Textile & Leather Review

ISSN 2623-6281| www.tlr-journal.com | 10.31881/TLR

Experimental Study on the Measurement of High-Quality Development of Shanghai's New Quality Productive Forces Based on the Improved TOPSIS Algorithm

Yu Sun, Rong Huang

How to cite: Sun Y, Huang R. Experimental Study on the Measurement of High-Quality Development of Shanghai's New Quality Productive Forces Based on the Improved TOPSIS Algorithm. Textile & Leather Review. 2026; 9:5539-5564. https://doi.org/10.31881/TLR.2026.5539

How to link: https://doi.org/10.31881/TLR.2026.5539

Published: 13 November 2026

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

Experimental Study on the Measurement of High-Quality Development of Shanghai's New Quality Productive Forces Based on the Improved TOPSIS Algorithm

Yu Sun, Rong Huang*

School of Economics and Management, Shanghai Ocean University, Shanghai 201308, China

*rhuang@shou.edu.cn

Article

https://doi.org/10.31881/TLR.2026.5539

Published 13 November 2026

ABSTRACT

Existing studies on new quality productive forces (NQP) and high-quality development primarily focus on the national level, lacking local empirical research and sufficient details regarding algorithm application. This study centers on computer algorithm modeling and experimental verification and constructs an improved TOPSIS algorithm system integrated with the entropy weight method. This system innovatively optimizes two key aspects: (1) adopting global standardization to avoid deviations caused by isolated annual data fluctuations; (2) enabling adaptive processing of mixed-type indicators (relative share and absolute value) to match the characteristics of the NQP measurement system. The study conducts quantitative measurement of the high-quality development level of Shanghai's NQP from 2018 to 2022. An evaluation system covering 10 subsystems and 50 measurement indicators is established. Considering Shanghai's industrial background, this framework provides a macro-environmental assessment for the high-end and intelligent transition of traditional pillar industries, such as the textile sector. The research results show that the development level of each subsystem varies across different years, while the overall development level shows a consistent upward trend. Specifically, the enhancement of the "Innovation-Driven" and "Infrastructure" subsystems demonstrates a growing technical foundation for modernizing the textile industry. Based on the overall development level of NQP, this study divides the period from 2018 to 2022 into three distinct development stages: the "high-level development period", the "medium-level development period", and the "low-level development period". The study concludes that leveraging NQP to promote the transformation of the textile industry will be a vital path for Shanghai's sustained high-quality advancement.

KEYWORDS

high-quality advancement, new quality productive forces (NQP), entropy-weighted TOPSIS method, measurement system, textile industry transformation

INTRODUCTION

In the 2022 report of the 20th Party Congress, Xi Jinping emphasized that "the primary task of comprehensively building a socialist modernized country is high-quality advancement". Xi first introduced the concept of "new quality productive forces (NQP)" in September 2023 while conducting research and inspection in Heilongjiang. He noted that it is essential to "utilize sci-tech innovation resources, lead the advancement of strategic emerging industries (SEI) and future industries (FI), and accelerate the formation of NQP" [1]. He pointed out that this transformation is not only relevant for emerging sectors, but also provides a strategic path for the high-end, intelligent, and green transition of traditional pillar industries, such as the textile industry. He also emphasized the need to lead the comprehensive revitalization of industries through scientific and technological innovation. At the Central Economic Work Conference in December of that year, it was underlined that scientific and technological innovation—particularly disruptive and cutting-edge technologies—should propel industrial innovation to create new industries, modes, and kinetic energies, as well as new, high-quality productive forces. By promoting industrial upgrading through scientific and technological innovation, NQP offers technical support for high-quality development across various sectors, including modern textiles and advanced manufacturing. High-quality advancement, in turn, develops application scenarios and policy guarantees for NQP through value leadership and system optimization.

Shanghai, as a representative megacity, is promoting high-quality economic and social development through innovation, coordination, green development, openness, and sharing. As an important part of Shanghai's industrial heritage and modern manufacturing system, the textile industry's evolution toward functional fibers and smart textiles serves as a vivid demonstration of NQP in practice. NQP represents a new form of productivity emerging in the current stage of economic development. To support Shanghai's high-quality advancement, this study begins by measuring the level of NQP development, suggests ten subsystems for gauging the degree of Shanghai's NQP, and examines the benefits and drawbacks of the city's NQP advancement.

LITERATURE REVIEW

Jin (2018) believes that the stage of high-quality advancement is distinct from the mechanism powered by instrumental rationality in the stage of high-speed growth. The stage of high-quality advancement requires a new power mechanism with more intrinsic value rationality, led by innovation on the supply side and people's demands on the demand side [2]. Using ten different aspects—improvement of the economic form, innovation-driven advancement, effective utilization of resources, enhancement of marketplace systems, maintenance of steady economic expansion, regional coordination

and collaboration, excellent goods and services, facilities enhancement, construction of sustainable civilization, and shared economic outcomes for the public—Wei Min and Li Shuhao creatively developed a measurement system for the degree of high-quality economic advancement [3]. From a supply and demand perspective, Gao Fan (2023) explains the rationale for the suggestion of NQP. From the perspectives of outcomes, components, and factor combinations, it delves into the significance of NQP [4]. According to Zhou Wen and Xu Lingyun, NQP are a significant increase in production, primarily driven by scientific and technological innovation. In this context, "new" refers to technology, economy, and business models that have never existed before, while "quality" refers to improvements in innovation and productivity resulting from essential and disruptive innovations [5]. Pu Qingping describes NQP as a newly emerging form of productivity, propelled by advances in science and technology [6]. Based on their theoretical understanding of NQP, Han Wenlong, Zhang Ruisheng, and Zhao Feng developed an index system to measure these factors, believing they are crucial to China's high-quality economic advancement [7]. Using the aforementioned three aspects of production, Wang Jue and Wang Rongji dismantled the prior solo viewpoint. Labor inputs, production objects, and production methods constitute the three pillars of the measurement system around which they built the measurement system and indices of NQP [8]. According to Huang Qunhui and Sheng Fangfu, the NQP system stands out from traditional productivity due to its four main traits: innovation-driven, green and low-carbon, openness and integration, and people-oriented embeddedness. These characteristics are interconnected, interact, and are coupled with each other, creating an organic whole [9].

Although there have been some results in recent years regarding China's high-caliber innovation and new, high-quality production mechanisms in the field of research, there is less research on these topics at the local level in provinces and cities. International studies have initially explored the spatial evolution characteristics and core influencing factors of urban innovation in Shanghai from a quantitative perspective, laying a foundational empirical research basis for measuring urban NQP in China's megacities [10]. Another frontier study has deeply analyzed the fundamental logic and operational mechanism of scientific and technological innovation empowering the development of NQP, further supplementing the theoretical framework of NQP's core driving forces from an international perspective [11]. Shanghai, as China's largest city in terms of economic output, is also home to international centers for trade, shipping, finance, and scientific and technological innovation. As such, it has consistently insisted on pursuing economic growth of exceptional quality. International frontier studies have constructed a bibliometric multicriteria assessment model for urban quality in the future city, which provides a systematic methodological reference for the multidimensional measurement of urban development quality [12]. This paper offers a thorough assessment of Shanghai's NQP level of advancement across ten

subsystems from 2018 to 2022. It then begins to examine in detail the problems, advancement status, and issues in various fields. Finally, it makes policy recommendations to support the growth of Shanghai's NQP, coupled with concentrated, high-quality economic growth.

