

RESEARCH ARTICLE



Exploring the Impact of the Environmental Protection Tax on Chinese Enterprise Performance: The Mediating Role of Agency Costs

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Abstract: The aim of this study is to test the effect of the environmental protection tax on the financial performance of A-share listed companies in Shanghai and Shenzhen from 2016 to 2021. To achieve this, a differences-in-differences model was established to explore the impact of the environmental protection tax, agency costs, and enterprise performance. The analysis specifically examines how the implementation of the environmental protection tax influences enterprise financial outcomes and the function of agency costs between them. The results indicate that the introduction of an environmental protection tax notably lowers agency costs and increases the financial performance of Chinese listed companies. Furthermore, agency costs serve as a mediator in this relationship, amplifying the positive impact of the tax on enterprise performance. To ensure effective environmental protection practices in institutional contexts, the government should reinforce environmental protection tax laws and regulations while strengthening collaborative management mechanisms. Ultimately, the study provides valuable insights into the potential for policy-driven mechanisms to foster a more sustainable and economically viable corporate landscape in China.

Keywords: environmental protection tax, agency costs, enterprise performance, DID model

1. Introduction

Historically, enterprises have often tended to prioritize rapid economic growth while neglecting environmental stewardship. This has led to substantial environmental degradation, intensifying the conflict between economic expansion and ecological conservation with global climate warming. The swift expansion of economic activity and material consumption by residents has impeded sustainable development [1]. Under such circumstances, there are scholars who propose that environmental taxes and regulations are essential instruments for environmental protection [2, 3]. Due to its structured, fixed, and obligatory characteristics, the environmental protection tax has become a significant tool for fostering sustainable development and tackling pollution emissions in China. However, shifts in tax policy can profoundly affect the profitability and financial stability of enterprises [4, 5].

Tax regulation is an effective mechanism to internalize the external costs of pollution for businesses [6, 7]. The implementation of an environmental protection tax has financially burdened enterprises, pushing them toward more eco-friendly practices. However, transitioning from conventional to more sustainable business

strategies necessitates significant financial investment. From the company's point of view, financial investments, especially for long-term innovation investments, significantly consume production and working capital, leading to a decrease in productivity and increased costs compared to economic benefits. If the financial impact of the environmental tax is lesser than the profits from conventional production methods, enterprises may lack the motivation to modernize their processes [8].

Furthermore, transitioning from an emission fee to an environmental protection tax means that companies are now required to allocate a portion of their revenues toward environmental protection. This added financial burden puts pressure on firms to adapt their operations, potentially impacting their performance and making them more vulnerable to financing constraints. Consequently, this could deter firms from investing in environmental protection measures. In any case, the purpose of the law is to encourage companies to implement environmentally conscious practices, such as investing in green technology innovation, to improve their production processes [9]. Although green innovation requires extra investment in both labor and finances, the efficiency gains from a sustainable environmental approach can balance out the heightened costs and ultimately enhance a company's financial viability.

In modern enterprises, where ownership and management rights are separate, agency problems have become increasingly

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pronounced. Drawing from principal-agent theories, the conflicts of interest between shareholders and managers can aggravate these problems, prompting managers to act contrary to shareholder interests [10]. This misalignment can lead to over-investment, excessive pollutant emissions, and the misallocation of funds intended for environmental protection, thereby increasing agency costs and diminishing corporate performance. To mitigate these issues, the Environmental Protection Tax Law not only regulates both the operational activities and managerial environmental governance behavior of enterprises but also compels highly polluting companies to be more attentive and engaged in environmental restoration efforts. This ensures that business strategies align with shareholder interests, encourages corporate accountability in environmental initiatives, and prevents enterprises from prioritizing short-term performance over other vital considerations.

