

Research on the Dynamic Interaction Between New Quality Productive Forces and Industrial Structure Optimization

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Abstract: Amidst the qualitative transformation and advancement of China's economy, the optimization of novel quality productive forces and industrial structures has emerged as a pivotal driver of economic growth. Utilizing panel data from 30 provinces in China spanning 2012 to 2022, this study constructs a panel vector autoregressive (PVAR) model to empirically investigate the bidirectional interaction between industrial structure optimization and new quality productive forces. By transcending the traditional static research framework, this analysis explores the short-term fluctuations and dynamic adjustments inherent in the economic transformation process. The findings reveal that while the upgrading of industrial structure initially exerts an inhibitory effect on new quality productive forces, this influence gradually becomes positive as adaptation to technology and policies progresses. Furthermore, the rationalization of the industrial structure promotes the growth of new quality productive forces by enhancing resource allocation efficiency and leveraging industrial synergy effects. This study underscores the importance of addressing transitional challenges and technological adaptation in the short term to ensure the smooth progression of economic transformation. Based on these insights, the article proposes policy recommendations, particularly emphasizing the reinforcement of scientific and technological innovation and the facilitation of digital transformation among small and medium-sized enterprises, to achieve more stable and sustainable economic growth.

Keywords: new quality productive forces, industrial structure optimization, economic growth

1. Introduction

Amid significant changes in the global economic framework and the rapid establishment of a new "dual circulation" development model both domestically and internationally, the enhancement of productive forces and the optimization of industrial structures have emerged as key drivers of China's high-quality economic growth. To sustain a competitive advantage in the intense global market and achieve superior economic development, China must leverage scientific and technological advancements to propel industrial innovation, foster new competitive strengths through industrial upgrades, and expedite the development of high-quality productive forces. These new productive forces, focused on technological innovation, transform the fundamental principles of production efficiency through advancements in workforce quality, intelligent reorganization of production elements, and a shift towards green, low-carbon practices. Concurrently, industrial structure optimization is characterized by the dual processes of upgrading and rationalization, which involve climbing the industrial value chain and enhancing resource allocation efficiency. Together, these

elements constitute the "one body, two wings" framework for economic transformation and advancement.

As reported in the "Report on the Development of the Digital Economy in Chinese Cities," China's digital economy surpassed 50 trillion yuan in 2023, making up 41.5% of the GDP. Despite the growth of strategic emerging industries, the digital transformation rate among small and medium-sized enterprises (SMEs) remains low, and regional productivity disparities are increasing. This underscores the need to investigate the dynamic mechanisms of new quality productive forces and the optimization of industrial structures. These are not only theoretical concepts for achieving an innovation-driven development strategy but also crucial for addressing the "transition anxiety" of SMEs and fostering coordinated regional development. Although the road to digital transformation for SMEs is long, the iterative progress of new quality productive forces and their expanding application scope are expected to create new opportunities and scenarios for enterprise development [1].

The emergence of advanced productive forces is fundamentally propelled by breakthroughs in technology, which catalyze transformative improvements in production capabilities through industrial modernization and the strategic reorganization of key inputs. Scholar Nanan Li's analysis highlights that these next-generation productive forces exhibit distinct attributes, including cutting-edge innovation, digital intelligence, and environmental sustainability. When firms adopt state-of-the-art manufacturing technologies and optimized operational methods, they achieve substantial gains in operational performance while simultaneously facilitating comprehensive restructuring within industrial frameworks [2]. Such evolution not only elevates conventional sectors toward sophisticated value chains but also creates favorable conditions for nascent industries to flourish. Contemporary production paradigms are undergoing a significant transition, moving away from reliance on manual labor and heavy capital investment toward smarter, eco-friendly, and highly efficient approaches. As emphasized by researcher Baoping Ren, the progressive nature of technological advancement serves as the primary catalyst for these modern productive forces, enabling substantial enhancements through both technical discoveries and thorough reorganization of supply networks [3]. Within the current wave of technological transformation, innovation is universally acknowledged as the central element powering the evolution of these advanced production systems. The growing prevalence of automated, data-driven, and intelligent manufacturing processes is progressively displacing conventional techniques, marking a new era where industrial progress is fueled by continuous innovation. Furthermore, the rapid expansion of next-generation sectors, particularly in digital and sustainable economies, is accelerating the modernization of traditional industries. This dynamic contributes to more profound refinements in the overall industrial architecture [4].

