Journal of Social Economics Research
2025 Vol. 12, No. 4, pp. 303-313
ISSN(e): 2312-6264
ISSN(p): 2312-6329
DOI: 10.18488/35.v12i4.4589

Environmental governance and the digital-green shift of firms in Vietnam

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Article History
Received: 9 September 2025
Revised: 1 December 2025
Accepted: 11 December 2025
Published: 19 December 2025

Keywords
Digital-green transition
Environmental governance
Provincial administration
Technology investment
Vietnam.

JEL Classification:
H83; O32; O38.

ABSTRACT

This paper investigates how provincial environmental governance shapes firms' technology upgrading during the COVID-19 shock and early recovery in Vietnam. Using 1,886 firm-year observations for 2019–2021, the analysis combines the environmental governance sub-index of the Provincial Governance and Public Administration Performance Index with listed firms' financial statements from FiinPro and applies panel regression models with rich fixed effects and event-time specifications to estimate the impact of environmental governance on corporate technology investment. The results reveal a robust positive association between effective environmental governance and technology upgrading, with stronger effects for pollution-intensive firms, financial institutions, and firms headquartered in export-oriented Southeast provinces. Event-time estimates further show that this relationship intensifies during the lockdown period and remains significant in the initial reopening phase, suggesting that capable local administration lowers uncertainty and transaction costs for digital and green investment when firms are under stress. These findings indicate that environmental governance functions as an important but often overlooked driver of the digital–green shift in an emerging economy context. Policymakers can foster resilient, innovation-led growth by strengthening provincial environmental governance capacity, integrating environmental management with industrial and digital transformation programs, and targeting support to small and medium-sized enterprises that face greater constraints in financing and implementing digital–green technologies.

Contribution/Originality: This study shows that effective provincial environmental governance strengthens firms' technology investment during and after the COVID-19 shock. It contributes by providing rare sub-national evidence from Vietnam and demonstrating that environmental governance is an important driver of firms' digital–green transition in periods of heightened uncertainty.

1. INTRODUCTION

The COVID-19 pandemic triggered one of the most profound disruptions to corporate investment strategies worldwide, forcing firms to reassess risks, reallocate resources, and accelerate digital and green transitions. Vietnam, an emerging economy with a dynamic manufacturing base and a growing emphasis on innovation, provides a particularly revealing case. While its economy was once dominated by traditional, labor-intensive sectors, the

pandemic shock catalyzed a pivot toward technology-driven investments as firms sought resilience and competitiveness in a volatile global environment.

This study investigates how provincial governance, and especially environmental governance, shaped corporate technology investment during this period of turbulence and early recovery. In Vietnam, the quality of local administration, ranging from regulatory transparency to enforcement predictability, plays a decisive role in shaping firms' strategic choices. Effective governance can reduce uncertainty, lower compliance costs, and create incentives for firms to adopt new technologies, while weak governance may discourage innovation and entrench reliance on older practices.

By framing COVID-19 as both a stress test and an accelerator, we examine how the interaction between environmental governance and corporate decision-making influenced Vietnam's trajectory from lockdown to lift-off. Our analysis combines data from the Public Administration and Public Service Delivery Index (PAPI), focusing on the environmental governance dimension, with firm-level financial information from the FiinPro database. The resulting dataset of 1,886 firm-year observations from 2019 to 2021 allows us to assess whether stronger provincial governance enhanced firms' capacity to invest in digital and green technologies under crisis conditions.

This paper makes three contributions. First, it treats the pandemic as a natural experiment, showing how governance quality amplifies or dampens firms' ability to pursue technology upgrading under stress. Second, it extends the literature on the governance–technology nexus by providing rare evidence from an emerging economy where provincial administration plays a pivotal role. Third, it links environmental governance to the broader digital-green shift, positioning governance not merely as a compliance mechanism but as a hidden accelerator of resilience and innovation.

The rest of this study proceeds as follows. Section 2 reviews prominent literature and outlines our hypothesis. Section 3 describes the research design. Section 4 presents our empirical results. Finally, Section 5 concludes the study.

