Proceedings of the 2023 International Conference on Management Research and Economic Development
DOI: 10.54254/2754-1169/22/20230332

Research on the Influence of Monopoly Market Structure of China's Steel Industry on Price Mechanism Based on Game Theory

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Abstract: This article aims to study how the monopoly market structure affects the price mechanism of China's steel industry, which is an important pillar of China's national economy. Every year, the steel industry has made outstanding contributions to China's economy and indicates healthy economic development. Therefore, the research on the steel industry is of great significance. In this paper, based on the theory of game theory, scholars have selected the Abstract production method and comparative analysis method for research and have obtained some results. The most significant result is that the monopoly market structure affects the steel industry's price mechanism, which almost plays a decisive role. Scholars have subdivided large and small enterprises, as well as upstream and downstream enterprises. The results of the two have a similar trend. By analyzing these results, scholars pointed out the problems faced by the steel industry and made policy recommendations for the development of the steel industry in the future, mainly from the perspective of large enterprises, small enterprises and the government. It points out the direction for the future healthy and stable development of the steel industry. It has made a breakthrough in the uncertain development prospects of steel enterprises in China, providing experience and guidance for suppliers, entrepreneurs, and government departments on preparing for the next step.

Keywords: steel industry, monopoly market, price mechanism, game theory

1. Introduction

1.1. Research Background

Due to the concentration of the geographical distribution of steel raw materials and the high demand for capital, China's steel industry has been in a monopolistic market structure for a long time. The steel industry is an important basic enterprise of China's national economy, providing support for the construction of a modern country, and also has a profound impact on green and low-carbon development. In 2021, China's steel industry performed well, with real GDP growth of 18.3%, 7.9%, and 4.9%, respectively, in the four quarters of 4.0%. The average growth rate of the two years in each quarter is 4.9%, 5.5%, 4.9%, and 5.2% [1]. Therefore, studying the healthy operation of the steel industry for China's economy is significant. The steel industry's price mechanism and trading

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rules have undergone great changes in recent years. Large steel mills often have strong pricing power; it dominates the raw materials. At the same time, small and medium-sized enterprises can only passively accept, and the corresponding profitability is also much less than the former. Therefore, mastering and applying these laws has a positive impact on the operation and development of enterprises.

1.2. Literature Review

Many scholars have done detailed research on China's steel industry. Huang found that under the influence of China's dual policies of capacity and output, the price of crude steel has continued to decline, the strength of steel price support has declined, and the overall benefit of the industry has declined [2]. Zhang analyzed the current situation of China's steel industry and predicted that China's steel production and consumption had entered the peak arc zone [3]. Wang proposed that China's steel industry has entered a new and healthy development pattern, and the marketization operation mechanism and steel price have also changed [4]. Hu analyzed the factors that affect steel prices by establishing a grey model, in which iron ore is the most significant factor, and other factors only play a supporting role [5]. The analysis of the current situation and price mechanism of the steel industry in the above paper has important guiding significance for this paper.

1.3. Research Gap

These articles can be roughly divided into several research directions. Most scholars have studied and analyzed the current situation of China's steel industry and the changing trend of steel prices and support strength in recent years. In addition, based on monopoly, some articles analyze the trend of steel pricing mechanism through the method of establishing a model, put forward the prospect of the future development of China's steel industry, and give some policy suggestions. Few scholars have studied the impact of a monopoly market on the price mechanism of the steel industry from the game theory perspective.

1.4. Research Framework

The logic of this paper is as follows. First of all, this paper analyzes the development status of China's steel industry and points out the basic background, namely the monopoly market and environment. Secondly, it puts forward the hypothesis of economic significance, that is, how the monopoly market affects the price of steel. Thirdly, collect materials and data, verify the scientificity and rationality of assumptions based on the perspective of game theory, and draw conclusions. Finally, based on the conclusion, this paper will make a prospect for the development of China's steel industry and put forward policy recommendations conducive to the healthy and sustainable development of the industry.

2. Methods

Based on the game theory perspective, this paper analyzes two research methods.

2.1. Abstract Deduction Method

The abstract deduction method is to reduce various economic phenomena to various simple elements and then measure them to find out the laws of movement and explain economic phenomena. This paper combines the abstract deduction method with game theory taking the relationship between steel industry players as the starting point of political and economic research. In order to achieve the goal of maximizing profits with limited resources, players must play games.

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By analyzing this game's process, we can understand the influence of upstream and downstream enterprises on the steel price in the monopoly market.

