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Research on the impact of high quality manufacturing development on industrial structure upgrading

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Abstract: *The entropy method is employed to gauge the index of high-grade manufacturing industry growth in 30 provinces, cities, and autonomous regions from 2011 to 2020, and the double-fixed model is utilized to investigate the correlation between high-grade manufacturing industry growth and industrial structure upgrading. The upgrading of industrial structure is significantly and positively impacted by the high-grade production of goods. Analysis shows that Beijing has the highest manufacturing quality development index and Xinjiang has the lowest manufacturing quality development index. The degree of government intervention and economic development have a detrimental and considerable effect on industrial upgrading, whereas social consumption and financial growth have a beneficial and noteworthy effect. Consequently, several proposals are proposed to advance the industrial structure's advancement.*

Keywords: *High quality manufacturing development, Upgrading of the industrial structure, Entropy method, Double fixing formula*

1. Introduction

1.1 Research Background

In 2021, the 14th Five-Year Plan and 2035 Visionary Goals Outline clarified the core position of the manufacturing industry as the real economy. The manufacturing power strategy should be the focal point of this modern industrial system, and the acceleration of the manufacturing industry's high-quality development is a critical factor in augmenting the industrial structure's optimisation and upgrading.

However, with the acceleration of the global economic integration process, the inter-industry linkage is also becoming more and more close, and the "domino" effect is becoming more and more significant. The manufacturing industry also has problems such as being large but not strong, comprehensive but not excellent. The manufacturing industry's high-quality development is not only hindered, but the upgrading of the industrial structure may be detrimentally affected. The importance of examining and assessing the effect of high-grade manufacturing industry growth on the optimization and enhancement of industrial structure, and the realization of modern industrial system, is of great practical importance.

1.2 The connotation of high quality in manufacturing

The manufacturing industry, as the foundation of the country and the basis of a strong country. However, the definition of high-quality manufacturing development is still being explored by the theoretical community. Liutianen (2019) argues that quality development in manufacturing is dynamic and evolving with the times in order to meet the needs of a better human life [1].

1.3 The connotation of industrial restructuring

The proportion of primary, secondary and tertiary sectors in the national economy, as well as the internal allocation of each sector, is typically reflected in an industry, which reflects the relative relationship between the various sectors of the national economy. According to Jiang Zehua (2006), the upgrading of industrial structure covers three main aspects: firstly, the expansion of the output value and scale of the industry; secondly, the optimisation and upgrading of the structural level; and thirdly, the

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close linkage of the industry [2]. Yang (2009) states that sound economic development triggers the upgrading of industrial structure, and that the essence of development is the improvement of labour productivity and industrial efficiency [3].

1.4 Research related to the high quality development of manufacturing for industrial upgrading

1.4.1 The impact of manufacturing development on the upgrading of the industrial structure

Zhang Weiwei (2022) used an adjacency weight matrix to construct a spatial Durbin model to explore the spatial spillover effect of high-quality development of manufacturing on the transformation and upgrading of industrial structure, and found that high-quality development of manufacturing had a catalytic effect on the transformation and upgrading of industrial structure in both the region and the surrounding areas[4].Xia Qiu (2021) explored the impact of manufacturing servitization on industrial structure upgrading based on a mediating effect model and found that manufacturing servitization is beneficial to industrial structure, while technological innovation and service demand are its mediating channels[5].

1.4.2 The impact of high quality manufacturing on industrial development

Based on POI data, Tang Bo (2023) used kernel density analysis, spatial autocorrelation, and multiple linear regression to explore the spatial evolution and influencing factors of high-tech industries in Foshan, the only pilot city for comprehensive reform of manufacturing transformation and upgrading in China[6].Chen Gang (2023) analyses the problems faced by Guangzhou under today's high-quality modern industrial system, taking Guangzhou as an example, and proposes corresponding development suggestions[7].Tang (2020) empirically investigated the effect of industrial intelligence technology on industrial structural upgrading based on the relationship between industrial intelligence technology and industrial structural upgrading, using the estimation method of the spatial Durbin model, which found that industrial intelligence technology would significantly promote industrial structural upgrading, and under the spatial weight matrix of innovative talent flow, industrial intelligence technology had a significant positive spatial spillover effect on industrial structural upgrading[8].

