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Competitiveness analysis of coal industry in China: A diamond model study

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ABSTRACT

Under the effects of environmental pollution, macro-economical conditions, markets downturn, and squeeze of clean energy, the operation condition of China's whole coal industry attracts more attentions in recent years. This study aims to investigate the comprehensive competitiveness of coal industry in Chinese policy and economy environment. Then, this paper adopts diamond model to analyze internal and external factors that have significant influences on the competitiveness of China's coal industry, namely resource condition, demand condition, industry structure and enterprise strategy, related and support industries, the government, technology and chance. The research indicates that Chinese coal industry suffers from excessive capacity, low coal price and substitute of clean energy, etc. The current performance of Chinese coal industry is not optimistic. Fortunately, Chinese government unceasingly issues policies to support and regulate coal industry, and coal enterprises actively participate in industrial structure adjustments to deal with pressure of downturn. Furthermore, some national strategies, such as Ultra High Voltage transmission and 'One Belt And One Road', will greatly promote the recovery of domestic coal industry. In order to survive the downturn and sustain its fundamental position, coal industry should attach importance to these key factors in diamond model for each of them has crucial influences on the comprehensive competitiveness of Chinese coal industry.

1. Introduction

Environment and resource are two key influencing factors for China's sustainable development. As the worldwide environmental pollution worsens continuously, promotion of energy saving and emission reduction, and development of green economy become urgent and necessary. Determined by resource endowment and technology level, China initially developed economy at the expense of excessive exploitation of fossil resources, which leads to excessive ratio of fossil resources in energy structure. While, unsustainable development patterns and unreasonable energy structures result in China's growing environmental pollution problems. The using coal enterprises release lots of pollutions, such as PM2.5 and mercury (Ancora et al., 2016), which threatens the health of the mankind. Though the proportion of clean energy in primary energy is increasing, it still has great gap with those in some developed countries and the proportion of coal remains too high. Extensive coal consumption and development pattern of intensive-energy consumption result in China's worsening air quality to a great extent.

The slow growth of China's economy, substitute of clean energy and squeeze of imported coal all challenge the resource advantages of domestic coal. The official PMI (Purchasing Managers' Index) and Caixin PMI both drop below 50%, which means the shrinking manufacturing will reduce the demand for raw materials, and any reduction in coal consumption will negatively affect their industrial added value as well as economic growth (Muhammad et al., 2015). Simultaneously, renewable and clean energy develop rapidly and gradually substitute coal, and the government is eliminating disqualified production capacity, which cause great pressure to industrial chains of coal industry. Besides, domestic coal price and protection policy of fossil energy make imported coal further squeeze domestic coal demand. Under these conditions, the downturn situation of coal industry will continue, for industrial recovery cannot be achieved in short time.

Influenced by the pressure from economy, energy and environment, China's coal industry is encountering tremendous challenges in recent years. Thus, coal industry reform is an urgent yet essential issue for China to ensure economic development and respond to climate change mitigations. In 2016, merging and reorganization, transformation and exit will be main trends of coal industry. This industry tends to be more intensive, more efficient and greener. However, the coal industry reform needs much exploration for no mature experience to learn from. And a comprehensive analysis from industrial conditions to external environment will benefit the enterprises and the whole industry.

This paper focuses on gaining a comprehensive acknowledgement

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of China's coal industry. It begins by introducing diamond model that can be used to construct a framework for the competitiveness analysis of China's coal industry. Previous research lacks comprehensive and systematic analysis, and diamond model is a comprehensive analysis method that focuses on the holistic industrial competitive advantage, while the holistic competitive advantage relies on the integration of basic elements and assistant elements (internal and external factors in this paper). This model is suitable for analyzing the mutual influences between elements and their influences on the whole industry, so it suits the research target of this paper. Then, the paper continues with the analysis of internal and external components in the model. These components include internal basic elements such as resources demand, market demand, industry structure and its enterprises, related and support industries, and external elements such as government policies, support technology, and industrial chance analysis. Based on the analysis above, the mutual influence of each factor on other factors and the whole industry development can be identified, and targeted measures can be taken to recover China's coal industry.

