The Design on China's Carbon Tax to Mitigate Climate Change

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Abstract：Carbon tax was an effective policy tool to cope with the climate change and promote energy saving and emission reduction. A Computable General Equilibrium Model was set up to simulate the influence of levy carbon tax on China's macro-economy, energy saving and CO_2 emission reduction. The results suggest that low rate carbon tax was a feasible option in China's near future. Lower carbon tax rate of RMB yuans 20/t C has smaller influence on the economic development of China[1], but can lead to obvious CO_2 emission reduction. In order to build China's carbon tax system, implement the targets of energy-saving and emission reduction and reduce CO_2 emission, the paper designs a carbon tax implementation scheme.

Key words：climate change; carbon tax; policy research; China

It has become a hot issue in world politics, economy, diplomacy, energy and environment to mitigate and adapt to climate change [1]. It is generally regarded as one of the most effective economical instruments to reduce CO_2 emission by levying carbon tax. From the viewpoint of welfare economics, the essence of climate change caused by CO_2 emission is an external diseconomy, which formed the theoretical foundation of carbon tax. Countries such as Denmark, Norway, Sweden, Finland and the Netherland started to implement carbon tax in the 1990's. But different carbon tax policies lead to different results. A comparative summary of carbon taxes in above mentioned countries has been made by Wang Jinnan[2] and his colleagues.

The establish and levy of carbon tax policy is by far complicated because it not only has to balance the social and economic effect but as well take the political and public acceptance into consideration. Hence, great number of researches [3-7] on carbon tax policies has been carried out by scholars both home and abroad. The influence on income distribution, international competitiveness produced by carbon tax or energy tax is a key element[8] to measure whether the tax can be politically accepted. A review of case studies of the present carbon tax or energy tax in these countries has been done by Mr. Zhang Z. X. [9] who holds the view that the competitiveness lost and distribution effect caused by carbon tax and energy tax is not great, yet, under the given target of *Kyoto Protocol*, the tax rate may increase gradually and even leads to dramatic economic influence. And the way of utilizing the carbon tax income plays a decisive role for the final economic effect of carbon tax policy.

Many researches [10-16] on the simulated carbon tax policy of China have been carried out at present. These researches mainly focus on the analysis of carbon tax rate under the given target of carbon emission reduction and its influence on social economy. The successful practice of carbon tax provides experience for the international society to cope with climate changes on one hand, but on the other hand it also imposes pressure on the implication of carbon tax in China. In the future, the developed countries may make green trade barriers by carbon tax differences, which will definitely bring adverse effect on Chinese products in the international competition. Therefore, it is an important policy option to reinforce the study of carbon tax and make it possible to levy carbon tax in the near future.

[1] US$ 1=RM B 6.9 Yunas.

1 Research Approach

1.1 Computable General Equilibrium Model

The Computable General Equilibrium (CGE) Model has become a standardized policy analysis instrument [17] after over 30 years development and it has been widely applied to the analysis and research on taxation, trade, income distribution, energy, environment and agriculture. In order to inspect the influence and effect of carbon tax on Chinese macro-economy so as to design a feasible carbon tax scenario which fits for China's actual conditions, this paper simulated the influences of various carbon tax scenarios on China's national economy, energy saving and CO_2 emission by the adoption of the IPAC-SGM (comprehensive evaluation model of China's energy policy - energy economics model) Model developed independently by the Energy Research Institute of the State Development and Reform Commission, then it puts forward reference bases for the design of China's carbon tax scenario. The principle of economics of this model is the computable general equilibrium theory which poses the function of predicting in multi-circumstances the green gas emission caused by human activities.

1.2 Scenario of tax rates

The design of carbon tax rate should be based on China's national circumstances which means it should neither over affect the international competitiveness of Chinese products nor over reduce the standard of living of the low-income people. According to both the present market price of CDM in China (the price of CO_2 emission is US$6 per tone) and the carbon tax rates adopted by some countries at present, while taking into consideration the principle of initial low tax rate which will not bring great influence on China's economic production, this paper designed three scenario plans (see table 1):

Table 1 Different scenarios for carbon tax rate (yuan/tC)

Scenario	2005	2010	2020	2030
High	0	100	150	200
Medium	0	50	75	100
Low	0	20	30	40