2. REVIEW OF LITERATURE AND HYPOTHESIS DEVELOPMENT

The COVID-19 pandemic has heightened awareness of the various factors influencing firm performance (Obrenovic et al., 2020). One of the more positive outcomes of the crisis was the rapid adaptation of many firms' operations, utilizing digital tools and experimenting with new revenue models to improve efficiency (Obrenovic et al., 2020).

Simultaneously, the pandemic exposed the deep interdependence between firms and the broader institutional environment, including their reliance on public support and governance structures. May and Mackin (2020) argue that large corporations with well-resourced leadership and wealthy shareholders should be subject to closer scrutiny and accountability when accessing government-backed aid. Against this backdrop, the relationship between public administration reform and corporate technology investment in Vietnam, especially during COVID-19, has become an urgent research question.

2.1. COVID-19 and Public Administration Reform

The pandemic introduced unprecedented volatility, uncertainty, complexity, and ambiguity for public administration. Governments' effectiveness was closely tied to their ability to adapt, innovate, and learn from past crises, particularly through investments in technology and human capital. In many emerging economies, administrations leveraged information and communication technologies (ICT) to maintain operations and sustain interaction with citizens (Liu & Yuan, 2015). This underscores the centrality of digital capacity, knowledge, and competencies in ensuring collective well-being.

In Vietnam, firm surveys confirm that while most companies suffered severe pandemic shocks, many responded by promoting e-commerce, retraining workers, and exploring new markets, especially those that benefited from

government assistance (Nguyen, Do, & Pham, 2023). Such findings highlight the importance of governance capacity in shaping corporate resilience. More broadly, the crisis also exposed vulnerabilities in global supply chains (Hayakawa & Mukunoki, 2021) and reinforced the need for environmentally responsible practices in long-term corporate strategies (He & Harris, 2020).

2.2. Public Administration Reform and Corporate Technology Investment

The effect of provincial environmental governance on corporate operations is shaped by a dynamic interplay of regulations, incentives, resources, and market forces. Empirical evidence supports the view that environmental regulation can act as a catalyst for innovation. Classic work by Jaffe and Palmer (1997) demonstrated that environmental compliance expenditures spurred R&D in U.S. manufacturing, while Lanjouw and Mody (1996) found a cross-country correlation between stricter ecological regulations and patenting activity. More recently, Mappong (2023) examined how regulatory frameworks affect funding allocations for corporate social and environmental responsibility.

Emerging literature emphasizes the synergies between digital transformation and environmental governance. In China, digital economy growth has been shown to significantly improve urban green development, with the effect strongest where environmental governance is more effective (Zhang, 2025). A European policy study also stresses that only integrated "twin transitions," digital and green, can yield sustainable outcomes, warning that fragmented approaches fall short (Meissner, 2024).

These studies collectively suggest that stronger governance does not suppress corporate activity; instead, it can stimulate innovation and technology upgrading. However, the impact likely varies across provinces depending on regulatory enforcement, industry structure, and firms' readiness to embrace sustainability. For Vietnam, this leads to the following hypothesis.

Hypothesis: Provinces with higher levels of efficiency in environmental governance are more likely to host firms that prioritize and invest in technology-driven strategies.

Beyond Vietnam, evidence from Southeast Asia highlights that governance quality and institutional capacity are key drivers of firms' technological upgrading and environmental performance. In Indonesia, the PROPER program, a public disclosure-based environmental compliance ranking, has been recognized by the World Bank as an effective governance mechanism that incentivizes cleaner technologies and better corporate behavior (World Bank, 1995, 2010).

In Malaysia and Thailand, empirical studies show that strong corporate governance and environmental, social, and governance (ESG) integration are positively associated with innovation and sustainability outcomes, suggesting that conducive institutional settings help internalize green innovation incentives (Suparak, Kamthornphiphatthanakul, & Theeraworawit, 2025).

