



Analysis of thermal coal pricing and the coal price distortion in China from the perspective of market forces



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ABSTRACT

The price of thermal coal has always been the focus of the debate between coal mining industry and electric power industry. The thermal coal price is always lower than other same quality coal, and this phenomenon of thermal coal price distortion has been existing in China for a long time. The distortion coal price can not reflect the external cost and the resource scarcity of coal, which could result in environment deteriorating and inefficient resource allocation. This paper studied the phenomenon of thermal coal price distortion through economic theoretical modeling and empirical cointegration analysis from the perspective of market forces. The results show that thermal coal price is determined by electricity price, the prediction elasticity of a electricity enterprise, price elasticity of demand of electricity, the input prediction elasticity of a electricity enterprise and the price elasticity of supply of thermal coal. The main reason of coal price distortion is the unbalance market force of coal industry and thermal coal generation industry. The distortion rate of coal price is positively related to the market force of electric power industry and negatively related to the industrial concentration of coal industry.

1. Introduction

As the most important primary energy source in China, coal has been playing a dominant role for many years. As of 2014, coal consumption accounts for 66.1% of the total energy consumption (National Bureau of Statistics (NBS), 2015). In 2004, China's generating capacity was 5604 TW h, is the largest power generation country in the world. Within the generating capacity of 5604 TW h, coal-fired power plants accounted for 75.4%, hydropower for nearly 18.9%, while wind power, nuclear power, and other energy types for only 5.7% (China Electricity Council, 2015). However, the asymmetry of Chinese electricity and thermal coal pricing reforms have lead to serious conflict between electricity generation enterprises and coal supplying enterprises for a long time (Li et al., 2015). The price of thermal coal has always been the focus of the debate between coal mining industry and electric power industry. Under China's industry policies, when coal can transact in free market with price fluctuating but electricity price keep regulation by government, distortions between these two industries are inevitable (Mou, 2014).

The distortion coal price can not reflect the external cost and the resource scarcity of coal, which could also result in environment deteriorating and inefficient resource allocation. Facing the phenomenon of coal price distortion in China, this paper tries to explore the

driving forces of coal pricing distortion from the perspective of market forces. And furthermore, this study tries to analyze the relationship between the influencing factors and coal price using econometric method.

The remaining parts of this paper are organized as follows. Section 2 briefly reviews the related literature and previous studies on thermal coal pricing. Section 3 offers an overview of China's coal and electricity industry. Section 4 constructed an economic model to analyze the coal pricing. Then, Section 5 presents the cointegration analysis of distortion rate of coal price and its factors, followed by some conclusions of this paper in Section 6.

2. Literature review

In recent years, with the contradiction between coal and electricity industry increasingly intensifying, it have attracted more and more attention from domestic and foreign scholars. This paper reviewed the relevant literatures from the following aspects.

Researches on the vertical dual-price system between coal prices and electricity prices: Yu and Liu analyzed the coal-electricity relation in China from the view of the industrial organization, and they considered that the vertical dual-price system was the basic reason, which caused this intense relationship between the coal mining

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enterprises and the power enterprises (Yu and Liu, 2004). Liu gave the definition of coal-electricity rent, and the so-called coal-electricity rent is the absolute value of the difference between the initial supply price of coal (cost of unit coal) and the initial purchase price of coal (the coal price that could make the electric power enterprise' profit margins be zero). Liu also argued that the amount of coal-electricity rent depended on the market forces of the coal mining enterprises and the power enterprises. As a result, there was a great uncertainty in the allocation of coal-electricity rent, and this was also the reason that caused the intense relationship between the coal mining enterprises and the power enterprises (Liu, 2007).

Liu et al. studied how Chinese government adjusted electricity prices for both residential and industrial subscribers in response to the changes in coal prices with the help of an asymmetric error correction model. Their results showed that there was a long-term relation between the electricity price and coal price but the relationship is relatively weak especially for residential users' pricing (Liu et al., 2013). Jiao et al. explored the impacts of the coal-electricity price linkage mechanism on the profit margins of China's power generation enterprise based on a game model. Their results showed that the coal-electricity price linkage mechanism could abate the decrease in power generation enterprise's profit margins, and the decrease in power generation enterprise's profit margins mounts up in accordance with the increase in power generation enterprise's market share (Jiao et al., 2010).

Researches on the coal-electricity industry chain: Yu et al. analyzed China's coal- electricity vertical regulation based on industry chain efficiency. From the perspective of vertical relationship of the industry chain, they believed that the dispute of the coal price came from the changes in market force of the upstream and downstream industries (Yu and Yu, 2006). Zhao and Qi concluded that the conflict of the coal-electricity industry chain should be resolved by the self-enforcing regulation and government regulation (Zhao and Qi, 2008). Vanessa and Chen explored whether the vertical integration between China's coal and electricity industries is a way to create a competitive electricity market. And they suggested that policy makers and regulators should balance the transaction of the vertical integration between electricity and coal enterprises and make sure that efficiency gains should offset anti-competitive effects (Vanessa and Chen, 2011).