The optimization of industrial structures plays a pivotal role in facilitating China's shift toward a more advanced economic model. This transformation entails a progressive and sustained effort encompassing technological advancement, industrial modernization, and more efficient utilization of resources [5]. At the macroeconomic level, the pursuit of high-quality growth is marked by diminished cyclical fluctuations and sustained expansion. The progressive refinement of industrial frameworks serves to dampen economic instability while elevating overall productive efficiency. Furthermore, it accelerates the integration of cutting-edge innovations, including AI and digital connectivity, thereby enhancing corporate operational capabilities and managerial sophistication. Such developments strengthen economic robustness, enabling greater resistance to global uncertainties. Nevertheless, the enhancement of next-generation productive forces faces considerable obstacles, including the substantial financial burdens and inherent uncertainties of technological R&D, delays in workforce skill development, and the intricate nature of structural realignment within industries. These challenges underscore the complexity of achieving meaningful progress in this domain.

New quality productive forces have the potential to optimize industrial structure, but there are financial and technical barriers to their growth. Talent shortages, financial limitations, and high technical obstacles have made it difficult for many conventional businesses to change. Furthermore, resources are frequently not directed toward the most worthwhile initiatives, which results in waste and lost chances. Therefore, businesses must maximize resource allocation, fortify industrial chain coordination, and raise managerial levels in addition to relying on technological innovation to foster new, high-quality productive forces. In order to promote technical innovation, industrial upgrading, and ecological growth, policy assistance is equally important.

China's industrial structure upgrading has intensified and produced phased results in the new development stage. There are still issues, nevertheless, such as the low degree of industrial structure greenness, the need to enhance integrated R&D capabilities, and a lack of technical innovation capabilities. Even though scholarly studies have made great strides in comprehending the development of industrial structure and new quality productive forces, they frequently use a static theoretical framework and concentrate on long-term equilibrium states. Economic systems are not always in balance in practice, and industrial development frequently entails "creative destruction," in which new industries and technology upend established institutions, resulting in transient volatility and uncertainty. Additionally, conventional research approaches frequently ignore the intricate interaction between industrial structure optimization and new quality productive forces in favor of viewing it as a linear process.

In order to overcome these constraints, this study presents dynamic research methodologies and analyzes the dynamic relationship between industrial structure optimization and new quality productive forces using a panel vector autoregressive model. The model incorporates lagged variables to account for short-term variations, including the effect of rationalization and upgrading of industrial structures on new quality productive forces in the early phases of economic transition. Productivity fluctuations during industrial structure transformation may result from short-term technology adaptation and industrial adjustment phases, according to this dynamic analysis.

2. Methodology

2.1. Model

This paper employs the Panel Vector Autoregression (PVAR) model to explore the dynamic relationship between new quality productivity and industrial structure optimization [6]. The PVAR model incorporates lagged terms based on panel data, enabling it to capture dynamic effects across time and cross-sectional data. Unlike traditional panel data regression models, the PVAR model can simultaneously consider endogeneity and feedback effects among multiple variables, making it suitable for studying situations where variables interact with each other. The specific model is as follows:

$$y_{it} = \alpha_0 + \sum_{j=1}^k \alpha_j y_{i,t-j} + \gamma_i + \theta_t + \varepsilon_{i,t}$$

Here, i represents the province, t represents the year, p indicates the lag order, y_{it} represents the column vector of endogenous variables, including new quality productivity, upgrading of industrial structure and rationalization of industrial structure, α_0 is the intercept term, α_j represents the parameter matrix of lag j order, γ_i represents the fixed effect term, reflecting the heterogeneity of individuals, θ_t represents the time effect term, reflecting the impact of time changes on individuals, and $\varepsilon_{i,t}$ is the random disturbance term.

2.2. Variables

2.2.1. Measurement of new quality productivity

The advancement of next-generation productive capabilities reflects a fundamental transformation in the synergistic integration of production elements - including workforce, capital goods, subject materials, and their dynamic interrelations - exhibiting robust growth potential. Building upon the methodological framework established by Jue Wang and Rongji Wang [7], we further elaborate from three main dimensions: new quality laborers, new quality labor objects and new quality production materials. The construction of the comprehensive evaluation indicators is shown in Table 1. The entropy weight method is adopted to calculate the new quality productivity.

