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Analysis of the changes in the scale of natural gas subsidy in China and its decomposition factors

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ABSTRACT

This paper applied the price-gap approach to estimate natural gas subsidy in China during 2007–2015 and employed the LMDI method to analyze the influencing factors of the changes in the subsidy scale. The results showed that the Chinese government raised the domestic gas price in contrast to the slump in global gas price in 2009, which accelerated the huge decrease in the natural gas subsidy scale. But the stagnation in price adjustment immediately led to a rebound in natural gas subsidy during 2010–2012. However, the level of natural gas subsidy has declined substantially in the industrial and commercial sectors since the natural gas pricing mechanism reform began in 2013. But the level of residential natural gas subsidy still remained high because the city gate pricing mechanism was not extended to this sector. The pricing mechanism was the most important decomposition factor of changes in the level of natural gas subsidy. The contribution rates of competitive gas price, pricing mechanism, consumption structure and natural gas consumption on decrease in natural gas subsidy scale were 11.08%, 101.21%, −3.15% and −9.14% respectively during 2013–2015. A reasonable and well-implemented pricing mechanism can prevent a rebound in natural gas subsidy. Therefore, the government should seize the current opportunity of sufficient natural gas supply and relatively low gas price to deepen and advance the natural gas pricing mechanism reform.

1. Introduction

China is now the third largest natural gas consumer in the world and accounts for the majority of the increase in global natural gas demand. In 2015, natural gas consumption in China was 193.06 billion cubic meters. Natural gas usually accounts for about 24% of the total primary energy mix globally. However, the share of natural gas in total primary energy mix in China was still about 6% in 2015, which is limited by the characteristics of resource endowments (rich in coal but poor in oil and gas). Under the pressure of air pollution, the Chinese government has been making efforts to optimize the energy consumption structure and promote clean energy (especially natural gas). In December 2014, the State Council published the *Energy Development Strategy Action Plan* (2014–2020) and proposed some mandatory targets for 2020: the share of natural gas would be higher than 10%, the total mileage of natural gas pipelines would exceed 120,000 km and most urban residents would be able to use natural gas. IEA predicted that natural gas consumption in China would increase to 314 billion cubic meters by 2020 (IEA, 2015). The growth rate of natural gas consumption slowed to 3.3% in 2015, which was driven by economy slow down, climate change and lower energy price. However, considering the share of natural gas in total primary energy mix, there is still enormous room for natural gas consumption growth in China in the future.

In the past, domestic natural gas price in China was traditionally regulated by the government and followed the fundamental of “cost-plus pricing”. The cost-plus pricing means that the natural gas price was determined by the production cost and reasonable profit. Natural gas end-user prices comprised of three parts: the ex-plant price, the pipeline transportation fees and the local distribution fees. The ex-plant natural gas price and pipeline transportation fee were set by the central government and administered by the National Development and Reform Commission (NDRC). The producers and buyers could negotiate the ex-plant price within a +10%/−10% band based on the benchmark price set by the NDRC. The local distribution fee and natural gas end-user prices were regulated by the local government and supervised by the provincial pricing bureaus. China has become a net importer of natural gas since 2007, and natural gas imports have risen annually. The imported natural gas price was well above the natural gas end-user price. The companies which imported natural gas experienced heavy losses. For example, PetroChina, the biggest natural gas company in China, lose CNY 5 billion from importing LNG and pipeline gas in

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2010, and the loss increased to CNY 41.87 billion in 2013. Natural gas subsidy accounted for only 10.68% of the total fossil fuels subsidy in China in 2007 (Lin and Jiang, 2011). However, natural gas subsidy increased sharply with the rapid growth of natural gas consumption. It accounted for nearly half of the total fossil fuel subsidy in 2013 (Lin and Liu, 2016). The issues of paradox in natural gas pricing and subsidy became serious with the growth of natural gas consumption.

To accelerate the natural gas marketization process and reflect the resource scarcity through the linkage of natural gas price to alternative fossil fuel price, the Chinese government carried out the natural gas pricing mechanism reform in pilot areas (Guangdong and Guangxi provinces) in 2011 and scales it nationwide in 2013. The pricing mechanism was changed from a "cost-plus pricing" to a "net-back pricing". The regulated pricing point was shifted from the natural gas ex-plant price to the city gate price (before the pricing reform, the natural gas city gate price contains the ex-plant price and the pipeline transportation fee). The new city gate prices are linked to the international prices of alternative fossil fuels (LPG and fuel oil). The natural gas city gate price is calculated by the following formula:

$$Pgas = \mathrm{K} \times (\alpha \times \mathrm{P}FO \times Hgas/HFO + \beta \times \mathrm{P}LPG \times Hgas/HLPG) \times (1+R) \tag{1}$$

where K is a discount rate to promote natural gas use and set at 0.85 by the NDRC; α and β are the weighted proportions of fuel oil and LPG, $\alpha =$ 60% and $\beta =$ 40%; R is the natural gas VAT rate (13%); PFO and PLPG are the import price of fuel oil and LPG during the period in CNY/kg; HFO, $HLPG$ and $Hgas$ are the heating value of fuel oil, LPG and natural gas respectively. $HFO =$ 10,000 Mcal/kg, $HLPG =$ 12,000 Mcal/kg and $Hgas =$ 8000 Mcal/kg. The NDRC announced two regulated price ceiling for each province in June 2013: one was applied to incremental gas and the other to existing gas.[1] It implied a gradual shift from cost-plus pricing to net-back pricing.

