UDC 338.2: 69.03
JEL L74, O25, R58

IMPACT OF NEW QUALITY PRODUCTIVE FORCES ON THE HIGH-QUALITY DEVELOPMENT OF THE CONSTRUCTION INDUSTRY: EVIDENCE FROM CHINA

Fuming Chen
Hunan University of Technology,
Zhuzhou, China
ORCID iD: 0009-0008-3468-7556

Yibai Yao
Hunan University of Technology,
Zhuzhou, China
ORCID iD: 0009-0009-4508-1266

Xi Yang *
Hunan University of Technology,
Zhuzhou, China
ORCID iD: 0009-0008-9464-7791

*Corresponding author:
E-mail: yangxi@hut.edu.cn

Received: 14/04/2025
Revised: 16/05/2025
Accepted: 02/06/2025

DOI: 10.61954/2616-7107/2025.9.2-1

Introduction. Recognised as an emerging and advanced mode of productivity, new quality productive forces (NQPF) have significantly contributed to the development of various industries. Investigating their influence on the high-quality development of the construction industry (HDCI) can offer theoretical support and practical guidance for the transformation and upgrading of the industry. This includes improving quality and efficiency, advancing green development, and promoting sustainable practices. Such efforts are of great significance for the high-quality development of the national economy.

Aim and tasks. This study aims to develop an index system for assessing the impact of new quality productive forces on the high-quality development of the construction industry, and empirically examines their relationship within the context of industrial structure modernisation.

Results. The regression coefficient of NQPF on HDCI was 0.293, and all regression results remained positive after the sequential inclusion of the control variables. The regression coefficient of NQPF on industrial structure upgrading was 0.056, whereas the regression coefficients of NQPF and industrial structure upgrading on HDCI were 0.201 and 0.256, respectively. A bootstrap test involving 1,000 resampling iterations was performed, and the resulting confidence interval was [0.0005, 0.0406], which does not include zero. The results of the regional heterogeneity analysis indicate that the positive effect of NQPF on HDCI was strongest in the eastern region (0.348), followed by the western region (0.132), with the impact on the central region being statistically insignificant. After applying the robustness checks, all regression results remained positive and statistically significant at the 1% level.

Conclusions. This study develops a framework for analysing the impact of NQPF on HDCI and provides recommendations for the forthcoming construction industry and related policy research. Under the NQPF policy framework, the impetus to promote high-quality development of China's economy and construction industry is reasonably policy-driven, featuring industrial upgrading and regional optimisation in synergy with technological popularisation. Policy choices under the NQPF regarding China's construction industry and the high-quality development of its economy are of critical importance. Moreover, they further contribute to the promotion and enhancement of environmental sustainability.

Keywords: NQPF, HDCI, industrial structure upgrading, productivity, technological innovation.

1. Introduction.

Under the traditional productivity model, economic growth primarily relies on excessive resource and labour input consumption. However, this model has become unsustainable amid growing resource scarcity and environmental constraints. The concept of new quality productive forces (NQPF) was first introduced in 2023 by Xi Jinping, and its methodological development was further advanced (Gao, 2024). The development and formation of the NQPF occurs within the context of a new technological revolution. This represents a significant advancement beyond traditional forms of productivity.

The NQPF can be interpreted through the lens of three elements of productivity. Labour is transitioning from manual to cognitive work. The means of labour are increasingly automated and digitised through the integration of big data, AI, and other advanced technologies. Moreover, the object of labour is expanding beyond the boundaries of traditional industries, signalling the emergence of new industries, business models, and organisational forms (Chen et al., 2025a).

The NQPF has emerged as a key concept within policy discourse aimed at achieving qualitative improvements in economic practices, drawing increasing attention in recent years. Productivity is a fundamental indicator of economic development. The NQPF represents a refined productivity enhancement and signifies a shift from traditional production frameworks toward limitless modern possibilities (Li & Cui, 2024). A deep understanding of its connotation, recognition of its relationship with conventional productivity, and acceleration of its formation path are of theoretical and practical significance for promoting high-quality development.

China's economy has shifted from high-speed growth to high-quality development, with a report of the 19th National Congress (Xi, 2022) emphasising the need to promote high-quality development and advance the construction of a new development pattern. As a key sector of the national economy, the construction industry significantly alleviates employment pressure, facilitates new urbanisation, and enhances public well-being.

As a critical sector within the Chinese market, the construction industry requires focused attention to achieve sustainable development, given its inefficient development methods, limited capacity for innovation, and substandard development quality (Duan et al., 2020).

The introduction of the NQPF has fuelled national economic growth and injected new momentum into the development of the construction industry. Industrial upgrading and advancements in research and technological innovation have emerged as key factors in the development of NQPF. As a crucial element of the country's economic transformation, high-quality development of the construction industry (HDCI) should be accelerated to facilitate the advancement of NQPF, thereby injecting new vitality and momentum into HDCI.

2. Literature Review.

2.1. The Concept of New Quality Productive Forces.

The NQPF is grounded in the integration of labour, tools, production elements and their optimal combination. By combining advanced factors of production with effective management, they represent a new type of productive force in the context of modern economic conditions. This is especially evident in policy documents that optimise the socio-economic structure of production through more efficient resource allocation. Driven by research and technological innovation, it facilitates upgrading economic structures and advancing social productivity.

In contrast to the three core elements of traditional productivity, labourers have shifted from manual to knowledge-based positions. The integration of labour inputs with AI, big data, and other advanced technologies has deepened significantly, accelerating the transition toward digitalisation and automation. This transformed economic paradigm dissolves traditional industry boundaries, giving rise to new sectors and innovative organisational forms (Chen et al., 2025b). The core characteristics of the NQPF can be categorised into three primary dimensions.

e-ISSN 2786-8958
ISSN-L 2616-7107

The first dimension is knowledge and technology. The centrality of knowledge and technology constitutes a fundamental feature of the NQPF. Continuous advancements in artificial intelligence, big data, and related fields have prompted enterprises to upskill and technologise their workforce, thereby enhancing productivity and fostering the creation of innovative products and services (Chen et al., 2025a).

Second, innovation-driven development: Innovation is the central driving force of NQPF. Through technological advancements and restructuring of management and business models, long-term impacts on traditional and emerging industries can be realised (Han & Li, 2024).

Third, intelligent production: The current technological revolution has fostered the rapid development of advanced technologies, particularly AI. Intelligence has become a defining characteristic of contemporary production, as it reduces costs, accelerates production processes, and drives digital transformation across industries.

Regarding the theoretical background, Yang (2024) argues that establishing a development pathway for NQPF and promoting its advancement are inevitable choices for addressing the Fourth Industrial Revolution (Industry 4.0), achieving high-quality economic development, and building a modernised industrial system with Chinese characteristics.

Guo et al. (2024) emphasise that scientific and technological innovation is the core factor in developing NQPF, arising from breakthroughs and qualitative transformations in key technologies. Regarding its value implications, Zeng and Xie (2023) contend that NQPF is a crucial driver in building a new development pattern and achieving a leap in social productivity.

It is argued that NQPF gives new direction to modernisation with Chinese characteristics, helping to overcome external barriers to self-sufficiency and self-development. Shi and Xu (2024) argue that NQPF is a new type of productivity resulting from the close integration of advanced factors of production and new technologies.

Therefore, the accelerated development of NQPF should promote the realisation of high-quality development. According to Wang et al. (2024), the driving role of NQPF in achieving high-quality economic growth will increase with the improvement of creative allocation of factors of production.