In summary, the results of existing research on high quality development of manufacturing and industrial structure are quite fruitful. Little literature exists on the correlation between industrial structure upgrading and the development of high-quality manufacturing. This study employs the double-fixed formula and entropy method to thoroughly analyze the effect of high-grade manufacturing growth on industrial structure enhancement in each province, city, and autonomous region, with the aim of furnishing a benchmark for the further advancement of each province, city, and autonomous region's economy.

2. Model construction

2.1 Fixed effects regression models

The cyclical and phased nature of industrial upgrading often necessitates a lengthy period of time, and the quality of the manufacturing industry, economic growth, government involvement, social consumption, and financial progress vary between provinces, cities, and autonomous regions. Therefore, the inclusion of regional dummy variables in the baseline modeland time dummy variables, constructing a time-area bifixed model.

$$Q_{CR_{i,t}}=\beta_0+\beta_1 X_{debti,t}+\beta_2+\sum X_{controli,\,t}+\lambda_t+\mu_i+\varepsilon_{i,\,t} \quad (1)$$

2.2 Entropy method

This study employed the entropy method to calculate the weights of each indicator and measure the composite index of the sample, all while utilizing this method to measure the manufacturing quality development index.

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$$\begin{cases} Y_{it} = \sum_{j=1}^{n} W_j \times x'i_j \\ i = 1,2,\cdots,30;\ j = 1,2,\cdots,19 \\ t = 2011,2012,\cdots,2020 \end{cases} \quad (2)$$

Of which Y_{it} is the manufacturing quality development index of a province, city or municipality in a given year. x'_{ij} are normalized values. W_j are the indicator weights. t represents the year, j represents the index, i represents a province or autonomous region. The larger the composite index is, the higher the quality development level of the manufacturing industry is, and the lower it is.

2.3 Variable Description

2.3.1 Explained variables

From the viewpoint of industrial structure high plan, the measurement of Upg is mainly done by utilizing the industrial structure level coefficient to mirror the industrial structure evolution process of primary, secondary and tertiary industries; the formula for this is.

$$IS = \sum_{i=1}^{3} \frac{Y_i}{Y} \times i, i = 1,2,3 \quad (3)$$

where IS indicates an upgrade of the industrial structure. Y_i denotes the output value of industry i, Y for total output. If the result is larger, the more advanced the industrial structure upgrade tends to be.

2.3.2 Explanatory variables

Table 1: Manufacturing quality development evaluation index system

Guideline level	Tier 1 indicators	Secondary indicators	Properties
Strategic Foundations	Strategic Foundations	Industrial value added	+
Elemental inputs	Labour input	Number of employees in manufacturing	+
Innovation driven	Innovative environment	Share of science and technology expenditure	+
	Innovation input	R&D staff input intensity in manufacturing	+
		R&D investment intensity in manufacturing	+
Structural optimisation	Industrial structure	Share of main business income from high-tech industries	+
	Product structure	Percentage of revenue from new product sales	+
	Export structure	Share of exports of high technology products	+
Green development	Solids pollution	Solid waste emission intensity	-
	Wastewater pollution	Wastewater discharge intensity	-
	Atmospheric pollution	Exhaust emission intensity	-
Integrated development	Integration of two cultures	Internet penetration rate	+
		Share of mobile phone subscribers	+
Innovative results	Innovative outputs	Number of R&D expenses per unit of patent	-
		Number of patents granted per R&D personnel	+
		Technology market turnover per R&D personnel	+
Social effects	Environment	Percentage of expenditure on environmental protection	+
	Employment	Number of people employed in industry as a percentage	+
		Average wage growth of employed persons	+

Based on the principles of operability, comparability and systematization, this paper constructs an evaluation index system for the high-quality development of manufacturing industry covering 8 guideline levels and containing 14 primary indicators and 19 secondary indicators. The specific information is shown in Table 1.

2.3.3 Control variables

Variables of control encompass economic growth, governmental interference, social consumption, and financial advancement. The details are as follows. ①Level of economic development (Pgdp): GDP per capita; ②Level of government intervention (Gov): The ratio of public finance expenditure to GDP for the year expressed. ③Social Consumption (Sc): Total retail sales of consumer goods as a share of GDP for

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the year ④ Financial Development (Find): The ratio of financial sector value added to GDP for the year is expressed .