2 Result Analysis

2.1 The effect on China's national economy by carbon tax

Based on different scenarios for carbon tax rates (see table 1), a figure of GDP loss was drawn (see figure 1). A limited GDP loss could be produced for China's economy (see Figure 1). The GDP loss caused by the three different scenarios would not go beyond 0.5%. Take the scenario of the year 2010 for example, the carbon tax rate is 20yuan/tC which results in GDP loss less than 0.1% in comparison with the base scenario. While higher carbon tax rate would contribute to higher GDP loss. For the year 2025, the GDP loss could be as high as 0.45%. But this research did not take the economic promotional effect of reducing China's import into consideration, neither did it consider the positive effect of reducing domestic investments in energy so as to increase the investments in new industries. If these factors are taken into consideration, then the GDP loss brought by carbon tax would be less or even a positive effect might be produced. One point should be noticed that the GDP loss is in comparison with polluted GDP. If green GDP is taken into consideration, the loss would be greatly reduced. As the carbon

tax policy would promote the development of new industries, the progress of new energy technology and the update of industrial techniques, these factors would become important driving elements of China's carbon tax.

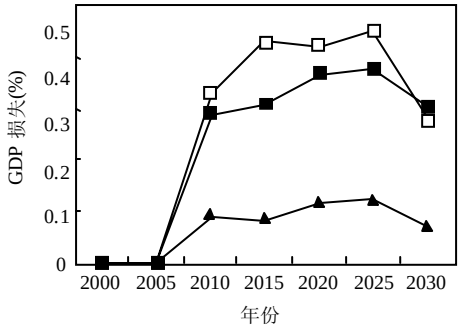

Fig.1 GDP loss under different carbon tax rate scenarios

—□—High scenario —■— Middle scenario —▲——Low scenario

2.2 The effect on China's energy saving by carbon tax

Carbon tax levy may increase energy price and promote the industrial energy efficiency so as to achieve the aim of energy saving. Figure 2 shows the effect on energy saving of different carbon tax rate scenarios. As it is shown in Figure 2, an obvious increasing tendency of energy saving is obtained by the increase of carbon tax rate. In the case of high carbon tax rate scenario, when the tax rate is as high as 200yuan/tC in 2030, compared with the base scenario, the effect of energy saving rate could reach the point of above 20%. The research result also indicates that even if the low carbon tax rate scenario is adopted, that is when the tax rate is as high as 20yuan/tC in 2010, the effect of energy saving rate could almost reach the point of 3%. Hence, even if the carbon tax rate is very low, it can as well play an important role in promoting energy saving in China by sending an active signal.

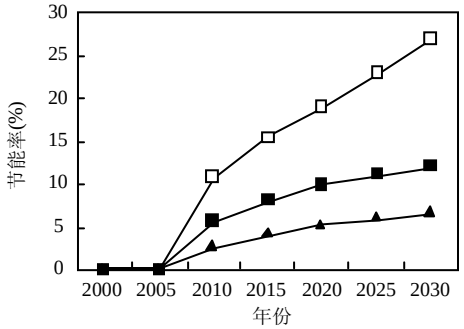

Fig.2 The effect on energy saving of different carbon tax rate scenarios

—□—High scenario —■— Middle scenario —▲——Low scenario

2.3 The effect of controlling China's CO_2 emission by carbon tax

The restrain or control CO_2 emission is the most direct aim of carbon tax levy. As it is shown in Figure 3, an obvious effect on restraining CO_2 emission is achieved by carbon tax. In comparison with the base scenario, when the carbon tax rate reaches 20yuan/tC in 2010, the CO_2 emission reductions could reach 90 million tons of carbon which is equal to 4.5% of China's CO_2 emission. If the carbon tax rate reaches 50yuan/tC in 2010, then the CO_2 emission reductions

could reach 1.9 billion tons of carbon which is equal to 9.5% of China's CO2 emission. Hence, carbon tax levy can produce an obvious effect of stimulation on the restrain of China's CO_2 emission.

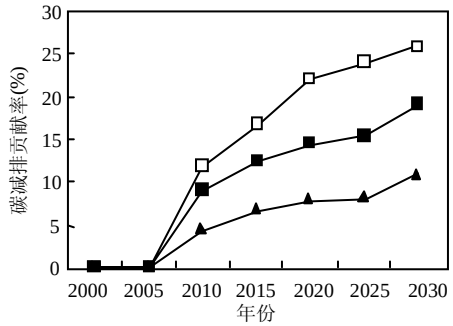

Fig.3 The effect on CO_2 emission reductions of different carbon tax rate scenarios

