

The International Practice of Carbon Tax and its Implications for China

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Abstract. With the emergence of environmental problems such as global warming, sea level rise and frequent climate extremes, countries around the world are now placing great emphasis on controlling carbon emissions, and China is also actively reforming its environmental tax by introducing a carbon tax to align with international standards. This paper summarises the experience of carbon taxation in Europe and Japan, and proposes policy recommendations in the light of the current economic development and actual situation in China, taking into account the experience of carbon taxation countries. This paper argues that China's carbon tax rate should develop in a stepwise manner, gradually increasing from low to high over time, and that the carbon tax should only be levied on the upstream production stage, but not on the downstream consumption stage for the time being, with the tax base based on the carbon content of energy products. In terms of carbon tax revenue, this paper argues that the "double dividend" effect of the carbon tax should be fully utilised to stimulate the economy, actively promote the rapid recovery and development of the affected industries in the post-epidemic era, and reduce the burden on households. In terms of tax relief, a certain degree of incentive should be given to enterprises that have achieved their emission reduction targets, and attention should be paid to the carbon tax balance of domestic industries in bilateral trade.

Keywords: Carbon tax; Double dividend; International practice.

1. Introduction

As global climate issues are receiving more and more attention around the world, China, as a major carbon emitting country, is actively involved in global climate governance and has set ambitious targets of "carbon peaking" by 2030 and "carbon neutrality" by 2060. As a result, economic initiatives that correspond to energy saving and emission reduction have also been given high priority by the government. In addition to the carbon trading market, which is already in operation, the introduction of a carbon tax has also been a key focus of the Chinese government.

The effectiveness of carbon taxes as a fiscal policy tool to combat high carbon emissions in many developed countries around the world has been continuously proven. In addition to effectively reducing carbon emissions, a carbon tax can also help to promote overall national environmental taxation and even systemic tax reform and can help to address "green barriers" in international trade [1]. The purpose of a carbon tax is to discourage carbon emissions from economic activities, thereby providing an incentive for economic actors to reduce carbon emissions automatically. Although a carbon tax is a type of environmental tax, it has characteristics that other environmental taxes do not [2], such as being inducing, extensive and economically disincentive.

The introduction of a carbon tax has a wide and profound impact on a country, not only on carbon emissions and the environment, but also on the competitiveness of a country's industries, the regulation of income distribution and national finances. The complex interactions between economic agents are difficulties that must be overcome when formulating carbon tax policies.

This article aims to provide broad empirical support for the development of China's carbon tax policy in the context of the objective economic environment of the new era. The article presents a comparative analysis of the carbon tax policies of some European countries and Japan and discusses the commonalities and differences between the carbon tax regimes of different countries. The article also combines the results of several scholars' empirical analyses to show in more depth the "double dividend" effect of carbon tax revenues on the revenue cycle and the specific effects of carbon

taxation on several economic variables. Finally, based on the experience and economic measures of carbon taxation in other countries, and in the light of China's current economic development and actual situation, the article puts forward some pertinent scientific opinions and insights on the introduction of carbon taxation and carbon tax reform in China.

2. International experience with carbon tax

2.1 Tax rate and tax base setting

The carbon tax rate is the basis for the introduction of a carbon tax, and a good tax rate is the only way to make the carbon tax mechanism work. Currently, almost all countries that are imposing a carbon tax have adopted a gradual approach to increasing the tax rate, with the government often choosing a lower level of carbon tax at the initial stage, mainly due to the level of adaptation and acceptance of the tax by society and enterprises. In a market economy, it is important to effectively build the expectations of people and businesses about the future of the economy and policies, especially in terms of inflation and market price stability, as a relatively stable expectation and a stable income and consumption structure is crucial for both households and businesses. In any case, even if households are not included in the levy, the tax will be passed on to them to a greater or lesser extent. Therefore, the introduction of a carbon tax is a policy that affects society as a whole, and if the tax rate is initially set too high, it is likely that the consumption and production plans of households and businesses will be seriously affected, which will not only create serious political resistance, but also deepen possible social tensions.

