ACADEMIC INVESTIGATIONS & CONCEPTS

SECTION 1

CHANGE IN EARNINGS QUALITY SURROUNDING ERP IMPLEMENTATION

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Abstract

Enterprise Resource Planning (ERP) systems have become widely adopted by companies to fulfil various purposes. ERP systems make information flow more transparent and timelier. From a capital markets perspective, an interesting question is whether the implementation of ERP systems reduces earnings management. One argument is that it will not make any difference for managers who are intent on managing earnings. In this case, managers will find ways to circumvent the constraints imposed by the new system. It may also be argued that ERP makes it easier for the auditors to detect earnings management, thus dissuading any intent on the part of managers to indulge in earnings management. Another argument is that ERP systems will provide managers with the information necessary to anticipate potential problems earlier in the period, allowing them to make operating adjustments, thereby reducing the need for earnings management through accounting accruals. We examine the question of changes in earnings management brought about by ERP system implementation using an alternate measure of earnings management and earnings quality – a firm's likelihood of a GAAP violation. Our findings are that the probability of a GAAP violation decreases significantly after the implementation of ERP systems, but less for larger firms, and more for high growth firms.

Keywords: Earnings Management, Enterprise Resource Planning Systems, Earnings Quality, GAAP Violation, Beneish M-Score

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1. INTRODUCTION AND MOTIVATION

The vast majority of publicly traded and privately held companies have adopted Enterprise Resource Planning (ERP) software systems during the last two decades. Because the implementation of ERP systems eliminates barriers between the functional areas of the firm, management can get a unified enterprise view of the company's financial condition at any time. This unprecedented access to

information can result in an improvement in operational performance, and the market response to ERP implementation announcements, in general, has been positive. However, Wright and Wright (2002) find that there may be reductions in internal control effectiveness and deterioration in audit quality in ERP system settings. Brazel and Dang (2008) find that the quality of earnings (as measured by discretionary current accruals) deteriorates after the firm implements ERP system. They attribute this to ERP systems providing management with access to additional information in a more timely fashion, making it easier to manage earnings and meet the market's earnings expectation. A counter argument to this hypothesis is that automated systems make it inherently harder to manipulate earnings without leaving a digital trace that can be detected by auditors. Thus, the managers may have more timely information, they may not have all of the means to manage earnings that they did before the implementation of ERP systems. This study provides additional evidence on this question by using an alternate metric of earnings management that focuses on earnings manipulations that lead to GAAP violation. Because the primary concern of the auditors is to ensure conformance to GAAP, the metric used in this study provides a direct test of the efficacy of ERP implementation.

There are several reasons to believe that the findings of prior studies could be biased and need re-examination. First, the implementation of ERP systems requires large capital expenditures that can bias the accruals measures as noted in the context of firms going through an IPO (Ball and Shivkumar, 2008). The use of discretionary accruals to measure earnings management has been criticized in the accounting literature (Fields et al., 2000). In order to address these shortcomings, Beneish (1999) devised a dichotomous choice model to separate the GAAP violators from non-violators based on eight critical ratios. The parameter estimates from the Beneish model can be used as weights for these ratios in constructing the M-Score and estimating the likelihood of a GAAP violation for any firm. A recent study (Jones et al., 2007) comparing the performance of various metrics in detecting fraud, documents that the Beneish model performs as well (if not better) than most of the accrual based metrics used in previous literature. Previously, Sinha (2012) used the likelihood of a GAAP violation (M-Score) to measure earnings management and audit quality in the context of assessing auditor conflict of interest. This study uses the M-Score to estimate a firm's propensity to violate GAAP as an alternate metric of earnings management. There are several advantages to using this metric over the accruals based measures used in prior literature. First, it is a measure of a firm's propensity to violate GAAP, and an opinion on compliance with GAAP is one of the primary responsibilities of the firm's auditors. Thus, an association of this metric with an ERP implementation provides a *direct* test of the change in accounting quality. No prior study has used this measure to study the impact of ERP systems on earnings management. Second, it has a strong out-of-sample validity (Beneish, 1999). Finally, instead of focusing on a single earnings number, as most of the accruals based metrics do, the Beneish model is derived from a wide range of balance sheet and income statement items that are likely to be affected when firms violate GAAP to achieve certain financial statement outcomes.

The M-Score used in this study has been used in prior studies as a proxy for earnings manipulation and to represent a firm's propensity to violate GAAP (Sinha & Hunt, 2013; Teoh, 1998; Beneish, 1997). McNichols (2000) provides motivation for the Beneish M-Score approach, stating that using specific accruals, rather than overall accruals, can provide a greater understanding of earnings management because it utilizes a richer information set than most accrual models. By estimating a firm's likelihood of a GAAP violation and relating it to ERP adoption, this study seeks to answer the following research question: Do firms that adopt ERP systems also exhibit a lower propensity to violate GAAP?

