Impacts of Different Environmental Policies on Green Economy

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Abstract. Energy conservation, carbon emission reduction, and finally the development of a green economy have become the universal aims of humanity in the current period of escalating global warming. Many nations have enacted carbon emissions trading or carbon tax laws to minimize carbon emissions, and they are actively working to develop new technologies that will help them employ renewable energy sources to address the energy dilemma. This article primarily investigates which carbon policy is more effective and efficient and if it will have an impact on a nation's per capita carbon emissions. To accomplish the aforementioned goal, this study focused on China and Finland, and relevant data was utilized to create a multiple regression model for quantitative analysis. According to the research, per capita carbon emissions are influenced by country situations such as wealth and population density. However, when it comes to lowering per capita carbon emissions, there is little difference between the two main programs while economic expansion continues.

Keywords: Environmental Policy, Carbon Emissions, Multiple Linear Regression Model

1 Introduction

For many years, humans have tried to introduce and develop a green economy to save nonrenewable resources like water and energy, to deal with climate change mainly referring to global warming caused by greenhouse gas emissions like CO_2, and ultimately to preserve and improve the earth for our long-term living so as our future generations.

In this domain, carbon dioxide emissions and green technology adoption have been hot issues for a long time. This study adds to the considerable literature of research on how different environmental legislation influence the amounts of CO_2 emissions caused by the contrasting policies: the carbon emissions trading system now in China and carbon taxation in Finland.

China's carbon market, the largest carbon emissions trading system in the world, has become more and more active recently, demonstrated by the annual increases in transaction volume and value. The amount of carbon emissions per capita in China has grown year by year from 1990 to 2013 be due to the rapid economic development and it comes to the stable period in recent years which can represent the huge contribution

T. Ramayah et al. (eds.), *Proceedings of the 2024 International Conference on Applied Economics, Management Science and Social Development (AEMSS 2024)*,
Advances in Economics, Business and Management Research 284,
https://doi.org/10.2991/978-2-38476-257-6_75

China has made in the emission reduction as mentioned in figure 1. Despite these, carbon prices in China still remain the lowest globally, and there is still a long way to go.

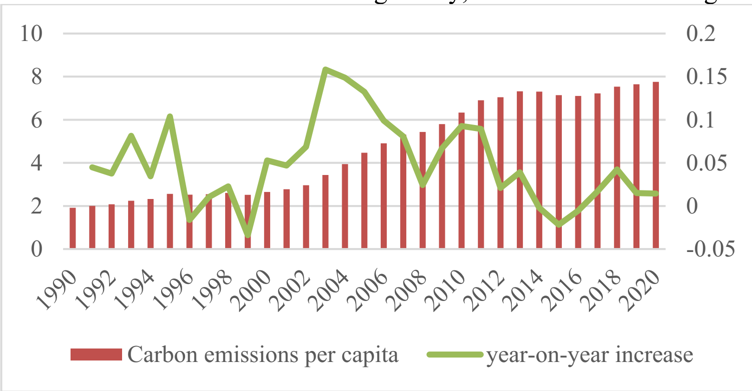

Fig. 1. China's carbon emissions per capita (metric tones) (Photo credit : Original)

Data from world https://data.worldbank.org.cn/

This paper has chosen Beijing's carbon market transactions in 2021 to represent overall China's carbon market. The carbon market quota and CCER are both showing a climbing trend from March to December, so their price stands for a sign that the carbon trading market's long-term prospects are improving, drawing more investors and businesses thereby further stimulating the price as mentioned in figure 2. From the enterprises' site, this trend may boost the burden in carbon costs for some over-emitting companies, while those with excess carbon quotas can seek a chance to make considerable profits.

