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THE IMPACT OF GREEN TAX REFORMS ON ENVIRONMENTAL PERFORMANCE: A VIETNAM'S LEGAL INSTITUTIONS PERSPECTIVE

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ABSTRACT

Purpose – The current paper explores the effect of green taxation reforms on environmental performance in Vietnam, paying particular attention to the moderation effect caused by high-quality institutions in terms of laws and regulations.

Design/ menthodology/ approach – Based on World Bank data from 1990 to 2022, the research utilizes a threshold model for the assessment of the effect of environmental taxation on environmental performance depending on the intensity of the applied measures.

Findings – It is revealed that environmental taxes can positively contribute to the reduction of carbon dioxide emissions and help introduce more advanced technologies into operation; however, this is possible if a certain threshold is reached or exceeded. Moreover, the effect of environmental taxation is significantly intensified in the case of effective law enforcement.

Originality/ value – Consequently, environmental performance can be improved through proper taxation and institutional reforms. The significance of this paper lies in its identification of threshold effects of green taxation in Vietnam, but more empirical studies need to be done in other institutions and sectors as well.

Practical implications – The policy makers need to make green taxes adaptable and region-specific in nature and give financial benefits (such as tax rebates, subsidies, and special loans) to companies (particularly small and medium enterprises) for helping them in using green technology. Besides, resource licensing on condition, strong monitoring of the environment, international technology transfer, and carbon index/data system should also be put in place.

Social implications – Green technology, fair resource use, and regional cooperation can help in limiting industrial pollution and carbon emissions, improving health of people and protecting natural ecosystems in Vietnam.

1. Introduction

In the situation of the emerging difficulties for developing nations such as Vietnam caused by environmental pollution, climate change, and resource degradation, it is necessary to adopt effective policy instruments that help promote sustainable development. One such instrument that is considered an effective economic means to solve the identified problem and encourage a green economic model is called environmental taxation (green tax). Theoretically, green tax is a classic Pigovian solution that helps put a price on the social cost of environmentally unfriendly behavior to shape people's behavior. Practically, many countries around the world, especially the ones that belong to the OECD and have a transitional economy, use environmental taxation as one of the key tools for implementing sustainable development practices. In Vietnam, the law on environmental protection tax entered into force in 2012 after being approved in 2010 and was expected to provide sustainable revenue as well as regulate the production and consumption of goods based on environmentally sustainable principles. Still, after almost a decade of its implementation, this policy raises many questions because there is not enough legal and institutional foundation for green taxation practices.

Indeed, in recent times, there has emerged a realization of the environmental consequences of economic growth, especially in developing nations such as Vietnam. The issue of air and water pollution, natural calamities caused by changes in climate and exhaustion of resources are not any more considered as one-offs; instead, they are a continuous threat to sustainable development in the future. In this light, there has been a growing interest in the use of economic instruments such as environmental taxation as a way of dealing with environmental externalities and promoting green growth behavior.

Previous studies have preliminarily acknowledged the mediating role of institutional quality in enhancing the effectiveness of environmental policy instruments by Li et al. (2024) and Zhou et al. (2018). Nonetheless, most of this literature has focused on developed economies and has yet to clarify the nonlinear nature of the relationship or the existence of a policy threshold, defined as the tax level beyond which environmental effectiveness becomes significant. Vietnam is a country that is growing quickly. The economy of Vietnam is getting bigger and bigger. This is also causing a lot of pollution. Vietnam is an example of a country that has to balance making money and taking care of the environment. So this study has three goals to try to figure out some solutions to these problems, with Vietnam and the environment and the economy of Vietnam: (i) to assess the impact of green taxation on per capita greenhouse gas emissions in Vietnam; (ii) to test for the existence of a policy threshold using threshold regression method; and (iii) to analyze the moderating role of legal-institutional quality, as measured by indicators of transparency, accountability, and governance effectiveness (from the World Bank's Worldwide Governance Indicators, WGI).

Data covering the period 1990–2022 reveal that the impact of green tax on carbon emissions is nonlinear, and that emission

reduction effects only become statistically significant once the tax surpasses a certain threshold. In addition, the effect of green tax will be enhanced if there is a good institutional quality, while the effect will either decrease or become statistically insignificant if there is weak institutional quality in a certain area. It can be concluded from these results that green tax would not be able to work effectively in places where institutions are ineffective, while it should undergo institutional reform to be able to achieve its intended purpose. On this basis, three main policy suggestions for this study include: designing a tax rate plan that eventually moves towards the effectiveness threshold; enhancing the institutional and regulatory mechanism; and combining green tax policies with additional tools like technology and green investments. These suggestions could provide important insights for Vietnam as well as other developing countries having comparable levels of institutional capacity.