As a new productive force in China's modernisation process, the insignificant allocation of factors of production in promoting high-quality development has been demonstrated in practice (Yu et al., 2024; Zhou & Bai, 2025). Zheng et al. (2025) analysed how the digital economy affects NQF using panel data from 31 Chinese provinces from 2012 to 2022, and made specific policy recommendations from four different perspectives.

2.2. High-Quality Development of the Construction Industry.

HDCI has been the subject of theoretical and empirical research as a model for successful and sustainable development. Sun et al. (2019) emphasise the importance and necessity of HDCI in the contemporary Chinese context and argue that it significantly impacts the overall economic system. Improving the quality of production factors, encouraging management innovation, and further restructuring government services to fit the new economic and social paradigm better were also suggested ways to further the development of the construction industry. By thoroughly examining high-quality development and contemporary construction industry trends, Gao and Li (2021) contended that HDCI is a modernised development model marked by increased quality, efficiency, and a greater focus on intensification and environmental protection.

Li et al. (2024) concluded that the digital economy drives the transformation and upgrading of the construction industry, with entrepreneurial innovation and initiatives serving as key mechanisms for this process. Wang and Wu (2022) examined the spatial and temporal distribution of HDCI in China from 2006 to 2021 using an unexpected output SE-SBM model, GML index analysis, and gray correlation model.

e-ISSN 2786-8958
ISSN-L 2616-7107

Based on the concept of the “five developments”, Wang and Cheng (2024) utilised construction industry data from 29 provinces (autonomous regions and municipalities) in China. They employed a combination of Necessary Condition Analysis and fuzzy-set Qualitative Comparative Analysis to construct a driving model for HDCI, revealing its development pathways and assessing its applicability (Gao et al., 2024). Several Chinese scholars have developed provincial index systems for HDCI (Sun & Liu, 2022; Wu & Zhang, 2021; Yang et al., 2020) for regional evaluations. Zhang and Zhang (2024) employed a spatiotemporal geographically weighted regression model to investigate the spatiotemporal evolution and influencing factors of HDCI levels in 30 provinces.

Wang et al. (2019) assessed HDCI levels in 30 provinces in China and made recommendations for appropriate policies. Furthermore, Gao and Li (2021) developed a five-dimensional system for assessing HDCI, which includes factors such as industrial base and construction products. This system allows authorities to identify gaps in the sphere, make targeted political approaches, and statistically monitor industrial developments. Using panel vector autoregressive (PVAR) models and the new structural economic theory, Li et al. (2024) collected interregional reports from 30 Chinese provinces from 2008 to 2022. These show that environmental regulations positively impact the growth of HDCI, especially in developing regions, where the agricultural sector is still in its infancy (Li et al., 2022).

2.3. Research Gaps.

Based on the preceding analysis, research on NQPF has increased in recent years, primarily focusing on its background, concepts, characteristics, value, and significance. Nonetheless, empirical studies are still relatively rare, especially concerning the influence mechanisms of NQPF, its effects, and spatial and regional heterogeneity (Lin et al., 2024). Research on HDCI has concentrated chiefly on empirical studies and conceptual analyses. Second, current research has not examined NQPF's interaction with HDCI.

HDCI is closely linked to industrial structure upgrades and technological innovation. At the same time, NQPF, as the most advanced productivity model, can promote HDCI through the mediating effect of upgrading industrial structures and moderating technological innovation (Yao et al., 2025). Therefore, the contributions of this study are as follows.

First, the interrelated theoretical relationships among NQPF, industrial structural upgrading, and HDCI, as well as the systematic analysis of their dynamics, have scarcely been explored.

Second, this study enhances existing research on NQPF and HDCI by diversifying methodological approaches. Third, quantitative approaches were used to extend the scope of the research by evaluating the function of NQPF in HDCI and revealing mediating, moderating, and heterogeneous effects.

Finally, the suggested actions – including accelerating NQPF development, supporting industrial upgrading and synergistic growth, strengthening technological innovation, and lowering regional disparities – provide great insight for improving NQPF policies and HDCI in China.

3. Theoretical Mechanisms and Research Hypotheses.

3.1. Principles of NQPF Affecting HDCI.

NQPF supports HDCI by introducing scientific and technological innovations, upgrading industrial structures, inventing management models, and changing production methods. Particularly, NQPF improves new growth momentum for high-quality development utilising synergistic effects of integrated innovative technologies, where science and technology innovation take the front stage. Research and technological innovation are essential for high-quality development to raise production capacity, boost efficiency, and optimise demand structures. This process encourages the development from a rough to an intense mode, helps new industries to flourish, and promotes the change and upgrading of conventional sectors.

At the same time, it prioritises resource conservation and environmental protection, promotes the development of a circular economy, and seeks coordinated economic and ecological development. Ultimately, these efforts contribute to achieving high-quality development (Zhou & Hu, 2024).

NQPF is crucial in advancing industrial restructuring and innovation, creating pathways for HDCI. Combining the benefits of digital and conventional production elements creates additional value in all spheres of the building sector. Early on in HDCI, labour inputs still largely determined production.

Hence, adding NQPF could negatively affect HDCI. By integrating NQPF with big data and cloud computing, creative products such as smart and green buildings have emerged, fostering the growth of future industries within the building sector and supporting sustainable development.

Weak digital infrastructure in underdeveloped regions, exemplified by limited 5G coverage in rural areas, may result in an unequal distribution of policy benefits. Moreover, new quality productive forces have facilitated the emergence of new forms of production organisation, enabling the scientific allocation of resources in the construction industry.

The NQPF is driving a systematic transformation of the production mode within the construction industry; the traditional operation mode, which relies on manual intervention, is gradually being replaced by mechanised production systems, and the synergy between digital platforms and industrialised production is continuously being enhanced.

Supported by smart building technologies, the range of applications of assembly building techniques continues to grow. However, gathering IoT data in the building sector may cause sensitive data to be leaked, which emphasises the need to create adaptive encryption rules. Thus, the following theory is proposed:

Hypothesis 1: NQPF enhances HDCI by integrating digital technologies and innovation-driven processes.

3.2. NQPF's Impact Mechanisms on HDCI.

NQPF integrates technologies such as AI algorithms, cloud data, and intelligent computing to facilitate the formation of an organic, collaborative network among traditional building elements (Liu, 2024). This technological integration not only reconfigures the trajectory of industrial upgrading but also effectively eliminates information silos, accelerates technological iteration and knowledge sharing, and provides the fundamental driving force for innovation within the construction industry.

The digital transformation of the construction sector, driven by the use of standardised components, plays a key role in achieving sectoral transformation and upgrading (Ding & Liu, 2023). It promotes comprehensive development through a specialised, large-scale, and information-based production system

One important expression of NQPF is industrial structural improvement. Long operating under a manual-dominated approach, the conventional building sector has seen limited application of machinery, so impeding innovations in construction efficiency and energy consumption control. The manual labour-dependent production system clearly shows limits in response to the developmental demands of the new era. Thus, it is necessary to change the industrial form through technical integration completely. Innovation in advanced manufacturing systems is changing the building sector's technical limits and industrial scene.

The penetration of intelligent construction technologies presents a dual effect: the resulting changes in employment structure give rise to new occupational clusters (Liu et al., 2023), attracting high-quality talent through the premium placed on digital skills.