MEASUREMENT LOGIC, SYSTEM, AND METHODOLOGY

Measurement Logic

This study examines Shanghai from 2018 to 2022 by integrating both the process and outcomes of high-quality development. It evaluates not only the current capacity of Shanghai's advancement but also its prospects and potential, thoroughly assessing the existing challenges confronting Shanghai's current high-quality development and the guiding ideology and philosophy in the modern period. The study divides Shanghai's NQP measurement into ten subsystems: improvement of the economic form, innovation-driven advancement, effective utilization of resources, improvement of market systems, maintenance of steady economic expansion, regional coordination and sharing, goods and services of a high standard, infrastructure improvement, construction of ecological civilization, and shared economic outcomes for the public [3]. The following are the specific concepts:

(1) Improvement of the economic form. In the modern era, Shanghai's advancement of NQP needs to break through dependence on conventional industries and establish a contemporary industrial system centered on scientific and technological innovation. First, by advancing new quality industries and evaluating the development level of the industrial system through the proportion of SEI (value-added of SEI/GDP), and identifying potential future breakthroughs through "Shanghai industrial robot output/national total output" and "Shanghai IC sales/national total output". Second, by enhancing the evolution of the industrial framework towards a sophisticated model, utilizing the "index of rationalization of industrial structure" measured by Theil's entropy, and the "Index of Sophisticated Industrial Structure", which reflects the dominant trend of the service economy based on the ratio of the tertiary sector to the secondary sector. Third, to optimize the structure of the open economy, monitoring the quality and upgrading of foreign investment through "Actual Utilization of Foreign Direct Investment/GDP", and assessing the ability of global resource allocation through "Total Volume of Foreign Trade/GDP", to jointly build an analytical framework for the new advancement pattern of "dual circulation".

(2) Innovation-driven advancement. Facing new global scientific and technological competition, developing NQP in Shanghai requires building a comprehensive innovation monitoring system. First, by enhancing the quality of innovation factor inputs, "R&D investment intensity" (R&D spending/GDP) reflects the degree of intellectual capital accumulation,

and “R&D personnel input intensity” (R&D personnel/total number of employees) measures the density of high-end human capital. Together, these constitute the basis of innovation. Second, by enhancing the efficiency of innovation transformation, “patent possession per capita” (number of patents granted/population) quantifies the original capability of technology, and “technology market turnover ratio” (turnover/GDP) reveals the level of marketization of technological factors. Finally, to highlight the degree of economic contribution of innovation, “innovative product profitability” (innovative product revenue/industrial revenue) measures the speed of product iteration, and “high-tech income generation” (high-tech output value/industrial output value) evaluates the effectiveness of industrial upgrading. These three levels form a complete observation chain of “factor input – result transformation – economic contribution”, accurately portraying the trajectory of technological and scientific breakthroughs from laboratory to industrialization.

(3) Effective utilization of resources. Developing NQP requires a breakthrough in the traditional diminishing marginal output of factors. First, to improve the efficiency of capital factors, “capital productivity” (GDP/investment in fixed assets) reveals the quality of capital deepening. Second, to optimize the allocation of labor factors, “labor productivity” (GDP/number of employees) reflects the value-added level of human capital. Third, to promote intensive use of energy, “energy productivity” (GDP/tons of standard coal) monitors the process of green transformation. Finally, to improve the efficiency of land elements, “land productivity” (food production/cultivated land area) assesses the quality of spatial utilization. By continuously improving the productivity of capital, labor, energy, and land, high-quality and high-efficiency advancement can be fully realized.

(4) Improvement of market systems. Cultivating NQP requires deepening market-oriented reforms. First, to boost market participants’ vitality, the dual indicators “proportion of investment in non-state economy” and “proportion of output in non-state economy” reflect the synergistic advancement pattern of diversified ownership. Second, to regulate the boundaries of governmental behavior, the “proportion of governmental investment” (budgetary funds/fixed investment) and “proportion of governmental consumption” monitor the construction of an “effective market + capable government.” Lastly, to promote reform of the factor market, the “value-added of the financial industry/GDP” reveals the allocation quality of capital factors, and the “proportion of individual employment” shows labor market flexibility. These two factors work together to create the reform of factor marketization.

(5) Maintenance of steady economic expansion. The advancement of NQP requires building a resilience assessment framework. First, the “economic volatility rate” (standard deviation of GDP growth) quantifies output stability, reflecting macroeconomic risk resistance. Second, the “industrial producer price index” and “consumer price index” monitor the price transmission mechanism in two dimensions to prevent the risk of imported inflation. Lastly, the “urban registered

unemployment rate" indicates the social safety valve to guard the bottom line of livelihood protection. The three-in-one indicator system accurately anchors economic operation within a reasonable range.

(6) Regional coordination and sharing. Promoting the inclusive advancement of NQP requires constructing a spatially balanced assessment mechanism. The "coordinated level of urban and rural income" (income ratio) and the "coordinated level of urban and rural consumption" (consumption comparison) directly quantify the gap between urban and rural integrated advancement, reflect the effectiveness of regional coordination, and form a people-centered observation network for sharing the fruits of advancement.

(7) Goods and services of a high standard. The realization of the value of NQP relies on the supply quality revolution. "Food safety pass rate" establishes the baseline for product safety, "value-added of service industry/GDP" reflects the leading trend of the service economy, "density of high-star hotels" and "tourism revenues/visits" measure the improvement of service capacity from the perspectives of facility supply and consumption experience, respectively, building a three-dimensional observation framework for enhancing the supply system's effectiveness and quality.

(8) Infrastructure improvement. A new infrastructure system is required to support the operation of NQP. "The number of 5G mobile subscribers" quantifies the level of digital base construction, "the density of graded highways" and "the number of medical beds" measure the service capacity of traditional facilities, "the density of ordinary universities" and "the number of library collections" assess the depth of knowledge infrastructure, and "the number of Internet broadband ports" reflects the efficiency of information circulation, forming a synergistic and empowering assessment matrix of "hard facilities and soft environment".

(9) Construction of ecological civilization. The advancement of NQP must practice the concept of green advancement. "Forest coverage" measures the quality of the ecological background, "environmental protection investment/GDP" reflects the intensity of environmental governance inputs, "three wastes per unit of GDP" monitors the effectiveness of green transformation of the production model, establishing a modern observational yardstick for the peaceful coexistence of environment and humans.

(10) Shared economic outcomes for the public. The ultimate goal of NQP advancement is to improve people's well-being. "Per capita disposable income" and "consumption expenditure" quantify the material standard of living, "population mortality rate" assesses basic health protection, "education expenditure/GDP" measures the intensity of human capital investment, and "education, culture, and recreation expenditure as a proportion of total expenditure" measures the level of leisure and welfare. The evaluation of quality of life can be enhanced by measuring welfare in multiple aspects such as income, consumption, health, education, and leisure, systematically constructing a monitoring system

for the universal sharing of advancement achievements.

Measurement System

Comprehensive Measurement of the Advancement Level of NQP in Shanghai, 2018–2022. The logic of measuring the NQP advancement level, while considering the hierarchy of measurement indicators and data availability, is used to construct the NQP advancement level. With 50 indicators divided into 10 subsystems, the NQP level measurement system includes: economic form optimization, innovation-driven advancement, effective resource allocation, enhancement of market system, maintenance of steady economic expansion, regional coordination and sharing, goods and services of a high standard, ideal infrastructure, ecological civilization, and economic outcomes for the people's benefit, as shown in Table 1.