From these perspectives, a more scientific approach is to start with a low tax rate, taking into account the current level of economic development and the living conditions of the population, and to propose a relatively moderate tax strategy, so that the carbon tax can be better aligned with the current socio-economic environment, and households and enterprises will have more room to gradually adjust their consumption and production structures and stabilise their expectations for the future, which will also stabilise the market environment at the macro level, so that This will also stabilise the market environment at the macro level, so that macroeconomic indicators do not fluctuate drastically in the short term.

The Nordic countries, as pioneers in the introduction of carbon taxation, have a number of special provisions or regulations for setting tax rates that are different from those of other countries, and these designs are also worthy of our consideration and reference. The Swedish government began indexing its carbon tax in 1995, linking it to the rate of inflation so that it keeps track of changes in the CPI and ensures that the tax rate is realistic. The Norwegian government, on the other hand, levies carbon taxes at different rates for different industries and different energy sources, which can vary considerably between industries, but this is also due to the structure of the economy and the level of industrial development.

Some countries set their carbon tax rates at a high level when they first developed their carbon tax. Denmark was one of the first countries in the world to develop the idea of a carbon water tax, but it took a relatively one-step approach to setting the rate when the tax was first introduced, and the high rate led to political pressure on the proposal when it was first introduced, resulting in the proposal not being unanimously adopted and thus being terminated [1]. In Japan, the highest rate proposed in the early stages of the carbon tax was as high as 30,000 yen per tonne of carbon, which was already out of line with the reality of the national economy and the living standards of the population and would have led to serious social tensions. Therefore, after a wide range of opinions, the final rate was only 2,400 yen per tonne of carbon when the tax was officially introduced five years later [3]. Such a huge adjustment in the tax rate reflects the need for a gradual process to develop the carbon tax.

In terms of the tax base, most countries with a carbon tax include carbon dioxide and other greenhouse gases from the world's major fossil fuels such as coal, gasoline, diesel and natural gas, and liquefied petroleum gas, but the definition of the source of carbon is still highly controversial. A carbon tax based on the carbon content of energy products would largely reduce the cost and difficulty

of regulation, but it would not be conducive to the long-term development of energy efficiency and emission reduction. A carbon tax would be less flexible, and its incentives would be largely upstream along the production process, affecting more energy extraction and processing companies and less energy-using companies. A carbon tax based on the carbon emissions of energy products would be more effective and flexible and would encourage technological innovation and progress in both production and energy companies, but it would make regulation more costly and difficult to define [4].

Here is a special case, Japan. Japan's tax on carbon is not only limited to the upstream production sector, i.e. a tax on carbon emissions for companies, but the Japanese government also levies a carbon tax on households located downstream in the consumption sector [5]. While this may impose some tax burden on households, there are two points to note. The first is that a tax on households will encourage taxpayers to capture and sequester carbon, and the second is that even if the tax is not imposed on households, the cost of the tax will be borne by households as a result of carbon tax shifting from companies, and this is something that the government needs to consider.

2.2 The use of carbon tax

Do A carbon tax can bring a double dividend to the economy [6]. On the one hand, as an environmental tax, a carbon tax can effectively reduce carbon emissions, achieve the goal of energy saving and emission reduction, and reduce the impact of climate change on the economy; on the other hand, a carbon tax increases fiscal revenue, and this aspect of revenue can be used to reduce the tax distortion on factor markets, thus promoting economic development.

