ATLANTIS PRESS

Advances in Economics, Business and Management Research, volume 85

2nd International Conference on Economy, Management and Entrepreneurship (ICOEME 2019)

Measurement of Capacity Utilization Level in China's Iron and Steel Industry and Its Relationship with Macroeconomic Fluctuations

Qi Xu
School of Statistics
Shandong University of Finance and Economics
Ji'nan, China

***Abstract*—Since 2000, a large scale of capital has been invested to infrastructures of China, and the overheating of economy therefore gives rise to excess capacity in certain industries. The eruption of 2008 US economic crisis, followed by the European sovereign debt crisis in 2010, has influenced the world as a whole. Central banks introduced a variety of plans to stimulate the economy, including China, who has taken the 4 trillion economic stimulus plans in order to restore market confidence. The plan, on the one hand, increases investment in infrastructures and in cement, steel and other energy-intensive and high polluting industries and has contributed to excess capacity to a certain extent. On the other hand, the contractionary monetary policy has led financial strains to many small and medium-sized enterprises and private enterprises. The significance to the study of excess capacity lies, first, in determining the reasonable level of capacity to optimize enterprise market strategy as well as providing references for government policies. Second, the level of redundant constructions can be declined. To analyze the problem of excess capacity in Chinese steel industry, this paper uses the rate of capacity utilization to measure the degree of excess production, and the data envelopment analysis (DEA) method to measure the rate of capacity utilization of iron and steel industry using data collected from 29 areas in China from 2004 to 2011 and compare the differences between each provinces.**

Keywords—capacity utilization level; DEA; macroeconomic fluctuations

I. INTRODUCTION

With the development of steel industry in our country, the domestic steel production growth is always higher than that of the domestic market demand growth, many companies focused on the overseas market, at the start of the profits, but the advent of the 2008 world economic crisis, the steel market plunge, overseas in the year to the domestic iron and steel enterprises in overseas has been unprofitable. In the domestic market of transfer, the real estate bubble is on the verge of collapse, and the stagnation of infrastructure construction leads to the reduction of steel demand, while the excessive production capacity leads to the continuous decline of domestic steel prices. According to the data of the national bureau of statistics, the national key steel enterprises can only earn 0.84 yuan per ton of steel produced by 2014. Steelmakers' profits have fallen to record lows, in part because of overcapacity.

II. MEASUREMENT OF CAPACITY UTILIZATION LEVEL OF CHINA'S IRON AND STEEL INDUSTRY

In this chapter, the method to measure capacity utilization level will be systematically introduced to provide effective data support for subsequent empirical analysis. This case USES data envelopment (DEA) method to measure the productivity utilization level [5].

A. Selection of Indicators and Data Processing

In this paper, data envelopment method (DEA) is used to measure the capacity utilization level of output indicators of the steel industry. The output variable of this paper is the actual output of the steel industry, which is the total industrial output value of the steel industry in each province. 's devotion to the steel industry index, this paper will be the fixed assets investment and energy consumption as the input variables, due to the differences in the provinces of the steel industry's fixed assets, and the number of different iron and steel enterprise, this paper will be fixed assets investment as an input variable [6], in addition, from the Angle of the iron and steel enterprise's actual investment, this paper also selected the big coke, iron and steel, as the cost of its investment targets. In this paper, data of 30 Chinese provinces from 2011 to 2016 were collected from China iron and steel statistical yearbook. For the prices of steel and coke, this paper calculated according to the average annual price of each province market.

B. DEA Calculation Results and Empirical Results Analysis

In this paper, DEAP2.1 software was used to calculate the comprehensive efficiency and pure technical efficiency of the steel industry in each province based on CCR model and BCC model, and the scale efficiency status was given. The calculation results are shown in “Table I” and “Table II”.

TABLE I. COMPREHENSIVE EFFICIENCY CU

Region	2011	2012	2013	2014	2015	2016
Beijing	1	0.864	0.525	0.721	1	1
Tianjin	0.696	0.695	0.562	0.951	1	1
Hebei	0.414	0.424	0.393	0.421	0.437	0.859
Shanxi	0.442	0.4	0.378	0.436	0.45	0.634
Neimenggu	0.284	0.329	0.521	0.52	0.452	0.581
Liaoning	0.345	0.311	0.412	0.47	0.45	0.681
Jilin	0.366	0.383	0.316	0.35	0.269	0.46
Heilongjiang	0.289	0.315	0.304	0.256	0.262	0.318
Shanghai	0.497	0.346	0.334	0.449	0.45	0.865
Jiangsu	1	1	0.945	1	0.629	0.683
Zhejiang	1	1	1	1	1	1
Anhui	0.26	0.243	0.376	0.35	0.372	0.734
Jiangxi	0.913	0.843	0.808	0.911	0.7	0.863
Fujian	0.697	0.4	0.318	0.338	0.35	0.383
Shandong	0.628	0.92	0.595	0.637	0.453	0.842
Henan	0.401	0.389	0.388	0.408	0.347	0.602
Hubei	0.389	0.363	0.344	0.376	0.452	0.54
Hunan	0.398	0.395	0.378	0.389	0.337	0.509
Guangdong	0.964	1	0.896	1	1	1
Guangxi	0.504	0.534	0.484	0.531	0.572	0.667
Sichuan	0.482	0.478	0.503	0.548	0.548	0.534
Chongqing	0.581	0.618	0.492	0.419	0.523	0.695
Guizhou	0.465	0.576	0.573	0.419	0.424	0.562
Yunnan	0.266	0.487	0.41	0.326	0.338	0.412
Shanxi	0.395	0.509	0.49	0.537	0.357	0.434
Gansu	0.344	0.412	0.405	0.436	0.441	0.53
Qinghai	0.78	0.373	0.626	0.455	0.672	0.632
Ningxia	1	1	0.921	0.814	0.77	0.501
Xinjiang	0.318	0.295	0.365	0.314	0.39	0.4

