Research on the Brand Mechanism of the Chinese Manufacturing Industry Upgrading Under the Constraints of Energy and Environment

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Abstract
The development of China's economy has achieved remarkable achievements that have attracted global attention, but currently, the development of China's manufacturing industry is under dual pressure from domestic environmental regulations and foreign value chains. There is an urgent need for appropriate paths for transformation and upgrading. How to transform and upgrade the manufacturing industry is a key challenge on the path of China's economic development. This article starts from the perspective of brand economics and uses brand economy theory to study the brand mechanism of upgrading China's manufacturing industry. It decomposes the energy output rate into scale effect, technology effect, and brand effect. The analysis focuses on the mechanism of enterprise brand effect on scale effect and technology effect. It concludes that the brand effect can mitigate the negative impact of the scale effect and enhance the positive impact of production technology, thereby improving the energy output rate and promoting the transformation and upgrading of the manufacturing industry. Finally, this article proposes three models for differentiated brand development for various types of manufacturing enterprises: the brand alliance model, the self-developed high-end brand model, and the brand acquisition model.

Keywords
Environmental regulation, manufacturing industry, upgrade, brand

1. Introduction
China's manufacturing industry has experienced 40 years of rapid development and achieved remarkable achievements that have attracted global attention. However, placing China's manufacturing industry in the context of the global economy, the current situation facing China's manufacturing industry is still severe, facing dual pressures from both domestic and foreign sources, as well as constraints from energy and the environment. On the domestic side, there is a problem of low-end supply structure in the manufacturing industry. Internationally, China's manufacturing industry is large but not strong.

Under the constraints of energy and environment, how to upgrade China's manufacturing industry is a challenge for its development. Energy productivity (EP) is a comprehensive indicator that reflects energy conservation, environmental protection, and production efficiency of enterprises. This article utilizes brand economy theory to break down the energy output rate into scale effect, technology effect, and brand effect from the perspective of Chinese enterprise energy output rate. It analyzes the mechanism through which Chinese manufacturing enterprises leverage brand-building effects on scale and technology effects to enhance energy output under energy and environmental constraints. Finally, it proposes brand development models for various types of manufacturing enterprises in China.
2. Literature Review

The upgrading of the manufacturing industry is a hot topic of concern for scholars from various countries. In China, relevant research mainly focuses on the impact of environmental regulations on China's manufacturing industry and the brand strategy of China's manufacturing industry upgrading. Research on the impact of environmental regulations on the manufacturing industry. Marx (2010) found that environmental regulations can drive technological research and development in enterprises. Wu Minjie et al. (2019) found regional heterogeneity in the impact of environmental regulations on the structural upgrading of China’s manufacturing industry. Ambec (2013) believes that reasonable environmental regulations are beneficial for enhancing the competitiveness of the manufacturing industry. Testa (2011) found that environmental regulations are not conducive to enhancing the competitiveness of manufacturing enterprises in the short term, but have a positive impact in the long term. Yu Donghua (2019) found that environmental regulations have a U-shaped impact on the transformation and upgrading of the manufacturing industry. Zhu Dongbo (2020) believes that environmental regulations have a negative impact on industrial upgrading. GONG (2020) found an inverted U-shaped relationship between environmental regulation and the transformation and upgrading of the manufacturing industry. Zhang Dongmin (2021) believes that environmental regulations will hinder the improvement of its competitiveness in the early stages of implementation. Wan Panbing (2021) found that environmental regulations can help reduce pollution emission intensity and improve production efficiency, driving manufacturing enterprises to achieve upgrading.

Existing literature has provided inspiration for this article, but there are still shortcomings in the research: (1) Most scholars believe that technological progress in supply under energy and environmental constraints is a key factor affecting the upgrading of the manufacturing industry. However, this article believes that brand building in-demand plays a more important role in the upgrading of the manufacturing industry; (2) The relevant literature does not delve into the different brand strategies for upgrading China's manufacturing industry. This article further explores the upgrading of China's manufacturing industry at the micro level of enterprises and analyzes the brand development models of different types of manufacturing enterprises.

