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THE IMPLEMENTATION OF CARBON TAX AS AN EMISSION REDUCTION INSTRUMENT POLICY IN THE NORDIC COUNTRIES: PIGOVIAN TAX EFFECT ANALYSIS

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Abstract
Climate change has caused an urgency to implement regulations in various countries to address the factors that cause climate change. Carbon tax is one of tools to address climate change. Carbon tax is one of implementation of the Pigovian tax that aims to internalize the negative impacts of carbon emissions by imposing a fee on the emissions produced. This research aims to analyze the effect of carbon tax policies and factors that influence carbon emissions in Nordic countries in 2010-2019 using panel data regression with fixed effect model estimation. Economic growth, population growth, renewable energy consumption, and fossil consumption are variables added as control variables in this study. The sample in this study consists of four Nordic countries, namely Denmark, Finland, Norway, and Sweden. The results of the study show that carbon taxes, population growth, and renewable energy consumption have a negative and significant effect on carbon emissions. Then it was found that economic growth and fossil consumption has a positive and significant effect on carbon emissions.
Keywords: Carbon emission, Carbon tax, Nordic countries, Pigovian effect

INTRODUCTION

Extreme climate change in recent decades is a very important issue because drastic climate change has a destructive impact on the sustainability of humanity. The environmental externality that has the potential to cause the greatest loss to humans is climate change (Gruber, 2019). World Health Organization (2023) states that climate change has an impact on human health in various ways, one of which is by increasing the risk of diseases related to extreme heat weather and increasing disease transmission from animals to humans. The study by Angles et al. (2011) found that extreme climate change has a large impact on dryland crop yields. Meanwhile, Ranson (2014) indicate that increasing temperature effect crime related to social interaction positively. Global warming, which continues to increase throughout the year, is the main cause of climate change related to hot temperatures. Global warming is an increase in global surface temperature relative to the base period, which is averaged over a period sufficient to eliminate interannual variation (IPCC, 2023). Since 1975, there has been an increase in the world's annual average temperature of around 0.15 °C to 0.20 °C per decade and since the start of measuring the world's average temperature by the WMO in 1850, the world's annual average temperature has increased by at least 1.1 °C (World Meteorological Organization, 2023). The annual increase in greenhouse gases contributes to extreme temperature changes. Greenhouse gases are defined as gases that are in the atmosphere that have the ability to absorb and emit radiation at certain wavelengths in the radiation spectrum released by the earth's surface (IPCC, 2023). The effect produced by this greenhouse gas is referred to as the greenhouse effect. The main components of greenhouse gases include carbon dioxide or known as carbon emissions (CO_2), methane (CH_4), nitrogen oxides (N_2O), and F gases (F-gases). Carbon emissions are the largest component of greenhouse gases with total emissions of 44.6 Gigatons or 74% of total greenhouse gases in 2019, as shown by the summary of the IPCC's 6th assessment working group 1 report (The Sixth Assessment Report). According to research by Harrathi & Almohaimeed (2022) , the factors that affect the increase in carbon emissions are energy consumption, real GDP, foreign direct investment, trade openness, and urbanization. Meanwhile, according to research by Jia et al. (2023), ease of doing business and logistics operations are factors that contribute positively to carbon emissions. Until now, the carbon emissions that have been emitted have reached 37.1 billion tons (IPCC, 2022).

This worrying climate change raises the urgency of implementing regulations in various countries to prevent climate change. The United Nations (UN), through the United Nations Framework Convention on Climate Change (UNFCCC), has united the vision and mission of countries in the world related to climate change by formulating an international agreement aimed at reducing carbon emission production. On June 4, 1992, 154 countries ratified this international agreement with the aim of stabilizing greenhouse gas concentrations at levels that could prevent the impact of human activities on climate change. The Kyoto Protocol, signed in 1997, is the first implementation of the Framework Convention on Climate Change. 38 industrialized countries in the world reached an agreement to mitigate climate change by lowering greenhouse gas emissions to 5 percent below the 1990 level in 2010 as a result of the Kyoto Protocol agreement (Gruber, 2019). However, the Kyoto Protocol is seen as ineffective in reducing carbon emissions. According to Napoli (2012), the Kyoto Protocol is not effective in reducing carbon emissions because there is still a lack of collective action by countries that have signed the Kyoto Protocol on reducing carbon emissions. The implementation of the Kyoto protocol, which is considered ineffective in reducing carbon emissions, has led to the need for a new agreement to correct the shortcomings in the Kyoto protocol, namely the Paris Agreement. The Paris Agreement, which was signed by 195 countries in the world in 2015, aims to strengthen the commitment of countries around the world to mitigate climate change by implementing a limit on global temperature rise well below 2°C and seeking to increase the limit on temperature rise further to 1.5°C. Countries that sign the agreement are required to submit their NDC (Nationally Determined Contribution), which is a target commitment of each country to reduce its carbon emissions by 2025 or 2030. Later, an evaluation will be carried out every five years from the global community to assess the success of each country in maintaining its commitments (Gruber, 2019).

