Empirical Study on the Factors Affecting Steel Production in Beijing-Tianjin-Hebei Area

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Abstract. The Beijing-Tianjin-Hebei region is currently the most concentrated area of China's steel industry. In 2016, steel production accounted for about one-third of the national output. While the steel production in the Beijing-Tianjin-Hebei region has made a great contribution to the local economy, it has also made up for the shortage of steel production in other regions. This paper uses two models to explore the impact of steel comprehensive price index, steel R&D expenditure, construction area of the whole society and annual automobile output as explanatory variables on steel production in Beijing-Tianjin-Hebei region. Through empirical analysis, it is concluded that the increase in steel R&D expenditure will lead to an increase in steel production. The increase in the comprehensive price index of steel will lead to a decrease in production. The increase in the construction area of the whole society will lead to an increase in steel production. The increase in annual production of automobiles will also lead to steel production increase.

Introduction

The Beijing-Tianjin-Hebei region is a place with intensive steel production. In 2015, crude steel production accounted for 26% of the country's crude steel output[1]. Figure 1 summarizes the total steel output and growth rate in the Beijing-Tianjin-Hebei region from 2005 to 2016. We can visually see the total steel output in the Beijing-Tianjin-Hebei region has been rising steadily year by year, but the growth rate has slowed down markedly. In 2006, the growth rate was 25.27%, and the growth rate in 2016 was 5.49%. The growth rate showed a trend of slowing down. However, the growth rate was still higher than the national average. The growth rate of the national growth rate has shown a significant downward trend in recent years. In 2016, the growth rate was only 0.98%. In 2011, the output value of Beijing-Tianjin-Hebei steel industry accounted for 27.58%, and the proportion in the country in 2016 rose to 29.46%. According to the above statistics, in recent years, the growth rate of total steel production in the Beijing-Tianjin-Hebei region exceeded the national total steel production growth rate, and the proportion in the country has shown an upward trend. This shows that the problem of overcapacity in the Beijing-Tianjin-Hebei region cannot be underestimated. This paper analyzes the factors affecting steel production in Beijing-Tianjin-Hebei region, focusing on R&D expenditure, steel prices, real estate investment, and manufacturing investment. It can provide reference value for steel companies to improve their profit and operational goals.
Figure 1. The output and growth rate of steel in Beijing, Tianjin and Hebei in 2005-2016 years (unit of output: 10000 tons).

The Impact of Technical Level on Steel Production

In recent years, China's iron and steel enterprises have attached great importance to independent innovation and continuously increased investment in scientific research. The research and development funds for ferrous metal smelting and rolling processing industries of industrial enterprises above designated size in the Beijing-Tianjin-Hebei region are also increasing year by year. The purpose of increasing investment in science and technology is to increase the company's original innovation and integrated innovation capabilities, accelerate the upgrading of the steel industry, improve production efficiency, reduce energy consumption, and increase original technological innovations[2].

The Impact of Market Environment on Steel Production

There is a strong positive correlation between steel capacity utilization rate and steel comprehensive price index. Before 2011: during the industry boom period, high-speed growth of crude steel production was supported by downstream industry demand. Capacity utilization rate and price were relatively high[3]. At the same time, both the capacity utilization rate and the steel price index are rising. From 2011 to 2015, the production capacity was over-expanded, and the annual production capacity of crude steel continued to grow rapidly. However, due to the gradual decline in demand growth, the overcapacity problem in the steel industry gradually appeared, and the capacity utilization rate and price index fell. At this stage, the capacity utilization rate dropped significantly. The China Steel Association's steel comprehensive price index also showed a downward trend. The steel price index in 2015 reached its lowest point in recent years[4]. Therefore, in recent years, despite the steady increase in steel production in the Beijing-Tianjin-Hebei region, capacity utilization has declined and the steel price index has also declined.

