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Review of Research on Overcapacity Measurement and Evaluation

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Abstract. Overcapacity will have an important impact on economic and social development, so it is a key research topic in academia. To study the problem of overcapacity, it is necessary to accurately measure overcapacity. Since different scholars have different interpretations of the connotation and denotation of overcapacity, a variety of overcapacity evaluation methods have emerged. This paper will review the domestic and foreign literature on the measurement and evaluation of overcapacity, analyze and compare different methods, and lay a theoretical foundation for subsequent relevant research, in order to provide help for China's overcapacity reduction work.

Keywords: Overcapacity; Measurement; Evaluation; Capacity Utilization; Comprehensive Index Method.

1. Background

Overcapacity is a key research topic in industrial economics. The term‘overcapacity’was first proposed by Chamberlin in 1933, and since then the academic circle has carried out a wealth of research on overcapacity. In foreign studies, although foreign scholars believe that overcapacity has certain benefits from the perspective of strategic competition[1] and demand uncertainty[2], they do not deny that overcapacity will lead to resource waste and social welfare losses[3]. In China, overcapacity is considered one of the current major macroeconomic risks[4]. Therefore, studying the problem of overcapacity has strong practical significance. This first requires accurate measurement of overcapacity, so that the degree and changing trends of overcapacity can be analyzed objectively and comprehensively. At present, different scholars have certain differences in their understanding of the connotation and denotation of overcapacity, which makes their calculation methods and evaluation standards inconsistent. Therefore, this paper believes that it is necessary to comb the relevant literature on the measurement and evaluation of overcapacity at home and abroad, analyze and compare different methods, and find out the shortcomings of China in this respect, in order to provide help for the government departments to control overcapacity.

2. Measurement and Evaluation of Overcapacity

First, it is necessary to introduce the concept of indicators related to overcapacity. Capacity refers to the theoretical maximum output capacity of a thing. Excess capacity occurs when actual output is less than the maximum output. Capacity utilization is the ratio of actual output to maximum output. By definition, capacity utilization is a direct indicator of overcapacity, so most countries in the world use capacity utilization as a measure of overcapacity. Foreign scholars have conducted extensive research on the measurement of capacity utilization, and proposed a variety of measurement methods including direct survey method, peak method, cost function method, production function method, frontier analysis method, etc. However, there are not many innovations by domestic scholars, and they mainly follow foreign calculation ideas.

2.1. Capacity Utilization

(1) Direct survey method

The direct survey method refers to the measurement of capacity utilization through direct surveys by large professional institutions such as the American McGraw-Hill Company, the National Bureau of Statistics of China, and Eurostat. The advantage of this method is that it can obtain data directly and

accurately. The disadvantages are that it requires huge manpower, material and financial resources, the cost is too high, and there are limitations in the time span[5]. Guosheng Zhang used the China Investment Environment Survey data released by the World Bank to measure capacity utilization[6]. However, the sample size is limited and is not suitable for examining the overall industrial capacity utilization[7].

(2) Peak method

The peak value method was first proposed by Klein, which assumes that the capacity utilization rate of the enterprise in the past year with the largest output reaches 100%, and regards this output as potential capacity[8]. The advantages of this method are low data requirements and convenient and quick measurement. There are two shortcomings. First, this method assumes that capacity utilization is only related to technological changes and does not consider the impact of structure and scale[9]. Second, there will be a‘weak peak’problem. The production capacity may not be fully utilized in the year with the highest output, resulting in a smaller potential production capacity calculated by this method and an overestimation of the capacity utilization rate.

(3) Cost function method.

The cost function method is currently the most widely used measurement method. The basic theory of this method is that it is difficult for enterprises to adjust their inputs in the short term, so actual output cannot reach the theoretical optimal. However, in the long run, the optimal scale can be achieved through adjustment. The output at this time is defined as the potential production capacity of the enterprise, that is, the capital stock of the enterprise determines whether the optimal production scale can be achieved. The advantage of this method is that it is based on the economic production capacity theory proposed by Chamberlin and has a strong theoretical foundation[3]. The disadvantages are twofold. First, this method takes cost minimization as a premise, but in reality, Chinese enterprises, especially state-owned enterprises, are burdened with multiple tasks that make it impossible to conduct production and operations in accordance with the goal of cost minimization[10]. Second, the prices of production factors are not easy to obtain. Due to the slow progress of China's market-oriented reform, the prices of production factors such as raw materials, energy, and land cannot be truly reflected[11].

(4) Production function method

The method of production function method is to first set the specific production function form based on the definition of technical production capacity, and then use the elimination trend method and other related measurement methods[12] to process the model to obtain the measurement model of potential production capacity. Finally, Calculate capacity utilization. The advantages of this method are: first, the model is based on neoclassical growth theory, which has theoretical advantages and the measurement results are credible[13]; second, all parameters in the model have economic significance and can test the impact of each factor on capacity utilization, which is conducive to a comprehensive understanding of the characteristics of structural changes and provides a reference for relevant government departments to formulate policies[14]. The disadvantage of this method is that it is difficult to determine which model to use.

