Retraction

Retracted: Analysis on Transformation and Upgrading Levels of Three Industries in 11 Prefectures of Zhejiang Based on Shift-Share Method

Discrete Dynamics in Nature and Society

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope

(2) Discrepancies in the description of the research reported

(3) Discrepancies between the availability of data and the research described

(4) Inappropriate citations

(5) Incoherent, meaningless and/or irrelevant content included in the article

(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] J. Ye, J. Wang, and Y. Zhang, "Analysis on Transformation and Upgrading Levels of Three Industries in 11 Prefectures of Zhejiang Based on Shift-Share Method," *Discrete Dynamics in Nature and Society*, vol. 2021, Article ID 2428602, 12 pages, 2021.

Research Article

Analysis on Transformation and Upgrading Levels of Three Industries in 11 Prefectures of Zhejiang Based on Shift-Share Method

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This paper attempts to evaluate the transformation and upgrading (T&U) levels of the three industries in 11 prefectures of Zhejiang Province, China, since 2016. Taking the provincial T&U levels of the three industries as the benchmark, the three industries in each prefecture were analyzed by shift-share method (SSM). The main results are as follows: In terms of primary industry, none of the 11 prefectures had structural advantage (structural shifts < 0), but 3 had regional competitiveness (competitiveness shifts > 0); in terms of secondary industry, none of the 11 prefectures had structural advantage (structural shifts < 0), but 5 had regional competitiveness (competitiveness shifts > 0); in terms of tertiary industry, all of the 11 prefectures had structural advantage (structural shifts > 0), and 6 had regional competitiveness (competitiveness shifts > 0); Shaoxing was competitive in all three industries, ranking the first in the competitiveness of every industry; Huzhou, Quzhou, and Jinhua were not competitive in tertiary industry. The research provides a new yardstick of industrial T&U level and lays the decision-making basis for local governments in Zhejiang to formulate industrial T&U policies.

1. Introduction

The traditional industries contribute more than 50% of output, jobs, and taxes in China and underpin China's social and economic development. However, most traditional industries need structural optimization through transformation and upgrading (T&U), in order to cope with the pressures from overcapacity, as well as energy conservation and emission reduction. In 2019, the Chinese Premier called for the T&U of traditional industries and the integrated development of advanced manufacturing and modern service industries, both of which are the key to promoting Chinese products and services at home and abroad. The officials of Zhejiang Province also attached great importance to the T&U of traditional industries. In the past five years, Zhejiang has taken a series of concrete actions to facilitate industrial T&U, including phasing out outdated capacity, implementing green and scientific governance, and attracting the backflow of investment by local entrepreneurs. Against this backdrop, the gross domestic product (GDP) of Zhejiang has been growing at 7.9% in recent years. Overall, the old drivers are being rapidly replaced by new engines, while the development of high-tech industry and modern service industry is picking up speed.

The existing studies on the T&U of traditional industries mainly focus on the following four aspects.

1.1. The Paths to the T&U of Traditional Industries. Industrial upgrading refers to the flow of the industrial chain from low value to high value, from extensive model to intensive model, and from high energy consumption and high

pollution to energy efficiency and environmental friendliness [1]. The integration of high and new technology into traditional industries is a feasible T&U path [2].

During the T&U, enterprises need to reorganize the organizational architecture, organizational culture, product, and corporate competitiveness [3]. To realize innovation-driven T&U of traditional industries to emerging industrial clusters, it is necessary to choose suitable innovation forms to cultivate emerging products and businesses, effectively integrate innovation chain with traditional industrial chain, and gather innovation elements to transform traditional industrial clusters to strategic emerging industrial clusters [4, 5].

There are three stages of the path towards the integration between traditional industries and strategic emerging industries: mutual adaptation, coordinated development, and differentiation replacement [2]. By the similarity to strategic emerging industries, traditional industries can be divided into four types. Each type of traditional industries requires a specific development path: transformation for star industries, maintenance for profitable industries, transformation or scrapping for problematic industries, and scrapping for weak and outdated industries.