The results of this research should be of interest to researchers, regulators, and practitioners. The empirical evidence shows that implementing ERP systems increases the quality of earnings, as measured by a decrease in the probability of a GAAP violation. The increase in accrual based deterioration in earnings quality, as documented in prior studies, is within the flexibility provided by GAAP. Regulators can use the results to adjust their efforts and allocation of resources to where there are more likely to be disclosure-related issues. Analysts and other practitioners can increase their reliance on earnings reported by firms that have implemented ERP systems because of the decreased financial reporting risk. Companies considering implementing ERP systems can use the results to help justify the return on investment of information technology expenditures because of the potential reduction in the future cost of capital. Improvement in the firm's financial reporting environment might be considered a valuable benefit of implementing an ERP system.

2. LITERATURE REVIEW

2.1. ERP and Earnings Management

Previous research on the relationship between ERP systems (also referred to as Enterprise Systems, or ES) and earnings management is sparse and inconsistent. Brazel and Dang (2008) find an increase in earnings management for firms that adopted ERP systems in the years 1993 to 1999. They tested the change in the absolute value of discretionary accruals and found a significant increase after ERP adoption, which was greater when more ERP modules were adopted. They found that on average firms managed earnings upward after ERP implementation.

Brazel and Dang (2008) is in direct contrast to Morris and Laksamana (2010). Using a wider window of ERP system implementations (1994 through 2003), Morris and Laksamana (2010) find a significant decrease in earnings management, also measured as the absolute value of total discretionary accruals. They further test short-term versus long-term discretionary accruals and find that the results are due to decreases in the short-term accruals. There was no significant change in long-term discretionary accruals after adopting ERP systems.

There are two important differences between the research conducted by Brazel and Dang (2008) and Morris and Laksamana (2010). First, Morris and Laksamana (2010) used a sample of 143 ERP adopters over 10 years, while Brazel and Dang (2008) used a sample of 204 firms over seven years.

Second, Brazel and Dang (2008) compared discretionary accruals pre- and post-adoption for ERP adopters without a matching control group. Morris and Laksamana (2010) used a matched pair design, controlling for overall changes in earnings management, which Cohen et al. (2008) find increased from 1987 to 2002.

The third paper that examined earnings management around ERP adoptions, Dorantes, et al. (2013), find no change in earnings management after ERP implementation, using a variety of measures based on the frequency distribution approach (McNichols, 2000). Their sample consists of 353 firms over the 1995 to 2008 period, using a matched-pair design.

2.2. ERP and Accounting Benefits[1]

In addition to reducing the possibility of earnings management, ERP systems provide benefits to the accounting function including the immediacy of information for decision-making and the integration of applications (Spathis and Constantinides, 2004). These benefits are also likely to reduce the probability of a GAAP violation by ERP implementing firms. Over the years, there have been many studies on the interrelationship between accounting and ERP systems. Because of ERP adoption, the accounting components have the greater adaptability to generate necessary information and accounting applications with an increase in the quality of reports. This has allowed for an improvement of decisions due to time efficiency and information reliability.

Due to ERP implementation, advancement of decision-making processes and enterprise integration (Colmenares, 2009) has taken place. There has been research demonstrating the improvement of decision-making within organizations (Spathis, 2006; Kanellou and Spathis, 2007), along with the improved accuracy of accounting reports, which includes the statement of accounts (Velcu, 2007; Colmenares, 2009). There have also been studies that incorporate the findings that ERP systems reduce the length of time in reporting lags (Brazel and Dang, 2008). Findings from these studies have shown that companies benefit from ERP systems by improving coordination and eliminating redundant reports and data entry tasks (Gattiker and Goodhue, 2004). This research is in addition to Chang (2006) demonstrating that traditional business functions are consolidated into a shared database helping to eliminate reiteration of data entry. Olhager and Seldin (2003) analysed that ERP systems improve the quality and availability of information within functions of the business.

