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Economic and Environmental Effects of Coal Resource Tax Reform in China: Based on a Dynamic CGE Approach

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Abstract

Coal resource tax reform from quantity-based collection to ad valorem collection has been raised recently by the Chinese government, to develop a low-carbon economy. This paper builds a multi-sectoral dynamic computable general equilibrium (CGE) model to study the general impacts of such reform policy on the Chinese economy and environment. Based on the proposed model, different policy designs with different ad valorem tax rates are simulated and further compared with the current quantity-based policy, and some results can be obtained. As for the economic influence, the gross domestic product (GDP) of China would be somewhat negatively affected by the reform. From the environmental perspective, total carbon emissions would be significantly mitigated, which can effectively improve the Chinese environment.

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Keywords: Coal resource tax reform; Dynamic computable general equilibrium model; Economic growth; Carbon emissions

1. Introduction

Resource tax reform from quantity-based collection to ad valorem collection has recently aroused considerable attention in China to develop a low-carbon economy. A national resource tax reform on oil and gas was carried out in the year 2011, from quantity-based collection (8-30 RMB yuan/ton on oil and 2-15 RMB yuan/m3 on gas) to ad valorem collection with a tax rate of 5%-10%, and this reform policy has been shown to largely impact the Chinese economy and environment. However, the reform policy only covers oil and gas, whereas the coal resource with even larger share in total energy consumption and higher carbon-intensity is not considered. Besides, the current coal resource tax rate is still at a low level (around 0.3-5 RMB yuan/ton), which neglects or at least underestimates its environmental cost. Therefore, an appropriate design on coal resource taxation reform would benefit China, in terms of mitigating carbon emissions and improving energy structure

There are an abundance of studies focusing on the resource tax. Hotelling [1] put forward the concept of “time-tilting” and suggested that the government could control the exploitation of some exhaustible resources by using resource tax. Based on the study of Hotelling, Gopta and Mahler [2], Groth and Schou [3] and Hung

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and Quyen [4] studied the resource tax from different perspectives. As for the resource tax in China, the existing studies mainly focused on the impacts of such tax policy on China's economy [5-6]. However, to the best of our knowledge, there are few studies concerning the general impact of coal resource tax reform on China's whole economy, based on a dynamic CGE model.

The main aim of this paper is to study the economic and environmental impacts of the coal resource tax reform in China by using a multi-sectoral dynamic CGE model, and provide some valuable insights into policy design. The rest of the paper is organized as follows. The multi-sectoral dynamic CGE model of China are formulated in Section 2. The simulation results are reported and discussed in Section 3. Section 4 concludes the paper.

2. Methodology

A multi-sectoral dynamic computable general equilibrium (CGE) model is developed in this section to study the impacts of coal resource tax reform on China's economy and environment. The model contains 30 non-energy sectors and 10 energy sectors, and three main modules are involved in the proposed model, i.e., the supply module, demand module, and closure and equilibrium module.

The supply of the market is derived from domestic products and foreign imports, and Armington assumption [7] is adopted. As for domestic products, producers make optimal production decisions by minimizing the production costs. A five-level nested production structure is constructed to describe the production process, via Leontief function at the top level and constant elasticity substitution (CES) function at the other four level. As for imports, the optimal importing strategy is derived by cost minimization following a CES function. For simplicity, small country assumption is adopted that the import price is determined exogenously by world price. The demand of the market includes four kinds of agents, i.e., households, enterprise, government and foreign countries. Each agent gets their income from the respective resources they own, like labor (for households), capital (mainly for enterprises) and taxation (for the government). Part of the income will be spent on the consumption of diverse commodities and services, which constitute the final demand.

Three important assumptions are adopted in the model closure. First, the government savings are assumed to be endogenous, while various tax rates, including coal resource taxation, are assumed to be exogenous. Second, the exchange rate is assumed to be exogenous and fixed to be a numeraire. It is worth noticing that the foreign investment in China is assumed to be determined exogenously, to reflect the capital control policy in China. Finally, the neoclassical closure assumption is used that, the total investment equals the total savings.

In general equilibrium, the total supply of each commodity equals the total demand by various agents in commodity markets. In factor markets, wages for labor are determined endogenously with an exogenous growth in total labor force [8], and capitals in different sectors are determined endogenously with an exogenous interest rate [9]. Besides, the model dynamics are driven by three main factors, i.e., the technological progress, labor force growth and capital accumulation.

The model is calibrated based on the social accounting matrix (SAM) of the year 2007. The data source of SAM comes from China's national input-output (IO) of the year 2007, National Bureau of Statistics of P.R. China (2009), General Administration of Customs of P.R. China (2009) and Almanac of China's Finance and Banking Editorial Board (2009). Besides, substitution elasticity among different products and factors are specified according to some related studies [10-11].