For industries in underdeveloped areas, the key is to construct a regional value chain and find the suitable industrial upgrading paths, including extension, deepening, and reconstruction of value chain [3]. In terms of the online to offline (O2O) e-commerce model, the traditional industries can be transformed and upgraded through four paths: industrial chain, value chain, innovative chain, and production factor combination.

1.2. The Institution, Mechanism, or Model of the T&U of Traditional Industries. In the Yangtze River Delta, the development of high-tech industry should drive service industry and manufacturing through informatization: integrate innovations and realize win-win via outsourcing; lead the upgrading of service clusters and industries with industrial parks; promote industrial integration and independent innovation through integration.

In the aspect of institution, it is important to strike a balance between utilizing and creating comparative advantages: respect the market while giving full play to comparative advantages and create such advantages by building up platforms [4]. The upgrading of traditional industrial clusters calls for mechanism innovation, such as optimizing the cluster network, improving knowledge overflow and technology absorption efficiency, and elevating the rank of industrial clusters in the global value chain [6].

The mechanism of innovation-driven industrial T&U should be designed from multiple angles: improving the original product (business) quality, developing new product (business), renovating business model, building cooperation network, policy regulation, low-cost innovation, and institutional guarantee [7]. Against the backdrop of Internet Plus, the T&U of industrial clusters must be implemented in four stages, while clarifying the relationship between the government, the industrial cluster, and the market [8].

1.3. Influencing Factors of the T&U of Traditional Industries. Foreign scholars believed that foreign direct investment (FDI), technological innovation, human capital, and other factors have a significant impact on industrial structure upgrading [9, 10] and summarized six major influencing factors: supply, social demand, technological progress, opening-up, industrialization and urbanization, and government policy [11].

In recent years, industrial upgrading in China has slowed down, mainly due to such constraints as insufficient investment in research and development (R&D), severe homogeneity, underdevelopment of production services, lack of unified planning for information development and utilization, and noninnovative industrial structure [12].

Technology innovation is an important support and driver of regional industrial upgrading. Through technology introduction, independent R&D, and cooperative R&D, underdeveloped regions can effectively upgrade their industries by means of technology innovation [13].

The transformation of industrial structure is mainly influenced by technological innovation capabilities, level of demand satisfaction, foreign trade, and environmental protection [14]. When emerging industries raise fund for science and technology activities, the collaboration is not significantly affected by the proportion of government funds or market-based reform; environmental regulation does not suppress the growth of high pollution industry; human capital growth could improve the collaboration [15].

1.4. Performance Evaluation of the T&U of Traditional Industries. The industrial T&U level has been mainly quantified from the speed and direction of T&U. The speed is usually evaluated by More value, Lilien index, and annual mean change of industrial structure; the direction is often assessed by the forward coefficient of industrial structure; the structural advantage and competitiveness are commonly appraised by shift-share method (SSM) [16, 17].

From such five aspects as regional economic development, technological innovation, industrial structure, economic openness, and eco-environmental governance, some scholars constructed an evaluation index system for the comprehensive performance of regional industrial T&U and carried out comprehensive evaluation of the T&U performance in each year [18–20].

In summary, many scholars have explored the path, mechanism, influencing factors, and performance evaluation of industrial T&U. Their studies generally emphasize qualitative analysis over quantitative analysis, large scales (e.g., provincial scale) over small scales (e.g., city scale), comprehensive performance over performance difference, and height, speed, and direction over advantages of industrial T&U. In fact, different regions in the same province should coordinate the implementation of industrial T&U. Scientific analysis of the location differences between regions helps to identify defects, seize the keys, and design pertinent strategies.

Targeting the 11 prefectures of Zhejiang Province, China, this paper analyzes the prefectural differences in the T&U levels of the three industries since 2016, providing a

reference for the decision-makers in relevant departments. Section 2 reviews the measuring methods of industrial T&U; Section 3 evaluates the T&U levels of the three industries in each prefecture; Section 4 compares the differences between the 11 prefectures in the T&U level of each industry and identifies the competitive industries in each prefecture; Section 5 summarizes the research results, probes the deep-level reasons, and presents countermeasures.