3. Economic Analysis of Enterprise Brand Building

A brand comprehensively reflects the quality of a company's products and services, and is the credibility of the company's products and services. A higher brand credit can enhance consumers' loyalty to products and increase their acceptance of brand premiums. According to the theory of brand economy, product price $P$ and consumer choice cost $C_c$ jointly determine consumer product demand $Q$, and product brand credit $B$ determines consumer choice cost $C_c$. Therefore, the consumer demand function can be expressed as $Q=f\{P, C_c (B)\}$. In general, the higher the product price, the smaller the consumer demand, the higher the consumer selection cost, and the smaller the consumer demand. The higher the brand's credit rating, the stronger the product's premium ability, provided that other conditions remain unchanged.

$$\frac{dP}{dB}>0$$

![Figure 1. The mechanism of brand prevalence in brand construction.](image)

4. Mechanism Analysis of Improving Energy Output Rate through Enterprise Brand Building

How can Chinese manufacturing enterprises achieve industrial upgrading through brand building under the constraints of energy and environment? Due to the fact that energy output rate (EP) is a comprehensive indicator that reflects resource conservation, environmental protection, and production efficiency of enterprises, this article starts with the indicator of enterprise energy output rate to analyze the mechanism of manufacturing enterprises improving energy output rate through brand building.
4.1 Energy output rate model

The energy output rate of a company reflects the energy utilization efficiency in its production, usually measured by the economic value generated by consuming a unit of energy, with a unit of 10,000 yuan/ton of standard coal. Energy mainly includes raw coal, crude oil, natural gas, electricity, and other energy sources. As the value of this indicator increases, it indicates that the energy utilization efficiency of the company is improving. Expressed as:

\[ EP = \frac{G}{R} = \frac{PQ}{E} = \frac{P}{f^{-1}(Q,C,(B))}{g(T)} \]  

(1)

Among them, \( G \) represents the total output value of the enterprise, represented by the product of output \( Q \) and sales price \( P \); \( R \) represents the total energy consumption of the enterprise, expressed as the product of output \( Q \) and unit product energy consumption \( E \), where unit product energy consumption \( E \) is a decreasing function of production technology \( T \). Therefore, the energy output rate can be written in the form of formula (1), which shows that under other conditions remaining unchanged, the energy output rate of a company changes in the opposite direction to the energy consumption per unit product and in the same direction as the sales price of the product. This indicates that increasing the energy output rate of a company can be achieved by reducing the energy consumption per unit product or increasing the sales price of the product.

4.2 Decomposition of energy output rate: scale effect, technology effect, and brand effect

According to the energy output rate formula (1), \( EP \) is influenced by three variables: \( Q \), \( T \), and \( B \). Therefore, the change in energy output rate can be decomposed into three effects: the combined effect of scale effect, the technology effect, and the brand effect. The scale effect refers to the impact of changes in enterprise output scale on product prices and subsequently on energy output rates; The technological effect is the change in energy consumption per unit product caused by technological progress, which in turn affects the energy output rate; The brand effect is due to the impact of changes in corporate brand credit on product prices, which in turn affects energy output rates.

(1) Scale effect. The demand curve for enterprise products tilts downwards to the right, and the demand volume and sales price show a reverse change. If the production scale of the enterprise increases from \( Q_1 \) to \( Q_2 \), the sales price decreases from \( P_1 \) to \( P_2 \). According to formula (1), the energy output rate decreases, indicating that the expansion of the enterprise's production scale has a negative effect on the energy output rate.

(2) Technology effect. If the enterprise improves its production technology and the production technology increases from \( T_1 \) to \( T_2 \), as the energy consumption per unit product is a decreasing function of technological progress, \( E_2 < E_1 \). Formula (1) shows an increase in the energy output rate, indicating that technological progress in the enterprise has a positive effect on the energy output rate.

(3) Brand effect. In the demand function, \( dP/dB > 0 \). If a company conducts brand building and increases brand credit from \( B_1 \) to \( B_2 \), then there is \( P_2 < P_2 \). Formula (1) shows an increase in the energy output rate, indicating that increasing brand credit has a positive effect on the energy output rate.

