

# *The Promotion Mechanism of the Innovation Chain for Facilitating Premium Development in Manufacturing Industry*

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**Abstract:** The manufacturing industry constitutes the core of the real economy and serves as a fundamental pillar in constructing a modern economic system. The premium development in manufacturing industry is pivotal for attaining high-quality economic growth in the new era. Innovation is the primary driving force for premium development in manufacturing industry which plays a strategic supporting role. The present study constructs an evaluation index system of the innovation chain promoting the premium development in manufacturing industry. It comprehensively employs panel regression, mediating effect, and spatial econometric models to analyse the mechanism and impact of this innovation chain on promoting high-quality development in the manufacturing industry. The findings demonstrate that (1) The innovation chain plays a significant positive role in promoting the premium development in manufacturing industry; (2) The industrial chain plays a crucial role in facilitating the premium development in manufacturing industry, while the innovation chain further enhances this development by driving optimization and upgrading within the industrial chain.

## **1. Introduction**

Manufacturing is the cornerstone of the real economy, which in turn acts as the bedrock for China's development and plays a pivotal role in establishing strategic advantages for future growth. At present China's manufacturing scale has been the world's leading position for many years in a row. However, amid the backdrop of the new global manufacturing landscape, China's manufacturing sector still confronts fundamental challenges such as deficiencies in basic research and development and key core technologies, as well as a reliance on imported industrial development.

The premium development in manufacturing industry is the top priority for the high-quality development of China's economy. Innovation serves as the primary catalyst for propelling the premium development in manufacturing industry. Promoting the high-quality development of the industrial chain is a significant foundation for building a new development pattern. The innovation chain is a process from the original idea to product marketization, the industrial chain is the

interconnected form of production factors that are shaped based on the upstream and downstream relationships as well as the spatial layout of the production process. It serves as a tangible manifestation of innovative accomplishments. Currently, despite significant advancements in China's scientific and technological innovation capabilities, they still fall short of meeting the demands for high-quality economic development. The persistent issue of a "two-tiered" relationship between scientific and technological progress and economic growth persists [1]. The 20th CPC National Congress Report clearly proposed to "promote the deep integration of innovation chain with industrial chain. Therefore, promoting the organic matching and interactive integration of the innovation chain and the industrial chain has become an inevitable choice for China under the new situation.

Despite extensive research by numerous scholars on the definition, essence, and interconnections of the innovation chain and industrial chain, there remain gaps in our current understanding. To address these knowledge voids, the following inquiries are undertaken: Firstly, an examination of the influence of utilizing fixed effect models to assess the innovation chain's impact on the elevated progression of the manufacturing sector. Additionally, to gain a deeper comprehension of the inner workings of innovation integration, we utilize the intermediary effect model to meticulously inspect the intermediary function of the industrial chain in the correlation between the advancement of the innovation chain and the high-quality evolution of the manufacturing industry.

## 2. Theoretical Analysis and Research Hypotheses

The core of the innovation chain resides in the seamless integration of diverse innovative elements via various innovation activities. This integration ultimately leads to the creation of innovative products and services that are tailored to meet the demands of the market. Furthermore, it ensures the efficient allocation of innovation resources through market mechanisms, thereby fostering a dynamic and sustainable innovation ecosystem. In the theory of innovation-driven economic growth, endogenous R&D and innovation are the core factors driving economic growth and technological progress [2]. Ting W believed that measures to deepen innovation system reform, such as increasing innovation input and enhancing the dominant position of enterprises in innovation, are important transformation mechanisms to realize the new normal economic growth drivers [3]. Therefore, this paper puts forward hypothesis H1.

H1: The innovation chain exerts a significant positive influence on the high-quality advancement of the manufacturing industry.

To a certain extent, the premium development in manufacturing industry refers to the continuous expansion of industrial scale, optimization of industrial layout, reasonable structure, continuous transformation and upgrading, and significantly improving the benefits of industrial development [4]. Bi J believes that building a modern industrial system around the real economy is the only way to build advanced manufacturing industry and promote high-quality development [5]. Huang H believes that only by accelerating the construction of a modern industrial system and building a complete and resilient industrial chain and supply chain can industrial security, economic security and national security is firmly in their own hands [6].