Accounting processes change with the implementation of ERP systems. ERP systems create new accounting routines throughout organizations due to the additional sources of data for these accounting practices (Booth et al., 2000). Accountants are also able to conduct routine activities for management accounting more efficiently and effectively even with larger amounts of data from their databases (Järvenpää, 2007). Rom and Rohde (2006) found that ERP systems are beneficial for data collection and managerial accounting. Granlund and Malmi (2002) explored the integrated effects of ERP systems, finding that management accountants had the ability to focus more on the analysis of data due to the consolidated processing of documents and information. This result was similar to Scapens and Jazayeri's (2003) study indicating that managerial accountants were able to be more versatile in their functioning within an organization while moving to roles of consultants and data analysts rather than the traditional focus on accounting activities. Another study (Hyvönen et al., 2008) indicated that IT accounting solutions create the necessity for accountants to utilize the concepts of the combination of accounting and management rationales. Newman and Westrup (2005) focused on the idea that although the relationship between accounting tasks and ERP systems become increasingly interwoven, accountants continue to use the relevant information in order to advance their own knowledge of the system and profession. Grabski et al. (2011) studied that ERP systems are transforming the accounting profession requiring accountants to learn and develop additional skills and tasks.

O'Leary's (2004) study was to determine if a variety of industries experienced the same benefits from ERP systems. Deloitte Consulting's (1998) study determined the list of benefits industries could experience with additional benefits determined by O'Leary's (2004) study. Additional benefits were noted as inventory reduction, IT cost reduction and financial controls improvement.

Shang and Seddon's (2002) study investigated a framework for the benefits of ERP systems classified into five categories: operational, managerial, strategic, IT infrastructure, and organizational. Esteves (2009) used these categories to assess benefits for small and medium-sized enterprises (SMEs), which suggested that the benefits are interrelated and perceiving these benefits will be along a continual cycle. The benefits that were studied in the research (Esteves, 2009) included quality, decision-making, and IT infrastructure capability improvement.

Spathis (2006) continued to develop and classify benefits from ERP systems based on Shang and Seddon's (2002) initial classification. Spathis' (2006) classification consisted of organizing benefits retrieved from enterprise systems (ES) into four different categories. These categories consisted of organizational benefits, operational benefits, managerial benefits and IT benefits. The main accounting components Spathis (2006) realized from surveying companies were greater flexibility in information generation, higher quality of accounting reports, and reduced time requirements to close annual accounts. The outcomes produced reflected similar results to the Spathis and Ananiadis (2005) study and the Kanellou and Spathis (2007) study.

Another research study was conducted by Nicolaou (2004) which was conducted to measure financial performance using a variety of eight different financial indicators after the integration of ERP systems which were based on indicators such as ROA (return on assets), ROI (return on investment) and ROS (return on sales). During this study, there was a classification of modules into two categories: primary modules and support modules. The study suggested that the different modules created

[1] Summary from Kanellou and Spathis (2013).

different results on financial performance after the ERP systems were integrated.

In conclusion, from the prior research, ERP systems increase flexibility, integrate accounting applications, improve gathering of information, and improve processing of data. With the integration of ERP systems, it is believed that the benefits ERP systems give to a variety of business functions are also beneficial to integral parts of an organization's accounting process.

3. RESEARCH HYPOTHESES

Earnings management and the propensity of a GAAP violation might decrease for three reasons after firms implement ERP systems. First, as discussed above, ERP systems will improve the accounting function, making errors resulting in GAAP violations less likely. Second, the auditor's ability to detect GAAP violations will increase after the implementation of ERP systems due to increased transparency in the accounting function. Third, ERP systems provide managers more timely information for decision-making. This immediacy of information allows managers to take corrective action earlier in the year. These operational changes reduce the need for accruals-based earnings management to meet the market's expectation. It also gives managers more time to manage the market's expectation up or down to better match the firm's true results. This leads to our first hypothesis:

H_1: The propensity of a GAAP violation decreases after the implementation of ERP systems.

Due to the complexity of large firms, some of the reasons that ERP systems are likely to decrease the likelihood of a GAAP violation might not hold. Integrating ERP systems across multiple subsidiaries and locations is as likely to cause an increase in the probability of an error as it is to decrease the probability of an error resulting in a GAAP violation. In addition, the size of the firm increases the difficulty of the audit function, possibly diminishing much of the increased transparency granted by ERP systems. Managers of large firms are also less likely to be able to make substantive operational changes quickly enough to correct for failing to meet the market's expectation, meaning those same managers are more likely to use accruals based earnings management to meet those same market expectations. This leads to our second hypothesis:

H_2: Large firms will have smaller decreases in the probability of a GAAP violation after the implementation of an ERP system.

Many of these same arguments could be made for high growth firms. Firms facing rapid growth are likely to quickly be outgrowing the accounting function, and adding the complexity of an ERP implementation is likely to increase the probability of a GAAP violation. Auditors of growth companies are also less likely to find a GAAP violation for the same reason. In addition, focusing on growth, often at all costs, means that managers of growth companies are less likely to make the operational changes necessary to meet the market's expectation, meaning that in order to meet expectations they are more likely to resort to accruals-based earnings management. This leads to our third hypothesis:

H_3: High growth firms will have a smaller decrease in the probability of a GAAP violation after the implementation of an ERP system.

