# Research on Measurement and Transformation Path of Integrated Development of Enterprise Environmental Performance Driven by Green Tax Law: Evidence from China

**Abstract**: The implementation of the environmental protection tax law (EPTL) is a comprehensive reflection of China's efforts to green its tax system. This research systematically explores the impact and internal mechanisms of the green tax law reform on corporate environmental performance. The findings indicate that the EPTL significantly and robustly enhances corporate environmental performance, a conclusion that remains valid after a series of robustness tests. Heterogeneity analysis reveals that the EPTL promotes corporate environmental performance in companies with stronger financing constraints; the effect is more pronounced in companies with higher internal transparency; state-owned enterprises (SOEs) show a stronger improvement in environmental performance, indicating that SOEs can set an example; the background of senior executives is a significant factor influencing the improvement of environmental performance. Mechanism analysis shows that the EPTL primarily enhances corporate environmental performance by strengthening local government enforcement, increasing local government attention to environmental issues, promoting corporate green innovation, and resolving collusion between government and enterprises. Extended analysis indicates that the EPTL does not significantly trigger negative pollution transfer across regions but instead drives corporate green transformation. The research conclusions offer important insights for improving corporate green governance and promoting high-quality national economic development.

**Keywords**: Environmental Protection Tax Law; Environmental Performance; Pollution Refuge Hypothesis; Porter Hypothesis

# 1. Introduction

The extensive economic development model, characterized by high energy consumption and pollution, has driven China's rapid economic growth, creating a growth miracle for the Chinese economy. However, the fundamental pressure of ecological and environmental protection has not been fundamentally alleviated, and pollution emissions and ecological destruction have become major obstacles to building a beautiful China. Given the current state of pollution control, adopting efficient and appropriate environmental regulatory measures is now the top priority in the construction of ecological civilization. Although command-and-control policy-based regulatory measures have achieved significant results in environmental protection and pollution control, they face practical issues such as high enforcement costs and “one-size-fits-all” approaches; market-based environmental policies are urgently needed to play a profound role. Although China's market-based environmental regulatory policies started late, they are increasingly recognized by all sectors of society as a crucial force in pollution control. The environmental protection tax law (EPTL), an important market mechanism-based environmental regulatory policy in China, requires further in-depth exploration of its environmental governance effects and mechanisms (Liu et al., 2022; Li and Hua, 2024).

Tracing the implementation of the EPTL, before its enforcement, the Chinese government led and continuously evolved a system of pollution discharge fees. This system-imposed charges on industrial enterprises for discharging wastewater, exhaust gas, and waste residue that exceeded environmental standards, which helped to slow down environmental degradation. However, two significant issues emerged as the pollution discharge fee system progressed. First, the low threshold for pollution discharge fees had a severe adverse effect on market participants, as companies lacked the incentive to convert pollution control costs into their production expenses. Despite the State Council and other ministries issuing a series of management regulations aimed at reversing the passive payment for pollution discharge phenomenon, empirical evidence has not effectively demonstrated the environmental governance outcomes (Chen et al., 2014). Second, the scope of pollution discharge fee collection was relatively narrow, and the rigidity of local collection was generally insufficient, leading to the collection targets being concentrated in the production sector, mostly in large and medium-sized cities, while many small and medium-sized enterprises were scattered in a “disorderly and polluting” pattern. From the perspective of enterprises themselves, pollution control, being a non-economic project with obvious externalities, makes it difficult for companies to have the motivation to actively manage pollution. From the perspective of local alienation behavior, there is a deep contradiction between the rules of pollution discharge fee collection and rapid economic growth. Due to the contradictions between environmental law enforcement and local protectionism, the pollution discharge fee system primarily targets large enterprises, severely neglecting small and medium-sized enterprises, ultimately leading to a 'dilemma' between environmental pollution and the rapid development of enterprises.

Whether the concept of green development can be effectively transformed into a driving force for environmental governance by entities primarily depends on whether these entities can internalize the costs of pollution control, shifting from passive to active governance. The EPTL, enacted in 2016 and officially implemented on January 1, 2018, as an extension of the pollution discharge fee system, marks the smooth transition from a fee to a tax. This law signifies the formal implementation of China's first standalone tax law centered on green taxation and represents a comprehensive reflection of the greening process of China's tax system. In this context, can the EPTL fundamentally address the challenges of environmental pollution control? Additionally, does it have a Porter's Law effect on enterprises, thereby effectively promoting improvements in their environmental performance? Addressing this question is crucial for resolving environmental issues arising during enterprise development and further advancing the comprehensive green transformation of economic and social development.

# 2. Literature review

The concept of green taxation originates from Pigou's' Welfare Economics, 'which discusses the dual benefits of environmental and economic effects (Bovenberg et al., 1997). Foreign scholars generally agree that green taxation can achieve environmental benefits, but there is ongoing debate about whether it can also achieve economic benefits (Bonnet et al., 2018). The' Porter Hypothesis 'suggests that green taxation can drive corporate innovation, thereby achieving both environmental and economic benefits. However, some argue that if green innovation is beneficial to companies, why do they not act on their own initiative? Instead, innovation is often driven by external incentives and penalties. China has not had a genuine environmental tax for a long time, and domestic scholars have primarily focused on the pollution discharge fee system, which can be summarized in three aspects: first, the environmental impact of the pollution discharge fee system; second, the economic impact of the pollution discharge fee system; and third, the comprehensive impact of the pollution discharge fee system (Gunningham, 2009). By 2018, China gradually transitioned from a fee-based system to a tax-based system, implementing the EPTL. It is therefore essential to verify whether the dual benefits effect has been realized in China.

The literature related to this study can be categorized into three main areas: First, it examines the microeconomic effects of the EPTL from various perspectives; Second, it analyzes the primary mechanisms through which the EPTL influences corporate behavior, including the rectification actions and relocation behaviors of companies in response to environmental regulations; Third, it focuses on the economic incentives that drive companies to improve their environmental performance.

The microeconomic effects of the EPTL. Scholars have empirically found that the implementation of the EPTL has positive economic outcomes for enterprises, including reducing emissions (Farooq et al., 2023), green transformation (Boubaker et al., 2024), innovation (Sahoo et al., 2023; Ameer and Khan, 2023), total factor productivity (Hanif et al., 2023), and environmental investment (Awawdeh et al., 2021). Omran (2021) found that the implementation of the EPTL helps improve the ESG performance of heavily polluting enterprises, thereby enhancing their sustainable development capabilities. The ESG indicators include environmental performance metrics, but the nine-level standard is too coarse to reveal significant differences in environmental performance among enterprises at the same level, making it difficult to provide direct evidence of improvements in environmental performance.

The EPTL influences the micro-level mechanisms of enterprises. Due to information asymmetry among enterprises, the primary mechanism by which the EPTL impacts enterprise behavior is through the transformation from passive to active governance. Specifically, the law exerts strong environmental legitimacy pressure, compelling enterprises to take proactive measures against pollution (Boubaker et al., 2024). This pressure encourages enterprises to improve their product structures through technological innovation, making them ‘cleaner’ and reducing the proportion of polluting products, thus addressing pollution at its source. Under the exogenous impact of environmental regulations, enterprise behavior undergoes significant changes. According to the 'pollution haven' hypothesis, the high costs of environmental regulation force polluting enterprises to relocate (Hanif et al., 2023). Faced with the pollution control pressure from the EPTL, enterprises may choose to produce in regions with less stringent environmental regulations, thereby reallocating their operations spatially. However, few studies have provided empirical evidence based on the EPTL.