At the ASEAN level, reports by ERIA and UNESCO emphasize that COVID-19 accelerated both digitalization and environmental policy convergence, reinforcing the role of transparent, predictable governance in enabling firms' digital-green transition (Ember, 2025; ERIA, 2023; UNESCO, 2024).

3. RESEARCH METHODOLOGY

3.1. Sample Construction

Our sample intersects two primary data sources: (i) The Vietnam Provincial Governance and Public Administration Performance Index (PAPI) is the country's largest annual time series. PAPI assesses three mutually reinforcing processes: policymaking, policy implementation, and the monitoring of public service delivery. Our sample contains provincial-level panel data on 523 companies from 63 provinces between 2019 and 2021.

We use one component of the PAPI index that appeared in 2019: Environmental governance; (ii) secondary data of audited financial statements from the FiinPro data system provided by FiinGroup Joint Stock Company (Vietnam).

We exclude observations with insufficient information for constructing firm-level technology investment measures and those with missing values for control variables. This filtering process and merging with other databases yield a final sample of 1,886 firm-year observations between 2019 and 2021.

3.2. Measuring Corporate Technology Investment

We gauge a company's technology investment by examining its Science and Technology Development (STD) fund, as reported in its financial statements. The STD investment fund represents the portion of the company's STD fund that remains unspent at the reporting date. In Vietnam, listed firms establish STD funds to finance scientific research and technological development.[1] When the value of the STD fund increases, it indicates that the unutilized STD fund for the year has increased, suggesting a decrease in the efficiency of using the fund for science and technology development and vice versa. Accordingly, we measure the level of corporate technology investment by using the value of the STD fund in the balance sheet from FiinPro data as follows:

(1) TEC_1 is defined as the natural logarithm of the unspent STD funds.

(2) TEC_2 is defined as the amount of unspent STD funds divided by the firm's sales revenue.

Since only a small number of companies have established STD funds, we found that 32 out of 523 companies contributed to the STD fund, representing 10% of the total. To address the impact of numerous zero values, we employ a Tobit model in our regression analysis.

3.3. Control Variables

We include a range of firm-specific attributes that are good predictors of firm technologization based on prior literature (Gan & Xu, 2019; Tong, Liu, Zhang, & Wang, 2018; Yan, Xu, & Lai, 2021). At the firm level, we control for the following variables:

(1) *Size* is the natural logarithm of a firm's market value, (2) *Leverage* is the ratio of long-term debt to total assets, (3) *Cash* is the ratio of cash to total assets, (4) *ROA* is the ratio of net income to total assets, (5) *ROE* is the ratio of net income to shareholders' equity. All continuous variables are winsorized at the 1% and 99% levels. The descriptive statistics of these firm-level control variables are presented in Panel A of Table 1.

4. EMPIRICAL RESULTS

4.1. Descriptive Statistics

Panel A of Table 1 reports the descriptive statistics of the main variables used in the study. There are 1,886 observations in total from 2019 to 2021. The mean value of TEC_1 is 1.24, and the mean value of TEC_2 is 0.0003. At the provincial level, the mean value of *Environmental governance* is 3.487.

Panel B reports the Pearson correlation analysis of the variables. As shown in Panel B, the pairwise correlation *Environmental governance* with other variables is generally low, as expected, indicating that no serious multicollinearity problem exists when including these variables in the regression model.

[1] The Technology Transfer Law No. 07/2017/QH14 of 2017 stipulates: "Enterprises are allowed to use their science and technology development funds to invest, match capital, receive co-investment for technology innovation, technology incubation, incubation of science and technology enterprises, innovative startups, and the commercialization of their scientific research and technology development results."

Table 1. Descriptive statistics.