Conversely, the contraction of traditional job roles and delays in the skills training system may result in a mismatch within the labour market. This transitional tension is particularly pronounced during the evolution of new quality productivities.

e-ISSN 2786-8958
ISSN-L 2616-7107

As the green innovation paradigm expands the product-service dimension, the uneven allocation of policy resources (e.g. R&D agglomeration by leading firms) may hinder the technological catch-up capabilities of small and medium-sized enterprises (SMEs). Based on the foregoing analysis, this study proposes Hypothesis 2:

Hypothesis 2: NQPF promotes HDCI through industrial structure upgrading.

3.3. The Moderating Role of Technological Innovation.

Technological innovation affects the path of NQPF and HDCI and requires a well-developed construction industry as a foundational prerequisite. Furthermore, influencing the effectiveness of NQPF in fostering HDCI is the moderating factor of technological innovation. While technological innovation is a vital means of reaching high performance and quality by enhancing building processes and so promoting a virtuous cycle that advances HDCI, NQPF stresses high performance and quality (Ren et al., 2024).

Accordingly, technological innovation enhances HDCI through synergy with NQPF. Furthermore, science and technology are recognised as primary productive forces. Higher levels of technological innovation can convert innovation outcomes more efficiently, drive continuous progress in HDCI, improve economic and social benefits, yield significant environmental benefits, promote industrial transformation and upgrading, and support sustainable development. These findings provide a strong basis for the long-term expansion of the building sector.

Especially artificial intelligence and other advanced technologies, technological innovation increases the production efficiency of the building sector and its associated sectors. Data-driven path-dependent impact exhibits dual properties when the degree of intelligent penetration in the building sector exceeds a critical threshold. Empirical cases indicate that after three years of deploying an Artificial intelligence design system, the innovation patent output intensity of a leading assembly building enterprise declined. This duality suggests the necessity of establishing a dualistic innovation governance framework: leveraging smart tools to enhance technological transformation efficiency while preventing the dissipation of innovation elasticity through dynamic evaluation mechanisms. Based on the foregoing analysis, Hypothesis 3 is proposed:

Hypothesis 3: The combination of technological innovation and NQPF can promote HDCI.

3.4. Regional Heterogeneity.

The East-Middle-West gradient economic belt division directly reflects China's geospatial heterogeneity. This spatial differentiation manifests at two levels: firstly, in the interregional gradient differences in resource endowment, and secondly, in the uneven distribution of economic development potential, forming an interactive structure characterised by typical geo-economic features. Interaction effects have become more prominent with the gradual removal of geographical divisions and regional barriers, and the increasingly close economic linkages among these regions.

The combined influence of resource endowment disparities and institutional variations has led to distinct regional development patterns. The factor agglomeration effect in the eastern coastal region generates a first-mover advantage for NQPF, and this spatial differentiation plays a critical moderating role in the formation mechanism of HDCI.

The heterogeneity of NQPF conduction effects arising from regional development gradients necessitates conducting this study from a geo-economic perspective to deconstruct spatial dimensional differences in technology diffusion.

Hypothesis 4: The impact of NQPF on HDCI exhibits regional heterogeneity.

Based on the above analysis, Fig. 1 illustrates the theoretical mechanisms through which NQPF influences HDCI.

e-ISSN 2786-8958
ISSN-L 2616-7107

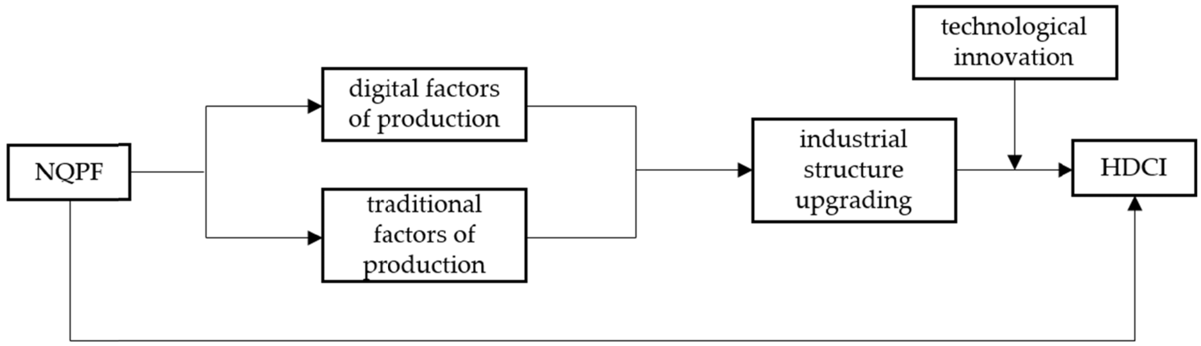

Fig. 1. Theoretical Mechanisms of NQPF on HDCI.
Source: developed by the authors.

4. Research Design.

4.1. Model Setting.

4.1.1. Selection and Setting of Time-Individual Fixed Effects Models.

First, to explore the impact of NQPF on HDCI, a time-individual fixed effects model was constructed, drawing upon the research frameworks proposed by Ren et al. (2024) and Li et al. (2024):

$$HDCI_{i,t} = \alpha_0 + \alpha_1 NQPF_{i,t} + \alpha_2 Contrls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (1)$$

In model (1), $HDCI_{i,t}$ is the explained variable, interpreted as the observed value for the first individual at the first time point, representing the level of HDCI in the province i at time t; $NQPF_{i,t}$ is the core explanatory variable; $Contrls_{i,t}$ is the control variable. At the parameter estimation level, α_1 represents the coefficient of NQPF, while α_2 denotes the coefficients of the control variables. A two-way fixed-effects model, μ_i and φ_t representing individual and time effects respectively, is employed to effectively control for confounding effects arising from spatial heterogeneity and time-varying factors. $\varepsilon_{i,t}$ is the random error term. Finally, i denotes the province, and t denotes the year.

4.1.2. Intermediary Model Setting.

Secondly, to verify whether industrial structure upgrading exerts a mediating effect in promoting HDCI, the mediating effect model is established based on model (1).

This model is drawn from the research of Lu et al. (2025) and is presented as follows:

$$ISU_{i,t} = \beta_0 + \beta_1 NQPF_{i,t} + \beta_2 Contrls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (2)$$

$$HDCI_{i,t} = \gamma_0 + \gamma_1 NQPF_{i,t} + \gamma_2 ISU_{i,t} + \gamma_3 Contrls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (3)$$

In the model (2), $ISU_{i,t}$ represents the industrial structure upgrading variable; β_1 denotes the coefficient of the effect of NQPF on industrial structure upgrading and represents the coefficient of the effect of industrial structure upgrading on HDCI. If β_1 and γ_2 are statistically significant, it indicates the presence of a mediating effect of industrial structure upgrading.

4.1.3. Moderated Effects Model Setting.

To further explore the moderating effect of technological innovation on the relationship between NQPF and HDCI, and drawing on the research of Li et al. (2022), the following moderating effect model is constructed:

$$HDCI_{i,t} = \theta_0 + \theta_1 NQPF_{i,t} + \theta_2 INNO_{i,t} + \theta_3 NQPF_{i,t} \times INNO_{i,t} + \theta_4 Contrls_{i,t} + \mu_i + \varphi_t + \varepsilon_{i,t} \quad (4)$$

In the model (4), $INNO_{i,t}$ represents the moderating variable of technological innovation, and $NQPF_{i,t} \times INNO_{i,t}$ denotes the interaction term between NQPF and technological innovation.