Table 1: Comprehensive evaluation index of new quality production forces

Dimension	Indicators	Measurement method
New type of laborer	Educational attainment	Average years of education
	Labor force human capital structure	The labor force educational attainment is classified into 5 grades, and the vector angle is used to measure it.
	Per capita GDP	Per capita GDP/Gross population
	Per capita wage	On-the-job employee wage (yuan)
	Employment concept	Proportion of third industry employees in total employment
	Entrepreneurship concept	Entrepreneurial activity: Number of new enterprises per hundred people
Subject of new quality labor	Strategic emerging industries	Technology market transaction volume
	The intensity of environmental protection	Environmental protection expenditure / Government public finance
Newly produced means of production	Traditional infrastructure	Railway mileage
	Digital infrastructure	Fiber length
	Unit energy consumption	Energy consumption/GDP
	Per capita patent quantity	Number of patent authorizations per capita / Total population
	R&D investment	R&D expenditure / GDP
	Digital economy	Digital economy index
	Enterprise digitalization	Enterprise digitalization level

2.2.2. Measurement of industrial structure optimization

Regarding the aspect of industrial structure optimization, this paper measures industrial structure optimization from two aspects: the upgrading of industrial structure (ais) and the rationalization of industrial structure (theil) [8].

For the upgrading of industrial structure, this paper adopts the approach of Yonghui Han et al. [9] and calculates it by using the ratio of the output value of the tertiary industry to that of the secondary industry. The larger the value of ais is, the more advanced the industrial structure is.

For the rationalization of industrial structure, the deviation degree of structure is adopted to measure it. The specific formula is as follows:

$$E = \sum_{i=1}^n \left| \frac{Y_i/L_i}{Y/L} - 1 \right| = \sum_{i=1}^n \left| \frac{Y_i/Y}{L_i/L} - 1 \right|$$

Where E represents the deviation degree of structure, Y represents the output value, L represents the employment, i represents the industry, and n represents the number of industrial sectors. The larger the E value is, the more it deviates from the equilibrium state, and the less reasonable the industrial structure is. For the convenience of subsequent analysis, it is processed by taking the negative value, which is recorded as theil. The larger the value of theil is, the more reasonable the industrial structure is.

3. Empirical analysis

3.1. Determining the stationarity test and the determination of the lag order

To verify the robustness of our regression analysis, we employed four distinct stationarity testing approaches to thoroughly examine the panel dataset. The detailed outcomes of these tests are displayed in Table 2. Initial test results for all variables were unable to reject the null hypothesis, suggesting the presence of non-stationary characteristics in the raw data. Consequently, we applied first-order differencing to each variable and repeated the stationarity examinations. The transformed data demonstrated significant results, with all variables rejecting the null hypothesis at $p < 0.01$, confirming the achievement of stationarity across all time series. These findings justify our subsequent methodological approach of utilizing the first-differenced variables for constructing the PVAR framework, which enables us to systematically investigate the dynamic interactions between the examined variables.

Table 2: Stationarity test

Variable	IPS test	LLC test	HT test	ADF test	Test conclusion
ngp	0.9962	0.9964	0.0001***	0.9999	Non-stationary
ais	0.3871	0.0000***	0.5929	0.0193**	Non-stationary
theil	0.6871	0.0000***	0.9913	0.0000***	Non-stationary
dnqp	0.0000***	0.0000***	0.0000***	0.0000***	Stationary
dais	0.0000***	0.0000***	0.0000***	0.0000***	Stationary
dtheil	0.0000***	0.0000***	0.0741*	0.0000***	Stationary

In order to ensure the accuracy and validity of the model, before constructing the PVAR model, this paper first determines the optimal lag order. This paper adopts the consistent moment model selection criterion proposed by Andrews and Lu[10] to determine the lag order. According to the results in Table 4, when the model lags by one order, the MBIC, MAIC and MQIC values all reach the minimum. Therefore, the lag order of one is selected as the optimal lag order to ensure that the model can accurately reflect the dynamic relationship between variables.