Panel A: Summary statistics						
Variable	**N**	**mean**	**sd**	**p25**	**p50**	**p75**
Environmental governance	1886	3.487	0.695	2.904	3.317	3.687
TEC1	1886	1.079	4.756	0	0	0
TEC2	1886	0.0003	0.0027	0	0	0
LEV	1886	0.509	0.479	0.251	0.478	0.683
SIZE	1886	26.599	1.755	25.537	26.627	27.687
ROA	1886	0.041	0.079	0.009	0.036	0.076
ROE	1886	0.088	0.177	0.024	0.085	0.159
CASH	1886	0.077	0.085	0.017	0.049	0.104

Table 1. Continue.

Panel B: Pearson correlation matrix								
	Environmental governance	***TEC1***	***TEC2***	***LEV***	***SIZE***	***ROA***	***ROE***	***CASH***
Environmental governance	1.000							
TEC1	-0.015	1.000						
TEC2	0.008	0.576	1.000					
LEV	0.034	-0.027	-0.018	1.000				
SIZE	-0.004	0.207	0.050	0.047	1.000			
ROA	0.017	0.087	0.046	-0.446	0.211	1.000		
ROE	0.036	0.060	0.034	-0.028	0.196	0.645	1.000	
CASH	-0.090	-0.013	-0.022	-0.206	-0.104	0.197	0.125	1.000

Note: The table presents descriptive statistics for key variables used in our baseline analysis. All continuous variables are winsorized at the 1% and 99% levels. Variable definitions and data sources are included in Appendix A. Panel A reports the observation counts and summary statistics for the entire sample. Panel B shows the Pearson correlation coefficients for each pair of variables.

4.2. Baseline Results

To examine the relationship between the efficiency of provincial-level public administration and the corporate technology investment level by estimating the following regression model.

$$Technology_t = \beta_0 + \beta_1\ Public\ administration_t + \beta_2 X_t + \gamma_t + \varepsilon_t \quad (1)$$

Here, $Technology_t$ represents the corporate technology investment index estimated in years t, TEC_1 and TEC_2. $Public\ administration_t$ stands for *Environmental governance* in year t. X is a vector of control variables, as presented in section 3.3, calculated in year t.

The year-fixed effects (denoted as γ_t) are included in our baseline model. Importantly, the coefficient β_1 reflects the impact of public administration efficiency on corporate technology investment. We adopted the Tobit model to conduct the regression analysis because TEC1 and TEC2 have many zero values, and we report the estimated regressions controlling for year-fixed effects in Table 2.

The coefficients of *Environmental governance* in Columns (1) to (4) are negative and statistically significant at the 1% level. For instance, the coefficients in columns (1) and (2) on TEC_1 and TEC_2 are -5.120 and -5.472, respectively. The negative coefficients indicate that when citizens are aware of the environment, corporations are encouraged to allocate more STD funds for science and technology transformation.

The evidence aligns with our hypotheses. The coefficients of control variables are also consistent with previous studies. For example, *Size*, *Lev*, *ROA*, *ROE*, and *Cash* coefficients are statistically significant and positive, in line with prior research (Yan et al., 2021).

Table 2. Provincial administration and corporate technology investment.

Variable	(1) TEC1	(2) TEC1	(3) TEC2	(4) TEC2
Environmental governance	-5.120***	-5.472***	-0.002***	-0.003***
	(-14.35)	(-13.62)	(-13.86)	(-13.33)
LEV		-11.936***		-0.005***
		(-5.68)		(-4.47)
SIZE		11.833***		0.005***
		(224.98)		(175.09)
ROA		44.306***		0.015***
		(4.50)		(3.05)
ROE		2.585		0.004**
		(0.64)		(2.08)
CASH		1.381		-0.000
		(0.19)		(-0.14)
Constant	-215.189***	-524.536***	-0.089***	-0.222***
	(-165.47)	(-358.59)	(-153.06)	(-304.47)
Obs.	1,886	1,886	1,886	1,886
Year FE	Yes	Yes	Yes	Yes
Pseudo R2	0.148	0.148	12.61	12.63

Note: This table examines the effect of environmental governance on technology investment. The dependent variable of the regressions alternatively represents one of two corporate technology investment measures, TEC_1 and TEC_2. The independent variable is $Public\ administration_t$ variable in year t. X is a vector of control variables, including *Size, Leverage, ROA, ROE and Cash.* To account for the impact of firm location, we introduce the variable *Geography*, a dummy variable that takes the value of one for firms headquartered in the Southeast region of Vietnam and zero otherwise. Variable definitions and data sources of these controls are presented in Appendix A. The continuous variables are winsorized at the top and bottom 1% of the sample distribution. Year-fixed effects are included unless otherwise stated. The symbols *** and ** denote the statistical significance at 1% and 5%, respectively. Obs is the number of observations.

