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The Effect of Internal Controls on Operational Efficiency: Evidence from Manufacturing Firms

Tesfalidet Tukue[1*]
[1*](College of Business, Southern University and A&M College, USA)

ABSTRACT: The COSO framework and several academic theories and practices from management and operations highlights the positive impact of effective internal control systems on operational performance. Using internal control deficiencies as indicators of ineffective control systems and employing propensity score matching, this study demonstrates that improvements in internal control quality are positively associated with enhanced operational efficiency in manufacturing firms, as measured through data envelopment analysis. These findings contribute to the ongoing debate regarding the organizational impacts of the Sarbanes-Oxley Act (SOX).

KEYWORDS: Internal Controls, Manufacturing, Operational Efficiency, SOX,

I. INTRODUCTION

The Sarbanes-Oxley Act of 2002 (SOX) has sparked significant debate regarding its costs and benefits. Among its provisions, Sections 302 and 404 have been the most costly and contentious as section 302 mandates that management certify their responsibility for designing, establishing, maintaining, and evaluating internal controls whereas, section 404 requires management to assess the effectiveness of these controls in financial statements, with auditors attesting to these assessments [1].

Numerous reports suggest that SOX has enhanced corporate governance [2], internal controls ([3], [4], [5]) fraud prevention [6], financial statement reliability [5], and investor confidence [7], while also reducing the cost of equity [8]. However, critics argue that compliance costs have far exceeded expectations [9], potentially outweighing the benefits and harming U.S. companies' global competitiveness ([10], [11], [12]).

In response to this ongoing debate, a growing body of accounting and finance research has examined SOX's impact. This includes studies on (1) compliance costs and their organizational effects ([13], [14], [15], [16]); (2) the broader implications of SOX for capital markets ([17], [18], [19], [20]); and (3) anticipated benefits, such as improved corporate governance [21], enhanced financial statement reliability and relevance ([22], [23], [24], [25], [26]), greater accounting conservatism [27], increased executive accountability [28],, and reductions in the costs of equity ([29],[30]) and debt ([31], [32], [33], [34]). While these studies offer valuable insights, they provide an incomplete understanding of SOX's organizational impact.

Most organizations subject to SOX Section 404 have adopted the Committee of Sponsoring Organizations of the Treadway Commission (COSO) Internal Control-Integrated Framework. This framework asserts that beyond improving financial statement reliability, internal controls can contribute to achieving operational objectives (COSO, 1992). Cheng et al. [35] document compelling evidence that operational efficiency is significantly lower among firms with material weaknesses in internal control compared to firms without such weaknesses. Their study highlights the critical role of internal controls in enhancing operational outcomes. Furthermore, they find that remediation of these material weaknesses leads to measurable improvements in operational efficiency, underscoring the value of effective internal control systems.

The objective of this study, therefore, is to investigate whether improvements in internal controls yield additional benefits in terms of operational efficiency in manufacturing firms located in the US. To evaluate this proposition, I collected pre- and post-SOX data for organizations with internal control opinions reported in the post-SOX period. Consistent with prior research ([22], [29], [30], [36], [37]), I use a post-SOX internal control weakness (ICW) opinion as a signal of ineffective controls and a clean post-SOX opinion (non-ICW) as a signal of effective controls. Given the focus of this study on changes in internal control quality, and since direct measures of pre-SOX internal control quality are unavailable, I adopt a logit model similar to Ashbaugh-Skaife et al. [36] to estimate pre-SOX internal control quality. I then match non-ICW manufacturing firms with ICW manufacturing firms based on predicted pre-SOX internal control quality.

Additionally, following Barber and Lyon [38] and Lie [39], I match firms based on pre-event operating performance, changes in performance, and market expectations of future performance (as indicated by market-to-book value). To account for multiple matching variables, I use propensity score matching, as recommended in the accounting literature ([40], [41], [42], [43]).

The results reveal that matched non-ICW companies experienced a significantly more positive (or less negative) change in operational efficiency than ICW companies between the pre- and post-SOX periods. Since non-ICW companies exhibited stronger internal controls in the post-SOX period while having similar internal control quality pre-SOX, this finding indicates that improvements in internal control quality are positively associated with changes in operational efficiency. These results remain consistent across several analyses, including (1) comparisons of firms that remedied ICWs versus those that did not, providing more direct signals of both pre- and post-event internal control quality; (2) two-stage least squares (2SLS) estimations to control for omitted variable bias; and (3) sensitivity tests assessing the robustness of the main analysis to various research design choices.