Industrial development is a stepping stone for scientific and technological innovation, and scientific and technological innovation can transform the results of the innovation chain into economic benefits. Scientific and technological innovation is the first driving force leading development, and modern industry is an important player in development. Overall, it can be seen that promoting the integrated development of industrial chains and innovation chains is an inevitable choice for China to enter a new development stage, promote the transformation of China's economic development from element-driven to innovation-driven and achieve the

transformation of China's manufacturing industry from large to strong. Hypotheses H1 and H2 are therefore proposed.

H2: The industrial chain exerts a significant positive influence on the high-quality advancement of the manufacturing industry.

H3: The industrial chain plays a mediating role in the impact of the innovation chain on the premium development in manufacturing industry

### **3. Data Description and Model Setting**

#### **3.1. Source of Data**

The research period of this paper spans from 2015 to 2021, encompassing a total of 30 provinces in China (excluding Hong Kong, Macao, and Taiwan) establish panel data. The main data sources include China Statistics Yearbook, the Yearbook of Chinese Science and Technology, Chinese Fiscal and Technological Yearbook, and the National Bureau of Statistics and CSMAR databases. Missing data were completed by linear interpolation.

#### **3.2. Variable Selection and Description**

##### **3.2.1. Outcome variable: premium development in manufacturing industry.**

The concept of high-quality development encompasses a comprehensive and intricate set of factors, making it difficult to accurately measure by a single index. Therefore, this paper establishes a comprehensive evaluation system for the manufacturing industry's high-quality development based on eight primary indicators: growth scale, innovation-driven approach, structural optimization, integration of information and industrialization, brand quality, green development, and open development. The measurement is conducted through the entropy method and entropy weight method.

##### **3.2.2. Explanatory variable: innovation chain**

Drawing upon scientific principles, systematic methodology, and available data, the evaluation index system for the innovation chain is constructed encompassing three primary dimensions: investment in innovation, outcomes of innovation, and the value generated through innovation.

##### **3.2.3. Intermediary variable: industrial chain**

This paper drawn on previous research, constructs the industrial chain evaluation index system from three aspects: industrial base, industrial economic benefits, industrial environmental protection.

##### **3.2.4. Control variables**

To mitigate the influence of extraneous variables on the premium development in manufacturing industry, the following control variables have been carefully chosen: the economic development level, educational attainment, the extent of governmental involvement, and the rate of urbanization.

### 3.3. Model Building

#### 3.3.1. Benchmark regression model

In order to empirically analyze the impact of innovation chain on premium development in manufacturing industry this paper selects the premium development in manufacturing industry as the outcome variable, the innovation chain as the explanatory variable. The panel fixed regression model as shown in Equation (1) is constructed.

$$manufacturing_{it} = a_0 + a_1 innovation_{it} + a_2 Controls_{it} + u_i + \theta_t + \varepsilon_{it} \quad (1)$$

Where manufacturing it represents the high-quality development level of the manufacturing industry in province i in year t. innovation it represents the development level of the innovation chain of province i in year t. Controls it is the control variable, including economic development level, education level, government intervention and urbanization level.  $a_0$  is the constant term,  $a_1$  is the coefficient of explanatory variable and control variable,  $u_i, \theta_t, \varepsilon_{it}$  represent the province fixed effect, year fixed effect and error disturbance term respectively.

#### 3.3.2. Mediating effect model

In order to further verify the influence path of innovation chain on premium development in manufacturing industry Equation (2) and Equation (3) are constructed as follows:

$$manufacturing_{it} = b_0 + b_1 innovation_{it} + b_2 Controls_{it} + u_i + \theta_t + \varepsilon_{it} \quad (2)$$

$$industry_{it} = c_0 + c_1 innovation_{it} + c_2 Controls_{it} + u_i + \theta_t + \varepsilon_{it} \quad (3)$$

Where industry it is the mediating variable, representing the industrial chain level of province i in year t, and other variables are the same as in Equation (1)