In this research paper, named *"The impact of green tax reforms on environmental performance. A Vietnam's legal institutions perspective"* the effect of the green tax reform on environmental efficiency is examined using an institutional and legal perspective in Vietnam. Using the World Bank dataset for the period of 1990-2022 and applying the concept of threshold regression, the study examines the correlation between green taxes, carbon emission, gross domestic product, and institutional variables like transparency and accountability. Based on findings, some policy suggestions have been made which can help Vietnam achieve its sustainable development goals amid globalizations.

2. Background and theoretical overview

2.1. Theoretical framework of the study

Negative externality is a concept mentioned by Marshall (1952), which refers to the adverse effects arising from the economic activity of a subject but affecting individuals or organizations that are not directly involved in that activity. Environmental pollution is a good example of negative externalities, especially prevalent in developing countries such as Vietnam. To overcome these effects, Pigou (1920) proposed the concept of the Pigouvian tax – a tax applied to activities that cause negative externalities, with the goal of forcing polluters to bear an additional cost corresponding to the level of damage they cause to society. On that basis, the green tax is considered a policy tool that has many similarities with the Pigouvian tax. Green tax reform has the potential to convert external costs caused by pollution into internal costs of polluters, thereby regulating the behavior of economic actors by increasing the cost of environmentally harmful activities. From a theoretical perspective, these tax tools are expected to reduce the total supply of pollution in the economy. This is also an important rationale for building a research model, which assumes that the application of green taxes will contribute to reducing polluting activities and improving emission efficiency, as measured through the CO_2 equivalence index (CDE). This study aims to test the effectiveness of the green tax mechanism in controlling carbon emissions in Vietnam.

2.2. Literature review

A team of empirical studies has provided ample evidence of the positive impact of green taxes on reducing carbon emissions, improving environmental performance, and accelerating the shift away from traditional industry to cleaner technology and energy. Nakata et al. (2001) used a partial equilibrium model to analyze the impact of carbon taxes and energy taxes on Japan's energy system. A similar study by Wissema et al. (2007) used the general equilibrium model (CGE) and the SAM model to assess the impact of energy taxes in Ireland.

The results show that the energy tax policy has helped significantly reduce CO_2 emissions, and at the same time have a positive impact on improving the country's environmental performance. Murray et al. (2015) also conducted a study in North America and found that the implementation of carbon taxes has contributed to a significant reduction in CO_2 emissions in heavy industries. This shows that when there is government intervention through tax tools, businesses will tend to invest in cleaner production solutions to reduce the cost of taxes to pay. In another study, Ploeg and Withagen (2015) argued that while strict climate policies can lead to carbon leakage – i.e., businesses relocating production to countries with looser environmental regulations – the introduction of a higher carbon tax could still have the effect of significantly reducing greenhouse gas emissions through the restriction of fossil fuel extraction. This research further confirms that, in addition to helping reduce pollution, green taxes may be a factor driving the economy in a sustainable direction.

Empirical studies worldwide demonstrate the crucial role of green taxation and technological innovation in reducing emissions. In Europe, Kok (2015) found that a CO_2 tax in the Netherlands effectively encouraged consumers to choose lower-emission vehicles. In China, Zhou et al. (2018) showed that a 50 RMB/ton CO_2 tax mitigated emissions and promoted green innovations in the transport sector without incurring macroeconomic costs; Fu and Wang (2018) confirmed that both broad and narrow green taxes positively impact CO_2 reduction; and Xu et al. (2015) emphasized that strict environmental regulations enhance environmental performance through industrial restructuring and technological innovation. Notably, Zhou and Luo (2021) identified a threshold effect, revealing that green taxes strongly control emissions before reaching a certain threshold, after which their efficacy declines, necessitating flexible, region-specific policy adjustments. Furthermore, recent studies highlight green technology innovation as a key mediator; specifically, Li et al. (2024) applied the Driscoll–Kraay method across BRICS countries, proving that green taxes significantly foster environmental and social sustainability by driving firms to innovate technology and enhance energy efficiency.