This study provides empirical evidence on the positive impact of internal controls on operational efficiency. Organizations considering investments in internal controls should not only weigh the benefits of improved financial reporting reliability against implementation costs but also consider the broader benefits for operational performance. These findings are particularly relevant to the debate surrounding SOX's costs and benefits, and they challenge claims that SOX has undermined U.S. companies' global competitiveness. In fact, given the operational improvements associated with stronger internal controls, SOX may have bolstered U.S. firms' competitiveness in global markets.

Finally, these findings hold important implications for other countries that are contemplating or implementing legislation similar to SOX Sections 302 and 404. By providing robust empirical evidence, this study contributes to informed debates and policy-making decisions on the global stage.
I next develop the research hypothesis, followed by a description of the research design and results. The paper concludes with a discussion of findings, contributions, limitations, and directions for future research.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1. The Relationship Between Internal Controls and Operating Performance

The Committee of Sponsoring Organizations of the Treadway Commission (COSO) framework [44], adopted by many organizations complying with the Sarbanes-Oxley Act (SOX), defines internal control as "a process … designed to provide reasonable assurance regarding the achievement of objectives in the following categories: effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations" (p. 3). According to COSO [44], internal controls are implemented to steer organizations toward profitability goals, minimize disruptions, promote efficiency, and reduce the risk of asset loss. These principles suggest that effective internal controls can significantly enhance operational efficiency.

While COSO outlines the objectives of internal controls, prior empirical research has yet to fully examine their direct impact on operational efficiency. However, related studies provide partial support for this notion. For instance, Baxter et al. [45] demonstrate that risk management—one of the five components of the COSO framework—has a positive effect on operational performance. Similarly, theories from management ([46], [47], [48], [49]) and operations research ([50], [51]) offer additional insights into how improvements in internal controls can foster operational efficiency.

The Total Quality Management (TQM) literature, for example, posits that improving process quality through a "do it right the first time" philosophy [47], reduces processing costs associated with defects, waste, and rework ([48], [49]). Empirical studies also find that quality improvements lower costs by minimizing delays, mistakes, and scrap [50]. Likewise, operations research shows that implementing preventive maintenance and controls in line with Total Productive Maintenance (TPM) yields cost savings and performance improvements ([51], [52]).

In line with these findings, internal controls are expected to reduce inefficiencies by minimizing waste, rework, and errors. For example, internal controls that require reconciling invoices, receiving reports, and purchase orders before authorizing payments can prevent overpayments and unauthorized transactions, thereby controlling costs. Similarly, controls ensuring accurate shipping practices reduce rework and waste by preventing errors in customer orders.

2.2. The Relationship Between Financial Reporting and Operating Internal Controls

While the prior discussion emphasizes how operational controls directly improve efficiency, the link between financial reporting controls—central to SOX—and operational performance requires further exploration. This relationship is likely mediated by several factors. First, the COSO framework consists of five components—control environment, risk assessment, information and communication, control activities, and monitoring. Except for control activities, these components broadly impact multiple organizational objectives, including operational performance and financial reporti2007ng reliability. For instance, a strong control environment, characterized by managerial integrity and a commitment to competence, underpins robust internal controls across the organization. Second, many control activities designed to ensure reliable financial reporting also contribute to operational performance objectives. For example, periodic inventory reconciliations enhance both operational efficiency and financial statement reliability by reducing discrepancies and improving asset management. Third, organizations that demonstrate strong internal controls for financial reporting likely have the resources, capabilities, and cultural values needed to develop equally robust operational controls.

2.3. The Relationship Between SOX and Operating Performance

Empirical and anecdotal evidence suggests that SOX-induced improvements in internal controls positively influence operational performance. Several surveys ([3], [4], [7]) indicate that SOX compliance has enhanced internal controls. Wagner and Dittmar [53] argue that the standardization of processes and control structures required for SOX compliance reduces complexity, redundancy, and inefficiencies. Similarly, Harrington [54] notes that SOX compliance has driven technological and procedural improvements, yielding cost savings through reduced errors and streamlined operations.

Based on the COSO framework and prior research, the following hypothesis is forwarded:

H1: There is a positive relationship between changes in internal control quality and changes in operational efficiency.

III. RESEARCH DESIGN, MEASUREMENTS AND SAMPLE SELECTIONS

3. Overview of Research Design

To assess the performance effects of internal control changes, I compare pre- and post-SOX operating performance changes between firms reporting material weaknesses in internal controls (ICW) and firms with clean internal control opinions (non-ICW). By analyzing changes in operational performance, I control for firm-specific characteristics that remain constant over time, while comparing ICW and non-ICW firms accounts for industry-wide and economic factors affecting all firms.