Researches on the coal-electricity joint venture: Kerkvliet researched four hypothesis regarding the efficiency of joint venture between electricity enterprises and coal suppliers. His finding included that there were significant differences in the allocative efficiency of joint venture versus non joint venture plants and increased technical efficiency for vertically joint venture plants (Kerkvliet, 1991). Zhao et al. explored whether establishing joint venture between electricity enterprises and coal suppliers can resolve the two sectors' conflicts. And their results showed that relational contracting between electricity enterprises and coals suppliers could improve the market performance of electricity enterprises (Zhao et al., 2012b). Wang analyzed the development of electricity and coal sectors in China and he concluded that China's electricity and coal industries do have a strong reliance on each other in the long run (Wang, 2007).

Researches on the electricity industry reform's impacts on the social welfare: Toba reported an empirical investigation into the welfare influences of introducing the private sector participation into Philippines power generation sector using a social cost and benefit analysis method. And the investigation concluded that the reform could largely increase social welfare (Toba, 2007). Wang and Xi analyzed the market-oriented reform in China's electricity industry. They contended that the relative monopoly in China's electric industry has reversed the market-oriented reform. And if the situation of relative monopoly remained unchanged, it would be harmful to the public welfare (Wang and Chen, 2012). Kopsakangas-Savolainen and Svento compared the welfare impacts of different regulation schemes of electricity distribution utilities. And their chief result was that the social welfare could be

improved by making a change on the regulation scheme (Kopsakangas-Savolainen and Svento, 2010). Zhao et al. analyzed China's electricity policies (1985–2007), and they argued that electricity policies reforms ended the significant social welfare losses successfully, by introducing real or potential competition as well as encouraging technological progress (Zhao et al., 2012a).

In the theory of industrial organization, the market force is regarded as the ability to increase the sales price, cut down the input price, re-distribute the profit and maintain the profit. Allen pointed out that the substitution elasticity of intermediate inputs would reduce the demand elasticity of downstream manufacturers to intermediate products. Thus, being monopoly, the downstream firms could squeeze the profit of the upstream suppliers (Allen, 2007). Morgan also illustrated that the variation of buyer's market force would force the intermediate products to lower their input price (Morgan, 1949). But in the duopoly market, with the increasing of upstream vendor force, Waterson considered that the marginal price-cost of downstream enterprises would constantly raise (Waterson, 1980). As for empirical research, Atkinson and Kerkvliet studied the relationship between buyer and seller's concentration and efficiency of the electric power industry in the United States. The results showed that the monopolistic behavior of the buyer and seller would lead to a decline in output efficiency (Atkinson and Kerkvliet, 1989). Wolak also made a research on the major power generation enterprises in the United States. He found that the enterprises would use their bilateral monopoly force to interfere in the bidding, and thus distorting the feed-in tariff (Wolak, 2003). Bai studied the coal price distortion in China from two aspects, the monopsony and the government regulation. And she thought that the government regulation on coal price was the structural cause of coal price distortion (Bai, 2009).

Currently, the coal mining market in China has been market-oriented, but the electricity market is still in the initial stage of market-oriented reform, which has a stronger market force than the coal mining enterprises. Being in a monopoly status, the electricity enterprises force the coal mining enterprises to lower the coal price, which has resulted in serious distortion of the coal price in China. Facing the phenomenon of coal price distortion in China, this paper tries to explore the driving forces of coal pricing distortion from the perspective of market forces. And furthermore, this study tries to analyze the relationship between the influencing factors and coal price using econometric method.

3. Overview of China's coal and electricity industry

3.1. Market force

Common measuring index of market force are Lerner index and industrial concentration.

$$\text{Lerner index} = (P - MC)/P \quad (1)$$

Where P is the price, and MC is the marginal cost. Lerner index represents the ability of enterprises to raise its product's price. However, the data of marginal cost is hardly to obtain, this paper will use the industrial concentration to measure market force.

Concentration ratio is usually to measure industry concentration.

$$CR_n = \sum_{i=1}^n S_i\% \quad (2)$$

Where CR_n represents the market share of the n largest enterprises in the industry, $S_i\%$ is the market share of enterprise i , and $S_1 \geq S_2 \geq \dots \geq S_n$.

3.2. Coal pricing reforms in China

As is shown in Table 1, due to the specifically historical factors in China, the coal pricing mechanism has undergone many reforms.

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