"Quantitative and qualitative investments in internal control personnel and firm operational efficiency: Evidence from Korea"

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BUSINESS PERSPECTIVES

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QUANTITATIVE AND QUALITATIVE INVESTMENTS IN INTERNAL CONTROL PERSONNEL AND FIRM OPERATIONAL EFFICIENCY: EVIDENCE FROM KOREA

Abstract

Although internal control systems in firms aim to provide reasonable assurance regarding objectives related to operations, reporting, and compliance, research focusing on operational efficiency is limited. This study investigates the impact of both quantitative and qualitative investments in internal control personnel on a firm's operational efficiency. Utilizing a fixed-effect regression model, the Heckman (1979) two-stage model, and a two-stage least squares procedure, this study analyzes 4,471 firm-year observations from Korean listed firms from 2018 to 2020. The findings indicate a positive association between investment in internal control personnel and operational efficiency. This relationship remains robust even under sensitivity tests and concerns of potential endogeneity, as confirmed by the Heckman and two-stage least squares models. Specifically, the Heckman model shows that the ratio of the number of employees (coef = 0.023, t-value = 5.20) and certified public accountants (coef = 0.256, t-value = 5.43) responsible for internal control is positively associated with operational efficiency. Average work experience (coef = 0.002, t-value = 1.84) of internal control personnel is also positively related to operational efficiency. This study provides empirical evidence for the significance of investing in internal control personnel to boost operational efficiency and suggests that firms should consider both quantitative and qualitative aspects of internal control.

Keywords	internal control, internal control personnel, human resource investment, operations, operational efficiency, internal information quality, data envelopment analysis, quantitative investment, qualitative investment
JEL Classification	J21, M40, M41

INTRODUCTION

According to the Committee of Sponsoring Organizations of the Treadway Commission (COSO), an internal control system aims to facilitate efficient and effective company operations, covering both operational and financial performance. Specifically, the internal control framework has three categories of objectives: operations, reporting, and compliance. The *COSO Internal Control-Integrated Framework* (COSO, 2013) defined internal control as "a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance."

While existing research has extensively explored internal control's impact on reporting and compliance, studies addressing operational efficiency are scarce (Alexander et al., 2013). A few recent works (Feng et al., 2015; Cheng et al., 2018; Shin & Park, 2020) have begun to fill this

gap, but the role of human resource investment in internal control personnel for operational efficiency remains underexplored, particularly in terms of quantitative and qualitative aspects.

In the academic literature, operational efficiency is the managerial effectiveness in converting resources into revenue. According to Demerjian et al. (2012), operationally efficient firms can either produce higher revenue for a given level of resources or, conversely, minimize the consumption of resources to produce the same level of revenue. Research indicates that high-quality internal information, stemming from robust internal control systems, is pivotal for optimal operational decisions (Bauer, 2016; Cheng et al., 2018; Choi et al., 2021).

The quality of a firm's internal control is contingent upon the human capital managing it. In the U.S., the Public Company Accounting Oversight Board (PCAOB) has highlighted that losing employees responsible for internal control can impair its effectiveness. Existing studies affirm the importance of both quantitative and qualitative investments in internal control personnel (Choi et al., 2013; Choi et al., 2021; Shin et al., 2017), suggesting that such human resource investments can enhance operational efficiency.

1. LITERATURE REVIEW AND HYPOTHESIS

In the United States, the Sarbanes-Oxley Act (SOX) of 2002 was enacted to enhance the quality and transparency of a firm's financial reporting (SEC 2002, 2003). This legislation mandates that managers evaluate and report on the effectiveness of a firm's internal controls and requires auditors to verify these assessments. The aim is to ensure the delivery of reliable financial reports to external markets. Consequently, both regulators and investors expect that effective internal controls will improve not only the quality of a firm's financial reporting but also its overall information environment. In light of these objectives, a considerable amount of research has been conducted to study the impact of internal controls on financial reporting quality and the information environment.

Past research confirms that effective internal controls can enhance a firm's financial reporting quality (Ashbaugh-Skaife et al., 2008; Doyle et al., 2007; Krishnan, 2005), reduce its cost of debt (Dhaliwal et al., 2011; Kim et al., 2011), and cost of equity (Beneish et al., 2008; Ashbaugh-Skaife et al., 2009), as well as curtail earnings management (Chan et al., 2008; Li et al., 2020). Additionally, effective internal controls can improve the forecast accuracy of both management and analysts (Feng et al., 2009; Li et al., 2012). In summary, existing studies have convincingly demonstrated that effective internal controls contribute to enhancing a firm's financial reporting quality and overall information environment.