3.1. Sample Selection and Matching

Following prior studies ([22], [29], [30], [36], [37]), I use ICW as a proxy for ineffective internal controls and non-ICW as a proxy for effective controls in the post-SOX period. To estimate pre-SOX internal control quality, I use propensity score matching to pair ICW and non-ICW firms with similar characteristics, such as firm size, operational complexity, and pre-SOX performance levels. Propensity score matching ensures that the matched firms are comparable in the pre-SOX period but differ in post-SOX internal control quality, enabling us to isolate the effect of internal control improvements on operational efficiency.

3.2. Measurements

3.2.1. Measuring Operational Efficiency

Operational efficiency is defined as the ratio of organizational output (e.g., sales revenue) to inputs (e.g., assets, operating expenses, and employees). Using data from COMPUSTAT, I estimate efficiency scores through Data Envelopment Analysis (DEA), a non-parametric method for assessing the efficiency of decision-making units (DMUs). DEA constructs an efficiency frontier based on the most efficient DMUs, with all other units compared relative to this frontier.

I employ an input-oriented DEA model with variable returns to scale, excluding super-efficient firms to ensure robust comparisons. Efficiency scores are calculated for three periods: pre-SOX (t-2), baseline (t-1), and post-SOX (t+1). These scores are used to measure operational efficiency levels and changes over time.

3.2.2. Predicting Pre-SOX ICW Likelihood

Consistent with prior research ([36], [56], [57]), I use firm characteristics such as size, operational complexity, resource constraints, and performance to predict the likelihood of reporting an ICW. A logit model generates propensity scores based on post-SOX ICW data, which are then used to match firms with similar pre-SOX characteristics.

ICWt+1 = ƒ (SIZE+1, SEGt+1, FCTt+1, RSTRt+1, M&At+1, INVt+1, CFOt+1, LOSSt+1, Z-scoret+1, Industry) (1),

where ICW is a dummy variable that is equal to one if the company reported an internal control weakness, SIZE is the log of total assets, SEG is number of reported business segments, FCT is a dichotomous variable equal to one if the company reported foreign currency translation, zero otherwise, zero otherwise, RSTR is a dichotomous variable equal to one if a company has a restructuring charge in the measured year or in the two years prior, zero otherwise, M&A is a dichotomous variable equal to one if a company is involved in a merger or acquisition in the measured year or in the prior two years, INV is the average of inventory to assets in the measured year and the prior two years, CFO is cash flow from operations to assets, LOSS is the proportion of years in the measured year and the prior two years that a company reports negative earnings, and Z-score is Altman's (1968) Z-score measure of bankruptcy risk. I also include an industry control variable using 1-digit SIC codes.

3.2.3. Propensity Score Matching

In line with recent accounting research employing propensity score matching techniques (e.g., ([40], [41], [42], [43]), this study uses propensity score matching to construct a matched sample of firms with internal control weaknesses (ICW) and those without (non-ICW). The matching process ensures similarity between ICW and non-ICW firms in year t-1 based on their likelihood of reporting a post-SOX ICW.

The matching procedure relies on the following three key elements: (1) Predicted Pre-SOX Internal Control Quality: Derived from Model 1, (2) Pre-SOX Operating Performance Levels and Changes suggested by Barber and Lyon [38] and Lie [39], and (3), Market Expectations of Future Performance: Indicated by the market-to-book ratio.

This approach aims to mitigate the risk of confounding factors, ensuring that differences in post-SOX outcomes between ICW and non-ICW firms are not attributable to pre-SOX disparities in internal control quality, operating performance, or market expectations. Such variables are critical as they may simultaneously influence both operating performance and the likelihood of reporting an ICW.

3.2.4. Rationale for Matching Variables

Organizations with weaker internal control systems in the pre-SOX period are more likely to receive a post-SOX ICW and, as hypothesized, exhibit poorer operational performance. Pre-event operating performance levels and changes, as well as market expectations of future performance, are particularly relevant for matching, as recommended by Barber and Lyon [38] and Lie [39]. Firms with suboptimal performance may face resource constraints, limiting their ability to design and implement robust internal control systems. Matching on these variables ensures that the ICW and non-ICW firms are comparable in terms of pre-SOX characteristics, thereby isolating the effect of internal control quality changes on operating performance.