Regarding the demand for steel in the downstream industries of steel, we analyse representative downstream industries with strong steel demand. Construction steel is the largest variety of steel consumption in China, and its total consumption of steel accounts for more than 50%. In recently years, the rapidly growing construction industry has provided a broad market for the development and application of construction steel. The machinery industry is a supportive industry in the middle reaches, and its steel consumption depends on downstream demand industries such as residential, infrastructure and automobiles[5]. Automobile steel mainly includes steel plates, high-quality steel, section steel, etc, and various steels account for about 70% of the total weight ratio of automobiles.
Empirical Analysis of the Impact of R&D Expenditure and Market Environment on Steel Production

Data Source and Description
In order to explore the influencing factors of steel production, and based on the availability of data, the data in this paper are from the National Bureau of Statistics, the Beijing Tianjin Hebei Province Statistical Yearbook and the China Iron and Steel Association website. Due to the differences in the statistical metrics of the three provinces, this article will compare and analyze the annual data collected from various channels, and then eliminate or replace unreasonable data.

Variable Selection
The total amount of steel (QUA) in the three provinces of Beijing-Tianjin-Hebei region is the explained variable and the main research object of this paper. This article uses the relevant data of the steel industry in each year. Since the above statistical yearbook does not have data on the total output value of the steel industry, therefore, we add up the production of three major branches of the steel industry - steel, pig iron, crude steel to obtain total steel output.

R&D expenditure (DEV) represents the smelting and rolling processing industry of industrial enterprises above designated size in the Beijing-Tianjin-Hebei region as a measurement index to represent the technological innovation capability of the Beijing-Tianjin-Hebei region.

The steel price (PRI) is based on the steel comprehensive price index. The original data comes from the China Iron and Steel Association. The average of the first week of January, May and September is taken as the representative of the steel price of the year.

In order to accurately study the demand of downstream industries, this paper analyzes the changes in annual real estate investment and automobile production. The change in the construction area of the whole society (AREA) represents the demand for real estate investment in recent years, and the change in automobile production (CAR) represents the demand for manufacturing investment[6]. Therefore, this paper mainly explores the influencing factors of steel production from the perspective of technology and market environment.

Construction of the Model
The first model uses the relevant data for 2009-2016, focusing on the upstream and downstream of the steel industry chain, and studying the impact of technology and market on steel production. Since we are investigating the steel production, R&D expenditure and market demand in the Beijing-Tianjin-Hebei region, it is more appropriate to use the panel data fixed-effects model for analysis, which can overcome the limitations of the sample size and obtain better estimates of parameters and models. In order to smooth out the fluctuations of the time series data and eliminate the influence of the data dimension, the natural logarithm of the explanatory variables are taken as: LDEV, LPRI, LAREA, LCAR. Based on the above analysis, the following model of influencing factors of steel production was constructed:

\[ \text{QUA}_i = \alpha_i + \beta_1 \text{LDEV}_i + \beta_2 \text{LPRI}_i + \beta_3 \text{LAREA}_i + \mu_i \]  

(1)

\( \alpha_i \) represents the individual effect of the city. \( \beta_i \) (i=1, 2, 3) represents the regression coefficient that does not change with time, represents the city and time respectively. \( \mu_i \) indicates the random disturbance term.

The second model uses the relevant annual data for 2005-2016, mainly from the market level to study the main factors affecting the steel production of Beijing-Tianjin-Hebei region. Compared with the first model, we examine the demand for steel production in the automotive industry in the market. At the same time, the influencing factors affecting the technical level of steel production, that is, R&D expenditure, have been removed. We have built a multiple linear regression model:
Regression Results and Analysis

Through the regression of the model of the factors affecting the production of Beijing-Tianjin-Hebei steel, we obtained the results in Table 1. Model 1 mainly studies the impact of research funding, market price, and real estate investment on steel production. We used the relevant data from 2009 to 2016. From the regression results, R&D expenditure, market price, and real estate investment demand have had a significant impact on steel production. The increase in R&D expenditure will significantly increase steel production, indicating that R&D investment provides technological innovation support for steel production, which can increase steel production. The steel price index has a strong negative correlation with production, because the annual output of Beijing-Tianjin-Hebei Steel has increased year by year, but the capacity utilization rate is declining, and the capacity utilization rate has a strong positive correlation with the steel comprehensive price index. Strong demand for real estate investment will lead to an increase in demand for steel, which will lead to an increase in steel production[7].