All three hypotheses are tested using firms adopting ERP systems from 1990 through 2001 and discussed in the sample selection section next.

4. DATA AND SAMPLE SELECTION

We begin with an examination of firms that adopted ERP systems in 1990 through 2001. This sample period was chosen because it was the period of rapid adoption of ERP systems and for most firms the first company-wide ERP system. Later periods of ERP adoption include more companies that are replacing or upgrading an already existing ERP system. Firms were identified through announcements from the Lexis-Nexis Academic Universe (News) Wire Service Reports. ERP vendor names and the search terms "implement," "convert," and "contract" yielded a sample of 183 ERP adopting firms with data on COMPUSTAT. Data retrieved from COMPUSTAT includes sales and sales growth, among other control variables. In the final sample, there are 117 firms representing ERP adopters for which both pre and post-adoption data are available.

We use *SALES* as a measure of firm-size and *SALES GROWTH* as a measure of growth rate in our model formulation. For each firm, COMPUSTAT data is used to compute the probability of a GAAP violation using the M-Score (Beneish, 1999), which is a linear combination of various ratios that capture the propensity to violate GAAP. In addition, industry data, matched on the two-digit SIC code of the firms in the ERP-adopters list, was retrieved from COMPUSTAT and various industry averages were computed that were used in building the model.

The estimation of the M-Score and probability of a GAAP violation will require the computation of eight financial ratios. Appendix 1 provides an intuitive explanation of the significance of these ratios. The ratio definitions along with the COMPUSTAT variable identifiers [#] are presented in parentheses next to each financial measure below:

$$DSRI = \frac{Receivable\ s_t[2]/Sales_t[12]}{Receivable\ s_{t-1}/Sales_{t-1}}$$

$$GMI = \frac{(Sales_{t-1}[12] - Cost\ of\ goods\ sold_{t-1}[41])/Sales_{t-1}[12]}{(Sales_t[12] - Cost\ of\ goods\ sold_t[41])/Sales_t[12]}$$

$$AQI = \frac{1 - (Current\ assets_t[4] + PP\ \&\ E[8])/Total\ assets_t[6]}{1 - (Current\ assets_{t-1} + PP\ \&\ E_{t-1})/Total\ assets_{t-1}}$$

$$SGI = \frac{Sales_t[12]}{Sales_{t-1}}$$

$$DEPI = \frac{Depreciation_{t-1}[14-65]/(Depreciation_{t-1} + PP\ \&\ E_{t-1}[8])}{Depreciation_t/(Depreciation_t + PP\ \&\ E_t)}$$

$$SGAI = \frac{Sales, general, and\ administrative\ expense_t[189]/Sales_t[12]}{Sales, general, and\ administrative\ expense_{t-1}/Sales_{t-1}}$$

$$LVGI = \frac{(LTD_t[9] + Current\ liabilities_t[5])/Total\ assets_t[6]}{(LTD_{t-1} + Current\ liabilities_{t-1})/Total\ assets_{t-1}}$$

$$TATA = \frac{\Delta CA_t[4] - \Delta Cash_t[1] - \Delta CL_t[5] - \Delta Current\ Maturities\ of\ LTD_t[44] - \Delta IT\ payable_t[71] - D\ \&\ A_t[14]}{Total\ Assets\ [6]}$$

The weights in the M-Score computation are derived from the un-weighted probit model estimated in Beneish (1999). The M-Score for each firm is computed as a linear combination of the above ratios as follows:

M-Score = – 4.840 + 0.920 *DSRI* + 0.528 *GMI* + 0.404 *AQI* + 0.0892 *SGI* + 0.115 *DEPI* – 0.172 *SGAI* – 0.327 *LVGI* + 4.679 *TATA*

This M-Score is used in the empirical tests as outlined in the next section.

5. VARIABLE CONSTRUCTION

The ERP implementing firms in the sample have implementation years ranging from 1990 to 2001. In order to make comparisons, the year of ERP adoption is considered to be Year 0. The year before (pre-implementation) and after (post-implementation) ERP systems implementation years are measured relatively and designated as Years –1 and Years +1 respectively. The M-Score is computed and averaged over three symmetrically-matched pre and post implementation period combinations. The M-Scores are compared in three pre and post implementation windows, of one, two, and three years. Three symmetrically-matched and averaged time period pairs (pre, post) are (–1, +1), (–2 to –1, +1 to +2), and (–3 to –1, +1 to +3).

