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Effect of Environmental Taxation on Carbon Emissions of World's Top Cabon Tax Revenue Countries

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ABSTRACT

This study looks at how environmental taxes affect carbon emission levels in the top four nations that earn the most money from carbon taxes between 2015 and 2025. Using secondary data from the World Bank's Global Data on Carbon Emissions and Carbon Taxes the study employs a simple linear regression model to assess whether higher carbon tax levels significantly reduce national carbon emission rates. High explanatory power is demonstrated by the regression results (R^2 = 0.64) as well as a significant negative correlation (R = 0.80). This result indicates that up to 64% of carbon reduction levels within the four countries in the sample of study can be linked to the carbon tax with a p-value of P<0.001 and a carbon tax regression coefficient of -0.0001. The tax implication therefore is that a rise in carbon tax could be an effective means of actualising a reduction in national carbon emission. This study demonstrates that the application of carbon tax and the increase thereof is effective carbon reduction policy instrument which countries may consider. It is by extension an veritable tool for accelerating aspired global environmentally sustainable economic development. It concludes that carbon tax offers a dual advantage of enhancing carbon reduction and creating revenue for national governments.

1. Introduction

The global quest for environmental conservation and sustainable development has galvanized national and international advocacy for placing a price on carbon (Kaufman, Obeiter and Krause, 2016). Policy makers and environmental conservationists are striving for more effective options to motivate carbon reduction. Among other measures, include carbon trading schemes where carbon emissions are capped and emissions allowances can be purchased. This pricing of carbon emissions and the capping makes the emitters to be more responsive to reductions carbon reduction initiatives. Aside from carbon pricing, environmental tax and in this paper (carbon tax) is another tool being implemented by some countries across the world to place the responsibility on carbon reduction among the emitters. It is therefore important to examine the extent to which the usage of carbon tax assists in the reduction levels of carbon of emissions. The objective of this paper therefore is to analyse the effect of carbon tax on the carbon emission levels of top global countries with the highest carbon tax revenue earnings. The following sections present the literature review, the methodology, data analysis and conclusions.

2. Literature review

To reduce air pollution and promote sustainability, environmental taxes are essential because they absorb the social costs of environmental harm. These taxes incentivize cleaner practices and technological innovation by providing polluters with financial disincentives (Murad et al., 2025). Carbon emissions are a major cause of environmental deterioration and present significant threats to international efforts to mitigate climate change especially in the economies of South-East Asian Nations. Despite being essential to comprehending environmental effects, CO2 emissions are only one component of the larger sustainability framework (Shaikh et al., 2025).

The impact of environmental tax shocks on carbon emissions was examined by (Niu et al., 2018). They discovered that Chinas carbon emissions can be reduced through environmental tax shocks. However, carbon emissions may also be increased by other exogenous shocks such as energy sector productivity shocks final goods sector productivity shocks and energy price shocks. Other exogenous shocks may have more detrimental effects than environmental tax shocks. Consequently, environmental taxes have less of a mitigating effect and Chinas carbon emissions are probably going to continue to rise for some time to come. By encouraging the

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market introduction of clean energy and pollution control of fossil fuel use environmental taxes can enhance the energy structure and lower carbon emissions.

By using the difference-in-difference (DID) method Lin and Li (2011) analysed the actual mitigation effects of the five northern European nations. According to the findings, Finland's carbon tax has a major and detrimental effect on the rise in the country's CO2 emissions per person. In the meantime, the carbon tax has had a negative but insignificant impact in Denmark Sweden and the Netherlands. Because of these nations tax exemptions for specific energy-intensive industries the carbon tax mitigating effects are lessened. Xu and Li (2025) used the difference-in-differences model to study the listed industrial enterprises with panel data technique. They examine how the green tax system affects industrial carbon emissions. According to the findings (1) the Environmental Protection Tax Law considerably lowers corporate carbon emissions, (2) this effect is more noticeable among state-owned and highly polluting industrial firms with limited funding and firms with a high level of regional marketization and (3) the law encourages businesses to engage in carbon emission reduction initiatives through two avenues: enhanced green innovation and increased environmental protection investment which helps to accelerate the shift to low-carbon development.

By employing a dynamic panel threshold model Wang and Pang (2025) analyse the nonlinear effects of renewable energy consumption climate mitigation technology environmental taxes and economic growth using panel data for 38 OECD nations from 2000 to 2020. Our research confirms the threshold effect of environmental taxes and climate mitigation technologies in the connection between economic growth and the use of renewable energy. As climate mitigation technology advances their findings demonstrate that using renewable energy significantly boosts economic growth with the impact coefficient being higher in high-carbon regions. Using environmental taxes as the threshold variable the threshold effect of renewable energy consumption on economic growth is greater in high-carbon regions than in low-carbon ones.