To date, many studies on this subject have examined the impact of environmental regulations on enterprise performance, focusing on factors such as enterprise productivity, R&D innovation, financing constraints, and investment in environmental protection [11–14]. However, few have explored the relatively recent implementation of an environmental protection tax in China. What's more, existing studies regarding agency costs predominantly examine the impact of internal and external governance mechanisms on enterprise performance, while often ignoring the governance effects caused by exogenous institutional shocks that enhance communication between shareholders and managers. This study intends to address this deficiency by utilizing a quasi-natural experiment presented by the Environmental Protection Tax Law to analyze its effects on A-share listed companies in Shanghai and Shenzhen from 2016 to 2021. The approach distinguishes the present study from previous work while deepening scholarly understanding of how environmental protection tax influences enterprise performance. By using a differences-in-differences (DID) model, we empirically assess the impact of the environmental protection tax on enterprise performance and incorporate a mediating effect model to explore the underlying mechanisms. By considering agency costs, the research enhances the understanding of how environmental protection tax affects enterprise performance and provides new insights.

2. Background and Hypothesis

2.1. Policy background

Developed countries have actively implemented environmental and green taxes since the 1980s to regulate pollutant emissions from firms [15]. For instance, the Organization for Economic Cooperation and Development countries embraced the “polluter pays” principle in 1972, obliging companies to pay fees for the pollution they generate. The US Congress introduced a bill for sulfide taxation in 1971, leading to the establishment of a comprehensive environmental tax system. In 2018, China implemented the “Environmental Protection Tax Law of the People's Republic of China,” mandating a tax on pollutant emissions from enterprises. Environmental taxes are considered a powerful economic mechanism to encourage environmentally friendly production and consumption, lower pollution, and advance sustainable development [16]. China's Environmental Protection Tax Law greatly influences production operations, investment decisions, disclosure of environmental information, and other corporate activities, thereby impacting overall enterprise performance. By clarifying the environmental responsibilities of enterprises and curbing their pollutant emissions, this legislation aims to achieve environmental governance objectives [7].

2.2. Environmental protection tax and enterprise performance

There are three primary perspectives from which academics have explored the impact of the environmental protection tax on enterprise performance. According to neoclassical economic theory, an environmental protection tax puts pressure on companies to improve their environmental stewardship, potentially hindering other performance improvements. For example, Levinsohn and Petrin [17] found that the paper industry in the United States has invested a significant amount of money in pollution prevention, but their productivity has stagnated; this suggests that stringent environmental regulations may inhibit enterprises' productivity and growth. The results of Yan et al. [18] show an unexpected negative relationship between environmental protection tax and company productivity. In contrast, there is a progressive view that although environmental protection taxes can increase costs, they can also spur innovation and lend competitive advantages [9, 19, 20]. This could offset the additional costs associated with taxation and boost profitability, resulting in the “compensation effect” and ultimately promoting economic growth [21]. Berman and Bui [22], Kong et al. [23], and Liu et al. [24] argued that environmental taxes could incentivize companies to enhance productivity, leading to improved performance. The uncertainty hypothesis, on the other hand, suggests that the link between environmental protection tax and enterprise performance is ambiguous, influenced by factors such as corporate heterogeneity and environmental externalities. This relationship might exhibit an inverted U-shape, initially rising then declining, or a positive U-shape, transitioning from an “offsetting effect” to a “compensating effect” as regulatory intensity varies [8, 16].

The environmental protection tax is a market-based regulatory tool that aims to motivate companies to meet their environmental responsibilities [25]. The tax policy is dynamic and allows local governments to adjust their tax rates within a set range determined by the central government. This flexibility enables local authorities to tailor their tax policies to suit the needs of their region's economic development and environmental conditions. By imposing higher taxes on pollutants, an environmental protection tax has the potential to significantly decrease air pollution and create a healthier environment for businesses to operate and thrive [26]. Research has shown that environmental taxes contribute positively to economic growth by incentivizing businesses to adopt more sustainable practices [27]. Higher levels of gross domestic product result in increased revenue from environmental taxes, which in turn can stimulate further economic growth [28]. The interdependence between environmental protection tax and economic growth highlights the need for effective tax policies to drive sustainable development. Additionally, new tax incentives encourage enterprises to balance profit maximization objectives with emissions limitations, helping to alleviate cost pressure, support development, and ultimately enhance economic benefits [29]. Based on this analysis, Hypothesis 1 was proposed.

Hypothesis 1: Environmental protection tax can improve the financial performance of enterprises.