One of the more common uses of carbon tax revenues in various countries is to compensate for tax distortions. As can be seen in the history of carbon tax collection in the Nordic countries, the collection of carbon taxes is generally accompanied by a reduction in income tax rates [7], while Japan has chosen to reduce its consumption tax rate, all of which have the effect of promoting consumption and thus stimulating economic growth. While keeping the government tax rate unchanged, the introduction of a carbon tax can replace other taxes to a certain extent, thus allowing the government to reduce taxes in the relevant areas in response to the current economic development and the living standards of the population, thus stimulating economic development and boosting the economy. However, in practice, many countries do not necessarily follow the principle of tax neutrality in the substitution of carbon tax with other taxes, especially income tax, in other words, the carbon tax levied does not fully compensate for the revenue gap brought about by the tax reduction [7], while some countries strictly follow the principle of tax neutrality. Therefore, the choice of tax neutrality is still largely a matter of making targeted decisions, taking into account economic realities and government fiscal policy objectives.

Many countries that impose a carbon tax also use it for a number of specific purposes. In addition to targeting it to compensate for the reduction in other distortionary taxes, many countries also choose to continue to use a portion of the revenue from the carbon tax for environmental protection, often in two ways. One is to use the carbon tax directly for environmental protection projects, or to invest in national research and development of environmental technologies, or as an environmental fund to support local governments in building low carbon cities and green regions [5]. The other is to return subsidies to companies that have achieved their emission reduction targets, and to continue to encourage them to innovate in low carbon production, thus reducing the impact of the carbon tax on these companies and increasing their enthusiasm for technological innovation.

2.3 Tax incentives and deductions

A carbon tax may have an economic impact on energy companies, or companies that use fossil fuels for their production. In order to minimise the impact of a carbon tax on the national economy (especially on key industries or industries that need to be protected). And if the losses to these businesses from the carbon tax are not smoothed out properly, there is a high risk that these industries will flow out of the country and into countries that do not impose a carbon tax, which is known as

'carbon leakage' [8]. This will not only affect the competitiveness of domestic industries, but will also lead to an increase in pollution in other countries and, given the global nature of the climate problem, will in effect make the domestic carbon tax less effective. So, almost all countries that have a carbon tax in place have the discretion to reduce the tax based on the current state of their economy and government policies.

However, it should be noted that carbon tax concessions for high pollution sectors will inevitably lead to more stringent carbon tax levies on other polluting sectors if the total amount of tax revenue remains unchanged, while failure to ensure the total amount of tax revenue will not achieve the purpose of energy saving and emission reduction. Therefore, carbon tax concessions are bound to be used only as a transitional concession in the early stage of carbon tax implementation, playing an adaptive role, rather than as a long-term policy.

For the time being, tax incentives in various countries are focused on two models, the first of which is a tax credit for the use of specific energy sources in the production process. Most countries have a low or no carbon tax on electricity and gas used in production, and some countries have a tax break on coal used in production. The choice of specific items to be taxed in each country is largely based on the country's energy and industrial structure.

The second type of tax relief is the degree to which it is applied to different sectors of the economy [9]. For example, some countries offer tax incentives for energy products used in the production of agriculture, livestock and fisheries, either by exempting them from taxation, or by setting a special protective carbon tax rate for the agriculture, livestock and fisheries sector that lasts for a certain period of time, or by setting up a special protection fund by the national government to compensate for the losses caused by the carbon tax on these sectors. There are also preferential policies for resource-intensive industries (based on the proportion of the total cost of energy products), including setting a tax cap and not imposing a carbon tax on energy consumption above a certain amount, or signing a carbon emissions agreement with the government to provide a rebate for the current period or a tax break for the next period for companies that meet the set reduction targets.

3. International study of the socio-economic effects of carbon taxes

3.1 The double dividend of carbon tax

Many scholars agree that there is a double dividend from the carbon tax - and in theory this is true but the extent and scope of the double dividend requires more empirical evidence to investigate and confirm, and many scholars have already provided some empirical discussion and research.

As early as 1996, Carlo Carraro et al. studied data on European carbon tax projections for the EU and its member states up to 2010 through developed econometric general equilibrium models, where these carbon tax revenues would be used to cycle down employers' social security payments. Their study demonstrated that the double dividend that such recycling of carbon tax revenues could provide could only have a significant impact on employment in the short term [10].

