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Impacts of increasing renewable energy subsidies and phasing out fossil fuel subsidies in China

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ABSTRACT

Subsidies to fossil-fuel consumption have made China's energy system fragile and unsustainable. It is necessary for China to reform fossil-fuel subsidies and reflect the resource cost and environmental cost in energy prices. Considering the life-cycle external costs, this paper estimates the scale of fossil-fuel subsidy and the true cost of renewable energy in 2010 and evaluates impacts of increasing renewable energy subsidies and phasing out fossil fuel subsidies on macro-economy and energy system in China based on scenario analysis. Simulation results show that the negative impacts on economic growth can be reduced from 4.460% to 0.432%, if only 10% of fossil fuel subsidies were removed. Increasing subsidies for renewable energy has positive impacts on macroeconomic variables. Although the economic benefits per unit of subsidies for renewable energy are lower than those for fossil fuels by 0.06–0.19 CNY, the revenue gap can be narrowed by shifting more subsidies from fossil fuels to renewables. Increasing subsidies for renewable energy helps optimize China's energy system in three ways: the first is making energy consumption structure cleaner; the second is improving energy efficiency; and the third is addressing the problem of imbalanced distribution and consumption of energy.

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1. Introduction

China's energy system has been environmentally unsustainable due to increased use of coal. More importantly, energy consumption in China has huge potential for growth: first, China's urbanization and industrialization process, which is projected not to come to an end until at least 2020, is characterized by rapid growth of energy consumption and rigid demand [1]; second, China's energy consumption per capita is still relatively low. The situation of future carbon emissions reduction would also be tough. Both of China's energy and electricity structures are dominated by coal, which are difficult to change in the short term. Coal is the cheapest type of energy, while has the highest carbon content. It can be estimated that China will continue to be the major driving force of the growth in global carbon emissions. In addition, with rapid and continual growth of energy consumption, the contradiction between energy supply and demand in China will get worse, and the rising energy price as well as foreign oil dependence will greatly threat national energy security.

However, the Chinese government keeps subsidizing fossil fuels by price regulation. One purpose is to support economic growth by lower energy cost. For instance, in order to reduce the cost of electricity generation, the Chinese government required coal enterprises to sale coal to electric-generation companies below the market price; and in order to enhance industrial competitiveness, the Chinese government regulated the ex-factory price of natural gas and provided preferential electricity tariffs to energy-intensive industries, etc. The other purpose is to alleviate energy poverty. For example, in order to enable access to modern sources of energy, the Chinese government fixed the residential electricity price and controlled prices of natural gas as well as oil products. However, the inefficient subsidy mechanism has led to the excessive subsidies for fossil fuels. On one hand, price distortions of fossil fuels have resulted in inefficient use of energy and wasteful consumption. On the other, low prices of fossil fuels have inhabited technological innovation and renewable energy development in China. In particular, China's energy subsidies benefit the rich far more than the poor due to poor targeting of subsidies [2].

On the G20 summit in Pittsburgh in September 2009, G20 committed "to rationalize and phase out over the medium term inefficient fossil fuel subsidies that encourage wasteful consumption". The pledge was repeated at the 19th Asia-Pacific Economic Cooperation (APEC) Economic Leaders Meeting in 2011 and the UN Conference on Sustainable Development in 2012. Increasing subsidies for renewable energy is an effective measure for coping with climate change, meeting energy access challenge [3], and promoting economic growth through job creation. Subsidies for renewable energy in China lagged far behind those for fossil fuels, which discouraged renewable energy production and investment. The International Energy Agency (IEA) [4] estimated that, apart from wind power, sources of renewable energy still need subsidies at least over the next two decades to remain competitive, particularly if fossil fuels continue to receive subsidies and their environmental impacts are not priced. Renewable energy subsidies are common in developed and developing countries, which are aimed at correcting market failures, increasing energy access, building up domestic industrial capacity to manufacture renewable energy equipment, and so on. The adjustment of energy subsidy from fossil fuels to renewable energy is beneficial for optimizing China's energy system [5]. From the perspective of demand side, only by rationalizing energy prices can energy conservation be achieved, and only by reflecting the environmental and resource costs of fossil fuels can renewable energy be price-competitive. From the perspective of supply side, increasing subsidies for renewable energy contributes to the increased supply of renewable energy, thereby helps ease the contradiction between energy supply and demand and energy price volatility.

Considering the life-cycle external costs of different types of energy, this paper estimates the scale of fossil-fuel subsidy and the true cost of renewable energy in 2010, and evaluates impacts of energy subsidy adjustment on China's economic growth and energy system. The remainder of this paper is organized as follows. Section 2 presents literature review. Section 3 determines subsidies in China's energy system. Section 4 evaluates impacts of energy subsidy adjustment from fossil fuels to renewable energy. Section 5 summarizes our findings and draws policy implications.

2. Literature review

Studies on energy subsidies are mainly focused on two aspects: the estimation of energy subsidy amounts, and the impact evaluation of energy subsidy removal [6]. According to the World Bank [7], the total order of magnitude of subsidies to consumers and producers is roughly equivalent to 1% of world GDP. Subsidy measures in demand side (consumers) are mainly price controls, transfer payments and consumer tax relief, etc., which are prevalent in developing countries. Global Subsidies Initiative (GSI) [8] indicated that, energy subsidies in demand side in the world's 20 largest non-OECD countries were US$ 400 billion in the year 2007. Subsidies in the supply side aim at increasing the income (e.g. lowering taxes, supporting research and development) or reducing the cost (such as increasing the supply price) of energy producers. Supply-side subsidies are more prevalent in developed countries, which have been gradually shifted from fossil fuels to renewable energy [9]. According to IEA [4], subsidies for renewable energy were about US$ 66 billion in 2010, of which renewable electricity accounted for 66.7%. EIA [10] indicated that energy subsidies in the U.S. amounted to US$ 37.2 billion in 2010, and subsidies to renewable energy accounted for 40%. Silveira et al. [11] highlighted the importance of financial subsidy from the government for implementation of photovoltaic solar energy. Chang et al. [12] explored the causal relationship of solar water heater (SWH) installation in Taiwan and showed that if the government continues to subsidize SWH installation with NT$2250/$m^2$, SWH installation areas will reach the promoted target of 140,000 m^2 by 2020.

Phasing out fossil fuel subsidies has social, economic and environmental impacts. OECD [13] showed that if the world's fossil-fuel subsidies on industry were eliminated, carbon emissions would decrease by 6.2% and the real income would increase by 0.1% in 2010 in comparison to the baseline scenario. According to IEA, OECD and the World Bank [14], the complete phase-out of

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