## 4. Empirical Analysis

### 4.1. Benchmark regression

Table 1: Innovation chain benchmark regression

	manufacturing					
	(1)	(2)	(3)	(4)	(5)	(6)
	model1	model2	model3	model4	model5	model6
innovation	0.6070*** (0.0141)	0.3754*** (0.0219)	0.5946*** (0.0212)	0.3593*** (0.0230)	0.3483*** (0.0244)	0.6088*** (0.0204)
Province fixed	No	Yes	No	Yes	No	Yes
Time fixed	No	Yes	No	Yes	Yes	No
_cons	0.1794*** (0.0039)	0.2064*** (0.0085)	0.2338* (0.1350)	-0.6163*** (0.2329)	-0.0436 (0.1823)	0.0523 (0.1343)
N	210	210	210	210	210	210
adj.R <sup>2</sup>	0.8985	0.9856	0.9035	0.9870	0.9849	0.9130

The benchmark regression model is employed to investigate the correlation between the innovation chain and the enhanced development of the manufacturing industry. The outcomes of the regression analysis are detailed in Table 1. Without incorporating any control variables, Columns (1) and (2) of Table 1 present the regression findings. Specifically, Column (1) reveals a coefficient value of 0.6070 for the innovation chain, which carries a statistical significance at the 1% level.

Column (2) demonstrates the results from the fixed-effect model, where the coefficient for the innovation chain stands at 0.3754, also significant at the 1% level. When all control variables are included, Column (3) showcases the multiple regression results, with the innovation chain coefficient being 0.5946, significant at the 1% level. Columns (4), (5), and (6) exhibit two-way fixed, year fixed, and provincial fixed regression results, respectively, with coefficient values of 0.3593, 0.3483, and 0.6088 for the innovation chain. All three regression coefficients maintain a 1% significance level. In conclusion, the maturity of the innovation chain positively impacts the high-quality progression of the manufacturing industry, thereby validating Hypothesis 1.

#### 4.2. Mediating Effect Regression

In this paper, a two-step approach is employed to investigate the mediating role of the industrial chain. Initially, we assess the significance of the relationship between the innovation chain and the premium development in manufacturing industry. Subsequently, we analyze the significance of the association between the innovation chain and the industrial chain. Ultimately, we delve into the influence exerted by the industrial chain on the premium development in manufacturing sector, thereby elucidating the mediating mechanism at play.

As shown in Column (1) of Table 2, the coefficient of the innovation chain exhibits a significant impact at the 1% level, suggestive of its ability to foster the premium development in manufacturing industry. Similarly, in Column (2), the innovation chain coefficient maintains its significance at the 1% level, indicating a marked contribution to the enhancement of the industrial chain's level. Consequently, Hypothesis H2 is confirmed.

Table 2: Intermediary effect of industrial chain

	(1)	(2)
	manufacturing	industry
innovation	0.359*** (15.63)	0.148*** (3.89)
_cons	-0.616** (-2.65)	-0.149 (-0.39)
<i>N</i>	210	210
Controls	Yes	Yes
Province fixed	Yes	Yes
Time fixed	Yes	Yes
adj. <i>R</i> <sup>2</sup>	0.99	0.98

#### 4.3. Analysis of Heterogeneity

Due to the varying environmental conditions and resource stock levels across different regions in China, this paper employs a regional heterogeneity test method to analyze how innovation chains in these regions facilitate the premium development in manufacturing industry. The paper classifies China into the eastern, central, and western regions, with the research findings corresponding to the columns in Table (1)~(3). The regression results in Table 3 reveal that the promotion effect of innovation chain development in the western region on high-quality manufacturing industry is statistically insignificant. However, the influence coefficients of innovation chain in the eastern and central regions exhibit positive effects on high-quality manufacturing industry at significance levels of 1% and 10%, respectively.

This indicates that innovation chain in the eastern and central regions positively contributes to

promoting high-quality manufacturing industry.

Table 3: Results of heterogeneity analysis

	(1)	(2)	(3)
	manufacturing		
	East	Middle	West
innovation	0.3986*** (0.0271)	0.1493* (0.0869)	0.1183 (0.0838)
Controls	Yes	Yes	Yes
_cons	-0.5809* (0.3118)	-1.8999*** (0.5548)	-0.4890 (0.4128)
Province fixed	Yes	Yes	Yes
Time fixed	Yes	Yes	Yes
<i>N</i>	77	56	77
adj. <i>R</i> <sup>2</sup>	0.9942	0.9297	0.9206

#### 4.4. Robustness Test

The robustness of the research conclusions is tested using various methodologies in this paper. To mitigate the potential confounding effects of reverse causality, this paper introduces the explanatory variable lagged by one period as a new explanatory variable for regression. The findings from Column (1) demonstrate that the one-period-lagged innovation chain level continues to facilitate the premium development in manufacturing industry. The purpose of Column (2) is to reduce the time period for benchmark regression to 2016-2020, and the estimated result shows a positive effect with a significance level of 1% (Table 4).