One form of commitment of various governments in the world to overcome climate change is a carbon tax. Carbon tax is a form of implementation of the pigovian tax which aims to internalize the negative impact of carbon emissions by charging a fee for these emissions. In theory, a carbon tax is expected to reduce emissions by creating a disincentive for carbon producers, thus encouraging them to switch to more environmentally friendly alternatives. It is recorded that until now there have been 39 regions, both national and regional coverage, that have implemented this policy. The carbon tax was first implemented in Finland in 1990. Based on data from the World Bank, carbon emissions emitted in Finland in 2019 decreased by 26% compared to the total carbon emissions produced by Finland in 1990. Nordic countries, such as Finland, are known as pioneers in the implementation of strict and progressive environmental policies. As developed countries, the Nordic countries understand the importance of protecting the environment as an integral part of people's well-being and long-term economic sustainability. All Nordic countries have a commitment to mitigate climate change through the implementation of strict environmental policies.

The effect of carbon tax on carbon emissions has been widely researched by many parties. Research by Doğan et al. (2022) shows that environmental taxes are effective in reducing emissions in G7 member countries. Sen & Vollebergh (2018) showed that energy tax policies can reduce emissions generated by fossil fuel consumption in OECD member countries. Gugler et al. (2021) showed that the carbon pricing tax policy, which consists of a carbon tax and carbon trading, in the UK is more effective in reducing carbon emissions than the renewable energy subsidy policy in Germany. Gupta et al. (2019) found that with the carbon tax, carbon emissions have decreased between 26% to 40% in India. Nong (2020) found that South Africa can effectively reduce its carbon emissions by implementing a carbon tax policy. Nguyen (2023) found that the higher the carbon tax rate, the higher the impact of reducing carbon emissions in Vietnam. Andersson (2019) found that carbon taxes reduce gasoline

consumption, thereby reducing carbon emissions in the transportation sector in Sweden. Hájek et al. (2019) found that the implementation of carbon taxes in energy-related sectors is effective in reducing per capita carbon emissions in Sweden, Finland, Denmark, Ireland and Slovenia. Gugler et al. (2023) found that the implementation of a carbon tax significantly affects the reduction of carbon emissions in the UK. Wolde-Rufael & Mulat-Weldemeskel (2022) found that environmental taxes and renewable energy have a significant impact on carbon emissions produced by countries that produce the largest volumes of carbon emissions in 18 Latin American countries and Caribbean island countries.

Although previous studies have found that carbon taxes can reduce carbon emissions, research by Pretis (2022) shows that although there is a decrease in carbon emissions in some sectors, the impact of carbon taxes is found to be insignificant in all sectors as a whole in British Columbia. Then the findings on the effectiveness of carbon taxes by Lin & Li (2011) found that although carbon taxes affect the decrease in per capita carbon emissions in Finland, it is found that carbon taxes affect the increase in per capita carbon emissions in Norway. Meanwhile, in the Netherlands, Denmark, and Sweden, carbon tax policies were found to have no effect. The impact of increasing carbon emissions from carbon taxes in Norway is in line with the research of Bruvoll & Larsen (2004) which found that carbon taxes do not have a large impact and carbon emissions tend to increase in Norway. In addition, research by Wolde-Rufael & Mulat-Weldemeskel (2022) found that environmental and renewable energy taxes did not have a significant impact on carbon emissions in low-carbon emitting countries in 18 Latin American countries and Caribbean island countries.