Table 3: Determination of the optimal lag order

Lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	0.9716	54.0283	0.25505	-175.771*	-41.9717*	-96.3083*
2	0.9493	39.8446	0.16057	-113.3551	-24.1554	-60.3798
3	0.2276	19.30145	0.25334	-57.2984	-12.6986	-30.8108

3.2. The results of GMM estimation

Construct a model to analyze the relationship between new quality productive forces and the upgrading and rationalization of industrial structure. If the traditional ordinary least squares method is adopted, the estimation results may be biased. Considering the endogeneity problem of variables, the GMM model is used for generalized method of moments estimation. The results are shown in Table 4.

Table 4: The results of GMM estimation

	h_dnqp	h_dais	h_dtheil
L.h_dnqp	-0.5586	1.2736	0.8873
L.h_dais	-0.0506***	0.3968***	0.2561***
L.h_dtheil	0.0134**	0.0216	0.3045***

Next, conduct a stability test on the PVAR model. As shown in Figure 1, all the characteristic roots of the model are located within the unit circle. This result indicates that the model is stable. This ensures that the established PVAR model can accurately reflect the interaction relationships among variables in the long term, further enhancing its reliability and effectiveness in practical economic issues.

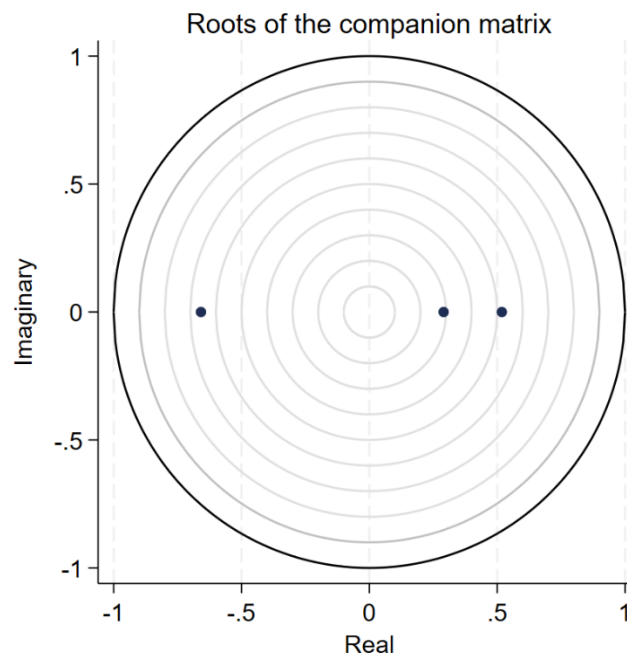


Figure 1: The results of the model stability test

3.3. Granger causality test

The Granger causality test was used to investigate the causal relationship between the upgrading of industrial structure, the rationalization of industrial structure, and the new quality productive forces. Table 5 displays the findings.

Table 5: Granger test results

Variable	Causal Relationship	chi ²	P	Test conclusion
New quality productive force	Industrial structure upgrading is not the cause	9.467	0.002	Reject
	Industrial structure rationalization is not the cause	2.161	0.142	Acceptance
	All variables are not the cause	15.011	0.001	Reject
Industrial structure upgrading	New quality productive force is not the cause	0.831	0.362	Acceptance
	Industrial structure rationalization is not the cause	0.162	0.687	Acceptance
	All variables are not the cause	0.900	0.638	Acceptance
Industrial structure rationalization	New quality productive force is not the cause	1.091	0.296	Acceptance
	Industrial structure upgrading is not the cause	9.725	0.002	Reject
	All variables are not the cause	9.753	0.008	Reject

4. Conclusion

Table 4 reveals a significant negative correlation (at the 1% level) between the first-order lag of industrial structure upgrading and the level of new quality productive forces. This suggests that, in the short term, advancements in industrial restructuring may temporarily suppress the growth of new quality productivity. Such upgrading typically involves adjustments to industrial chains, the adoption of technological innovations, and organizational restructuring within enterprises. During the transitional phase, these systemic changes can lead to productivity fluctuations and delays in adapting to new technologies. For instance, when transitioning from traditional manufacturing to high-tech industries, enterprises and workers require time to assimilate advanced production methods, while the phasing out of legacy industries may result in underutilized resources and labor mismatches. These factors collectively hinder the immediate enhancement of new quality productive forces, particularly during the initial stages of transformation.