2. Measuring Methods of Industrial T&U Level

2.1. Introduction to Measuring Methods. Currently, industrial T&U level is mainly evaluated from three angles: the speed, direction, and height of industrial T&U.

2.1.1. Speed Indices. The essence of measuring the industrial T&U speed is to compare how the structure of different industries changes with time. The common indicators include Lilien index, More value, and annual mean change of industrial structure. Lilien index and More value are based on employment structure and industrial structure, respectively. Lilien index can be calculated by

$$L = \sqrt{\sum_{i=1}^{n} w_i \left(\Delta \log A_i - \Delta \log A \right)^2}, \tag{1}$$

where A_i is the number of employees in industry i; A is the total number of employees; w_i is the mean employment proportion of industry i. The Lilien index is positively correlated with the speed of industrial T&U.

The More value represents n industries with an n-dimensional vector and measures the speed of industrial structure changes with the cosine M of the angle C between the industrial structure (proportion) vector of base period $\overrightarrow{a} = (x_1, x_2, \ldots, x_n)$ and that of report period $\overrightarrow{b} = (y_1, y_2, \ldots, y_n)$:

$$M = \cos C = \frac{\overrightarrow{a} \, \overrightarrow{b}}{|\overrightarrow{a}||\overrightarrow{b}|} = \frac{x_1 y_1 + x_2 y_2 + \cdots + x_n y_n}{\sqrt{\sum_{i=1}^{n} x_i^2} \sqrt{\sum_{i=1}^{n} y_i^2}}. \tag{2}$$

The More value is negatively correlated with the speed of industrial T&U. The More value reflects the mutual influence between industrial structures but fails to manifest the impact of each industrial sector on the speed of industrial structure changes.

To make up for the defect, the annual mean change of industrial structure can be introduced to measure how each industrial sector affects the speed of industrial structure changes. This indicator compares the structure (proportion) of each industry in base period and report period, find the absolute value of the difference, and solve the average value by time point:

$$P = \frac{1}{m} \sum_{i=1}^{n} |x_i - y_i|, \tag{3}$$

where m is the number of periods. The annual mean change of industrial structure P is positively correlated with the speed of industrial T&U.

However, More value and annual mean change of industrial structure have a common weakness. As indicated by their calculation formulas, neither can judge whether the industrial T&U is picking up speed or slowing down. The two scenarios need to be differentiated by the variation in components of each vector. What is worse, the two indicators might sometimes yield contradictory results.

2.1.2. Direction Index. The direction of industrial T&U is primarily measured by forward coefficient of industrial structure, which reflects the lead of the structural growth of an industry over that of the entire economic system:

$$F = r + \frac{r - 1}{R}, \tag{4}$$

where r is the ratio of the proportion of an industry in the report period to that in the base period; R is the mean growth rate of the entire economic system in the same period ($R = (\ln \text{GDP}_{\text{report period}} - \ln \text{GDP}_{\text{base period}})/m$), with m being the number of years from the base period to the report period. If $\gamma > 1$, the industrial development leads the entire economic system, and its proportion is on the rise; if $\gamma < 1$, the industrial development lags the entire economic system, and its proportion is in the decline.

2.1.3. Height Index. The height of industrial T&U is measured by the sum of the structure (proportion) ratios between different industries:

$$H = \frac{B}{A} + \frac{C}{A} + \frac{C}{B}, \tag{5}$$

where A, B, and C are the structure (proportion) of the primary, secondary, and tertiary industries, respectively. The height H is positively correlated with the level of industrial T&U.

Based on industrial (employment) structure, speed, direction, and height indices illustrate the changes in the structure of an industry and reflect the level of industrial T&U. Each of them could only demonstrate the structural advantage of an industry or the T&U level of the whole economic system. But none of them could reflect the regional competitiveness of the industry.

2.2. SSM. The SSM was perfected by Dunn et al. into a popular yardstick of the benefits of regional economy and industrial structure [21].

As a comprehensive and dynamic approach, the SSM compares the level of economic development of a region with that of the standard region (the selected reference object) and captures the regional competitiveness of the target region over the standard region in the development level of different sectors or industries [22–26].