TABLE II. CU AVERAGE VALUE OF CAPACITY UTILIZATION RATE BY REGION

Region	CU	Rank	Region	CU	Rank
Beijing	0.8888	4	Henan	0.444	19
Tianjin	0.8443	6	Hubei	0.4091	22
Hebei	0.4941	15	Hunan	0.4069	24
Shanxi	0.4826	16	Guangdong	0.9169	2
Neinenggu	0.4286	20	Guangxi	0.544	10
Liaoning	0.4496	18	Sichuan	0.5139	14
Jiling	0.3815	27	Chongqing	0.5323	11
Heilongjiang	0.3063	29	Guizhou	0.5211	12
Shanghai	0.5265	13	Yunnan	0.3828	26
Jiangsu	0.9071	3	Shanxi	0.4544	17
Zhejiang	0.995	1	Gansu	0.4134	21
Anhui	0.3933	25	Qinghai	0.6923	8
Jiangxi	0.8365	7	Ningxia	0.8758	5
Fujian	0.4083	23	Xinijiang	0.3563	28
Shandong	0.6456	9			

It can be seen from "Table I" that the steel capacity utilization rate of some years corresponding to some provinces and cities is 1, indicating that there is no excess capacity at this time, which seems to be contrary to the fact that the occurrence of this situation is caused by the characteristics of DEA model. The productivity utilization rate obtained by the model is the relative value, and the province with the comprehensive technical efficiency of 1 represents the region to be in the leading position in terms of steel production efficiency, that is, in the state of efficiency. The productivity efficiency value of other provinces is calculated based on this standard, which reflects the relative change of the productivity utilization rate of each province and does not represent its real productivity utilization rate. The closer the technical efficiency of steel production capacity in a province is to 1, the more significant efficiency advantage the steel enterprises in the province have on the whole. The further away the comprehensive technical efficiency of production capacity in a province is from 1, the less effective production and operation efficiency and the less significant economies of scale exist in iron and steel enterprises in the province as a whole [7].

The capacity utilization rate in the above table is divided into three levels: The first grade: the steel capacity utilization rate of Beijing and Zhejiang province remained around 1 from 2011 to 2016 (except for a few years), which indicates that the production and operation efficiency of iron and steel enterprises in Beijing and Zhejiang province has been in a leading and effective state, and there is basically no excess capacity. During this period, the capacity utilization rate of Tianjin iron and steel industry showed a trend of decreasing first and then increasing, while the capacity utilization rate of Guangdong iron and steel enterprises showed a trend of increasing after 2014and reached the state of full efficiency until 2016. There were significant economies of scale and the degree of overcapacity became lower and lower. Second grade: the capacity utilization efficiency of this grade is between 0.5 and 0.9. The utilization rate of steel production capacity in Jiangxi province is basically between 0.8 and 0.9, which is close to the production frontier of the first grade and in a state of relative efficiency. The production capacity utilization efficiency of Shandong, Shanghai, Ningxia autonomous region and Guangxi was basically maintained between 0.5 and 0.8 (except that the steel production

capacity utilization rate of some provinces was lower than 0.5 in some years). The production capacity utilization efficiency of Shandong province increased year by year from 2011 to 2016, and reached the maximum value of 0.92 in 2014. After2015, it showed a decreasing trend. The iron and steel capacity utilization rate of Ningxia autonomous region was in the leading state from 2011 to 2016 but began to decline after 2015, that is, the degree of excess capacity is getting higher and higher. Third tier: the third tier has a steel capacity utilization rate below 0.5. Provinces in this tier are Hebei, Hunan, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Anhui, Yunnan, Henan, Hubei, Fujian, Chongqing, Guizhou, Shaanxi, Gansu, Shanxi and Xinjiang. On the one hand, it shows that the capacity utilization rate of steel industry in these provinces is relatively low compared with provinces at the first and second levels, which is far away from the production frontier, and the degree of overcapacity is also relatively serious. On the other hand, it shows that about half of the steel industry in China has a serious overcapacity problem. The degree is getting higher and higher.

On the basis of the above analysis, we can further calculate the degree of steel overcapacity EC through the degree of steel capacity utilization CU, that is, EC= 1-cu. The calculation results are shown in "Table III".