2.3. Environmental protection tax and agency costs

Agency problems are prevalent in modern enterprises. Numerous studies have highlighted the role of internal governance in solving these problems. However, research on the impact of external institutional factors, like environmental protection tax, on agency costs has been limited. Pratiwi [30] noted that tax collection and management are significant external forces that can help reduce

agency costs and serve as a form of corporate governance. Similarly, Armour et al. [31] argued that a strong legal framework can play a role in reducing managerial agency problems and lowering agency costs. Further research by Schäuble [32] indicated that improvements in the external institutional environment can reduce agency costs and enhance corporate governance effectiveness.

The implementation of the environmental protection tax plays a crucial role in regulating environmental pollution through system construction. By limiting the decision-making authority of enterprise managers at the institutional level and imposing stricter regulations on corporate behavior, the tax effectively mitigates the negative effects of adverse selection and ethical hazards on environmental governance. It also helps mitigate agency problems to a certain extent. Building on this analysis, Hypothesis 2 was formulated.

Hypothesis 2: Environmental protection tax can reduce the agency costs of enterprises.

2.4. Environmental protection tax, agency costs, and enterprise performance

Currently, there is a gap in research investigating the relationship between environmental protection tax, agency costs, and enterprise performance. While some studies have tested the impact of environmental regulations on enterprises based on agency costs, using investments in pollution control as a measure of regulatory intensity, few have specifically explored this triad. For example, Baxamusa and Jalal [33] investigated the relationship between environmental protection tax and agency costs, finding that environmental regulations can decrease agency costs while enhancing future profitability. Similarly, Tian et al. [34] suggested that market-based environmental regulations significantly improve the environmental, social, and governance performance of enterprises, with agency costs acting as a mediator between the two variables.

As a market-based regulatory approach, the environmental protection tax uses various economic tools, including financial subsidies, to recalibrate the balance between pollution costs and profits. Following the introduction of the environmental tax, companies that adopt clean production methods can lower production costs, boost efficiency, and enhance product quality. This approach encourages enterprises to proactively manage their pollutant emissions. By directing management's environmental governance practices, the environmental protection tax mitigates the risk of misconduct and reduces agency costs for enterprises, thereby improving their performance. Hypothesis 3 was developed accordingly.

Hypothesis 3: Agency costs strengthen the promotional effect of the environmental protection tax on enterprise performance.

3. Data and Methodology

3.1. Data sources

This study focuses on the impact of an environmental protection tax on listed companies in Shanghai and Shenzhen from 2016 to 2021. The legislative day (December 25, 2016) was selected instead of the implementation day (January 1, 2018) because it marks the formal announcement of the Environmental Protection Tax Law, which is anticipated to have the greatest impact on stock prices [35]. In contrast, the implementation day may not provide any new information since the introduction of the new tax law was already anticipated and assured. The sample companies were selected based on the "Guidelines for the Industry Classification of Listed Companies" and the "Guidelines for the Disclosure of

Environmental Information of Listed Companies" (Draft for Solicitation of Comments). The sampled enterprises were divided into two groups: an experimental group consisting of heavy-polluting industries (e.g., steel and chemical) and a control group encompassing light-polluting industries (e.g., transportation, business services, culture, sports, entertainment). We identified heavy-polluting firms and non-heavy-polluting firms based on the updated classification in the 2022 Guidelines on Environmental Information Disclosure for Listed Firms. We compared data from before and after the implementation of the environmental protection tax to assess its impact on these two groups.

To guarantee the accuracy and reliability of the regression outcomes, several screening steps were applied. First, ST and *ST companies were excluded. Second, samples with missing data for variables were removed. Third, companies in the financial and insurance industries were excluded. Ultimately, 732 samples were obtained for the experimental group and 330 samples for the control group. To minimize the impact of outlier values, data were winsorized at the 1% and 99% quantiles. The primary data sources used for this study were primarily derived from the CSMAR database and the annual reports of listed companies.