3.2.5. Propensity Score Estimation

To generate propensity scores that represents the predicted probability of a post-SOX ICW for each firm, I estimate Model 2 using a logistic regression (logit). This approach quantifies the likelihood of an ICW, enabling us to match ICW firms with non-ICW firms that have comparable pre-SOX characteristics. By controlling for these pre-SOX factors, the propensity score matching process reduces selection bias and strengthens the validity of subsequent analyses.

ICW+1 = f (OpEfft-1, OpEffChanget-1, MTBt-1, ICW likelihoodt-1, Industry) (2),

where ICWt+1 is a dummy variable that is equal to one if the company reported an ICW, zero otherwise, OpEfft-1 is a DEA efficiency score that indicates how efficient the company is at converting operating expenses, assets, and labor into sales in year t-1, OpEffChanget-1 is the change in operational efficiency between t-2 and t-1, MTBt-1 is the market value of the company in year t-1, and ICW likelihoodt-1 is the prediction of ICW likelihood in year t-1 from model 1 based on company characteristics that have been found in prior research to be associated with the reporting of an ICW. Industry is industry control variable using 1-digit SIC codes. The propensity scores are the likelihood estimates of internal control weaknesses in year t+1. This rigorous matching procedure ensures that the results are attributable to changes in internal control quality rather than pre-existing disparities, thereby enhancing the robustness of the findings.

The matching approach ensured comparability between ICW and non-ICW firms in terms of pre-SOX internal control quality (predicted from Model 1), pre-SOX operational efficiency levels and changes, and market-to-book values, which reflect market expectations of future performance. This rigorous matching process minimized biases that could arise from pre-existing differences in firm characteristics, strengthening the validity of the analysis.

While the primary analysis relies on propensity score matching to create a sample of firms with comparable pre-SOX internal control quality, this matching is based on an estimate derived from a logit model since pre-SOX internal control reports are unavailable. If this estimate is biased, alternative explanations may account for the results rather than supporting the hypothesis. To address this concern, I implement two additional research designs to validate the findings.

3.3. Hypothesis Tests

3.3.1 Main Analysis

I use the matched sample and model 3 to test whether matched non-ICW companies have a more positive (or less negative) change in operating performance than ICW companies:

$$\Delta OpEff_{t+1} = f\ (ICW_{t+1},\ OpEff_{t-1},\ OpEff_{t-2},\ MTB_{t-1},\ Pr.\ Score_{t-1},\ Pr.\ ICW_{t-1},\ SIZE_{+1},\ SEG_{t+1},\ FCT_{t-1},\ RSTR_{t-1},\ M\&A_{t-1},\ INV_{t-1},\ CFO_{t-1},\ LOSS_{t+1},\ Z\text{-}score_{t-1},\ Industry)\ (3),$$

where ΔOpEfft+1 is defined as the difference between Operational efficiencyt+1 and Operational efficiencyt-1. All other variables are defined in models 1 and 2.

Given that the propensity scores matched ICW and non-ICW samples are similar in terms of pre-SOX operational efficiency, change in operational efficiency, market-to-book, and estimated pre-SOX internal control quality, but differ in terms of internal control quality in the post-SOX period, an ICW compared to a non-ICW in the post-SOX period indicates a less positive (or more negative) change in internal control quality. A significant negative effect of control weaknesst+1 on Δoperational efficiencyt+1, thus, supports the hypothesis that there is a positive relationship between internal control quality change and operational efficiency change.

3.3.2 Additional Analyses

I conduct a remediation analysis using internal control reports as direct signals of internal control quality in both pre- and post-event periods. In this approach, a remediation of an internal control weakness (ICW) and a clean opinion in year t+1 is considered evidence of an improvement in internal controls. Conversely, firms reporting ICWs in two consecutive periods are deemed to have made no or minimal improvements in internal controls. This framework enables us to test whether firms that remedy their ICWs exhibit more positive (or less negative) changes in operational performance compared to firms with persistent ICWs. While this analysis provides a direct measure of internal control improvement, it may be less powerful than the primary analysis due to potentially smaller differences in internal control quality between remediation and non-remediation firms compared to ICW and non-ICW firms in the initial SOX reporting year.

Second, it is also possible that certain firm characteristics simultaneously influence both internal control quality and operational efficiency. While the primary analysis incorporates various matching procedures, control variables, and an examination of changes in operational performance to address this issue, there remains a risk of omitted variable bias. To mitigate this concern, I re-examine the main results using a two-stage least squares (2SLS) regression approach.

