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Carbon Tax Development in the EU in the Context of Carbon Neutrality

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Abstract

Facing the climate change crisis, the carbon tax is internationally recognized as one of the most effective market-based policy instruments to reduce greenhouse gas emissions. It is significant for the European Union to explore how to structure a uniform carbon tax system to achieve the objective of "carbon neutrality". Its primary function is to internalize the external environmental costs so that fossil energy consumers can consider the environmental costs in their decisions. This paper reviews the existing carbon tax policy, identifies the necessity of imposing a carbon tax based on the public goods theory and the polluter pays principle, further determines that the tax should be calculated based on fossil fuel consumption and carbon content, clarifies the rationality of imposing the tax at the consumption end, To be more equitable and to avoid a disconnect between tax capacity and tax burden, a more moderate taxation approach is proposed for progressive rates of carbon taxation. A reasonable policy proposal for the EU to achieve the objective of "carbon neutrality".

Keywords: Carbon neutrality; carbon tax; climate change; environmental costs; super progressive tax rate.

1. Carbon tax development in the EU in the context of carbon neutrality

Industrialization for more than 150 years, massive deforestation, and overconsumption of resources due to the massive use of disposable goods have produced many greenhouse gases, including carbon dioxide, and the level of greenhouse gases in the atmosphere has grown to unprecedented levels, and the growing greenhouse gases cause global warming. Global warming will trigger the melting of glaciers and permafrost and rising sea levels, jeopardizing the balance of natural ecosystems and threatening the human environment, undermining the harmony between humans and nature. The global ecological balance has been disrupted and climate change is already having a significant impact on a global scale, with frequent extreme weather conditions, increasing catastrophic floods, and exposing coastal cities and countries to extreme risks. The concept of "carbon neutrality" has been created to prevent and control the risks posed by climate change. Carbon neutrality means that the total amount of carbon dioxide or

greenhouse gas emissions produced directly or indirectly by a country, company, product, activity, or individual over a certain period of time is offset by its own carbon dioxide or greenhouse gas emissions in the form of afforestation, energy saving, and emission reduction to achieve a positive or negative offset and achieve relative 'zero emissions'. Controlling carbon dioxide emissions and achieving a balanced carbon cycle is significant for combating climate change, and is also an international obligation for the EU as a global benchmark for emissions reduction.

A market-based measure to reduce emissions has been proposed as a way of reducing emissions due to the importance and urgency of reducing emissions globally. A Carbon Tax (CT) is a tax imposed on carbon dioxide emissions. The purpose of the tax is to protect the environment and to reduce global warming by increasing the cost of emissions and curbing CO_2 emissions. The main objective is to reduce fossil fuel consumption and CO_2 emissions by taxing the carbon content of various fossil fuel products in proportion to their carbon content. A carbon tax originated in 1920 in the book The Economics of Welfare by the British economist Pigou, also known as the Pigou tax (e.g., Pigou,1920) [1], who argued that the divergence between marginal net private output and marginal net social output was due to the existence of marginal social costs and that the cost of pollution should be added to the price of the product because it made the manufacturer profitable but cost nothing. The cost of pollution should be added to the price of the product, in the shape of a tax to make up the difference between marginal net private output and marginal net social output. However, it was not until 1990 that Finland first introduced a carbon tax based on the carbon content of fossil fuels, which was then €1.12 per tonne of CO_2 equivalent(e.g. Khastar and Aslani,2020)[2]. According to the World Bank's State and Trends of Carbon Pricing 2022 report released in May 2022, as of April 2022, more than forty countries or regions around the world have priced carbon through carbon tax policies or carbon emissions trading, and a total of 68 carbon pricing mechanisms have been implemented, accounting for approximately 23% of global greenhouse gas emissions, 37 of which are carbon tax systems, involving 27 countries. The imposition of carbon taxes varies from country to country, ranging from US$1/t to US$137/t, with significant differences in the level of taxation(The World Bank,2022)[3].

Generally speaking, European countries have higher carbon tax rates, with national carbon tax levies as shown in Table 1. However, most carbon prices are still well below the US$40-80/t needed to meet the Paris Agreement's 1.5°C temperature control target, and a report by The High-Level Commission on Carbon Prices identified the need to set a carbon price of US$50-100/t by 2030 to keep the global temperature control target below 2°C. EU countries are also considering the introduction of a harmonized carbon tax system across their member states to compensate for the shortcomings of their carbon emissions trading system, which was implemented in January 2005.

Table 1: Status of carbon tax collection in European countries

Country	**Carbon tax rate (US$/t CO_2)**
Poland	0.08
Spain	17
Latvia	17
Slovenia	19
Portugal	26
Denmark	22-27
Luxembourg	28-43
Ireland	37-45
Netherlands	46
France	49
Finland	59-85
Sweden	130

In recent years, several countries around the world have introduced carbon taxes, but the EU does not have a more uniform carbon tax system, and there are still large amounts of carbon emissions outside the scope of the levy. To maximize the benefits of carbon reduction, the signaling role of carbon pricing should be strengthened to cover a wider range of emissions and achieve more emission limits. This paper will examine the current situation of carbon taxation in the EU, to provide useful policy recommendations for the development of a carbon tax in the EU and the regulation of carbon.

