Measurement of natural and cyclical excess capacity in China's coal industry

Qing Yang, Xiaochao Hou, Lei Zhang*

School of Management, China University of Mining and Technology, Xuzhou 221116, PR China

A B S T R A C T

Overcapacity is a persistent problem in China's economy. Previous de-capacity measures based on the quantity of the total excess capacity have failed to prevent the recurrence of increasingly worse overcapacity. To solve this problem we attempt to quantitatively analyze China's excess coal capacity by dividing it into the long-term natural excess capacity and short-term cyclical excess capacity using the state-space model and Kalman filter algorithm. The results show that China's excess coal capacity can indeed be divided into natural excess capacity and cyclical excess capacity, and they have different causes, fluctuations, roles, and effects on the price. In 1995–2001, cyclical excess capacity was the main factor of overcapacity, but in 2002–2015 natural excess capacity played a key role. Cyclical excess capacity has a negative effect on the price, whereas natural excess capacity has little effect on it. Therefore, policy makers should focus on the causes, the fluctuations, and the roles of natural excess and cyclical excess in addition to those of the total excess capacity. They should also consider the relationship between the capacity and price based on the different effects of the natural excess capacity and cyclical excess capacity on the price.

1. Introduction

Since the 1990s China has experienced periods of substantial overcapacity. These periods are characterized by long lasting time spans, recurrence, multiple causes, and serious effects (Yang, 2013). For example, the latest cycle of overcapacity, which continued for about seven years from 2008, occurred in the steel, coal, cement, flat glass, and photovoltaic and wind power equipment industries. These cycles have led to harmful competition, deteriorating profitability, mass unemployment, and heavy bad debts for the banks (Dong et al., 2015; Jiang et al., 2012). To solve this problem the government assigned de-capacity tasks to every province based on the quantity of the excess capacity, which brought about a rapid reduction of capacity and higher prices but failed to avoid the recurrence of increasingly worse overcapacity. Therefore, it is worthwhile to further examine Chinese overcapacity and thereby provide policy suggestions to avoid the implementation of inappropriate measures.

China's overcapacity is not always the outcome of economic recession. For the three overcapacity cycles in China since the 1990s, the first and third overcapacity cycles appeared after the Asian financial crisis in 1997 and the global financial crisis in 2008, respectively. China experienced significant declines in GDP growth, which dropped from 9.92% in 1996 to 7.85% in 1998, and from 14.23% in 2007 to 9.40% in 2009. Thus, these two overcapacity cycles were obviously affected by the economic recession. However, the second overcapacity cycle occurred in favorable economic circumstances with double-digit economic growth, but the capacity utilizations (CU) in 2005 in the iron alloy, calcium carbide, steel, electrolytic aluminum, and automotive industries were only about 50–70%. Thus, this overcapacity cycle cannot be attributed to the business cycle on the demand side but rather overinvestment on the supply side (Lin, 2007; Lin, 2010). Unlike Western developed countries, China's severe overinvestment not only stems from the manufacturers' strategy to prevent new entrants by maintaining excess capacity but also from the undesirable investment incentives of local governments (Wang and Zhang, 2010; Zhou, 2004). Local governments have a strong motive and ability to encourage capacity expansion by lower factor prices and higher investment subsidies under China's political promotion system between local officials based on GDP growth and soft local government budget constraints (Zhou, 2007; Zhou and Fu, 2011). Hence, we suspect that China's total excess capacity can be divided into two parts: one is caused by demand shocks on the demand side, and the other is driven by overinvestment on the supply side. Conceptually, the percentages of the excess capacity caused by demand shocks and the excess capacity driven by overinvestment are defined as the cyclical excess capacity rate (CECR) and the natural excess capacity rate (NECR), respectively. Research on the US lodging industry also implies that the excess capacity rate (ECR) can be divided into the CECR and NECR. The reasons are that the natural occupancy rate (NOR) was introduced and measured, and the CECR and NECR can be obtained by 100% - NOR and NOR – CU (Deroos, 1999; Lee and

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* Corresponding author.
  E-mail address: mailing126@126.com (L. Zhang).

Jang, 2012). If the NECR and CECR indeed exist in China, the examination of NECR and CECR can offer a new perspective for a deep understanding of the compositions and the inherent mechanism of China's overcapacity as well as a new path to its long-term-effect management or the optimal policy mix based on the laws of the CECR and NECR. Correct identification provides the basis for more specific cause analysis and the support for a capacity policy focusing on the demand stimulus or supply side reform.

However, previous studies have suffered from a lack of verification of the existence of the NECR and CECR in China, and then a lack of their data, thereby bringing about the following undesirable effects. (1) It is difficult to obtain a correct understanding of China's excess capacity and effective policy designs. Specifically, if the NECR and CECR exist, the cause analyses only based on the CER could be less persuasive than those based on the respective driving mechanisms of the NECR and CECR, and the policies regardless of the NECR and CECR would be less effective than those in consideration of the different roles in overcapacity and the responses to the policies. (2) The lack of their data poses challenges to empirical research on the causes of, and policies for, excess capacity. For example, with the data of the ECR employed to reveal the driving factors of the NECR, the results could be distorted by the fluctuation of the CECR, and less useful policy suggestions could be proposed based on the results.