For example, the primary industry in Wenzhou was taken as the target, and the primary industry in Zhejiang Province as the reference object.

Let A_0 and A_1 be the GDP of Wenzhou in the base period and report period, respectively, a_0 and a_1 be the primary industry output of Wenzhou in the base period and report period, respectively, B_0 and B_1 be the GDP of Zhejiang in the base period and report period, respectively, and b_0 and b_1 be the primary industry output of Zhejiang in the base period and report period, respectively.

From the base period to the report period, the change rate of the primary industry output of Wenzhou, the change rate of the primary industry output of Zhejiang, the change rate of the GDP of Zhejiang, and the increment of the primary industry output of Wenzhou can be, respectively, expressed as

$$
\begin{aligned}
r_1 &= \frac{a_1 - a_0}{a_0}, \\
R_1 &= \frac{b_1 - b_0}{b_0}, \\
R &= \frac{B_1 - B_0}{B_0}, \\
G &= a_1 - a_0 = a_0 r_1 \\
&= a_0 R + (a_0 R_1 - a_0 R) + (a_0 r_1 - a_0 R_1).
\end{aligned}
\tag{6}
$$

Suppose

$$
\begin{aligned}
N &= a_0 R, \\
P &= a_0 R_1 - a_0 R, \\
D &= a_0 r_1 - a_0 R_1, \\
S &= P + D.
\end{aligned}
\tag{7}
$$

Then,

$$
G = N + P + D = N + S, \tag{8}
$$

where N is the share component of the primary industry of Wenzhou, i.e., the increment of the primary industry output of Wenzhou by the GDP growth rate of Zhejiang (i.e., mean growth rate) compared with the true primary industry output of Wenzhou from the base period to the report period; P is the structural shift component of the primary industry of Wenzhou, i.e., the increment of the primary industry output of Wenzhou brought by its structural advantage (if $P > 0$, Wenzhou has structural advantage in primary industry; if $P < 0$, Wenzhou lacks structural advantage in primary industry); D is the competitiveness shift component of the primary industry of Wenzhou, i.e., the increment of the primary industry output of Wenzhou brought by its regional competitiveness (if $D > 0$, Wenzhou has regional competitiveness in primary industry; if $D < 0$, Wenzhou lacks regional competitiveness in primary industry); S is the total shift of the primary industry of Wenzhou (if $S > 0$, the primary industry in Wenzhou grows faster than the mean growth rate of Zhejiang; if $S < 0$, the primary industry in Wenzhou grows slower than the mean growth rate of Zhejiang).

If $N > 0$, and $S >$, the primary industry in Wenzhou is a competitive industry; if $P > 0$ and $D > 0$, the primary industry in Wenzhou boasts a good structure and strong competitiveness.

3. Measurement of T&U Levels of Three Industries in Each Prefecture

3.1. Data Source. To measure the industrial T&U levels in 2016–2020 of each prefecture in Zhejiang, 2015 and 2019 were taken as the base period and report period, respectively. Hence, the GDP and three industry outputs of each prefecture and the province in the two years were collected from *Zhejiang Statistical Yearbook* [27].

3.2. Measurement Results. The SSM was adopted to obtain the share component, structural shift component, and competitiveness shift component of the primary, secondary, and tertiary industries in each prefecture of Zhejiang, laying a solid basis for the evaluation, horizontal comparison, and vertical comparison of the structural advantage and regional competitiveness among these prefectures. The SSM results are recorded in Table 1.

4. Difference in Prefectural T&U Levels of Three Industries

4.1. Difference in Prefectural T&U Level of Primary Industry. Based on Table 1, the histograms of the structural shift component and competitiveness shift component for the primary industry in the 11 prefectures were plotted (Figures 1 and 2). The following conclusions can be drawn from the plots.

(1) None of the 11 prefectures had structural advantage in primary industry; that is, the primary industry in every prefecture grew slower than the GDP growth rate of Zhejiang Province. Hangzhou and Ningbo ranked at the first and second to the bottom in the structural advantage of primary industry, respectively.