3.2. Selected variables

3.2.1. Independent variable

The independent variable in this study is the multiplier term representing the implementation of the environmental protection tax, which is denoted as DID. $DID_{i,t}$ ($treated_i \times post_t$) represents the dummy variable of whether the enterprise is affected by the environmental protection tax in year t , i denotes the i -th enterprise, and $treated_i$ is the object of policy implementation. Heavy-polluting enterprises, which face stricter regulations under the Environmental Protection Tax, are treated as 1; light-polluting enterprises are treated as 0. The variable $post_t$ denotes the implementation time of the tax, January 1, 2018, so $post=0$ refers to the period before 2018 when the tax was not levied, and $post=1$ refers to the period after and including 2018 when the tax law was in effect.

3.2.2. Mediating variable

The management expense ratio (MER) serves here as a proxy variable for agency costs (AC), measured from the perspective of input. MER was calculated by dividing management expenses by primary business income. It reflects the level of agency costs like on-the-job consumption and improper spending on the part of senior executives.

3.2.3. Dependent variable

Return on total assets (ROA), return on equity (ROE), and Tobin's Q are typically utilized by scholars as proxy variables to assess enterprise performance. ROE provides a clear indication of an enterprise's operational performance and is a crucial factor in its profitability. In this study, ROE was used to measure enterprise performance and ROA to test the robustness of the results.

3.2.4. Control variables

To isolate the influence of variables reflecting the characteristics of corporate internal governance on agency costs and enterprise performance, this study builds on the work of Su et al. [36] and Su et al. [37] and selects several control variables, including company size (Size), ownership concentration (OC), equity balance degree (EBD), board independence (Board), and management shareholding ratio (Stock). By incorporating these control variables, the

analysis of factors affecting the financial performance of the selected firms becomes more comprehensive, enhancing the robustness of the study's findings.

The definitions of all variables are outlined in Table 1.

Table 1
Variable definitions

Variable types	VAR	Description
Dependent variable	ROE	Net profit/net assets
Mediating variable	AC	Management expense ratio
Independent variable	treated	Heavily polluting enterprises are coded as 1, otherwise 0
	post	1 after implementation, otherwise 0
Controls Variables	DID	$DID_{i,t} = (treated_i \times post_t)$
	Size	The natural logarithm of the company's total assets
	OC	Shareholding ratio of the top ten largest shareholders
	EBD	Shareholding ratio of the 2nd–5th largest shareholder/shareholding ratio of the largest shareholder
	Board	Number of independent directors/total number of directors
	Stock	Number of shares held by directors and supervisors/total number of shares

3.3. Research methodology

The mediating effect was included in the DID model used in this study. Model (1) was constructed to assess the impact of the environmental protection tax on enterprise performance. Model (2) was developed to examine its effect on agency costs. Model (3) was constructed to verify whether there is a mediating effect on agency costs.

$$ROE_{i,t} = \alpha_0 + \alpha_1 treated_{i,t} + \alpha_2 post_{i,t} + \alpha_3 DID_{i,t} + \lambda X_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (1)$$

$$AC_{i,t} = \beta_0 + \beta_1 treated_{i,t} + \beta_2 post_{i,t} + \beta_3 DID_{i,t} + \lambda X_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (2)$$

$$ROE_{i,t} = \eta_0 + \eta_1 treated_{i,t} + \eta_2 post_{i,t} + \eta_3 DID_{i,t} + \eta_4 AC_{i,t} + \lambda X_{i,t} + \gamma_t + \varepsilon_{i,t} \quad (3)$$

where $DID_{i,t}$, $(treated_i \times post_t)$ represents the independent variable, $ROE_{i,t}$ represents the dependent variable, $AC_{i,t}$ stands for the mediating variable, $X_{i,t}$ indicates all control variables, γ_t denotes year-fixed effects, and $\varepsilon_{i,t}$ is an error term.

4. Results

4.1. Descriptive statistics

Table 2 presents the descriptive statistics for each variable of the sample enterprises. The results show an average ROE of 0.0670, with values ranging from −0.595 to 0.363, indicating considerable variation in financial performance among the sampled enterprises. The range for AC is 0.00471–0.479, with a standard deviation of 0.0724, indicating that some enterprises may have more serious principal-agent problems.