Takeda, Shiro (2007) examined the double dividend impact of carbon regulation on the Japanese economy from 1995 to 2095, using a dynamic CGE model with 27 sectors and commodities. According to his study, firstly, a weak double dividend emerges in all cases, with the carbon tax alleviating existing tax distortions more cost effectively and efficiently than a one-off tax break for households; secondly, the effect of the double dividend varies across sectors of the economy, with the dividend emerging less strongly for labour and consumption tax breaks and more significantly for capital tax breaks. This second phenomenon is due to the fact that the current tax system distorts the tax on capital much more than on labour and consumption, which better reflects the moderating and soothing effect of the carbon tax on tax distortions [11].

Freire-González, J. and Ho, M.S. in 2019 developed a dynamic CGE model with data from Spain, testing the impact of three different carbon taxes of €10, €20 and €30 per tonne of CO₂, and for each tax studied four scenarios of revenue recycling reducing capital taxes, labour taxes, VAT and no revenue recycling. Their study expands on the double dividend of the carbon tax, finding that the

double dividend of a low tax rate is significant and has a significant emission reduction effect, and that revenue recycling using carbon tax revenues to reduce existing tax distortions can significantly reduce the cost of imposing a carbon tax [12].

It is clear from these studies that the double dividend effect of a carbon tax is significant, that this effect is influenced by the carbon tax rate, and that the dividend effect is influenced by the degree of tax distortion of the tax in effect. This shows that a carbon tax can have a positive impact on the regulation of social income and the promotion of consumer and investment behaviour.

3.2 The impact of carbon tax based on the E3ME model

As carbon taxation is bound to have a significant impact on the entire socio-economic system, whether through the tax cycle or the possible impact on energy prices, these effects are difficult to completely disentangle from the independent impact of a carbon tax due to the complexity of the economic system. Therefore, a more scientific approach would be to analyse the impact of a carbon tax in depth through comparative modelling of possible baseline scenarios without the implementation of a carbon tax, thus comparing them with the results of the implementation of a carbon tax. In this regard, the E3ME (Energy- Environment- Economy) model is well suited to this type of study. This model was first developed by the European Commission Research Agency for the evaluation of environmental policies in Europe and analyses the impact of implementing a carbon tax by comparing a reference case with a baseline case. This paper summarises the combined socio-economic impact of carbon taxes on European countries as studied by Cambridge Econometrics based on the E3ME model [13].

The first is the effect of the carbon tax on GDP. With the implementation of the tax cycle, the GDP of all four countries implementing the carbon tax (Sweden, Denmark, the Netherlands and Finland) rose, and the overall effect of the carbon tax on economic performance was positive, with the tax cycle alleviating tax distortions in the labour market and the second dividend of the double dividend having a clear effect. Without the implementation of the tax cycle, on the other hand, the impact of the carbon tax on GDP almost always tends to be negative due to the dramatic negative impact on GDP of the high energy prices that may result from the imposition of a carbon tax. The comparison shows the important role that implementing a tax cycle for carbon taxation can play in mitigating tax distortions and promoting economic development. Metcalf G. E. and Stock J. H. validate the macro effects of carbon taxes on GDP and employment and growth in 2020 using multiple cases and a new carbon tax dataset, and their point estimates support the conclusion above that the range of effects of carbon taxes on GDP is from zero to moderately positive, at least in the empirical case of Europe [14].

Then there is the impact of the carbon tax on inflation. There is no doubt that the imposition of a carbon tax will lead directly to an increase in the price of fuels, as well as to an increase in the general level of prices, the extent of which will depend on the magnitude of the change in fuel prices in relation to the substitutability of fuels, or the change in the weight of fuels in the consumption basket. The tax cycle may also have a negative impact on inflation. Konradt M. and Weder B. (2021) verify the inflationary impact of a carbon tax using data from Europe and Canada over the last 30 years. Their empirical results show that the carbon tax did not lead to the intuitive perception of inflation that might have been triggered by higher energy prices, but on the contrary, there was even deflation in the data for some wealthy households as the increase in energy prices was offset by a decrease in the prices of other services and non-tradable goods [15].