Since 2013, the government has issued series of polices to improve the city gate pricing mechanism and tried to spread the reform to the residential sector. In 2014, the NDRC announced that the ex-plant price of unconventional gas and LNG imports prices would no longer be regulated, and required to establish increasing block pricing for residential natural gas in all cities before 2015. The government gradually increased the price of existing gas, and the prices of existing gas and incremental gas were converged in April 2015. In November 2015, the government moved the city gate price ceiling to the benchmark price. The producers and buyers can negotiate a final natural gas city gate price within a +20%/−100% band.

In the past, most literatures focus on calculating the scale of fossil fuel subsidies in China and quantifying the impact of removing the subsidies. However, China's fossil fuel subsidies have changed greatly in the past decade. Especially, the level of natural gas subsidy and its share in the total fossil fuel subsidy have increased since China became a net natural gas importer in 2007. But the government took a succession of measures to improve the natural gas pricing mechanism during 2013–2015. Was it beneficial to curb the increasing trend of natural gas subsidy? In this paper we will analyze the changing process of the scale of natural gas subsidy in China during 2007–2015, especially in the stage of natural gas city gate pricing reform (2013–2015).

It is worth mentioning that the growth rate of natural gas consumption slowed considerably during the pricing reform period. The average growth rate of natural gas consumption was 13.9%, 9.6% and 3.3% respectively during 2013–2015. Meanwhile, natural gas prices fell significantly in all markets and regions. The varieties of natural gas price - US Henry Hub, UK NBP and Japan LNG - decreased by 29.3%, 37.7% and 34.2% respectively during 2013–2015. How much impact do the fall in price, slowdown of consumption growth rate and changes in pricing mechanism have on natural gas subsidy scale? It is necessary to analyze the main influencing factors of changes in the scale of natural gas subsidy in China.

The main contributions of the paper are as follows: Firstly, we extensively described the changes in the scale of natural gas subsidy combined with the pricing mechanism reform in China in recent years. We pay more attention to understanding the factors that affect changes in the subsidy scale and whether the subsidy scales will rebound or not in the future. This is more reasonable than simulating the impact of subsidies removal because the level of fossil fuel subsidy in China has changed greatly. Secondly, to the best of our knowledge, this is the first attempt to analyze the changes in the scale of energy subsidy using the Logarithmic Mean Divisia Index (LMDI) method. The introduction of LMDI could be easier to quantify the factors that influence the scale of energy subsidy. This paper would be a reference for researchers to apply the LMDI method to further analyze energy subsidy.

The remainder of this paper is organized as follows. We provide a brief overview of the existing studies on natural gas subsidy in Section 2. The price-gap approach is applied to estimate the scale of natural gas subsidy in China during 2007–2015 in Section 3. We applied the LMDI method to analyze the influencing factors of changes in the scale of natural gas subsidy, such as natural gas consumption, competitive natural gas price, natural gas consumption structure and pricing mechanism in Section 4. The main conclusions and policy implications are provided in the final section.

2. Literature review

As a big consumer and CO_2 emitter, China's fossil fuel subsidies have always attracted attention globally. There are several recent studies in the literatures that analyze China's fossil fuel subsidies, and the studies can be mainly classified into two parts.

Firstly, some researchers attempted to estimate the scale of fossil fuel subsidies in China. The Price-gap Approach, Producer Subsidy Equivalent approach, Consumer Subsidy Equivalent approach and Program Specific Approach are the main approaches to estimate the subsidy level. However, due to limited data, almost all researchers applied the price-gap approach to estimate the scale of China's fossil fuel subsidy. Lin and Jiang (2011) first used the price-gap approach which was described in IEA (1999) to estimate the scale of fossil fuel subsidy in China in 2007, and this estimation was followed by Liu and Li (2011), Jiang and Tan (2013), Lin and Ouyang (2014), Li and Lin (2017). Particularly, with the commencement of natural gas pricing reform in China, some researchers focused on estimating the scale of natural gas subsidy in China. Wang and Lin (2014) estimated China's natural gas subsidies during 2006–2010 and Lin et al. (2015) estimated it during 2010–2012. However, there are several literatures explaining the factors that cause change in the subsidy scale.

Secondly, numerous researchers applied the CGE model, ESCGE model, EIMO mode and I-O model to analyze the macro impact of removing fossil fuel subsides on welfare, GDP, employment, CO_2 emissions and so on (Lin and Jiang, 2011; Liu and Li, 2011; Li et al., 2013; Jiang and Tan, 2013; Jiang et al., 2015; He et al., 2015). In addition, Li and Jiang (2016), Li et al. (2017) respectively adopted a modified I-O model and CGE model to estimate the rebound effects of fossil fuel subsidies. But little studies considered whether the fossil fuel subsidies would rebound after implementing the pricing reforms.

Actually, China has implemented a series of natural gas pricing reform measures since 2013, which has deeply influenced the natural gas subsidies. Some researchers described the natural gas pricing reform (Hu and Dong, 2015; Paltsev and Zhang, 2015; Dong et al., 2017; Shi and Sun, 2017). However, there were several literatures focusing on natural gas pricing reform in the view of natural gas subsidies. It is worth mentioning that Lin et al. (2015) applied the I-O model and SVAR model to evaluate the impact of removing natural gas subsidies on the various price indexes. They analyzed the natural gas subsidies during 2010–2012 but do not extend it after the natural gas pricing reform.

[1] The existing gas means the actual usage of natural gas volumes for non-residential users in 2012 and the incremental gas means the excess volumes of existing gas.