Energy Conversion and Management 82 (2014) 124–134

Contents lists available at ScienceDirect

Energy Conversion and Management

journal homepage: www.elsevier.com/locate/enconman

A revisit of fossil-fuel subsidies in China: Challenges and opportunities for energy price reform

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ARTICLE INFO

Article history:
Received 8 November 2013
Accepted 8 March 2014
Available online 26 March 2014

Keywords:
Fossil-fuel subsidies
Energy price reform
Macroeconomic impacts
China

ABSTRACT

Fossil-fuel subsidies contribute to the extensive growth of energy demand and the related carbon dioxide emissions in China. However, the process of energy price reform is slow, even though China faces increasing problems of energy scarcity and environmental deterioration. This paper focuses on analyzing fossil fuel subsidies in China by estimating subsidies scale and the implications for future reform. We begin by measuring fossil-fuel subsidies and the effects of subsidy removal in a systematic fashion during 2006–2010 using a price-gap approach. Results indicate that the oil price reform in 2009 significantly reduced China's fossil-fuel subsidies and modified the subsidy structure. Fossil-fuel subsidies scale in China was 881.94 billion CNY in 2010, which was lower than the amount in 2006, equivalent to 2.59% of the GDP. The macro-economic impacts of removing fossil-fuel subsidies are then evaluated by the computable general equilibrium (CGE) model. Results demonstrate that the economic growth and employment will be negatively affected as well as energy demand, carbon dioxide and sulfur dioxide emissions. Finally, policy implications are suggested: first, risks of government pricing of energy are far from negligible; second, an acceptable macroeconomic impact is a criterion for energy price reform in China; third, the future energy policy should focus on designing transparent, targeted and efficient energy subsidies.

1. Introduction

Energy subsidy is the core of energy problems in China. Although many studies have estimated energy subsidies scale in China, the results vary considerably due to different types of calibration. This paper attempts to correct the deficiency by evaluating energy subsidies scale in a systematic fashion. We choose the period 2006–2010 as the scope of study for three reasons. First, China was at the stage of accelerated urbanization and industrialization during that period. In particular, China became the world's largest carbon dioxide emitter in 2006 [1] and overtook the US as the world's largest energy consumer in 2010 [2]. Second, it was the starting point of China's transition into a low-carbon economy, during which China committed to reduce energy and carbon intensities and began to make several efforts to reduce energy consumption and mitigate related CO_2 emissions. Third, implications will be practical by 2020 because of the same economic development stage.

Supported by energy subsidies, China's rapid economic growth has resulted in a huge spurt in energy demand growth [3,4]: the average annual growth rates of the primary energy consumption and electricity consumption during 2006–2010 were 6.6% and 11%, respectively [5]. The increment of worldwide energy consumption was driven by China. China's growing energy demand has transformed global energy markets and will increasingly shape the global energy landscape [6,7]. Therefore, it is crucial to investigate China's fossil-fuel subsidies. Moreover, it is necessary to analyze the challenges and opportunities of energy pricing reform to provide implications for policy makers.

Subsidies to support policy objectives have a long tradition in China [8,9]. Government pricing of energy, which is contributed by state-owned energy monopolies, has become one of the policy instruments and the major barrier hindering energy efficiency in China [10]. The passive energy price reform in China can be explained by three reasons: first, energy price reform is not the top priority for the macroeconomic policy [4]; second, the government has no motivation to initiative any reforms unless they are absolutely necessary. Furthermore, barriers to energy price reform are the major concerns for the government. In the short term, energy price reform will inevitably lead to the rise in energy prices; how-

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http://dx.doi.org/10.1016/j.enconman.2014.03.030
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ever, this phenomenon is regarded as the result of the government actions rather than the market mechanism due to the non-transparent energy subsidies. Consequently, the general public has always questioned energy price adjustments. Public opposition is a major barrier to enacting effective environmental policies [11]. If the government slowed down the reform process, state-owned energy companies would suffer huge losses. Therefore, it is inevitable for the Chinese government to be tested to take sides in the general public or the state-owned energy companies. It can be seen that the impacts and risks of energy price reform are the major factors affecting the reform process and the central government's efforts.

Recent facts have identified the year 2009 as an important starting point for energy price reform in China. For example, in 2009, the Chinese government reformed the domestic price of oil products to bring it closer in line with international oil price; in 2012, the Chinese government implemented the tiered pricing for household electricity to make residential electricity subsidies more targeted; in 2013, the Chinese government abolished the double-track coal pricing system for the market coal and the contract coal. It is worth noting that, during the rapid urbanization process, economic growth, energy structure and the major challenges that China faced in moving from a low-income to a middle-income country would be similar. However, China's transition to a low-carbon economy implies that energy price reform would be the most urgent energy issue in China. Therefore, implications of this study will be important references for policy makers on future policy design. The main contributions of this paper to literature are as follows: first, the process of energy price reform during 2006–2010 is captured by the evaluation of energy subsidies scale; second, impacts of energy subsidy removal are estimated to provide references for future reforms; third, risks of energy price distortions are analyzed and policy implications for the direction of energy price reform are suggested.