2.4 Data sources

In this paper, from a scientific and objective point of view, we choose data that are published continuously in the temporal dimension and indicators that are commonly used in all provinces, municipalities and autonomous regions in the spatial dimension. Relevant data from National Bureau of Statistics, China Statistical Yearbook, etc. The time span is 2011-2020 and the spatial span is 30 provinces, cities (except Hong Kong, Macao and Taiwan) and autonomous regions (except Tibet Autonomous Region) of China. Some of the indicator values are based on quadratic calculations, and individual data for individual years are missing and have been dealt with by interpolation.

3. Empirical Results and Analysis

Table 2's Part (1) provides the specific data for regressing the effect of the manufacturing industry's quality development on the industrial structure's enhancement. In Table 2, part (2) is the regression result after adding other control variables that may have an impact on the upgrading of the industrial structure.

Table 2: Baseline regression

Variables	Upg	
	(1)	(2)
Hqdmi	0.1375***	0.1127**
	(0.04480)	(0.0434)
Pgdp		-0.0092***
		(0.0024)
Sc		0.0795**
		(0.0343)
Gov		-0.1807**
		(0.0904)
Find		0.7828***
		(0.1909)
id	YES	YES
year	YES	YES
N	300	300

Note: ***, **, * indicate significant at 1%, 5%, and 10% significance levels respectively

From model (2) in table (2), it can be seen that the regression coefficient of higAt the 5% level, the positive and significant effect of high-quality development of manufacturing industry on industrial structure is evident, suggesting that such development is conducive to the upgrading of industrial structure. When the manufacturing industry's development is high, its tertiary sector is a significant contributor. The predominance of the tertiary sector, high technological content and good network infrastructure provide a strong impetus for upgrading the industrial structure.

A negative correlation between economic development and industrial structure is significant at the 1% level, suggesting that economic development has a detrimental effect on industrial structure. From this analysis, it is clear that this phenomenon may be due to a more serious mismatch between the current economic structure and the industrial structure.

Social consumption has a positive relationship with industrial structure and is significant at the 5% level, indicating a positive impact of social consumption on industrial structure. The analysis reveals that the alteration of the consumption structure is a major impetus for the alteration of the industrial structure, and the industrial restructuring will have a certain degree of influence on the consumption structure.

A negative correlation between government intervention and industrial structure is significant at the 1% level, implying that government intervention may not be a factor in the improvement of industrial structure.

A positive correlation and significance of 1% between financial development and industrial structure implies that the higher the level of financial development, the more advanced the industrial structure. Financial development can improve the external financing environment for enterprises by facilitating the deployment of capital in infrastructure projects and the flow of capital markets, thus leading to the upgrading of the industrial structure.

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4. Conclusions and recommendations

4.1 Conclusion

A system to gauge the quality advancement of the manufacturing sector, based on panel data from 30 provinces, autonomous regions and municipalities under the Chinese central government from 2011 to 2020, is constructed in this study. Employing entropy, the manufacturing industry's quality development indices are examined, and then the double fixed effect model is employed to investigate the correlation between quality development of the manufacturing sector and industrial structure upgrading and its associated influencing factors. The upgrading of industrial structure was found to be positively and significantly impacted by the quality development of manufacturing, financial growth, and social consumption, whereas the level of economic development and the degree of government intervention had a negative and significant effect.

4.2 Recommendations and shortcomings

Attention should be devoted to the innovation-driven role of core technologies in order to hasten the transformation and upgrade of China's manufacturing industry. The state and enterprises should foster a drive for manufacturing innovation development by intensifying the research and development of essential core technologies and augmenting the conversion rate of scientific and technological accomplishments.

Promoting the development of industrial integration is conducive to creating new competitive advantages in industry, so it is important to promote the deep integration of informatisation and industrialization, advanced manufacturing and modern service industries, and to improve and develop an information innovation system that combines industry, academia and research.

A good development environment is the basic condition for the high-quality development of the manufacturing industry. The government should improve the relevant mechanisms and institutions, remove the shortcomings of the institutional mechanism, provide a fair and competitive market environment and stimulate the vitality of the market economy.

This paper's research object is 30 provinces, autonomous regions and municipalities directly under the central government; however, the results are more general and thus, not applicable to each province or municipality. To review this paper, first and foremost. Secondly, due to the limitations of operability and technicality, the level of measurement of industrial structure in this paper is relatively limited, and there is still much room for progress. In the future, we may consider continuing to study the mechanism of the influence of high quality in manufacturing on the upgrading of industrial structure.

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