The conditional heterogeneous impact of governance and environmental taxes on carbon emissions across 23 African countries is examined by Kamil et al. (2025) considering the moderating effect of governance quality. For robustness over the 1994–2020 timeframe the study uses the Method of Moments Quantile Regression (MMQR) in conjunction with hierarchical regression. Using the 2SLS estimations and taking lagged effects into account Kamil et al. (2025) addressed possible endogeneity. The results show that the effects of environmental taxes on carbon emissions differ for all carbon emission distributions. They find that environmental taxes have a substantially negative coefficient. (Liu et al. 2021) applied the Computable General Equilibrium model to analyse carbon taxes in China; their results showed that they are effective at reducing carbon emissions but can also have a negative effect on economic growth. Nevertheless, they also found that implementing a carbon tax recycling mechanism like lowering personal income tax can lessen these adverse effects and produce a double dividend which is advantageous for the economy and the environment Furthermore, a review of Chinas Environmental Protection Tax Law by Xu and Li (2025) shows that it lowers corporate carbon emissions considerably. In heavily polluting state-owned industrial enterprises this decrease is more noticeable. A shift towards low-carbon development is encouraged by the tax law which incentivizes businesses to invest in environmental protection and green innovation.

In South Africa the food and agriculture industries reacted favourably to carbon taxes most likely because of tax exemptions and the recycling of tax income into production subsidies (Ntombela et al. 2019). Carbon emissions trading schemes (CETS) have demonstrated markedly lower carbon emissions and better air quality in China. By providing incentives for cleaner operations and technological advancements these market-based mechanisms frequently complement carbon taxes more successfully in achieving larger environmental goals (Li and Wang, 2024). The foregoing literature indicate that carbon taxes offer definite financial incentives for lowering emissions in a variety of industries. It also shows that their efficacy is frequently increased when paired with more conventional regulatory actions or when accompanied by technological and financial support networks. More thorough and long-lasting environmental improvements can result from these integrated approaches which can more effectively handle the opportunities and problems within each sector. However, this current paper focusses on how a single measure namely carbon tax contributes to the reduction of carbon emission within the global top earners in carbon tax revenue. This focus of study is currently scant in the literature, hence this study bridges existing gap in the literature on carbon tax and carbon emissions reduction.

3. Methodology

To investigate the impact of carbon taxation on the reduction of carbon emissions in countries with the highest carbon tax revenues, this study uses a quantitative research design. The design makes it possible to evaluate how much changes in carbon tax rates affect carbon emission results. Because it enables statistical testing of the relationship between measurable variables (dependent and independent), the quantitative design approach is seen as most appropriate for this type of research as indicated by (Creswell, 2018).

The 15 countries with the highest global carbon tax revenue make up the population for this study. The World Bank Global Data on Carbon Emissions Trading Schemes, Carbon Emissions and Carbon Tax available at the (World Bank, 2025) was the source of data used in this paper. The study used a non-probability sampling method popularly referred to as the judgmental (purposive) sampling. This chosen approach was justified because it enables the thoughtful selection of cases that are most pertinent to the research goal (Etikan

Musa and Alkassim 2016). Five countries (France, Canada, Sweden, Norway, Japan) were chosen as a sample from the population of fifteen countries with the highest carbon tax revenue generation globally (Visual Capitalist, 2024). However, due to data continuity and availability over the fifteen years period, four countries (France, Sweden, Norway, Japan) were finally used as the sample given that the four countries have continuous data on carbon tax and carbon emissions for the entire eleven years period of 2015 – 2025. This choice was made because concentrating on the top four nations with the highest carbon tax revenues offers a more accurate evaluation of how well high carbon taxes may assist in lowering carbon emissions. As the most active participants in carbon taxation these countries serve as veritable benchmark cases to provide global examples of how carbon tax may assist with the actualisation of global sustainability goal of carbon reduction and environmental conservation.

Secondary data from reliable international database mainly the World Bank Global Data on Carbon Emissions Trading Schemes, Carbon Emissions and Carbon Tax were used in the study. The dataset provided eleven years of observations from 2015 to 2025. To capture both short-term and long-term trends in carbon taxation and its possible effects on emission levels this time frame was therefore relevant. Combining the eleven years data for each of the four countries gave a total observation of forty-four (44) data collection periods. Because secondary data offer reliable and consistent macroeconomic and environmental indicators across nations they were selected as more suitable for this paper.

