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...
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
cost (unit of 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 en-
terprise 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 re-
searched 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 coal 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 distribu-
tion 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.

\[
\text{Lerner index} = \frac{P - MC}{P} 
\]

(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.

\[
CR_n = \sum_{i=1}^{n} S_i/\% 
\]

(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
\( S_1 \geq S_2 \geq \ldots \geq S_n \).

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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