2.2. Comparative Analysis

The comparative analysis method is an analysis method that compares two or more things or objects to find out the similarities and differences between them. This paper compares the decisions of players at different time points and in different order of action, such as how the decisions of upstream suppliers affect the steel price and the decisions of downstream enterprises, and how the actions of downstream enterprises react to the former, which is conducive to improving the scientific and rational conclusions.

3. Results

Game theory is a new branch of modern mathematics and an important part of operational research. It mainly studies the interaction between formulaic incentive structures and is a mathematical theory and method for studying the phenomenon of struggle or competition. The game theory considers individuals' predicted behavior and actual behavior in the game and studies their optimization strategies. It is widely used in the field of economics. Therefore, game theory helps study how the monopoly market affects the price mechanism of the steel industry.

Scholars make assumptions based on economic common sense. In the monopolistic competitive market, the main factors affecting steel products are the leading large backbone enterprises and the upstream manufacturers with the pricing power of raw materials.

China's steel industry is still an important part of the national economy and has made many contributions to the Chinese economy every year. However, the steel industry also faces some problems, such as the slowdown in industry investment growth, the continuous decline in steel prices, and a slight decline in steel inventories, but still maintaining a high level. The profit of steel enterprises has a downward trend, and the profit growth of large and medium-sized enterprises has also slowed. In addition, green and environmental protection has gradually become the theme of the times, the living space of high-polluting enterprises has been compressed, and energy conservation and carbon reduction have become the goal of steel enterprises [6]. In addition, the price of imported iron ore has gradually increased at a higher level, and the impact of increased steel exports has been received. The import of raw materials has shown a trend of decreasing quantity and increasing price. And after the massive industrial restructuring, many iron and steel enterprises are facing the problems of excessive government intervention and unreasonable resource allocation among regions.

From the game theory perspective, it can be divided into two basic situations. In the first case, the two players are large steel mills with control over steel prices and strong profitability and the other small and medium-sized enterprises. In the second case, the two players are upstream enterprises in the steel industry, such as crude and coke suppliers. The other player is a downstream enterprise, which takes processing primary products into more refined products as its tasks, such as China Baowu Iron and Steel Co., Ltd. and Xilin Iron and Steel Co., Ltd. Next, the game tree is used to analyze these two situations.

Situation One: Under the monopolistic market structure, some large steel mills have a large market share and strong profitability [7]. Scholars call these companies player one; In addition, small and medium-sized enterprises in the steel industry (lack of competitiveness and voice and weak profitability) are called "Player 2". The game between the two on price mechanism is shown in figure 1 below.

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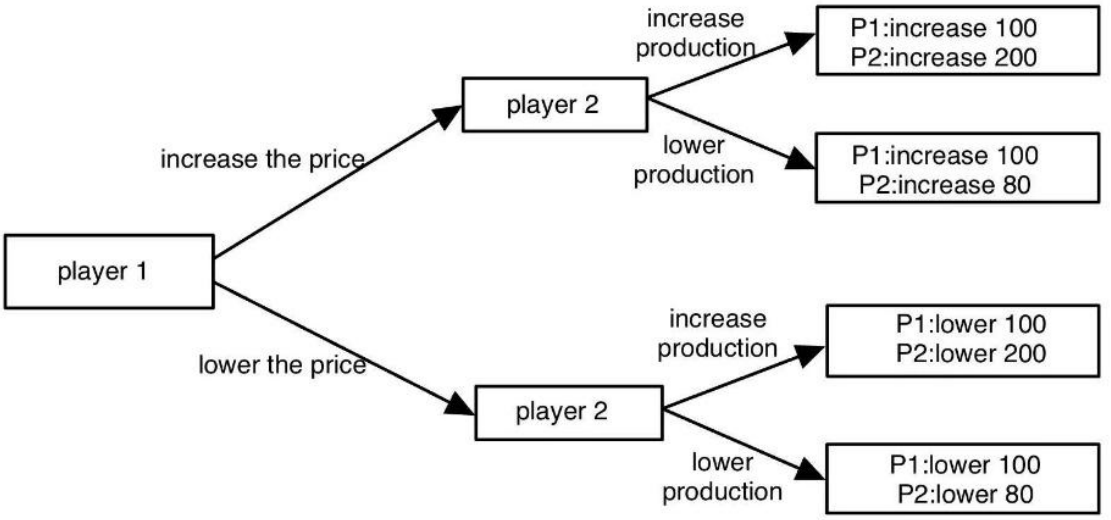

Figure 1: Game tree (photo credit: original).

It can be seen from this that player one, that is, large enterprises, have the pricing power and act ahead of player two. When it decides to raise the price, small and medium-sized enterprises can only accept the price. What it can decide is its own output. Whether they choose to increase or reduce the output, the expected value is positive, 50 and 20, respectively, and vice versa; the expected value is - 50 and - 20, respectively. Obviously, the choice of a few leading enterprises significantly affects the final steel price.