Finally, there is the impact of a carbon tax on energy demand. Basically, fuel demand is falling in all European countries after the implementation of the carbon tax, only the magnitude of the fall varies. Most countries set their carbon tax at a rate that does not rise in line with rising fuel prices, and to some extent decreases, while a different proportional increase in the carbon tax at a time of rising international energy prices would make the impact of the carbon tax on fuel demand much less significant. Floros, N., & Vlachou, A. (2005) verify the substitutability between electricity and liquid fuels, as well as between energy, capital and labour, using data from 1982-1998 for Greece. Therefore,

a carbon tax on manufacturing can significantly reduce the demand for energy and thus shift to other inputs, with the effect of curbing carbon emissions, albeit at a high cost [16].

4. Implications of the international carbon tax experience for China

4.1 Carbon tax design

The design of a carbon tax is mainly concerned with the tax rate, the tax base and the mechanism for collecting the carbon tax. As we can see from the previous discussion, the design of carbon tax rates is relatively uniform across countries, with a gradual transition from lower to higher rates. With regard to the specific arrangement of the tax rate, Chinese scholars have done a lot of research in the form of model simulations and projections [17]. These carbon tax designs can serve as a reference for the future introduction of a carbon tax. Under the current circumstances, it is advisable to focus on fossil energy sources with a high concentration of carbon emissions, including coal, oil and gas. The choice between taxing the amount of carbon contained or the actual amount of carbon emitted will depend on whether the mechanisms and means of testing carbon emissions can meet the needs and costs of testing. If the cost of testing is acceptable, it makes sense to tax the entire production chain and try to adopt a carbon tax based on actual carbon emissions.

There is no doubt that taxes should be levied on the upstream production segment - enterprises - but there is room for discussion as to whether taxes should be levied on the downstream consumption segment - households. It should be noted that under the current state of China's economic development and the current state of the population's income, especially when the overall poverty eradication has just been completed and the state of development is extremely uneven, there is a huge difference between the carbon consumption and carbon emissions of urban residents and rural residents. If a carbon tax is imposed on households, it will undoubtedly increase the burden on rural residents, while for urban residents, a carbon tax will also increase the cost of living in the city, which is not conducive to the further development of urbanisation when the dual economy is still evident. Therefore, a carbon tax should not be levied on households, but only on enterprises, and in the case of possible tax shifting, other tax breaks for households in different regions and income levels or relief for enterprises are necessary, as we will discuss below.

There is also a focus on the need to design the carbon tax with a view to systemic adjustments to the overall tax system. The emergence of a carbon tax and its independence as a tax will inevitably lead to tax overlaps or tax conflicts with many taxes in the old tax system. As a tax on the environment, it may result in duplication of taxes on pollution when it is not yet possible to distinguish between a system of comprehensive management of pollution and carbon emissions, while the different aspects of carbon taxation may also cause some overlap with different aspects of taxation. These are all important considerations in the design of a carbon tax, and the reform of the tax system is an important part of the process before a carbon tax is introduced.

4.2 The use of carbon tax revenues and the double dividend

In terms of the use of taxation, in the light of the current economic downturn following the epidemic, the use of carbon taxation should be more flexible, and the use of carbon taxation should not be limited to carbon emission reduction and the construction of green cities, but should focus on the exploration of the second dividend of carbon taxation. First of all, in order to stimulate economic vitality, stimulate consumption and relieve the pressure of living, it would be a good option to reduce personal income tax, following the Nordic model, and in combination with other consumption stimulation policies of local governments (e.g. consumption vouchers) to effectively stimulate the growth of consumption. As to whether tax neutrality should be pursued, in general, tax neutrality should not be strictly adhered to in order to curb the economic downturn, but it should be noted that China's current epidemic prevention policy still requires a high level of investment in virus detection and quarantine, which is therefore a huge pressure on both local and central government finances, and extra attention should be paid to the use of tax revenue after the carbon tax is collected.