4.2. Variable Definition.

4.2.1. Explained Variable: HDCI.

Based on prior studies (Wen et al., 2024; Zhang & Zhang, 2024), an evaluation index system for the HDCI is constructed.

As shown in Table 1, it is based on six dimensions: scale growth, innovative development, green development, comprehensive efficiency, corporate structure, and people's livelihood and sharing.

Table 1. Evaluation index system for HDCI.

Primary Index	Secondary Index	Stats	Weight
Scale growth	Capacity growth rate	+	0.009
	Capacity growth Output/GDP	+	0.038
	Contracts awarded	+	0.101
Innovative development	Labour productivity	+	0.059
	Technology readiness rate	+	0.067
	power equipment ratio	+	0.056
	Percentage of senior-titled staff in survey and design organizations	+	0.042
Green development	Steel consumption per 100 million dollars of output value	-	0.030
	Wood consumption per 100 million dollars of output value	-	0.028
	Cement consumption per 100 million dollars of output value	-	0.026
	Glass consumption per 100 million dollars of output value	-	0.027
	City's daily sewage treatment capacity	+	0.088
Comprehensive efficiency	Output Profitability	+	0.015
	Assets-liability ratio	-	0.033
	Total profits	+	0.113
Corporate structure	Percentage of private sector output	+	0.045
	Percentage of output value completed outside the province	+	0.063
	Percentage of output value of local enterprises	+	0.017
	Percentage of the number of general contractors above the first level	+	0.043
	Percentage of the number of first-class specialized contractors	+	0.041
People's livelihood and sharing	Average urban wage in construction	+	0.053
	Main business taxes and surcharges in the construction industry	-	0.006

Considering that the entropy weight TOPSIS method effectively mitigates the interference caused by information overlap among multiple indicators and reduces human subjectivity, this study adopted a method to calculate the weight of each indicator and comprehensively evaluate the level of HDCI.

(1) The expansion of the construction industry is reflected primarily in its growth rate and total output volume. The rate of capacity expansion was used to quantify industry growth. The total output volume was assessed using two primary metrics: the share of the construction industry's output in GDP and the scale of investment. Investment is typically represented by the value of the signed contracts, indicating the investment scale.

(2) Innovation is the primary productive force, and efficiency improvement is the core objective of innovation-driven development.

The extent to which innovation enhances efficiency is used to evaluate its influence on the effective utilisation of other production factors.

Improvements in labour productivity serve as a key measure of this impact. Technological innovations in the construction process can significantly reduce equipment usage costs and increase the assembly rate and ownership levels of construction machinery, thereby improving construction efficiency. Accordingly, the technology and power equipment rates were selected as representative indicators.

Additionally, the proportion of professional and technical personnel reflects the adequacy of the human resource composition in the construction industry. Currently, the industry is characterised by an insufficient and low-skilled technical workforce.

e-ISSN 2786-8958
ISSN-L 2616-7107

Therefore, the proportion of personnel with senior titles in the survey and design units was used to evaluate the advancement of the human resource structure.

(3) Development of the construction industry should aim to reduce resource consumption and enhance ecological preservation. The consumption of key materials such as glass, steel, and cement is used as an indicator of resource usage. Daily urban sewage treatment capacity was employed to measure the industry's commitment to environmental protection for ecological preservation.

(4) Profit is a fundamental measure of economic performance. Three indicators (the profit margin on output value, the asset-liability ratio, and total profit) are selected to evaluate the overall performance of the construction industry.

(5) Although the state-owned economy remains dominant in China, the rise of local and private enterprises has enhanced market dynamics. Accordingly, the proportion of output value from private and local enterprises and the number of enterprises with Grade One or higher general contracting and professional qualifications are used to characterise the enterprise structure of the construction industry.

(6) The objective of high-quality development is to meet the public's aspirations for an improved standard of living. HDCI is expected to contribute to enhancing social welfare. In China's distribution system, which is centred on labour remuneration and supplemented by various methods, wages are the primary indicator of this system. Therefore, the average salary in the urban and rural construction sectors was selected as a key indicator of the economic welfare distribution.

Additionally, tax adjustments serve as another crucial mechanism for redistributing economic benefits, with business taxes and surcharges in the construction industry acting as corresponding evaluation indices.

To minimise subjective bias in selecting a weight calculation method, the studies of Xu et al. (2024) and Jin et al. (2024) were consulted.

Based on this, the entropy weight TOPSIS method was the most appropriate for this study, and was therefore selected. The detailed steps of the entropy-weighted TOPSIS method are outlined below.

First, the data were standardised to eliminate dimensional differences between the different evaluation indicators.

– Positive indicators:

$$p_{ij} = \frac{x_{ij} - min(x_{ij})}{max(x_{ij}) - min(x_{ij})} \tag{5}$$

– Negative indicators:

$$p_{ij} = \frac{max(x_{ij}) - x_{ij}}{max(x_{ij}) - min(x_{ij})} \tag{6}$$

Secondly, the feature weight y of the *i-th* index in the *j-th* sample was calculated:

$$y_{ij} = \frac{p_{ij}}{\sum_{i=1}^{m} P_{ij}} \tag{7}$$

Thirdly, the entropy value and coefficient of variation for the *i-th* index were calculated.

$$e_j = -\frac{1}{\ln m} \sum_{i=1}^{m} y_{ij} \times \ln y_{ij} \tag{8}$$

$$g_j = 1 - e_j \tag{9}$$

Subsequently, the weight of each index is calculated:

$$w_j = \frac{g_i}{\sum_{j=1}^{n} g_i} \tag{10}$$

Finally, the integrated level of HDCI and NQPF with is calculated as follows:

$$U_i = \sum_{j=1}^{m} w_j P_{ij} \tag{11}$$

4.2.2. Explanatory variable: NQPF.

Based on a study by Liu et al. (2024) and Song and Tong (2024), an evaluation index system for NQPF (Table 2) was constructed to measure its comprehensive level using the weighted TOPSIS approach.

e-ISSN 2786-8958
ISSN-L 2616-7107

Table 2. NQPF Evaluation Indicator System.

Primary Index	Secondary Index	Three-Level Index	Stats	Weight
New quality labourers	Worker skills	Percentage of employed persons with a bachelor's degree or higher	+	0.088
		Average years of schooling per capita	+	0.007
	Labour productivity	Wages of employed workers	+	0.064
New quality labour objects	Emerging industry	Robot mounting density	+	0.202
	Ecological environment	Expenditures on environmental protection/government public finance expenditures	+	0.229
		Sulphur dioxide emissions/GDP	-	0.005
		Industrial wastewater discharges/GDP	-	0.014
		Industrial solid waste generation/GDP	-	0.006
New quality labour materials	Material means of production	Internet broadband access ports per capita	+	0.045
		Fibber Length	+	0.076
		Energy consumption/GDP	-	0.015
		Highway mileage	+	0.051
	Intangible means of production	Number of patents granted/total population	+	0.138
		Digital Economy Index	+	0.060

The NQPF concept consists of three core elements: new quality labourers, new quality labour objects, and new quality labour materials. This study developed an evaluative index system for measuring the NQPF based on these components.

1) New quality labourers play a critical role in advancing NQPF. To accurately reflect their attributes, this study establishes evaluation indices from two dimensions: labour skills and labour productivity. The proportion of employed individuals with a university degree or higher indicates the availability of highly educated labour. Additionally, the average years of education per capita provides a quantitative measure of the educational attainment of the labour force.