The 2SLS method allows us to account for potential endogeneity by introducing instrumental variables that are correlated with internal control weaknesses but uncorrelated with unobserved factors influencing operational efficiency. This additional evaluation provides a robust check on the validity of the findings and helps ensure that the observed relationships between internal control quality and operational efficiency are not driven by omitted confounding factors.

3.4. Sample

Financial data were collected from COMPUSTAT for the pre-SOX period, t-1, defined as the period during which companies filed their last annual financial statements before the passage of SOX on June 30, 2002 (i.e., between June 15, 2001 and June 14, 2002), the post-SOX period, t+1, defined as the period during which companies filed their first annual financial statements after public companies were required to comply with SOX Section 404 (i.e., November 15, 2004 through November 14, 2005), and the year before the pre-SOX period, t-2 (i.e., between June 15, 2000 and June 14, 2001). By selecting the post-SOX period to be the first year immediately following the implementation years, rather than a later year, I reduce the number of other events that impact organizations' operating performance and thereby reduce noise. However, by selecting this period induces bias against finding a significant effect as it is possible that organizations have not yet reaped the full benefit of the internal control improvements.

The initial sample includes all accelerated filers that report internal control opinions, including 53 manufacturing receiving an adverse internal control opinion (ICW) and 514 manufacturing firms receiving a clean internal control opinion (non-ICW companies) in the first post SOX-period. I then removed both ICW and non-ICW companies with missing COMPUSTAT data needed to estimate operational efficiency using DEA and pre-SOX ICW likelihood, and to perform the propensity score matching procedure with 31 ICW and 306 non-ICW manufacturing firms.

IV. RESULTS AND ANALYSES

4.1 Descriptive Statistics

Table 1 Panel A presents summary statistics for the pre-matched sample that contains 39 ICW companies and 306 non-ICW companies. As expected, compared to non-ICW companies, ICW companies are more likely to have poor pre-SOX internal control quality ($p= 0.002$), as indicated by predicted ICW likelihood, and higher propensity scores ($p<0.003$). They are also smaller ($p<0.003$), have worse pre-SOX performance in terms of cash flow from operations ($p<0.002$) and recent loss years ($p<0.001$), and have more complex operations, as indicated by foreign currency translations ($p=0.040$) and inventory ($p=0.031$). All other differences are insignificant in the pre-matching sample.

The summary statistics for the matched sample of 31 manufacturing firms that report an ICW and their respective matched non-ICW company(s) is shown in Panel B of Table 1. These results do not provide initial support for the hypothesis; and the difference between ICW and non-ICW companies in terms of changes in Operational Efficiencyt+1 is significant ($p=0.289$). The results, however, indicate that the matching procedure was successful. While some differences remain between the two samples, the insignificant difference in propensity scores between the ICW and non-ICW samples after the matching ($p=0.540$) compared to the significant difference before the matching ($p<0.002$) indicates that the matching procedure improved the balance between the two samples. Similarly, the difference between ICW and non-ICW companies in terms of predicted ICW likelihood is significant before ($p<0.002$) and insignificant after the matching procedure ($p=0.560$). The other matching variables, i.e., MTB, Operational Efficiency, and Changes in Operational Efficiency are insignificant both before ($p=0.600$, $p=0.373$, $p=0.897$, respectively) and after ($p=0.630$, $p=0.713$, $p=0.882$, respectively) the matching procedure. However, ICW and non-ICW companies are significantly different in terms of Company size and CFO ($p=0.059$ and $p=0.036$, respectively), and marginally significantly different in terms of recent average inventoryt-1 ($p=0.136$) after the matching procedure. Compared to non-ICW companies, ICW companies are smaller (5.78 vs. 6.02), have higher inventory levels in the pre-SOX period and the two years prior (15.6 vs. 37.3), and have lower cash flow from operations to assets (0.057 vs. 0.077). The summary statistics do not show any significant difference between ICW and non-ICW companies for foreign currency translations ($p=0.252$), proportion of pre-SOX loss years ($p=0.344$), Z-score bankruptcy risk ($p=0.454$), recent restructuring ($p=0.489$), recent M&A activity ($p=0.771$), and number of segments ($p=806$).