This table displays the estimation results of the following regression.

$$Technology_t = \beta_0 + \beta_1\ Public\ administration_t + \beta_2 X_t + \gamma_t + \varepsilon_t \quad (2)$$

Where t denotes the year. $Technology_t$ represents one of two corporate science and technology investment measures, TEC_1 and TEC_2. $Public\ administration_t$ stands for one dimension of the PAPI index (*Environmental governance*) in year t. X is a vector of control variables, including *Size*, *Leverage*, *ROA*, *ROE*, *and Cash.* Variable definitions and data sources of these controls are presented in Appendix A. All continuous variables are winsorized at the top and bottom 1% of the sample distribution. Year-fixed effect is included unless otherwise stated. The symbols ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

4.3. Cross-Sectional Analyses

In the line of inquiry, we conduct cross-sectional analyses to examine how corporations in different geographic regions, firm sizes, and business types can moderate the association between provincial administration and corporate technology transformation. In this section, we introduce three variables corresponding to each moderator: (1) *Geo_dum*, a dummy variable that takes the value of one for firms headquartered in the Southeast region of Vietnam and zero otherwise; (2) *Size_dum*, which takes the value of 1 if firm size is bigger than the median for the large firms and 0 otherwise for the small firms; (3) *Business_dum* is dummy variable that equals one if firms belong to stock, insurance and bank sections.

4.3.1. Effect of Public Administration Conditional on Geographic Regions

The Southeast Region is the largest economic hub in the country. However, during the COVID-19 pandemic, the growth rate of the Southeast Region has tended to decrease and is lower than the national average. From this, solutions for technological innovation and advanced digital technology are proposed to enhance the quality of growth in the Southeast Region. With an area of 9% and a population of 20%, the Southeast Region has contributed over 30%

of the GDP, approximately 45% of the total state budget revenue, and more than 32% of the national export turnover.[2] Since 2020, the Southeast Region has been actively implementing a digitalization strategy for socio-economic activities, rapidly adopting various forms of industry technologies in the management of society, the economy, and business operations of enterprises. All regional provinces have local technology development strategies with specific action programs. Therefore, we investigate whether the Southeast region and other regions influence the association between public administration and corporate technology investment differently.

Table 3 displays the estimation results of extended models with interaction terms of *public administration variables* with the firm's geographic factor. The estimated coefficients of the interaction terms are negative and statistically significant. The evidence implies that the Southeast region is a potential factor countervailing the increased public administration related to the environment associated with corporate technology investment.

Table 3. Effect of public administration conditional on geographic regions.

	(1)	(2)	(3)	(4)
Variable	**TEC1**	**TEC1**	**TEC2**	**TEC2**
Environmental governance	-2.608***	-2.741***	-0.001***	-0.002***
	(-7.02)	(-6.74)	(-7.80)	(-7.96)
Geo_dum	33.211***	33.351***	0.013***	0.014***
	(16.59)	(17.15)	(15.28)	(15.06)
Environmental governance#Geo_dum	-11.355***	-11.329***	-0.004***	-0.005***
	(-18.88)	(-19.38)	(-17.45)	(-17.18)
LEV		-12.046***		-0.005***
		(-5.63)		(-4.44)
SIZE		11.815***		0.005***
		(221.20)		(172.97)
ROA		46.255***		0.016***
		(4.58)		(3.21)
ROE		2.458		0.004**
		(0.60)		(1.98)
CASH		1.275		-0.001
		(0.17)		(-0.15)
Constant	-226.532***	-537.348***	-0.093***	-0.227***
	(-167.03)	(-362.33)	(-155.36)	(-308.23)
Obs.	1,886	1,886	1,886	1,886
Year FE	Yes	Yes	Yes	Yes
Pseudo R2	0.149	0.149	12.67	12.66