Recent studies have expanded the implications of a firm's internal controls beyond financial reporting and the information environment, exploring their impact on business operations and corporate decisions. For instance, Cheng et al. (2013) demonstrate a significant association between a firm's internal controls and investment efficiency, showing that material weaknesses can reduce investment efficiency. Similarly, Feng et al. (2015) investigate the effects of inventory-related material weaknesses on firm operations. They find that such weaknesses systematically reduce inventory turnover ratios and increase the likelihood of reporting inventory impairment. These findings suggest that ineffective internal controls can compromise a firm's operational efficiency. Specifically, the study argues that inaccurate inventory tracking and management result in abnormal order quantities and inventory levels, leading to increased holding costs.

In a similar vein, other recent research has provided evidence that a firm's internal controls play a significant role in determining its operational efficiency. For example, Cheng et al. (2018) document that firms with internal control material weaknesses have lower operational efficiency, as measured by frontier analysis, compared to firms without such weaknesses. They find that the negative effect of material weaknesses on operational efficiency is stronger for firms with a greater demand for high-quality information, more severe weaknesses, and, to some extent, smaller firms. Their study also shows that remediation of material weaknesses leads to improvements in operational efficiency. Shin and Park (2020) discover

that operational efficiency increases when internal control managers possess task-related and diverse firm knowledge, aligning with human capital theory. These findings suggest that the establishment and maintenance of effective internal controls are critical for enhancing a firm's operational efficiency, which can positively impact its overall performance and decision-making processes.

Generally, research investigating the effects of internal controls on a firm's operational efficiency has convincingly demonstrated that ineffective internal controls are more likely to produce errors in internal management reports, adversely affecting the firm's operational decisions. Anecdotal evidence further supports the argument that ineffective internal controls have a negative impact on corporate decisions. For example, in its 2019 annual report, Marriott International disclosed a material weakness in internal controls related to accounting for their loyalty program, which led to revenue recognition errors for 2018. Similarly, Peloton Interactive noted in their annual report dated June 30, 2021, that they had identified a material weakness in internal controls related to inventory management. Peloton Interactive specified that their internal controls were not effectively designed or implemented to ensure accurate physical inventory counts were captured and properly reported in financial statements. This anecdotal evidence explicitly indicates that ineffective internal controls can decrease a firm's operational efficiency by providing managers with inaccurate internal information. In summary, both academic and anecdotal evidence show that effective internal controls are crucial for enabling a firm to make optimal operational decisions, leading to higher operational efficiency.

Human resources are one of the most important factors determining the effectiveness of a firm's internal controls. For instance, the *COSO Internal Control-Integrated Framework,* issued by COSO in 2013, outlines five components and 17 principles of internal controls. Through these principles, COSO emphasizes the significance of human capital in maintaining effective internal controls and achieving its objectives. Specifically, four of the five underlying principles associated with the control environment – the first component of effective internal controls according to the COSO

framework – are directly related to human capital. These principles pertain to the independence of the board of directors, the financial reporting competence established by management, human resource, and the assignment of authority and responsibility. These principles underscore a firm's commitment to attract, develop, and retain competent human capital to achieve internal control objectives. Moreover, the PCAOB stresses the importance of personnel responsible for internal controls. According to the PCAOB's *Staff Audit Practice Alert*, a loss of such personnel increases the risk of deficiencies in a firm's internal controls.

Several other studies have underscored the significance of human resource investment in internal controls as a crucial component for achieving the intended objectives of internal controls. For example, Choi et al. (2013) emphasize the role of human resource in maintaining effective internal controls. They demonstrate that investment in internal control-related personnel reduces a firm's disclosure of material weaknesses in internal controls. They further assert that an increase in internal control-related personnel boosts the likelihood of rectifying previously disclosed material weaknesses. Thus, they suggest that human resource investment in internal controls aids firms in monitoring and detecting potential fraud or errors in financial reporting. Similarly, Shin et al. (2017) show that the average work experience of internal control-related personnel is inversely related to the audit reporting lag. This implies that qualitative investment in internal control-related personnel enhances the timeliness of financial reporting. Additionally, Choi et al. (2021) affirm that human resource investment in internal controls, particularly in the IT department, significantly influences investment efficiency by improving a firm's information environment quality.