(2) Three prefectures had regional competitiveness in primary industry; that is, the primary industry in these prefectures grew faster than the provincial mean rate. Among them, Shaoxing boasted the strongest regional competitiveness, followed by Zhoushan. The other prefectures lacked regional competitiveness in primary industry. Huzhou and Quzhou were the first and second weakest, respectively.

4.2. Difference in Prefectural T&U Level of Secondary Industry. Based on Table 1, the histograms of the structural shift component and competitiveness shift component for the secondary industry in the 11 prefectures were plotted

TABLE 1: SSM results of the 11 prefectures in Zhejiang (unit: 100 million yuan).

| Prefecture	Industry	Share component	Structural shift component	Competitiveness shift component
Hangzhou	Primary industry	130.7	−89.1	−3.5
	Secondary industry	1,774.2	−414.8	−393.4
	Tertiary industry	2,656.7	729.3	932.8
Ningbo	Primary industry	129.2	−88.1	−3.8
	Secondary industry	1,860.1	−434.9	259.6
	Tertiary industry	1,643.4	451.1	164.8
Wenzhou	Primary industry	63.1	−43.1	−7.5
	Secondary industry	840.0	−196.4	317.6
	Tertiary industry	693.5	190.4	1,230.5
Jiaxing	Primary industry	55.6	−38.0	−19.4
	Secondary industry	463.4	−108.4	1516.4
	Tertiary industry	426.9	117.2	872.2
Huzhou	Primary industry	90.3	−61.6	−93.8
	Secondary industry	1,022.5	−239.1	−1440.9
	Tertiary industry	914.2	251.0	−1786.1
Shaoxing	Primary industry	50.4	−34.4	81.0
	Secondary industry	204.1	−47.7	2,165.0
	Tertiary industry	241.6	66.3	1,961.9
Jinhua	Primary industry	58.8	−40.1	−2.4
	Secondary industry	918.0	−214.6	−892.9
	Tertiary industry	1,119.2	307.3	−1311.3
Quzhou	Primary industry	64.0	−43.7	−74.9
	Secondary industry	703.1	−164.4	−1436.8
	Tertiary industry	777.1	213.3	−1866.7
Zhoushan	Primary industry	38.3	−26.1	49.8
	Secondary industry	242.7	−56.8	−245.3
	Tertiary industry	239.1	65.6	−81.9
Taizhou	Primary industry	104.3	−71.1	19.2
	Secondary industry	711.5	−166.4	227.1
	Tertiary industry	797.2	218.9	−260.4
Lishui	Primary industry	41.5	−28.3	−4.5
	Secondary industry	228.7	−53.5	−107.8
	Tertiary industry	230.6	63.3	3.3
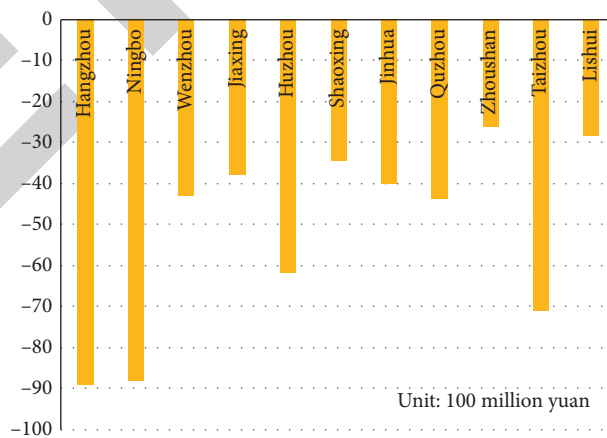
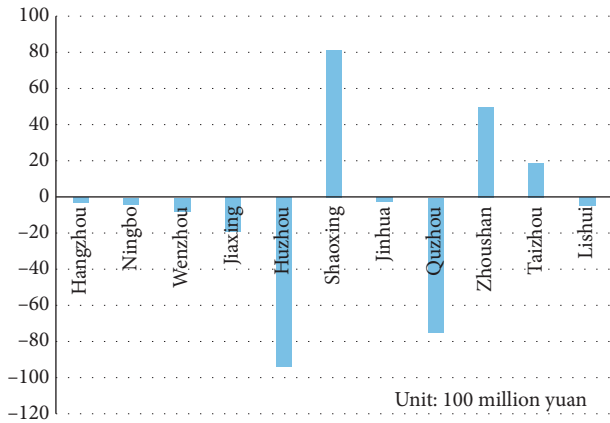FIGURE 1: Comparison of structural shift component of primary industry.