Note: This table examines the effect of public administration conditional on firm's geographic location. The dependent variable of the regressions alternatively represents one of two corporate technology investment measures, TEC_1 and TEC_2. The independent variable is $Public\ administration_t$ variable in year t. X is a vector of control variables, including *Size, Leverage, ROA, ROE and Cash*. To account for the impact of firm location, we introduce the variable *Geography*, a dummy variable that takes the value of one for firms headquartered in the Southeast region of Vietnam and zero otherwise. Variable definitions and data sources of these controls are presented in Appendix A. The continuous variables are winsorized at the top and bottom 1% of the sample distribution. Year-fixed effects are included unless otherwise stated. The symbols *** and ** denote the statistical significance at 1% and 5%. Obs is the number of observations.

4.3.2. Effect of Public Administration Conditional on Firm Size

In Vietnam, particularly among small and medium-sized enterprises (SMEs), there is a general lack of awareness regarding their role in the Fourth Industrial Revolution's technology investment. SMEs, accounting for around 97% of the country's businesses, still struggle with technological and innovative capabilities, with a significant portion of their machinery being imported and outdated. SMEs' machinery difficulties present a critical challenge for their technology investment efforts. Moreover, limited budgets among SMEs result in slow decision-making processes,

[2] https://www.hcmcpv.org.vn/tin-tuc/lien-ket-dua-dong-nam-bo-tro-thanh-vung-phat-trien-nang-dong-co-toc-do-tang-truong-kinh-te-cao-don-1491906216
https://future.ueh.edu.vn/chi-tiet-knowlege/podcast-phat-trien-khoa-hoc-ky-thuat-va-doi-moi-cong-nghe-o-vung-dong-nam-bo-phan-1-thanh-tuu-doi-moi-cong-nghe-va-ung-dung-cong-nghe-cao/

and most of them face capital difficulties, leading them to view technology investment as a prerogative of larger corporates.[3]

The evidence from previous results supports the idea that more stringent environmental regulations will encourage innovation. However, Jaffe, Newell, and Stavins (2002) discuss that market-based ecological policies (such as pollution taxes) may provide more substantial incentives for firms to implement cheaper and more efficient production technologies compared to command-and-control approaches (such as environmental compliance regulation). Therefore, in this section, we study whether big and small firms will have different moderating effects on the association between ecological government and firm innovation.

To account for the impact of firm size, we introduce the variable *Size_dum* and incorporate the interaction term, *Public Administration* x *Size_dum*, into Equation 1 to investigate how firm size moderates the relationship between *Public Administration* and technology transformation investment at the firm level. As seen in Table 4, Columns (1) and (3) show that the coefficients of the interaction term *Environmental governance x Size_dum* are statistically significant at the 1% level, with values of 10.764 and 0.006. These findings indicate that the impact of environmental concern on provincial governance appears to be less pronounced for large firms than for small firms.

Table 4. Effect of public administration conditional on firm size.

	(1)	(2)	(3)	(4)
Variable	**TEC1**	**TEC1**	**TEC2**	**TEC2**
Size_dum	-2.286*	-33.171***	-0.004***	-0.016***
	(-1.67)	(-23.06)	(-6.70)	(-22.61)
Environmental governance	-15.649***	-15.785***	-0.008***	-0.008***
	(-40.23)	(-37.61)	(-41.52)	(-40.00)
Environmental governance#Size_dum	10.914***	10.764***	0.005***	0.006***
	(28.01)	(26.48)	(30.73)	(29.88)
LEV		-12.632***		-0.005***
		(-5.70)		(-4.77)
SIZE		11.417***		0.004***
		(208.98)		(143.70)
ROA		44.083***		0.013***
		(4.36)		(2.61)
ROE		2.735		0.005**
		(0.66)		(2.34)
CASH		0.127		-0.001
		(0.02)		(-0.32)
Constant	-194.942***	-479.447***	-0.082***	-0.182***
	(-140.24)	(-318.15)	(-128.42)	(-244.32)
Observations	1,886	1,886	1,886	1,886
Year FE	Yes	Yes	Yes	Yes
Pseudo R2	0.149	0.149	12.81	12.74