The economic incentives for companies to enhance their environmental performance. The first type of incentive stems from the desire to reduce compliance costs and alleviate environmental cost pressures by improving environmental performance. As environmental regulations become increasingly stringent, companies that ignore pollution control will face severe penalties for environmental pollution, which contradicts their goal of maximizing profits. The second type of incentive comes from companies fulfilling their environmental social responsibilities, thereby building intangible assets and enhancing their reputation value. Specifically, this is achieved by enhancing environmental performance, establishing a responsible image, attracting more attention from investors in the capital market, easing financing constraints, and promoting corporate social value (Nyilasy et al., 2014). More evidence supports the first type of incentive. Sahoo (2023) examined the micro effects of environmental law enforcement supervision from the perspective of corporate environmental performance, finding that environmental inspections significantly improved the environmental performance of enterprises in the inspected regions. Gunningham (2009) used the establishment of the Environmental Protection Law as an event to verify that the law significantly improved corporate environmental performance through its legal mechanisms of punishment and incentives.

In summary, the specific environmental decisions made by microeconomic actors under the EPTL and the discussion on the motives for companies to improve their environmental performance within other economic effects are insightful. However, there are still potential areas for further exploration: (1) In terms of research perspective, existing literature rarely integrates the significant event of China's tax reform, the EPTL, with corporate environmental performance in a single research framework. Moreover, few studies have examined the migration behavior of enterprises caused by the implementation of the EPTL based on the' pollution haven 'hypothesis; (2) In terms of research methods, existing literature often uses methods such as pollutant emission levels (Uddin et al., 2023) and environmental indicator scores (Clarkson et al., 2008) to measure corporate environmental performance. These methods are subjective and fail to fully capture the potential impact of corporate environmental decisions on their own operations; (3) In terms of identification strategies, existing literature only roughly categorizes enterprises into polluting and non-polluting types, without considering the differences in law enforcement intensity across industries due to industry size or clustering, leading to biased regression results; (4) Few studies have attempted to analyze whether the EPTL can enhance local environmental awareness, reduce collusion between government and enterprises, increase law enforcement rigidity, and thus eliminate the' hidden economy' to boost environmental performance.

Based on this, the article uses micro data from listed companies in the Shanghai and Shenzhen A-share markets, along with relevant data from the 'China Environmental Statistics Yearbook' and provincial statistical yearbooks over the years, to examine how the establishment of the EPTL affects corporate environmental performance. It also analyzes whether companies will rectify their practices or engage in cross-regional production under such environmental regulations. The research theme enriches previous studies on environmental regulation and corporate environmental behavior, with potential marginal contributions in three main areas: First, it examines the specific impact of the implementation of the EPTL on corporate environmental performance at the micro-level, further enriching research in this area. Building on existing studies, this exploration helps deepen our understanding of the current dynamic development of the EPTL and enhances research on the interaction between enterprises and environmental policies. Second, using rich macro and micro data, the article explores two channels-corporate environmental pollution rectification and increased location selection-to reveal the possible behaviors of companies facing the green tax law and the internal logic behind their pursuit of optimal environmental protection decisions in response to environmental regulation. This study examines how companies can flexibly adapt to macro environmental regulation and adapt to new characteristics of changes in regulatory intensity from both theoretical and empirical perspectives. Third, the article expands the intrinsic driving factors of corporate environmental performance from the perspective of the implementation of the EPTL. The findings are significant for promoting corporate responsibility in environmental pollution control and building a modern society where humans and nature coexist harmoniously.

# 3. Institutional background and research hypothesis

**3.1 Institutional background**

The environmental protection tax system in China originated from the pollution discharge fee system, which began as a pilot program in 1979 and was officially implemented nationwide in 1982. The ETPL was approved on December 25,2016, and came into effect on January 1, 2018, marking the end of the more than 30-year-old pollution discharge fee system. The law primarily draws on the design of the pollution discharge fee system, ensuring a smooth transition from a fee-based to a tax-based system through institutional and tax burden transfers. It also promotes corporate compliance with environmental obligations through mandatory punitive and positive incentive mechanisms outlined in the tax law.

According to the EPTL, the tax is levied on enterprises, institutions, and other producers and operators. The taxable pollutants include air pollutants, water pollutants, solid waste, and noise, as specified in the attached regulations of the law. Compared to the pollution discharge fee system, the EPTL has strengthened both institutional and policy arrangements. The law taxes enterprises based on the type and degree of pollution of their emissions. For instance, if a taxpayer's emission concentration is 30% below the standard, the tax is reduced to 75%; if it is below 50%, the tax is reduced to 50%. The law also implements differentiated management based on the pollution level of the pollutants. Additionally, a dynamic tax rate adjustment mechanism is adopted, where the central government sets the minimum standard, and local governments can adjust it upward as needed. The EPTL specifies the upper and lower limits of the taxable amount, authorizes local governments to propose specific applicable tax rates based on local conditions, and reports these to the standing committee of the same-level people's congress for approval, to meet the environmental governance needs of different regions.

In terms of policy arrangements, the EPTL encourages enterprises to engage in clean production activities. Specifically, the law offers multiple tax reduction benefits for companies that implement clean production practices, thereby maximizing the positive incentives of tax incentives. Additionally, it supports enterprises in concentrating on pollutant treatment. The law stipulates that enterprises, institutions, and other producers and operators that discharge taxable pollutants to legally established centralized sewage treatment facilities or centralized household waste treatment facilities are exempt from the environmental protection tax. It also encourages enterprises to recycle emissions; taxpayers who comprehensively utilize solid waste that meets national and local environmental protection standards are temporarily exempt from the environmental protection tax. As a significant practice in China's tax system reform, the ETPL marks the formal elevation of China's environmental protection system from an administrative level to a legal one. This article will examine whether the implementation of the EPTL can effectively enhance corporate environmental performance, based on the official implementation of the law.

**3.2 Research hypothesis**

Unforeseen expenses lead to increased private costs for businesses, hindering their ability to expand production and contradicting the goal of maximizing profits. If companies allocate part of their funds to pollution control, it generates positive externalities that cannot be internalized, eroding their price advantage and placing them at a disadvantage in an imperfect competitive market. Therefore, when there are no external constraints, companies lack the incentive to actively manage pollution. What methods can address this issue? Pigou's' polluter pays principle' provides a theoretical solution. This principle involves imposing a Pigou tax on polluters based on the severity of their pollution, using the tax to bridge the gap between private and social costs. Environmental taxes, derived from the Pigou tax, increase the costs for firms that impose negative externalities through taxation, indirectly raising the cost of resource use and correcting intergenerational unfairness in resource allocation. EPTL, green credit policies, and emission trading policies are all market-based regulatory tools, but EPTL have a more solid legal foundation, relying on the authority and enforceability of the law to regulate corporate pollution. From a punishment mechanism perspective, environmental protection taxes establish strict pollutant emission standards, clearly defining taxable items, units, and amounts, thereby increasing compliance costs to control corporate emissions of pollutants and greenhouse gases, forcing companies to reduce pollution and improve their environmental performance. From the perspective of the tax law's incentive mechanism, the EPTL adopts a positive emission reduction incentive system that levies taxes based on emissions: more emissions, more taxes; fewer emissions, fewer taxes; no emissions, no taxes. This system encourages companies to reduce energy consumption and emissions, guides them to accelerate the development of green industrial and supply chains, and expands the scale of green production. Additionally, the EPTL supports companies in making environmental decisions and implementing green governance by providing policy support and resource allocation to those that proactively manage pollution and fulfill their environmental social responsibilities, thereby enhancing their environmental performance.