Therefore, these two metrics were selected to evaluate labour skills. Moreover, employee salaries are generally positively associated with labour productivity, as higher wages often indicate greater value creation. Consequently, the average salary of employed workers indicates labour productivity.

2) New-quality labour objects shape the trajectory and magnitude of productivity development. This study provides a two-dimensional evaluation system for newly designed quality labour products. Whereas the ecological constraint dimension uses the environmental load indicator, the technological innovation dimension is based on the robot installation density indicator.

This essentially captures the technology-driven productivity enhancement mechanism. Consequently, the ratio of environmental protection expenditure to total government public financial expenditure and emissions of pollutants (including sulphur dioxide, industrial wastewater, and industrial solid waste) per unit of GDP were employed as evaluative measures.

The development of NQPF fundamentally relies on the availability of superior labour materials. This study develops a two-dimensional assessment framework for new and qualitative means of labour. At the level of material means of production, digital infrastructure (measured by the number of Internet broadband access ports per capita and optical fibre length), traditional infrastructure (road mileage), and overall energy consumption (energy intensity per unit of GDP) were considered. Two indicators were selected at the level of intangible means of production: the number of patents granted per capita and the digital economy index. The number of authorised patents per capita and digital economy index are key indicators for measuring these intangibles.

4.2.3. Intermediary Variable: Industrial Structure Upgrading (ISU).

Apart from hastening the integration of NQPF, upgrading the industrial structure offers the building sector more opportunities for development and better allocation of resources.

e-ISSN 2786-8958
ISSN-L 2616-7107

This change has helped the building sector fit more with changing market demand, providing a strong basis for HDCI. Drawing on the research of Liu and Wang (2024), the proportion of GDP accounted for by the sum of the value added by the secondary and tertiary industries is used to represent the upgrading of the industrial structure.

4.2.4. Moderating Variable: Technological Innovation ($inno$).

The transformative effect of technological innovation in the construction industry follows a dual path. Its direct effect is manifested in the reconstruction of total factor productivity and a systematic reduction in the defect rate of engineering quality. This catalyses the industry's transformation toward a green and intelligent paradigm via the penetration of BIM technology and the advancement of intelligent construction technology.

Based on the theory of innovation input intensity, this study employs the construction industry's R&D intensity index (R&D expenditure/GDP) as a measurement indicator (Song & Tong, 2024).

4.2.5. Control Variable.

This study establishes a multidimensional set of control variables to account for potential confounding effects.

Economic openness ($open$) is measured by the ratio of total imports and exports (merchandise trade) to GDP (Dong et al., 2022). Government fiscal capacity ($gover$) is represented by fiscal general budget revenue relative to GDP (Wang, 2024). Informatization intensity ($infor$) is measured as the ratio of total postal and information transmission business to GDP (Wang, 2024). Human capital intensity (cap) is measured by the ratio of students enrolled in higher education to the total population (Xu et al., 2025).

4.2.6. Data Sources and Descriptive Statistic.

Considering the accessibility of provincial panel data and the comparability of the samples, panel data from 30 Chinese provinces (excluding the Tibet Autonomous Region, Hong Kong, Macao, and Taiwan) for the period 2012–2022 were selected as the research sample for this study.

The primary data sources were derived from WIND, the EPS database, the website of the National Bureau of Statistics, and the statistical yearbooks of each province. Table 3 presents the descriptive statistics for these variables. The mean variance inflation factor (VIF) among the variables was 1.42; all individual VIF values below 10 indicated no multicollinearity.

Table 3. Descriptive Statistics.

Variable	N	Mean	Std. Dev	Min	Max
HDCI	330	0.318	0.073	0.164	0.575
NQPF	330	0.178	0.092	0.034	0.546
ISU	330	0.904	0.052	0.749	0.998
INNO	330	1.770	1.171	0.446	6.830
open	330	0.259	0.274	0.008	1.438
gover	330	0.249	0.102	0.107	0.643
infor	330	0.060	0.055	0.014	0.290
cap	330	0.021	0.006	0.009	0.044

5. Empirical Results and Analysis.

5.1. Benchmark Regression Analysis.

The benchmark regression results of Model (1) are presented in Table 4. According to the results, the regression coefficients of NQPF on HDCI are consistently positive and statistically significant at the 1% level, thereby confirming Hypothesis 1.

Although NQPF significantly impacts HDCI, the negative coefficient of the 'open' variable indicates that increased openness has a suppressive effect on the regression results. This may be attributed to heightened competition and the dispersion of resources associated with greater openness.

e-ISSN 2786-8958
ISSN-L 2616-7107

Table 4. Basic Regression Results.

Variable	(1)	(2)	(3)	(4)	(5)
	HDCI	HDCI	HDCI	HDCI	HDCI
NQPF	0.293*** (6.752)	0.230*** (5.009)	0.218*** (4.850)	0.216*** (4.778)	0.215*** (4.631)
open		-0.071*** (-3.653)	-0.064*** (-3.362)	-0.063*** (-3.282)	-0.062*** (-3.065)
gover			-0.185*** (-3.778)	-0.179*** (-3.581)	-0.179*** (-3.552)
infor				-0.036 (-0.592)	-0.036 (-0.572)
cap					-0.097 (-0.093)
_Cons	0.256*** (47.144)	0.284*** (30.519)	0.327*** (22.459)	0.326*** (22.345)	0.328*** (13.578)
Time	yes	yes	yes	yes	yes
Individual	yes	yes	yes	yes	yes
N	330	330	330	330	330
R^2	0.720	0.732	0.745	0.745	0.745
F	67.402	65.536	64.381	59.672	55.501

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

5.2. Mediating Effects Analysis.

The regression results of models (2) and (3) indicate (Table 5) that industrial structure upgrading plays a significant mediating role between NQPF and HDCI. Model (2) has a statistically significant coefficient for NQPF at the 5% level, estimated at 0.056. This outcome shows that NQPF encourages upgrading industrial structures. The coefficients of industrial structure upgrading and NQPF in Model (3) are positive and statistically significant, respectively.

Table 5. Mediating Effects Test.

Variable	(1)	(2)	(3)
	HDCI	ISU	HDCI
NQPF	0.215*** (4.631)	0.056** (2.464)	0.201*** (4.305)
ISU			0.256** (2.113)
_Cons	yes	yes	yes
Time	yes	yes	yes
Individual	yes	yes	yes
N	330	330	330
R^2	0.745	0.460	0.749
F	55.501	16.165	52.944

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

This suggests that upgrading the industrial structure serves as a mediating variable. A Bootstrap method with 1,000 resamples was employed to test the robustness of the mediation effect.

The resulting confidence interval is [0.0005–0.0406] (Table 6), which did not include zero. This finding strengthens the statistical validity of the mediation effect. Thus, Hypothesis 2 is validated

Table 6. Bootstrap Test Results.

Effect	Bootstrap standard error	Z-value	95% Confidence interval	_Cons	Time	Individual
Indirect effect	0.0100	1.42	[0.0005, 0.0406]	yes	yes	yes
Direct effect	0.0715	2.81	[0.0851, 0.3506]	yes	yes	yes

e-ISSN 2786-8958
ISSN-L 2616-7107

5.3. Moderated Effects Analysis.

Table 7 shows the analysis of the moderating effect, known as INNO, when considering the research contributions of Pan (2025) and Wu and Gao (2025). Introducing an interaction effect following decentralisation did not markedly alter the coefficients for NQPF and INNO. Furthermore, INNO exerted no significant direct influence on HDCI.