Table 1. Measurement System for the Advancement Level of NQP

Subsystems	Standardized layer	Specific measurement indicators	Indicator measurement modalities	Efficacy
economic form optimization	new quality industry	Percentage of SEI	Value added of SEI/GDP	+
		Degree of FI advancement	Shanghai Industrial Robot Production / National Total Production	+
			Shanghai IC sales/National total production	+
	industrial structure	Rationalization of industrial structure	Industrial structure rationalization index	-
		Sophisticated industrial structure	Index of sophisticated industrial structure	+
	Investment and consumption structure	investment structure	Share of investment in the tertiary sector	+
		consumer structure	Share of consumption expenditure on food by the population	-
	Economic openness structure	openness to foreign investment	Actual utilization of FDI/GDP	+
		Foreign trade openness	Total Volume of Foreign Trade/GDP	+
innovation-driven advancement	Innovative inputs	R&D investment intensity	R&D expenditure/GDP	+
		R&D personnel's investment efforts	Number of R&D personnel/number of all employees	+
	Innovation outputs	Patent holdings per capita	Number of three kinds of patents granted in Shanghai/total population	+
		Technology market turnover as a percentage	Technology market turnover/GDP	+

	Innovative contributions	Innovative products to increase profitability	Revenue from sales of innovative products/revenue from the primary business of industrial enterprises	+

Table 1. Measurement System for the Advancement Level of NQP (Continued)

Subsystems	Standardized layer	Specific measurement indicators	Indicator measurement modalities	Efficacy
		High-tech revenue generation	Share of industrial output value of high-tech industries in the city	+
Effective resource allocation	capital efficiency	capital productivity	GDP/total investment in fixed assets	+
	labor efficiency	labor productivity	GDP/number of total employees	+
	energy efficiency	Energy productivity	GDP/tons of standard coal	+
	Land efficiency	Land productivity	Total grain production/total cultivated area	+
Perfect market system	Diversification of economic agents	Share of investment in the non-state economy	Share of investment in fixed assets in the non-state economy	+
		Share of output of the non-state economy	Industrial output/total industrial output of non-state enterprises	+
	Government Code of Conduct	Share of government investment	Shanghai's budgetary funds/total investment in fixed assets of the whole society	-
	Factor market advancement	Degree of capital factor marketization	Financial sector value added/GDP	+
		Degree of marketization of labour factors	Number of self-employed persons/number of all employed persons	+
Maintenance of steady economic expansion	Stabilization of outputs	economic volatility	year-on-year GDP growth rate	-
	Price stability	Producer price index	Industrial producers' ex-factory price index	-
		Consumer Price Index CPI	Consumer price index CPI	-
	stable employment	unemployment rate	Urban registered unemployment rate	-
Regional coordination and sharing	Level of urban-rural coordination	Level of income harmonization between urban and rural areas	Ratio of income between urban and rural areas	-

Table 1. Measurement System for the Advancement Level of NQP (Continued)

Subsystems	Standardized layer	Specific measurement indicators	Indicator measurement modalities	Efficacy
		Level of urban-rural consumption harmonization	Comparison of consumption levels between urban and rural areas	-
Goods and services of a high standard	food safety	Food safety compliance rate	Food safety compliance rate	+
	Quality of service	Service Industry Emphasis	Tertiary value added/GDP	+

		Service product sophistication	Density of high-star (four- and five-star) hotels	+
		Degree of optimization of services consumption	Gross tourism receipts/total tourist arrivals	+
Ideal infrastructure	New infrastructure enhanced	5G mobile subscriptions	Number of 5G mobile subscribers	+
	Complete hard facilities	Improvement of transportation facilities	Density of graded roads	+
		Improvement of medical facilities	Number of beds per capita in health-care facilities	+
		Improvement of sanitation facilities	Public toilets per 10,000 population	+
	Well-established soft facilities	Degree of sophistication of educational facilities	The density of general colleges and universities	+
		Improvement of cultural facilities	Public library holdings per capita	+
		Improvement of network facilities	Internet broadband access ports per capita	+
Ecological civilization	greening	forest cover	forest cover	+
		Proportion of investment in environmental protection equivalent to Shanghai's GDP	Proportion of investment in environmental protection equivalent to Shanghai s GDP	+
	reduce pollution	Wastewater discharge per unit of GDP	Total wastewater discharge/GDP	-
		Exhaust emissions per unit of GDP	Sulphur dioxide emissions/GDP	-
		Solid waste emissions per unit of GDP	General industrial solid waste generation/GDP	-
Shared economic outcomes for the public	Income benefits	Per capita disposable income	Per capita disposable income	+

Table 1. Measurement System for the Advancement Level of NQP (Continued)

Subsystems	Standardized layer	Specific measurement indicators	Indicator measurement modalities	Efficacy
	consumer welfare	Consumption expenditure per capita	Consumption expenditure per inhabitant	+
	Health benefits	Population mortality rate	Population mortality rate	-

	Educational benefits	Level of importance attached to education	Expenditure on education/GDP	+
	Leisure benefits	Share of expenditure on recreation and education	Expenditure on education, culture and recreation as a share of total expenditure	+

Note:

1. "+/-" in the "Efficacy" column signifies that the measure is positively (negatively) skewed in a set measurement format, with the larger (smaller) the better.

2. Clarify that Shanghai was in a critical transition period for cultivating NQP from 2018 to 2022. Some economic volatility originated from transformative factors such as the connection between old and new growth drivers, investment in scientific and technological innovation, and adjustment of production capacity structure. Such volatility is not an absolute reflection of insufficient macroeconomic risk resistance, but a phased byproduct of industrial structure optimization, which needs to be comprehensively evaluated in combination with the transformation background.

It should be emphasized that the definition of NQP as "breaking away from dependence on traditional industries" in this study does not mean completely separating from traditional economic foundations, but rather promoting the coordinated development of "transformation and upgrading of traditional industries" and "innovative breakthroughs of emerging industries". The inclusion of indicators such as "land productivity (grain output/cultivated land area)" and "density of graded roads" in the 50-indicator system is not the application of 20th-century industrial and agricultural measurement benchmarks, but the integration of their new-quality connotations adapted to the new era. These are important supporting dimensions for the development of NQP.

Specifically, for "land productivity (grain output/cultivated land area)" under the "effective resource allocation" subsystem: This indicator does not simply measure the scale of agricultural output, but reflects the improvement of land use efficiency empowered by agricultural technology. Its measurement connotation covers the application of smart agriculture technologies (such as precision irrigation and unmanned farming), the promotion of green production models (such as organic farming and circular agriculture), and the transformation of agricultural production from "extensive growth" to "high-quality development". This is the concrete manifestation of NQP in the agricultural field, which is essentially different from the traditional land output measurement in the 20th century.

For "density of graded roads" under the "infrastructure improvement" subsystem: This indicator is not merely a measure of transportation infrastructure scale, but a key carrier for supporting the spatial coordination of new-quality industries. A sound graded highway network provides basic guarantees for the integration of industrial chains and supply chains in the Yangtze River Delta, accelerates the circulation of factors such as talent, technologies, and products in emerging industries (such as digital economy and high-end equipment manufacturing), and effectively supports the market expansion and regional collaboration of NQP. Its functional value has been fully adapted to the development needs of the

new era, and it is an indispensable infrastructure support for NQP development.

This paper measures the high-quality advancement level of Shanghai from the standpoint of NQP. It is based on the ten subsystems for measuring the high-quality advancement level proposed by Wei Min and Li Shuhao, while also adding specific measurement indicators such as “the proportion of SEI”, “the advancement degree of FI”, and “the number of 5G mobile users”. In the specific measurement indicators of Table 1, the rationalization index of industrial structure and the index of sophisticated industrial structure were calculated by referring to the practices of Gan Chunhui, Zheng Ruogu, and Yu Fanpin [13]. The proportion of SEI was quantified by the ratio of the added value of SEI to GDP, referring to the practices of Lyu Yanwei and Sun Hui [14]. Economic volatility was calculated according to Zhan Xinyu and Cui Peipei [15], and the improvement degree of new infrastructure was measured by the number of 5G mobile users, referencing Han Wenlong, Zhang Ruisheng, and Zhao Feng [7]. Based on this series of indicators, the comprehensive advancement level of NQP in Shanghai during the high-quality advancement stage is comprehensively measured. Subsequently, utilizing the enhanced entropy weight Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, a measurement model for the advancement level of Shanghai’s NQP was constructed to conduct a measurement study on the high-quality advancement level of Shanghai.