Table 1. Descriptive Statistics and Univariate Mean Differences Tests

Panel A. ICW and Non-ICW Firms Before Propensity Score Matching

	ICW (N=39)			Non- ICW (N=306)			
Variables	Mean	Median	Std	Mean	Median	Std	p-value
ΔOpEfft+1	-0.0045	-0.008	0.2403	0.006	0	0.226	0.493
ΔOpEfft1	0.0063	0.0144	0.2214	0.004	0.017	0.188	0.897
OpEfft	0.6255	0.6822	0.2952	0.641	0.683	0.260	0.373
MTBt	2.8692	1.602	6.0678	2.556	1.791	10.05	0.600
Predicted ICWt-1	0.2025	0.1683	0.1494	0.112	0.086	0.098	0.018
Propensity Score	0.1962	0.1539	0.135	0.113	0.097	0.080	0.002
SIZEt-1	5.7348	5.5251	1.539	6.205	6.093	1.529	0.003
SEGt-1	2.5263	3	1.8198	2.661	3	2.07	0.344
FCTt-1	0.2313	2	0.3942	0.176	2	0.357	0.040
M&At-1	0.5967	1	0.4266	0.605	1	0.422	0.711
RSTRt-1	0.3699	0	0.4437	0.343	0	0.437	0.396
INVt-1	0.1485	0.1188	0.1296	0.129	0.099	0.117	0.031
CFOt-1	0.0594	0.2997	0.1071	0.082	0.082	0.268	0.001
LOSSt-1	0.2907	0.0711	0.3348	0.171	0	4.703	0.002
Z-Score	3.7089	0.2997	5.9949	3.897	2.7504	0	0.551

Table 1. Descriptive Statistics and Univariate Mean Differences Tests							
Panel B. Matched ICW and Non-ICW Firms							
	ICW (n=31)			Non- ICW (n=31)			
Variables	Mean	Median	Std	Mean	Median	Std	p-value
ΔOpEfft+1	-0.0045	-0.008	0.245	0.0162	0.0117	0.153	0.2898
ΔOpEfft1	0.0009	0.0144	0.215	0.00	0.0135	0.1314	0.8829
OpEfft	0.6273	0.6822	0.291	0.621	0.6633	0.207	0.7137
MTBt	2.8278	0.1539	6.088	2.608	1.9512	4.4775	0.630
Predicted ICWt-1	0.171	1.53	0.11	0.169	0.1476	0.1125	0.5607
Propensity Score	0.1647	0.1413	0.095	0.164	0.1395	0.0954	0.5409
SIZEt-1	5.7798	5.6871	1.567	6.016	6.0192	1.0017	0.0594
SEGt-1	2.6316	3	1.874	2.654	3	1.3401	0.806
FCTt-1	0.2304	2	0.394	0.197	2	0.2403	0.2529
M&At-1	0.5913	1	0.428	0.598	1	0.2439	0.7713
RSTRt-1	0.351	0	0.440	0.343	0	0.2691	0.4896
INVt-1	0.1566	0.1305	0.133	0.3735	0.1332	0.0891	0.136
CFOt-1	0.0567	0.072	0.108	0.1422	0.0774	0.0594	0.036
LOSSt-1	0.2637	0.00	0.315	0.243	0.1935	0.2241	0.3447
Z-Score	3.9861	2.622	6.335	3.717	3.0942	3.1752	0.4545

4.2. Matched Sample Analysis

Table 2 shows the OLS regression results for Model 3 using the matched sample of ICW and non-ICW companies. The regression results show, as hypothesized, a significant negative coefficient for ICW companies. This negative coefficient indicates that when comparing organizations that are similar in the pre-SOX period in terms of estimated internal control quality, operational efficiency, change in operational efficiency, and market-to-book, organizations that have stronger internal controls in the post-SOX period experience a more positive (or less negative) change in efficiency between the pre- and post-SOX period.

When dealing with the control variables, I adopted the approach used in prior operating performance research ([38], [39]), a reversal effect is evident in the significant negative effect of cash flow from operationst-1 and the significant positive effect of recent loss yearst-1 on Δoperational efficiencyt+1. However, operational efficiencyt-1 is positively related to Δoperational efficiencyt+1. The result shows that, at a marginal significance level, firms that are larger and have more operating segments have a less positive (or more negative) change in operational efficiency. All other relationships are insignificant

Table 2. Regression Results: Effect of Control Weakness on Operational Efficiency

	ΔOperational efficiency$_{t+1}$		
Variable	*Estimate*	*Standard Error*	*prob>p*[b]
Intercept	-0.170	0.072	0.022
Control weakness remediation$_{t+1}$	-0.022	0.0072	0.0036
ΔOperational efficiency$_{t-1}$	-0.094	0.081	0.301
Operational efficiency$_{t-1}$	0.520	0.062	0.001
Market-to-book$_{t-1}$	-0.032	0.108	0.921
Company size$_{t-1}$	-0.002	0.002	0.475
Number of segments$_{t-1}$	-0.013	0.0072	0.068
Foreign currency translation$_{t-1}$	-0.007	0.004	0.111
Recent M&A$_{t-1}$	-0.015	0.022	0.583
Recent restructuring$_{t-1}$	0.021	0.021	0.391
Recent average inventory$_{t-1}$	-0.006	0.021	0.931
Cash flow from operations$_{t-1}$	-0.114	0.074	0.147
Recent loss years$_{t-1}$	-1.100	0.111	0.001
Z-score bankruptcy risk$_{t-1}$	0.123	0.034	0.001