Situation Two: The safety of China's steel industry chain is crucial to realizing high-quality economic development, and it is urgent to improve the ability of independent control [8]. For steel raw material suppliers, scholars call them Player One, while downstream enterprises engaged in high-end product processing are called Player Two. The game between the two on price mechanism is shown in figure 2 below.

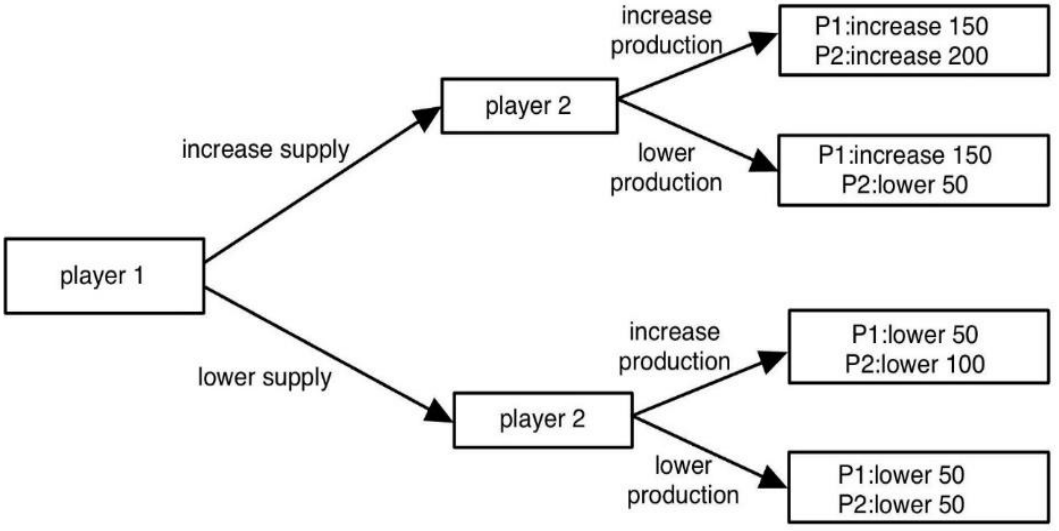

Figure 2: Game tree (photo credit: original).

It can be seen from this that player 1, that is, upstream enterprises, can control the price and supply of raw materials. When they increase the supply, downstream enterprises (player 2) can choose whether to increase or reduce the output. At this time, if player 2 chooses to increase the

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output, the expected value is 50, and the expected value during the period of reducing the output is -12.5. On the contrary, when player 1 chooses to reduce the supply of raw materials, the expected value is - 25 and - 12.5, respectively.

Combined with the comprehensive analysis of the above two situations, we can confirm the hypothesis of scholars that in the monopoly market, the backbone enterprises that play a leading role in the steel price mechanism. In addition, the upstream enterprises that control the raw material resources are the ones that almost determine the profitability and output of small and medium-sized enterprises.

Tutors adopt a simple game model with only two players interacting. In reality, there must be more complex factors and influences, such as the influence of politics and national history. The expansive game model can be used for detailed research. This is only for scientific consideration.

4. Discussion

To sum up, the price mechanism of China's steel industry is affected by many factors in a monopolistic environment. Therefore, the long-term and stable development of China's steel industry requires the joint efforts of players. The government, large enterprises represented by state-owned enterprises, small and medium-sized enterprises, and foreign suppliers are the main players that play an important role. Although the monopolistic competitive market is the established basic background, each non-decisive subject can still give full play to its initiative.

First, increase the supervision of government departments. Although it is in a monopoly market, the government needs to do something and cannot completely rely on the invisible hand to adjust. The listing of steel futures makes the steel trade tend to be financial, and there are more factors affecting its production. The government should strengthen control, issue relevant laws and regulations, give play the role of the visible hand, limit production according to the real demand, and conduct an appropriate intervention in the financial market to prevent the occurrence of market disruption.

Second, steel production enterprises shall produce according to demand. The supply side and the demand side are closely connected. Domestic steel mills, large and small, should organize production in strict accordance with orders, match the market's real demand, and prohibit the waste of resources to reduce overcapacity. Solve the problem of low efficiency of resource allocation after industry restructuring and improve the efficiency of resource allocation.

Third, steel trading enterprises should use modern information technology to improve their service level. Steel trading enterprises can combine their own trade with the Internet to achieve e-commerce steel trade. It is beneficial for operators to grasp the market dynamics in real-time, obtain the steel price for the first time, and help enterprises respond more sensitively [9].