In addition to lowering emissions and strengthening the environmental protection performance of enterprises, recent studies indicate that environmental tax may help to facilitate corporate social sustainability outcomes more broadly. Duan et al. (2026) report that environmental taxes could promote firm's ESG performance through green innovation and intensified external monitoring. Meanwhile, Chen and Liu (2026) conclude that environmental tax policies strengthen environmental governance by enhancing institutional constraints, public scrutiny and strategic green transition in firms. These results show that environmental tax can be used as a policy tool for environmental regulation as well as an instrument of governance in promoting sustainable business practices.

The effect of environmental tax policies on performance has, however, resulted in different evidence. These differences can be attributed to institutional quality, the specific design of the tax policy itself and whether or not supporting and complementary policies accompany the tax policy.

Firstly, the performance of a green tax is strongly influenced by the quality of an institution in the relevant country. In countries with well-structured, and transparent institutions that are accountable for their actions – for example in Japan, Ireland and in The Netherlands - effective policies may be better enforced reducing 'cheating' on behalf of taxpayers thus positively affecting the reduction

of carbon. In many third-world developing countries institutional and legal structures are often weaker, thus limiting the enforcement of a given tax policy. It will be therefore essential to complement it with enhanced institutions and regulative mechanisms.

Second, appropriate tax policy design is essential in influencing firms' behavior. A low tax rate may provide insufficient incentives for behavioral change, as shown by Zhou and Luo (2021), while an excessively high rate may lead to reduced production, industrial restructuring, or tax avoidance. Therefore, determining an appropriate tax threshold is necessary to balance environmental protection with economic sustainability and encourage firms to adopt greener practices without excessive pressure on their current activities.

Third, complementary supporting policies are necessary to improve the effectiveness of green taxation. Measures such as subsidies for technological innovation, financial incentives, and investment in renewable energy can create complementary effects. Li et al. (2024) show that when green tax policies are supported by investment in energy efficiency, environmental performance improves significantly. Conversely, implementing tax policies without adequate support may reduce their effectiveness because firms may lack sufficient resources to adapt to the required changes.

The above analysis has shown a clear research gap, which is the lack of studies evaluating the effectiveness of green tax thresholds in the context of institutions that are not strong enough like in Vietnam. Most current research focuses only on developed economies or countries with very strong institutional systems. There are very few studies to verify the effectiveness of green tax policies applied to economies with weak institutional systems, lack of transparency and limited monitoring and enforcement capacity like many areas in Vietnam. In addition, the direct connection of tax policies with the effectiveness of technological innovation at the local level is also a factor that deserves attention but has not been explored in depth.

Therefore, the proposed research hypothesis is that green taxes have positive impacts on environmental performance, but this impact is only optimal when tax policies are designed at an appropriate threshold and accompanied by supportive policies. This hypothesis aims to help orient the development of an optimal tax threshold assessment model, as well as analyze and evaluate the roles of institutional system factors, production structure shifts, technological innovation, and lines in improving environmental performance.

Based on the above conclusions, the study has implemented a strategy to assess the impact of green tax reform on environmental performance in Vietnam from a legal and institutional perspective. By using threshold regression methodology to analyze the link between green taxes, carbon emissions, GDP, and institutional factors such as transparency and accountability for process resolution (Voice & Accountability Index). On that basis, the study proposes policies to optimize the effectiveness of green tax enforcement, contribute to minimizing negative impacts on the environment, promote technological innovation and move towards sustainable development in Vietnam.

Research hypothesis

Hypothesis H_0*:* Green tax mechanism does not affect environmental performance in the legal framework in Vietnam.

Hypothesis H_1*:* Green tax mechanism affect environmental performance in the legal framework in Vietnam.

3. Research model

3.1. Data collection, processing and analysis methods

This study uses secondary data from the World Bank (WB) for the period 1990-2022, including important indicators such as carbon emission growth rate (GCDE), green tax (Tax), gross domestic product (GDP), and voice and duty to resolve index (VAAI). The data is collected from reputable sources to protect customers and ensure high reliability. After collection, the data is checked, survey duplication is removed, missing values are processed, and normalized to ensure the best properties. Some variables are converted to logarithmic form to minimize the largest deviation between values, and green tax data is analyzed into different thresholds to check the performance at each specific level.