However, when combined with NQPF, the coefficient of the interaction term (NQPF×INNO) was notably positive. Although INNO does not directly affect HDCI improvement, its combination with NQPF improves HDCI. In the absence of NQPF, the beneficial influence of INNO on HDCI vanishes completely, highlighting the indispensable function of NQPF in industrial upgrading. Hypothesis 3 was entirely supported by double statistical and economic verification.

Table 7. Regression Results of the Moderated Mediation Effects.

Variable	(1)	(3)
	HDCI	HDCI
NQPF	0.292*** (6.294)	0.195*** (3.712)
INNO	0.001 (0.082)	-0.005 (-0.629)
NQPF×INNO		0.049*** (3.699)
_Cons	yes	yes
Time	yes	yes
Individual	yes	yes
N	330	330
R^2	0.720	0.732
F	61.574	60.393

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

5.4. Regional Heterogeneity Analysis.

Given China's large geographic extent and notable regional differences in resource endowment and economic development, the heterogeneous effects of NQPF on HDCI across different regions are unavoidable.

Considering the regional division suggested by Shen et al. (2021), China is divided into eastern, central, and western regions (Table 8). Based on this, a group regression analysis was conducted to examine regional differences in the effectiveness of NQPF implementation.

Table 8. Division of the Eastern, Central and Western Regions.

Area	Eastern	Western	Central
Province	Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan	Inner Mongolia, Chongqing, Sichuan, Guangxi, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	Shanxi, Jilin, Heilongjiang, Henan, Hubei, Hunan, Anhui, Jiangxi

Table 9 presents the regression results. The impact coefficients of the NQPF were significant in the eastern and western regions of China but were not statistically significant in the central region. This suggests that NQPF has a positive facilitating effect on promoting HDCI in the eastern and western regions, whereas its effect remains insignificant in the central region. This outcome may be attributed to several regional factors: the eastern region benefits from talent concentration, industrial chain synergy, and technological innovation; the western region benefits from national policy support (e.g., the “Belt and Road” initiative);

e-ISSN 2786-8958
ISSN-L 2616-7107

The central region is constrained by underdeveloped digital infrastructure and inconsistent policy implementation, which limits its ability to fully absorb the benefits of NQPF. Using Fisher's test (1,000 samples), the value for the between-group difference in the estimated heterogeneity of coefficients between the eastern and western regions is 0.06, implying that the eastern region has more clearly marked NQPF efficacy. This is probably the result of the comparatively low level of development in the western region, lack of NQPF-related talent, and relatively weaker infrastructure and technological capacity, which limit the influence of NQPF on HDCI in that area.

Table 9. Results of the Regional Heterogeneous Effect.

Variable	Eastern HDCI	Western HDCI	Central HDCI
NQPF	0.348*** (3.949)	0.132* (1.905)	0.082 (0.397)
_Cons	yes	yes	yes
Time	yes	yes	yes
Individual	yes	yes	yes
N	121	121	88
R^2	0.733	0.799	0.849
F	17.430	25.220	24.366
Fisher's test	0.06		0.40

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

5.5. Endogenous Test.

This study uses lagged one-period NQPF as an instrumental variable to solve indigeneity issues, considering the possible bidirectional causal relationship between NQPF and HDCI (Wu & Shi, 2025).

NQPF shows temporal continuity; the lagged one-period NQPF can efficiently capture the current trend of NQPF. The regression results are shown in Table 10.

The coefficient of the lagged term of NQPF is 0.633, which is significant at the 1% level, with an LM statistic of 100.654 and F-values greater than 16.38. This indicates that the basic conditions for the instrumental variables are met. The coefficient of NQPF in the second stage is 0.306 and significant at the 1% level. This suggests that, after introducing instrumental variables, the conclusions of this study remain valid.

Table 10. Results of Endogenous Test.

Variable	First	Second
	NQPF	HDCI
L.NQPF	0.633*** (12.231)	
NQPF		0.306*** (4.335)
_Cons	yes	yes
K-P LM	100.654***	
C-D Wald F	149.61 （16.38）	
Time	yes	yes
Individual	yes	yes
N	300	300
R^2	0.943	

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

e-ISSN 2786-8958
ISSN-L 2616-7107

5.6. Robustness Tests.

5.6.1. Substitution of Explained Variable.

First, a robustness test was conducted by replacing the explanatory variables. Considered the most indicative of HDCI, the scale expansion of the building sector was calculated using the entropy weight TOPSIS approach to yield a complete score.

Subsequently, the original model was replaced with this score in the regression study. The results in Column (1) of Table 11 show that the regression coefficient of NQPF on HDCI is 0.945 and significant at the 1% level. This finding confirmed that the positive effect of NQPF on HDCI is robust.

5.6.2. Shrinkage Treatment.

After shrinking the HDCI, NQPF, and all control variables by 1% at both ends and substituting them into the original model for regression analysis, the results are presented in column (2) of Table 11. The regression coefficient of NQPF on HDCI is 0.220 and significant at the 1% level, indicating that the contribution of NQPF to HDCI is robust.

5.6.3. Excluding Municipalities.

The four municipalities directly under the central government – Beijing, Tianjin, Shanghai, and Chongqing – have higher levels of economic development, which may influence the impact of NQPF on the regression results for HDCI, these municipalities were excluded from the analysis. The remaining data were substituted into the original model for benchmark regression analysis, with the results presented in column (3) of Table 11. The regression coefficient of NQPF on HDCI is 0.265 and is significant at the 1% level, indicating that the promotional effect of NQPF on HDCI is robust.

5.6.4. Excluding of Anomalous Years.

Due to the significant impact of the COVID-19 epidemic on the real economy, data from 2019 to 2022 were excluded to enhance the persuasiveness of the model. The remaining samples were substituted into the model for regression. The results are presented in column (4) of Table 11. The regression coefficient of NQPF on the HDCI is 0.198 and significant at the 1% level, indicating that the contribution of NQPF to the HDCI remains robust.

Table 11. Robustness Test.

Variable	(1)	(2)	(3)	(4)
NQPF	0.945*** (7.845)	0.220*** (4.450)	0.265*** (5.585)	0.198*** (2.814)
_Cons	yes	yes	yes	yes
Time	yes	yes	yes	yes
Individual	yes	yes	yes	yes
N	330	330	286	210
R^2	0.559	0.745	0.773	0.514
F	24.092	55.514	55.741	16.252

*Note: ***p<0.01, **p<0.05, *p<0.10, Z-values in brackets.*

6. Discussion and Implications.

6.1. Conclusions.

This study uses panel data from 30 Chinese provinces from 2012 to 2022, based on upgrading industrial structures. The mechanism by which NQPF affects HDCI is investigated in this study. Three main conclusions were drawn from the empirical analysis:

1) NQPF improves HDCI (coefficient = 0.293, $p < 0.01$), highlighting its significance in regional and national economic strategies.

2) Industrial upgrading is an important mediating factor.

3) The regression results indicate the need for regional policy measures that are significant in the eastern (0.348) and western (0.132) regions but not in the central region.

6.2. Recommendations.

Based on the above discussion, the following recommendations are proposed.

First, policy-based initiatives include recommendations to accelerate the adoption of NQPF technologies through tax incentives and regulations. For instance, small enterprises implementing AI, IoT, and BIM technologies could be exempted from income tax, and provincial construction budgets could allocate annual subsidies for equipment upgrades.

