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Measuring the capacity utilization of the coal sector and its decoupling with economic growth in China's supply-side reform

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ABSTRACT

As the regulation of coal capacity utilization (CU) is a vital step to implement the optimization of energy mix, this article intends to measure the coal CU during 1990–2014 to scientifically evaluate the resources allocation of China's coal industry. Hicks-neutral and Solow-neutral models are established respectively to assess the coal capacity considering the technical progress, and the decoupling index is applied to analyze the effect of coal CU on China's economic growth. The main results are as follows: (1) the Solow-neutral model is more suitable for evaluating CU compared to the Hicks-neutral. (2) China's coal CU has a 10-year cyclical fluctuation with a reasonable range of 89%–105%, and the overcapacity cordon is 85%. (3) Most years in the study period saw the decoupling effect of the coal CU and China's economic growth from the decoupling index and Johansen Cointegration test. (4) A predicted expansive or strong recoupling effect will occur in the following China's 13th Five-Year Plan period. The government is expected to adopt more supportive measures to ensure the quality of supply-side reform and guide China's coal CU back to a reasonable level.

1. Introduction

It is obvious that a new energy revolution is brewing, and an energy mix reform aimed at energy conservation and emission reduction is underway around the world (IEA, 2015). Although it is presently difficult to depict its developmental process in detail, this revolution exerts a significant impact on the production, consumption and trade terms of China's energy sector. Currently, a variety of energy reform measures are being implemented actively on the demand and supply side to achieve the government's significant commitment in China—namely, reducing carbon emissions per unit of GDP by 60%-65% by 2030 compared to the 2005 level.[1] The low carbonization of the energy mix is the aim of demand-side reform in China's industrial sectors, which is achieved by upgrading the downstream industry. Compared to this, supply-side reform refers to reducing overcapacity based on policy and technological transformation. Relative to the demand side, supply-side reform—a popular word when discussing China's economy as of late—is more powerful to resolve the legacy issues of the industrial structure imbalance and supply-demand contradictions resulting from the high-speed development of China's economy (Shen, 2015).

At present, the core task of China's supply-side reform is de-capacity (De-Capacity Scheme, 2015)—namely, removing uncompetitive backward capacity from the market, to ease the pressure of excessive capacity and product supply in the domestic market, to release the dividends of reform, and to increase the potential economic growth. In the process of energy reforms, the de-capacity of the coal sector which accounts for the largest proportion of energy consumption plays a vital role in the optimization of China's energy mix. China's coal enterprises have been distressed since 2012 because of market sluggishness and massive overcapacity (Wang et al., 2016). Based on the issued opinions by the State Council (2016), the total amount of capacity elimination will be over 1 billion tons, including 620 million tons from suspending production and 492 million tons from implementing de-capacity policy; however, the amount of coal production exiting the market will be only 64 million tons (Chang, 2016). According to one survey, 90% of large and medium-sized coal enterprises were in a deficit by the end of 2015 (Coal Industry, 2016). It is concluded that the de-capacity measures of substantially slashing or suspending production in coal sector has not renewed the coal enterprises and overcapacity is still a serious problem.

2016 is the first year of China's 13th Five-Year Plan. The de-capacity reform on the supply side poses a major challenge to the development of China's coal sector. This paper proposes the

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[1] Official document, "Enhanced action on climate change-China national independent contribution" was proposed to the United Nations framework convention on climate change (UNFCCC) secretariat by China in June 30, 2015.

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following questions. How can the utilization level of China's coal capacity be measured and evaluated? How can the reasonable fluctuation range be defined and then be judged as to whether overcapacity exists? Would the capacity elimination in China's coal sector lead to the macro-economic downturn?

To answer the above questions, this study attempts to scientifically measure and evaluate the capacity utilization (CU) of China's coal industry over the past few decades using the production function method with technical progress. Second, given the CU standard in western countries' industrial sectors and the tendency of supply and demand changes in China's coal market during the last 25 years, this paper rationally classifies the fluctuation range of China's coal CU and the warning line of overcapacity. Third, the decoupling index is constructed to analyze the decoupling effect of coal CU and economic growth, and the econometric analysis technology is employed to verify their long-term conduction relationship. The contribution of this paper is two-folded. In social we demonstrate reasonable policies for China's supply-side reform to maintain steady economic growth and digest excessive coal capacity. And in academic field we address two challenges: how to evaluate CU with different neutral technical progresses to avoid the deviation caused by estimation method; a significant exploration by linking CU with economic growth to broaden the empirical literature of the decoupling theory.

The rest of the paper is organized as follows. Section 2 describes the concept of CU in China's coal sector and the related literature reviews. Section 3 presents the research methodologies and data definitions. Section 4 measures and assesses coal CU and discusses the decoupling relationships between coal CU and China's economic growth. The last section concludes the paper and offers policy recommendations.