Conversely, the first-order lag of industrial structure rationalization demonstrates a positive correlation with new quality productive forces at the 5% significance level. Rationalization enhances productivity by optimizing resource allocation and fostering inter-industry synergy. Specifically, it facilitates the exit of inefficient industries and redirects resources toward innovative, high-value sectors such as information technology and green industries. This reallocation not only eliminates structural redundancies but also accelerates technological diffusion through innovation clusters. Furthermore, enhanced coordination across industrial chains amplifies complementary advantages among sectors, thereby elevating overall production efficiency and sustaining the momentum of new quality productive forces.

Notably, the lagged term of industrial structure upgrading exhibits a significant positive impact (1% level) on industrial rationalization. Upgrading, characterized by an increased share of technology-intensive and capital-intensive industries, strengthens resource optimization mechanisms. For example, the expansion of advanced manufacturing drives technological upgrades in upstream and downstream industries, while the growth of modern services enhances industrial network resilience through specialized divisions of labor. These dynamics collectively promote a more balanced and coordinated industrial structure.

Our empirical analysis reveals a unidirectional Granger causal relationship running from industrial structural transformation to advanced production capabilities, suggesting that structural upgrading serves as a fundamental driver of productivity evolution. The mechanism operates through two primary channels: first, the increasing dominance of technology-intensive and high value-added sectors creates endogenous incentives for innovation; second, this structural shift facilitates knowledge economy development through enhanced specialization and learning effects. These transmission channels collectively elevate the economy's overall productive efficiency. Existing literature corroborates these findings. Wanyuan Liu and Lei Ji [11] proposed in their research: "The deep upgrading transformation of industrial structure is the key to generating new quality productive forces. Accelerating the formation of new quality productive forces requires optimizing the layout of productive forces." Yinxing Hong and Kunyi Wang [12] identify "breakthrough innovations and their sectoral implementation through value chain reorganization" as the core mechanism. These scholarly perspectives confirm that industrial upgrading functions not merely as an environmental factor, but rather as an active catalyst that systematically transforms production paradigms through technological diffusion and industrial recomposition. The evidence collectively demonstrates that structural advancement initiates a virtuous cycle where industrial modernization begets technological progress, which in turn reinforces productivity gains - establishing industrial upgrading as both necessary and sufficient for developing advanced production systems.

The upgrading of industrial structure exhibits a significant Granger causality effect on the rationalization of industrial structure, underscoring the reciprocal relationship between the optimization and coordination of industrial structures. This upgrading, particularly through the advancement of high-tech and modern service industries, not only enhances the added value and technological sophistication of various sectors but also improves resource allocation among industries, thereby optimizing the overall coordination of the industrial framework. This mechanism facilitates further progress in the rationalization of industrial structure, steering the economy towards a more efficient and sustainable trajectory.

Conversely, our analysis reveals an important asymmetry: while industrial upgrading drives productivity gains, the reverse causal pathway appears statistically insignificant. This finding suggests that although advanced production capabilities fundamentally enable technological progress and industrial development, their structural effects operate through longer-term temporal channels. The immediate manifestations of productivity improvements are typically confined to operational efficiencies and innovation outputs, whereas meaningful industrial reorganization requires extended periods for technology diffusion, capital redeployment, and institutional adaptation. This temporal disconnect implies that the structural impacts of productivity advances follow a J-curve trajectory: initial investments in productive capacity must first mature through learning processes and network effects before catalyzing industrial rebalancing. The delayed transmission mechanism helps explain why our short-to-medium term analysis failed to detect significant structural effects, even as theoretical models predict eventual transformation. These findings align with evolutionary economic theories emphasizing the path-dependent nature of industrial change, where productivity shocks require institutional and technological co-evolution to manifest structural impacts. The policy implication is clear: initiatives aimed at industrial rebalancing through productivity enhancement must account for substantial implementation lags, with structural benefits likely emerging only after critical thresholds in technology adoption and skill development are achieved.

The causal relationships among these elements indicate that the upgrading of industrial structure is a pivotal factor in fostering both new quality productive forces and the rationalization of industrial structure. This upgrading not only contributes to the enhancement of new quality productive forces but also optimizes the allocation of industrial resources, thereby promoting the rationalization of the industrial framework. This conclusion carries substantial policy implications, suggesting that

initiatives aimed at advancing the upgrading of industrial structure can significantly support the enhancement of new quality productive forces and the rationalization of industries. Future policy efforts should prioritize the promotion of high-tech industries, the optimization of industrial structures, and the comprehensive enhancement of the economic structure through technological innovation.

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