As coal overcapacity has not only the general characteristic of China's broader industry overcapacity but more serious impacts on the economy and society, we attempt to test whether the CER in China's coal industry can be divided into the NECR and CECR and whether we can obtain their data. First, a state-space model was constructed based on the assumptions presented in Section 3.2. This model includes equality between the ECR and the sum of the CECR and NECR, a negative relationship between the CECR and price, and the change processes of the NECR and CECR across time. Second, using the Kalman filter algorithm, the state variables of the model and the data of the NECR and CECR in 1995–2015 were obtained, and the existence of the NECR and CECR was tested based on the criteria of 0.05 significance levels. Finally, we evaluate and discuss the laws of fluctuation of the CECR and NECR and their impact on China's coal overcapacity.

The objectives of this study are to (1) develop a method for the verification of the existence of the CECR and NECR, (2) present a new path of the cause analysis and policy design of China's coal overcapacity based on the characteristics of the CECR and NECR such as their causes, fluctuations, roles in overcapacity, and effects on price, and (3) provide data on CECR and NECR for more improved studies on the causes of China's coal overcapacity and for improved policies in the future. In addition, some extensions to, and advances on, the existing research work are presented in Section 2.3.

The remainder of this paper is organized as follows. Section 2 reviews the theoretical source and factors of the NECR. China's coal overcapacity and its policies since the 1990s are overviewed and the theoretical assumptions are presented in Section 3. Section 4 presents the model and data sources. The estimated results are presented and the existence and laws of the NECR and CECR are discussed in Section 5. Finally, the conclusions and some policy implications are put forward in Section 6 along with suggestions for further studies.

2. Literature review

2.1. Theoretical source of natural excess capacity

As the NECR concept has rarely been introduced in the previous research, and there is an equal relationship between the natural occupancy rate (NOR) and the difference between 100% and the NECR, we reviewed the background and research status of the NOR. The NOR is also widely called the non-accelerating inflation rate of capacity utilization (NAIRCU), and it was first introduced to improve the proxy variable in the Phillips curve (PC). The PC describes the substitution

relationship between inflation and unemployment in the short term; the unemployment rate will reach a natural unemployment rate, also known as the non-accelerating inflation rate of unemployment (NAIRU) with an inflation rate of zero value in the long term (McElhattan, 1978; Nahuis, 2003; Phelps, 1968).

As the NAIRU, which is vulnerable to the demographic change of the labor force, is inclined to be overrated or underrated, the CU has been believed to be a better proxy variable of the demand shock than the unemployment rate (Shapiro et al., 1989). Further, there is a substitution relationship between the CU and inflation in the short term. It was verified that the CU is equal to the NAIRCU with invariable inflation in the long term, indicating that higher CU could push inflation upward in the short run, but the effect would be invalid in the long term, which has been widely acknowledged and is expressed as Eq. (1) (Emery and Chang, 1997; Fichtenbaum, 2003; Garner, 1994),

$$\Delta\pi_t = b_0 + b_1 CU_t + b_2 Z_t + e_t \tag{1}$$

where $\Delta\pi$ is the difference of inflation, CU is the capacity utilization, Z is the matrix of the supply factors, e is the random disturbance, and t is the time subscript. The NAIRCU can be yielded as $-b_0/b_1$ by setting $Z_t = 0$, $e = 0$, and $\Delta\pi_t = 0$.

Nevertheless, in some studies the CU was verified to fail to significantly affect inflation (Deroos, 1999). Considering the question of the existence of constant NAIRCU, it can be speculated that this relationship may exist significantly if the NAIRCU is time-varying (Lee and Jang, 2012).

In addition to the studies at the macro level, the existence of the NAIRCU also has been verified in some industries (Cheng, 2015; Fan et al., 2007).

2.2. Factors of China's natural excess capacity

The factors of China's NECR are summarized below in accordance with contemporary literature and the definition of NECR in the current study. Among these factors, the first two occur in all market economy countries and the last two only in China and some developing countries (Wang et al., 2014; Gan et al., 2015).

(1) The hoarding of production factors under demand uncertainty. As the decisions on capacity are made before the demand is known, firms are inclined to respond to the uncertainty of the future demand fluctuations by maintaining excess capacity in order to maximize their profit (Abel, 1983; Burnside and Eichenbaum, 1994, 1996; Fair, 1985; Fay and Medoff, 1985; Paraskevopoulos et al., 1991).

(2) Excess capacity maintained in oligopoly to deter new entrants. In an oligopoly, maintaining an excess capacity in the incumbent firms can be a credible entry barrier to deter new entrants (Boyle and Guthrie, 2003; Dixit, 1980; Mason and Weeds, 2010; Spence, 1977).

(3) Industrial investment wave. Due to the advantage of backwardness, for firms in China and other developing countries, it is easy to reach an agreement on the next promising industries. Consequently, as the capacity of a firm is decided before that of other firms and the industry is known, these industries experience overinvestment, which eventually results in overcapacity (Lin, 2007; Lin et al., 2010).

(4) Undesirable investment incentives of government due to system distortion. With a fiscally decentralized system, a political promotion system between local officials based on GDP growth and soft local government budget constraints, local governments have a strong motive and ability to encourage capacity expansion by lower production costs via negative distorted factor prices, the attraction of foreign capital through preferential foreign policies, and the exit of fewer enterprises due to subsidies (Zhou, 2004, 2007; Zhou and Fu, 2011).