at a p -value = 0.05 for each dependent variable (consistent with non-normal data). Additionally, normality and stem-and-leaf plots of the dependent variables indicated evidence of non-normality. The Levene's Test of Equality of Error Variances indicated statistical significance at a p -value = 0.01 for multiple dependent

(compared to investors using paper-based information) will perceive XBRL-enabled analysis as more efficient. As presented in Table 1 and consistent with H1, the XBRL-based group's mean (1.90; standard deviation = 0.94) was significantly less than the paper-based group's mean (3.30; standard deviation = 2.25; F -statistic = 11.39, p -value < 0.01).¹⁴ Both means were on the "agreeable" side of the scale regarding using XBRL for financial statement analysis.¹⁵ The Kruskal-Wallis test confirms the ANCOVA results (Chi-Square = 5.47, p -value = 0.02). Thus, H1 is supported.

[Insert Table 1 about here]

Hypothesis 2

Hypothesis 2 examines the perceived effectiveness of using XBRL in financial statement analysis. The hypothesis predicts that investors using XBRL-based information (compared to investors using paper-based information) will perceive XBRL-enabled analysis as more effective. As displayed on Table 2, the ANCOVA results support this hypothesis (F -statistic = 4.33, p -value = 0.04). Specifically, the XBRL-based group's mean (2.20; standard deviation = 1.21) is statistically lower than the paper-based group's mean (3.15; standard deviation = 2.25) and both means are again on the lower (agreeable) half of the scale. However, the Kruskal-Wallis result (Chi-Square = 1.32, p -value = 0.25) indicates no significance between groups. As a result of the ANOVA assumptions' violations mentioned in footnote #13, analysis of the hypothesis should be based on the non-parametric result when there is a disparity. Thus, in being conservative, H2 is not supported.

variables: indicating inequality in variances. As a result of the assumptions violations, all hypotheses were statistically analyzed using the non-parametric Kruskal-Wallis test in addition to ANCOVA.

¹⁴ An alpha of 0.05 is used for all hypothesis testing.

[Insert Table 2 about here]

Hypothesis 3

Hypothesis 3 compares the perceived efficiency of a firm using XBRL for financial reporting versus the same firm providing only paper-based information. The hypothesis predicts that firms providing XBRL-enabled information will be perceived by XBRL-based investors as more efficient (compared to investors using paper-based information). The results of the ANCOVA are presented in Table 3 and are consistent with H3. Specifically, the XBRL-based group's mean (1.98; standard deviation = 1.13) was significantly lower than the paper-based group's mean (2.98; standard deviation = 2.00). An interesting finding is that both groups' means are on the "agreeable" side of the scale. The results of the Kruskal-Wallis test confirm the ANCOVA results (Chi-Square = 3.86, p -value = 0.05). Thus, H3 is supported.

[Insert Table 3 about here]

Hypothesis 4

Hypothesis 4 compares the perceived effectiveness of a firm using XBRL for financial reporting versus the same firm providing only paper-based information. The hypothesis predicts that firms providing XBRL-enabled information will be perceived by XBRL-based investors as more effective (compared to investors using paper-based information). As displayed in Table 4 and consistent with H4, the XBRL-based group's mean (2.32; standard deviation = 1.31) is significantly lower than the paper-based group's mean (3.20; standard deviation = 1.47; F -statistic = 4.84, p -value = 0.03). Once again, both means favor XBRL-based reporting. The Kruskal-Wallis result confirms the

¹⁵ Unless otherwise indicated, results of t -tests confirm the mean is statistically lower than the midpoint of the scale.

ANCOVA (Chi-Square = 5.40, p -value = 0.02). Thus, H4 is supported. Table 5 presents a summary of the hypothesis testing.

[Insert Tables 4 and 5 about here]

Sensitivity Analysis

We asked participants to respond to two additional statements in order to improve construct validity and provide further evidence that XBRL usage results in perceived effectiveness gains. Specifically, we wanted to find out if XBRL usage would result in increased perceived accuracy both in firm-preparers' information and in nonprofessional investor analysis, where increased accuracy is one of the objectives of XBRL use and therefore another indicator of effectiveness (Yuthas and Eining 1995). Both statements included the same seven-point Likert scale used in the dependent variables for hypothesis testing (i.e., 1 = 'strongly agree', 4 = 'not sure', 7 = 'strongly disagree').