Industry (sic 1)	-0.002	0.002	0.276
Industry (sic 2)	0.009	0.034	0.925
Industry (sic 3)	0.03	0.021	0.114
Industry (sic 4)	0.002	0.019	1.071
Industry (sic 5)	-0.038	0.031	0.262
Industry (sic 6)	0.022	0.024	0.428
Industry (sic 7)	0.003	0.03	1.086
Adjusted R^2	49.3%		
N	31		

4.3. ICW Remediation

Internal control opinions from 2005 through 2009 were collected and remediation manufacturing firms were compared to non-remediation manufacturing firms using model 3 where ICWt+1 is replaced by ICW remediationt+1 and time dummies are added to control for year effects. Control weakness remediationt+1 is a dichotomous variable equal to one if the company received an adverse audit internal control opinion in year t-1 and then received a clean opinion in year t+1, and zero if it received an adverse internal control opinion in two consecutive years.

Table 3 presents the OLS regression results for the control weakness remediation analysis. These results provide additional support for the hypothesized relationship between internal control strength and operational efficiency. More specifically, the results show a positive and significant relationship between ICW remediationt+1 and Δoperational efficiencyt+1. The results indicate that companies that improve internal controls from one period to another, as indicated by internal control weakness opinion remediation, have more positive (or less negative) changes in operational efficiency than companies that do not improve (or improve to a lesser extent) their internal controls, as indicated by adverse internal control opinions in two consecutive years.

Table 3. Regression Results: Effect of Control Weakness Remediation on Operational Efficiency

	ΔOperational efficiency$_{t+1}$		
Variable	*Estimate*	*Standard Error*	*prob>p*[b]
Intercept	0.054	0.018	0.0036
Control weakness remediation$_{t+1}$	0.0063	0.003	0.0639
ΔOperational efficiency$_{t-1}$	-0.1593	0.042	0.0009
Operational efficiency$_{t-1}$	-0.2025	0.026	0.0009
Market-to-book$_{t-1}$	0.0009	0.001	0.117
Company size$_{t-1}$	0.0036	0.003	0.1233
Number of segments$_{t-1}$	0.0009	0	0.117
Foreign currency translation$_{t-1}$	-0.0045	0.0036	0.1872
Recent M&A$_{t-1}$	0.0027	0.0036	0.3087
Recent restructuring$_{t-1}$	0.0054	0.0036	0.1179
Recent average inventory$_{t-1}$	0.0243	0.0306	0.3879
Cash flow from operations$_{t-1}$	0.0594	0.0288	0.0387
Recent loss years$_{t-1}$	-0.0027	0.0036	0.3258
Z-score bankruptcy risk$_{t-1}$	0.0009	0.0009	0.2133
Industry (sic 1)	-0.0216	0.0117	0.0612
Industry (sic 2)	0.0243	0.0072	0.0018
Industry (sic 3)	0.0027	0.0072	0.6687
Industry (sic 4)	0.0054	0.009	0.5103
Industry (sic 5)	0.0288	0.0108	0.0081
Industry (sic 6)	-0.0054	0.0198	0.693
Industry (sic 7)	-0.0153	0.0081	0.0477
Year (2006)	-0.0387	0.0054	0.0009
Year (2007)	0.0216	0.0045	0.0009
Year (2008)	0.0486	0.0054	0.0009
Adjusted R^2	46.2%		
N	51		

4.4. Two Stage Least Square (2SLS) Analysis

When conducting 2SLS, the instrumental variables should be theoretically correlated to the independent variable of interest while uncorrelated to the dependent variables. The pre-SOX operating performance variables are, thus, poor candidates. The company characteristics variables were included as prior research found them to be significant predictors of control weakness and as it is possible that they also predict post-SOX operational efficiency. While many of these variables are theoretically predictors of post-SOX operational efficiency, this study argues that number of segmentst-1, foreign currency translationt-1, recent M&At-1, and recent restructuringt-1 may not necessarily predict Δoperational efficiencyt+1. Based on a review of variable correlations and the primary regression results, I use foreign currency translationt-1, recent M&At-1, and recent restructuringt-1 as instrumental variables in the 2SLS given their insignificant Spearman's correlations with Δoperational efficiencyt+1 and insignificant relationships with Δoperational efficiencyt+1 in the model 3 regression analysis.

