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The perverse fossil fuel subsidies in China—The scale and effects

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A B S T R A C T

To address the problem of climate change, G-20 government leaders committed to "rationalize and phase-out inefficient fossil fuel subsidies that encourage excessive consumption over the medium term", i.e., removing the perverse subsidies. Considering China's particular circumstances and the purposes of energy subsidies, the perverse fossil fuel subsidies in China mainly concentrated on industries, and gasoline, diesel and natural gas consumption, which are always regressive. Other subsidies, such as those for residential electricity consumption and agriculture, should be kept for the time being. Results indicate that China's perverse fossil fuel subsidies amounted to CNY 509.22 billion in 2008, equivalent to 61.2% of total fossil fuel subsidies and 1.69% of GDP in that year. In addition, reasonable subsidies will not affect energy conservation and emission reduction. Furthermore, CGE (Computable General Equilibrium) model is used to analyze the impacts of energy subsidy reforms. Our finding shows that removing perverse energy subsidies will result in a significant decline in energy demand and CO_2 emissions, but will have negative impacts on the macro-economy. Therefore, supporting (or offsetting) policies, like carrying out other cost-benefit and sustainable programs with the revenues saved from subsidy reduction, are needed to alleviate the adverse impacts of removing perverse subsidies.

1. Introduction

Energy subsidies, which are widely considered as "any government action that raises the price received by energy producers, lowers the cost of energy production, or lowers the price paid by energy consumers" (OECD (Organization for Economic Co-operation and Development), 1998; IEA (International Energy Agency), 1999) [1,2], are often used to promote economic development and alleviate energy poverty by providing affordable modern energy services. These subsidies are often justified as instruments of redistribution in many developing countries, partly because of the lack of broad-based institutions that enable direct cash transfers (Piketty and Qian, 2009) [3].

However, in recent years, there has been increasing momentum to phase out certain types of fossil-fuel subsidies which often fail to meet their intended objectives (IEA et al., 2010) [4]. Subsidies have been shown to impose serious fiscal burden on budgets, exacerbate energy–price volatility by blurring market signals, encourage inefficient energy consumption, and consequently result in more CO_2 emissions. Moreover, some energy subsidies (such as gasoline, natural gas, electricity) tend to be regressive, which benefit high-income households more than the poor. The IEG (Independent Evaluation Group) of the World Bank (2008) [5] found that, in developing countries, the bottom 40% of the population, ranked by income, only received 15–20% of the fuel subsidies. IMF (International Monetary Fund) estimated that 80% of the total petroleum subsidies in 2009 flowed into the richest 40% of households (Coady et al., 2010) [6]. Similarly in China, Lin and Jiang et al. (2009) [7] found that the poorest 22% received 10% of electricity subsidies, while the richest 27% shared 45% of the subsidies.

Moreover, subsidizing fossil energy can make renewable energy uncompetitive. Besides, huge energy subsidies also occupy the limited financial resources that could otherwise be used to deliver essential services, such as health and education services (Koplow and Dernbach, 2001) [8]. Fatih Birol, the Chief Economist of IEA (International Energy Agency), holds the opinion that fossil fuel subsidy is the appendicitis of international energy system that should be cut off. In September 2009, government leaders of G-20 nations advanced to "rationalize and phase out the inefficient fossil

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fuel subsidies that encourage excessive consumption" in all countries, and reaffirmed this again in 2012.

Most energy prices are controlled by the government in China, usually in the form of depressing the domestic energy price, which implies energy subsidies. Given the critical role of energy in the economy, and the rigid energy demand associated with China's current industrialization and urbanization processes, fossil energy subsidy reform will have impacts on the economy and society. However, the G-20 emphasizes only the subsidies that encourage wasteful consumption, and not all subsidies. Therefore, the Chinese government should clearly identify the types of subsidies that need to be reformed, and this paper attempts to provide a preliminary discussion on this problem. The remainder of the paper is organized as follows: Section 2 reviews the present literature on energy subsidies. Section 3 estimates the scale of China's fossil-fuel related subsidies. Section 4 defines the perverse energy subsidies, and estimates the magnitude of energy subsidies which lead to excessive energy consumption and carbon emissions. Section 5 applies the CGE (Computable General Equilibrium) model to simulate the impact of energy subsidies reform on the macro-economy. Conclusions and policy suggestions are provided in Section 6.