The first statement was, "I believe that using XBRL to report a company's financial information would result in more accurate information than using the current technology." The ANOVA was significant (F -statistic = 23.96, p -value < 0.01), with the XBRL-based group having a significantly smaller mean (2.17; standard deviation = 1.09) than the paper-based group (mean = 4.20; standard deviation = 2.07). Thus, the participants who had used the Excel Investor Tool were strongly in agreement with firms being more accurate in reporting if they used XBRL (consistent with one of XBRL's intended benefits); whereas, participants who did their analysis solely using paper-based information were unsure.

The second statement was phrased, "I believe that using XBRL to analyze a company's annual report would provide more accurate results than using a paper version

of the annual report.” Once again, the mean for the XBRL-based group (2.54; standard deviation = 1.31) was statistically lower than the mean for the paper-based group (3.55; standard deviation = 1.50; F -statistic = 7.59, p -value < 0.01). The mean for the paper-based group was not statistically less than the midpoint of the scale (p -value > 0.05), indicating this group was unsure of this XBRL intended benefit as well.

Overall, the empirical evidence derived from the sensitivity analysis is consistent with XBRL’s intended accuracy (perhaps due to decreased data entry errors) for both preparers and users of financial information.

5. DISCUSSION

Three out of the four hypotheses were supported. Combining the results of the hypotheses testing and the sensitivity analysis, empirical evidence indicates that perceived efficiency and effectiveness advantages can be derived from a preparer’s perspective through use of XBRL-enabled software. These results complement Hodge et al.’s (2004) findings, which indicated XBRL provided more transparent information to nonprofessional investors.

The second hypothesis, relating to perceived effectiveness in using XBRL for analysis, was not supported. This result is consistent with the investment choices of all participants. Except for one student in the paper-based group, all participants correctly chose the appropriate firm to invest in. The non-significant result for H2 can therefore be interpreted as participants not perceiving any difference in making the correct investment decision based on the information format. One explanation for this result is that the participants only had to analyze two firms. The effectiveness benefits of XBRL may only appear when comparisons between many firms are required.

Although the XBRL-based group did not perceive XBRL usage as being more effective for annual report analysis, both this group's mean and the paper-based group's mean followed the same trend throughout the hypothesis testing. Specifically, both groups were agreeable to XBRL's perceived efficiency and effectiveness advantages for both preparers and users of financial information. This suggests that educating firm management and external stakeholders about XBRL and providing an example of its use could bring about positive perceptions of the firm. Hands-on use of XBRL appeared to enhance favorable perceptions of efficiency and effectiveness.

The NASDAQ demo is no longer available online. The empirical evidence, however, provided in both Hodge et al. (2004) and the current paper, indicate XBRL-enabled software has advantages over other existing formats available for analysis. If stock exchanges, firms, and other stakeholders would like to increase XBRL usage, they should consider providing online XBRL-enabled tools to market participants.

6. CONCLUSIONS

Our paper investigates the perceived efficiency and effectiveness of XBRL-based reporting compared to paper-based reporting. Our motivation was based on firms' current focus on reducing compliance costs and regulators' increased interest in electronic reporting. XBRL provides firms with one method to reduce compliance costs by standardizing their financial data for use in multiple reporting contexts. While prior studies have shown that XBRL has practical benefits (e.g., Hodge et al. 2004), research on the effects of XBRL use on perceptions has been lacking, although theory indicates that perception strongly influences behavior, including IT use. This study fills that gap.

The results of our between-subjects experiment indicate that nonprofessional investors who used XBRL-based information had higher perceptions of analytical efficiency through the use of XBRL-enabled information (compared to paper-based investors), but there was no significant difference regarding perceived analytical effectiveness. Further, XBRL-based investors had higher efficiency and effectiveness perceptions (relative to paper-based investors) regarding firms that provide XBRL-enabled information. An interesting non-hypothesized finding is that both groups of investors had means below the midpoint (i.e., on the “agreeable” side of the scale) for all hypotheses. Thus, the sample in general appeared receptive to XBRL in terms of perceived efficiency and effectiveness gains.

In conjunction with Hodge et al.’s (2004) findings, our results have important implications for standard-setters, financial statement preparers, and users. The SEC and other international regulatory bodies currently have pilot programs involving XBRL reporting. Our results reinforce the value of these programs and indicate that XBRL supporters should continue to promote and encourage wider adoption of XBRL reporting. The positive perceptions formed by XBRL users of its capabilities suggest that the acceptance and adoption of XBRL will not be impeded by negative user attitudes. The results also significantly add to the existing TAM literature, given that we investigated the perceptions related to both individual analysis and firm preparation of information.