Note: This table examines the effect of public administration conditioning on firm size. The dependent variable of the regressions alternatively represents one of two corporate technology investment measures, *TEC1 and TEC2*. The independent variable is $Public\ administration_t$ variable in year t. X is a vector of control variables, including *Size, Leverage, ROA, ROE and Cash*. To account for the impact of firm size, we introduce the variable *Size_dum*, which takes the value of 1 if firm size is bigger than the median for the large firms and 0 otherwise for the small firms. Variable definitions and data sources of these controls are presented in Appendix A. The continuous variables are winsorized at the top and bottom 1% of the sample distribution. Year-fixed effects are included unless otherwise stated. The symbols ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

4.3.3. Effect of Public Administration Conditional on Industry Type

The level of technology investment among businesses is currently undergoing its fastest phase ever, primarily driven by the COVID-19 pandemic. In recent times, many industries, including financial institutions, insurance companies, and banks, have adopted technology to improve the efficiency of financial services and have implemented a digital banking strategy by offering highly personalized financial products and services through digital channels

[3] https://moit.gov.vn/tin-tuc/bo-cong-thuong-voi-doanh-nghiep/dau-tu-vao-khoa-hoc-cong-nghe-vi-sao-dn-con-lung-tung-chan-c.html

such as mobile payments, e-KYC, QR codes, etc., to enhance the customer experience when accessing financing services. Accordingly, there has also been a substantial shift from traditional business models to new digital models. In this section, we expect that public administration on technology investment for financial institutions has a more significant impact than for other industries.

To examine the impact of business type, we build the variable *Business_type* and incorporate the interaction term *Public Administration x Business_type* into Equation 1 to investigate how the stock market moderates the relationship between Public Administration and technology investment at the firm level. As indicated in Table 5, the coefficient of the interaction term demonstrates statistical significance at the 1% level, with a notable negative value. These results imply that the business type of listed firms moderates the connection between Public Administration and corporate technology investment. Furthermore, this influence seems particularly pronounced among financial sector firms compared to other businesses, consistent with our prior expectations.

Table 5. Effect of public administration conditional on industry type.

Variable	(1) TEC1	(2) TEC1	(3) TEC2	(4) TEC2
Environmental governance	-4.951***	-5.162***	-0.002***	-0.002***
	(-13.76)	(-12.93)	(-12.70)	(-12.16)
Business_dum	11.139***	30.666***	0.014***	0.024***
	(4.65)	(14.53)	(13.58)	(23.08)
Environmental governance#business_dum	0.890	-1.360**	-0.002***	-0.004***
	(1.21)	(-2.10)	(-7.89)	(-12.42)
LEV		-14.648***		-0.006***
		(-6.93)		(-5.49)
SIZE		12.658***		0.005***
		(242.19)		(187.44)
ROA		51.872***		0.017***
		(5.23)		(3.40)
ROE		0.126		0.004*
		(0.03)		(1.70)
CASH		3.472		0.000
		(0.49)		(0.02)
Constant	-228.132***	-567.431***	-0.093***	-0.237***
	(-173.82)	(-389.85)	(-157.79)	(-321.35)
Obs.	1,886	1,868	1,886	1,886
Year FE	Yes	Yes	Yes	Yes
Pseudo R2	0.158	19.63	13.30	13.32

Note: This table examines the effect of public administration conditioning on industry type. The dependent variable of the regressions alternatively represents one of two corporate technology investment measures, *TEC1 and TEC2*. The independent variable is $Public\ administration_t$ variable in year t. X is a vector of control variables, including *Size, Leverage, ROA, ROE and Cash*. To account for the impact of a firm's industry type, we introduce the dummy variable that equals one if firms belong to stock, insurance and bank sections. Variable definitions and data sources of these controls are presented in Appendix A. The continuous variables are winsorized at the top and bottom 1% of the sample distribution. Year-fixed effects are included unless otherwise stated. The symbols ***, **, and * denote the statistical significance at 1%, 5%, and 10%, respectively. Obs is the number of observations.