—□—High scenario —■— Middle scenario —▲—Low scenario

To sum up, it is a feasible option to initiate low carbon tax in China in the near future. An analysis of different scenarios of free carbon tax, 20yuan/tC or 50yuan/tC brings the predictable result of China's CO_2 emission in 2010-2030 (see Figure 4). As it is shown in Figure 4, if the carbon tax rate scenario of 50yuan/tC is implemented, in comparison with the base scenario, China's CO_2 emission reduction would reach 18.6%. It means a great contribution to China's, even the global climate change. In comparison, carbon tax would produce limited effect on China's economic development. According to international experience, carbon tax levy would promote energy technical progress and industrial update which would result in the development and expansion of new industries such as clean coal technique industry, renewable energy industry, nuclear electricity industry, energy saving industry and so on. Therefore, carbon tax could be regarded as one of the important options in a package of policies dealing with climate change in the near future in China.

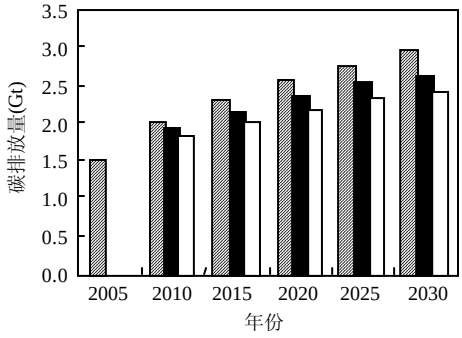

Fig.4 Carbon emission forecast in different carbon tax rate scenarios

free 20yuans/tc 50yuans/tC

3 Carbon tax scheme suggested

3.1 Base of carbon tax

The analysis of different countries' bases of carbon taxation shows that carbon tax usually

aims at coal, petrol, natural gas and other fossil fuels and the taxation is done according to the designed tax of carbon content with the exception of a few countries which levy tax directly on CO2 emission [2]. It is due to the difficult practice technically if CO_2 emission is treated as the direct target of levy. Moreover, CO_2 emission produced by burning fossil fuels makes up 65%-85% of the total. Therefore, a carbon tax levy on fossil fuels basically covers the majority of the sources of CO_2 emission. But strictly speaking, a great difference of effect could be existed between carbon tax levy on fossil fuels and directly on CO_2 emission. The former encourages industries to reduce the consumption of fossil fuels which is not in favor of the elimination of CO_2 emission by industries, neither for the research and development of recycling techniques. Taking both the advantages and disadvantages of both taxations, this research suggests China's carbon taxation scenario should most favorably be based on the calculation of carbon content of the fossil fuels such as coal, petrol, natural gas and so on.

3.2 Initial time for levying carbon tax

It is suggested that the best initial time for carbon tax in China should be 2012 because according to *the Kyoto Protocol* the countries of Annex 1 should carry out their promise by the year 2012. A new structure in response to global climate change would be formed after the year 2012. Moreover, based on the agreement reached by *Bali Road Map*, not only the developed countries are responsible for emission reductions which should be measured, reported and verified, but the developing countries as well are responsible for taking appropriate emission reduction activities which should be measured, reported and verified after the year 2012. In such a background, it goes without doubt that 2012 would be the best initial time for China's carbon tax levy.

3.3 Carbon tax rate scenario

The principle that China's carbon tax rate scenario should be abided by is to increase the rate step by step and to follow in proper sequence. That means in the year 2012, the initial carbon tax rate is better fixed at 20yuan/tC, and then step by step, the rate should be increased to 50yuan/tC in 2020, and 100yuan/tC in 2030. Table 2 shows the scenario suggested for carbon tax rate which is converted into various kinds of fuels in China.

Table 2 Scenario suggested for carbon tax rate in China

Indicators	2012	2020	2030
Tax rate(yuans/tC)	20	50	100
Tax rate for coal (yuans/t coal)	11	27	54
Tax rate for oil (yuans/t oil)	17	44	87
Tax rate for natural gas (yuans/km^3 of natural gas)	12	29	59

3.4 Targets for carbon tax

From the viewpoint of fully playing social effect of carbon tax policy, carbon tax should be more favorably levied on consuming links, which could stimulate the consumers to reduce energy consumption. Yet, from the viewpoint of practical management and operation, carbon tax should be more easily levied on sale links. However, as far as the consumers are concerned, it merely means to raise the buying price of energy, which could not make a full social play of carbon tax. What's more, the carbon tax rate in the near future in China would be certainly very low.