Our study is subject to a number of limitations. First, the use of MBA students may limit the external validity of the experiment, because they may not adequately substitute for actual nonprofessional investors. This threat is mitigated, however, by the past experience of most MBA students used in the study. Using actual investors may

have also introduced bias into the study as they are likely to have pre-determined beliefs and methods on how to collect financial statement information. The threat to external validity is also mitigated because the task was administered as a take-home exam. A take-home exam more accurately reflects real world conditions by allowing participants more time to analyze the data and make the investment decision.

As mentioned in footnote #7, the honor pledge taken by the participants can be viewed as a signed affidavit indicating that no discussion outside concerning the task occurred. However, we cannot be “guaranteed” that participant contamination did not occur. The carryover of participants into successive semesters, enhance the possibility of participant contamination.

The use of single item constructs to measure efficiency and effectiveness represents another limitation. The definition of efficiency and effectiveness are open to different interpretations by students and therefore the reliability of the results may be negatively affected. We minimized this threat by conducting sensitivity analyses using perceived accuracy as a proxy for effectiveness.

Finally, the use of a dichotomous variable to measure XBRL usage is a potential limitation of the study. As with any innovation, XBRL can be adopted and used to different degrees by firms and individuals. This limitation is minimized however, by the fact that most firms and individuals use standard tools when viewing and using XBRL data, reducing the potential level of actual XBRL adoption variance.

The limitations discussed above suggest a number of interesting areas for future research. Further research on XBRL adoption could survey actual investors (professional and nonprofessional), financial institutions, and financial statement preparers to assess

any differences in their perceptions of efficiency and effectiveness. Another interesting area is the development of more comprehensive measures of XBRL efficiency and effectiveness. Finally, future research should investigate what level of adoption and usage across firms is required before investors perceive a benefit to adopting the technology.

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APPENDIX A XBRL Group's Task

Take-Home Portion of Final Exam

The purpose of this problem is to have you do a comprehensive analysis of two companies, given the information distributed to you and your knowledge of the course content. Assume you are a manager for a medium-sized U.S. public company. Your company has been somewhat profitable for the past few years, but foresees a need for a greater amount of cash in the future. Instead of investing in low-interest, but safe government bonds, your boss has decided to invest in the stock market. Over time, the average returns from the stock market have far exceeded many other types of investments. Your boss has decided that the investment should be in the semiconductor/technology area and after extensive research, has narrowed the choices to two companies: Applied Micro Circuits Corporation (AMCC) and Maxim Integrated Products, Inc. (MXIM). Both companies are publicly traded on the NASDAQ stock exchange.

You are to **ONLY** use information for the fiscal years ending **2000** and **2001** for your analysis. In essence then, you are to assume post-2001 has not happened yet, and cannot use any information from that time (including general economic information). You are only allowed to use the information provided to you, except that if you want to track the stock price/volume over the two years, you may either go to the companies' websites or go to quote.yahoo.com.

Required:

- 1) Using the Excel Analyzer program (which is posted under "Course Materials" in BlackBoard), analyze both companies' performance in the years 2000 and 2001. You should use any applicable ratios and footnotes to answer this part. Cite any concerns or positives you notice over these two years. In short, repeat what you did in your group case studies, but in a more comprehensive manner (i.e., don't just look at liabilities, cash flows, etc. on an individual basis, combine them all together in one analysis). Additionally, analyze both companies' prospects for 2002 and beyond. Based on a 2-year trend analysis, describe any patterns you see in key financial and nonfinancial areas. For example, if you believe Maxim's COGS as a percentage of sales is going to decrease, state that and tell me why. Precise numbers or projections are not required.**
- 2) In your position as a manager, which company would you invest your company's funds in and why?**
- 3) Please fill out the attached survey. Although not required, it will help me understand what you thought about this problem and learning about XBRL. Your responses should help me better organize my future XBRL lectures, benefiting future classes.**

Appendix B Paper-Based Group's Task

Take-Home Portion of Final Exam

The purpose of this problem is to have you do a comprehensive analysis of two companies, given the information distributed to you and your knowledge of the course content. Assume you are a manager for a medium-sized U.S. public company. Your company has been somewhat profitable for the past few years, but foresees a need for a greater amount of cash in the future. Instead of investing in low-interest, but safe government bonds, your boss has decided to invest in the stock market. Over time, the average returns from the stock market have far exceeded many other types of investments. Your boss has decided that the investment should be in the semiconductor/technology area and after extensive research, has narrowed the choices to two companies: Applied Micro Circuits Corporation (AMCC) and Maxim Integrated Products, Inc. (MXIM). Both companies are publicly traded on the NASDAQ stock exchange.