Fourth, to give full play to the role of an export tax rebate, the Ministry of Finance will cancel the export tax rebate for primary imported steel, further strengthening the industrial structure adjustment of the steel industry. Achieve the goal of maximizing profits of domestic steel enterprises by importing iron ore [10].

Fifth, state-owned enterprises need to play a leading role in guiding the establishment and improvement of the supply chain of the iron and steel industry, building a new industrial ecological pattern of "backbone enterprises+new high-tech small and medium-sized enterprises", building a new pattern of resource supply at home and abroad, building a global technological innovation platform, and striving to improve the safety level of the supply chain of China's iron and steel industry [8].

Sixth, small and medium-sized profiled steel mills need to give full play to their initiative, flexibly seek changes in the monopolistic and competitive market, actively communicate with large

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enterprises, especially following the pace of state-owned enterprises, following the policy trend, and preventing disconnection from the market.

Seventh, in the new era, iron and steel enterprises should follow the policy concept of low carbon and environmental protection, abandon the traditional high-pollution production mode, introduce green and environment-friendly production technology, achieve carbon neutrality, and build an eco-industrial pattern that is friendly to society and environment. In order to encourage iron and steel enterprises to accelerate the process of environmental protection, the government provides financial support and subsidies for enterprises with outstanding achievements in environmental protection. It encourages other enterprises to follow suit actively.

Eighth, the steel industry needs to speed up the process of industrial transformation and upgrading. In the era of the digital economy, the digital transformation and service level of the manufacturing industry is the key factor in promoting and measuring the manufacturing industry's high-quality development [11]. The steel enterprises deepen the top-level design of digital strategy, seek common ground while reserving differences, explore the efficient transformation path, and create extraordinary enterprise wisdom.

Ninth, the steel industry should fully consider its capital capacity and production level and act according to its ability. Due to the nature of the monopoly competition market, the entry barrier of the steel market is very low, and almost every enterprise can easily enter. However, when the profitability is insufficient, and the enterprise wants to exit the industry due to losses, it will find that the exit barrier is very high and difficult to exit. Small and medium-sized enterprises can only operate in the industry with difficulty.

Tenth, the central government needs to play a leading role, and the local government should take active action. Due to the concentration of the distribution of steel raw materials, most of China's major steel towns are distributed in the three provinces in the northeast, as well as in Hebei Province and other regions. The local government should fully use the geographical and raw material advantages to assist the development of the local steel industry, set local policies and regulations, and ensure that the steel industry can benefit the local economy safely and stably.

Finally, the government should continue to promote the anti-malicious competition policy, set up administrative penalties, punish malicious competition enterprises, prevent enterprises at the top of the industry from crowding out other competitors by means of price reduction and other means, establish and improve the regulatory mechanism, and combine with the role of the market to play the best effect.

5. Conclusion

5.1. Findings

First, the scholar summarizes this paper's core content and achievements. Based on the game theory perspective, this paper confirmed that the monopoly market structure of the iron and steel industry significantly affected the price mechanism. Through in-depth research on the two research paths of large and small enterprises, upstream enterprises and downstream enterprises, the game tree was designed, and the expected value of the two paths was calculated. The monopoly market makes the large and upstream enterprises that occupy an important position almost play a decisive role in the small and downstream enterprises. Secondly, according to the research results, combined with the current situation of the steel industry, scholars put forward some policy recommendations conducive to the healthy and stable development of the steel industry from the perspective of large enterprises, small enterprises, and the government, which helped the transformation and upgrading of the steel industry.

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In today's society, China's steel industry faces difficulties in transformation and upgrading, and high pollution enterprises are limited, raw material prices continue to fluctuate, and other issues. The policy recommendations made in this paper based on the actual situation align with China's national conditions, which are conducive to the full play of the leading role of large steel enterprises, rational use of pricing power, and becoming the mainstay of steel enterprises. For small enterprises, it is beneficial to clarify their own positioning, give full play to their auxiliary role, not drift with the tide, and actively and flexibly respond to various situations. In addition, it also helps the government to play a role of supervision and guidance, assist the decisive role of the market, guide the stable and sustainable development of iron and steel enterprises, and make the prospects for the development of iron and steel enterprises broader.

5.2. Limitations and Future Study

The data in this paper is the real original primary data collected by scholars independently, including the price of steel raw materials, enterprise profits, and other datas, but it lacks the use of secondary data and uses the existing experience and research of other scholars. Future scholars will consider referring to existing data and icons for analysis to save analysis time and absorb the experience of other scholars.

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