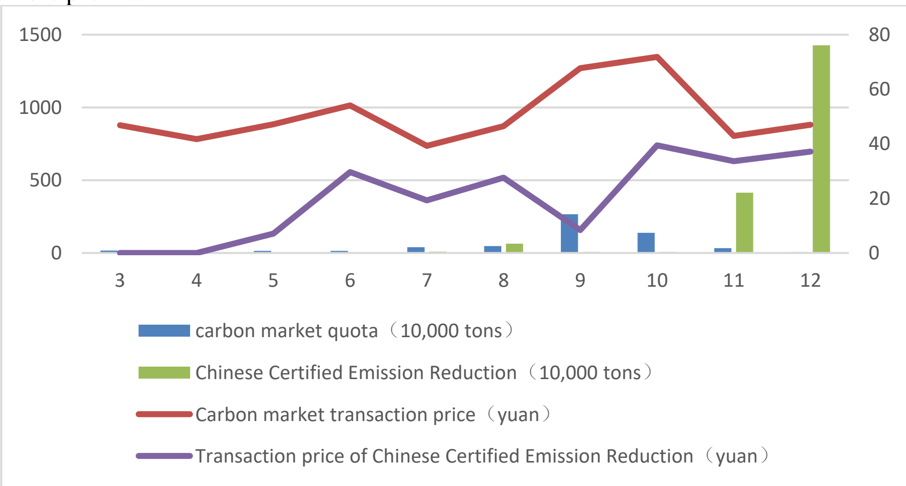

Fig. 2. Carbon market transactions in 2021 in Beijing (Picture credit : Original)

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Finland, the first country to introduce the carbon tax market in 1990, has continuously improved its carbon tax policies. The amount of carbon emissions per capita in Finland decreased gradually after 2007 as shown in figure 3.

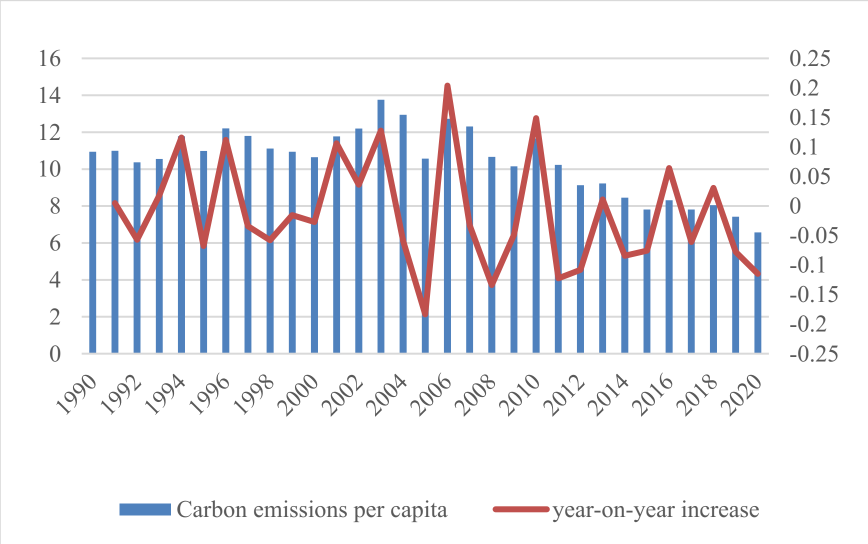

Fig. 3. Finland's carbon emissions per capita(metric tones) (Photo credit : Original)

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2 Literature review

2.1 The Effect of Carbon Trading System and Carbon Tax

Concerning the innovation of green technology, Juan Carlos Bárcena-Ruiza and Amagoia Sagasta have made the comparison between the policy of tradable permits and setting emission standards, and the results indicate that firms show more corporate social responsibility which also indicates more innovation and application of green technology under the trading system, while that is different when it comes to the latter [1]. However, Davide Dragone holds the view that there is no significant difference between using a suitable tax rate or setting a limited level for the enterprises allowed to enter the market when gradually gaining green innovation [2]. There is Md Azizur Rahman who thinks the Porter Hypothesis is not been proven in 500 energy-intensive firms in u.s, and the Regional Greenhouse Gas Initiative which can be both of the policies has also prevented the revolution of green technology [3]. Quite the opposite, Tiho Ancev argues that higher total efficiency and lower tradable permit prices can be achieved under the combination of taxation and tradable permit schedule, which also bring appropriate investment in abatement tech [4].

About carbon dioxide emissions, Xin Chang takes the attitude that the implementation of Carbon emission trading and tradable green certificates have an efficient effect on the reduction of carbon emissions compared with the only set mechanism [5].

2.2 The effect of single policy: carbon trading system

Bosung Kim suggests that supplier's initiatives in innovation may be prevented by the rising tax burden and double counting emissions (the supplier is also subject to the emission tax), while it can be maximized under a relatively low tax intensity level [6]. Nevertheless, K.B. Tchorzewska suggests that the higher the amount of taxation, the larger the introduction of green technologies will be in the firms. Combining lower taxation with reasonable government funds, also can be productive considering the adoption of environmental-friendly technologies [7].

Divya Sharma and Sri Vanamalla Venkataraman harbor the idea that taxing and remanufacturing are useful tactics for reducing carbon emissions and also increasing profits for the manufacturer and the store [8]. Yuecheng Xu concludes that sustainable gas-emitting coordination can be achieved by increasing emission taxation rates [9]. Similarly, Tian-tian Feng maintains the position that the power industry’s CO2 emissions are expected to peak sooner rather than slower because of the slowdown in expansion under the implementation of Carbon Emissions Trading and Tradable Green Certificates [10].