The second point is the appropriate use of carbon tax revenues to subsidise or provide tax relief to businesses that are subject to high volatility from the epidemic, depending on the economic situation after the epidemic. As most energy companies, especially those with a relatively large market share, are state-owned, and as energy is extremely inelastic due to its nature as a necessity, it was far less affected by the epidemic than other industries, especially those with more elastic demand such as services. In the course of the recurring epidemic, many small and medium-sized enterprises and individual operators have been hit hard by the epidemic containment policy and are in serious loss or bankruptcy. Therefore, a portion of the carbon tax revenue can be appropriately used to provide certain subsidies to private SMEs and self-employed households that received a large impact from the epidemic, or income tax relief according to a certain percentage. This tax revenue cycle will help to change the status quo of the economic downturn of some industries after the epidemic in a targeted manner, but this cycle should not exist as a permanent policy, but rather as a temporary emergency adjustment.

4.3 Tax incentive policy

Carbon tax credits for energy-concentrated industries are widely used in various countries, including incentive rebates for companies that meet targets. However, another aspect that needs to be taken into account is the carbon border tax adjustment for domestic industries when trading internationally.

If two bilateral trading countries have carbon tax mechanisms in place, then there is no need for carbon tax adjustments; however, if one country does not have a carbon tax mechanism and the other country has already started to levy a carbon tax, then the carbon tax will not be passed on and the country will be at a disadvantage in terms of product competition. This would not only undermine the international competitiveness of the corresponding industry, but could also lead to a shift of industry across borders from the carbon taxing country to the non-carbon taxing country, resulting in a so-called 'carbon leakage', which would further increase pollution in the non-carbon taxing country and weaken the effectiveness of the carbon tax in the country.

For carbon border tax adjustments, there are two main forms, for imports and exports. For the export of domestic carbon tax products, if the exporting country does not levy carbon tax, the exported carbon tax products can be refunded, but this tax reduction should preferably be linked to the production behaviour of the enterprise in the country and the market environment, for example, if it completes the emission reduction target or focuses on foreign trade, it can be given a certain degree of tax relief so that the product will not lose its competitive advantage in the competition because of the carbon tax levy. For the import of products from countries that do not levy carbon tax, an import adjustment tax can be levied on such goods based on the carbon content of the products and the carbon tax mechanism of the country. This adjustment tax rate is based on the carbon content and can effectively prevent products from other countries that are exempt from carbon tax from being dumped into the domestic market, thus making the domestic products lose their competitive advantage.

China is still an export-led country with a large trade surplus and will continue to balance the internal and external cycles in its economic development for the future, so it should also pay attention to the international trade of carbon taxes so that it is not at a relative disadvantage in future international trade.

5. Conclusion

This paper synthesizes the history and experience of carbon tax policy formulation in several developed countries around the world, and discusses the links and implications of carbon tax collection from different perspectives, thus providing a powerful policy insight to address the high carbon emission problem in China today.

However, it should be noted that the world is now in a post-epidemic reconstruction phase, with many countries facing different dilemmas of economic recession, high inflation and high

unemployment, and how to balance energy conservation and emission reduction, carbon emission control and rapid economic recovery and sustainable healthy development remains a central challenge.

The objective nature of different industries can be used to strengthen national and regional economic collaboration and cooperation on carbon emissions control, to link carbon emissions control with new industries, and to encourage the development of green and emission-reducing industries, so that these industries can contribute to sustainable economic growth. At the same time, as a fiscal tool, the redistributive nature of the carbon tax must be given due attention, so that the "double dividend" effect of the carbon tax can be brought into full play. All of the above discussions are at the heart of the problem that we need to keep focusing on.

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