Simultaneously, drawing on the European Union's Near Zero Energy Building (NZEB) standard and Shenzhen's pilot implementation, new public construction projects should be mandated to achieve a 30% reduction in energy consumption and a 20% prefabrication rate.

Noncompliance penalties should be collected and redirected to the Compliance Enterprise Incentive Fund (CEEIF), establishing a dual "penalty-incentive" mechanism.

Second, to achieve industrial upgrades, costs should be reduced through prefabrication and collaborative innovation. In alignment with the National Development and Reform Commission's "14th Five-Year Plan" for industrial clusters, three national prefabrication centres have been established in Chengdu, Wuhan, and Shenyang, integrating research and development, production, and training.

Building on the inter-regional innovation network experience of the Yangtze River Delta, an industry alliance should be established, led by major construction firms (e.g., CSCEC), universities (e.g., Tongji and Tsinghua), and technology enterprises (e.g., Huawei and Aliyun), to promote design modularisation and material recycling.

This alliance should aim to reduce construction waste by 25% aligning with the Ministry of Housing and Urban-Rural Development's "Plan for the Resource Utilization of Construction Waste".

Third, regional coordination and technological inclusion should be pursued through differentiated investments in workforce transformations. In the western region, infrastructure development expenditures under the Belt and Road Initiative in Sichuan have been utilised to enhance AI-powered smart logistics centres.

This initiative should be complemented by the outcomes of talent incentive programs in Guangdong Province with a concurrent focus on retaining highly skilled professionals. In the central region, efforts should be aligned with the Ministry of Industry and Information Technology's goal of achieving 95% 5G coverage of construction sites by 2027.

Local governments should be mandated to align their annual budgets with NQPF-related objectives, such as smart city development. In the eastern region, the experience of the Yangtze River Delta Innovation Corridor should be leveraged to establish cross-regional technology transfer mechanisms and promote the sharing of BIM platforms and low-carbon patents. Simultaneously, implementing the reduction target set by the Ministry of Industry and Information Technology under the "Digital Talent Planning for the Construction Industry", which aims to certify 500,000 workers in digital skills by 2027, could help mitigate the risk of structural unemployment caused by automation.

Acknowledgements.

This research was funded by the Hunan Provincial and Municipal Joint Fund (2023JJ50170, 2024-2025).

REFERENCES

Chen, S. G., Liu, Y. X., & Wang, B. (2025a). New Quality Productivity Empowering High-quality Economic Development: Mechanism of Action and Spatial Spillover Effects. Statistics & Decision, 41 (08), 107-112. http://doi.org/10.13546/j.cnki.tjyjc.2025.08.018

Chen, X. F., Li, S. Q., & Wu, S. S. (2025b). The Cultivation of Intelligent Accounting Talents under the Collaboration between Industry and Education in the New Quality Productivity. Friends of Accounting, (09), 147-153.

Ding, Z. K., & Liu, Z. W. (2023). Digital Development Trend of Construction Industry under the Metaverse. Construction Economy, 44(04), 5-14. http://doi.org/10.14181/j.cnki.1002-851x.202304005

Dong, J. B., Zhang, M., & Cheng, G. B. (2022). Impacts of Upgrading of Consumption Structure and Human Capital Level on Carbon Emissions—Empirical Evidence Based on China's Provincial Panel Data. Sustainability, 14(19), 12373. http://doi.org/10.3390/su141912373

Duan, H. Y., Chen, S. Y., Liu, Y. Y., Zhang, S. P., Wang, X. N., Wang, S., & Song, J. N. (2020). Characteristics of reginal energy consumption of China's construction industry from the perspective of life cycle. China Population, Resources and Environment, 30(07), 57-65.

Gao, H. J., & Li, X. D. (2021). Research on Evaluation for HDCI Based on Matter-element Extension Model. Construction Economy, 42(11), 85-89. http://doi.org/10.14181/j.cnki.1002-851x.202111085

Gao, M. Y., Cao, M., Huang, H., & He, Q. (2024). Research on the Connotation, Characteristics and Development Path of New Quality Productive Force. The World of Survey and Research, 11, 27-35. http://doi.org/10.13778/j.cnki.11-3705/c.2024.11.003

Gao, T.Y. (2024). New Quality Productive Forces Promote and Facilitate High-quality Development. Highlights in Business, Economics and Management, 45, 491–495. https://doi.org/10.54097/vk9jet43

Han, P., & Li, K. (2024). The "Change" and "Constancy" in the Intrinsic Logic of Financial Intelligentization Transformation: Based on Marx's Labor Value Theory. Friends of Accounting, (20), 72-77.

Jin, X., Wang, Y. W., & Yin, K. D. (2024). Research on the measurement and spatiotemporal evolution characteristics of new quality productive forces in China's marine economy. Frontiers in Marine Science, 11, 1497167. http://doi.org/10.3389/fmars.2024.1497167

Li, F. Y., Fang, H., & Deng, S. H. (2022). Environmental Regulation, Industrial Structure Upgrading and Technological Innovation: Empirical Data from Guangdong Province in China. Polish Journal of Environmental Studies, 31(3), 2157-2166. http://doi.org/10.15244/pjoes/143919

Li, H., Yang, X., Meng, F. Y., Hou, Y., Zhang, J. S., Zhang, L. Y., . . . Liu, J. Y. (2024). A Dynamic Impact Evaluation of the High-Quality Development of China's Construction Industry Using the Panel Vector Autoregressive Model. Buildings, 14(9), 2871. http://doi.org/10.3390/buildings14092871

Li, H., Zhang, L. Y., Liu, J. Y., Zhang, J. S., Gao, Z. H., Liu, Y. L., . . . Yang, G. (2024). The High-Quality Development of the Construction Industry in the Context of the Digital Economy—Based on the Mediating Effect of Entrepreneurship. Buildings, 14(11), 3490. http://doi.org/10.3390/buildings14113490

Li, Z., & Cui, H. Y. (2024). On new quality productivity from the perspective of historical materialism: Connotation, formation conditions and effective paths. Journal of Chongqing University (Social Science Edition), 30(01), 129-144. http://doi.org/10.11835/j.issn.1008-5831.pj.2023.12.003

Lin, L., Gu, T. Y., & Shi, Y. (2024). The Influence of New Quality Productive Forces on High-Quality Agricultural Development in China: Mechanisms and Empirical Testing. Agriculture, 14(7), 1022. http://doi.org/10.3390/agriculture14071022

Liu, J. T. (2024). Digital New Quality Productivity Promoting Domestic and International Dual Circulation：Based on Mediating Effect Test of Industrial Structure Upgrading. Journal of Technical Economics & Management, (12), 47-52.

Liu, K. Q., & Wang, G. F. (2024). How Does the Spatial Structure of Innovation Agglomeration Affect Energy Efficiency? From the Role of Industrial Structure Upgrading. Energies, 17(16), 3977. http://doi.org/10.3390/en17163977

Liu, Y. B., Zhao, T. Y., & Gao, S. L. (2023). Can the strategic emerging industry venture capital guidance fund promote enterprise innovation? Industrial Economics Research, (01), 73-85+142. http://doi.org/10.13269/j.cnki.ier.2023.01.008

Pan, D. D. (2025). Entrepreneurship, Venture Capital and County-Level Industrial Restructuring. Modern Economic Research, (05), 80-90. http://doi.org/10.13891/j.cnki.mer.2025.05.011

Ren, Y. X., Wu, Y., & Wu, Z. (2024). Financial Agglomeration, Industry-University Research Cooperation, and New Quality Productivity. The Theory and Practice of Finance and Economics, 45(03), 27-34. http://doi.org/10.16339/j.cnki.hdxbcjb.2024.03.004

Shen, X. B., Chen, Y., & Lin, B. Q. (2021). The Impacts of Technological Progress and Industrial Structure Distortion on China's Energy Intensity. Economic Research Journal, 56(02), 157-173.