2.3 The Effect of Single Policy: Carbon Tax

Ge Wang has found that when setting a goal aimed at lowering the amount of co2 emissions while popularizing renewable energy at the same time, the National Tradable carbon emission permits market will coordinate more economical-efficiently with the Renewable Electricity Certificates market, so long as the efficient coordination space is applied to the matching carbon intensity and Renewable Portfolio Standards target [11].

3 Methodology

This study adds to the considerable literature of research on how different environmental legislation influences business behavior.

Below is the bar chart illustrating the carbon emissions per capita in 2020 in six countries, it is known that there are diverse factors like policy, population, oil storage capacity, technique level, and so on that influence carbon emissions per capita. This study would like to use a multiple regression linear model to find out what can affect carbon emissions per capita and whether a carbon trading system or carbon tax is more efficient and effective (Figure 4).

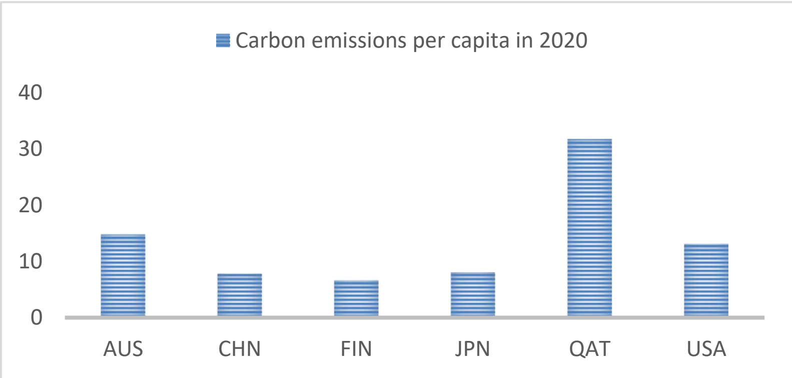

Fig. 4. Carbon emissions per capita in 2020 (Photo credit: Original)

Data from world https://data.worldbank.org.cn/

3.1 Model Structure

From 1990 to 2018, carbon emissions in Finland were much more than that in China, while the figure came to merely the same in 2019, and went lower in 2020 as shown in the below figure 5. It seems that different policies will lead to revers outcomes in the beginning but come to the same with the year by. So which independent variable is more significant and do different policies affect the carbon emissions?

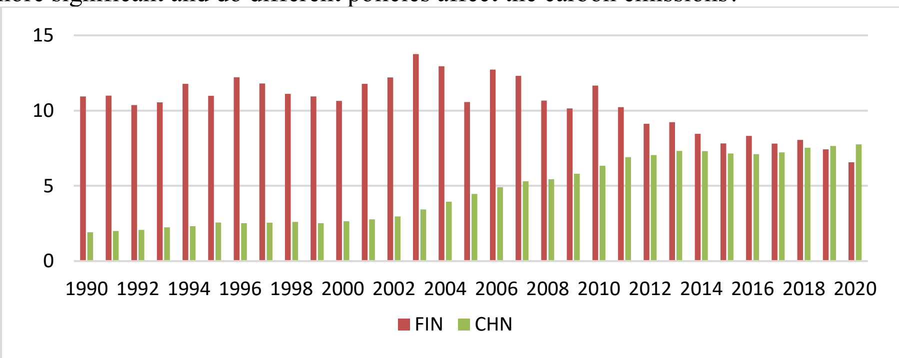

Fig. 5. Carbon emissions per capita from 1990 to 2020 (Photo credit : Original)

Data from world https://data.worldbank.org.cn/

To solve this problems, this study use carbon emissions per capita as dependent variable Y, and the data about population in China as X1, the coal's share of total energy consumption (%) as X2, the urbanization rate as X3, the number of patent applications accepted in China as X4 and the Per capita income as X5 as independent variables in the year from 2000 to 2020 in China. Moreover, the data from 2000 to 2020 about the population as X1, the proportion of coal-fired power generation (%) as X2, the urbanization rate (%) is X3, the number of patent applications accepted(%) is X4 and per capita income as X5 as covariates in Finland in the second multiple regression linear model. All these data are from the World Bank.

3.2 The First Model about Carbon Emissions per Capita in China

It can be seen in table 1 that the adjusted R-squared in this model is about 0.99, which indicates that it's highly fitted. And the prob(F-statistic) is zero which means that the model is reliable. As for the independent variables, the coefficients of pop and income are significant as their prob in the T-test are smaller than 0.05, while those in the others are converse.

