THE CO-BENEFIT OF EMPLOYMENT DURING LOW-CARBON TRANSFORMATION: A CGE ASSESSMENT FOR CHINA

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Overview

Through the analysis of China's economic data, it is found that the labor demand per unit of GDP of the tertiary industry is generally higher than that of the secondary industry, which means that during low-carbon transformation, employment demand will not only migrate, but the total amount will also change. In order to achieve these NDC targets, the Chinese government directly incorporated low-carbon development into the 13th Five-Year National Development Plan, including measures to optimize industrial and energy systems, implement energy conservation and emissions reduction projects, strengthen technical support for energy saving and emissions reduction technologies, and establish a comprehensive market-based mitigation mechanism. In recognition of the latter measure, the national emissions trading system (ETS) is an important tool that can leverage market forces to optimize resource allocation in response to the need to mitigate climate change. This study evaluates the potential for a national ETS in China especially the labor demand. Using a dynamic computable general equilibrium (CGE) model with detailed representations of economic activity, emissions, and income distribution, we examine alternative mitigation policies from now until 2050. Based on statistical and survey data, we disaggregate the labor and household sectors and simulate the impact of ETS policies on the income of different groups of household.

Methods

This study adopts the China Hybrid Energy and Economic Research (CHEER) model, a dynamic CGE model of the Chinese economy constructed at the Tsinghua University, which can be used to analyze China's energy and climate policies [1]. The CHEER model is calibrated to the 2012 Input-Output table of China [2] and the 2012 energy balance table [3] with 42 aggregated production sectors. To identify heterogeneous impacts on different groups from ETS policies, this research disaggregated labor and household categories. The datasets used for the disaggregation include the following: (1) the China Statistical Yearbook 2012 [4], which provides the household expenditure per capita and rural household income per capita data; (2) the China Urban Life and Price Yearbook 2012 [5], which provides the urban household income per capita data; (3) the 6th Chinese population census [6], which provides the quantity of employment in sectors for different labor types; (4) the 2012 Chinese Input-Output table [2], which provides the total value of labor compensation in sectors; and (5) the Chinese Household Income Project (CHIP) database [7], which was compiled by Beijing Normal University with 26,527 samples and provides the average wage for each labor type and the ratio of different labor types in household sectors. According to the division of labor and household sectors in the above datasets, we disaggregated labor sectors into 28 types by gender, region, and education level. We disaggregated household sectors into 12 types by region (urban/rural) and household income level based on ratios from the National Bureau of Statistics.

To evaluate the impact of the ETS policy, this research sets the BAU (Business As Usual) and ETS (Emissions Trading System) scenarios. In the BAU scenario, the model simulates the pathway of China's future low carbon development without an ETS policy. Many research institutions have offered predictions and roadmaps on China's green future and low-carbon development. We use Reinventing Fire China: A Roadmap For China's Revolution In Energy Consumption And Production To 2050[8], produced jointly by China's Energy Research Institute, the Lawrence Berkeley National Laboratory, Rocky Mountain Institute, and the Energy Foundation China, published in September 2016. This report provided an innovative energy roadmap to 2050 using a bottom-up technology model in which China meets its energy needs and improves energy security and environmental quality using the maximum feasible share of cost-effective energy efficiency technologies and renewable energy sources. The BAU scenario in this model is based on the key parameters in the Reinventing Fire China report. Firstly, the structure of China's power sector was adjusted from initial year values. The proportion of fossil energy declines over time while renewable energy increases. Secondly, the share of primary coal use for heavy industry sectors (chemistry, non-metallic mineral products, metal smelting and refining) gradually decreases, while the share of primary gas use increases. Thirdly, we specified autonomous energy efficiency improvements based on the findings of the

bottom-up technology model from the Reinventing Fire China Roadmap. For the ETS scenario, since some scholars are optimistic about China's CO2 emissions peak [9,10], we specified that total CO2 emissions would be further reduced under the ETS scenario in this model compared with the Baseline scenario. The ETS policy begins in 2020, matching the expected start date for the national ETS in China. For the ETS, we specify a 20% reduction in economy-wide emissions below BAU by 2030 and a 30% reduction by 2050. The carbon market revenue is added to government accounts as government revenue.

Results

Decarbonization and demand shifting do induce structural adjustment in China, however, and some industries are adversely affected. Looking at employment in various industries in 2012 and 2050 in the ETS scenario, we identify the five industries with the largest reduction in labor demand during China's low carbon transition process. These are textiles, apparel, coal, wood production, and construction. The total employment decline in these five sectors accounted for about two-thirds of all reductions in labor demand (relative to Baseline). In these five industries, the reduction ratio in the coal industry is significantly higher than other industries. By 2050, the labor demand in the coal industry will be reduced by about 75%. Through further analysis of different labor types, we see that coal workers are mainly male urban junior high and middle school graduates and male rural junior high school graduates. The results show that under the Baseline scenario, the coal industry will lose 0.89 million male urban middle school graduates, 0.59 million male rural middle school graduates, and 0.51 million male urban high school graduates from the coal industry. Under the ETS scenario, job losses in coal will total 1.06 million, 0.67 million and 0.61 million from the same categories, respectively. On one hand, because the education level of these workers is not high, they may find it difficult to find suitable new jobs within a short period of time. On the other hand, as adult males, many are the main source of family income. Thus, coal sector job losses will present substantial economic difficulties, locally and in the home communities of migrant coal workers.

By comparing the labor demand in the two scenarios, it can be concluded that in the ETS scenario, the economic structure is transferred to a lower carbon situation due to the addition of stricter carbon emission constraints. The labor demand of the secondary industries will be less than that in BAU scenario, of which the three sectors with the largest reduction are gas, oil and coal production. On the other hand, the labor demand of the tertiary industries will be greater, of which the three sectors with the largest increase are wholesale and retail, education and accommodation and catering. By summing up the employment demand, it is found that under the ETS scenario, the total employment will increase by 620 thousand in 2050. In addition, the situation of labor with different education levels, regions and genders is also different during the transformation.

Conclusions

There are three key findings in our paper. First, the ETS policy will increase around 620 thousand labor demand in 2050. Second, under the low-carbon policy, most of the secondary industry's employment demand will decrease, while the tertiary industry's demand will increase. Third, the situation of labor with different education levels, regions and genders is also different during the transformation.

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