Shi, J. X., & Xu, L. (2024). Major Strategic Significance and Implementation Path of Accelerating the Formation of New Quality Productivity. Research on Financial and Economic Issues, 01(01), 3-12. http://doi.org/10.19654/j.cnki.cjwtyj.2024.01.001

Song, J. R., & Tong, X., L. (2024). How New Quality Productivity Affects Industrial Chain Resilience: Theoretical Analysis and Empirical Evidence. Statistics & Decision, 40(14), 17-22. http://doi.org/10.13546/j.cnki.tjyjc.2024.14.003

Sun, J. D., Zheng, M., & Fu, J. W. (2019). Connotation and Policy Suggestions of High-quality Development of Construction Industry in New Era. Construction Economy, 40(05), 5-9. http://doi.org/10.14181/j.cnki.1002-851x.201905005

Sun, Y., & Liu, W. C. (2022). Research on Evaluation of High-Quality Development of the Construction Industry: Taking the Study of Liaoning Province as an Example. Construction Economy, 43(S2), 32-36. http://doi.org/10.14181/j.cnki.1002-851x.2022S2032

Wang, D., & Cheng, X. D. (2024). Study on the path of high-quality development of the construction industry and its applicability. Scientific Reports, 14(1), 14727. http://doi.org/10.1038/s41598-024-64786-y

Wang, M. (2024). New Quality Productivity, Open Innovation and Common Prosperity. Journal of Technical Economics & Management, (12), 35-40.

Wang, W. Z., Qi, Z. F., & Zhang, L. T. (2019). Construction and Evaluation of the Measuring System for High-quality Development of Construction Industry in New Era. Construction Economy, 40(12), 21-26. http://doi.org/10.14181/j.cnki.1002-851x.201912021

Wang, Y. R., Xie, X. X., & Yang, Y. (2024). How new quality productive forces empower high-quality economic development: Based on the perspective of innovation factor allocation. Social Sciences in Xinjiang, 06(06), 42-53. http://doi.org/10.20003/j.cnki.xjshkx.2024.06.005

Wang, Y., & Wu, X. (2022). Research on High-Quality Development Evaluation, Space–Time Characteristics and Driving Factors of China’s Construction Industry under Carbon Emission Constraints. Sustainability, 14(17), 10729. http://doi.org/10.3390/su141710729

Wen, H. Z., Zhang, B., Li, S. Y., Zhang, L., Gui, B., & Liu, Z. L. (2024). Evaluating High-Quality Development in the Construction Industry via the Matter-Element Extension Method: A Case Study of 11 Cities in Zhejiang, China. Buildings, 14(11), 3499. http://doi.org/10.3390/buildings14113499

Wu, J. Q., & Gao, Y. (2025). Digital Economy, Supply Chain Stability, and Agricultural Enterprise Performance. Communication of Finance and Accounting, (08), 34-38. http://doi.org/10.16144/j.cnki.issn1002-8072.2025.08.008

Wu, Q., & Shi, K. J. (2025). Theoretical Analysis and Empirical Evidence of New Quality Productivity and Agricultural Economic Resilience. On Economic Problems, (02), 111-120. http://doi.org/10.16011/j.cnki.jjwt.2025.02.008

Wu, X. H., & Zhang, T. L. (2021). Research on Comprehensive Evaluation of the High-quality Development of Construction Industry：Take Jiangsu Province as an Example. Construction Economy, 42(12), 20-26. http://doi.org/10.14181/j.cnki.1002-851x.202112020

Xi, J.P. (2022). Holding high the great banner of socialism with Chinese characteristics and working together for the comprehensive construction of a modern socialist country. Report at the 20th National Congress of the Communist Party of China. Xinhua News Agency.Retrieved from http://www.xinhuanet.com/politics/2022-10/25/c_1129079429.htm

Xu, L., Liu, Y. T., Liu, S., Zhang, Q., & Chu, J. R. (2025). Impact of new quality productive forces and resource allocation efficiency on industrial structure upgrading in resource-based cities. China Mining Magazine, 34(03), 33-42. http://doi.org/10.12075/j.issn.1004-4051.20242468

Xu, S., Wang, J. T., & Peng, Z. S. (2024). Study on the Promotional Effect and Mechanism of New Quality Productive Forces on Green Development. Sustainability, 16(20), 8818. http://doi.org/10.3390/su16208818

Yang, C. Q., Xiong, H. P., & Li, M. Z. (2020). Research on Evaluation of High-quality Development of Construction Industry in Hubei Province. Construction Economy, 41(12), 15-20. http://doi.org/10.14181/j.cnki.1002-851x.202012015

Yang, Y. L. (2024). Some issues in promotion of new quality productivity in chemical industry. Modern Chemical Industry, 44(12), 1-9. http://doi.org/10.16606/j.cnki.issn0253-4320.2024.12.001

Yao, L., Li, A. Y., & Yan, E. W. (2025). Research on digital infrastructure construction empowering new quality productivity. Scientific Reports, 15(1), 6645. http://doi.org/10.1038/s41598-025-90811-9

Yu, W., Zhao, W. Y., & Zhao, T. T. (2024). Research on the internal mechanism and improvement path of digital economy empowering the development of new quality productivity. Journal of Chongqing University (Social Science Edition). Retrieved from https://link.cnki.net/urlid/50.1023.C.20241226.1054.004

Zeng, L., & Xie, P. J. (2023). Accelerating the Formation of Emergence Context, Functional Positioning, and Advancing Path of New Quality Productivity. Economic Review Journal, 12(12), 29-37. http://doi.org/10.16528/j.cnki.22-1054/f.202312029

Zhang, L. X., & Zhang, J. R. (2024). Evaluation and promotion path of high-quality development in the Chinese construction industry under the context of carbon neutrality. Environment Development and Sustainability, 1-32. http://doi.org/10.1007/s10668-024-04837-6

Zhang, L. X., & Zhang, J. R. (2024). Evolution and Influencing Factors of High-quality Development of Construction Industry in China. Areal Research and Development, 43(01), 1-8. http://doi.org/10.3969/j.issn.1003-2363.2024.01.001

Zheng, M. G., Yan, S., & Xu, S. Q. (2025). Digital Economy, Industry-Academia-Research Collaborative Innovation, and the Development of New-Quality Productive Forces. Sustainability, 17(1), 318. http://doi.org/10.3390/su17010318

Zhou, S. D., & Hu, H. J. (2024). A Political Economy Study on How New Quality Productivity Promotes Innovative Development. Journal of Xinjiang Normal University (Edition of Philosophy and Social Sciences), 45(05), 26-35. http://doi.org/10.14100/j.cnki.65-1039/g4.20231012.001

Zhou, W., & Bai, J. (2025). New-quality Productivity and New Type of Production Relations: The Leap in Productivity and the Transformation of Production Relations. Journal of Yunnan Minzu University (Philosophy and Social Sciences Edition), 42(01), 131-142. http://doi.org/10.13727/j.cnki.53-1191/c.20241231.003