Table 1. The result of the first model.

Variable	Coefficient	t-Statistic	Prob.
pop	-6.47E-04	-3.156726	0.0065
coal	-0.007226	-0.207645	0.8383
urban	0.223161	2.114708	0.0516
patent	-4.17E-07	-1.768986	0.0972
income	-0.000208	-2.408714	0.0293
c	86.9019	3.079115	0.0076
Adjusted R-squared	0.991398	meas dependent var	5.762157
S.E.of regression	0.163916	S.D.dependent var	1.767353
Sum squared resid	0.403026	Akaike info criterion	-0.543974
Log likelihood	11.71172	Schwarz criterion	-0.245539
Durbin-Watson stat	1.163022	Prob(F-ststistic)	0.000000

3.3 The second model about carbon emissions per capita in Finland

Table 2. The result of the second model.

Variable	Coefficient	t-Statistic	Prob.
pop	-2.29E-05	-8.114034	0.0000
coal	0.243964	9.775375	0.0000
urban	1.394082	7.673286	0.0000
patent	0.001065	1.021324	0.3290
income	0.000317	4.517634	0.0009
Adjusted R-squared	0.954685	meas dependent var	10.89051
S.E. of regression	0.362061	S.D. dependent var	1.700831
Sum squared resid	1.441967	Akaike info criterion	1.056297
Log likelihood	-3.4503729	Schwarz criterion	1.29773
Durbin-Watson stat	1.441531	Hannan-Quinn criter	1.068660
Variable	Coefficient	t-Statistic	Prob.

This model fits very well and it is reliable as its adjusted R-squared which can be seen in table 2 is about 0.95. Independent variables all significantly decide the Y except the variable X4.

4 Results

4.1 Results of the First Model

The result shows that population and income are two factors that deeply influence the carbon emissions per capita, however, the coal's share of total energy consumption (%), the urbanization rate and the number of patent applications accepted in China do not have that much correlation.

4.2 Results of the Second Model

The result indicates a small correlation between the number of patent applications accepted in Finland and its carbon emissions per capita, while the others significantly affect it.

4.3 Comparison

These two models indicate that population and income per capita both influence the carbon emissions in these two countries, while the proportion of coal-fired power generation and the urbanization rate weigh a lot on Finland's carbon emissions per capita, it does not means something to that in China.

4.4 Reasons

With more residents in the country, more carbon emissions will be as there are more activities and energy use. People's income also is important and necessary and it decides the choice of more environmentally friendly energy or not. Considering the proportion of coal-fired power generation, new energy power generation accounts for nearly 50% in Finland, while China still relies on coal power generation. As a developed country, the urbanization process is almost complete in Finland, while China is still in the process.

5 Discussion

These two reverse policies have some differences when developing them and putting them in to practice. In terms of the implementation costs, a complete trading platform with real-time detection is made by governments. With no more supporting infrastructure settled or new institutions established, that is easier and more money-saving to use the carbon tax thanks to the already existing tax system. When it comes to the significant emission reduction effects of the two, the former focuses on the total stable amount of carbon emissions made by the governments, leading to a more efficient and intuitive outcome, and the latter instead uses the taxation price to guide enterprises to emit less carbon oxide and to adopt environmental-friendly technologies or devices voluntarily. However, carbon taxation can be applied to diverse emission sources of all sizes, while carbon trading systems aim at a smaller scope of regulation.

The two policies all have their advantages and disadvantages. Though more material and human resources are involved, the carbon trading system results in a more direct and obvious result. With lower regulatory costs and more simple regulatory mechanisms, using carbon taxation and supervising its procedure is more transparent and inexpensive. When choosing which of them is more efficient and effective, many factors like national economic status and technological level, per capita income, and so on need to be considered.

All in all, to better transform or develop a green economy, cooperation and assistance is necessary. It is the appropriate policies made by the governments and compatriot's support that make a more harmonious and greener world.

6 Conclusion

This study primarily makes two multiple regression models to investigate which policy is more effective and successful, the carbon tax or carbon trading system.
The results indicate that:

(1). Per capita carbon emissions in a nation will be significantly affected by its total population and average national disposable income.

(2). In terms of lowering per capita carbon emissions, carbon tax and carbon trading system policies do not massive differences.

(3). When developing pertinent policies, fundamental circumstances of a country, such as its level of economic development, population, level of technology, and overall volume of coal reserves, must be fully and carefully considered.

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