Various factors, such as policy design, tax rates, responses from the industrial sector, and public support can affect the outcome of a carbon tax policy. Based on the results of previous inconsistent findings, researchers are interested in conducting further research on the effect of carbon taxes on carbon emissions. The researcher sampled four Nordic countries, namely Denmark, Finland, Norway, and Sweden in 2010-2019. The researcher took the four Nordic countries as a sample because the four Nordic countries are known as pioneers in environmental policy, especially the four Nordic countries are four of the first five countries to implement carbon taxes in the world. In addition, the study sampled Norway because two previous studies found that carbon tax policies tend to increase carbon emissions in Norway. This study allows for further exploration of the impact of carbon tax policies in regions that have a strong commitment to the environment and relatively similar economic and environmental characteristics. In addition, the research period includes important developments in environmental policy, especially the 2015 Paris Agreement which transformed both developed and developing countries to reduce carbon emissions. Through the regression analysis of panel data, this study will analyze and further explore the contribution of carbon taxes in reducing carbon emissions in Nordic countries from 2010 to 2019 with four control variables, namely economic growth, population growth, renewable energy consumption, and fossil fuel consumption.

LITERATURE REVIEW

Externality

Water and air pollution are two well-known examples of externalities. According to Stiglitz & Rosengard (2015), externality is an action of an individual or company that has an impact on another individual or company that is not paid for or compensated by the individual or company that caused it.

Pigovian Tax

Tax that implemented to address negative externalities is Pigovian tax (Mankiw, 2021). If the negative externalities caused by emitters, both producers and consumers, are not

addressed, it can lead to market failure. Government intervention is needed to correct the negative externalities caused by emitters. One form of the intervention is implementation of a Pigovian tax, also known as a correction tax (Gruber, 2019). A carbon tax is a form of Pigovian tax that targets carbon emissions caused by individuals and companies.

Environmental Kuznets Curve (EKC)

According to this theory, in conditions where the community's economic level is still low, the level of environmental damage will increase along with the increase in the level of economic growth. However, when the community's economic level is at a certain point, the community will switch to products that use renewable technology so that they are more environmentally friendly (Robbins, 2005). Several recent studies have expanded the concept of the EKC concept. This advanced concept of EKC explains that in the third stage after the economy is focused on improving environmental quality, emissions can increase again due to a very high level of economy. The third stage of EKC makes the EKC curve form the letter N.

Malthus's Theory

Malthus' theory states that uncontrolled population growth will result in an imbalance in food production which will potentially cause serious problems in the end. This theory explains that the human population tends to grow exponentially, while food production can only grow arithmetically (Robbins, 2005). Uncontrolled population growth will increase the decline in nature's ability to absorb carbon emissions through increased deforestation due to the increasing need for residential land, which in turn will increase greenhouse gases.

Hypothesis

The Effect of Carbon Tax on Carbon Emissions

According to research conducted by Doğan et al. (2022), carbon taxes can help reduce emissions in G7 countries. Doğan et al. (2022) explained that carbon taxes will increase the price of goods so that it will limit energy consumption. Other research results also show that carbon taxes are effective in reducing emissions by reducing energy consumption (Sen & Vollebergh, 2018; Gugler et al., 2021; Gupta et al., 2019; Nong, 2020). Consumers are more sensitive to changes in gasoline prices due to carbon taxes than changes in gasoline prices due to market demand (Andersson, 2019). The higher the carbon tax rate, the higher the emission reduction. Carbon taxes will reduce output production in high energy consumption sectors such as the mining sector, manufacturing sector, and electricity sector (Nguyen, 2023; Hájek et al., 2019; Gugler et al., 2023).

H1: It is suspected that carbon tax has a negative effect on carbon emissions.

The Effect of Economic Growth on Carbon Emissions

The findings of the study by Owusu et al. (2024) show economic growth had a positive effect on carbon emissions in Nordic countries in 2010-2019. Owusu et al. (2024) explained that economic growth in Nordic countries encourages the growth of sectors that contribute greatly to carbon emissions. So that indirectly carbon emissions will increase along with economic growth. The findings of the study are consistent with research by Alola & Adebayo (2023) which found economic growth has a positive effect on carbon emissions in the long term as well as in the short term in the Nordic countries in the 1990-2019. In addition, Georgescu et al. (2024) found that economic growth has a positive impact on carbon emissions in Southeast European countries and in Nordic countries.

H2: It is suspected that economic growth has a positive effect on carbon emissions.

