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Nexus Among Administrative Environmental Innovation and Firm Financial Performance

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Abstract

This paper explores the effect of administrative environmental innovation (AEI) on firm financial performance (FFP) by considering the dynamic capability theory and resource-based view. Specifically, this study tests the linkages between administrative environmental innovation (AEI) and firm financial performance (FFP)by using worldwide data from 685 companies from 42 countries for the period 2004 to 2020. In the final sample, we have 4368 year-annual observations. In this study, AEI is segregated into internal AEI and external AEI. The findings of this study show that Internal AEI and external AEI both enhance FFP under a dynamic capability approach. In this way, this study provides some managerial implications such as the implementation of AEI helps in green innovation strategy that can raise firm profitability in the long run period.

Keywords: Administrative Environmental Innovation, Financial Performance, Internal AEI, External AEI

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Title

Nexus Among Administrative Environmental Innovation and Firm Financial Performance

Abstract

This paper explores the effect of administrative environmental innovation (AEI) on firm financial performance (FFP) by considering the dynamic capability theory and resource-based view. Specifically, this study tests the linkages between administrative environmental innovation (AEI) and firm financial performance (FFP)by using worldwide data from 685 companies from 42 countries for the period 2004 to 2020. In the final sample, we have 4368 year-annual observations. In this study, AEI is segregated into internal AEI and external AEI. The findings of this study show that Internal AEI and external AEI both enhance FFP under a dynamic capability approach. In this way, this study provides some managerial implications such as the implementation of AEI helps in green innovation strategy that can raise firm profitability in the long run period.

Keywords: Administrative Environmental Innovation, Financial Performance, Internal AEI, External AEI

Contents

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Introduction

Fast-growing industrialization is creating serious environmental challenges for the global economies (Hizarci-Payne et al., 2021). Disturbing worldwide climate problems and increasing use of natural resources exhibit the failures of current business practices in sustainable development (Binder & Belz, 2014). Environmental degradation has attracted the focus of academics, experts, and legislators (Paulraj, 2009). Over the period firms started to realize that their financial performance is linked with environmental performance, and this is the fundamental change in doing business that influenced firms' priorities. Now firms focus on financial gains and their environmental contribution (Tsai & Liao, 2017b). Further, firms are under innumerable pressure the implement green strategies to control environmental degradation and target sustainable growth (Gerged et al., 2024; Liao, 2018). This study

analyzed how FFP behaves with the implementation of environmental innovation strategies.

Environmental degradation and change in climate have significant importance over time. Nowadays, managers and policymakers are rewarded for the value of green innovation. It refers to innovations in processes, products, and organizations that have minimized environmental impact. In this study, we focused on organizational innovation. While (Daft, 1978) classified organizational innovation into AEI and technical innovation. Whereas firms and policymakers are aware that technical innovation provides specific unique skills that improve the firm's financial performance. Further, nowadays regulatory bodies and stakeholders build regulatory and social pressure on firms, and researchers claim that implementation of AEI boosts the FFP (Arocena Garro et al., 2020). However, in existing studies, researchers only linked internal AEI with FFP. While firms are also devoting their resources to implement external AEI practices which could directly affect FFP, that aspect is missing in previous studies.

In addition, past research has not examined how AEI tactics affect company performance. Due to sustainability-oriented innovation skills, firms that implement green innovative strategies innovate better than those that don't. (Demirel & Kesidou, 2019). The link between green innovation and corporate success like sales growth, job growth, and labor productivity is still unclear. Growth gains from green innovation techniques include higher business values, access to new markets, and cost savings from resource efficiency (see, e.g., the studies in (Porter & Linde, 1995). However, in the shorter period, green innovation strategy can raise costs and so lower returns growth decline (Palmer et al., 1995). Innovation has a U-shaped effect on firm growth has been discovered in recent studies (Soltmann et al., 2015).