2. Methods

2.1. Theoretical analysis method

The theoretical analysis method is a scientific analysis method to understand the essence of things and their laws through rational thinking based on perceptual understanding. It is a method of analysis that breaks things down into components, characteristics, attributes, and relationships, and then defines and establishes them in essence, and then grasps their regularity through comprehensive analysis. In this paper, the necessity of a carbon tax is explained through the "public goods theory" and the "polluter pays principle".

Public Goods Theory defines the environment as a public good that is non-competitive and non-exclusive, from which there can be benefits at no cost. Public goods are difficult to sell and their market mechanisms are not well developed, so non-market forces, and therefore government forces, need to intervene. Carbon emissions allow fossil energy consumers to benefit economically without excessive costs but hurt the overall social environment, which makes government intervention necessary and justifiable. The government should play a corrective role in the market economy by allocating resources and regulating market demand, following the principle of 'utility-cost-taxation', whereby those who use public goods pay the appropriate price.

The Polluter Pays Principle (PPP) refers to the principle that all individuals and organizations that discharge pollutants into the environment should pay a certain amount of money to compensate for the damage caused by their polluting behavior. The principle establishes the idea that environmental resources have a 'price' and fundamentally reverses the traditional perception of 'free air'. The cost of preventing environmental pollution caused by the consumption of fossil fuels and the cost of compensating for the damage caused by pollution should ultimately be reflected in the price of the product or service, which is the internalization of external costs.

2.2. Literature analysis method

It has been over a century since the carbon tax was first proposed in 1920, and it has been an enduring topic of academic research. Based on the current urgency of carbon neutrality, a large number of scholars have conducted research on carbon taxes as a market-based means of reducing emissions in recent years.

Carbon tax, as a type of environmental protection tax, is usually levied on the production and consumption of carbon-containing fossil fuels (Poterba,1991; Lin and Li,2011)[4][5]. It is an economic policy tool for environmental protection aimed at reducing greenhouse gas emissions and is considered to be the most cost-effective means of reflecting environmental costs in the price of the final product(Hájek,2019; Jaffe,2002)[6][7]. The carbon tax has the dual attributes of environmental law and tax law, as well as the functions of both market and government mechanisms, and can achieve "double dividends". (Pearce,1991) [8]formally defines the concept of double dividend when discussing tax reform, arguing that a carbon tax can achieve two purposes for the government: the first is a "green dividend", which increases the cost of using traditional fossil energy sources and thus induces companies to use new energy sources or improve the efficiency of energy use to reduce emissions. The second is the "social dividend", in which carbon tax revenues can be used by the government to promote social equity and increase social welfare. (Wesseh,2019)[9] argues that the social dividend is driven by job creation through the input of renewable energy technologies, increasing the supply of additional labor. The use of a neutral carbon tax can achieve the goal of reducing greenhouse gas emissions and adjusting the degree of economic distortion of the existing tax system. Unlike emission reduction mechanisms such as the Emissions Trading System (ETS), which controls total emissions, a carbon tax requires only a relatively

small increase in administrative costs to achieve higher emission reduction targets. At its core is price control, which does not set a cap on the total amount of emissions, but rather uses price intervention to guide emitters to optimize their behavior in producing products or providing services, thereby achieving the goal of emission reduction.

Although carbon taxes have been implemented in some countries, there is no reliable data on their actual impact(Tol,2017)[10], and therefore research in this area is necessary. The current academic consensus is that carbon taxes are effective in reducing CO_2, with optimal pricing of emissions presenting a key challenge (Kickhöfer and Agarwal,2018)[11]. Although a carbon tax can reduce energy consumption, improve energy efficiency, and promote the use of renewable energy, it will also have a negative impact on the economy, reduce the competitiveness of the industry and produce carbon leakage effects(Lin and Li,2011)[5], so a scientific and reasonable carbon tax system is of great importance to the EU.

2.3. Logical deduction method

Through the previous literature review, this paper presents an overview of carbon tax studies, analyses the theoretical basis of carbon tax formulation, clarifies its mechanism of action and, on this basis, provides a theoretical basis for the formulation of a carbon tax more in line with the EU market.

Carbon taxes are based on two main types of taxation. The first is a direct tax on emissions or carbon content, but it requires high measurement requirements and is expensive to implement, and is currently only used by a few countries such as Poland and the Czech Republic; the second is a tax based on total fuel consumption and the carbon content of the fuel to calculate carbon emissions, which is a simpler model and is used by most countries. Therefore, the second approach could be considered more often for carbon taxation.