3.2. Research methodology

The research methodology employed to examine the impact of green tax reform on the Environmental Performance Index from a legal perspective in Vietnam is the regression method using averaged data from 1990 to 2022, with each year serving as an observation. The basic regression equation is as follows:

$$y_i = \alpha T_i + \sigma G_i + \gamma X_i + u_i \quad (1)$$

Where: y_i represents carbon emission growth, T_i is the tax, G_i is GDP, X_i is a set of other legal institutional variables affecting green growth.

Taxation (T_i) can simultaneously be influenced by Vietnam's green growth (y_i), leading to a bidirectional relationship known as endogeneity. Consequently, may be affected by the error term, causing regression results to be inaccurate. To address this issue, this study employs the instrumental threshold regression method of Caner and Hansen (2004). This method divides the sample into two groups based on a threshold variable (such as institutional quality, tax, etc.) to examine whether taxation has differing effects across these groups. The equation (1) is expanded into:

$$y_i = (\alpha_1 T_i + \sigma_1 G_i + \gamma_1 X_i) 1(Q_i \le \varphi_i) + (\alpha_2 T_i + \sigma 2 G_i + \gamma_2 X_i) 1(Q_i > \varphi_i) + u_i \quad (2)$$

$$T_i = (\theta_1 W_i + \pi_1 X_i) 1(Q_i \le \varphi_i) + (\theta_2 W_i + \pi_2 X_i) 1(Q_i > \varphi_i) + v_i \quad (3)$$

Where: $1(\cdot)$ is an indicator function, Q_i is the threshold variable, φ is the threshold parameter, W_i is the vector of instrumental variables, vi is the error term.

The parameter estimation procedure is comprised of three steps. First, estimating equation (3) using the Least Squares (LS) method to obtain predicted values. Second, estimating the threshold parameter using LS, which is the point dividing the sample into two groups. Final, estimating the regression coefficients using the Generalized Method of Moments (GMM) on these threshold-divided samples.

3.3. Threshold regression model by tax

The threshold regression model was used to examine how tax policies have affected the environmental performance of Vietnam. With taxation split into different thresholds, the threshold regression model makes it easier to identify variations in the linkage between taxation, good governance, accountability, economic growth, and carbon dioxide emissions growth. These findings have critical implications for law and policy as regards green taxation reforms. Four thresholds of taxation were examined through this model:

Threshold 1: TAXES < 13.10935

Threshold 2: 13.10935 TAXES < 18.217299

Threshold 3: 18.217299 TAXES < 18.78647

Threshold 4: TAXES ≥ 18.78647

The generalized model is expressed as:

$$Y = \alpha_j T + \sigma_j G + \gamma_j V + u_i \text{ , } j = \{1,2,3,4\}$$

Where: Y represents carbon emissions growth (GCDE), calculated as:

$$Y = \frac{\ln(CDEt)}{\ln(CDEt - 1)} \times 100\%$$

T is the tax, G is GDP, V is the Voice and Accountability Index.

Examining the effects of individual variables at different tax thresholds offers insights into the level of influence exerted by taxation on economic and environmental outcomes. This facilitates optimal tax policy formulation and distribution.

3.4. Variable Description

The study focuses on the effects of the economic and policy variables of Vietnam on the growth rate of carbon dioxide emission (GCDE). The dataset used in the analysis is obtained from the World Bank between 1990 and 2022. The dataset contains the following important variables: carbon emissions growth rate (GCDE), GDP, taxes, and Voice and Accountability index.

Dependent variable (GCDE): In measuring environmental performance, the research team employs the CO_2 equivalent index (CO2e) or also known as CDE. The index was developed and widely adopted in the 1990s, when climate scientists and international meteorological organizations needed a tool to measure the impact of greenhouse gases. Currently, with climate change becoming a common problem that is on red alert around the world, measuring and evaluating the factors that cause the greenhouse effect on the global ecosystem has become an extremely urgent requirement. In the Kyoto Protocol of the United Nations Framework Convention on Climate Change (1997), there is a mechanism to monitor and limit the emission of six greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6, from which the CO_2e index is applied and has become the international standard for reporting greenhouse gas emissions at the Kyoto Decree. The CO_2e calculation method is based on the Global Warming Potential (GWP) of each greenhouse. This index is an important parameter that helps determine and evaluate the overall impact of greenhouse gas emissions, the index measures total greenhouse gas emissions, emission reduction planning, and the development of carbon tax policies and carbon markets

Independent variables:

GDP: Reflects total economic output within a given period, often measured in USD or purchasing power parity. Level of GDP is a critical variable in measuring the rate of economic development and may be related to CO_2 emission. High GDP levels denote a high rate of industrial and business activities, which affect the environmental conditions.