A recent literature study found a good empirical association between green innovation strategy and financial success. Green innovation has a stronger association with environmental, corporate, and social success than environmental innovation has with financial performance (Zheng & Iatridis, 2022). In recent literature there is some contradictory pieces of evidence are reported, few studies found that green innovation strategy has a positive impact on firm financial and economic performance (Horbach & Rammer, 2020) and some studies reported a negative relationship (Cainelli et al., 2011). Further, innovation is defined, as such activities that contribute to sustainable development by considering environmental and social aspects. Horbach & Rammer (2020) found a negative association between innovation and FFP and they applied the quintile regression method. Hackman's two-step procedure was applied by (Cainelli et al., 2011) in the industrial sector of Italian firms. They differentiate the high and low-growth firms and argue that based on empirical findings innovation enhances a firm's sales growth (Colombelli et al., 2019).

Firms pursue green business strategies to address environmental problems (Gerged et al., 2024; Tsai & Liao, 2017a). Therefore, the importance of using green innovative business practices to control environmental degradation has become a top priority for management (Doran & Ryan, 2016). Further, (Przychodzen & Przychodzen, 2015) explains that the pro-ecological business viewpoint discloses the firm adaptability of environmental policies in its production, planning, organizing, and other challenging business activities to minimize environmental costs. In this context, environmental innovations play a role in the enrichment of a firm financial and environmental performance through "creation of novel and competitively priced goods, systems, services, processes, and procedures, designed to please human desires and provide the quality of life for everyone with lifecycle minimum use of natural resources and slight discharge of toxic substances" (Reid & Miedzinski, 2008). Furthermore, (Golicic & Smith, 2013) focused on the connotation between environmentally green business practices and firm performance, when more and more firms considering ecologically proactive strategies gained upward momentum.

In this study, we segregate AEI into internal AEI and external AEI as segregated by (Bellamy et al., 2020). For internal AEI we used a binary construct ISO14001 certification as a proxy variable. It represents that if a firm is ISO14001 certified, it means the firm implements sustainable environmental practices within the boundaries of the organization which comes under AEI. For external AEI, environmental supplier activities are used as a proxy variable. Investment in these activities shows that the firm has responsible environmental behaviors which could impact the market share of that organization in the long term. Further, this study explains, with the help of internal AEI and external AEI, what kind of spending on environmental initiatives is beneficial for the organization. Our finding shows that internal AEI and external AEI both have a significant positive impact on FFP. It implies that environmentally responsible innovation enriches the public image in the eyes of stakeholders being a more responsible behavior that enhances the FFP (Memon & Ooi, 2023).

The next section of the study provides a literature review on the connection between AEI and FFP and develops the research hypothesis. Following that, the methodology, results, discussion, and conclusion are presented in subsequent sections.

Literature Review

Financial Performance

RBV theory proposes that an organization's competitive policy and performance rely on its valued, unusual, and unique organizational resources (Barney, 1991). RBV theory explains that environmental management contributes to enhancing company skill level which is helpful in cost saving, increased corporate reputation, and greater morale for employees that have a positive impact on FFP (Lannelongue et al., 2017; Sharma & Vredenburg, 1998). Whereas diversified environmental practices help in the development of unique organizational skills that support EMS and improve the firm performance (Khanna & Anton, 2002; Schaltegger & Synnestvedt, 2002). Researchers also demonstrate that companies usually have superior business success with the complete implementation of environmental management systems.

Efficient environmental management may minimize a company's costs so that its financial performance may be improved. Firm policies in the context of environmental management contribute to developing new connections between companies and external parties (government, environmental, media) and minimize the risk management expenses connected with the administration of companies (Stefan & Paul, 2008). Good standards regarding the environment may decrease the costs of a product, enhance the use of resources, and increase the firm capability to generate profit (Heras-Saizarbitoria et al., 2016). Those firms that have strict policies for environmental betterment get support in fundraising from various stakeholders, especially from financial institutions (Stefan & Paul, 2008). Further healthier environmental participation may increase the company's social image and help in the reduction of firm production costs that enhance FFP. (Baumgartner & Rauter, 2017; Wong et al., 2018).