You are to **ONLY** use information for the fiscal years ending **2000** and **2001** for your analysis. In essence then, you are to assume post-2001 has not happened yet, and cannot use any information from that time (including general economic information). You are only allowed to use the information provided to you, except that if you want to track the stock price/volume over the two years, you may either go to the companies' websites or go to quote.yahoo.com. Additionally, you are not allowed to use any information that is crossed out in your handouts.

Required:

- 1) Using the annual reports, analyze both companies' performance in the years 2000 and 2001. You should use any applicable ratios and footnotes to answer this part. Cite any concerns or positives you notice over these two years. In short, repeat what you did in your group case studies, but in a more comprehensive manner (i.e., don't just look at liabilities, cash flows, etc. on an individual basis, combine them all together in one analysis). Additionally, analyze both companies' prospects for 2002 and beyond. Based on a 2-year trend analysis, describe any patterns you see in key financial and nonfinancial areas. For example, if you believe Maxim's COGS as a percentage of sales is going to decrease, state that and tell me why. Precise numbers or projections are not required.**
- 2) In your position as a manager, which company would you invest your company's funds in and why?**
- 3) Please fill out the attached survey. Although not required, it will help me understand what you thought about this problem and learning about XBRL. Your responses should help me better organize my future XBRL lectures, benefiting future classes.**

Table 1
ANCOVA Table for H1 – Perceived Investor Analysis Efficiency

<u>Source of Variation</u>	<u>DF</u>	<u>SS</u>	<u>MS</u>	<u>F-stat</u>	<u>p-value</u>
Main Effect:					
Format	1	25.88	25.88	11.39	< 0.01
Covariate:					
Degree	1	3.08	3.08	0.01	0.91
Model	2	26.29	13.14	5.79	< 0.01

Table 2
ANCOVA Table for H2 – Perceived Investor Analysis Effectiveness

<u>Source of Variation</u>	<u>DF</u>	<u>SS</u>	<u>MS</u>	<u>F-stat</u>	<u>p-value</u>
Main Effect:					
Format	1	11.57	11.57	4.33	0.04
Covariate:					
Degree	1	0.12	0.12	0.05	0.83
Model	2	12.38	6.19	2.32	0.10

Table 3
ANCOVA Table for H3 – Perceived Company Efficiency

<u>Source of Variation</u>	<u>DF</u>	<u>SS</u>	<u>MS</u>	<u>F-stat</u>	<u>p-value</u>
Main Effect:					
Format	1	12.46	12.46	5.69	0.02
Covariate:					
Degree	1	0.31	0.31	0.14	0.71
Model	2	13.74	6.87	3.14	0.05

Table 4
ANCOVA Table for H4 – Perceived Company Effectiveness

<u>Source of Variation</u>	<u>DF</u>	<u>SS</u>	<u>MS</u>	<u>F-stat</u>	<u>p-value</u>
Main Effect:					
Format	1	9.06	9.06	4.84	0.03
Covariate:					
Degree	1	1.37	1.37	0.73	0.40
Model	2	11.85	5.92	3.16	0.05