2. Literature reviews

Along with the normalization and ripple effect of overcapacity, the coal capacity and CU have received increasing amounts of attention from academics, practitioners and politicians since the 1970s, especially in recent decades. Capacity is typically regarded as the ability of a firm or industry to provide a specific product and is represented by the largest amount of production. The concept of capacity was first proposed by Johansen (1968), who defined capacity as "the maximum amount that can be produced per unit of time with the plant and equipment, provided the availability of variable factors of production is not restricted." In other words, capacity can be an unlimited increase under the full use of variable production inputs. However, capacity is considered differently by Klein et al. (1973), where capacity refers to output produced under normal conditions (non-extend work hours and the inclusion of regular holidays and machine maintenance), i.e., an attainable level of output. From the above description, both capacity viewpoints are production decisions made by micro-manufacturers essentially to determine the level of capacity or output size for profit maximization, the latter of which is used more widely at present.

Meanwhile, capacity measure methods are divided into strictly economic measure and technical-economic measure (Morrison, 1985a). On the one hand, the current economic measure is based on the cost-minimization theory (Klein, 1960; Morrison, 1985b) and profit-maximization theory (Fousekis and Stefanous, 1996; Färe et al., 2000). However, this economic concept of capacity cannot be used to measure the industry capacity because no explicit economic objective or assumption for a particular industry capacity exists. On the other hand, the technical-economic measure is used more widely than the former (Johansen, 1968; Färe et al., 1989; Kirkley et al., 2002; Lindebo et al., 2007; Karagiannis, 2015), which is consistent with the Johansen concept of capacity, i.e., the potential maximum output. The American Federal Reserve Board (AFRB) uses this measure to conduct innovative research on industrial sectors in the United States and has regularly released industrial production index and capacity utilization since 1972.[2] Overall, the technical-economic measure can be employed widely to assess microscopic and macroscopic capacity with the potential maximum output.

In the coal industry, few studies on coal capacity and capacity utilization exist. According to the Klein concept of capacity, coal capacity is defined as the quantity of the products or raw materials managed by a single coal mine with fixed technology. Moreover, Kavalov and Peteves (2007) and Rodríguez and Arias (2008) indicated that the reservation level of coal resources determines the coal sector's long-term capacity due to the scarcity and non-renewal of mineral resources; hence, this paper defines coal capacity as the overall capacity of the coal sector in China, which represents the industrial level and depends on resource reserves, equipment advancement and other factors. Furthermore, coal production is defined as the actual output in the market, while capacity is the level of output attainable by "full utilization" of the variable factors of production and a long-term decision based on expectations of future production possibilities (such as resource stocks, market fluctuation, among others). Finally, the technical-economic measure is utilized to calculate the coal capacity despite the lack of necessary economic data.

Based on previous studies, there is a body of literature that considers the utilization level of capacity output. Representing the proportion of available capacity that is utilized, the capacity utilization (CU) is defined as the ratio of actual output (denoted as Y) to capacity output (denoted as $\hat{Y}$) (Cassels, 1937; Morrison, 1986; Segerson and Squires, 1990; Kirkley et al., 2002; Shaikh, 2004; Taleizadeh et al., 2010). The capacity output therein is the estimate level of the overall capacity, representing a potential maximum output defined by Nelson (1989) and is regarded as a pure economic concept differing from that of Morrison (1985a). Thus $CU = Y/\hat{Y}$, which indicates the development potential of the coal industry. If $CU < 1$, this indicates that the current observed output is less than the potential capacity output, i.e., coal sector could attain greater production levels without the increasing inputs of new equipment or capital (Klein and Summers, 1967). When CU declines continually, excess capacity may exist in the industry, which has occurred in China's coal sector. Lin et al. (2010) maintained that abnormal CU fluctuation and coal overcapacity in China arise from the wave phenomena of capacity investment; Zhang et al. (2016) also regarded the coal overcapacity as a structural imbalance of CU considering the excess supply and shrinking demand. It is notable that the CU data released by AFRB indicates that the value of CU is between 0 and 100%. However, this paper argues that the value of CU is likely greater than 100% if coal mines increase the actual output by extending working hours or reducing the equipment maintenance work hours. In fact, most coal enterprises kept frequently the mine equipment operational 24 h a day and ignored the designed capacity in China in the past, which led to the CU's value more than 100%.

In addition, the coal capacity in China increased rapidly in the past decades, and the government is choosing a slowdown in economic growth in the current period of coal overcapacity, which leads us to question: 1) whether there is a constant decoupling relationship between coal CU and China's economic growth; 2) what kind of influence the de-capacity reform in supply side has on economic growth. Hence, this paper tries to utilize the decoupling index to solve the above issues. In general, little literature discussed

[2] Source: http://www.federalreserve.gov/releases/g17/Current/default.htm.

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