In the first window, the M-Score in Year –1 is compared to the M-Score in Year +1. In the second window, the M-Score is averaged in Year –2 to –1 and in Year +1 to +2, and the comparison is made between the average two-year M-Scores. In the third window, the M-Score is averaged in Year –3 to –1 and in Year +1 to +3, and the comparison is made between the average three-year M-Scores. By extending the pre- and post- time periods to different time durations, we the findings to be robust to the sample period selected and noise associated with the ERP implementation date measurement.

To test the hypotheses, we measure all of the variables as deviations from the yearly industry mean to remove the year-specific effect. This is essential as the pre- and post- implementation years are different fiscal years for each firm. Thus, the difference in differences specification is used to test the three hypotheses. This differencing is noted in the equations and tables with a "D_" prefix. To ensure that size factors do not confound the results, variables are "mean-centered," or measured as the deviation from the industry sample mean. Variables that are industry-adjusted are noted in the equations and tables with an "IA_" prefix before the variable names.

6. MODELS

The models used in the empirical tests are as follows:

$$D\_PROB_{i,t} = \alpha + \beta_1\ SALES_{i,t} + \beta_2\ SGR_{i,t} + \varepsilon \qquad (1)$$

$$IA\_D\_PROB_{i,t} = \alpha + \beta_1\ SALES_{i,t} + \beta_2\ SGR_{i,t} + \varepsilon \qquad (2)$$

Where:

- $D\_PROB_{i,t}$ is the change in the probability of a GAAP violation after adoption of ERP systems (after – before);
- $IA\_D\_PROB_{i,t}$ is the industry adjusted change in the probability of a GAAP violation after adoption of ERP systems (after – before);
- *SALES* is sales revenue for the year before ERP implementation (–1); and
- *SGR* is sales growth, the rate of change in sales revenue for the year before ERP implementation (–2 to –1).

For the *first* hypothesis, the probability of a GAAP violation decreasing after ERP implementation, we estimate and test if α is strictly less than zero. Because all variables are measured in differences, a significantly negative value of α will indicate an improvement in earnings quality and a decrease in the likelihood of earnings management after the implementation of ERP systems.

For the *second* hypothesis, the effect of firm size on the change in the probability of a GAAP violation, we test if the estimated coefficient β_1 is significantly different from zero. If β_1 is significantly greater than zero, we would infer that the effect is stronger for larger firms. If β_1 is significantly less than zero, we would infer that the effect is weaker for larger firms.

For the *third* hypothesis, the effect of firm growth rates on the change in the probability of a GAAP violation, we test if the estimated coefficient β_2 is significantly different from zero. If β_2 is significantly greater than zero, we would infer that firms with high growth show a larger reduction in the propensity to violate GAAP after the implementation of ERP systems. However, if the estimated coefficient β_2 is significantly less than zero, then it will suggest that the probability of a GAAP violation is less for high growth firms.

7. RESULTS

Table 1 presents descriptive statistics on the key variables used in the analysis. At a univariate level, the findings on the probability of a GAAP violation are very striking. The average probability of a GAAP violation before the implementation of ERP systems was about 8% in our sample of firms. After ERP systems implementation, this probability drops to 4%, a 50% reduction in the probability of a GAAP violation. These findings provide strong support for our primary line of inquiry. To ensure that this finding is not influenced by size and growth factors, we perform multivariate analysis with all of the independent variables measured as deviations from their respective means. In addition, each firm serves as its own control because the M-Score is measured as the change in the probability of a GAAP violation, pre vs. post ERP implementation. These procedures eliminate the need for additional controls in the model.

Table 1. Descriptive statistics

Variable	*N*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
PROB_B	117	0.08032	0.16677	0.0005361	1
PROB_A	117	0.04349	0.10804	1.301E-18	0.81946
IA_PROB_A	117	-0.05385	0.11974	-0.20665	0.76599
IA_PROB_B	117	-0.01406	0.16602	-0.17514	0.85721
IA_D_PROB	117	-0.0398	0.19452	-1.04971	0.37353
D_PROB	117	-0.03682	0.1883	-0.99637	0.37125
D_IA_SALES	117	0	2.42317	-6.39236	6.69308
D_IA_SGR	117	0	134.96875	-671.05266	428.60124
D_IA_ TASS	117	0	22345	-17691	210519
D_IA_B2M	117	0	1545	-562.79491	16550
D_SALES	117	0	2.58219	-8.06454	5.67474

Table 2 presents correlation coefficients between the various measures used in the study. The probability of a GAAP violation, with or without adjustment for industry effects, is associated with sales and sales growth, with or without adjustment for industry effects. These correlations are weak to non-existent after the implementation of ERP systems, more strong evidence in the direction of our hypotheses.