For the control variables reflecting internal governance levels, the mean value for OC is 0.586, suggesting a relatively concentrated equity concentration among the sampled enterprises. The standard deviation for EBD is 0.589, with a range of 0.0335–2.721, highlighting significant differences in the balancing ability and internal governance of enterprises. The standard deviation for Board is 0.0522, with a minimum value of 0.333, in accordance with the stipulations of the “Company Law.” The range for Stock is 0–0.622, revealing a wide variance in the shareholding proportions of internal management across enterprises.

Table 2
Descriptive statistics

VAR	Total	Standard deviation	Mean	Min	Max
ROE	6,372	0.119	0.0670	−0.595	0.363
AC	6,372	0.0724	0.0807	0.00471	0.479
Size	6,372	1.320	22.66	20.10	26.37
OC	6,372	0.148	0.586	0.245	0.908
EBD	6,372	0.589	0.710	0.0335	2.721
Board	6,372	0.0522	0.373	0.333	0.571
Stock	6,372	0.160	0.0871	0	0.622

4.2. Correlation analysis

Prior to conducting an empirical analysis, a correlation coefficient test was performed on the sample to evaluate the linear correlation between variables and identify any potential collinearity issues. The correlation coefficient matrix for each variable is presented in Table 3. The findings indicate significant correlations between environmental protection tax and agency costs, confirming that the selected indicators are appropriate for further analysis. Specifically, there is a significant and positive correlation between environmental protection tax and enterprise performance ($\beta = 0.081$, $p < 0.01$), confirming Hypothesis 1. Additionally, the relationship between environmental protection tax and agency costs is significantly negative ($\beta = -0.179$, $p < 0.01$), validating Hypothesis 2.

Furthermore, all control variables, except for Board, demonstrate significant correlations with enterprise performance. This affirms the suitability of the chosen control variables. Notably, OC is negatively correlated with AC, implying that enterprises with more concentrated ownership may more effectively regulate managerial behavior. Conversely, EBD is positively correlated with AC, indicating that enterprises with a higher equity balance may neglect managerial oversight, potentially leading to increased agency costs.

Table 3
Correlation coefficients

	ROE	DID	AC	Size	OC	EBD	Board	Stock
ROE	1							
DID	0.081***	1						
AC	-0.256***	-0.179***	1					
Size	0.129***	0.048***	-0.305***	1				
OC	0.163***	-0.076***	-0.100***	0.305***	1			
EBD	-0.083***	-0.00300	0.097***	-0.069***	0	1		
Board	-0.0150	0.00300	0.0200	0.023*	0.026**	-0.021*	1	
Stock	0.045***	0.028**	-0.0110	-0.307***	0.055***	0.153***	0.042***	1

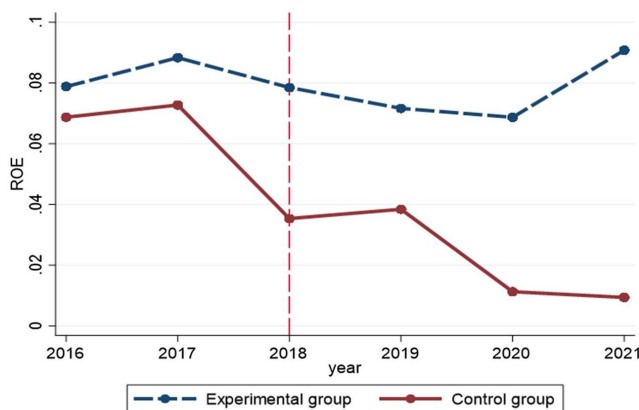
Note: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

4.3. Regression analysis

4.3.1. Parallel trend test

The assumption of parallel trends is essential for accurately determining DID model validity [38, 39]. Accordingly, a preliminary test on the trends in ROE for the sampled enterprises in both experimental and control groups was conducted prior to the regression analysis. The results are illustrated in Figure 1. While both groups exhibited a similar trend in ROE prior to the policy implementation, the trends diverged afterward. The parallel trend test confirms the validity of applying the DID model to these results.