Table 4: Robustness test results

	(1)	(2)
	L.innovation	Reduced time
L.innovation	0.3363*** (0.0264)	
innovation		0.3581*** (0.0623)
_cons	-0.7546*** (0.2644)	-0.4838 (0.4436)
Province fixed	Yes	Yes
Time fixed	Yes	Yes
<i>N</i>	180	150
adj. <i>R</i> <sup>2</sup>	0.9884	0.9887

## 5. Summary and Suggestions

### 5.1. Summary

This paper empirically investigates and comprehensively assesses the internal mechanisms of the innovation chain to promote quality growth in China's manufacturing sector using panel regression and mediation effect models. Based on panel data covering 30 provincial administrative regions from 2015 to 2021, the analysis provides important insights. The findings show that (1) the innovation chain plays an important role in facilitating the development of the manufacturing

premium. (2) Industrial chains facilitate the development of the high-end of the manufacturing sector. Innovation chains facilitate the development of the high-end of manufacturing by optimizing the structure of the industrial chain.

## 5.2. Suggestions

### 5.2.1. Improved the overall efficiency of the innovation chain.

The government should prioritize scientific and technological innovation as its central objective, strategically allocate and optimize the distribution of scientific and technological resources, comprehensively coordinate various resource elements such as land and capital, and establish a deeply integrated system for scientific and technological innovation. The government should proactively attract and integrate high-caliber professionals. Because innovation-driven is essentially talent-driven. Enterprises should establish and enhance the innovation management mechanism and R&D management system, while bolstering the overall independent innovation capability through talent cultivation and fostering industry-university-research collaboration.

### 5.2.2. Modernize industrial chains and deepen the integration of innovation chain and industrial chain.

The government should promote the modernization of the industrial chain by consolidating the general industrial foundation, enhancing financial support, improving personnel quality, respecting and protecting nature, as well as supplementing and extending the chain based on new data elements. The government should actively support the research and development of pivotal segments within the industrial chain, as well as core technologies within the innovation chain, in order to overcome barriers between these chains and achieve a more profound integration. Enterprises should enhance collaboration with upstream and downstream counterparts to establish an industrial ecosystem, strengthen partnerships with domestic and international universities and research institutions, and incorporate cutting-edge technology and management expertise, thereby achieving the optimization of overall enterprise structure.

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## References

- [1] Wu Q, Hu L, Jiang Z. *Integration Development of Industrial Chain and Innovation Chain: Connotation, Motivation and Path*. *Nanjing Journal of Social Sciences*, 2024, 24(02): 27-37. DOI:10.15937/j.cnki.issn1001-8263.2024.02.004.
- [2] Ren B, Li Y. *Power Transformation of China's Economy from High Speed Growth to High Quality Development in the New Era*. *Review of Economy and Management*, 2019, 35(1): 5-12. DOI:10.13962/j.cnki.37-1486/f.2019.01.001.
- [3] Ting W, Lizhu Z. *Theoretical and path analysis of China's economic growth momentum transformation under the new normal*. *Contemporary Economics*, 2018, 17: 11-13. DOI:10.3969/j.issn.1007-9378.2018.17.003.
- [4] Bi J. *Accelerate the construction of a new development pattern and strive to promote high-quality development*. *Qingdao Daily*, 2022, 11(02): 56-76. DOI:10.28617/n.cnki.nqdrb.2022.004283.
- [5] Huang X, Jiang Y. *Creating a New Development Pattern and Pursuing High-quality Development*. *Social Sciences in Chinese Higher Education Institutions*, 2024, (1): 62-69. DOI:10.3969/j.issn.2095-5804.2024.01.007.
- [6] Huang H, Sheng C. *Characteristics, evolutionary laws, and construction approaches of modern industrial system*. *China Soft Science*, 2023, (10): 1-8. DOI:10.3969/j.issn.1002-9753.2023.10.001.