Equitable environmental management techniques benefit the business development of a company, however, environmental management may damage the business performance of a company if the number of EMPs exceeds a firm affordable limit (Henriques & Sadorsky, 2013; Schaltegger & Synnestvedt, 2002). While most organizations make early cost savings through environmental management methods by offsetting current incompetence and waste of resources, the environmental activities cost will climb (Hart & Ahuja, 1996). However, when the company improves its environmental performance, it becomes increasingly harder to further cut down pollution, which generally involves considerable modifications in firm environmental plans and implementation of new environmental technology. Thus, environmental management may increase technology and capital intensity by moving companies closer to the minimum pollution level. In this scenario, the growth in EMP has prompted companies to invest more in people, material, and environmental management and organize companies' operations in such a way that has minimized CO2 and maximized firm profitability.

Further (Aragon-Correa et al., 2004) have shown that environmentally skilled staff or expert resources significantly improve the economic return through environmental improvement. The marginal return on environmental management strategies can decline (Lankoski, 2008) and investment in environmental policies might surpass the profits and decrease its financial performance. Dow et al. (1999) believe that if too many superfluous practices are included in a comprehensive quality improvement agenda, the anticipated benefits cannot be accomplished and support for the entire project is being undermined. Environmental management and firm performance have an inverted U-shaped relationship which suggests that the firm initial investment in EMS firm performance improves after a certain point performance dimmish and even after this it has a negative impact on FFP.

Administrative Environmental Innovation and Firm Financial Performance

AEIs are classified into internal and external practices defined by (Bellamy et al., 2020; Daft, 1978). These practices indicate whether the company used EMP within the organization or externally outside the organization with the help of green supply chain management (Formentini & Taticchi, 2016; Kleindorfer et al., 2005). Companies might implement internal AEIs by getting ISO 14001 certification and implementing EMS, which requires them to define objectives, collect information about environmental activities, and assess their progress in the context of environmental contribution (Florida & Davison, 2001; Russo, 2009). Firms can also use external AEIs as a tool to protect the environment by guiding and supporting suppliers to redesign environmental policies to overcome environmental pollution (Formentini & Taticchi, 2016). Both AEIs are necessary proactive environmental measures that drive regulatory, cost-effective, competitive, supply chain,

governance pressures and competition among competitors influence on firm performance (Darnall et al., 2008).

Besides, the literature also shows that ISO14001 certification has a positive impact on FFP. In this context, the theory of dynamic capability holds that ISO 14001 environmental standard complies with the management model "Plan-Do-Check Act (PDCA)," which creates a dynamic process of management within the organization and helps in cost saving. This management paradigm can improve resource reintegration through the improvement of organizational management systems that enhance firm operational efficiency (Wang et al., 2021). Furthermore, In the context of institutional theory, ISO14001-certified firms are more likely to gain superior prices and higher sales because of increasing market legitimacy and social inclusion. The increase in the social performance of ISO14001 raises FP by attracting green consumers as well as satisfying the needs of stakeholders (Jones, 1995).

However, signaling theory supports the idea that ISO14001 eliminates trade barriers, enhances the competitiveness of an enterprise in the worldwide market, enhances the market share of an organization, and minimizes communication costs (Feng et al., 2016). This signaling theory is more beneficial in low-income and middle-income nations because it's pride easy to stockholders to identify environmentally friendly firms. From an innovation point of view, Porter's hypothesis suggests that suitable environmental rules can increase green innovation and reduce costs for companies (Porter & Linde, 1995). Furthermore, experts have indicated that ISO14001 and other management standards, such as ISO9000, might influence managerial decisions. Similar management and operating methods can help companies reduce operating costs (M. A. Delmas & Pekovic, 2013; Siva et al., 2016).

Another perspective ISO 14001 might have an adverse effect. Certain literature shows that accreditation with ISO 14001 is sometimes not optional, it is mandatory for an organization to get ISO14001 certification. This is because ISO 14001, which has been certified by NGOs, such clients or stakeholders, may be passively acting (Zhu et al., 2013). From a cost perspective, the Agency hypothesis holds that improvement of the EP firm will use the resources of this firm and also require substantial cost contributions. This waste drain diverts firms from their main business and reduces profitability (M. Delmas, 2001; Kogg & Mont, 2012). Further. researcher argued that costs connected with ISO 14001 have become one of the major hurdles to efficacy of the certification (Singh et al., 2015). Because managers can also devote their resources toward the well-being of society rather than profit maximizing (Mclaughlin, 1996).