The Effect of Population Growth on Carbon Emissions

Research by Jorgenson & Clark (2010) found that population influence carbon emissions positively, in various developed and less developed countries. Activities such as fossil fuel consumption, economic growth, international trade, and deforestation have affected the accumulation of carbon emissions in the atmosphere. In addition, research by A. Ahmad et

al. (2018) found that population growth is the main driver of deforestation and increased carbon emissions.

H3: It is suspected that population growth has a positive effect on carbon emissions.

The Effect of Renewable Energy Consumption on Carbon Emissions

Saidi & Omri (2020) found that in 15 countries with renewable energy as the main energy consumption during the 1990-2014, the decrease in carbon emissions was influenced by renewable energy consumption. Saidi & Omri (2020) explained that renewable energy has several benefits, such as lower carbon emissions and improved air quality. In addition, renewable energy can boost economic growth. Research by Li et al. (2023) shows that renewable energy has the ability to reduce the amount of fossil fuels used. Thus, climate change can be avoided through the reduction of greenhouse gases. The widespread use of renewable energy sources, including wind and solar power, can reduce dependence on limited resources, such as fossil fuels.

H4: It is suspected that renewable energy consumption has a negative effect on carbon emissions.

The Effect of Fossil Fuel Consumption on Carbon Emissions

M. Ahmad et al. (2023) found that the consumption of fossil fuels negatively impacts the environment because it produces carbon emissions, leading to climate change. Research by He et al. (2019) shows that fossil fuel consumption has a short-term impact, namely air pollution, and long-term, which triggers climate change. As fossil fuel consumption increases, there is an increase in carbon emissions that also affect the volume of greenhouse gases in the atmosphere. So that fossil consumption causes the strengthening of the greenhouse effect that triggers climate change. Martins et al. (2021) found that there is a short-term and long-term relationship between fossil fuel consumption and carbon emissions in G7 member countries for the 1965 to 2018.

H5: It is suspected that fossil fuel consumption has a positive effect on carbon emissions.

METHODS

This study using quantitative method. Data sources are from the World Bank, the OurWorldinData website, and Statista. The population used in this study is four Nordic countries. The four Nordic countries sample consist of Denmark, Finland, Norway, and Sweden. The time period in this study is 2010-2019. This study employed multiple linear regression analysis of panel data to analyse and investigate the effects of carbon tax, economic growth, population growth, renewable energy consumption, and fossil fuel consumption on carbon emissions. The data used in this study was processed using RStudio. In determining the estimation model in the study using the multiple regression method of panel data, the Chow test and the Hausman test were used. The regression models in this study is:

$$LOG(EK_{it}) = \beta 0 + \beta 1\ LOG(PK_{it}) + \beta 2\ PDBG_{it} + \beta 3\ PG_{it} + \beta 4\ RE_{it} + \beta 5\ LOG(FOSIL_{it}) + e$$

Carbon emissions (EK) are defined as burning fossil fuels emissions in kilotons. Carbon tax (PK) is defined as the carbon tax rate in US dollars per emission. Economic growth (GDP) is defined as the percentage change in annual GDP from the previous year based on the 2015 constant price value of the local currency converted in United States dollars. Population growth (PG) is defined as the percentage change in the number of people from the previous year. Renewable energy consumption (RE) is defined as the proportion of renewable energy consumption to total overall energy consumption in percent. Fossil fuel consumption (FOSSIL) is defined as consumption of coal, oil, and natural gas in TWh (terawatt hour).

RESULTS AND DISCUSSION

This study's descriptive statistics for all variables yielded the following results:

Table 1. Descriptive Statistics

Variable	N	Mean	Minimum	Maximum	Standard Deviation
EK	40	41095	29697	62526	6188
PK	40	76,19	24,47	167,42	47,78
PDBG	40	1,032	-1,866	5,053	1,35
PG	40	0,72	0,11	1,35	0,36
RE	40	44,53	21,2	60,6	11,07
FOSIL	40	177,41	125,22	237,39	24,99

Source: processed by the author, 2024

The results of the descriptive statistic analysis in Table 1, shown that the EK or carbon emissions which are the dependent variables, have a minimum value of 29697 and a maximum value of 62526. This means that out of a total of 40 samples of observation data, the lowest carbon emission value is 29697, while the highest carbon emission value is 62526. The average of the dependent variable has a value of 41095. This means that the average carbon emissions produced by the four countries in 10 years is 41095. The value of standard deviation of this carbon emission variable is 6188. Value of standard deviation smaller than the average value means that the variation in carbon emission data is smaller than the average value.