Model 2 focuses on the factors affecting steel production from the market level. Compared with the first model, the time dimension is wider. Similarly, this multiple linear regression model, which analyzes the factors affecting steel production from a market perspective, exemplifies that the steel price index and real estate investment can have a significant impact on steel production. In addition, the model demonstrates that manufacturing, represented by automobile production, has a significant impact on steel production.

Table 1. Regression result.

<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>I</th>
<th>II</th>
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<tbody>
<tr>
<td>LDEV</td>
<td>4704.205*** (4.814)</td>
<td></td>
</tr>
<tr>
<td>LPRI</td>
<td>-10249.97*** (-3.253)</td>
<td>-7888.415** (-2.450)</td>
</tr>
<tr>
<td>LARER</td>
<td>14583.47*** (5.266)</td>
<td>16360.46*** (3.358)</td>
</tr>
<tr>
<td>LCAR</td>
<td>17817.24*** (4.214)</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>-138117.7*** (-2.988)</td>
<td>-261737.7*** (-6.666)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.9869</td>
<td>0.9882</td>
</tr>
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</table>

Note: ***, **, * indicate significant at the 1%, 5%, and 10% levels.

Conclusions and Policy Recommendations

Through the empirical analysis of the above two models, we can gain some inspiration from the technology and market level for the development of the steel industry in the Beijing-Tianjin-Hebei region.

Firstly, from the perspective of technology, R&D investment can greatly improve the level of local science and technology innovation. Although the investment in scientific research in the Beijing-Tianjin-Hebei region has shown an upward trend in recent years, the investment intensity of R&D expenditure lags far behind that of developed countries[8]. Therefore, Chinese steel companies should take the initiative to innovate. First, the entire steel industry should establish an environment that emphasizes technological innovation, increase intellectual property protection, increase investment in research and development, set up research and development institutions, and promote technological innovation alliances between enterprises and research institutes. Try to grasp the direction of scientific and technological development in key areas of the steel industry. At present, there is a certain deficiency in the development of the Beijing-Tianjin-Hebei steel industry. Although Beijing's steel research and investment strength is stronger than other regions, the production service industry is also relatively developed, but due to its limited environmental capacity, steel production capacity has migrated to the province[9]. The results of steel research and development cannot be
fully applied locally. Although Tianjin has certain scientific research and innovation capabilities, the comprehensive level needs to be improved compared with Beijing. The steel industry is under the pressure of transformation and upgrading. Although the production scale of steel enterprises in Hebei far exceeds that of other provinces, the local steel production enterprises are concentrated. Compared with Beijing and Tianjin, they have a wide application market for traditional industrial technology research and innovation, but Hebei has the problem of insufficient innovation capacity. Therefore, it is necessary to increase the intensity of investment in scientific research, avoid extensive investment and repetitive construction, and find a broad application market for traditional industrial technology research and innovation, so that the results of steel research and development can be fully applied locally.

Secondly, from the perspective of the market, the problem of severe overcapacity in the steel industry must be taken seriously. The losses of steel companies in Beijing are more serious than those in the other two provinces. Steel companies should optimize their product mix according to market consumption needs, and strive to achieve the goals of enterprise specialization and product specialization. Eliminate outdated products, use new equipment, improve production efficiency, carry out lean production, improve quality stability, optimize process and specialized production, and reduce operating costs. Iron and steel enterprises should increase the degree of specialization, maximize the value created for users, improve service levels, develop high-end products, accelerate the construction of independent R&D systems, and increase market share. They should also strive to strengthen the management level, scientifically analyze the cost structure, optimize the cost system, sort out controllable and uncontrollable costs, improve management performance. Grasping the development direction of smart factories, fully exploiting and utilizing information such as procurement, production, equipment quality, energy, inventory, logistics, etc.to improve the management level, build the visibility of the enterprise, and improve the after-sales service system. The above are steel enterprises. These are the key to making steel companies run well and reduce inventory.

References