5. CONCLUSION

This paper delves into the relationship between public administration reform specifically in environmental governance and corporate technology investment in Vietnam. Our empirical results reveal a positive impact of environmental governance efficiency on firms' science and technology investment, confirming that provinces with stronger governance structures tend to host companies that prioritize technological upgrading and innovation.

Provincial governance influence is most evident in the Southeast region, where firms benefit more from transparent and predictable administrative practices. The impact of governance is less pronounced for large enterprises than for smaller firms, while the financial sector exhibits a stronger moderating effect than other industries. These patterns underline that governance quality operates through context-specific mechanisms shaped by firm scale, sectoral structure, and regional capacity.

Beyond these findings, the study offers broader development policy implications. Effective provincial environmental governance should be viewed not only as a regulatory function but also as a strategic lever for driving the digital–green transition. Local authorities can integrate environmental management reforms with industrial upgrading programs to enhance incentives for sustainable technology investment. Targeted fiscal and technical support should strengthen small and medium-sized enterprises (SMEs) in meeting digital and environmental standards, thus enabling deeper participation in global value chains. Finally, coordinated ASEAN initiatives such as green taxonomy alignment, regional technology funds, and shared learning from governance models like Indonesia's PROPER can amplify regional resilience.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Data Availability Statement: The corresponding author can provide the supporting data of this study upon a reasonable request.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.
Disclosure of AI Use: The authors used OpenAI's ChatGPT to edit and refine the wording of the article. All outputs were reviewed and verified by the authors.

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Appendix A. Variable definition.

R&D measures	
TEC_1	A variable that is defined as the natural logarithm of the Science and Technology (STD) fund. The STD investment fund represents the portion of the company's STD fund that remains unspent at the reporting date. In Vietnam, listed firms establish STD funds to finance scientific research and technological development endeavors. (FiinPro datasource provided by FiinGroup Joint Stock Company, Vietnam).
TEC_2	A variable that is defined as the amount of STD fund divided by the firm's sales revenue.
PAPI index and its components	
PAPI	The Viet Nam Provincial Governance and Public Administration Performance Index (PAPI) is the country's largest annual time-series. PAPI assesses three mutually reinforcing processes: policy making, policy implementation, and the monitoring of public service delivery. The philosophy behind PAPI's innovative policy monitoring approach is that citizens are seen as "end-users of public administrative services" capable of assessing governance and public administration in their localities.
Environmental Governance	One out of eight dimensions of government performance (PAPI)
Control variables	
Size	The natural logarithm of a firm's market capitalization at the end of the fiscal year *t-1* (FiinPro datasource).
Leverage	The total long-term debts divided by total assets (FiinPro datasource).
ROA	The income before extraordinary items divided by the book value of total assets at the end of fiscal year t (FiinPro datasource).
ROE	The ratio of net income over shareholder's equity at the end of fiscal year t (FiinPro datasource).
Cash	The ratio over total assets (FiinPro datasource)
Other variables	
Geo_dum	A dummy variable that takes the value of one for firms headquartered in the Southeast region of Vietnam and zero otherwise (Source: https://vietstock.vn/)
Size_dum	A dummy variable which takes the value of 1 if firm size is bigger than the median for the large firms and 0 otherwise for the small firms (FiinPro datasource).
Business_dum	A dummy variable that equals one if firms belong to the stock, insurance, and banking sectors (Source: https://vietstock.vn/)