Table 5
Summary of Hypotheses

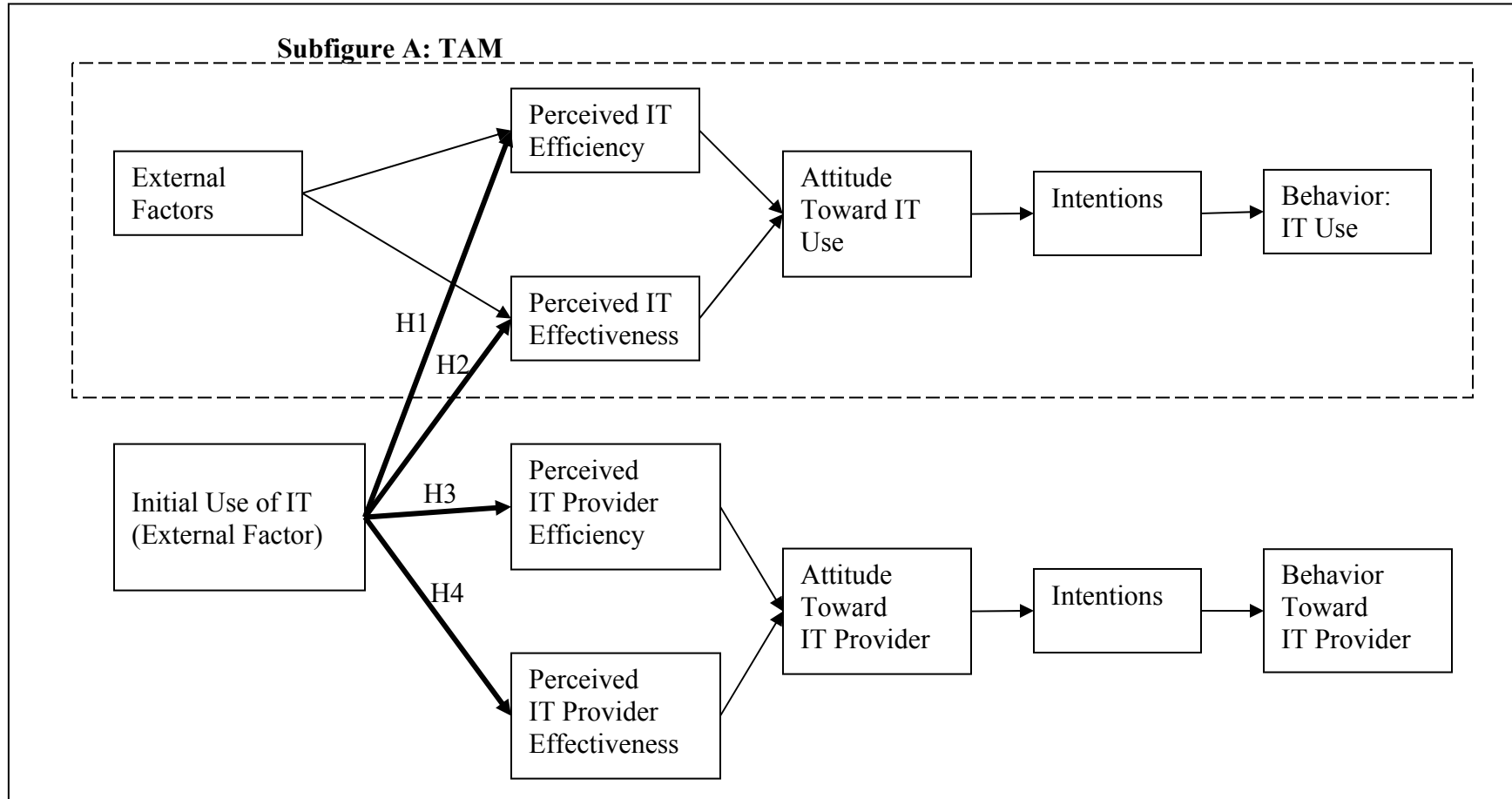
<u>Hypothesis</u>	Parametric		Nonparametric	<u>Support</u>
	<u>Mean X^a</u>	<u>Mean P^b</u>	<u>Kruskal-Wallis (<i>p</i>-value)</u>	
1 (The XBRL-based group perceives an investor as being more efficient using XBRL)	1.90*	3.30	5.47 (0.02)	Yes
2 (The XBRL-based group perceives an investor as being more effective using XBRL)	2.20*	3.15	1.31 (0.25)	No
3 (The XBRL-based group perceives a firm as being more efficient using XBRL)	1.98*	2.98	3.86 (0.05)	Yes
4 (The XBRL-based group perceives a firm as being more effective using XBRL)	2.32*	3.20	5.40 (0.02)	Yes

^a Means for the XBRL-based group

^b Means for the paper-based group

* Indicates significant differences between Mean X and Mean P at an alpha of 0.05.

Figure 1: Model of the Effects of IT Use on User Perceptions of IT and IT Provider



IT refers to XBRL-enabled or paper-based analysis of financial statements.

IT Provider refers to the company provider users either XBRL-formatted or paper financial statements.

TAM in Subfigure A refers to the technology acceptance model and is based on Davis et al. (1989).

H1 through *H4* refer to hypotheses 1 through 4.