The paper proposes the following hypothesis:

H1: ***The implementation of EPTL can improve the environmental performance of enterprises. Compared with other industries, the improvement effect of environmental performance of enterprises affected by EPTL is more significant.***

China implements a regional responsibility system to oversee local environmental quality, making the specific actions of local governments crucial for regional environmental quality. This situation means that, compared to environmental governance, if local governments prioritize economic performance over environmental protection, they may struggle to achieve effective local environmental governance. Given China's long-term' extensive 'economic development, the local competition model weakens the effectiveness of administrative supervision, making it difficult for command-and-control environmental regulations to function effectively (Yan et al., 2021; Boubaker et al., 2024). Local governments frequently intervene in environmental law enforcement through administrative measures, and the collusion between government and enterprises is an urgent issue that needs addressing (Verbeke and Coeck, 1997). Compared to traditional administrative regulatory methods, the EPTL helps address the issue of collusion between government and enterprises and promotes improvements in corporate environmental performance. Specifically, the EPTL enhances the willingness of tax enforcement agencies to enforce laws, breaks down collusion between government and enterprises, and strengthens the environmental focus of local governments. This helps to eliminate the' invisible economy' and forces enterprises to comply with environmental regulations. Additionally, the tax law requires the competent authorities to regularly report environmental protection information to the tax authorities and uses legal measures to strictly punish non-reporting or false reporting of enterprise emissions, ensuring the enforcement efficiency of the tax law. Furthermore, the diversity of entities involved in tax supervision means that the EPTL can better leverage the coordination and cooperation among various functional departments compared to other regulatory measures. This law has stronger enforcement rigidity, encourages local government departments to focus on environmental efficiency, and promotes the achievement of administrative goals (Gunningham, 2009). From a policy design perspective, the EPTL, as an extension of the pollution discharge fee system, is more deeply considered in response to China's current pollution control situation. In terms of policy implementation strategies, it complements and strengthens the pollution discharge fee system, making the increase in environmental taxes more direct and effective (Pham et al., 2024). Regarding the types of products regulated entities produce, well-designed environmental policies generate an' innovation compensation' effect, encouraging companies to integrate emerging technologies into their production processes, leading to the reallocation of internal product resources and productivity improvements (Chelly et al., 2022; Acemoglu et al., 2012). The increase in environmental taxes for non-green products by enterprises promotes greater investment in end-of-pipe treatment, driving companies to adjust their product structures through green innovation, resulting in a cleaner product structure.

The paper proposes the following hypothesis:

H2: ***The implementation of the EPTL will help improve the environmental awareness of local governments, strengthen the rigidity of law enforcement, break the collusion between government and enterprises, and encourage enterprises to make green innovation to promote the improvement of their environmental performance.***

From the classical agricultural location theory to the Weber industrial location theory, and then to the neoclassical location theory, companies typically choose locations with the lowest production costs and the greatest cost savings. As environmental regulations become stricter, leading to higher production and compliance costs, regulated companies, unable to afford the rising operational costs, are less motivated to improve and instead opt to evade environmental enforcement, resulting in negative cross-regional relocation (Farooq et al., 2023). The formal implementation of the EPTL means that heavily polluting enterprises must not only face local environmental policies such as environmental consultations and pilot projects (Boubaker et al., 2024) but also the environmental legitimacy pressure imposed by the EPTL, which increases their compliance costs. According to the 'Pollution Haven Hypothesis,' heavily polluting enterprises tend to choose regions with lower environmental thresholds for production (Tobey, 2001; Galeotti et al., 2020). Considering China's current development situation, the imbalance and inadequacy in development have led to continuous economic differentiation among regions, and the gradient differences in environmental standards and management strictness across regions make pollution transfer possible. Research by Gunningham (2009) has found that regional disparities in environmental regulations can lead to the near-term transfer of pollution. Bădîrcea et al. (2020) assessed the impact of environmental regulations on regional carbon emissions, highlighting that the varying intensity of these regulations across different regions in China leads to the transfer of carbon emissions within these regions. New economic geography, which examines spatial economic structures and changes, further emphasizes that market potential is a key factor influencing corporate location decisions. The Environmental Protection Law grants local governments the authority to set tax rates (İnceiplik and Şimşek, 2024), allowing them to determine and adjust the tax rates for certain taxable pollutants, balancing environmental protection with economic and social development. This regulation means that polluting enterprises in developed areas may face stricter environmental regulations. For instance, in Xinjiang, the tax rates for air and water pollutants are 1.2 yuan and 1.4 yuan per pollution equivalent, respectively, whereas in Jiangsu, the tax rate for air pollutants is 4.8 yuan per pollution equivalent (8.4 yuan per pollution equivalent in Nanjing), and for water pollutants, it is 5.6 yuan per pollution equivalent (8.4 yuan per pollution equivalent in Nanjing). This indicates that there are significant differences in the local applicable tax rates under the EPTL, and market potential varies significantly with the intensity of local regulations. Faced with varying environmental compliance pressures in different regions, if companies find it difficult to bear the costs of rectification, they may be motivated to engage in cross-regional production.

The paper proposes the following hypotheses:

H3a: ***Heavy polluting enterprises are faced with the implementation of EPTL, and more choose to produce in areas with less environmental regulation.***

H3b: ***Heavy polluting enterprises are faced with the implementation of EPTL. Due to market potential, they will also choose to rectify in order to improve their environmental legitimacy.***

# 4. Indicator construction, data source and identification strategy

In summary, the EPTL influences corporate environmental performance both internally and externally. However, the analysis primarily focuses on theoretical and logical aspects. Therefore, this section and subsequent parts of the article use panel data from A-share listed companies in the Shanghai and Shenzhen stock markets from 2016 to 2019 to further identify the impact of the formal implementation of the EPTL on corporate environmental performance and to empirically validate the aforementioned theoretical mechanisms.

**4.1 Identification strategies**

Our research uses the EPTL, which came into effect in 2018, as a quasi-natural experiment. It employs the difference-in-differences method to examine the impact of the environmental protection tax on corporate environmental performance. The difference-in-differences model, based on the period before and after the policy's implementation, effectively isolates the policy's effects, making it widely used by scholars for assessing policy impacts. Drawing on existing literature, this paper constructs a multi-dimensional fixed effects model, with the following form:

$EP\_{it}=β\_{0}+β\_{1}ET\_{it}+β\_{2}pul\_{it}+β\_{j}\sum\_{j}^{} Controls\_{it}+λ\_{i}+ind\_{j}+year\_{t}+prov\_{k}$+$ε\_{ijtk}$

where $i$ denotes firms, $t$ denotes years, $ind$ represents industries, and $prov$ indicates provinces, the dependent variable $EP\_{it}$ measures environmental performance of firm $i$ in year $t$. The policy-time interaction term $ET\_{it}$ captures whether treated firms are affected by the EPTL. $pul\_{it}$ is a binary variable indicating heavily polluting firms, while $Controls\_{it}$ denotes a vector of other control variables. All regression equations employ industry-clustered robust standard errors. We consistently include Firm fixed effects ($λ\_{i}$), industry fixed effects ($ind\_{j}$), year fixed effects ($year\_{t}$), province fixed effects ($prov\_{k}$) in all specifications to mitigate omitted variable bias, with $ε\_{it}$ denoting the error term. In robustness checks, we construct an industry pollution emission increment indicator to identify heterogeneous responses to the EPTL across industries, thereby further examining the tax law's effect on environmental performance enhancement.

The results of the double difference model are valid under the assumption that the parallel trends between the treatment and control groups are established and the timing of the policy is certain. Therefore, in the empirical analysis, we adopt the event study method to test the differences between the treatment and control groups before the policy began, and to verify the uniqueness of the policy timing, confirming that there was no policy effect prior to 2018. The method for testing the parallel trend is as follows:

$$EP\_{it}=β\_{0}+∑β\_{k}ET\_{it}^{k}+β\_{2}pul\_{it}+β\_{j}\sum\_{j}^{} Controls\_{it}+λ\_{i}+ind\_{j}+year\_{t}+prov\_{k}+ε\_{ijtk}$$

where *k* is the difference between each year and 2018, $ET\_{it}^{k}$indicates the implementation of the EPTL in a specific year. The rest of the model is the same as the previous one. This paper takes the year when the EPTL was formally implemented in 2018 as the base period to examine the parallel trend and the dynamic time change of policy effects

**4.2Index construction**

1. Core explained variables.

This article primarily examines the impact of EPTL on corporate environmental performance. Current methods for identifying environmental performance include: first, using the pollutant emission method, which primarily measures a company's pollution intensity. However, this method is subject to subjective selection of pollutants and challenges in data collection; second, using the environmental indicator evaluation method, which involves constructing an environmental performance index system to score and assess a company's environmental performance level. This method also suffers from subjectivity in index construction and weight measurement, making it difficult to accurately capture a company's true environmental performance.