The theory of "compensation costs" combined with an RB perspective also highlights that company resources are limited. Therefore, it implies that investment is required for the accomplishment of ISO 14001 and pollution management in the firm usual operations. Further technical innovation AEI creates an extrusion effect that reduces competitive edge and FFP. From the management point of view, both environmental and technological components and the application of the ISO 14001 standard are highly complicated (Lannelongue et al., 2015). Whereas the theory of the stakeholders believes that market hazards would be formed if a firm is unable to fulfill stakeholders' needs. These risks ultimately increased expenses and reduced profitability if the certification failed to meet the expectations of various stakeholders (Jones, 1995). Some intellectuals also propose that if most organizations are certified ISO 14001, the benefits are negated by the agreeing performance consistency because enterprises are no longer distinct with respect to other organizations that are ISO 14001 certified. Based on the above literature we draw the following research hypotheses.

Hypothesis

H1 Internal administrative environmental innovation has a significant impact on firm financial performance.

H2 External administrative environmental innovation has a significant impact on firm financial performance.

Research design and methodology

This section discusses the datasets employed in the paper and builds an empirical model to assess the impact of AEI on FFP.

Data and Sample

Firstly, the data set is collected from Thomson Reuters for non-financial firms worldwide for the period 2001 to 2020. Then, firms that lack complete data are excluded from the sample. In the final sample, we have 4368 observations of 685 firms from 42 countries that represent all the regions of the world.

Variable of the Study

The financial performance of a firm identifies how well a company manages its assets and liabilities to generate revenue for the best interests of its stakeholders. There are several ways to measure FFP including ROA, ROE MTB. These ratios explain the

firm's ability to generate profit. While this study used return on assets as a proxy variable for FFP, it shows the firm assets efficiency to generate profit (Minutolo et al., 2019).

The further independent variable is administrative EI which is classified into internal AEI and External AEI as used by Bellamy et al. (2020). We used the ISO14001 dummy variable as a proxy variable for internal AEI. Dummy variables contain the value "1" if the firm is ISO14001 certified otherwise "0". For external AEI we used a dummy variable, if the supplier is engaged in supplier development activities, then the dummy variable contains the value "1" otherwise "0". For Environmental awareness, we used the Environmental Performance Index (EPI). It is used by Arocena et al., 2020 as a proxy variable for environmental awareness of society.

Control variables such as SIZE DA and SG represent Firm Size Firm, leverage, and sales growth respectively also included in the model to understand the impact of other factors that could determine financial performance and to avoid model biases.

Table 1

Variable Descriptions

Variables	Descriptions
ROA	Return on assets
Internal AEI	We used the ISO14001 dummy variable as a proxy variable for internal AEI. Dummy variables contain the value "1" if the firm is ISO14001 certified otherwise "0".
External AE	For external AEI Proxy variable is supplier environmental activity if the supplier is engaged in such activities, then the dummy variable contains the value "1" otherwise "0".
EAS	Environmental awareness of society is proxy by the Environmental Performance Index.
SIZE	natural log of total assets.
DA	DA is the ratio between a firm long-term debt and a firm's total assets.
SGRT	SGRT is the sales growth rate

Empirical Modeling

For empirical analysis Horváthová, (2012) provides a linear regression model using all contemporaneous variables, following the research by (Jaggi & Freedman, 1992). The firm FP is a function of firm size, leverage, and growth, and is used to create the baseline model. We extend this model by adding administrative and technical EI in this model. It takes a new functional form for financial performance (FP), in which leverage, size, growth, technical Innovation, and administrative innovation are the predictors of profitability. So, we have the following baseline equation:

$$FP_{it} = \beta_0 + \beta_1 IAEI_{it} + +\beta_2 EAEI_{it} + \beta_3 EAS_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 SGRT_{it} + \varepsilon_{it} \quad 1$$

By adding industry, country and year impact the equation will become as follows:

$$FP_{it} = \beta_0 + \beta_1 IAEI_{it} + +\beta_2 EAEI_{it} + \beta_3 EAS_{it} + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 SGRT_{it} +, \eth Ikdustry_s + \lambda couktry_j + \eth year_t + \varepsilon_{it} \quad 2$$

〖FP〗 is dependent variable in above equation, 〖Industry〗_s is industry-specific a vector, 〖country〗_j is a country- specific dummy variable vector; 〖year〗_t is a dummy variable for a specific year; β, δ, γ, and λ are the coefficients of regression equation; and εit is error term.