The significant effect of human resources on internal controls is also evident in practice. For example, Marriott International's 2019 annual report stated that an insufficient number of resources, including IT and accounting processes and personnel, led to material weaknesses in internal controls. Similarly, MU Global Holdings disclosed that a lack of personnel resources related to internal controls, segregation of duties, and effective risk assessment results in material weaknesses.

In summary, existing research and practical examples suggest that investing in human resource for internal controls enhances a firm's financial reporting quality and internal information environment by bolstering the effectiveness of the firm's internal controls. Moreover, past studies propose that a firm's operational decisions largely depend on internally generated information. As such, an investment in human resource for internal controls is likely to improve a firm's operational efficiency. Considering the importance of investment in internal control personnel, this study aims to provide a more comprehensive understanding of the influence of human resource investment in internal controls by investigating the association between investment in internal control personnel and operational efficiency. Drawing upon previous literature reviews and anecdotal evidence, this study posits a positive effect of investment in internal control personnel on a firm's operational efficiency, leading to the following primary hypothesis:

H: *Human resource investment in internal controls is positively related to a firm's operational efficiency.*

2. METHODS

This paper defines 'operational efficiency' as a firm's relative ability to transform corporate resources into revenue (Demerjian et al., 2012). Specifically, this study measures a firm's operational efficiency by using data envelopment analysis (DEA), a common method for evaluating the relative efficiency of decision-making units (DMUs), which presents each firm in this study. DEA efficiency θ is defined as the ratio of output to input:

$$Max\theta = \frac{\sum_{i=1}^{s} u_i y_{ik}}{\sum_{j=1}^{m} v_j x_{jk}} k = 1,\ldots,n, \qquad (1)$$

where s and m represent output and input, indexed by i and j, respectively. Meanwhile, n represents DMUs. (See Demerjian et al. (2012) for the detailed estimation process.)

This study employs variables for human resource investment in internal controls internal controls

drawn from information in the "Report on the Operation of the internal control System", a section within the firm's annual report. The variable $EMPLOYEE_t$ signifies the quantitative investment in internal control-related personnel, calculated as the number of internal control-related personnel divided by the firm's total employee count. Meanwhile, CPA_t represents the qualitative investment in internal control-related personnel, measured as the number of internal control-related personnel who are certified public accountants (CPA), divided by the firm's total employee count. This provides a gauge of the expertise level of internal control-related personnel. Finally, the variable $CAREER_t$ represents the average working experience of employees responsible for internal control, offering another metric for qualitative investment in internal control-related personnel.

The primary objective of this study is to examine whether the investment in internal control-related personnel enhances a firm's operational efficiency. To test the main hypothesis, referencing the research of Cheng et al. (2018) and Cho et al. (2015), this study used the following model:

$$
\begin{aligned}
Efficiency_t &= \beta_0 + \\
&+ \beta_1 EMPLOYEE_t \left(CPA_t, CAREER_t \right) + \\
&+ \beta_2 SIZE_t + \beta_3 Leverage_t + \beta_4 AGE_t + \\
&+ \beta_5 FCF_t + \beta_6 FOREIGNC_t + \beta_7 MS_t + \\
&+ \beta_8 LARGE_t + \beta_9 OUT_t + \beta_{10} ROA_t + \\
&+ \beta_9 KSE_t + \sum Industry + \sum YEAR + \varepsilon_t,
\end{aligned}
\qquad (2)
$$

where the dependent variable $Efficiency_t$ captures a firm's relative operational efficiency. The variables of interest, $EMPLOYEE_t$, CPA_t, and $CAREER_t$, present quantitative and qualitative human resource investment in internal controls, respectively.