Given the numerous issues with the aforementioned methods, this paper adopts the ecological benefit method to measure corporate environmental performance. This method reflects a company's environmental performance by measuring the economic benefits of its environmental contributions, including the output of products or services. A higher value of this indicator indicates better environmental performance. In this paper, environmental protection expenditure is used as a proxy for a company's environmental contribution, with the measurement method following Hanif et al. (2023). For economic benefits, this paper draws on existing literature and uses the company's total operating revenue to reflect its business performance (Boubaker et al., 2024). Environmental performance is measured by the ratio of the company's economic benefits to its environmental contributions. Both the economic benefits and environmental contributions are logarithmically transformed in this paper. In the robustness test, the company's total factor productivity is used as a proxy for business performance.

**2. Core explanatory variables.**

The time point of environmental protection fee reform to tax is January 1, 2018. Based on the existing research, this paper takes 2018 as the starting period of the event, and takes heavy polluting enterprises as the experimental group and non-heavy polluting enterprises as the control group to evaluate the policy effect of the implementation of environmental protection tax.

**3. Control variables**

Based on existing research, the control variables selected in this study include: company size (Size), measured by taking the natural logarithm of total assets used over the year. The Tobinq value (Tobinq) is calculated using the formula (circulating market value + non-circulating shares \* net asset value per share + book value of liabilities) / total assets. The debt-to-asset ratio (Lev) is measured by dividing the total liabilities at the end of the year by the total assets at the end of the year. The revenue growth rate (Growth) is measured by dividing the increase in revenue by the total revenue of the previous year minus 1. The cash flow ratio (Cashflow) is measured by dividing the net cash flow from operating activities by total assets. The debt-to-asset ratio (Lev) is measured by dividing the total liabilities at the end of the year by the total assets at the end of the year. The return on total assets (Roa) is measured by dividing net profit by the average balance of total assets.

**4.3 Data sources and descriptive statistics**

To maintain the symmetry of the window period, this study uses A-share listed companies from 2016 to 2019 as the research sample. The sample is processed as follows: (1) financial and real estate samples with financial attributes are excluded; (2) ST, PT, and delisted samples are excluded; (3) samples with cross-listing on both A-shares and H-shares are excluded; (4) samples with missing key variables are excluded; (5) environmental protection expenditures are categorized into asset expenditures and expense expenditures, where asset expenditures are derived from the detailed construction in progress section of the financial statements, and expense expenditures are derived from the detailed management expenses section. The basic characteristics and financial data of listed companies are sourced from the China Stock Market & Accounting Research Database (CSMAR Database) and the Wind Database. Industry classification data is sourced from the Shenwan Hongyuan Securities Co., Ltd. website, and regional data is sourced from the China Statistical Yearbook, China Urban Statistical Yearbook, and the Chinese Research Data Services Platform (CNRDS) database. To reduce the impact of outliers on the regression results, all continuous variables are truncated by 1% at both ends.

**Table 1 Descriptive statistics of main variables**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable name |  Simple size  |  Mean  |  Median  |  Standard Deviation  | Min  | Max |
| Core explanatory variables |  |
| Environmental performance (EP) | 3044 | 1.366 | 1.358 | 0.175 | 0.947 | 2.285 |
| **Controlled variable**  |  |
| Enterprise size (size) | 3044 | 22.48 | 22.36 | 1.146 | 20.27 | 25.64 |
| Total asset return on equity (ROA) | 3044 | 0.0380 | 0.0360 | 0.0540 | -0.211 | 0.193 |
| Return on equity (roe) | 3044 | 0.0690 | 0.0690 | 0.110 | -0.514 | 0.388 |
| Cash flow ratio (cashflow) | 3044 | 0.0520 | 0.0510 | 0.0630 | -0.120 | 0.239 |
| Operating income growth (growth) | 3044 | 0.188 | 0.117 | 0.355 | -0.418 | 2.086 |
| Asset-liability ratio (lev) | 3044 | 0.436 | 0.436 | 0.187 | 0.0480 | 0.869 |
| Tobin q-value (tobinq) | 3044 | 1.726 | 1.450 | 0.975 | 0 | 8.012 |
| **Mechanism variables** |  |
| Environmental concerns (LNER) | 3044 | 3.338 | 3.611 | 1.066 | 0 | 4.454 |
| Green Innovation (Invent) | 3044 | 1.368 | 0 | 1.755 | 0 | 8.495 |
| Rigidity of law enforcement (law) | 3044 | 7.310 | 7.484 | 1.639 | 0 | 9.747 |
| Government-business collusion (PC) | 3044 | 0.300 | 0 | 0.458 | 0 | 1 |
| Government-enterprise collusion level (pclevel) | 3044 | 0.901 | 0 | 1.479 | 0 | 4 |

Table 1 presents the descriptive statistics of the variables related to the $EP\_{it}$article. The mean and standard deviation of the dependent variable are 1.366 and 0.175, respectively, with a minimum value of 0.947 and a maximum value of 2.285. This indicates significant differences in environmental performance among different companies. Listed companies generally exhibit lower environmental performance, with most failing to meet the average level. Overall, the environmental performance is still relatively low, which holds considerable research value. The statistical information for other control variables is similar to that found in previous studies.

# 5. Empirical test

**5.1 Benchmark regression**

Table 2 presents the regression results of the EPTL on corporate environmental performance. The dependent variable is the environmental performance indicator constructed using the ecological benefit method. Each regression result in the table has been adjusted for standard errors using industry-level clustering effects. The empirical results show that the estimated coefficients of the EPTL are all highly significant and positive, indicating that the implementation of the EPTL can effectively enhance the environmental performance of heavily polluting enterprises. Columns (1) to (2) do not control for any fixed effects. Columns (3) to (5) gradually control for various fixed effects, and the regression results for the core explanatory variables are all highly significant and positive, with little variation in the coefficients. The regression results suggest that the formal implementation of the EPTL can effectively promote environmental awareness among heavily polluting enterprises, compelling them to actively reduce pollution and improve their environmental performance, thus supporting Hypothesis 1.

**Table 2. Baseline regression results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) |
|  | EP | EP | EP | EP | EP |
| did | 0.0854\*\*\* | 0.0818\*\*\* | 0.0370\*\* | 0.0349\*\* | 0.0347\*\* |
|  | (0.0249) | (0.0226) | (0.0164) | (0.0156) | (0.0157) |
| pul | -0.0361 | -0.0331 | -0.0143 |  |  |
|  | (0.0241) | (0.0209) | (0.0258) |  |  |
| post | -0.0301\*\*\* | -0.0199\*\*\* |  |  |  |
|  | (0.0070) | (0.0070) |  |  |  |
| Constant | 1.3800\*\*\* | 1.6103\*\*\* | 1.8024\*\*\* | 2.1942\*\*\* | 2.1856\*\*\* |
|  | (0.0143) | (0.1219) | (0.4859) | (0.4846) | (0.4892) |
| Observations | 3,096 | 3,096 | 2,849 | 2,848 | 2,848 |
| R-squared | 0.015 | 0.044 | 0.766 | 0.774 | 0.774 |
| Controls | NO | YES | YES | YES | YES |
| Year FE | NO | NO | YES | YES | YES |
| Id FE | NO | NO | YES | YES | YES |
| Ind FE | NO | NO | NO | YES | YES |
| Prov FE | NO | NO | NO | NO | YES |

Note: \*, \*\*, \*\*\* indicate significance at the 10%, 5% and 1% levels respectively; and the same applies hereinafter.