2. Methodology

Previous researchers in coal industry have carried out a lot of research, such as technology, economy and environment. Take economic evaluation as an example, Table 1 displays the review of main previous works on the evaluation of related subtopics in coal field. However, they seldom focus on the comprehensive competitiveness of this industry, which greatly increases the management difficulty of enterprises managers and policy makers. Thus, this paper introduces diamond model to systematically and comprehensively analyze the competitiveness of coal industry. This model first constructs a framework to determine the external and internal factors that influence the competitiveness of China's coal industry; then, the influence of each factor on coal industry is analyzed in detail, in order to obtain the mutual influencing relations between each factor, and further obtain targeted schemes to promote industrial competitiveness. Porter's diamond model is widely used to analyze the competitive advantages of a national industry. For example, Jarungkitkul et al. (2016) developed assessment criteria based on this model and studied logistics cluster competitiveness among Asia main countries, which may provide logistics policy makers with some strategic recommendations, Zhao et al. (2011) used diamond model to analyze the factors that influence Chinese solar photovoltaic industry, Tae (2016) applied this model to study the competitiveness of the stock markets in ASEAN5, which provided rank for competitiveness of stock exchanges among ASEAN5 and identified the way to improve its competitive position.

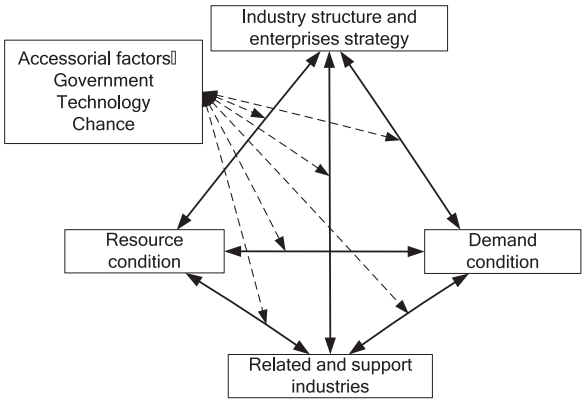

Fig. 1. Diamond model.

The diamond model in this paper is shown in Fig. 1, tetrahedron, accessorial factors and lines jointly constitute diamond model. The model is composed with internal and external factors that affect the competitiveness advantage of domestic coal industry. Internal factors consist of resource condition, demand condition, industry structure and enterprise strategy, related and support industries, which are positioned at four corners of the tetrahedron, and solid lines represent mutual influences between internal factors. Resource condition is initial advantages, and it is one of the initial driving forces of industrial development. Demand condition is the industry domestic demand, which has key catalytic influences on the international competitiveness of coal industry. Industry structure and enterprise strategy mean that the current industrial structure will adjust towards the corresponding changes of external environment, and the enterprises in this industry have to promptly develop coping strategies. Related and support industries represent the upstream and downstream related industries that stimulate the competitiveness of this industry. By contrast, the government, technology and chance are main external influencing factors of coal industry, which have mutual influences on internal factors, as dotted lines show. The government is the catalyst of industrial development, for it can put forward incentive and regulation policies that will bring opportunity and pressure to domestic coal industry. Technology means current main related technologies that will greatly promote the development advantages of coal industry. And chance means current industrial development advantages and future development trend, which will further influence the industry competitiveness and other main factors in this model. Based on the analysis above, diamond model can form a comprehensive result that includes

Table 1
Summary of main previous works on economic evaluation during 2012–2016.

Authors	Objects	Method/indicators
Hoffmann et al. (2012)	co-firing coal in thermal power plants in the south of Brazil	availability of biomass; technical feasibility of co-combustion; viability in terms of CO_2 emissions; economic viability
Li et al. (2015)	correlation between coal development and economic growth in China	multiple linear regression models, the measurement model of environmental damage cost/ GDP, gross value of industrial output, output of raw coal, gross value of coal industrial output, new investment in fixed assets of coal
Aitken and Loughlin (2016)	coal-and-biomass-to-liquids-and-electricity plants	system-wide sensitivity analysis/cost, efficiency, fuel prices, emission limits, performance characteristics
Bassano et al. (2014)	coal to Liquid plants	Aspen Plus software/Internal Rate of Return, the payback period and the net present value
Cormos (2014)	coal-based power plants	capital costs and specific capital investments, operational & maintenance costs, cost of electricity, CO_2 capture costs
Bae et al. (2012)	direct coal liquefaction, indirect coal liquefaction and hybrid coal liquefaction processes	costs of initial investment, annual operating and raw coal purchase, revenues from the sale of major products
Huang et al. (2012)	pulverized coal-fired power plants	ASU cost, CPU cost, ASU share of total EPC, CPU share of total EPC, total EPC, owner cost, total capital investment, specific investment, BESP
Chiuta and Blom (2012)	nuclear-assisted coal-to-liquid	mass-analysis model/ investment and operating costs, cost of CO_2 avoided, syngas manufacturing cost
Khorshidi et al. (2014)	coal-fired power plants	Capex, Opex, Coal and biomass, CO_2 penalties/credits, REC revenues
Jilvero et al. (2014)	coal-fired power plants	capital expenditures, operating expenditures