Table 2. Correlation coefficients

	PROB_B	*PROB_A*	*IA_PROB_A*	*IA_PROB_B*	*PROBI_B*	*PROBI_A*	*IA_D_PROB*	*D_PROB*	*D_IA_SALES*	*D_IA_SGR*	*D_IA_TASS*	*D_IA_B2M*	*D_SALES*
PROB_B		0.11	0.02	0.98	0.13	0.22	-0.82	-0.82	-0.35	0.28	-0.10	-0.02	-0.35
		0.23	0.83	<.0001	0.16	0.02	<.0001	<.0001	0.00	0.00	0.27	0.83	<.0001
PROB_A	0.11		0.93	0.13	-0.10	-0.07	0.46	0.47	-0.28	0.05	-0.08	-0.03	-0.21
	0.23		<.0001	0.15	0.30	0.44	<.0001	<.0001	0.00	0.62	0.40	0.73	0.03
IA_PROB_A	0.02	0.93		0.10	-0.37	-0.44	0.53	0.52	-0.29	0.11	-0.06	-0.03	-0.13
	0.83	<.0001		0.27	<.0001	<.0001	<.0001	<.0001	0.00	0.26	0.50	0.73	0.17
IA_PROB_B	0.98	0.13	0.10		-0.09	0.05	-0.79	-0.79	-0.37	0.33	-0.09	-0.03	-0.32
	<.0001	0.15	0.27		0.34	0.60	<.0001	<.0001	<.0001	0.00	0.35	0.79	0.00
PROBI_B	0.13	-0.10	-0.37	-0.09		0.76	-0.15	-0.17	0.09	-0.23	-0.07	0.02	-0.15
	0.16	0.30	<.0001	0.34		<.0001	0.10	0.07	0.33	0.01	0.44	0.82	0.11
PROBI_A	0.22	-0.07	-0.44	0.05	0.76		-0.31	-0.23	0.12	-0.17	-0.02	0.01	-0.16
	0.02	0.44	<.0001	0.60	<.0001	0.00		0.01	0.21	0.06	0.81	0.92	0.09
IA_D_PR0B	-0.82	0.46	0.53	-0.79	-0.15	-0.31		0.99	0.13	-0.22	0.04	0.00	0.20
	<0001	<.0001	<.0001	<.0001	0.10	0.00		<.0001	0.15	0.02	0.70	0.99	0.03
D_PROB	-0.82	0.47	0.52	-0.79	-0.17	-0.23	0.99		0.15	-0.22	0.05	0.00	0.19
	<0001	<.0001	<.0001	<.0001	0.07	0.01	<.0001		0.11	0.02	0.62	1.00	0.04
D_IA_SALES	-0.35	-0.28	-0.29	-0.37	0.09	0.12	0.13	0.15		-0.05	0.41	-0.05	0.91
	0.00	0.00	0.00	<.0001	0.33	0.21	0.15	0.11		0.62	<.0001	0.61	<.0001
D_IA_SGR	0.28	0.05	0.11	0.33	-0.23	-0.17	-0.22	-0.22	-0.05		0.05	0.03	-0.02
	0.00	0.62	0.26	0.00	0.01	0.06	0.02	0.02	0.62		0.56	0.77	0.87
D_IA_TASS	-0.10	-0.08	-0.06	-0.09	-0.07	-0.02	0.04	0.05	0.41	0.05		-0.02	0.41
	0.27	0.40	0.50	0.35	0.44	0.81	0.70	0.62	<.0001	0.56		0.81	<.0001
D_IA_B2M	-0.02	-0.03	-0.03	-0.03	0.02	0.01	0.00	0.00	-0.05	0.03	-0.02		-0.05
	0.83	0.73	0.73	0.79	0.82	0.92	0.99	1.00	0.61	0.77	0.81		0.56
D_SALES	-0.35	-0.21	-0.13	-0.32	-0.15	-0.16	0.20	0.19	0.91	-0.02	0.41	-0.05	
	<.0001	0.03	0.17	0.00	0.11	0.09	0.03	0.04	<.0001	0.87	<.0001	0.56	

Table 3 presents results from the multivariate regression of the change in the probability of a GAAP violation (*D_PROB*) for the +/–1 year window. Also reported are the industry adjusted changes in the probability of a GAAP violation (*IA_D_PROB*). Both dependent variables are regressed on the change in sales (*D_SALES*) and industry-adjusted sales (*D_IA_SALES*), and the industry-adjusted Sales Growth (*D_IA_SGR*). Unadjusted sales growth rates are meaningless because they vary significantly across industries. For this reason, raw growth rates were not considered. Results are presented in Table 3 and Table 4, depending upon the length of the pre- and post- sample periods. Table 4 presents results for the +/–2 year window and results for the +/–3 year window.