To address the potential for distorted comparisons caused by indicator dimensional discrepancies, this study first unifies the type of core industrial indicators: both “Shanghai Industrial Robot Production/National Total Production” and “Shanghai IC Sales/National Total IC Sales” are designed as relative share indicators, which reflect Shanghai’s comparative advantage in national new quality industries. Subsequently, all 50 measurement indicators (including the above relative share indicators and other absolute value indicators) are standardized using the extremum standardization method (detailed in Measurement Methods and Data Sources) to eliminate differences in units and scales. This two-step preprocessing ensures that indicators of different types are comparable within the same evaluation framework, thereby accurately reflecting the specificity of Shanghai’s NQP development.

Measurement Methods and Data Sources

1. Core Logic of Algorithm Design for Experimental Application

The improved TOPSIS algorithm is designed with the core experimental goal of “objective quantification in multi-attribute decision-making experiments” [16]. International methodological studies have verified the scientific validity of the hybrid approach integrating the entropy weight method and TOPSIS, providing methodological support for solving the

problem of subjective bias in traditional multi-attribute decision-making and the adaptive processing of complex indicators. To address critical experimental limitations of the traditional TOPSIS—such as biased results from subjective weight assignment (a common issue in manual weighting operations) and distorted comparisons caused by indicator dimensional discrepancies (e.g., units like "100 million CNY" vs. "percentage")—it integrates the entropy weight method's objective weighting mechanism into the experimental workflow. The experimental framework follows a three-stage process tailored for data analysis: "experimental data standardization to eliminate dimensional differences → entropy weight calculation for objective indicator weighting → spatial distance measurement to quantify closeness coefficients". From the perspective of experimental theoretical support, the algorithm adheres to the "distance optimization principle" in sample evaluation: in the experiment, each evaluated sample (e.g., Shanghai's NQP development level data for each year from 2018 to 2022, totaling five time-series samples) is mapped as a discrete point in a multi-dimensional indicator space (constructed based on 50 experimental indicators). Two reference benchmarks are established for the experiment: the "positive ideal solution" (a virtual sample composed of the theoretical maximum values of all experimental indicators, representing the optimal development state) and the "negative ideal solution" (a virtual sample composed of the theoretical minimum values of all experimental indicators, representing the worst development state). By calculating the Euclidean distances between each experimental sample point and the two ideal solutions using matrix operations, the relative closeness coefficient (C_t) of each sample is derived—this coefficient serves as the core experimental index for ranking samples and classifying their development levels.

Compared with the traditional TOPSIS, the improved algorithm's core innovations are optimized for experimental applicability:

Experimental weighting optimization: It replaces subjective weighting methods (e.g., Analytic Hierarchy Process (AHP), which requires manual pairwise comparison and is prone to human error) with the entropy weight method. In the experiment, the information entropy of each indicator is calculated to quantify its discrimination ability (i.e., how well the indicator distinguishes between different samples). This ensures that weight assignment is driven by experimental data characteristics rather than subjective judgments, reducing experimental bias.

Experimental data standardization optimization: It adopts "global standardization" instead of "local standardization" (which only standardizes data within a single sample). In the experiment, all time-series data (2018–2022) for each indicator are included in a unified standardization interval [0, 1]. This avoids experimental result deviations caused by isolated annual data fluctuations (e.g., abnormal 2020 data due to external factors) and is particularly suitable for experiments using panel data (such as the five-year time-series data in this NQP measurement experiment).

Compared with the existing entropy-weighted TOPSIS methods widely used in the literature, the improved algorithm in this study has two unique innovations oriented to the NQP measurement scenario. Recent international studies have further optimized the TOPSIS model through the integration of the G1 method and entropy weight method, verifying the effectiveness of the improved algorithm in dealing with complex indicator systems and enhancing measurement accuracy, providing valuable reference for the adaptive processing of mixed-type indicators in this study [17].

(1) Innovation in standardization logic: Unlike the local standardization (only standardizing data within a single year) adopted in traditional studies, this study applies global standardization to all time-series data (2018–2022) of each indicator. This optimization effectively avoids distortion of measurement results caused by abnormal annual data (such as the 2020 data affected by the pandemic) and ensures comparability and stability of evaluation results across years, which is more suitable for panel data analysis of NQP's long-term development.

(2) Innovation in indicator adaptation processing: Considering the mixed characteristics of the 50-indicator system (including relative share indicators reflecting regional comparative advantages and absolute value indicators measuring development scale), this study first unifies the type of core industrial indicators and then conducts standardized processing. This operation solves the problem of distorted comparisons caused by dimensional differences between different types of indicators, making the algorithm more adaptive to the complexity of the NQP measurement system.

Existing studies (e.g., Han et al., 2024; Wang et al., 2024) mostly apply the entropy-weighted TOPSIS method directly to measurement systems with single-type indicators, lacking targeted optimization for mixed-type indicators and panel data characteristics. The two innovations proposed in this study fill the gap in the application of the entropy-weighted TOPSIS method in the NQP measurement field, making the algorithm more scientific and reliable in practical application.

2. Implementation Steps of the Improved TOPSIS Algorithm and Data Sources

Step 1: Indicator Standardization

In the first step, the indicators are standardized using the extremum normalization method:

$$Y_{tj} = \begin{cases} \dfrac{X_{tj} - \min(X_j)}{\max(X_j) - \min(X_j)}, \text{for positive indicators} \\ \dfrac{\max(X_j) - X_{tj}}{\max(X_j) - \min(X_j)}, \text{for negative indicators} \end{cases} \quad (1)$$

where t denotes the year (2018–2022), and j represents the evaluation indicator. X_{tj} is the original value of indicator j in year t, and Y_{tj} is the standardized value within the interval [0, 1].

This extremum standardization method is applied to both relative share indicators (e.g., Shanghai industrial robot pro-

duction / national total production) and absolute value indicators, thereby unifying their measurement scales and preventing distorted comparisons caused by dimensional differences.

Step 2: Information Entropy Calculation

In the second step, the information entropy E_j of each indicator is calculated. The sample size is five years (n = 5). A smaller entropy indicates a higher degree of discrimination for the corresponding indicator.

$$E_j = -\frac{1}{\ln 5}\sum_{t=1}^{5} Y_{tj} \ln Y_{tj} \tag{2}$$

Step 3: Determination of Indicator Weights

In the third step, the entropy weight W_j is calculated.

Indicators with lower entropy values (i.e., higher discrimination) are assigned larger weights.

$$W_j = \frac{1 - E_j}{\sum_{j=1}^{m}(1 - E_j)} \tag{3}$$

where W_j represents the weight of indicator j, and m denotes the total number of indicators.

Step 4: Construction of the weighted matrix

In the fourth step, the weighted decision matrix R is constructed as

$$R=(r_{tj})_{5\times m}$$

$$r_{tj} = W_j Y_{tj} \tag{4}$$

The resulting matrix has a dimension of $5 \times m$, corresponding to five years and m evaluation indicator.

Step 5: Determination of the Ideal Solutions

In the fifth step, the positive ideal solution and negative ideal solution are determined for each indicator:

$$Q_j^{+}=\max(r_{1j},r_{2j},\cdots,r_{5j}),\ Q_j^{-}=\min(r_{1j},r_{2j},\cdots,r_{5j}) \tag{5}$$

where Q_j^{+} represents the positive ideal solution of indicator j, and Q_j^{-} represents the negative ideal solution.