Empirical Analysis and Findings

In this study, we are using panel data, as many researchers used in the literature to explore the impact of AEI on firm performance. GMM estimators provide the best result in dynamic panel data, and they provide consistent and reliable coefficient estimates of the variables. GMM estimates were introduced by Arellano & Bond (1991) and it is enriched by (Arellano & Bover, 1995) who are dynamic panel data estimators, now it is the most well-known estimation technique for those researchers who are dealing with dynamic panel data. The main characteristic of this technique is that it is used where the number of periods is less than the number of individuals, and there must be a linear relationship among the variables, which are dynamic in nature. These estimators provide robust results in a

case when the independent variable is correlated with the past realization of the error term, that independent variable is not strictly exogenous, it might be endogenous. GMM estimators are also useful in autocorrelation and heteroscedasticity.

Descriptive Statistics

Table 1 represents the descriptive statistics which represent the mean, maximum, minimum, and standard deviation, and observation of each variable which are included in this study. The ROA of firms is equal to 6.52 and maximum and minimum values vary around 0.01 to 30.67. The EPI in the sample varies from 27.6 to 81.5 and the average environmental performance score is 68.40. DA mean value is 25.17, ranging from 0 to 81.42. The average firm size value is 22.93 and minimum firm size value is 18.82 and the maximum value is 25.59. While the average DA value is 25.18 and the minimum loan DA value is 0 maximum value is 81.50 which indicates the firm maximum loan is 81.5% of total assets which is too high. The average SG is 1.05 and the minimum and maximum values are 0.48 and 2.11 respectively.

Furthermore, Table 1 shows VIF scores that are below the designated threshold of 5. This observation signifies the absence of a multicollinearity problem in the data set. The VIF values, which measure the extent to which variables are correlated, being below 5 suggest that the variables included in the analysis maintain a reasonably independent relationship with one another. This strengthens the reliability of the regression analysis and supports the validity of the results derived from it.

Table 2

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
ROA	6.52	4.89	0.01	30.67
ISO	0.17	0.37	0.00	1.00
ESC	0.18	0.39	0.00	1.00
EMT	0.28	0.44	0.00	1.00
EPI	68.41	12.68	27.60	81.50
DA	25.18	14.70	0.00	81.42
Size	22.93	1.24	18.82	25.59
SG	1.05	0.18	0.48	2.11

Note: Description of variables given in Table 1.

Table 3

Pearson's Pair Correlation and VIF

Variable	ROA	ISO	ESC	EMT	EPI	DA	Size	SG
ROA	1.00							
ISO	0.02	1.00						
ESC	0.01	0.33	1.00					
EMT	0.04	0.37	0.39	1.00				
EPI	0.07	0.02	0.07	0.01	1.00			
DA	-0.16	0.01	-0.04	-0.02	-0.05	1.00		
Size	-0.02	-0.26	-0.27	-0.28	-0.05	0.21	1.00	
SG	0.20	0.08	0.12	0.08	0.00	-0.03	-0.01	1.00
VIF	1.13	1.12	1.12	1.08	1.05	1.04	1.03	1.01

Note: Description of variables given in Table 1.

Table 4

Tests of heteroskedasticity

Test	H0	P-value
Breusch Pagan	Homoskedasticity	0.06
White test	Homoskedasticity	0.06

Diagnostic test

Multicollinearity property

The VIF and correlation matrix are used to assess multicollinearity between independent and control variables before doing regression analysis. Table 2 discloses that there is a weak relationship among all the variables, falling within the acceptable range (less than 0.70). The maximum VIF value for ROA is 1.13, which is significantly lower than the maximum acceptability threshold of 5. Our study dataset does not exhibit multicollinearity.