This study controls for various firm characteristics and governance that could affect a firm's operational efficiency utilized in previous studies (Cheng et al., 2018; Cho et al., 2015; Demerjian et al., 2012; Shin & Park 2020). Specifically, this study includes firm size (SIZE), leverage (Leverage), firm age (AGE), free cash flow (FCF), international operation (FOREIGNC), market share (MS), largest shareholder ownership (LARGE), number of outside directors (OUT), firm performance (ROA),

Table 1. Sample selection

Panel A. Sample selection process	
Sample selection process	**Obs.**
Korean-listed firms in 2018 to 2020 (KSE and KOSDAQ)	6,712
Less: samples without internal control personnel data	1,845
Less: samples without 1ˢᵗ stage regression variable data	135
Less: samples without data to compute operational efficiency variable	54
Less: samples without financial data to compute control variables	86
Less: samples with fewer than 10 observations by industry	121
Total	4,471

Panel B	
Year	**Obs.**
2018	1,433
2019	1,489
2020	1,549
Total	4,471

and KSE (*KSE*) to control for the characteristics of the stock market. The details of each variable can be found in Appendix A. Finally, this study controlled for both industry- and year-fixed effects.

This study employs distinctive, manually collected data on internal control related personnel from Korean listed firms spanning the period from 2018 to 2020. As mentioned earlier, information on internal control-related personnel has been publicly available since 2002. However, the study focuses on data from 2018 to 2020 to account for potential effects from changes in the Act on External Audit of Stock Companies in 2017. Data related to internal control personnel is sourced from DART, Korea's equivalent of EDGAR in the U.S. Financial data and the total employee count for each firm are collected from the TS2000, KIS-Value database, and FnGuide database, which parallels Compustat in the U.S. The study intentionally excludes financial firms due to their unique industry characteristics. Finally, firms lacking the required data for each variable are also excluded, yielding a final sample size of 4,471, as outlined in Panel A of Table 1.

3. RESULTS

Table 2 provides the descriptive statistics of the variables. This study winsorizes at the top and bottom 1% for each continuous variable. The mean and median values of *Efficiency* are 0.895 and 0.897, respectively, as *Efficiency* is standardized by scaling with industry-year median value. The sta-

tistics on the independent variables show that the mean value of *EMPLOYEE* is 0.090, indicating that approximately 9% of all employees are responsible for internal control. The mean value of 0.004 for *CPA* reveals that 0.4% of employees who are in charge of internal control are CPAs. *CAREER* shows a mean value of 4.705, which shows that the average working experience of internal control-related personnel is 110.5 months.

Table 2. Descriptive statistics

Variables	N	Median	Mean	Max	Min	SD
Efficiency	4,471	0.897	0.895	1.000	0.596	0.046
EMPLOYEE	4,471	0.045	0.090	0.929	0.002	0.144
CPA	4,471	0.000	0.004	0.083	0.000	0.012
CAREER	4,471	4.771	4.705	5.858	2.708	0.563
SIZE	4,471	19.013	19.252	23.475	16.367	1.345
Leverage	4,471	0.367	0.368	0.926	0.027	0.206
AGE	4,471	3.258	3.238	4.317	0.693	0.683
FCF	4,471	1.000	0.573	1.000	0.000	0.495
FOREIGNC	4,471	1.000	0.527	1.000	0.000	0.499
MS	4,471	0.004	0.029	0.892	0.000	0.081
LARGE	4,471	0.255	0.283	0.777	0.050	0.146
OUT	4,471	0.250	0.246	0.667	0.000	0.160
ROA	4,471	0.019	-0.001	0.370	-0.614	0.130
KSE	4,471	0.000	0.386	1.000	0.000	0.487
IMR	4,471	0.272	0.280	0.941	0.000	0.149

Note: (1) All continuous variables are winsorized at the 1% level. (2) Variable definitions are presented in Appendix A.

Table 3 displays Pearson correlations, demonstrating a significant negative correlation between the dependent variable, *Efficiency*, and the independent variables, *EMPLOYEE* and *CAREER*. However, the result shows there is not a significant correlation between *Efficiency* and *CPA*, which represents the number of internal control-related personnel

