Assessing China's Environmental Policies Using CGE Model with Disaggregated Environmental Management Sectors

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Along with the rapid economic development, serious environmental pollution problems have also emerged as the side effects of the unsustainable development. Currently, China mainly faces two environmental challenges in the new normal period. The first challenge is to solve the traditional environmental pollution problem, which means to decrease the emission of the solid, water, and gas pollutants. The second huge challenge is the climate change which requires reducing the emission of greenhouse gases (GHG), mainly referring to the carbon dioxide (CO2).

To solve the environmental problems, China has been put forward a series of environmental policies. Ever since the environmental policies were put into effect as policy instrument, there have been discussions on their impacts that whether these polices really achieve the goals in reducing pollutants, and there is any negative influence on the economy or the society. Thus, it is very important to have a comprehensive assessment of the impacts of the latest environmental policies. This paper focuses on the environmental and economic impacts of the latest environmental tax and potential carbon tax policies. The Environmental Protection Tax Law was issued in 2018 and represents the government's determination to upgrade the priority of the environmental issues. However, there is a research gap towards this latest policy. Though the carbon tax is not levied at present, it is a hot research topic and many experts are arguing to introduce it in response to the climate change. We are also interested in the co-benefits of the existing environmental tax and the potential carbon tax.

As this thesis aims to assess China's environmental and carbon taxes, the CGE approach is selected for the several reasons. First, in terms of the research goals, this thesis needs to analyse the cross-sectoral impacts of environment policies and at a macroeconomic scale. CGE is a mature model for this purpose. Second, in terms of data availability, the CGE model only requires the IO table or the SAM table of the base year as the main data input, while other approaches either require time-sequence data or detailed technology or product information, which is much more difficult. Third, in terms of extensibility, the CGE model could be incorporated with the physical emission data easily and allows further extension if more data is available in the future. Fourth, it is already widely applied to analyse environmental policies, and makes it easy to compare with different research results and provide policy implications for the policymakers. In the case of China, Zhang (1998) used the CGE and the base year data of 1987 to assess the macroeconomic effects if limiting the total carbon emission. Liang et al. (2007) used the CGE to compare different carbon tax schemes in China using the base year data of 2002. Ma (2008) also used CGE and the data of 2002 to analyse the effects of SO_2 tax and showed that the SO_2 tax could not only reduce the SO_2 amount but also improve the energy production structure. Xiao et al. (2015) used CGE to study the impacts of an integrated environmental tax containing CO_2 and other 3 pollutants: SO_2, CO, and NO_x. Wang et al. (2017) applied CGE to analyse the synergistic effect of SO_2 tax and CO_2 tax using the data from the year of 2007. In one word, the CGE is an appropriate approach to analysing China's environmental policies and realizing the research goals of this thesis.

However, there is still a research gap in analysing the impacts of the latest environmental policies using CGE models. On one hand, the Environmental Protection Tax Law has just been published in 2018 and there are few studies on the latest standards. On the other hand, most studies on environmental tax like Xiao et al. (2015) only focus on the major pollutants like SO_2, CO, and NO_x, while there are 44 kinds of taxable gas pollutants, 61 kinds of taxable water pollutants and 4 kinds of taxable solid pollutants in the Environmental Tax Law. Moreover, the electricity sector is not disaggregated in some studies like Xiao et al. (2015) and Wang et al. (2017), which makes it difficult to observe the low-carbon transitions among different kinds of electricity generation technologies.

To bridge the research gap, this paper updates the tax levels from the latest regulations and uses the sectoral emission data of 18 pollutants from the China Environmentally Extended Input-Output (CEEIO) table, covering the major gas, water, and solid pollutants. A very important feature of this paper is to disaggregate the environmental management sectors for CGE analysis. In the current IO system, there is only one environmental governance sector as accounted as a service sector, but the majority activities of pollutant treatment are included in the manufacture sectors due to the use of machines. This paper follows the methodology of (Zhao and Lei, 2010) to disaggregate the environmental management sectors. The electricity sector is also disaggregated into five different production technologies: hydroelectricity, coal power, gas electricity, nuclear power and renewable energies, and different environmental tax scenarios with and without carbon tax have been constructed to fully study the potential policy impacts.

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