Heteroskedasticity test

Heteroskedasticity is a serious concern in regression analysis, as it might provide insignificant test statistics. Further, to recognize heteroskedasticity, this study uses the Breusch Pagan test and the White test. In Table 3 Breusch–Pagan test statics show that the p-value is 0.06 and the null hypothesis is accepted. It implies that variance is constant which the necessary for robust regression analysis. Table 4 represents the summary of data and shows the implementation of ISO14001 ESC and EMT across the region. The data set shows Global West region has the highest implementation of ISO14001, ESC, and EMT. Further details are shown in 4.

Table 5

ISO14001 ESC and EMT Implementation in Different Regions

Region	Observations	Percentage	Internal AEI		External AEI	
			1	0	1	0
Asia-Pacific	1,630	37.31	103	1,527	352	1,278
Eastern Europe	101	2.31	1	100	39	62
Former Soviet States	86	1.96	22	64	53	33
Global West	2,111	48.32	554	1,557	640	1,471
Greater Middle East	10	0.22		10		10
Latin America & Caribbean	242	5.54	38	204	72	170
Southern Asia	93	2.12	7	86	22	71
Sub-Saharan Africa	95	2.17	17	78	47	48
TOTAL	4,368	100	742	3626	1225	3143

Note: The above table shows the data frequency.

Regression Results

Table 6 displays the outcomes derived from the system GMM analysis. The non-significant probabilities observed in AB, AR (2), and Hansen tests suggest the absence of serial correlation and over-identification issues, affirming the validity of the utilized instruments in controlling potential endogeneity.

Model 1 in Table 6 reveals the outcomes concerning the important independent variable internal AEI and its proxy variable is ISO14001. The coefficient of Internal AEI stands notably positive and significant at a 1% level (β2= 0.311; p = 0.000; sd= 0.0569), showing a positive relationship between the Internal AEI and firm ROA. These results align with and support the study's hypothesis (H1). It shows internal AEI has a significant positive influence on FFP. It implies that the implantation of internal AEI helps to cut down costs and enhance environmental legitimacy that positively affects firm FP. In terms of the economic significance of results in model (1), it can be suggested that when the firm implements internal AEI, the FFP increases by 31.1% while holding all the other variables at their mean values. Implementing Internal AEI boosts investor and customer trust which enhances the firm reputation and receives potential benefits by being a more socially responsible firm (Mondal & Sahu, 2023).

Further, this study documents the impact of external AEI on FFP. We used ESC as a proxy variable in Model 2 of Table 6. The result reveals that the coefficient linked to external AEI explains a positive relationship and is statistically significant at a 1% level (β2= 0.085; p = 0.000; sd= 0.036), between the external AEI and firm FP. These results align with and support the study's hypothesis (H2). It shows that external AEI also has a significant impact which enhances the FFP. It reveals that the external AEI of a firm decreases production cost, brings production efficiency and enhances the FFP. Further economic significance of model 2 can be expressed as follows; it shows that when the firm implements external AEI by one standard deviation from the mean, the FFP increases by 8.59% while keeping the remaining variables at their mean values. Because implementation of external AEI boosts the firm

reputation and is considered more environmentally friendly among various stakeholders and receives potential benefit by being a more socially responsible firm which has a positive impact on firm FFP (Arocena Garro et al., 2020).

Subsequently, model 3 of Table 6 included internal AEI and external AEI to test the robustness of these findings. The result reveals that the internal AEI is a positive impact and is statistically significant at a 1% level (β2= 0.369; p = 0.000; sd= 0.062), The coefficient of external AEI is also positive and statistically significant at a 1% level (β3= 0.194; p = 0.000; sd= 0.0462) and the results align with and support the study's hypothesis H1 and H2. It shows that both types of AEIs help to reduce production costs and enhance firm profitability. In terms of the economic significance of results in model (2), it can be suggested that when the firm implements internal AEI by one standard deviation from the mean, the FFP increases by 19.4 % while controlling all the other variables at mean values. The implementation of internal AEI boosts investor and customer trust which enhances the firm reputation and potential benefit by being a more socially responsible firm (Arocena Garro et al., 2020). When bearing in mind the economic significance of external AEI the results from Model 3 indicate that if a firm implements external AEI by one standard deviation from the mean, its financial performance increases by 36.5%, while keeping all other variables at their mean values. The implementation of internal AEI boosts investor and customer trust, thus enhancing the firm's reputation and potentially benefiting from being a more socially responsible firm (Fernández et al., 2024; Memon & Ooi, 2023).