Table 3. Pearson's correlation (N = 4,471)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Efficiency	1.000														
(2) EMPLOYEE	−0.087	1.000													
	(0.00)														
(3) CPA	0.002	0.487	1.000												
	(0.92)	(0.00)													
(4) CAREER	−0.033	−0.01	−0.05	1.000											
	(0.03)	(0.49)	(0.00)												
(5) SIZE	0.41	−0.151	−0.006	−0.157	1.000										
	(0.00)	(0.00)	(0.71)	(0.00)											
(6) Leverage	0.095	−0.243	−0.167	−0.078	0.147	1.000									
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)										
(7) AGE	0.194	0.01	−0.057	0.114	0.21	0.042	1.000								
	(0.00)	(0.52)	(0.00)	(0.00)	(0.00)	(0.01)									
(8) FCF	0.141	0.003	0.006	0.032	0.1	−0.096	0.04	1.000							
	(0.00)	(0.84)	(0.67)	(0.03)	(0.00)	(0.00)	(0.01)								
(9) FOREIGNC	0.04	−0.081	−0.037	0.072	0.02	0.047	0.033	0.017	1.000						
	(0.01)	(0.00)	(0.01)	(0.00)	(0.18)	(0.00)	(0.03)	(0.25)							
(10) MS	0.227	−0.135	−0.069	−0.114	0.503	0.111	0.103	0.039	0.041	1.000					
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)						
(11) LARGE	0.149	0.001	0.05	−0.092	0.174	−0.074	−0.101	0.058	−0.001	0.075	1.000				
	(0.00)	(0.93)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.96)	(0.00)					
(12) OUT	0.008	−0.074	−0.08	0.01	−0.048	0.044	0.029	−0.01	−0.016	0.009	−0.03	1.000			
	(0.61)	(0.00)	(0.00)	(0.53)	(0.00)	(0.00)	(0.06)	(0.51)	(0.28)	(0.54)	(0.05)				
(13) ROA	0.368	−0.148	−0.03	0.016	0.234	−0.299	0.012	0.144	0.021	0.08	0.191	−0.036	1.000		
	(0.00)	(0.00)	(0.05)	(0.29)	(0.00)	(0.00)	(0.42)	(0.00)	(0.16)	(0.00)	(0.00)	(0.02)			
(14) KSE	0.294	0.016	0.037	−0.095	0.592	0.094	0.333	0.088	−0.019	0.277	0.14	−0.052	0.07	1.000	
	(0.00)	(0.28)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.21)	(0.00)	(0.00)	(0.00)	(0.00)		
(15) IMR	−0.263	0.085	−0.037	0.122	−0.876	−0.142	−0.14	−0.069	0.006	−0.349	−0.134	−0.09	−0.194	−0.314	1.000
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.67)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	

Note: The numbers in parentheses indicate the p-value.

who are CPA. Despite this, it is challenging to draw definitive conclusions about the relationship between human resource investment in internal controls and a firm's operational efficiency solely based on these correlation coefficients presented in Table 3. Hence, Table 3 reports the regression results, taking into account all variables used in the analytical model. Additionally, the variance inflation factor analysis linked with the regression study indicates that multicollinearity does not pose a concern in this investigation.

Table 4 shows the primary regression results for testing the hypothesis. The first column presents the outcome of the regression of a firm's operational efficiency on the ratio of the number of employees responsible for internal control to the firm's total workforce (*EMPLOYEE*). The coefficient of *EMPLOYEE* is positive (0.011) and significant (t-value = 2.53). The second column of Table 4 demonstrates that the number of internal con-trol-related certified public accountants (*CPA*) is positively related to a firm's operational efficiency, exhibiting a significant positive coefficient at the 1% level (0.194, t-value = 4.00). The result suggests that an increase in the number of employees responsible for internal control and internal control-related personnel who are certified public accountants enhances a firm's operational efficiency. It also implies that both quantitative and qualitative investment in internal control-related human resources is significantly related to a firm's operational efficiency. The third column explores the relationship between a firm's operational efficiency and the average work experience (in months) of internal control-related personnel (*CAREER*). The coefficient of *CAREER* is not statistically significant. Among the control variables, *SIZE*, *Leverage*, *FCF*, *MS*, *LARGE*, *OUT*, *ROA*, and *KSE* have significant correlations with a firm's operational efficiency, aligning with the findings from previous studies (Cheng et al., 2018; Cho et al., 2015; Shin & Park 2020).