The positive ideal solution corresponds to the optimal value of each indicator, while the negative ideal solution corresponds to the worst value.

Step 6: Calculation of Euclidean Distances

In the sixth step, the Euclidean distance from each sample to the positive and negative ideal solutions are calculated:

$$d_t^{+}=\sqrt{\sum_{j=1}^{m}(Q_j^{+} - r_{tj})^2}$$

$$d_t^- = \sqrt{\sum_{j=1}^{m} (Q_j^- - r_{tj})^2} \quad (6)$$

where d_t^+ and d_t^- denote the distances from sample t to the positive and negative ideal solutions, respectively.

Step 7: Calculation of the Relative Closeness

In the seventh step, the relative closeness coefficient C_t is calculated as follows:

$$C_t = \frac{d_t^+}{d_t^+ + d_t^-} \quad (7)$$

where $C_t \in [0,1]$.

A larger value of C_t indicates that the evaluated sample is closer to the positive ideal solution, reflecting a higher level of NQP advancement, whereas a smaller value indicates a lower development level.

As for data sources, data on the value added of SEI, the ratio of investment in the tertiary sector, the value added of the financial sector, the food safety qualification rate, and the output of industrial robots in Shanghai from 2020–2022 come from the Social and Economic Advancement Bulletin of the People of Shanghai. The data on the output of industrial robots in Shanghai from 2018–2019 come from the CBSI Database; data on the total national industrial robot output from 2018 to 2022 are from the People's Republic of China's Statistical Bulletin on National Economic and Social Advancement for the corresponding year; data on the number of 5G mobile subscribers and the number of Internet broadband access ports per capita in Shanghai from 2018 to 2022 are from the Shanghai Communications Administration Bureau; data on education expenditure in Shanghai from 2018 to 2022 are from the Shanghai Municipality. The data used for the calculation of all remaining measures can be obtained from the Shanghai Statistical Yearbook 2018–2022.

ANALYSIS OF EMPIRICAL RESULTS

Levels of Subsystems of the NQP

We first evaluated the development levels of the ten NQP subsystems in Shanghai from 2018 to 2022 using the proposed measurement method. Table 2 displays the findings.

Table 2. The Levels of Each Subsystem of Shanghai's NQP Advancement from 2018 to 2022

Subsystem/Year	2022	2021	2020	2019	2018	average value
Optimization of the economic form	0.578	0.546	0.434	0.477	0.440	0.495
Innovation-driven advancement	0.743	0.440	0.556	0.409	0.333	0.496
Effective resourcing	0.557	0.456	0.500	0.457	0.413	0.477
Perfect market system	0.393	0.705	0.563	0.432	0.112	0.441
Maintenance of steady economic expansion	0.527	0.608	0.510	0.256	0.375	0.455

Regional coordinated sharing	1.000	0.783	0.448	0.228	0.000	0.492
Goods and services of a high standard	0.436	0.526	0.770	0.499	0.349	0.516
Ideal infrastructure	0.854	0.731	0.293	0.324	0.316	0.504
Ecological civilization	0.553	0.587	0.728	0.393	0.532	0.559
Shared economic outcomes for the public	0.540	0.612	0.443	0.532	0.405	0.506
aggregate level	0.584	0.583	0.510	0.417	0.374	0.494

(1) The level of economic form optimization is steadily increasing. The change in the optimization level of Shanghai's economic form from 2018 to 2022 demonstrates a pattern of rising, falling, and then rising again, but the overall trend is mainly upward. Among them, the economic form optimization level in 2020 is the lowest in five years (0.434). This is because the COVID-19 pandemic in 2020 had a partially restrictive impact on the optimization of the economic form, reflected in the comprehensive performance of multiple dimensions under the subsystem rather than a single indicator or dimension. According to the indicator system design (Table 1), the "economic form optimization" subsystem covers four core dimensions: new quality industry development, industrial structure upgrading, investment and consumption structure optimization, and open economic structure improvement. Specifically, although the "new quality industry development" dimension (represented by indicators such as "value added of SEI/GDP") showed strong resilience amid the pandemic, other dimensions were constrained to varying degrees: 1) The "open economic structure improvement" dimension was affected by global supply chain disruptions and cross-border mobility restrictions; 2) The "investment and consumption structure optimization" dimension faced slowdowns in service industry investment and consumption recovery; 3) The "industrial structure upgrading" dimension experienced a temporary slowdown in the pace of transformation due to production and operation constraints on enterprises. Driven by the comprehensive constraints of the above dimensions, the overall optimization level of the economic form in 2020 fell to the lowest point of the five years. However, the notable recovery and rebound in 2021 (0.546) and 2022 (0.578) show that Shanghai, as an important national and global economic and financial center, has strong adjustment capabilities in optimizing its economic form, with excellent potential for NQP development. In addition, among the three core indicators measuring the advancement level of Shanghai's new quality industries, "Shanghai industrial robot output/national total production" showed a downward trend, while the other two indicators maintained good growth momentum, reflecting the unbalanced but advancing development characteristics of new quality industries. The main characteristics that distinguish NQP from traditional productivity are: focusing on industrial cultivation, taking scientific and technological innovation as the fundamental driving force, and adopting a new development concept as the ideological guidance (Zheng Linhao, Cheng Mengyao, and Xu Zheng, 2023) [18]. Industrial cultivation is a key focus for cultivating NQP. To build a solid industrial foundation for

NQP development, Shanghai still needs to further cultivate and develop SEI and FI.

(2) The level of innovation-driven advancement has produced an enormous leap. Shanghai's advancement level changes from 2018 to 2022 show a trend of rising first, then falling in 2021, and rebounding strongly in 2022, but the overall trend is still upward. Moreover, from 2021 to 2022, it rose by 0.303, doubling relative to 2018, indicating that in 2022, Shanghai achieved a significant improvement in the three areas of innovation input, innovation output, and innovation contribution, establishing a crucial innovation base for the creation of NQP.

(3) The overall levels of effective resource allocation, maintenance of steady economic expansion, regional coordination and sharing, ideal infrastructure, ecological civilization construction, and economic achievements for the benefit of the people are relatively stable. International empirical studies have confirmed that the coupling coordination between urbanization quality and eco-environment pressure is a core dimension of high-quality development, which is consistent with the measurement logic of Shanghai's "ecological civilization construction" subsystem [19]. Except for regional coordination and sharing and ideal infrastructure, which reached a high level of 1 and 0.854 in 2022, the other four items were stable between 0.5 and 0.6 in 2022, with no sustained and obvious downturns, establishing a robust foundation and strength in these areas, providing a strong basis for future advancement.

(4) In 2022, the development level of the market system and the quality of goods and services decreased significantly, reaching 0.393 and 0.436, respectively, lower than 0.450. Combined with the 50-indicator system's design (Table 1), the market system's decline is mainly attributed to the "diversification of economic agents" dimension, reflecting insufficient vitality of non-state-owned economies due to the 2022 pandemic. This phenomenon indicates that in 2022, Shanghai still needs to improve in aspects such as the diversified advancement of economic entities, the standardization of government behavior, the advancement of the factor market, and the degree of marketization. Regarding product services, the specific measurement indicators need to be enhanced to optimize service consumption. The "total tourism revenue/total number of tourists" from 2018 to 2022 were 1,391, 1,563, 1,097, 784, and 615, respectively, with a significant decline. Therefore, the overall quality of products and services has dropped considerably, requiring the enhancement of tourism service quality in Shanghai. Promoting the recovery of the tourism industry and removing obstacles for Shanghai's growth in NQP are necessary.