The panel data regression model was chosen based on statistical testing using the Chow and Hausman tests. The chow test is used to choose the best model between Common Effect (CEM) and Fixed Effect (FEM). Meanwhile, the hausman test is used to choose the best estimating model between Random Effect (REM) and Fixed Effect (FEM).

Table 2. Chow and Hausman Test

METHODS	H0	H1	*p-value*	EXPLANATION
Chow	CEM	FEM	0,000	FEM
Hausman	REM	FEM	0,000	FEM

Source: processed by the author, 2024

Chow Test in Table 2 shown that the Fixed Effect model is more suitable for the research than the Common Effect model. This is shown in the p-value of the Chow Test which is less than 0.05, so H0 is rejected. Hausman test found that the Fixed Effect model is better to use than the Common Effect model. This is shown in the p-value of the Hausman Test which is less than 0.05, so H0 is rejected.

Classical assumption test showed that the model used was free from multicollinearity symptoms and heteroscedastial symptoms. This is shown by the VIF value of each variable which has a value of less than 10, while the p-value of the Breusch-Pagan test has a value less than its significance level, 0.05. However, the model used rejects the hypothesis of a normality test and an autocorrelation test. This is shown in p-values that have a value of less than 0.05 and p-values that have a value of less than 0.05. So from these two things, it can be concluded that the data used is not normally distributed and the model used is indicated to be autocorrelation. To overcome these autocorrelation symptoms, a Clustering Group is used so that valid conclusions can be used.

Table 3. Hypothesis Test

Variable	Coefficient	t-stat	*p-value*
Carbon Tax (USD/tCO2e)	-0,027	-4,8737	0,000 ***
Economic Growth (% annual)	0,007	3,3439	0,002 **
Population Growth (% annual)	-0,035	-3,3811	0,001 **
Renewable Energy Consumption (% energy total)	-0,016	-4,5673	0,000 ***
Fossil Consumption (TWh)	0,518	3,9200	0,000 ***
R^2	0,966		
F-statistic	176,034		
F Significance			0,000 ***

Source: processed by the author, 2024

Keterangan:
** Significant at 5 percent
*** Significant at 1 percent

The value of the determination coefficient was obtained as 0.966 or 96.6%. The results of the determination coefficient mean that the variation in carbon emissions can be explained by 96.6% by the variables of carbon tax (PK), economic growth (GDP), population growth (PG), renewable energy consumption (RE), and fossil fuel consumption (FOSSIL). Meanwhile, variables outside the research model affect carbon emissions by 3.4%.

According to Table 3, a significance value of 0.000 and a calculated F value of 176.034 were obtained. Significance value smaller than 0.05 show that all independent variables affecting the dependent variable simultaneously. The results also supported by the finding of F that has 176.034, which is more than the F Table, which is 5.339. Thus, from the results of the two statistical tests F, concluded that the independent variables affecting on the dependent variables simultaneously.

The results of the t-statistical test are shown in the p-value in Table 3. Based on the results of the statistical t-test, it can be concluded that the variables of carbon tax, economic growth, population growth, renewable energy consumption, and fossil fuel consumption have a partial influence on the dependent variable, carbon emissions.

According the finding that shown in Table 3, carbon tax found has a negative and significant effect on carbon emissions. If carbon tax rate rise by 1%, carbon emission predicted reduce by 0.027%. So, the first hypothesis (H1) is accepted. The findings consistent with previous study. Gugler et al. (2021), Gupta et al. (2019), Nong (2020), Nguyen (2023), Andersson (2019), Hájek et al. (2019), Gugler et al. (2023), Doğan et al. (2022), Sen & Vollebergh (2018), dan Wolde-Rufael & Mulat-Weldemeskel (2022), which show that the carbon tax reducing carbon emissions. These findings support the theory of pigovian taxes which explains the types of taxes used to overcome negative externalities. The form of application of this theory is a carbon tax aimed at reducing carbon emissions produced by emitters by setting a cost for each emission. Carbon taxes result in increased production costs for products that produce emissions. The rising cost of production affects both producers and consumers. Producers have incentives to address the increase in production costs due to carbon taxes in various ways, such as reducing production quantities, reducing fossil consumption, improving energy efficiency, switching to consuming renewable resources, encouraging more environmentally friendly technologies, and charging additional costs due to carbon taxes to consumers.