Table 4. Effect of investments in internal control-related personnel on a firm's operational efficiency

Variables	Dependent Variable: Efficiency		
	(1)	(2)	(3)
EMPLOYEE	0.011**		
	(2.53)		
CPA		0.194***	
		(4.00)	
CAREER			0.001
			(1.28)
SIZE	0.006***	0.006***	0.006***
	(10.41)	(10.08)	(10.23)
Leverage	0.024***	0.024***	0.022***
	(7.91)	(7.99)	(7.58)
AGE	0.004***	0.004***	0.004***
	(4.47)	(4.72)	(4.15)
FCF	0.005***	0.005***	0.005
	(4.72)	(4.76)	(4.65)
FOREIGNC	0.000	0.000	0.000***
	(0.35)	(0.27)	(0.19)
MS	0.033***	0.034***	0.032***
	(3.74)	(3.89)	(3.62)
LARGE	0.012***	0.012***	0.013**
	(3.23)	(3.14)	(3.31)
OUT	0.008**	0.008**	0.007***
	(2.32)	(2.37)	(2.13)
ROA	0.111***	0.110***	0.108***
	(23.78)	(24.02)	(23.68)
KSE	0.006***	0.006***	0.006***
	(3.88)	(3.99)	(4.08)
Constant	0.748***	0.753***	0.747***
	(49.91)	(50.84)	(47.54)
Industry and year FE	Included	Included	Included
# Obs	4,471	4,471	4,471
Adj. R^2	0.4330	0.4416	0.4324

Notes: (1) The numbers in parentheses indicate the t-statistics. (2) ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. (3) All continuous variables are winsorized at the 1% level. (4) Variable definitions are presented in Appendix A.

To address the endogeneity issue associated with sample selection bias and improve the robustness of the analysis, this study also carries out a two-stage analysis based on Heckman's (1979) model. Table 5 shows results of Heckman's (1979) two-stage analysis. The results in Table 4, as previously mentioned, reveal that only *EMPLOYEE* and *CPA* are significantly associated with a firm's operational efficiency. However, as shown in Table 5, the coefficient of *EMPLOYEE* (0.023, t-value = 5.20) and the coefficient of *CPA* (0.256, t-value = 5.43) are still significantly positive, and the coefficient of *CAREER* (0.002, t-value = 1.84) becomes weakly positive when addressing endogeneity problems through Heckman's (1979)

two-stage analysis. Control variables show qualitatively consistent results with the main analysis in Table 4, and additionally, inverse Mills ratio (*IMR*) reveals a significantly positive coefficient. Therefore, the results for the Heckman (1979) two-stage model more strongly support this study's main hypothesis by showing that both quantitative and qualitative investment in internal control-related personnel positively affects a firm's operational efficiency. Furthermore, the R^2 of the model increases when the study adopts Heckman's (1979) two-stage analysis, improving the explanatory power of the test.

Table 5. Heckman's (1979) two-stage analysis for Table 4

Variables	Dependent Variable: Efficiency		
	(1)	(2)	(3)
EMPLOYEE	0.023***		
	(5.20)		
CPA		0.256***	
		(5.43)	
CAREER			0.002*
			(1.84)
SIZE	0.028***	0.027***	0.026***
	(18.80)	(18.45)	(18.15)
Leverage	0.028***	0.027***	0.025***
	(9.55)	(9.21)	(8.62)
AGE	0.004***	0.004***	0.004***
	(4.81)	(5.09)	(4.31)
FCF	0.005***	0.005***	0.005***
	(4.46)	(4.51)	(4.36)
FOREIGNC	−0.001	−0.001	−0.001
	(−0.67)	(−0.82)	(−0.90)
MS	−0.020**	−0.018*	−0.019**
	(−2.14)	(−1.91)	(−2.10)
LARGE	0.012***	0.012***	0.013***
	(3.29)	(3.18)	(3.42)
OUT	0.028***	0.027***	0.026***
	(8.12)	(7.94)	(7.50)
ROA	0.108***	0.106***	0.104***
	(23.88)	(23.67)	(23.17)
KSE	−0.016***	−0.011***	−0.010***
	(−6.46)	(−6.07)	(−5.72)
IMR	0.160***	0.156***	0.152***
	(15.80)	(15.56)	(15.16)
Constant	0.311***	0.332***	0.335***
	(9.93)	(10.83)	(10.74)
Industry and year FE	Included	Included	Included
# Obs	4,471	4,471	4,471
Adj. R^2	0.4632	0.4635	0.4604

Notes: (1) The numbers in parentheses indicate the t-statistics. (2) ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. (3) All continuous variables are winsorized at the 1% level. (4) Variable definitions are presented in Appendix A.