4.3 The Mechanism of Brand Effect on Scale Effect and Technology Effect

The technological progress and brand-building of enterprises have a positive effect on the energy output rate, while the expansion of the production scale has a negative effect on the energy output rate. Through analysis, two important mechanisms can be identified.

(1) Mechanism 1: The situation where the energy output rate decreases due to the expansion of the production scale can be weakened through brand effect.

Due to the negative effect of enterprise-scale expansion on the energy output rate, while brand building has a positive effect on the energy output rate, the brand effect of enterprises can offset the negative effect of scale expansion on the energy output rate. Figure 2 depicts the mechanism of brand effect on scale effect. When a company's production scale expands from \( Q_1 \) to \( Q_2 \), the sales price decreases from \( P_1 \) to \( P_2 \). According to the scale effect, the expansion of the production scale reduces the company's energy output rate. If a company expands its production scale while building its brand, its demand curve shifts from \( D_1 \) to \( D_2 \). At this time, under the production scale conditions of \( Q_2 \), the company can set the sales price for \( P_3 \) based on the demand curve \( D_2 \). The sales revenue of the company increases from \( P_2Q_2 \) to \( P_3Q_3 \), and the brand effect improves the energy output rate of the company. Therefore, the brand effect can offset the
negative effect of enterprise expansion on energy output rate due to production scale.

![Figure 2. The transmission mechanism of brand effect weakening scale effect.]

(2) Mechanism 2: The situation where the energy output rate increases due to the advancement of production technology can be strengthened through brand effect. Due to the positive effect of enterprise technological progress on the energy output rate, and the positive effect of brand building on the energy output rate, the brand effect of enterprises can amplify the positive effect of technological progress on the energy output rate. Figure 3 describes the mechanism of enterprise brand effect on technology effect. When the demand curve of the enterprise is located at D1, and the technological progress of the enterprise increases from T1 to T2, the energy consumption curve per unit product shifts downward from E1 to E2. Therefore, based on the technological effect, technological progress improves the energy output rate of the enterprise. If a company moves its demand curve D1 to D2 while making technological progress, and the sales price increases from P1 to P2 while the production scale Q1 remains unchanged, the brand effect increases the company's energy output rate. Therefore, the brand effect amplifies the positive effect of the company's technological progress on energy output rate.

![Figure 3. The transmission mechanism of brand effect enhances technology effect.]

5. The Brand Building Model of Chinese Manufacturing Enterprises

(1) Enterprise brand alliance model. If the manufacturing industry enterprise’s own strength is still relatively limited and the brand awareness is low, the enterprise can partially compensate for its shortcomings by forming alliances with high-end brand enterprises to achieve upgrading from the low-end to the high-end. Enterprises should form alliances with companies with strong R&D and design capabilities or high brand influence, leveraging the influence of strong brands to enhance their product reputation, reduce consumer selection costs, and stimulate their potential purchasing intentions. (2) Enterprises independently develop high-end brand models. If manufacturing enterprises have a certain level of research and development design and market brand operation capabilities, they can adopt the model of independently developing high-end brands. This model can be divided into two situations. The first situation is that enterprises gradually abandon the low-end product market through brand building, and the overall product development is towards the high-end market. The second scenario is for enterprises to develop into the high-end product market while maintaining their low-end product business. (3) Enterprise brand acquisition model. The development of high-end brands has a long cycle and high risk. In order to save brand-building time and reduce brand-building risks, powerful large manufacturing enterprises can also achieve upgrading by acquiring foreign high-end brands. Whether to continue to leverage the advantages of high-end brands...
after mergers and acquisitions is the key to the success of the acquisition strategy. Therefore, the high-end brands after mergers and acquisitions must have a relatively independent operation stage in order to fully leverage the advantages of high-end brands.

6. Conclusion
This article uses the theory of brand economy to study the brand mechanism of China’s manufacturing industry upgrading, decomposing the energy output rate formula into scale effect, technology effect, and brand effect. It analyzes the mechanism of enterprise brand effect on scale effect and technology effect and concludes that brand effect can weaken the negative effect of scale effect and enhance the positive effect of production technology, ultimately improving energy output rate.

References