(5) Frontier analysis method

Frontier analysis methods include data envelopment analysis (DEA) and stochastic frontier analysis (SFA). The calculation idea of this method is: first solve the established production frontier model, and then use the deviation part between the actual output and the frontier, that is, the inefficiency part, as the calculation index. Fare et al. divides capacity utilization into biased capacity utilization and unbiased capacity utilization. The former is the ratio of actual output to production capacity, which includes technical efficiency. The latter is the ratio of maximum output to production capacity under a given factor, and it does not include technical efficiency and is equivalent to equipment utilization[15]. The advantage of the DEA method is that it does not need to establish a production

function and has high applicability. The advantage of the SFA is that it can find the substitution elasticity between different factors compared with the DEA method[16]. The shortcomings of these two methods are that they cannot prove that the relatively effective point is the point corresponding to full utilization of production capacity, and it is difficult to distinguish between the two indicators of capacity utilization and total factor productivity.

The above five methods represent different economic meanings. The peak method is an indicator replacement method, and its theoretical significance is not as strong as other methods. The direct survey method measures capacity utilization at the physical level, that is, equipment utilization. The cost function method measures capacity utilization at the economic level. The production function method and frontier analysis method measure capacity utilization at the technical level. Minjie Dong et al. pointed out that the meaning of capacity utilization at the physical level and at the technical level is different. At the physical level, it is assumed that enterprises choose machinery and equipment with the strongest production capacity when investing in fixed assets. However, in reality, enterprises may not do this due to various factors. That is, the physical level of machinery and equipment may not necessarily be the equipment with the strongest production capacity. This will lead to an underestimation of potential production capacity, and then the actual measured capacity utilization will be high, which can not reflect the waste of resources[17].

It is generally believed that it is necessary for various industries to retain a certain production capacity to adjust market demand fluctuations. When excess capacity reaches a certain level, it is defined as overcapacity. Therefore, the capacity utilization rate has a reasonable range, below this range is overcapacity, in this range indicates that capacity is fully utilized, above this range is insufficient capacity, need to increase investment. However, countries around the world have not yet reached a consensus on the reasonable range. The evaluation standards in European and American countries are that less than 79% is overcapacity, 79%-83% is a reasonable range, and more than 90% is insufficient production capacity and production equipment is overused[18]. Japan's reasonable range is 83%-86%, India's overcapacity threshold is considered to be 70%[4].

2.2. Comprehensive Index Method

Some Chinese scholars believe that it is not enough to measure overcapacity only by capacity utilization rate. This is because the meaning of capacity utilization rate pays more attention to the supply side, while the research on overcapacity in China pays attention to the mismatch between supply and demand, especially the phenomenon of product surplus, that is, the oversupply[19], poor sales[20] and falling demand[21] lead to inventory overstocking, profit decline and enterprise losses[22]. Therefore, when measuring overcapacity, in addition to the supply side, but also need to consider the demand side, as well as some of the accompanying impact, which means the need to use the comprehensive index method. Jin Zhou and Baozong Fu established an overcapacity evaluation system, using capacity utilization as a degree indicator, and then established three effect indicators: economic effect, social effect, and environmental effect[23]. Xingyan Wang constructed an overcapacity evaluation system based on the three principles of systematicity, objectivity, and operability. The system layer selects four indicators: fixed capital, labor, industry efficiency and price level, production demand and inventory. Below the system layer indicators, there are 17 basic variable layer indicators[24]. From the perspective of supply and demand balance, Ye Liu and Weiqi Ge designed 5 first-level indicators, including supply and demand situation, demand changes, supply capacity, capacity under construction, and operating conditions, and 14 second-level indicators[25]. When Mei Feng and Peng Chen investigated the overcapacity situation in the steel industry from 1996 to 2012, they selected four indicators: capacity utilization rate, price index change rate, inventory change rate, and sales profit rate change rate. Then, they used the entropy method to measure and divided the overcapacity range. Finally they used the gray prediction model to give an early warning of overcapacity in the next three years[26]. Kunrong Shen et al. used the production function method to measure capacity utilization and used product sales rate as an auxiliary indicator to divide ’strong surplus’and‘weak surplus’ industries[18].

3. Problems and Prospects

In the calculation and evaluation of overcapacity, foreign countries take capacity utilization as the proxy variable of overcapacity, and put forward a variety of measurement methods, including direct survey method, peak method, cost function method, production function method, frontier analysis method and so on. China has followed foreign methods for measuring capacity utilization, and has also added other indicators to enrich the overcapacity evaluation system. Currently, there are three shortcomings in domestic research. First, when it comes to measuring capacity utilization, China basically follows foreign measurement methods, but this has certain limitations. For example, the assumptions of the cost function method are not consistent with China's reality, and the data is not easy to obtain. Second, there is no recognized standard in China for judging capacity utilization. Some scholars follow European and American judgment standards, but the capacity utilization rates of various domestic industries are significantly heterogeneous[19], and it is obviously unreasonable to use one standard to evaluate all industries. Third, in the system construction of the comprehensive index method, in addition to capacity utilization, the selection of other indicators is highly subjective. Different scholars use different indicators, and there is currently no objective and unified evaluation system. Therefore, in the future, domestic academic circles need to innovate the measurement of capacity utilization and strengthen the objectivity of the comprehensive index method system, so that overcapacity can be measured and evaluated more accurately.

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