**5.2Parallel trend test**

The double difference must satisfy the prior assumption of common support, indicating that the control group and the treatment group had the same trend before the implementation of the EPTL. Figure 1 presents the estimated values of the coefficients for the parallel trend test. The regression results show that the coefficients of the key variables were not significant before the implementation of the EPTL. Specifically, in 2016-2017 and before the formal implementation of the protection tax law, there was no statistically significant difference between the experimental group and the control group, confirming the parallel trend hypothesis. However, in 2018-2019, there was a significant difference in the trend of environmental investment changes between the experimental group and the control group, with the regression coefficient being significantly positive. Therefore, the control group selected in this study is comparable to the treatment group before the policy shock, meeting the parallel trend hypothesis.



**Figure 1. Parallel trend test**

**5.3Robustness analysis**

(1)Replace the representation form of core variables. Referring to the research ideas of Greenstone (2023), this paper constructs the model by replacing the core explanatory variables as follows:

$$EP\_{it}=β\_{0}+β\_{1}ETT\_{it}+β\_{2}ET\_{it}+β\_{j}\sum\_{j}^{} Controls\_{it}+λ\_{i}+ind\_{j}+year\_{t}+prov\_{k}+ε\_{ijtk}$$

This section primarily illustrates the extent to which industries are affected by policies$ETT\_{it}=Treat\_{it}×Δpullutin\_{ }$ The paper measures the overall pollution level of each industry using the weighted average of pollutant increments across various sectors. The higher the pollution level, the greater the impact of the EPTL, which stipulates 'more emissions, more taxes; fewer emissions, fewer taxes; no emissions, no taxes.' The study focuses on three types of pollutants: industrial solid waste, industrial exhaust (sulfur dioxide, nitrogen oxides, and fly ash), and industrial wastewater. The method of normalization and equal-weight linear summation is used to determine the overall changes in pollutant emissions for each industry. The primary sources of industry-specific pollutant data are the 'China Environmental Statistics Yearbook' and the 'China Statistical Yearbook,' spanning multiple years. According to the 'National Economic Industry Classification and Code' (GB/T 4754-2017), two-digit industry codes are used to match the restricted industries under the EPTL with those of listed companies.

This research replaces the core explanatory variable, excluding non-restricted industries from the treatment group and characterizing the extent to which the treatment group is affected by policy. Only industries that are both restricted and significantly impacted by the EPTL experience a greater impact on their internal enterprises. The regression results in Table 3 show that after replacing the core explanatory variable, the regression results under the same baseline model are all highly significant and positive, with the coefficients and significance levels increasing, indicating the robustness of the baseline regression and further confirming Hypothesis 1.

**Table 3 Robustness test 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) |
|  | EP | EP | EP | EP | EP |
| ET2 | 11.5019\*\*\* | 12.5486\*\*\* | 6.7680\*\*\* | 6.4001\*\*\* | 6.4472\*\*\* |
|  | (1.8148) | (1.7636) | (1.3865) | (1.3966) | (1.3930) |
| pul | -0.0361 | -0.0328 | -0.0136 |  |  |
|  | (0.0241) | (0.0207) | (0.0260) |  |  |
| post | -0.0301\*\*\* | -0.0199\*\*\* |  |  |  |
|  | (0.0070) | (0.0071) |  |  |  |
| ET | -0.1243\*\*\* | -0.1478\*\*\* | -0.0882\*\*\* | -0.0835\*\*\* | -0.0846\*\*\* |
|  | (0.0372) | (0.0367) | (0.0269) | (0.0285) | (0.0284) |
| Constant | 1.3800\*\*\* | 1.6581\*\*\* | 1.7864\*\*\* | 2.1666\*\*\* | 2.1565\*\*\* |
|  | (0.0143) | (0.1221) | (0.5020) | (0.5070) | (0.5126) |
| Observations | 3,096 | 3,096 | 2,849 | 2,848 | 2,848 |
| R-squared | 0.038 | 0.070 | 0.770 | 0.777 | 0.777 |
| Controls | NO | YES | YES | YES | YES |
| Year FE | NO | NO | YES | YES | YES |
| Id FE | NO | NO | YES | YES | YES |
| Ind FE | NO | NO | NO | YES | YES |
| Prov FE | NO | NO | NO | NO | YES |

Furthermore, to avoid the interference of the measurement model of the dependent variable on the estimation results, this paper employs multiple evaluation methods to test the robustness of the core dependent variable, ensuring the robustness of the regression results. Previously, economic benefits were measured using the total operating revenue of enterprises to reflect their operational outcomes. In this section, total factor productivity is used as a replacement for the previous economic benefit measurement indicator to further test the robustness of the article. Total factor productivity reflects the production efficiency and resource allocation efficiency of enterprises, effectively demonstrating their operational outcomes. This paper uses the lp method and the op method to measure total factor productivity, which reflects the operational outcomes of enterprises. The measurement methods for environmental performance are the same as previously described. The results in columns (1) and (2) of Table 4 show that the regression coefficients of key variables remain highly significant, confirming the high robustness of the baseline regression results of this paper.

(2) Control time trends and macroeconomic factors:

In the benchmark regression, the article controls for individual fixed effects, time fixed effects, province fixed effects, and industry fixed effects to control for unobservable variables. In this section, based on the benchmark regression, the province year fixed effect and industry time trend are controlled to further control for industry trends and macroeconomic factors. The regression results in columns (3) and (4) of Table 4 show that the regression coefficients of key variables remain significantly positive, reaffirming the robustness of the previous findings.

**Table 4 Robustness test 2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
|  | LP law  | OP law  | EP | EP |
| ET | 0.0080\*\* | 0.0310\* | 0.0311\* | 0.0620\*\*\* |
|  | (0.0034) | (0.0160) | (0.0171) | (0.0230) |
| Constant | 0.4069\*\*\* | 2.1905\*\*\* | 2.2280\*\*\* | 2.1148\*\*\* |
|  | (0.1461) | (0.5243) | (0.5306) | (0.5281) |
| Observations | 2,848 | 2,848 | 2,847 | 2,848 |
| R-squared | 0.865 | 0.870 | 0.787 | 0.785 |
| Controls | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| Id FE | YES | YES | YES | YES |
| Ind FE | YES | YES | YES | YES |
| Prov FE | YES | YES | YES | YES |
| Prov-Year |  |  | YES |  |
| Ind-Trend |  |  |  | YES |

(3) Early policy

The previous parallel trend test examined the dynamic effects of policies by constructing dummy variables for each year, thus testing the uniqueness of the policy setting point. This section further advanced the implementation time of the EPTL by 1-2 years, setting up two 'pseudo-treatment effect variables' and incorporating them into the empirical framework for analysis. The empirical results in columns (1) and (2) of Table 5 show that after advancing the policy treatment point, the regression coefficients of the core explanatory variables were not significant, indicating that no significant average treatment effect was observed, thus reaffirming the robustness of the regression results from the previous section.

(4) Propensity score matching

The article uses propensity score matching (PSM) to address the issue of sample differences, selecting control variables such as firm size (size), return on assets (ROA), return on equity (ROE), revenue growth rate (cashflow), cashflow ratio (growth), debt-to-asset ratio (lev), and Tobin's q-value (tobinq) as covariates. The logit model is used for propensity score matching. The study employs a 1:2 resampling method with replacement for matching and re-runs the regression using the psm-did approach. As shown in the third column of Table 5, after matching and eliminating firm characteristic differences, the regression coefficients of the core explanatory variables remain highly significant, confirming the robustness of the previous findings.