Figure 1
Parallel trend test results



4.3.2. Regression results analysis

This study investigates the connection between environmental protection tax, agency costs, and enterprise performance. The results for Model 1 (Table 4) reveal a significant positive relationship between the tax and enterprise performance ($B = 0.0384, p < 0.01$), thereby confirming Hypothesis 1. The introduction of the environmental protection tax has raised production costs for businesses, prompting them to enhance production efficiency and alleviate the tax's economic impact. This, in turn, bolsters competitiveness and improves overall enterprise performance. The results also reveal a notable significant relationship between EBD and enterprise performance ($\beta = 0.122, p < 0.01$). This implies that as EBD increases, shareholders become more motivated to supervise managers and

safeguard their own interests, consequently improving enterprise performance.

In Model 2, a significant negative relationship is observed between environmental protection tax and agency costs ($\beta = -0.0253, p < 0.01$), confirming Hypothesis 2. This relationship can be attributed to the financial burden of the tax on enterprises, which, along with external tax policies and internal shareholder oversight, discourages management from engaging in misconduct related to environmental governance and thus reduces agency costs. Moreover, strong tax incentives encourage management to prioritize environmental governance, aligning managerial objectives with environmental protection and reducing the likelihood of management infringing upon shareholder interests.

Model 3 examines the mediating effect of agency costs, revealing a great negative impact of agency costs on enterprise performance ($\beta = -0.566, p < 0.01$). The environmental protection tax has a significant positive effect on enterprise performance ($\beta = 0.0241, p < 0.01$), although the coefficient is lower in Model 3 compared to Model 1. This suggests that agency costs act as a mediator between environmental protection taxes and enterprise performance, enhancing the impact of these taxes on improving enterprise performance. These results support Hypothesis 3 and underscore the importance of considering agency costs in determining the impact of an environmental protection tax on enterprise performance. According to the principal-agent theory, when managers and shareholders have conflicting goals, managers may engage in behaviors that exceed emission standards and waste resources, leading to actions that violate shareholder interests [40]. However, the environmental protection tax can alleviate information asymmetry between shareholders and executives, preventing a narrow focus on short-term performance at the cost of other crucial factors. The implementation of an environmental protection tax poses environmental reputation risks and environmental violation risks to enterprises [41]. In order to maintain their market reputation, executives are likely to make decisions that align with environmental regulations and prioritize shareholder interests. This means reducing agency costs, alleviating information asymmetry, increasing opportunities for corporate social responsibility, easing financing constraints, and ultimately improving financial performance [42].

4.4. Robustness tests

To further improve the reliability of our conclusions, robustness tests were performed to validate if our main results remain consistent when utilizing ROA. The outcomes (Table 5) closely align with the initial results, further reinforcing the hypotheses

Table 4
Regression results

	Model 1 ROE	Model 2 AC	Model 3 ROE
treated	0.151*** (3.59)	0.00980 (1.06)	0.157*** (3.45)
post	−0.0477*** (−6.00)	0.0174*** (5.54)	−0.0378*** (−4.89)
DID	0.0384*** (6.42)	−0.0253*** (−10.72)	0.0241*** (3.89)
AC			−0.566*** (−7.60)
Size	0.0367*** (4.76)	−0.0359*** (−11.02)	0.0163* (2.11)
OC	0.122*** (3.40)	0.0321 (1.93)	0.140*** (3.96)
EBD	−0.0137 (−1.72)	−0.00403 (−1.26)	−0.0159* (−2.08)
Board	0.0880 (1.64)	0.0321 (1.65)	0.106* (2.09)
Stock	0.0662 (1.64)	−0.0227 (−1.70)	0.0533 (1.36)
Constant terms	−0.869*** (−5.23)	0.809*** (11.67)	−0.411* (−2.45)
Year	control	control	control
R-sq	0.41	0.78	0.44
adj. R-sq	0.29	0.73	0.32

Note: Standard errors in parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Table 5
Robustness tests