Environmental taxation is a means of regulating environmental problems, which includes carbon tax, energy tax, and pollution taxes among others. Increased environmental taxation raises the cost of production for companies that emit pollutants and therefore encourages them to use environmentally friendly technologies.

Voice and Accountability Index (VAAI): To measure and analyze power and state governance, this study uses the Voice and Accountability Index, a component of the World Bank's WGI. In assessing CDE (Carbon Dioxide Equivalent Index), VAAI is used to examine the impact of governance and accountability on the environment and emission management. The index reflects the transparency of emission data disclosure by governments, businesses, and organizations, as well as the effectiveness of accountability mechanisms for environmental violations. Effective environmental governance requires businesses to publicly report emission data in accordance with international standards

such as the GHG Protocol and ISO 14064, ensuring data accuracy and enabling regulators, investors, and communities to monitor businesses' environmental activities.

Table 1. Table describing all variables

Variable Name	Symbol	Definition / Calculation	Unit / Scale	Role in the Model	Data Source
Carbon Emissions Growth	GCDE	$\log(CDE_t/CDE_{t-1})\times100$	Percentage (%)	Dependent variable (Y)	World Bank
Green Tax Rate	TAX	Percentage of environmental taxes in total government revenue	Percentage (%)	Independent variable	World Bank
Gross Domestic Product	GDP	Real GDP, transformed using natural log: log(GDP)	USD (real terms, log-transformed)	Independent variable	World Bank
Voice and Accountability Index	VAAI	Index measuring democracy, transparency, and civic participation	Scale from -2.5 to 2.5	Independent variable	WGI – World Bank

4. Analysis of research results

4.1. Descriptive statistical analysis

Descriptive statistics of CDE, GDP, Taxes, and the Voice and Accountability Index (VAAI) for Vietnam are provided in Table 1 (see Appendix 1). These statistics (covering 33 observations, from 1990 to 2022) collectively display some interesting trends in terms of taxes, economic growth, emissions, and institutional conditions during this period. The average tax rate was 16.76 with a standard deviation of 3.53.

The tax rate ranged from a minimum of 4.55 in 1990 and a maximum of 22.46 in 2008 with a median tax rate of 18.46. Average growth in real GDP has also fluctuated considerably, to some extent, as could be expected due to the COVID 19 effects. Over this 33- year period, the average real GDP growth rate of Vietnam stands at 6.34% with a high of 8.73 in 2022 and a low of 2.74 in 2021. In terms of emissions of COe, it can be noted that from the lowest of 9.97 in 1990 to its highest of 12.34 in 2022, Vietnam's COe emissions have followed a rising trend (average is 11.34). The country has been performing at average level for the global VAAI (-0.87 index for world according to Djankov et al. (2016), with an average score of -1.41 and minimum/ maximum of -1.54 (in 2006) and-1.24 (in 2000) respectively during the specified periods.

4.2. Results of threshold regression model analysis by tax

Threshold 1: TAXES < 13.10935

Table 3. Regression model results for tax threshold 1

GCDE = Growth of CDE Variables	Coefficient	Std. Error	t-Statistic	Prob.
T	0.254	0.075	3.403	0.001
V	-1.855	11.679	-0.159	0.874
G	0.160	0.531	0.302	0.763
C	-4.384	17.020	-0.258	0.797

On the other hand, when considering the range of environmental taxes lower than TAXES < 13.10935, it is found that taxation T (α_1 = 0.254) has a positive effect on GCDE (p-value < 0.001). These surprising findings suggest that in a scenario characterized by poor environmental taxes, carbon emissions will not be effectively discouraged from increasing. Indeed, producers and consumers will not change their activities towards environment-related goals in the case of weak fiscal signals. These results resonate with literature suggesting that tax rates must be higher than a threshold point to induce substantial shifts in intensive processes Samuel (2025).

The Voice and Accountability Index (VAAI) variable appears insignificant (γ_1 = -1.855, p-value = 0.874). Hence, it can be inferred that neither citizen participation nor government accountability plays any notable role in encouraging or discouraging the growth of carbon emissions in the case of low taxes. Likewise, GDP growth G is not significantly correlated with GCDE as p-value = 0.763. The constant term (C) is also statistically insignificant (p-value = 0.797) and is not interpreted, as it does not represent an explanatory variable. All together, these results demonstrate that economic growth and capital structure are less likely to affect emission trends in the absence of adequate fiscal-environmental tools.