Table 3. Results from the regression of change in probability of a GAAP violation on firms and industry adjusted attributes

Change in Probability measures over the +/- 1 years window				
	D_PROB	***D_PROB***	***IA_D_PROB***	***IA_D_PROB***
INTERCEPT	-0.03682**	-0.03682**	-0.0398**	-0.0398**
D_IA_SGR	-0.0002977**	-0.00030261**	-0.00030738**	-0.00030332**
D_SALES		0.01395**	0.01453**	
D_IA_SALES	0.0108			0.01001
N	117	117	117	117
ADJ R^2	0.0512	0.0688	0.0678	0.0458
F-VALUE	4.13	5.29	5.22	3.78

*Note: * p<0.05; ** p<0.01; *** p<0.001*

Because the number of available firms in a given year can change when examining longer windows, we construct an additional sample consisting of firms that are present in every pre- and post- year. This reduces the sample from 117 to 101 when constraining the firms to be present in two years pre- and post-. This reduces the sample from 117 to 85 when constraining the firms to be present in all three years pre- and post-. These results are also presented in Table 4.

The results in all three panels are very similar. In every regression, the estimated coefficient of α is less than zero at conventional levels of significance (0.05 or better). These findings provide support for the first hypothesis that the probability of a GAAP violation decreases after the implementation of ERP systems. The results from the estimation of the coefficient β_1 for size measures, D_SALES when regressed on D_PROB, show a positive association for a majority of the regressions. These findings suggest that large size lessens some of the decrease in the likelihood of a GAAP violation. However, when using D_IA_SALES regressed on *IA_D_PROB*, show there is no such association. These findings suggest that size factors are driven by the size of the average firm between industries, and when size is controlled for within industry, this effect disappears. Finally, results from the estimation of β_2 show that *D_IA_SGR* is negative and significant in a majority of the estimations. These findings suggest that when sales growth is positive, the probability of a GAAP violation decreases even more than the impact of adopting an ERP system for the average firm. However, the estimated β_2 coefficients are small when compared to alpha.[2] These findings suggest that the probability of a GAAP violation goes down after the implementation of ERP systems and slightly more for high growth firms. Prior studies that show that high growth firms are a significant GAAP violation risk. Adopting an ERP system lessens some of this risk.

Table 4. Results from the regression of change in probability of a GAAP violation on firms and industry adjusted attributes

Change in Probability measures over the +/- 2 years window				
Entire Sample:				
	D_PROB	***D_PROB***	***IA_D_PROB***	***IA_D_PROB***
INTERCEPT	-0.03626*	-0.03626*	-0.03875**	-0.03875**
D_IA_SGR	-0.0003964***	-0.00039721***	-0.00041902***	-0.00041819***
D_SALES		6.67831E-07	6.28391E-07	
D_IA_SALES	5.8009E-07			5.31455E-07
N	117	117	117	117
ADJ R^2	0.0509	0.0518	0.0545	0.0536
F-VALUE	4.11	4.17	4.34	4.29
Two-year Survival Sample:				
	D_PROB	***D_PROB***	***IA_D_PROB***	***IA_D_PROB***
INTERCEPT	-0.02529	-0.02529	-0.02792	-0.02792
D_IA_SGR	-0.0003143**	-0.0003173**	-0.00032037**	-0.00031838**
D_SALES		-0.01005	-0.01012	
D_IA_SALES	-0.00709			-0.00868
N	101	101	101	101
ADJ R2	0.0279	0.0318	0.0327	0.0302
F-VALUE	2.43	2.64	2.69	2.55
Change in Probability measures over the +/- 3 years window				
Entire Sample:				
	D_PROB	***D_PROB***	***IA_D_PROB***	***IA_D_PROB***
INTERCEPT	-0.04247**	-0.04247**	-0.04413**	-0.04413**
D_IA_SGR	-0.0002374***	-0.00023744*	-0.00023274*	-0.00023294**
D_SALES		0.01185***	0.01319**	
D_IA_SALES	0.00875			0.00948
N	117	117	117	117
ADJ R2	0.0559	0.0683	0.0649	0.0501
F-VALUE	4.43	5.25	5.03	4.06
Three-year Survival Sample:				
	D_PROB	***D_PROB***	***IA_D_PROB***	***IA_D_PROB***
INTERCEPT	-0.02301	-0.02301	-0.02627	-0.02627
D_IA_SGR	-0.0003362***	-0.00033393***	-0.00032446***	-0.00032843**
D_SALES		0.01436*	0.01349*	
D_IA_SALES	0.01375			0.00999
N	85	85	85	85
ADJ R2	0.1253	0.1338	0.12	0.1028
F-VALUE	7.02	7.49	6.73	5.81

*Note: * p<0.05; ** p<0.01; *** p<0.001*

Collectively, these findings provide strong support for hypotheses 1 and 2. The evidence against hypothesis 3 is weak but present nonetheless. In summary, the probability of a GAAP violation goes down after the implementation of ERP systems. The reduction in probability is less for industries with large firms but relatively larger for firms that are high growth in their industries.