TABLE III. CAPACITY OVER-CAPACITY EC BY REGION

Region	EC Ranking	Region	Ranking
Beijing	0.11125	Henan	0.556
Tianjin	0.15575	Hubei	0.590875
Hebei	0.505875	Hunan	0.593125
Shanxi	0.517375	Guangdong	0.083125
Neinenggu	0.571375	Guangxi	0.456
Liaoning	0.550375	Sichuan	0.486125
Jiling	0.6185	Chongqing	0.46775
Heilongjiang	0.69375	Guizhou	0.478875
Shanghai	0.4735	Yunnan	0.61725
Jiangsu	0.092875	Shanxi	0.545625
Zhejiang	0.005	Gansu	0.586625
Anhui	0.60675	Qinghai	0.30775
Jiangxi	0.1635	Ningxia	0.12425
Fujian	0.59175	Xinijiang	0.64375
Shandong	0.354375		

As can be seen from "Table III", the average level of overcapacity in the steel industry in Zhejiang, Guangdong, Jiangsu, Beijing, Ningxia, Tianjin and Jiangxi is within 0.2. On the contrary, the average level of overcapacity in Xinxiang, Heilongjiang, Jilin, Yunnan, Anhui, Hunan and other regions is above 0.6, and there is serious overcapacity.

III. RESEARCH ON THE RELATIONSHIP BETWEEN OVERCAPACITY AND MACROECONOMIC FLUCTUATIONS IN CHINA'S STEEL INDUSTRY

After the above utilization rate has been studied, this case will further study the correlation between the degree of steel overcapacity EC and China's macroeconomic fluctuations. According to the research needs of this paper, the economic volatility index is essentially a measure of the changes in the level of economic aggregate. The calculation form of specific indicators is as follows:

$$g_{it} = \frac{Y_{it} - Y_{it-1}}{Y_{it-1}}$$

Where, g_{it} represents the growth rate of industrial added value in year t of region I, Y_{it} represents the industrial added value in year t of region I, Y_{it-1}represents the industrial added value in year t of region I, represents the industrial added value in year t-1 of region I, and the data is referred to the statistical database of China's economic and social development.

The macroeconomic fluctuations and overcapacity in various regions generally show a trend of increasing and decreasing with each other. Especially around 2015 this relationship is particularly significant. It can be intuitively seen from the figure that in 2015, economic fluctuations and steel overcapacity index EC in various regions of China basically reached the maximum. After 2015, China's iron and steel industry was affected by the international economic crisis. After 2015, the global economy slowly recovered the demand for steel increased, China's steel industry picked up. From this we can see that macroeconomic fluctuations on the steel industry overcapacity have a greater impact.

IV. CONCLUSION

From the perspective of development stage, when the whole industry is in the early stage of development and a large number of social resources have not been invested, we can boldly expand the production scale of our own enterprises and increase daily output. At present the production scale of Jinan has reached the national top ten, production is enough to meet the demand of sales, and production of raw materials price is rising, freight, electricity and gas prices, the production cost is high, so should we must stick to the high-end product line, the high strength steel boiler container type, medium thickness, on the basis of the advantages of the high strength steel plate products, increase investment in science and technology innovation. Not only expanded the enterprise product category, but also through these high-end products to capture the market to win profits.

In addition, in order to respond to the call of the state, the needs of the people and alleviate the pressure of resource shortage, Jinan iron and steel group should consciously eliminate backward production capacity, build new and high technology production lines, carry out technological

innovation on old production equipment, improve operation efficiency and reduce environmental pollution. Disruptive innovation is allowed in the process.

REFERENCES

[1] Hao Qingmin, Sun Lihong. Analysis on the effectiveness of economies of scale in China's iron and steel enterprises [J]. Tianjin metallurgy, 2002, (6).

[2] Jiang Feitao, Chen Weigang et al. Defects and adverse effects of investment regulation policies — based on the investigation of China's iron and steel industry [J]. China industrial economy, 2007, (6).

[3] Jiao Guohua, Jiang Feitao, Chen Jiong. Relative efficiency and scale efficiency of Chinese steel enterprises [J]. China industrial economy, 2007, (10).

[4] Qu Guozhong, Zhang Yan. Comparative analysis of economies of scale in China's iron and steel enterprises [J]. Metallurgical management, 2000, (8)

[5] Li Jiangtao. Overcapacity — problems, theories and governance mechanism [M]. Beijing: China financial and economic press, 2006

[6] Liang Jinxiu. Causes and countermeasures of overcapacity in China [J]. Economic review, 2006, (7).

[7] Liu Zhibiao. On restraining blind and repeated construction and adjusting industrial structure [J]. Productivity research, 1997, (1).

[8] Qi Xiangdong. Operation situation of China's steel industry in 2006 and prospect in 2007 [J]. Metal world, 2007, (1).

[9] Chuan qinhai. Empirical analysis on excessive competition in Chinese industry [J]. Reform, 1996, (5).