Conclusively, the present analysis reveals that a particular tax threshold exists, after which environmental tax rates will lose their regulatory functions. That being said, it is evident that a tax rate below the identified threshold will not discourage carbon emissions. Therefore, further fiscal reforms and effective institutional arrangements become crucial for environmental sustainability.

Threshold 2: 13.10935 TAXES < 18.217299

Table 4. Regression model results for tax threshold 2

Variables	Coefficient	Std. Error	t-Statistic	Prob.
T	0.209	0.076	2.747	0.007
V	-0.001	1.630	-0.001	0.999
G	-0.581	0.130	-4.459	0.000
C	0.893	2.823	0.316	0.752

For the intermediate taxation threshold range (13.10935 ≤ TAXES < 18.217299), the taxation coefficient (T) is positive, statistically significant (α_2 = 0.209; p-value = 0.007), but less significant than in Threshold 1. This trend shows that there is a decreasing marginal effect of increase in environmental taxes on carbon dioxide emission growth (GCDE). It means

that while the taxation still positively affects emission growth at this tax threshold, its ability to promote degradation diminishes. Possible reasons for this observation include an initial reaction of economic agents, partial energy efficiency gains or similar.

It is essential to note that, in this case, the GDP growth coefficient (G) becomes negative and very statistically significant (σ_2 = -0.581; p-value < 0.001). This means that, contrary to the situation when the level of environmental taxes was lower, at the second taxation threshold GDP growth leads to reduced emissions. Such observations can be explained by the implementation of green structural changes or sustainable consumption–production processes that are better facilitated by the current tax rate.

As noted before, Voice and Accountability Index (VAAI) is not significant (p-value = 0.999) since the quality of institutions concerning political freedoms and civil rights does not have any impact on emissions. The estimated constant term (C) is statistically insignificant (p-value = 0.752). As it represents the intercept rather than an explanatory variable, no substantive economic interpretation is provided.

In conclusion, at the mid-level of environmental taxes, policies start working indirectly via economic growth channels. However, no direct effect of tax policy on decreased emission rates was found. Also, the process of growth-driven decarbonization becomes evident at this threshold.

Threshold 3: 18.217299 TAXES < 18.78647

Table 5. Regression model results for tax Threshold 3

Variables	Coefficient	Std. Error	t-Statistic	Prob.
T	-3.260	0.420	-7.765	0.000
V	7.524	1.282	5.869	0.000
G	0.115	0.041	2.806	0.006
C	69.998	7.534	9.291	0.000

The upper-bound threshold in taxation level (18.217299 ≤ TAXES < 18.78647) is accompanied by an important transition concerning the effect of tax instrument on the environment. In the specified tax regime, the taxation (T) coefficient has a very high significance level and is negative (α_3 = -3.260, p < 0.001). The obtained result shows that there is a curvilinear pattern between environmental tax level and emission reduction. Indeed, when the tax rate goes beyond a certain point, the taxation policy begins to reach the goal and helps reduce pollution. This result is consistent with the Environmental Kuznets Curve hypothesis concerning the effect of fiscal policies on the environment.

Another parameter which acquires high statistical significance at high levels of taxation is VAAI (γ_3 = 7.524, p < 0.001). Thus, the role of institutions should be considered to be crucial in case of high taxation policies. High levels of environmental tax require the effective functioning of institutions. The lack of a sufficient institutional structure will make the effects of the policy questionable and possibly lead to a number of adverse consequences related to the manipulation of the process.

The fact that GDP in the specified range of environmental tax level turns out to have a positive significant effect (σ_3 = 0.115, p = 0.006) shows that the effect of growth of economy on emissions changes from negative

at lower taxation to positive at higher taxation. Therefore, one can expect that economic growth in combination with high levels of environmental tax will contribute somewhat to pollution in terms of industry and energy consumption.

The estimated constant term (μ_3 = 69.998, $p < 0.001$) is statistically significant under this threshold. As the constant represents the intercept of the regression model rather than a substantive explanatory variable, no economic interpretation is provided.