Although the study addresses potential endogeneity issues by adopting Heckman's (1979) two-stage model, one might argue possible omitted variables and reverse causality problems. Thus, two-stage least squares (2SLS) procedure is performed to address the endogeneity issue. Table 6 shows the results of the second stage of 2SLS. As shown in Table 6, results using the fitted value of *EMPLOYEE*, *CPA*, and *CAREER* are qualitatively similar to the main analysis. This result supports the main argument and indicates that the endogeneity problem is not a major concern when evaluating the validity of main results.

Table 6. Effect of investments in internal control-related personnel on a firm's operational efficiency: Two-Stage least squares (2SLS) regressions

Variables	Dependent Variable: Efficiency		
	(1)	(2)	(3)
EMPLOYEE_ft	0.053***		
	(7.94)		
CPA_ft		1.113***	
		(7.69)	
CAREER_ft			0.034**
			(2.48)
SIZE	0.029***	0.027***	0.028***
	(19.19)	(18.27)	(13.78)
Leverage	0.033***	0.034***	0.030***
	(10.95)	(10.72)	(7.97)
AGE	0.004***	0.006***	−0.000
	(5.35)	(6.56)	(−0.10)
FCF	0.005***	0.005***	0.003***
	(4.66)	(4.74)	(2.60)
FOREIGNC	−0.001	−0.001	−0.003**
	(−0.47)	(−0.87)	(−2.12)
MS	−0.011	−0.001	−0.001
	(−1.17)	(−0.11)	(−0.10)
LARGE	0.013***	0.011***	0.019***
	(3.41)	(2.73)	(3.98)
OUT	0.031***	0.032***	0.027***
	(8.80)	(8.82)	(6.83)
ROA	0.115***	0.113***	0.099***
	(24.71)	(23.86)	(17.71)
KSE	−0.013***	−0.012***	−0.010***
	(−7.10)	(−6.60)	(−4.82)
IMR	0.167***	0.167***	0.159***
	(16.27)	(15.76)	(12.96)
Constant	0.216***	0.238***	0.082
	(6.87)	(7.54)	(0.87)
Industry and year FE	Included	Included	Included
1st stage F−value	1609.17***	282.72***	12.95***
# Obs	4,471	4,471	4,471
Adj. R2	0.4608	0.4275	0.3180

Notes: (1) The numbers in parentheses indicate the t-statistics. (2) ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively. (3) Variable definitions are presented in Appendix A.

4. DISCUSSION

The results indicate that an increase in both the number of employees responsible for internal control and internal control-related personnel who are CPAs can enhance a firm's operational efficiency. These findings imply that both quantitative and qualitative investments in internal control-related human resources have a significant connection to a firm's operational efficiency, supporting the primary hypothesis of the study. However, one could raise potential endogeneity issues relating to self-selection bias. As shown in Table 1, over 1,000 samples lack internal control personnel data. Therefore, the characteristics of firms without internal control personnel data could influence the primary result, leading to sample selection bias. Furthermore, the statistically significant inverse Mills ratio (IMR) in Heckman's (1979) two-stage model indicates a sample selection bias.

Consequently, this study conducts the two-stage analysis based on Heckman's (1979) model. In the first stage, the study regresses the dummy variable, which takes the value of 1 if the information on internal control-related personnel is disclosed, and 0 if not to estimate the Probit model. Following Choi et al. (2013) and Shin et al. (2017), this study includes firm size, leverage, sales, types of the stock market, types of external auditors, and the number of outside directors as variables that could impact the differences between firms that disclose information on internal control-related personnel and those that do not. In the second stage, the study integrates the inverse Mills ratio (IMR) estimated in the first stage into equation (1).

As previously mentioned, this study also applies two-stage least squares (2SLS) procedure to mitigate concerns related to the omitted variables and reverse causality problems. For 2SLS, the study uses the number of employees and average wage of employees as instrument variables for *EMPLOYEES* and *CPA*. The instrument variable selection is based on the human resource literature. Choi et al. (2013) proved that the number of internal control-related personnel increases with the total number of employees within the firm. Wagner's (2012) study shows that the average wage of employees is used as a proxy for the qualification of the human capital within a firm.