Integrated Level of Advancement of NQP

The integrated level measurement of Shanghai's NQP advancement from 2018 to 2022 is shown in Figure 1. The integrated level scores of Shanghai's NQP measurement in the five years from 2018 to 2022 are distributed in the range of

0.347 to 0.584, specifically 0.374, 0.417, 0.510, 0.583, and 0.584, respectively. As the years progress, the scores increase, with the overall mean (M) score for the five years from 2018 to 2022 being 0.494 and the standard deviation (SD) being 0.0959. The score for 2022 increased by 0.210 compared with 2018, demonstrating that the rapid advancement of Shanghai's NQP during these five years is excellent. Considering the correlation between the standard deviation (SD) and the score mean (M), the five years from 2018 to 2022 are categorized into three stages: the period of rapid advancement (score higher than M + 0.5SD), the period of general advancement (score in the range of M – 0.5SD to M + 0.5SD), and the period of slow advancement (score lower than M – 0.5SD) [3].

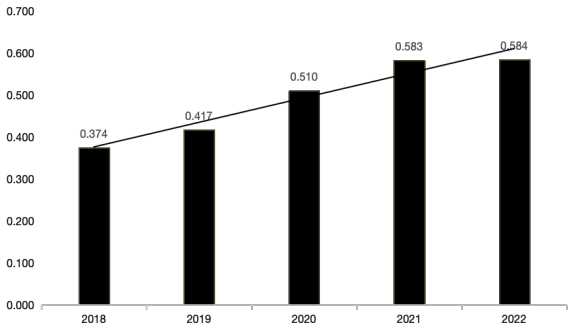

Figure 1. Comprehensive Level of NQP in Shanghai, 2018–2022

The comprehensive degree of Shanghai's NQP advancement is high from 2021 to 2022, with integrated levels of 0.583 and 0.584, respectively, in years when the score level is higher than 0.542. Over the last two years, Shanghai has improved its integrated level of NQP. Each of the ten subsystems has been improved and expanded. The scale of NQP development is increasing quickly, and during Shanghai's two years of economic advancement, the city has prioritized the quality of growth over simply increasing the economic growth rate. It also encourages the advancement of NQP through comprehensive enhancement. The comprehensive performance is excellent, reaching a high level of 0.584 in 2022. Shanghai's comprehensive level is at the general level in the period when the yearly score is between 0.446 and 0.542, for 2020, the NQP level is 0.510, indicating that in 2021 Shanghai gave considerable attention to the advancement of NQP and the cultivation of future industry, thus moving from a low level of enhancement to a general level, an increase of 0.093 points. However, in economic form improvement and infrastructure improvement, the attention is still insufficient and needs to be enhanced; policy attention to these areas remains insufficient, and the comprehensive level of NQP is slightly mediocre, with much room for improvement. In 2018 and 2019, Shanghai's new quality productivity advancement registered comprehensive levels of 0.374 and 0.417, respectively, indicating low performance (scores below 0.446). There is significant room for improvement in Shanghai's current state of innovation-driven advancement,

effective utilization of resources, enhancement of marketplace systems, regional coordination and collaboration, construction of sustainable civilization, and overall level of new quality productivity, which is low and has not yet received enough attention, especially in 2018, with only 0.374 points, seriously lower than 0.446, indicating deficiencies in NQP advancement concepts and actions.

Microscopically, Shanghai's NQP comprehensive level is not the same in each year, and the scores of different subsystems in each year vary; macroscopically, the comprehensive level of Shanghai's NQP improves as the years progress, with scores from 2018 to 2022 being 0.374, 0.417, 0.510, 0.583, and 0.584, respectively. The highest score improvement is in 2021 compared with 2020, amounting to 0.0935; the least improvement is in 2022, only 0.07, while 2022 has an increase of 0.210 over 2018, which is an improvement of about 56%, demonstrating Shanghai's rapid advancement of NQP from 2018 to 2022 and the high degree of emphasis on it. Focusing on the three subsystems of innovation-driven advancement, regional coordination and sharing, and infrastructure improvement, the growth scores in 2022 compared with 2018 are 0.410, 1, and 0.539, respectively, with these three subsystems developing rapidly and improving more, significantly contributing to the improvement of the comprehensive level of NQP.The specific stage division results are presented in Table 3.

Table 3. Yearly Distribution of Shanghai's NQP Advancement Level in Three Stages

Stage	**Particular Year**
High-level period	2021, 2022
General level period	2020
Low-level period	2018, 2019

The stage division in this study is entirely based on the relative closeness coefficient (C_t) output by the improved TOPSIS algorithm and the statistical judgment standard (M ± 0.5SD). The C_t value for 2018 (0.374) is lower than the low-level threshold (M – 0.5SD = 0.446), so it is determined as a low-level development period. This division is driven by quantitative calculation results and is not connected to 2018 being the starting year of the dataset.

Differences in the Growth Rate of NQP

The growth rates of each subsystem of NQP in Shanghai from 2019 to 2022 are shown in Figure 2. The average growth rates from 2019 to 2022 were 0.84%, –0.90%, 2.58%, and 0.59%, respectively. Overall, except for 2020, they all maintained a growth trend. Regarding specific growth rates, the growth rate in 2021 was slightly faster, while both 2019 and 2022 maintained relatively stable growth rates. This is a comprehensive analysis of the variations in the speed of growth

of NQP advancement in Shanghai each year.

(1) In 2022, the advancement of NQP in Shanghai showed positive growth in five subsystems: economic form optimization, innovation-driven advancement, effective resource allocation, regional coordinated sharing, and infrastructure improvement, which were 5.681%, 68.864%, 22.149%, 27.714%, and 16.826%, respectively. Among them, innovation-driven advancement achieved the highest growth rate of 68.864%, indicating Shanghai's focus and remarkable achievements in this field in 2022, which aligns with the core requirements of new quality productivity advancement. In 2021, the advancement of NQP in Shanghai showed positive growth in six subsystems: economic form optimization, perfect market system, maintenance of steady economic expansion, coordinated regional advancement, infrastructure improvement, and economic achievements benefiting the people. They were 25.806%, 25.222%, 19.216%, 74.777%, 149.488%, and 38.149%, respectively. Infrastructure improvement achieved the highest growth rate at 149.488%. The further improvement of infrastructure in Shanghai in 2021 laid a solid social foundation for the advancement of new productive forces. In 2020, the advancement of NQP in Shanghai showed positive growth in seven subsystems: innovation-driven advancement, effective resource allocation, perfect market system, maintenance of steady economic expansion, coordinated regional sharing, goods and services of a high standard, and construction of sustainable civilization. They were 35.941%, 9.409%, 30.324%, 99.219%, 96.491%, 54.309%, and 85.242%, respectively. Among them, economic growth was stable, achieving the highest growth rate of 99.219%. It can be seen that Shanghai's economy developed steadily in 2021 with small economic fluctuations, creating a favorable economic environment for developing NQP. In 2019, the advancement of NQP in Shanghai showed positive growth in seven subsystems: economic form optimization, innovation-driven advancement, effective resource allocation, perfect market system, goods and services of a high standard, enhanced infrastructure, and economic achievements benefiting the people. They were 8.409%, 22.823%, 10.654%, 285.714%, 42.980%, 2.532%, and 31.358%, respectively. Among them, improvement of the market system achieved the highest growth rate at 285.714%. Shanghai made significant progress in improving the market mechanism in 2019, creating a favorable market environment for developing NQP.