The remainder of this paper is organized as follows. Section 2 presents a literature review. Section 3 describes the methodology used in this paper. Section 4 estimates the scale of energy subsidies and the effects of subsidy removal. Section 5 analyzes the macroeconomic impacts of energy subsidy removal using the CGE model. Section 6 summarizes our findings, draws some policy implications and points out limitations and future research directions.

2. Literature

According to IEA [7], energy subsidy is any government action directed primarily at the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers. Existing literature shows that most energy subsidies went to fossil fuels [12,13] and the non-OECD countries accounted for the major part of the worldwide subsidies on fossil fuels [14]. This paper focuses on the review of fossil fuel subsidies in China.

The pioneering research is conducted by Larsen and Shah [15], and the definition, measurement and assessment of fossil fuel subsidies have been widely used in studies such as IEA [8], Lin and Jiang [9], and Jiang and Tan [16]. Larsen and Shah [15] revealed that China had the world's second highest level of energy subsides of US $11.03–14.07 billion per year during 1985–1992 (1990 price), accounting for 5.49–6.12% of the total world fossil-fuel subsidies. China's carbon emission reductions from removing subsidies on fossil fuels accounted for 9.36–13.21% of the world's total emission reductions. Moreover, China's welfare gains from subsidy removal were US $471–1063 million, accounting for 2.09–3.20% of the world's total welfare gains. Based on the GREEN model, estimates of fossil fuel subsidies by Burniaux et al. [14] are broadly in line with Larsen and Shah [15]. IEA [8] revealed the estimated fossil-fuel subsidy rate (percent of reference price) in China was 11%, and efficiency costs of subsidy were CNY 30.02 billion (1998 price). Annual economic efficiency gains (percent of GDP) were predicted to be 0.37% from subsidy removal; the reduction in energy consumption was 9.41% and reduction in CO_2 emissions was 13.44%. IEA [17] showed that, as the world's third largest country with economic value of energy subsidies, China had subsidies in excess of $25 billion per year (2005 price), and most subsidies went to coal and oil products. IEA [7] estimated the economic value of fossil-fuel consumption subsidies in China in 2009 was USD $18.6 billion – equivalent to 0.4% of GDP, and fossil fuels in China were subsidized at an average rate of 4%. Lin and Jiang [9] indicated that China's energy subsidies amounted to CNY 356.73 billion in 2007, equivalent to 1.43% of GDP, indicating that the results of IEA were underestimated. Considering the external costs of energy, Yao et al. [18] evaluated that China's fossil fuel subsidies in 2007 amounted to CNY 1124.68 billion, equivalent to 4.51% of GDP. Liu and Li [19] constructed the CGE model considering factors of pollutants and carbon emissions, and simulated China's fossil energy subsidy reform under different scenarios. Results showed that China's energy consumption structure could be improved by removing coal or oil subsidies, while the economic and social indexes would be influenced. From the perspectives of international trade and carbon emissions, Lin and Li [20] studied the impacts of subsidy removal on China based on the CGE model, and proposed that the government should develop a well-designed plan to overcome resistance to subsidy removal.

The most common justifications for the introduction of energy subsidies are alleviating energy poverty [7]. However, the untargeted and non-transparent energy subsidies paradoxically leave the poor worse off [21], because most subsidies flow to the rich (who consume the most energy) rather than the poor [22] or most subsidies value got diverted to distributors and retailers on the supply chain [23]. For example, Kebede [24] indicated that subsidies on kerosene and electricity did not significantly change the overall costs for households, and the objective of making energy affordable to the poor was not achieved. Nevertheless, the reduction of energy subsidy in developing countries needs to be supported by other policies that would limit the adverse impacts [25]. For instance, Lin et al. [26] indicated that the welfare losses due to the increase of electricity price had the biggest impact on low-income households in China.

Energy subsidy leads to market distortion and welfare loss [27]. Therefore, reform of inefficient subsidies has the potential to provide substantial gains in economic efficiency as well as reductions in carbon dioxide emissions [28,29]. By the empirical study of California's electricity market deregulation, Ritschel and Smestad [30] indicated that energy subsidy suppressed market incentives to improve energy conservation and went against the electricity structure adjustment; Liu and Li [19] also proved that fossil fuel subsidy reform was an effective method for improving energy consumption structure. In the case of China, Wang et al. [31] proved that government-regulated electricity pricing discouraged energy conservation and efficiency improvement and led to the rapid electricity demand in China; furthermore, it also impeded investment in power generation and competition in the power industry [32]. Ngan [33] suggested that further regulatory change in China's electricity market reform was necessary. The fact that fuel subsidy encourages wasteful consumption has also been proved by Nwachukwu and Chike [34]. However, Bazilian and Onyeji [35] have different opinions. They indicated that energy subsidy removal should reflect the specific economic environments of developing countries.

In this paper, we measure fossil-fuel subsidies and effects of subsidy removal in a systematic fashion during 2006–2010 using the price-gap approach. In order to explore the barriers as well