(5) Excluding the influence of other policies

This paper covers the period from 2016 to 2019 for empirical research, effectively excluding the influence of other policies. For instance, the Environmental Protection Law, implemented in 2015, was enacted before the study's timeframe, thus its impact is minimized. Additionally, the paper excludes the effect of the green finance pilot policy on the empirical results. Since 2016, China has established green finance innovation and reform pilot zones in nine locations across six provinces (regions), including Zhejiang, Jiangxi, and Guangdong. These pilot zones require companies within the zones to actively engage in environmental social responsibility. Existing literature indicates that the green finance pilot policy significantly reduces the production efficiency of polluting enterprises in the pilot zones while promoting the innovative development of green enterprises. Therefore, the green finance trends in these pilot zones are likely to differ from those in other regions. By excluding the provinces with green finance innovation and reform pilot zones, the regression results are shown in the fourth column of Table 5.

**Table 5 Robustness test 3**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) | (5) |
|  | The policy is a year ahead of schedule | The policy is two years ahead of schedule | PSM | Rule out other policies | Logit model  |
|  |  |  |  |  |  |
| ET\_2017 | 0.0078 |  |  |  |  |
|  | (0.0159) |  |  |  |  |
| ET\_2016 |  | -0.0169 |  |  |  |
|  |  | (0.0234) |  |  |  |
| ET |  |  | 0.0365\*\* | 0.0402\*\* | 0.2351 |
|  |  |  | (0.0164) | (0.0166) | (0.2314) |
| Constant | 2.0613\*\*\* | 1.8894\*\*\* | 2.1714\*\*\* | 2.1215\*\*\* | -3.0215\*\*\* |
|  | (0.6091) | (0.5779) | (0.5331) | (0.6621) | (1.0960) |
|  |  |  |  |  |  |
| Observations | 2,787 | 2,788 | 1,941 | 1,995 | 3,096 |
| R-squared | 0.771 | 0.764 | 0.780 | 0.782 |  |
| Pseudo R2 |  |  |  |  | 0.105 |
| Controls | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES |
| Id FE | YES | YES | YES | YES |  |
| Ind FE | YES | NO | YES | YES |  |
| Prov FE | YES | YES | YES | YES | YES |

(6) Re-examination of identification conditions

The previous section used parallel trend tests and policy pre-selection methods to examine the randomness of the timing of the EPTL's establishment. However, it did not consider whether the selection of heavily polluting industries was non-random. There might be a reverse causal relationship where industries with lower environmental performance are more likely to be selected as heavily polluting industries. To address this, this paper adopts the approach of Hanna (2015) and constructs a Logit model to estimate the probability of an industry being selected as a heavily polluting industry. The core explanatory variable in the logit model is whether the industry is a heavily polluting industry (pul), while environmental performance (EP) and the control variables selected earlier are used as explanatory variables. The regression results in the fifth column of Table 5 show that the regression coefficient of environmental performance is not significant, indicating that environmental performance levels do not influence the selection of heavily polluting industries in this study, suggesting no non-randomness in industry selection.

(7) Placebo test

The grouping of the experimental and control groups may be influenced by other random factors, necessitating a placebo test to enhance the robustness of the article's results. All enterprises were randomly reselected, with 1000 random samples repeated. Figure 2 presents the kernel density plot and p-value distribution of the regression coefficients under the placebo test. The regression results show that the mean of the estimated coefficients under the random process is close to 0, and most p-values are above 0.1. The actual estimated coefficients of the benchmark regression ET in this study fall within the range of small probability events on the kernel density plot of the placebo test, indicating that the true estimates in this study are empirically robust.



**Figure 2 Placebo test**

# 6. Heterogeneity analysis and mechanism test

**6.1Heterogeneity analysis**

The above research mainly discusses the average treatment effect of environmental protection policies. However, for subjects with different characteristics, it is difficult to have the same effect of policies considering the influence of factors such as product production cycle and differences in production factors. Therefore, it is necessary to discuss the asymmetric effect of EPTL on subjects with different characteristics from the perspective of heterogeneity.

 (1) Heterogeneity of financing constraints: "strengthening" or "weakening"? As the demands for sustainable development become increasingly stringent, the business philosophies of enterprises have undergone profound changes. With the increasing number of ecological, environmental, social, and economic issues, environmentally friendly investments are becoming an essential requirement. Given the current investment environment, the capital market is increasingly focusing on a company's ability to sustainably develop, leading to significant changes in external financing channels. The conflict between financing constraints and free cash flow has also intensified. Does the EPTL have different policy effects for companies with varying financing constraints? This paper employs three methods to measure financing constraints, constructing the WW index, KZ index, and SA index, to analyze the differential policy effects of the EPTL under heterogeneous financing constraints. The regression results in Table 6 show that companies with high financing constraints benefit more from the implementation of the EPTL, as evidenced by higher significance and coefficients. This may be because companies with high financing constraints face strong environmental regulation pressures. Without the motivation to rectify environmental issues, they might exacerbate their own operational difficulties, leading to poor economic outcomes. Therefore, in the face of the institutional pressure of the EPTL, companies with high financing constraints are more likely to rectify their operations, which is reflected in a significant improvement in their environmental performance.

**Table 6 Heterogeneity of financing constraints, "strengthening" or "weakening"?**

|  |  |  |  |
| --- | --- | --- | --- |
|  | WW index number  | KZ index number  | SA index number  |
|  | Low | High | Low | High | Low | High |
| ET | 0.0323 | 0.0393\*\* | 0.0291 | 0.0497\*\* | 0.0311 | 0.0387\* |
|  | (0.0239) | (0.0195) | (0.0205) | (0.0244) | (0.0211) | (0.0205) |
| Constant | 2.1627 | 2.8827\*\*\* | 2.6152\*\* | 1.9590\*\* | 2.1041\*\*\* | 2.3648\*\* |
|  | (1.4357) | (0.7510) | (0.9834) | (0.8853) | (0.6403) | (1.0469) |
| Observations | 966 | 1,497 | 1,181 | 1,229 | 1,377 | 1,347 |
| R-squared | 0.798 | 0.782 | 0.803 | 0.781 | 0.790 | 0.768 |
| Controls | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Id FE | YES | YES | YES | YES | YES | YES |
| Ind FE | YES | YES | YES | YES | YES | YES |
| Prov FE | YES | YES | YES | YES | YES | YES |

(2) Property right heterogeneity, can state-owned enterprises make a "model"? The previous section has detailed the specific effects of the EPTL. Compared to the pollution discharge fee system, the EPTL is more enforceable and widespread. Can this law achieve the same policy outcomes for both state-owned and non-state-owned enterprises, thereby comprehensively enhancing their environmental performance? The regression results in Table 7 show that the formal implementation of the EPTL significantly improves the environmental performance of both state-owned and non-state-owned enterprises. In terms of coefficient size and significance, the EPTL has a stronger promoting effect on the environmental performance of heavily polluting enterprises among state-owned enterprises. This may be due to two main reasons: First, compared to private enterprises, state-owned enterprises have more political connections, making their decision-making more susceptible to government influence. Therefore, when faced with the formal implementation of the EPTL, state-owned enterprises have a better ability to perceive and dynamically adjust to the policy, leading to more noticeable policy effects. Second, private enterprises, which face significant disadvantages in talent reserves, financing costs, and policy preferences compared to state-owned enterprises, find it difficult to make timely adjustments when policies are issued. As a result, the positive impact of the EPTL on non-state-owned enterprises is less pronounced.