Therefore, it might lead to the loss of social effect of carbon tax if it were levied on sale links. For this reason, this research suggests that carbon tax should be levied on consuming links and it could collected by government administrative sections together with environmental tax or pollution discharge tax in order to reduce administrative cost. The specific targets for carbon tax include all units and privately-owned businesses which emit CO_2 into the atmosphere. Individual tax payers would not be included in the near future so as to reduce the operation cost.

3.5 The management of the use of carbon tax revenue

According to the calculation of carbon tax rate of 20yuan/tC, the revenue of carbon tax in China should reach 40 billion yuan in 2012 which makes up about 0.1% of China's GDP. If the carbon tax rate is 50yuan/tC in 2020, then the revenue of carbon tax should reach about 180 billion yuan. Though compared with GDP, the revenue from carbon tax makes up a very limited percent, while the reasonable use of the revenue could produce an important effect on carbon tax collection. The biggest aim of carbon tax is to promote industrial energy saving and encourage the development of renewable energies. Therefore, this research suggests that the carbon tax revenue should follow the policy of special fund for special use. The government should set up a national special fund by carbon tax revenue which should be used for the projects of improving energy efficiency, researching energy saving techniques, developing low carbon emission energies, supporting tree planting and strengthening international exchanges and cooperation in dealing with global climate change.

4 Conclusion

It is a feasible option to initiate carbon tax levy in the near future in China. Carbon tax possesses a strategic importance for mitigating greenhouse gas emission and improving energy saving and CO_2 emission reductions in China. So, it is a significant policy option for China to deal with climate change. China's carbon tax rate would be better to initiate from a low point scenario so as not to bring forth a great influence on China's economy by carbon tax. And a perfect carbon tax system should be gradually established following the principle of proper sequence. Meanwhile, the proper use of carbon tax should be reinforced so as to achieve the expected effect of carbon tax.

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6 About the author

Dr. WANG Jinnan is the professor and vice president, chief engineer of Chinese Academy for Environmental Planning (CAEP), and chairman of Chinese Society for Environmental Economics (CSEE), chairman of Professional Association of China's Environment (PACE). He is the member of UN Expert Commission of Environmental and Economic Accounting, senior advisor of Asian Europe Center for Environmental Technology and Association of Resource and Environmental Economics（AREE）. He is standing council members of Chinese Forum for Reform and Opening, Chinese Society of Environmental Science, Chinese Society of Energy, Chinese Association for Promoting Environmental Culture, Chinese Environmental Protection Federation, Chinese Association of Ecological Agriculture, Chinese Society of National Accounting, Chinese Association of Electricity and Power Economics, Chinese Society of Environmental Planning, and Chinese Association of Environmental Consulting Industry. He is senior advisor for China Scientific Commission for Environmental Protection, MEP Commission for Strategic Environmental Assessment, Scientific Commission of Beijing Olympic Games, Scientific Commission of Shanghai World Exhibition, Gasu Provincial Government, Hebei Provincial Government, Guangdong Provincial Government.

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Prof. WANG Jinnan has presided over or worked as leading expert or a key team member for over 60 national-level projects and 20 international cooperative projects since 1988, of which some are highly claimed both at home and abroad. Now he is core expert of National Key R&D Project of Water Pollution Control. Related departments of Chinese central government have adopted most policy proposals from his research reports that were led and finished by him.

Dr. Wang Jinnan has done a great deal of work on the use of economic instruments for environmental protection in China. He took a leading scientist and expert in projects that were supported by the World Bank, UNEP, UNDP, OECD, EU, ADB, GEF, CCICED, RFF, WRI and USEPA. Recently he is leading several national research programs such as national twelfth five years plan for environment, green GDP accounting, national environmental security, regional environmental master plans, environmental taxes, environmental financing, ecological compensation, green national energy strategy, emission trading programs and national environmental plans. He has published over 20 monographs and over 100 papers in the field of environmental policy and management over last 20 years. His monograph, *Environmental Economics: Theories, Methodologies and Policies* was widely recognized and used as textbook for master and doctor students in Chinese universities since 1992.

Dr. Wang Jinnan's research programs have won eight awards presented by the Chinese Government. The State Council ranked him one of 100 excellent young scientists in 1997. He won the Award of the State Excellent Young Scientist in 2001, the Award of the State Excellent Environmental Policy Researcher in 2002, and the Award of Green China in 2006. He was invited as adjunct professor of Peking University, Nanjing University, City University of Hong Kong, China Mineral Industry University and China Environmental Management College.

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