8. CONCLUSIONS, SUGGESTIONS FOR FUTURE RESEARCH, AND LIMITATIONS

We hypothesized that companies that adopt ERP systems are likely to see a reduction in earnings management post-implementation. Using the probability of a GAAP violation to measure earnings management, we find that earnings management does decrease in the period following ERP adoption. This effect was smaller in industries with large firms, and the effect was slightly larger in high growth firms. There are two, non-mutually exclusive, explanations for our findings. First, increased transparency means that auditors are more likely to detect earnings management and disallow manipulations that might be in violation of GAAP. After implementation, there will also be less of a need for managers to use accruals to manage earnings. This is due to better information allowing them to make operational decisions in time to take corrective actions to meet earnings targets and analysts' earnings forecasts. Future research should find a way to measure these competing explanations and determine if one or the other, or both, are driving the results.

Future research on the relationship between ERP implementation and earnings management can focus on the type of earnings management possible depending on the level of decision-making within an organization. Companies with centralized versus decentralized decision-making might see very different levels and types of earnings management. ERP systems facilitate decision-making in decentralized systems due to information availability. Additional access to information might increase or decrease earnings management in centralized organizations when compared to decentralized organizations. Although we find the quality of earnings increases after ERP implementation, future research can focus on other aspects of the firm information environment.

Like any study, this study is also subject to few limitations. First, there is possible selection bias in the sample, because our sample is made up solely of firms that publicly announced their ERP adoption. To the extent that there is a systematic difference between firms that announce their ERP implementation versus those that do not, the results might not be generalizable. *Ex-ante*, however, we have no reason to believe that the earnings manipulators have an incentive to not announce the implementation of ERP systems. Second, the sample period is one of known increasing earnings management (Cohen et al., 2009). The empirical tests control for the industry level of earnings management, but an additional analysis using data covering later time periods is needed to ascertain the generalizability of our findings beyond the sample period examined. Lack of availability of data limits our ability to make that assertion. Finally, though we find that ERP implementing firms have a significantly lower probability of a GAAP violation, the sample firms might have changed their earnings management techniques rather than actually managing earnings less. Changing discretionary spending and making operational decisions to meet or beat earnings targets are aided by the implementation of an ERP system. This type of real earnings management might have replaced accrual-based earnings management in the sample firms. Additional research is needed to address these issues.

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APPENDIX 1

The eight financial ratios used in Beneish (1999) are intended to distinguish between GAAP violators and non-violators. They were developed to identify financial statement outcomes associated with the most frequently used means used by GAAP violators to manipulate income.

1. DSRI: identifies firms with increasing cash collection periods. This ratio identifies firms that may be recognizing bogus revenues that do not eventually result in cash collections. Thus, an increase in DSRI is associated with increased probability of a GAAP violation.

2. GMI: identifies firms with decreasing gross margins. Because decreasing margins put pressure on management to find alternate ways to manage earnings upwards, these firms are associated with a higher likelihood of a GAAP violation.

3. AQI: identifies firms whose asset quality is deteriorating. Asset quality is measured as the proportion of total assets that are either current assets or tangible assets. An increase in the proportion of lower quality assets over time is consistent with the potential capitalization of costs that should be otherwise expensed.

4. SGI: identifies firms with high sales growth. Past research has identified these firms to be associated with a higher probability of a GAAP violation.

5. DEPI: identifies firms with decreasing rates of depreciation. Because decreasing rates of depreciation may be an outcome of changed depreciation schedules intended to achieve higher earnings, this ratio identified another category of GAAP violators.

6. SGAI: identifies firms whose ratio of selling, general and administrative expenses to sales is increasing over time. These firms are associated with increasing overhead costs and have a higher propensity of a GAAP violation.

7. LVGI: identifies firms whose debt ratios are increasing. Because increasing levels of riskiness are associated with a higher propensity of a GAAP violation to achieve financial statement outcomes, these firms are identified for that purpose.

8. TATA: identifies firms with lower levels of cash earnings scaled by total assets. Because lower non-cash earnings are low-quality earnings, these firms tend to be associated with a higher probability of a GAAP violation.