The 2SLS analysis uses the unmatched data because the probability of on ICW is estimated in the first stage of the 2SLS procedure and the matching procedure was performed to remove differences between ICW and non-ICW firms in terms of ICW likelihood. The first stage then estimates ICW probability p(control weaknesst+1) using all independent variables from model 3 except control weaknesst+1, propensity scoret-1, and predicted ICW likelihoodt-1. I then replace control weaknesst+1 in this model with p(Control Weakness) and remove foreign currency translationt-1, recent M&At-1, and recent restructuringt-1 from the model. As hypothesized, P(Control weaknesst+1) is a negative and significant predictor of Δoperational efficiencyt+1 ($p<0.001$).

V. DISCUSSION AND PRACTICAL IMPLICATIONS

This study provides robust evidence supporting the hypothesis that improvements in internal control quality are positively associated with enhancements in operational efficiency. The findings are significant for several reasons. The COSO framework, widely adopted by accelerated filers to comply with the Sarbanes-Oxley Act (SOX), outlines three objectives of internal controls: financial statement reliability, operational effectiveness and efficiency, and compliance with laws and regulations. While prior research has predominantly focused on the first objective—financial statement reliability—and its associated outcomes, this study extends the literature by examining the second objective, operational efficiency.

By exploring the relationship between internal control systems and operational efficiency, this research identifies an additional, less anticipated benefit of SOX compliance. Specifically, the implementation of the COSO framework to meet SOX requirements not only enhances financial statement reliability but also improves operational efficiency. This outcome aligns with anecdotal evidence and theoretical perspectives from the management literature, which suggest that internal controls streamline processes, reduce redundancy, and mitigate inefficiencies.

These findings have significant implications for organizations considering the implementation or enhancement of internal control systems. As enterprise risk management frameworks gain prominence, this study underscores the operational benefits of robust internal controls. Additionally, the results provide critical insights for regulators and policymakers in the U.S. and other jurisdictions contemplating SOX-like legislation. For instance, as China implements internal control regulations similar to SOX, understanding both the costs and the multifaceted benefits of such frameworks becomes essential for informed decision-making. This study, therefore, contributes to global policy discussions, offering evidence that supports the broader utility of internal control systems beyond compliance and financial reporting.

VI. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This study demonstrates that organizations achieve operational efficiency improvements from implementing stronger internal controls, challenging the narrative that SOX compliance merely imposes high costs without commensurate benefits. Contrary to widespread criticisms that internal control improvements under SOX only enhance financial statement reliability at an unreasonable cost, these findings suggest that such enhancements also deliver tangible operational benefits. In the context of accounting, the results indicate that improved financial statement reliability may, in fact, be accompanied by significant operational efficiencies. This research provides an essential counterpoint to critiques of SOX, contributing to a more nuanced

understanding of its broader implications for organizations and informing both managerial decisions and policy debates globally

However, despite the promising results, this study has limitations that warrant attention. First, while the findings suggest a positive relationship between improvements in internal control quality and operational efficiency, the cross-sectional nature of the analysis limits the ability to establish causality. Future research could employ longitudinal designs to explore whether efficiency gains persist or increase over time as implementation and monitoring costs decline.

Second, although this study incorporates features of experimental design, such as pre- and post-treatment measures within a natural experimental setting, random assignment to control and treatment groups was not feasible. Additionally, the lack of direct pre-SOX internal control quality signals in the primary analysis limits the precision of the findings. To address these issues, this study utilized lagged operational efficiency measures, propensity score matching to align firms with similar pre-SOX characteristics, and robustness checks, including 2SLS regression and remediation analysis. However, future studies could adopt experimental or quasi-experimental research designs to strengthen causal inferences.

Finally, the study explores only one of the COSO framework's objectives—operational efficiency. Future research could expand this work by investigating the effects of internal control systems on compliance with laws and regulations. For example, do stronger internal controls reduce violations of regulations such as the Environmental Protection Agency (EPA) acts, the Gramm–Leach–Bliley Act (GLBA), or the Health Insurance Portability and Accountability Act (HIPAA)? Such inquiries would further elucidate the broader implications of internal control frameworks.

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Corresponding Author: Tesfalidet Tukue[1]
[1](College of Business, Southern University and A&M College, LA, USA