(3) The heterogeneity of corporate transparency: "sincerity" or "concealment"? Contract theory suggests that the process of multi-party games with diverse participants inevitably increases the cost of reaching a contract. Currently, China's formal institutional framework is not fully developed, and the factor market is still underdeveloped. The legal system has loopholes, and the cost of law enforcement is high, all of which increase the risk of companies failing to fulfill their obligations. With the implementation of the EPTL, companies with poor environmental performance may have the incentive to manipulate their environmental contributions to gain environmental legitimacy at a lower cost. Existing literature indicates that company transparency affects investors' information acquisition costs, thereby influencing the level of attention paid to the company. A low transparency information environment can reduce investors 'trust in the company's information, while high transparency can enhance corporate performance (Omran et al. ,2021). Does the effectiveness of the EPTL vary significantly among companies with different levels of transparency? This paper draws on existing research, using the Shenzhen Stock Exchange and Shanghai Stock Exchange Information Disclosure Rating (Dscore) as proxies for company transparency. It also adopts the manipulated accounting profit (DACC) as a proxy for information transparency, based on Nyilasy et al. (2014). The regression results in Table 7 show that companies with high transparency benefit more from the EPTL in terms of environmental performance improvement.

**Table 7 Heterogeneity analysis 2**

|  |  |  |
| --- | --- | --- |
|  | Property heterogeneity | Heterogeneity of company transparency |
|  |  belong to the state  | Non-state-owned | High | Low |
| ET | 0.0461\*\* | 0.0293\* | 0.0521\*\*\* | 0.0297 |
|  | (0.0198) | (0.0163) | (0.0185) | (0.0294) |
| Constant | 2.4802\*\* | 2.2904\*\*\* | 2.8036\*\* | 1.1596 |
|  | (0.9965) | (0.7883) | (1.1870) | (0.8847) |
| Observations | 1,081 | 1,737 | 1,070 | 979 |
| R-squared | 0.796 | 0.765 | 0.815 | 0.793 |
| Controls | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES |
| Id FE | YES | YES | YES | YES |
| Ind FE | YES | YES | YES | YES |
| Prov FE | YES | YES | YES | YES |

**2. Heterogeneity of corporate governance**

The analysis of corporate governance heterogeneity in the article comprises three aspects: whether executives have overseas backgrounds, financial backgrounds, and doctoral degrees. According to the High-Level Team Theory (Hambrick and Mason, 1984), the professional background of executives can lead to significant differences in psychological traits such as cognitive patterns, thinking styles, risk preferences, and decision-making methods. Research indicates that executive teams with overseas backgrounds can better foster innovation and social responsibility (Yan et al., 2021). In the face of stricter environmental regulations under the EPTL, executive teams with overseas backgrounds may demonstrate stronger adjustment capabilities and more effective improvements in environmental performance. Regarding the financial background of executives, companies can establish bank-enterprise relationships by hiring executives with financial expertise, which reduces financing difficulties and facilitates long-term loans. Conversely, executive teams without a financial background may find it harder to secure funding, are more susceptible to policy influences, and may need to improve their environmental performance to meet environmental legitimacy requirements and alleviate cash flow pressures. From the perspective of the academic background of executives, educational background to some extent reflects a company's management capabilities. The higher the educational level of executives, the more likely they are to take on social responsibilities. Therefore, companies with a team of highly educated executives tend to meet environmental compliance standards. In contrast, companies with a team of less educated executives face greater environmental pressure from the EPTL. As a result, companies with a team of highly educated executives can more effectively improve their environmental performance in the face of mandatory tax laws. Based on this, the article further explores whether the EPTL has a differential impact on corporate environmental performance. Table 8 presents the heterogeneity regression results of corporate governance, indicating that non-financial, overseas, and low-academic backgrounds have a stronger effect on improving environmental performance.

**Table 8 Analysis of corporate governance heterogeneity**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Whether it is a financial background | Whether it is an overseas background | Whether you have a PhD background |
|  | Yes | No | Yes | No | Yes | No |
| ET | 0.0250 | 0.0388\*\* | 0.0452\*\*\* | 0.0157 | 0.0280 | 0.0547\*\* |
|  | (0.0226) | (0.0186) | (0.0163) | (0.0215) | (0.0196) | (0.0221) |
| Constant | 2.2909\*\*\* | 2.4994\*\* | 1.2116 | 2.0818\*\*\* | 1.9924\*\*\* | 2.3963\*\*\* |
|  | (0.6949) | (1.1855) | (0.7612) | (0.7305) | (0.6632) | (0.7937) |
| Observations | 1,743 | 778 | 1,246 | 1,412 | 1,838 | 878 |
| R-squared | 0.780 | 0.776 | 0.787 | 0.799 | 0.776 | 0.788 |
| Controls | YES | YES | YES | YES | YES | YES |
| Year FE | YES | YES | YES | YES | YES | YES |
| Id FE | YES | YES | YES | YES | YES | YES |
| Ind FE | YES | YES | YES | YES | YES | YES |
| Prov FE | YES | YES | YES | YES | YES | YES |

**3. Mechanism analysis**

As previously discussed, the EPTL has been strengthened in both policy and institutional arrangements compared to the pollution discharge fee system. This is evident in the law's enforcement through its mandatory and universal nature, which enhances local environmental law enforcement, increases local government attention to environmental issues, and breaks down collusion between government and enterprises. The rational design of the tax law also promotes resource reallocation among enterprises, thereby encouraging green innovation and improving environmental performance. This section empirically examines these mechanisms to test the specific impact of the EPTL on corporate environmental performance.

(1) Strengthen law enforcement. This research compiles environmental penalty cases (Law) from various provinces, serving as a proxy for the intensity of regional environmental law enforcement. A higher Law value indicates stronger environmental law enforcement in the region. Following Khan (2023), the baseline regression model includes an ET\*Law interaction term and the original pre-ET difference term, using the three-way difference method for estimation. The regression results show that the coefficient of the ET\*Law interaction term is significantly positive at the 1% significance level. Table 9's regression results support the mechanism by which the EPTL enhances regional environmental law enforcement, thereby compelling companies to improve their environmental performance.

(2) Improve local government environmental concerns. Drawing on the research of Yan, Almandoz, and Ferraro (2021), this paper uses the logarithm of the environmental protection term frequency ER, as reported by prefecture-level city local governments, as a proxy for environmental concern. The selection of environmental terms follows the approach of Yan et al. (2021). In line with this method, this paper introduces an Lner\*Law interaction term and a double difference term ET into the baseline regression model, using the triple difference method for estimation. The regression results show that the regression coefficient of the Lner\*Law interaction term is significantly positive. Table 9 further confirms empirically that the EPTL can effectively enhance local government's environmental concern, encouraging them to actively fulfill their environmental supervision responsibilities, thereby promoting the improvement of corporate environmental performance.

(3) Encourage green innovation in enterprises. The Porter hypothesis suggests that well-designed environmental policies can provide 'innovation compensation' (Porter and Van der Linde, 1995), thereby encouraging companies to innovate. Green innovation, a key indicator of a company's green governance capabilities, reflects the company's technological innovations in using renewable energy in its production and operations, which enhances resource efficiency and, consequently, corporate environmental performance. Based on existing research, this paper measures corporate green innovation by taking the natural logarithm of the number of green patent applications. Following this approach, the paper introduces an interaction term between Lnvent and Law, adds the Lnvent term, and includes a difference-in-differences term ET, estimating the model using the triple difference method. The regression results show that the interaction term between Lnvent and Law has a significantly positive coefficient. Table 9 further confirms through empirical analysis that the EPTL effectively promotes corporate green innovation and enhances corporate environmental performance.