There are three main categories of taxation segments. The first is to tax only the production side of fossil fuels, such as Iceland and Japan; the second is to tax only the consumption side of fossil fuels, such as Poland and the UK; and the third is to tax both the production and consumption sides, such as the Netherlands, where the production side, importers, distributors and consumption side of fossil fuels are all taxed. The tax on the production side is easy to administer, but it is difficult to effectively transmit price signals to consumers, which affects the regulatory effect of the carbon tax. A tax on both the production and consumption sides would result in double taxation and would be too harsh to be replicated. A tax on the consumption side is in line with the “polluter pays principle” and the “principle of fairness”, and can effectively generate price transmission and awaken awareness of energy saving and emission reduction among consumers.

The core element of a carbon tax is the tax rate. The current tax rates are broadly divided into three types: fixed rates, proportional rates, and progressive rates. A flat rate is a fixed amount of tax directly based on the unit of taxation. The fixed tax rate often disconnects the tax capacity from the tax burden but is often used in academic research on carbon taxation because it is easy to calculate. A proportional tax rate is a tax rate where the tax base varies in equal proportion to the tax amount and is not shifted by the size of the tax base.

Proportional taxes are often based on amounts and are levied in proportion to the amounts, whereas emissions are not amounts and therefore proportional tax rates do not apply to carbon taxes. A progressive tax rate is a multi-tiered tax rate that is graduated according to the number or amount of objects to be taxed. The progressive tax rate reflects the principle of energy burden. The higher the carbon emissions, the higher the applicable tax rate, which better matches the burden level of the taxpayer with the tax capacity. Progressive tax rates can be divided into two types: fully progressive tax rates and over-progressive tax rates. The full progressive tax rate is a progressive tax rate at which the entire amount of the tax object is taxed at the corresponding level, and the tax burden will increase unreasonably at the threshold of the two levels. The over-progressive tax rate, on the other hand, divides the amount of the tax object into several levels and sets the corresponding tax rate for each part of the level. The degree of progression is more moderate and no unreasonable increase in tax burden will occur at the junction of the progressive levels, therefore, it is often used when setting tax rates.

2.4. Conclusion

A carbon tax is a market-based policy instrument whereby the government imposes a charge on carbon

emissions through a carbon tax to provide a policy incentive to reduce emissions, the price of carbon is determined by the government, and the market determines the level of emissions reduction under the price incentive. The implementation of a carbon tax policy can accelerate carbon neutrality. By reading and generalizing the literature, this paper concludes the specific features of a carbon tax, as shown in Table 2:

Table 2: Carbon tax features

Carbon tax		
Characteristic		A market-based tool to address climate change
Objective		Putting a price on carbon, internalizing the external costs to emitters, and reducing carbon emissions
Government level	Carbon price level	Government Decision
	Carbon emission level	Market Decision
	Scope of Implementation	The broad scope of taxation, applicable to dispersed, mobile emission sources
	Cost of implementation	Low cost of collection and easy to replicate, but dependent on national tax collection system supervision
	Implementation resistance	The increased tax burden on emitters, vulnerable to opposition
	Fairness	Relatively high transparency and fairness
	Income use effect	Carbon tax revenues can be used for energy saving and emission reduction projects, which can achieve both environmental and social welfare dividends
	International trading	Countries implementing carbon taxes risk weakening international competitiveness
Enterprise level	Emission reduction costs	Carbon abatement costs are determined to facilitate enterprises to choose the optimal abatement path on their own
	Technology Innovation Incentive	A single proportional tax rate provides little incentive for low-carbon technology innovation, while progressive tax rates are more effective in stimulating low-carbon innovative technologies

As discussed above, progressive tax rates may be more appropriate for taxing carbon emissions, but they have not been used in previous studies due to the complexity of the process of calculating progressive tax rates. The progressive tax rate is not the same as a proportional tax rate, for example, personal income tax is a progressive tax rate, the higher the income, the heavier the tax burden, and the same can be applied to the progressive carbon tax rate in this paper, the higher the carbon emissions, the heavier the tax burden should be, and according to the polluter pays principle, the tax should start from zero, as long as the consumption of fossil fuels generates carbon emissions, you will have to pay The tax should start at zero, with all fossil fuel consumption generating carbon emissions being subject to the relevant emission charges. A carbon tax would have a strong price pass-through and would result in higher

emission reductions at a lower cost than total emissions control through emissions trading.

3. Discussion

Given the imperative of achieving carbon neutrality, this paper investigates carbon tax policies. The analysis is made on three aspects: the basis of carbon taxation, the taxation segment, and the setting of tax rates. The main innovation is the idea of a progressive rate of carbon taxation, which offers a theoretical basis for policy formulation. However, the final carbon tax rate to be applied in the EU will still need to be determined in light of the specific circumstances of each country and the trade-offs between different sectors, and perhaps more in-depth research is needed at this level.

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