2. Literature review

Existing literature mainly focus on two aspects of energy subsidies, the size and the impacts. There is no systematic reporting of energy subsidies at the international level, the common ones concentrated on analyzing the subsidies to consumption, and the size is rather gigantic. IEA has been carrying out a systematic research on energy subsidies (1999, 2009, 2010, 2011, 2012) [2,9–12]. IEA (2012) [13] showed fossil-fuel subsidies to have amounted to USD 523 billion in 2011, of which oil products shared the largest part, followed by electricity and natural gas. Subsidy on coal was relatively less. In the absence of reforms, spending on fossil-fuel subsidies is likely to reach $600 billion in 2015, or 0.6 percent of global gross domestic product (IEA et al., 2010) [4]. In addition, other international organizations such as World Bank, EEA (European Environment Agency), and Stern Report have also made some estimation about energy subsidies [13–15]. Coady et al. (2010) [6] estimated that global consumption subsidies on petroleum products were $519 billion in 2008, $136 billion in 2009, while projecting a rebound to reach $240 billion in 2010. Based on a new database for 176 countries, Cottarelli (2013) [16] showed that taking the "externalities" costs into account, in 2011, post-tax subsidies amounted to $1.9 trillion, the equivalent of about 2.7 percent of world GDP (Gross Domestic Product) and 8 percent of total government revenues. Subsidies to non-fossil-fuel energy have been increasing over time. A rough estimated by the GSI (Global Subsidies Initiative) [17] indicated that around USD 100 billion per year were spent in subsidizing alternatives to fossil fuels. In developing countries, subsidies are mainly directed to energy consumption, while in developed countries, energy production.

Energy subsidies reform will have a series of comprehensive impacts on economic growth, residential welfare, international trade, energy consumption, and CO_2 emissions (IEA, 1999; Saunders and Schneider, 2000; OECD, 2000, 2009; Burniaux, 2009) [2,18–21]. IEA indicated that compared with a baseline case in which subsidy rates remain unchanged, the complete phase-out of consumption-related fossil fuel subsidies over 2011–2020 would reduce global primary energy demand by 5%, and cut global energy-related CO_2 emissions by 5.8% by 2020 (IEA, 2010) [10]. Recent OECD and IEA analysis found that, when carrying out a gradual phasing-out over 2013–2020, a multilateral removal of fossil-fuel subsidies would bring some real income gains at the world level, and these gains would be unevenly distributed across countries (OECD, 2009) [20]. However, the effect of removing energy subsidies unilaterally may be offset by the consumption increase of other countries (OECD, 2005) [22]. Supporting policies such as cash transfers or reinvestment with the fund saved from subsidies reduction are helpful and can alleviate the adverse impacts of the reform (ESMAP, 2004; Lin and Jiang, 2011) [23,24].

By far, few researches have studied China's energy subsidies. Lin and Jiang (2011) [24] made a primary discussion on this issue. However, this study did not consider which subsidies are efficient or not, which is important for the subsidies reform design. Therefore, based on the study of Lin and Jiang (2011) [24], this paper tries to analyze the inefficient energy subsidies and further discusses the impacts of subsidies reform.

3. Fossil-fuel-related subsides in China

3.1. Price–gap approach

There is no consensus on the measurement for energy subsidies. Because of its conceptual and analytical simplicity, the price–gap approach is the most commonly used method for quantifying consumer subsidies (Kosmo, 1987, Larsen and Shah, 1992, IEA, 2008, 2009, 2010; Coady et al., 2010) [6,9–11,25–26], even though it does have some limitations. For some non-OECD countries like China, the price–gap approach may be the only means for estimating energy subsidy, because of poor data availability in these countries.

The price–gap approach is based on the idea that subsidies to consumers lower the end-user prices of energy products and thus lead to more consumption than would occur in their absence. We follow common steps of this approach in literature [2]. First, as described by equations (1) and (2), we calculate the price gap of a specific type of energy in China by the difference between the consumer price and reference price, and then we estimate the scale of subsidy for this energy.

$$\Delta P = P_r - P_c \tag{1}$$

$$S = \Delta P \times E \tag{2}$$

where, P_r is the reference price which corresponds to an "efficient" price; P_c is the consumer price; ΔP is the price gap; S is the size of energy subsidies; and E is energy consumption. For internationally traded energy products, like petroleum products, the benchmark price used to calculate subsidies is the international price adjusted for distribution and transportation costs. Where the energy product is mostly non-traded, like electricity, the benchmark price is the LRMC (long-run marginal cost), adjusted by domestic electricity industry.

Then we estimate the impacts of subsidies removal on energy demand. We follow the methodology described in IEA (1999) [2], adopting the constant elasticity inverse demand functions for energy:

$$Q = p^{\varepsilon} \tag{3}$$

where Q, P and ε are demand, real price and the long-term price elasticity of demand of a specific energy. The log form of this demand function is:

$$\ln(Q) = \varepsilon \ln(P) \tag{4}$$

When energy subsidy, *i.e.* price gap, is removed, its impact on consumption is measured by the change of log demand $\Delta ln(Q) = ln(Q_1) - ln(Q_0)$ that can be explicitly written as:

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