Two key variables are examined in this study. Dependent Variable (Y): The amount of carbon emissions in each nation expressed in metric tons. Each nations annual carbon tax expressed in US dollars is an independent variable (X). For S. dollars or comparable national currency). The association between carbon emissions and the carbon tax was ascertained using a straightforward linear regression model. The following is a description of the statistical model used.

$$CE_i = \beta_0 + \beta_1 CT_i + \mu_i$$

Where:

CE_i= the level of Carbon emissions per country *i*

CT_i= the level of Carbon tax per country *i*

β_0= the regression intercept

β_1= the regression slope, or the coefficient, which represents the level of the impact of carbon tax on the levels of carbon emissions

μ_i= the regression random error term

To determine the impact of a carbon tax on carbon emission levels, the research data were analysed by applying the simple regression analysis. To achieve this, the Excel software was used as the data analysis tool. The direction strength and statistical significance of the relationship between the two variables were ascertained by interpreting the regression results.

4. Results

Using a simple linear regression model (Table 1), the study evaluated the relationship between carbon tax levels and carbon emission levels in the four chosen countries which ranks the highest in carbon tax revenues. The data analysis employed eleven-year period data from 2015 to 2025. Since the total number of companies studies is four, the total panel data observation amounted 44 data observation periods which is (4 x 11). A correlation coefficient (R) of 0. 80 was found in the regression results suggesting a significant negative correlation between carbon emissions and the carbon tax. The coefficient of determination (R2) was 0. 64 indicating that differences in carbon tax rates between the chosen nations account for about 64% of the variation in carbon emissions. The model's explanatory power is further supported by the adjusted R2 value of 0. 63 which takes the sample size and number of predictors into account.

The estimates standard error of 0.0046 shows that the average difference between the observed and predicted values was relatively small. The significant F-statistic value of F = 5 validated the regression models overall statistical significance. 10^{-11} × 41 (p 0). 001). This suggests that the model is reliable for making inferences and that changes in carbon emissions can be largely explained by the carbon tax variable. The estimated regression coefficient for the independent variable (carbon tax) was -0. 0001 with a 1 standard error. 42 x 10°F. p = < 0. 001 The t-statistic for the carbon tax was –8. High significance is indicated by 74. According to the negative coefficient higher carbon tax rates are associated with lower carbon emissions. It is expected that carbon emissions will drop by about 0%. 0001 units all other things being equal for each unit increase in the carbon tax rate. This result provides empirical evidence for the hypothesis that lower emission levels are associated with higher carbon taxes in countries with strong environmental tax laws. Overall the regression analysis demonstrates that the carbon tax and carbon emissions have a statistically significant negative correlation. The findings show that higher carbon tax revenues are effective in reducing national carbon emissions among the best environmental tax-performing countries.

Table 1. Regression Result on Carbon Tax (ctax) with Carbon Reduction (dependent Variable).

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.803109496					
R Square	0.644984862					
Adjusted R Square	0.636532121					
Standard Error	0.004664675					
Observations	44					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	0.001660331	0.00166	76.30481436	5.41E-11	
Residual	42	0.000913886	2.18E-05			
Total	43	0.002574217				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.013829179	0.001162585	11.8952	4.936E-15	0.011482988	0.0161754
ctax	-0.000124025	1.41981E-05	-8.73526	5.41E-11	-0.00015268	-9.54E-05

Source: Author's Analysis

5. Discussion and Conclusions

The urgency for tackling carbon emissions remains dire within national and international environmental agenda. Solutions for a low and zero carbon earth should be multifaceted. Hence this paper focused only on the effect of carbon tax on carbon emission reduction in the top four countries ranked highest in carbon tax revenue. The regression results show high significant and negative effect of carbon tax on carbon reduction with a high correlation coefficient of 0.803 and high R-square of 0.64 which indicates that within this period and within the countries of study, carbon tax contributes to account for up to 64% reduction in carbon emissions. These results which used simple linear regression corroborate previous research by Sundar et al (2016) wherein they used a nonlinear model to assess carbon tac impact on emissions reduction with a significant negative effect. The results also confirm the previous findings by Bashir et al (2016) in which they found that environmental taxation has a significant negative impact on carbon emissions. Accordingly, with this paper's finding and the confirmation of previous researchers, the policy implication is that an increase in carbon tax is needed to influence expedited reduction in carbon emissions. This paper contributes to previous research in a unique way; firstly, there is currently lack of research that focused on the top four countries with the highest carbon tax revenue; this paper therefore adds a new insight into existing understanding of how and where carbon tax may influence carbon reduction. It therefore means that these countries could improve their rate emission reduction by adding more carbon tax rates to their existing rates of carbon tax. It also means that carbon tax contributes to both national and international carbon reduction agenda and as well contributes to raising national revenue (carbon tax revenue). Consequently, environmental policy makers in national and international fora should prioritize carbon taxation (in addition to others) as a veritable and urgent tool to enhance improvement in carbon emissions reduction. Further research is encouraged to evaluate this

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