Moreover, Yanadori and Kato (2007) and Antoncic and Antoncic (2011) show that employee tenure and loyalty are significantly associated with firm growth. Thus, average wage of employees and asset growth rate are used as instrument variables for *CAREER*. The untabulated Sargan test for the validity of the instrument variables also provides evidence that the test fails to reject the null hypothesis that instrument variables are not correlated with the error term of the main regression, suggesting that the instrument variables are valid.

In summary, as previously mentioned in the result section, the results of robustness tests, including Heckman's (1979) two-stage analysis and two-stage least squares (2SLS) procedure, support the assertion that investment in personnel related to internal control has a positive impact on a firm's operational efficiency. Specifically, after addressing potential endogeneity issues to ensure the robustness of the findings, this study finds compelling evidence to support the primary analysis: both quantitative and qualitative investments in internal control-related personnel improve a firm's operational efficiency. These results shed light on the critical role that internal control personnel play in a company's operations, suggesting that firms should not only recognize this importance but also allocate resources accordingly. By investing in the right mix of internal control personnel, firms have the opportunity to optimize and significantly improve their operational efficiency, thereby improving their business performance. Managers can use these findings as a guidepost to strategically commit resources to internal control-related personnel for enhanced operational efficiency. The results of the study are aligned with previous studies supporting the positive aspect of the human resource investment in internal control, including Choi et al. (2013), Choi et al. (2021), and Shin and Park (2020).

CONCLUSION

The primary objective of this study is to investigate the influence of investment in personnel responsible for internal control on a firm's operational efficiency. This study offers compelling evidence that both quantitative and qualitative investments in internal control-related personnel yield positive outcomes for operational efficiency. To elaborate, the study identifies three key dimensions that are positively associated with enhanced operational efficiency: 1) the number of personnel dedicated to internal control, 2) the subset of internal control-related personnel who hold CPA license, and 3) the average work experience of internal control-related personnel. Importantly, the robustness of these findings is confirmed through advanced statistical methods. Specifically, both Heckman's (1979) two-stage analysis and the two-stage least squares (2SLS) procedures substantiate the core argument, even when accounting for potential endogeneity issues.

This study provides the inaugural evidence that investment in human resources related to internal control significantly associated with a firm's operational efficiency. Furthermore, the findings offer invaluable insights for various stakeholders – ranging from management and investors to regulatory bodies – underscoring the direct link between internal control-related human resource management and operational efficiency of the firm, a relationship vital for future performance. Recognizing the positive impact of human resource investment in internal control on operational efficiency is of paramount importance, especially considering that not all companies allocate resources to internal control-related human capital, even as the significance of internal controls in effective business operation continues to escalate.

This study conclusively illustrates that investing in internal control-related personnel significantly elevates a firm's operational efficiency. For managers, these findings could serve as a compelling guidepost: Committing resources to internal control-related personnel can be a strategic lever for attaining enhanced operational efficiency. Looking ahead, future research could delve into more nuanced areas, such as investigating the influence of specific activities or roles of internal control-related personnel across various departments on a firm's financial performance and market returns.

AUTHOR CONTRIBUTIONS

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APPENDIX A

Table A1. Variable definition

Variable	Definition
Dependent Variables	
Efficiency	Continuous variable of firm efficiency, ranging from 0 to 1, for fiscal year t based on the DEA (Demerjian, Lev, and McVay 2012).
Independent Variables	
EMPLOYEE	Ratio of number of employees responsible for internal control to total number of employees in firm
CPA	Ratio of number of CPAs responsible for internal control to total number of employees in firm
CAREER	The natural logarithm of average work experience of internal control personnel
SIZE	Natural logarithm of total assets
Leverage	Total liability divided by total asset
AGE	Natural logarithm of firm age (Natural logarithm of number of years a firm has appeared in database at end of fiscal year t)
FCF	Indicator variable that equals 1 if firm's free cash flow is not negative and zero otherwise
FOREIGNC	Indicator variable that equals 1 if firm reports a nonzero value for foreign currency adjustment in fiscal year t and zero otherwise
MS	Percentage of revenue (SALE) earned by firm within its industry for fiscal year t
LARGE	Share of ownership held by largest shareholder
OUT	Ratio of number of outside board members to number of board members
ROA	Net income divided by total asset at the beginning of the year
KSE	Indicator variable that equals 1 if a firm trades its shares on the KSE, and 0 if it trades on the KOSDAQ
IMR	Inverse Mills ratio obtained from first-stage Probit model