(2) In 2022, the advancement of NQP in Shanghai showed negative growth in four subsystems: the perfect market system, maintenance of steady economic expansion, goods and services of a high standard, and ecological civilization construction, which were –44.255%, –13.322%, –17.11%, and –5.792%, respectively. Compared with 2021, the market system was not further enhanced, economic growth fluctuated, the quality of products and services declined, and ecological civilization construction still needs to be strengthened. In 2021, the advancement of NQP in Shanghai showed negative growth in four subsystems: innovation-driven advancement, effective resource allocation, goods and services of a high

standard, and ecological civilization construction, which were –20.863%, –8.8%, –31.688%, and –19.368%, respectively. Compared with 2020, awareness of innovation in 2021 needs to be strengthened, innovation investment needs to be increased, the efficiency of resource allocation declined somewhat, and the quality of products and services, as well as ecological civilization construction, needs further strengthening. In 2020, the advancement of NQP in Shanghai showed negative growth in three subsystems: economic form optimization, infrastructure improvement, and economic achievements benefiting the people: –9.015%, –9.568%, and –16.729%, respectively. Compared with 2019, economic form in 2020 needs further optimization and enhancement, and infrastructure needs further improvement. Meanwhile, economic achievements have not benefited the people as well and require further optimization.

(3) From the perspective of specific data indicators, the significant increase in the "proportion of government investment" in 2019 led to rapid growth in improving the market mechanism, reaching 285.714%. In 2021, "5G mobile users" increased from 4.443 million to 9.263 million. The large-scale popularization of 5G networks brought about rapid growth in improving infrastructure in 2021, reaching 149.488%. In 2022, the percentage of production from the "non-state-owned economy" dropped from 0.708 in 2019 to 0.617, resulting in significant negative growth in the improvement of the market mechanism, which was –44.255%.

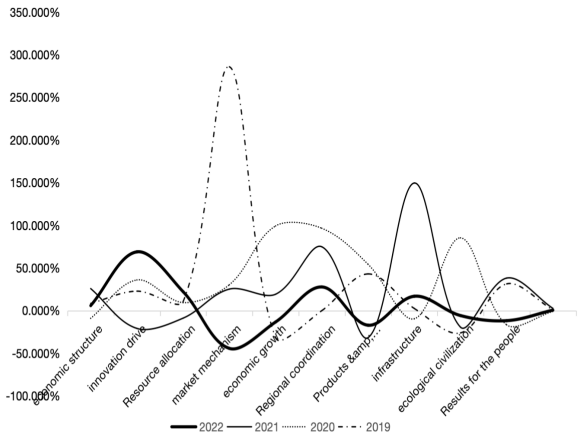

Figure 2. Growth Rate of Each Subsystem's Advancement Level of Shanghai's NQP from 2018 to 2022

CONCLUSIONS AND RECOMMENDATIONS

Algorithm Output and Stage Division

The output from the improved TOPSIS algorithm shows that there is annual heterogeneity in the development levels of Shanghai's ten subsystems from 2018 to 2022. For the "Innovation-Driven Development" subsystem, the relative closeness coefficient reached 0.743 in 2022, representing an increase of 0.410 compared with 2018. For the "Infrastructure Enhancement" subsystem, the relative closeness coefficient hit 0.854 in 2022, mainly driven by the indicator "number

of 5G mobile subscribers". In contrast, the "Market System Improvement" subsystem only achieved a relative closeness coefficient of 0.393 in 2022, which was attributed to the decline in the proportion of non-public sector investment.

The comprehensive relative closeness coefficient calculated by the algorithm rose from 0.374 in 2018 to 0.584 in 2022. Combined with the statistical experiment involving the mean value (0.494) and standard deviation (0.0959), the five-year period was divided into three stages. This stage division is highly consistent with Shanghai's actual economic policies, such as the "Special Plan for New Infrastructure Construction" launched in 2021.

Based on the construction of a system for measuring the degree of advancement of NQP, utilizing the enhanced TOPSIS technique, the levels of each subsystem and the comprehensive standard of NQP advancement in Shanghai from 2018 to 2022 were analyzed, along with their advancement status and problems encountered. The primary outcomes are as follows: From the standpoint of the subsystems, the advancement levels of each subsystem of Shanghai's NQP in the same year differ, and the advancement levels of the same subsystem of Shanghai's NQP in different years also vary. Specifically, in 2018, the levels of three subsystems—ecological civilization construction, economic form optimization, and effective resource allocation—exceeded 0.400, performing relatively well. In 2019, the levels of five subsystems—economic achievements benefiting the people, high-quality products and services, economic form optimization, effective resource allocation, and enhanced market systems—all exceeded 0.400, performing relatively well. In 2020, the levels of two subsystems—ecological civilization construction and high-quality products and services—exceeded 0.700, showing significant improvement. Moreover, except for infrastructure improvement, the levels of all subsystems exceeded 0.400, and the level of NQP also enhanced significantly. In 2021, the levels of three subsystems—infrastructure improvement, regional coordination and sharing, and market mechanism improvement—exceeded 0.700. The levels of two subsystems—economic achievements benefiting the people and maintenance of steady economic expansion—exceeded 0.600, while all other subsystems exceeded 0.400. NQP has further developed. In 2022, the standards for regional coordinated sharing and infrastructure improvement exceeded 0.800, and the level of innovation-driven advancement exceeded 0.700. Besides the enhanced market mechanism and high-quality products and services, the remaining subsystems' levels exceeded 0.500. From the standpoint of the comprehensive level, the overall comprehensive level of NQP advancement in Shanghai from 2018 to 2022 was moderate, with an average score of 0.494. However, year after year, it displayed an increasing tendency. This upward trend provides a macro-environmental foundation for the transformation of Shanghai's traditional industries. For instance, the improvement in "Innovation-Driven Development" and "Infrastructure Enhancement" subsystems creates necessary conditions for the textile industry to shift toward high-end and intelligent manufacturing. According to the comprehensive level of advancement of NQP, the five years from 2018

to 2022 are divided into three stages: the high-level period, the general level period, and the low-level period. 2021 and 2022 are the high-level advancement periods, 2020 is the general level period, and 2018 and 2019 are the low-level periods. Regarding the pace of growth, the growth rate of the same subsystem varies from year to year, and so do different subsystems within the same year. In 2019, market mechanism improvement grew at the fastest rate, reaching 285.714%. In 2020, the growth rate of maintenance of steady economic expansion was highest, at 99.219%. In 2021, the growth rate of infrastructure improvement was highest, at 149.488%. In 2022, the growth rate of innovation-driven advancement was highest, reaching 68.864%.

Recommendations

Based on the aforementioned research findings, the following policy proposals are made to actively support Shanghai's advancement of NQP and fully raise the growth levels of various subsystems.

On the one hand, efforts should continue to optimize the economic structure, further advance the innovation-driven development strategy, and enhance Shanghai's core competitiveness. The average values of the two subsystems—economic form optimization and innovation-driven advancement—are only 0.495 and 0.496, respectively. Although they show an upward trend, there is still much room for improvement. In terms of optimizing the economic form, efforts should be intensified to cultivate new-quality industries, namely SEI and FI, optimize the industrial structure, enhance the quality of advancement, improve the structure of consumption and investment, and gradually increase the openness of foreign investment and foreign trade. Innovation-driven advancement should be approached from three perspectives: innovation input, innovation output, and innovation contribution. The intensity of R&D expenditure and personnel input should be increased, a favorable atmosphere for innovation should be created, innovation ecosystems should be built, and the implementation and industrialization of new technologies and advancements should be promoted.

On the other hand, a comprehensive improvement policy for developing NQP in Shanghai should be formulated within an all-encompassing framework to encourage the overall enhancement of all subsystems of NQP. A single indicator cannot adequately measure the development level of NQP; instead, it is a composite measurement of multiple indicators from different subsystems (the measurement system constructed in this paper covers ten subsystems and fifty measurement indicators). The development levels of the ten subsystems in Shanghai are unbalanced: although the overall level in 2022 reached a five-year high of 0.584, some subsystems performed poorly, such as "market system enhancement" (0.393) and "goods and services of a high standard" (0.436).