Threshold 4: TAXES ≥ 18.78647

Table 6. Regression model results for tax threshold 4

Variables	Coefficient	Std. Error	t-Statistic	Prob.
T	-0.195	0.041	-4.697	0.000
V	-2.044	0.884	-2.311	0.023
G	-0.211	0.046	-4.535	0.000
C	3.192	1.056	3.024	0.003

First of all, it can be concluded that in the realm of extremely high taxation (TAXES ≥ 18.78647), the obtained empirical results have some important consequences in terms of the potential scope and effectiveness of green taxation policies. Although the coefficient of the tax rate in question (α_4 = -0.195, $p < 0.001$) turns out to be statistically significant and negative, the effect that green taxes have on the level of CO_2 emissions (GCDE) becomes relatively small compared to the coefficient identified at the previous stage (α_3 = -3.260).

Second, the obtained negative correlation between the Voice and Accountability Index (VAAI) and the level of carbon dioxide emissions (GCDE) (γ_4 = -2.044, p = 0.023) proves that institutional changes are still critical when the tax rate is extremely high. Since governments apply more pressure to taxpayers by raising fiscal costs, they must work towards enhancing governance effectiveness and making their institutions more legitimate and responsive. Thus, governance is one of the prerequisites of green taxation effectiveness in highly taxed countries.

Among other things, the most interesting finding in the current empirical analysis is that at this threshold there is a strong negative association between the GDP growth rate and the level of carbon dioxide emissions (σ_4 = -0.211, $p < 0.001$), which means that in this case the two variables are not positively correlated anymore. In other words, with extremely high taxation rates, GDP growth becomes negatively associated with emission growth at this threshold..

The estimated constant term remains positive and statistically significant ($\mu_4 = 3.192$, $p = 0.003$). This indicates the presence of a positive baseline level of carbon emissions after controlling for the explanatory variables included in the model. As the constant represents the intercept rather than a substantive explanatory variable, no further economic interpretation is provided.

4.3. Commenting on the impact of green tax and legal institutional variables on environmental performance

The threshold regression model used to analyze the effect of environmental tax, GDP, and governance (VAAI) on the growth rate of carbon emissions (GCDE) in Vietnam shows that there is no uniform effect of green taxation on carbon emissions depending on the level of taxes. For example, for levels of taxation below 13.1, the impact on emissions is low, meaning

that the motive to change behavior of individuals and companies is not strong in cases where taxes are low. However, once taxation exceeds 18.2, then the emission-reduction effects begin to emerge. This means that corporations tend to adapt to new tax policies by employing innovations and minimizing the usage of fossil fuels. Nonetheless, as taxes increase further, the effects become constant from a particular point onwards. For instance, once taxes are above 18.78, the effects remain unchanged even if taxation increases further. Probably, such a scenario occurs since too high taxation could make it profitable for companies to find ways to avoid taxation instead of reducing carbon emissions. Moreover, the legal system has an important influence on whether tax policies can effectively work or not. According to the results of the threshold model, the effects of green tax policies are higher when governance is higher because areas with high indices of VAAI show stronger tax effects. This means that green tax policies require a robust legal system if they are to succeed. Otherwise, companies operating in such regions would exploit legal loopholes and evade taxes.

In conclusion, the results of this paper can be compared with other research conducted in this area before. The studies of Nakata et al. (2001), Wissema et al. (2007), Murray et al. (2015), Phan et al. (2025) and Kok (2015) confirm the effectiveness of green tax policies in reducing carbon emissions. Moreover, these researchers found out that the effect of green tax on emission is more pronounced in less-developed urban environments. Lastly, the analysis of Zhou and Luo (2021) also shows similar results because, according to their study, there is a threshold where the effect of green tax increases substantially. However, if taxes continue increasing, the negative economic effects start to emerge. Similar observations were made by Le and Phan (2023), indicating that fiscal interventions would help Vietnamese authorities to stimulate green economic development.

Moreover, the study conducted by Li et al. (2024) concerning the impact of green taxation on carbon emissions within BRICS countries shows that the combination of renewable energy policies and green taxation increases carbon control effectiveness. This finding is valuable for Vietnam since currently, there are no green tax policies that adequately complement measures aimed at assisting companies in switching to renewable technologies. The introduction of such tax policies might allow improving carbon emission reductions in the country.

Besides, according to the results received during the simulation using the model described above and the model results align with prior studies by Cole et al. (2018), Ridzuan (2019) and Zhang and Chiu (2020) show that high levels of corruption and insufficient institutional capacity can hinder the process of controlling carbon emissions. In weak legal systems, companies may choose to evade environmental regulation which results in increased amounts of carbon emissions. Due to poor governance, regulatory authorities cannot effectively supervise corporations which makes them capable of avoiding stringent environmental policy implementation.