Table 6

Regression Results Based on the GMM Model

	Model 1	Model 2	Model 3
Variables	ROA	ROA	ROA
L.ROA	0.116***	0.159***	0.111***
	(0.025)	(0.024)	(0.025)
Internal AEI	0.311***		0.369***
	(0.056)		(0.062)
External AEI		0.085**	0.194***
		(0.036)	(0.046)
EPI	0.010***	0.009***	0.009**
	(0.003)	(0.003)	(0.003)
Size	0.106***	0.121***	0.117***
	(0.020)	(0.023)	(0.020)
DA	-0.011***	-0.010***	-0.010***
	(0.001)	(0.001)	(0.001)
SG	0.429***	0.430***	0.415***
	(0.045)	(0.044)	(0.045)
Constant	-1.981***	-2.180***	-2.298***
	(0.364)	(0.467)	(0.382)
Observations	3,736	3,736	3,736
AR2	0.456	0.222	0.853
Hansen	0.242	0.158	0.384
Year	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Region	Yes	Yes	Yes

*Note: description of the variable given in Table 1. * Represent a significant level at 90%, ** represents significant at 95%, and *** represents significant at 99%.*

Discussions

This study segregates the effect of AEI into internal AEI and External AEI to evaluate the firm's financial performance. Our findings infer that FFP is directly influenced by the implementation of AEIs. In this context, the results show that internal AEI leads to improved operational efficiency and cost savings. While, the implementation of EMS can identify opportunities for resource conservation, waste reduction, and energy efficiency. These improvements can result in reduced operating costs and increased profitability, potentially boosting ROA. Additionally, internal AEI can enhance organizational reputation and stakeholder relationships. Companies

with internal AEI demonstrate a commitment to environmentally friendly behavior, which can foster trust and goodwill among customers, investors, and other stakeholders. This improved reputation can positively impact customer loyalty, market share, and financial performance, ultimately contributing to higher ROA and these findings are also supported by (Gerged et al., 2024).

Further in this study, we examine the relationship between external AEI and Return on Assets (ROA). Our findings reveal a positive association between ROA and external AEI. This relationship is attributed to the implementation of environmentally sustainable practices within the supply chain, which includes initiatives such as reducing energy consumption, minimizing waste, and optimizing transportation. These efforts result in cost savings, thereby enhancing profitability and potentially increasing ROA. Additionally, external AEI practices, such as adopting clean manufacturing principles and green logistics, contribute to operational efficiency improvements by streamlining processes, reducing waste, and optimizing resource utilization. This heightened efficiency translates into increased productivity and profitability, ultimately positively impacting ROA which is consistent with the findings of (Saputra & Zulkifli, 2023).

Conclusion

This paper explores the effect of AEI on FFP by considering the dynamic capability theory and RBV. Specifically, in this study, we test the linkages between AEI and FFP by using worldwide data from 685 companies from 42 countries for the period 2004 to 2020. This research shows that firms tend to opt for internal AEI and external AEI policies within the organization and experience significant growth in returns due to the development of unique skills and environmental sustainability. AEI compliance firms might gain extra prices and higher sales because of increasing market legitimacy and social inclusion. Further, according to that theory dynamic capability and resource-based view, AEI implementation brings operational efficiency that uplifts firm profitability. Furthermore, this study also observed that large-size firms have more resources for the development of unique skills that bring operational and managerial efficiency. Therefore, firm size also has a positive significant impact on firm performance.

Further, this study is equally useful for industrialists and regulatory bodies and provides a clear insight to industrialists that spending on green technological initiatives enhances firm productivity and sales volume. The outcome of spending on technological innovation enhances firms' ROA with the passage of time, instead of declining. Further, this will be equally good for regulatory bodies to design such a policy which not only enhances the firm's performance but also saves our environment in the long run. Despite this study covering the worldwide data set to address the association between AEI and firm performance and captures the moderating effect of firm size, this study still has a few research limitations, this study does not apply a sectoral analysis. This study can be further extended by addressing the AEI impact on firm performance by using sectoral analysis which will give more insight to policymakers and practitioners to set a policy according to different sectors

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