Specifically, combined with the design logic of the 50-indicator system (Table 1), the decline in the "market system enhancement" subsystem in 2022 is mainly concentrated in the "diversification of economic agents" dimension. Driven by the insufficient vitality of non-state-owned economies (especially small and medium-sized enterprises) under the impact of the 2022 pandemic, core indicators such as the "proportion of non-state-owned economic investment" and "proportion of non-state-owned economic output" (key metrics for measuring market entity vitality) showed a downward trend. To address this, targeted strategies should be adopted for backward subsystems: for the market system, it is necessary to optimize the business environment for non-state-owned economies, strengthen precise support such as tax reductions and financing discounts to alleviate cash flow pressure, further liberalize industry access thresholds in high-end manufacturing and modern services, and enhance the protection of non-state-owned economic rights and interests to boost investment and operational confidence. For the quality of goods and services, efforts should focus on improving tourism service quality and promoting the recovery of the tourism industry, as reflected by the significant decline in indicators such as "total tourism revenue/total tourist arrivals".

By implementing preferential and priority policies for these key backward subsystems and integrating targeted measures into the overall policy framework, the coordinated improvement of all subsystems can be comprehensively promoted, solidifying the foundation for Shanghai's NQP development.

Author Contributions

Conceptualization – Surname Sun; methodology – Surname Sun and Surname Huang; formal analysis – Surname Sun and Surname Huang; investigation – Surname Sun; resources – Surname Sun; writing-original draft preparation – Surname Sun; writing-review and editing – Surname Sun and Surname Huang; visualization – Surname Sun; supervision – Surname Sun. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

Funding

This research received no external funding.

Acknowledgments

At this point, I have finished my writing. On the occasion of completing this thesis, I want to sincerely thank all of my instructors, fellow students, family members, and friends for their assistance and encouragement during this study process.

First of all, I sincerely thank my supervisor, Teacher Huang Rong. From the topic selection direction, research framework, to the finalization of the thesis, she has always given me patient guidance with her profound knowledge and rigorous academic attitude. Teacher Huang Rong not only taught me how to analyze problems with academic thinking, but also profoundly influenced my understanding of academic research with an interdisciplinary research perspective. Here, I pay the highest tribute to my respected teacher.

Special thanks to my family. My parents have always provided me with unconditional support on my academic journey, building a spiritual backing. Your understanding and encouragement are my greatest motivation for facing difficulties head-on, and your company has filled this journey with warmth.

Last but not least, I am deeply grateful to the professionals and academics who examined my thesis. Due to my ability, there may be some omissions in the text. I sincerely hope that everyone will not hesitate to point them out.

This article is dedicated to all the guides illuminating my academic path.

REFERENCES

[1] Jiao F, Zhang D. Research on the Mechanism of Accelerating the Formation of New Productive Forces Through the Advancement of Strategic Emerging Industries and Future Industries. Journal of Hunan University of Science and Technology (Social Sciences Edition). 2024; 27(01):110-116. doi: 10.13582/j.cnki.1672-7835.2024.01.014

[2] Jin B. Economic Research on "High-Quality Advancement". China Industrial Economy. 2018; (04):5-18. doi: 10.19581/j.cnki.ciejournal.2018.04.001

[3] Wei M, Li S. Research on Measuring the Level of High-Quality Advancement of China's Economy in the New Era. Research on Quantitative and Technical Economics. 2018; 35(11):3-20. doi: 10.13653/j.cnki.jqte.2018.11.001

[4] Gao F. The Logic, Multidimensional Connotation and Significance of "New Quality Productive Forces". Review of Political Economy. 2023; 14(06):127-145. doi: 10.3969/j.issn.1674-7542.2023.06.007

[5] Zhou W, Xu L. On the New Quality Productive Forces: Connotation. Characteristics and Important Focus Points. Reform. 2023; (10):1-13. doi：Not Assigned

[6] Pu Q, Huang Y. The Generative Logic, Theoretical Innovation, and Epochal Value of General Secretary Xi Jinping's Important Discourse on New Quality Productive Forces. Journal of Southwest University (Social Science Edition). 2023; 49(06):1-11. doi: 10.13718/j.cnki.xdsk.2023.06.001

[7] Han W, Zhang R, Zhao F. Measurement of the New Quality Productive Forces Level and the New Driving Force of China's Economic Growth. Research on Quantitative and Technical Economics. 2024; 41(06):5-25. doi: 10.13653/j.cnki.jqte.20240418.001

[8] Wang J, Wang R. New Quality Productive Forces: Indicator Construction and Spatial and Temporal Evolution. Journal of Xi'an University of Finance and Economics. 2024; 37(01):31-47. doi: 10.19331/j.cnki.jxufe.20231124.001

[9] Huang Q, Sheng F. New Quality Productive Forces System: Factor Characteristics, Structural Carrying and Functional Orientation. Reform. 2024; (02):15-24. doi: Not Assigned

[10] Li L, Zhang X. Spatial Evolution and Critical Factors of Urban Innovation: Evidence from Shanghai, China. Sustainability. 2020; 12(3):938. doi: 10.3390/su12030938

[11] Zhao X, Chen X. Research on the Fundamental Logic and Mechanism of Scientific and Technological Innovation Empowering the Development of New Quality Productive Forces. International Journal of Frontiers in Sociology. 2025; 7(6):53-58. doi: 10.25236/ijfs.2025.070609

[12] D'Alpaos C, Andreolli F. Urban Quality in the City of the Future: A Bibliometric Multicriteria Assessment Model. Ecological Indicators. 2020; 117:106575. doi: 10.1016/j.ecolind.2020.106575

[13] Gan C, Zheng R, Yu D. The Impact of Industrial Structure Change on Economic Growth and Volatility in China. Economic Research. 2011; 46(5):4-16. doi: Not Assigned

[14] Lv Y, Sun H. Research on the Technical Efficiency of China's Strategic Emerging Industries and its Influencing Factors--an Analysis Based on Panel Data of 18 Broad Industry Categories. Science and Technology Management. 2013; 34(11):137-146. doi: Not Assigned

[15] Zhan X, Cui P. Measuring and Evaluating the Quality of China's Interprovincial Economic Growth--an Empirical Analysis Based on the "Five Advancement Concepts". Fiscal research. 2016; (8):15. doi: CNKI: SUN: CZYJ.0.2016-08-004

[16] Banadkouki MRZ. Selection of Strategies to Improve Energy Efficiency in Industry: A Hybrid Approach Using Entropy Weight Method and Fuzzy TOPSIS. Energy. 2023; 279:128070. doi: 10.1016/j.energy.2023.128070

[17] Yu X, Suntrayuth S, Carayannis EG, Sindakis S, Showkat S. Advancing Industrial Wastewater Treatment Through Comprehensive Evaluation and Innovative Technology: A G1-Entropy Improved TOPSIS Model Approach. The Journal of Technology Transfer. 2023; 1-31. doi: 10.1007/s10961-023-10032-y

[18] Xu Z, Zheng L, Cheng M. Internal Logic and Practical Concept of High-Quality Advancement Empowered by New Quality Productive Forces. Contemporary Economic Research. 2023; (11):51-58. doi: 10.3969/j.issn.1005-2674.2023.11.006

[19] Lin X, Lu C, Song K, Su Y, Lei Y, Zhong L, et al. Analysis of Coupling Coordination Variance between Urbanization Quality and Eco-Environment Pressure: A Case Study of the West Taiwan Strait Urban Agglomeration, China. Sustainability. 2020; 12(7):2643. doi: 10.3390/su12072643