	Model 1 ROA	Model 2 AC	Model 3 ROA
treated	0.0668*** (3.46)	0.00980 (1.06)	0.0698*** (3.30)
post	−0.0193*** (−5.45)	0.0174*** (5.54)	−0.0141*** (−4.17)
DID	0.0188*** (7.07)	−0.0253*** (−10.72)	0.0111*** (4.18)
AC			−0.302*** (−9.22)
Size	0.0135*** (3.53)	−0.0359*** (−11.02)	0.00265 (0.72)
OC	0.0749*** (3.90)	0.0321 (1.93)	0.0846*** (4.44)
EBD	−0.00439 (−1.12)	−0.00403 (−1.26)	−0.00560 (−1.49)
Board	0.0149 (0.59)	0.0321 (1.65)	0.0246 (1.02)
Stock	0.0428* (2.30)	−0.0227 (−1.70)	0.0360* (1.99)
Constant terms	−0.325*** (−3.95)	0.809*** (11.67)	−0.0814 (−1.03)
Year	control	control	control
R-sq	0.51	0.78	0.54
adj. R-sq	0.41	0.73	0.44

Note: Standard errors in parentheses. ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

examined in this study. All control variables utilized in the primary regressions are accounted for and detailed in this analysis.

5. Conclusions

This study utilized data concerning A-share listed companies in Shanghai and Shenzhen from 2016 to 2021 to conduct a quasi-natural experiment investigating the implementation of the Environmental Protection Tax in 2018. We established a DID model to examine the connection between this tax, agency costs, and enterprise performance. The findings indicate that the implementation of the environmental protection tax has positively impacted the financial performance of listed companies in China, which is consistent with other literature in this field [5, 17]. Moreover, the tax can notably lower the agency costs of enterprises, with agency costs

acting as a mediator between the variables. These findings highlight the impact of the environmental protection tax in enhancing enterprise performance.

Therefore, we offer two suggestions based on this analysis:

First, the government and relevant departments should refine the implementation laws for the environmental protection tax and establish a more robust management mechanism in collaboration with tax authorities. For example, it is advisable to establish teams dedicated to environmental tax collection and management to oversee and monitor the declaration and collection of environmental tax within their respective areas of authority. Such measures would optimize the institutional environment, ensuring the successful implementation of the environmental protection tax system. Currently, tax incentives and reductions are primarily limited to agricultural production, urban and rural sewage, and domestic waste.

Therefore, expanding the scope of tax incentives is crucial for encouraging enterprises to increase their investments in environmental protection, foster greener practices, and achieve a balanced integration of economic growth and environmental sustainability. In addition, relevant authorities should center on mitigating the “compliance costs” imposed by the environmental tax on businesses. Efforts should be directed at reducing investment and financing risks, as well as easing the pressures associated with environmental management. Strengthening the oversight of implementation progress in various regions is crucial. Improve the level of environmental supervision and law enforcement to ensure close integration between environmental governance and official performance evaluation, while enhancing the transparency of environmental data to prevent “government-business collusion” [43, 44].

Second, enterprises must actively comply with national environmental protection regulations and fulfill their environmental responsibilities. This can be achieved by optimizing production processes, adopting advanced machinery and technology, and implementing waste recycling initiatives to promote green and sustainable development [45–47]. Enterprises should also focus on producing environmentally sustainable products to enhance their competitiveness and expand market share. This strategy has the potential to redirect the eco-industry chain and ultimately enhance financial performance. Moreover, establishing robust internal management systems and encouraging executives to “self-control” can help enterprises minimize agency costs, minimize information asymmetry between shareholders and executives, and expand the ways to fulfill corporate social responsibility, so as to ensure long-term sustainable growth.

Although rigorous analysis and robustness testing were performed to account for other policy impacts, missing variables, and sample selection biases, the potential effects of unaccounted factors cannot be completely ruled out. In addition, given the relatively short period since the implementation of the Environmental Protection Tax Law, this study covers merely the years 2016–2021. With the deepening of policy implementation, future research will focus on its long-term impacts.

Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Data available on request from the corresponding author upon reasonable request.

Author Contribution Statement

Jiixin Huang: Conceptualization, Methodology, Writing – review & editing. **Jing Cheng:** Conceptualization, Data curation, Writing – original draft, Visualization. **Xiao Zheng:** Formal analysis, Investigation. **Meifen Wu:** Data curation, Visualization.

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How to Cite: Huang, J., Cheng, J., Zheng, X., & Wu, M. (2025). Exploring the Impact of the Environmental Protection Tax on Chinese Enterprise Performance: The Mediating Role of Agency Costs. *Green and Low-Carbon Economy*. <https://doi.org/10.47852/bonviewGLCE52024758>