From the aspect of the current environmental situation and policy of green tax in Vietnam, tax rates rising into optimal level will lead to emission reduction increase but also lead to the excessive strain on economy. The application of tax on green economy not only as a financial lever, but also as the tool to lead to firm and consumer behavior. At optimal level, firms are inclined to introduce green technology and energy efficiency, promote green industries and reduce green production, but the weak tax level will weaken the competitiveness of firm, arise tax invasion and the outflow of capital. So revenue of green tax should be spent on environmental

protection, research and development and cleaner technologies

5. Conclusion and policy implications

5.1. Conclusions

The present study proves that the negative relationship between Green Taxation and carbon emission's growth start from the medium-high tax rate, which confirms the theory about Pigouvian Tax. In line with the result given by Li et al. (2024) regarding complementary green technology adoption, the relationship between the two- Green Taxation-carbon emission's growth is the form of no linear relationship and begins from the medium-high tax, while lower Green Taxation will reduce the incentive of firms and also cannot play a role in internalization environmental externalities. Additionally, institutional quality demonstrates an evident moderating effect consistent with Cole et al. (2018), Ridzuan (2019) and Zhang and Chiu (2020).

In addition, governance, accountability and the efficiency of institutions play an active role only when institutional quality is at higher tax rate ranges and are invalid under low Green Taxation rate. As such, in the case of developing countries like Vietnam, strengthening institutions must come under the umbrella of effective Green Taxation and this will act to boost the effectiveness of green taxation. Thus, building green industries and protection of environmental system means building a holistic and equitable system of flexible policy that would promote environmentally friendly technology application, boost firm's competition, and alleviate environmental burden.

5.2. Managerial Implications

According to the results, to build suitable policies, a series of holistic and flexible policies, appropriate with local conditions:

First, governments should impose geographically segregated Green Taxation based on local environmental impacts to encourage firms to move towards cleaner technologies and produce in cleaner regions by offering different rates. Specifically, lower Green Taxation rates for areas ecologically conscious with environmental protection incentives, and higher taxation rate should be applied in regions heavily polluted to push their technological innovation and sector reorganization.

Second, relevant financial policies such as targeted investments program, credit loans or subsidies must be formulated and applied in a differentiated way that helps SMES overcome financial difficulties and the high cost of technology acquisition when engaging in green technology transformation in the first step.

Third, governments shall make efforts to restrain natural resource exploration by setting up a monitoring mechanism, controlling their resource exploitation, ensuring they adhere to a sustainable resource system and recovery scheme, through the strict verification of resource renewal capacity and application of resource utilization policies which favor resource reuse (E.g. Innovative garbage and wastes treat technology). Additionally, the granting of licenses for natural resource exploration and utilization can be linked to the enforcement of relevant environmental regulations.

Fourth, encouraging inter-regional and international cooperation, developing trans-regional green technology transfer networking and information platform would have important implication in the treatment of cross-boundary transboundary pollutions as well as the transmission of technologies.

Finally, establishing a standardized CO equivalent measurement index and setting up

an environment data acquisition, management and dissemination mechanism of accuracy, speed, reliability and comprehensive could have useful purpose to measure the effect of policies efficiently and facilitate more strategic and correct policy making.

5.3. Future research directions

Future work should concentrate on how to identify the optimal Green Taxation rates and structures and what kind of incentives should be built up for promoting green industry, with use of comparative studies of a cross-industry and across-regions framework. Additional analysis is expected to explore how to encourage private investment to the green industry by optimizing those policies without placing burden on companies or examining the possible effect of lower Green Taxation rates on green SMEs or environmental taxes and even Green Tax incentives in heavily polluted regions. In the realm of cross and Macro level: the relationship between green taxation level and overall growth with the sectoral transformation, environmental efficiency and EPI index, the time-lags of Green Taxation in changing the firm productivity and production costs with green technology; evaluating the impacts of green technology adoption on production costs; best public private partnership models in technology transfer; assessment of subsidies/ loans; evaluating effective Green Taxation policy in promoting clean industry transition from polluting sectors to green ones, and green regions as a tool for enhancing sustained regional development.

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Data available upon reasonable request (contact corresponding author)

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