**Table 9 Mechanism analysis 1**

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | EP | EP | EP |
| ET\*Law | 0.3153\*\*\* |  |  |
|  | (0.0974) |  |  |
| ET | 0.5021 | 1.0315 | 1.3776 |
|  | (2.0478) | (2.1742) | (1.6880) |
| law | -0.0005 |  |  |
|  | (0.0047) |  |  |
| ET\*Lner |  | 0.6433\*\*\* |  |
|  |  | (0.2176) |  |
| Lner |  | -0.0168\* |  |
|  |  | (0.0096) |  |
| ET\* Lnvent |  |  | 1.4688\*\* |
|  |  |  | (0.7144) |
| Lnvent |  |  | 0.0050 |
|  |  |  | (0.0099) |
| Constant | 2.1836\*\*\* | 2.3690\*\*\* | 2.2099\*\*\* |
|  | (0.4964) | (0.4996) | (0.5059) |
| Observations | 2,848 | 2,612 | 2,848 |
| R-squared | 0.776 | 0.776 | 0.773 |
| Controls | YES | YES | YES |
| Year FE | YES | YES | YES |
| Id FE | YES | YES | YES |
| Ind FE | YES | YES | YES |
| Prov FE | YES | YES | YES |

(4) Resolve collusion between government and business. Drawing on the research of Porter, M. E. (2005), this paper collects information on political connections among listed companies from their executives' resumes to construct a variable called corporate political connection (pc). The specific measurement method is consistent with that of Esty, D. C. and Porter, M. E. (2005). Furthermore, based on the degree of political connection between listed companies and enterprises, the political connection is categorized into four levels: district and county level and below (pc\_1), city level (pc\_2), provincial level (pc\_3), and national level (pc\_4). The table presents the specific regression results. The results indicate that after incorporating the political connection control variable, the positive impact of the EPTL on environmental performance has not significantly changed, and the significance level remains unchanged compared to the baseline regression. The regression coefficients in Table 10 have not undergone significant changes. The empirical results suggest that corporate political connection does not significantly affect the policy effect of the EPTL on environmental performance improvement, and collusion between the government and enterprises is unlikely to influence the implementation effect of the EPTL.

**Table 10 Mechanism Analysis 2 --Resolve collusion between government and enterprise**

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | EP | EP |
| ET | 0.0347\*\* | 0.0352\*\* |
|  | (0.0157) | (0.0155) |
| pc | -0.0014 |  |
|  | (0.0133) |  |
| pc\_1 |  | 0.0057 |
|  |  | (0.0540) |
| pc\_2 |  | -0.0137 |
|  |  | (0.0218) |
| pc\_3 |  | 0.0036 |
|  |  | (0.0201) |
| pc\_4 |  | 0.0028 |
|  |  | (0.0203) |
| Constant | 2.1847\*\*\* | 2.2011\*\*\* |
|  | (0.4899) | (0.4963) |
| Observations | 2,848 | 2,848 |
| R-squared | 0.774 | 0.774 |
| Controls | YES | YES |
| Year FE | YES | YES |
| Id FE | YES | YES |
| Ind FE | YES | YES |
| Prov FE | YES | YES |

# 7.Further analysis

The previous analysis of the mechanism indicates that, in the face of rising production and compliance costs due to increasingly stringent environmental regulations, regulated companies may find it difficult to continue rectification efforts if they cannot afford the continuously increasing operating costs. Instead, they might opt to evade environmental law enforcement, leading to a negative transfer phenomenon across regions. Does the EPTL lead to such a negative pollution transfer phenomenon? In other words, when faced with the environmental legitimacy pressure from the EPTL, will companies choose to rectify or passively transfer their pollution?

**Table 11. Transfer or transformation analysis**

|  |  |  |  |
| --- | --- | --- | --- |
|  | (1) | (2) | (3) |
|  | Listed company subsidiaries | Overseas subsidiaries of listed companies | Countries along the "Belt and Road" |
| ET | -1.3129 | -0.1744 | -0.0415 |
|  | (1.2934) | (0.2682) | (0.0629) |
| Constant | -338.2465\*\* | -111.0276 | -18.9933\*\*\* |
|  | (135.3622) | (71.4622) | (6.0323) |
| Observations | 2,787 | 2,787 | 2,787 |
| R-squared | 0.918 | 0.869 | 0.913 |
| Controls | YES | YES | YES |
| Year FE | YES | YES | YES |
| Id FE | YES | YES | YES |
| Ind FE | YES | YES | YES |
| Prov FE | YES | YES | YES |

Based on the above analysis, this paper manually collected data on the number of subsidiaries of listed companies, the number of overseas subsidiaries of listed companies, and the number of subsidiaries established by listed companies in Belt and Road countries. This data was used to test the mechanism analysis presented earlier. The empirical results show that the regression coefficients for the core explanatory variables are negative but not significant, indicating that the EPTL has not significantly led to pollution transfer through the establishment of subsidiaries or the setting up of overseas subsidiaries in Belt and Road countries. The regression results in Table 11 suggest that the rationality of the EPTL's design reflects that its mandatory penalty mechanism has not severely impacted the operating costs of enterprises, nor has it resulted in negative cross-regional pollution transfer. Instead, it primarily promotes heavy polluting enterprises to voluntarily rectify their operations, control pollution, fulfill environmental social responsibilities, and engage in green governance through its internal incentive mechanisms.

# 8. Conclusions and policy recommendations

The official implementation of the EPTL marks the formal introduction of China's first standalone tax law centered on green taxation, reflecting the comprehensive greening of China's tax system. This paper uses the exogenous policy shock of the transition from a pollution discharge fee system to a tax system and the official implementation of the EPTL as a quasi-natural experiment to examine the impact of the EPTL on corporate environmental performance. Based on the internal policy logic of the tax law, Porter's hypothesis, and the pollution haven hypothesis, the paper analyzes the mechanisms. The study finds: First, the EPTL significantly and robustly promotes the improvement of corporate environmental performance. Second, the heterogeneity analysis reveals that the effect of the EPTL in promoting corporate environmental performance is more pronounced in companies with stronger financing constraints and higher internal transparency. Moreover, state-owned enterprises show a stronger improvement in environmental performance, indicating that they can set an example in response to the exogenous shock of the EPTL. Additionally, the heterogeneity in corporate governance indicates that the background of senior executives is a significant factor influencing the improvement of environmental performance. Third, the mechanism analysis shows that the EPTL primarily enhances corporate environmental performance by strengthening local government enforcement, increasing local government attention to environmental issues, promoting corporate green innovation, and resolving collusion between government and enterprises. Fourth, further analysis based on the empirical results of this study indicates that the EPTL has not led to negative cross-regional pollution transfer among heavily polluting enterprises.

Based on the above research results, this paper obtains the following four policy implications:

First, relevant departments need to provide guidance and education to managers based on the actual operation of regulated enterprises, guide the management of enterprises to actively undertake environmental governance obligations, shape the internal environmental supervision mechanism of enterprises, establish the ecological environment damage responsibility system for senior executives of enterprises, so as to promote the win-win of economic benefits and environmental benefits of enterprises.

Second, local governments should gradually improve the laws and regulations governing market entry and operations for heavily polluting enterprises. This ensures fair competition in the market while further encouraging these enterprises to optimize their product structures and promote cleaner production. Additionally, local governments should firmly adhere to the ecological protection red line, reasonably and orderly absorb some heavily polluting enterprises based on their own development needs, prevent industrial development models that harm the environment, practice the concept of green development, and promote sustainable growth.

Third, tax regulatory departments and local law enforcement departments should actively carry out cooperation, strengthen the overall coordination of various environmental policies, promote the coordinated, orderly and efficient implementation of policies, so that all policies can play their maximum role.

Fourth, the government should give full play to the role of external governance mechanisms such as media supervision and public participation supervision, strengthen the rectification of heavy polluting enterprises through the construction of external supervision mechanism, establish an external mechanism to prevent collusion between government and enterprises, and effectively promote the improvement of environmental protection of enterprises.

**Declaration**

We confirm that this manuscript has not been published elsewhere and is not under consideration by another journal. All authors have approved the manuscript and agree with submission to ***Asian Journal of Economics, Business and Accounting***. The authors have no conflicts of interest to declare.

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