Economic growth has positive and significant effect on carbon emissions. If economic growth rise by 1%, carbon emissions predicted to rise by 0.7%. So that the second hypothesis

(H2) is accepted. The results of this study are consistent with the findings of Owusu et al. (2024), Alola & Adebayo (2023), and Georgescu et al. (2024) that found economic growth has a positive effect on carbon emissions in Nordic countries. Owusu et al. (2024) explained that economic growth in Nordic countries in 2010-2019 encourages the growth of sectors that contribute greatly to carbon emissions, such as the transportation and manufacturing sectors, so that indirectly carbon emissions will increase along with economic growth. In addition, the findings are supporting advanced concept of the Enviromental Kuznet Curve (EKC).

Based on regressions analysis, population growth proven has a negative and significant effect on carbon emissions. If population growth increases by 1%, carbon emissions ar predicted to reduced by 3.5%. So, the third hypothesis (H3) was rejected. The finding did not succeed in supporting Malthus' theory that population growth has a negative impact on the environment through increased energy consumption. The finding also have different finding with other research by Jorgenson & Clark (2010) that found population growth has a positive influence on carbon emissions, both in developed and less developed countries. Researchers suspect that the increase in population in the Nordic countries is related to the effect of agglomeration on urban areas. The effect of agglomeration on urbanization will increase the energy consumption efficientcy in urban areas, especially in the transportation sector and the industrial sector (Q. Wang & Zhang, 2021).

According to Table 3, renewable energy consumption has a negative and significant effect on carbon emissions. If renewable energy consumption increases by 1%, carbon emissions are expected to decrease by 1.6%. So, the fourth hypothesis (H4) is accepted. The findings of this study are consistent with the results of other research by Saidi & Omri (2020) and Chen et al. (2022) that show renewable energy consumption has a negative effect on carbon emissions. Furthermore, the finding of the study show that renewable energy consumption is one of the good instruments to mitigate climate change through reducing carbon emissions, which are the largest component of greenhouse gases. This renewable energy can reduce carbon emissions by replacing fossil fuels as an energy source in economic activities. Research by Li et al. (2023) prove that renewable energy can reduce fossil fuels consumption, thereby lowering greenhouse gas emissions.

According to result of regression analysis, fossil fuel consumption has a positive and significant effect on carbon emissions. If fossil fuel consumption increases by 1%, carbon emissions are expected to increase by 0.518%. So, the fifth hypothesis (H5) is accepted. The findings regarding the influence of fossil consumption variables are in accordance with the results of studies by Martins et al. (2021), M. Ahmad et al. (2023), He et al. (2019), and J. Wang & Azam (2024) which found that fossil fuel consumption increases carbon emission production. Fossil fuel consumption has a short-term impact, namely air pollution, and long-term, namely triggering climate change. As the consumption of fossil fuels increases, there is an increase in carbon emissions which also affects the concentration of greenhouse gases in the atmosphere (He et al., 2019). J. Wang & Azam (2024) explained that emissions produced by the consumption of fossil materials are released into the atmosphere, those emissions will capture heat and increase global warming.

CONCLUSIONS

Based on the analysis, carbon emissions are negatively and significantly affected by carbon taxes. The results show that carbon tax are able to decreasing carbon emissions in Nordic countries. Carbon tax increasing production cost of the product. When production cost increasing, emitters will be incentivized to address the increase in production costs due to carbon taxes in various ways, such as reducing production quantities, reducing fossil consumption, improving energy efficiency, switching to consuming renewable resources,

encouraging more environmentally friendly technologies, and charging additional costs due to carbon taxes to consumers. As a results, the pigovian tax effect on the carbon tax is allow it to internalize the externalities caused by the emitters.

Other factors influencing carbon emissions are included as control variables. The study of the control variables revealed that population growth and renewable energy consumption had a negative and significant effect on carbon emissions. Meanwhile, economic growth and fossil fuel consumption have a positive and significant effect on carbon emissions.

Suggestion

According to the results of the research and the conclusion, carbon taxes have been proven reduce carbon emissions significantly. The government must enact carbon tax policy as tool to reduce carbon emissions, which are a contributing element to climate change. Furthermore, the government needs to design a carbon tax policy so that the carbon tax policy effectively able to reduce emission production.

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