3. Results

Based on the proposed multi-sectoral dynamic CGE model, the general impacts of the coal resource tax reform on China's economy and environment are carefully estimated. According to the existing taxation policy on oil and gas in China (with ad valorem tax rate of 2-10%), different policy designs with different ad valorem tax rates (e.g., 5%, 10%, and 15%) are simulated, and compare with the current policy with quantity-based collection as the impacts of the coal resource tax reform.

3.1. Impacts on real GDP

The economic impact of the coal resource tax reform policy is estimated in terms of the real gross domestic product (GDP). Two conclusions can be drawn from the simulation results. First, the reform would have a negative effect on the Chinese real GDP, and such negative effect would be increased with a higher tax rate. For example, when the tax rate is set to 5%, 10% and 15%, the real GDP will be cut down by about 0.0576%, 0.1687% and 0.3666% by the reform policy in the year 2020, respectively. Second, the negative effect of the proposed reform policy will decrease gradually as the time goes. For example, with a tax rate of 10%, the real GDP will be reduced by about 0.2084% and 0.1687% in 2015 and 2020, respectively.

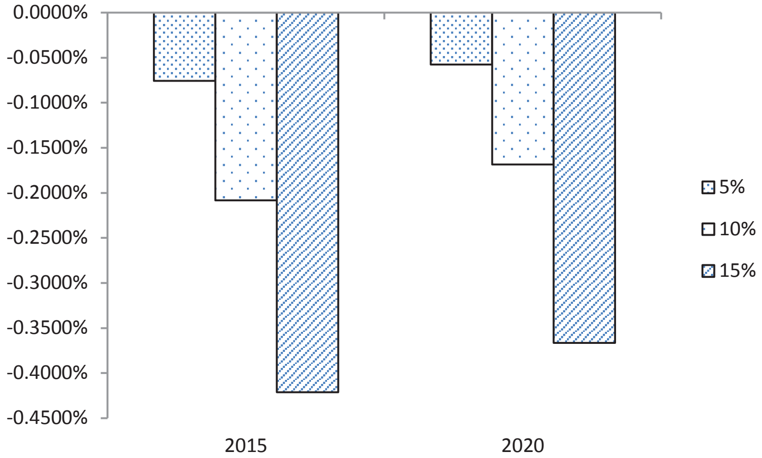

Fig. 1. Impacts of coal resource tax reform on real GDP with different ad valorem tax rates

3.2. Impacts on carbon emissions

Due to the reform policy, China's total CO2 emissions will be effectively mitigated, as the corresponding simulation results shown. On the one hand, the coal resource tax reform will significantly reduce total CO2 emissions which helps improve the environment in China. For example, at the tax rate of 5%, 10% and 15%, the total CO2 emissions will be cut down by about 0.7993%, 2.1815% and 4.3784% in 2020, respectively. On the other hand, the effects will decrease gradually as time goes. For example, when the tax rate is 10%, the total CO2 emissions would be cut down by about 2.3751% in 2015 and 2.1815% in 2020, respectively.

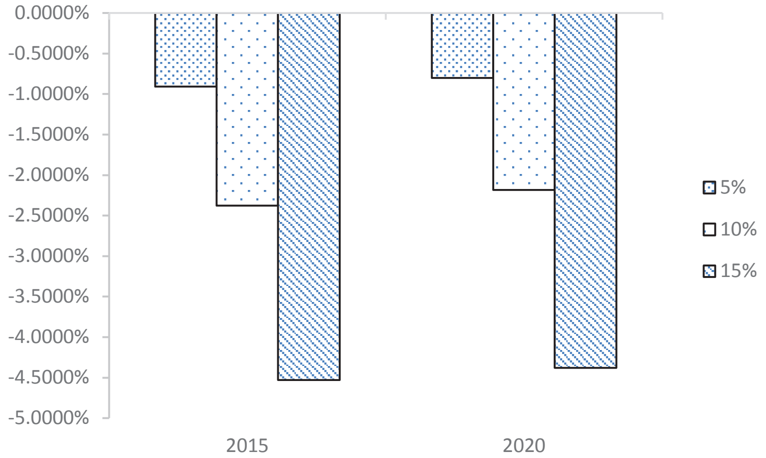

Fig. 2. Impacts of coal resource tax reform on total carbon emissions with different ad valorem tax rates

4. Conclusions

To develop a low-carbon economy, coal resource tax reform from quantity-based collection to ad valorem collection has aroused wide interest from both the Chinese government and researchers as an effective tool for carbon emissions mitigation. In this paper, a multi-sectoral dynamic computable general equilibrium (CGE) model is built to estimate the economic and environmental impacts of such reform policy on China.

Some conclusions can be obtained from the simulation results. As for the economic influence, the coal resource tax reform policy would have a negative effect on the Chinese economy, and such effect would increase with a higher tax rate but decrease gradually as the time goes. As for the environmental influence, the total carbon emissions would be significantly mitigated, which can effectively improve China's environment.

However, how to balance the negative economic impact and emissions mitigation effect is still a hot topic in this field. We will look into these issues in the near future.

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