FIGURE 2: Comparison of competitiveness shift component of primary industry.

(Figures 3 and 4). The following conclusions can be drawn from the plots.

(1) Since $a_0 R_1 - a_0 R < 0$, we have $R_1 < R$. Hence, none of the 11 prefectures had structural advantage in secondary industry. That is, the growth rate of secondary industry in each prefecture cannot catch up with the GDP growth rate of Zhejiang Province. Ningbo and Hangzhou ranked at the first and second to the bottom in the structural advantage of secondary industry, respectively.

(2) Five prefectures had regional competitiveness in secondary industry; that is, the secondary industry in these prefectures grew faster than the provincial mean rate. Among them, Shaoxing boasted the strongest regional competitiveness, followed by Jiaxing. The other prefectures lacked regional competitiveness in secondary industry. Huzhou and Quzhou were the first and second weakest, respectively.

4.3. Difference in Prefectural T&U Level of Tertiary Industry. Based on Table 1, the histograms of the structural shift component and competitiveness shift component for the tertiary industry in the 11 prefectures were plotted (Figures 5 and 6). The following conclusions can be drawn from the plots.

(1) None of the 11 prefectures had structural advantage in tertiary industry; that is, the tertiary industry in every prefecture grew slower than the GDP growth rate of Zhejiang Province. Hangzhou and Lishui ranked at the first and second to the bottom in the structural advantage of tertiary industry, respectively.

(2) Six prefectures had regional competitiveness in tertiary industry; that is, the tertiary industry in these prefectures grew faster than the provincial mean rate. Among them, Shaoxing boasted the strongest regional competitiveness, followed by Wenzhou. The other prefectures lacked regional
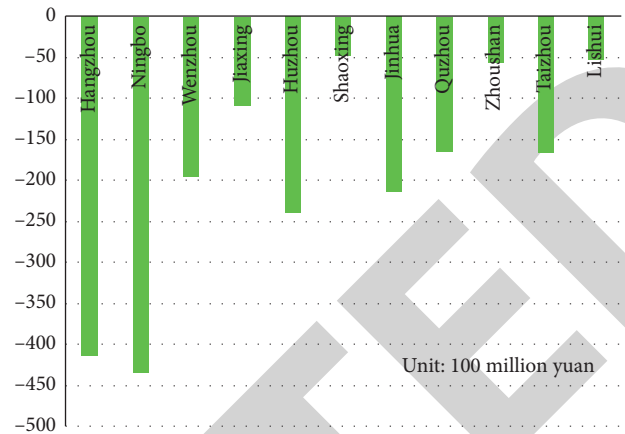

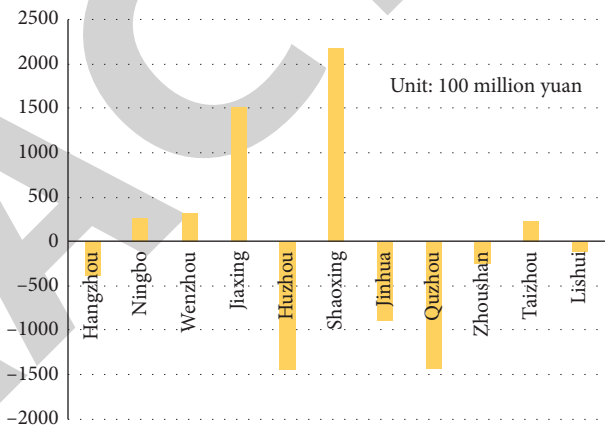FIGURE 3: Comparison of structural shift component of secondary industry.

FIGURE 4: Comparison of competitiveness shift component of secondary industry.
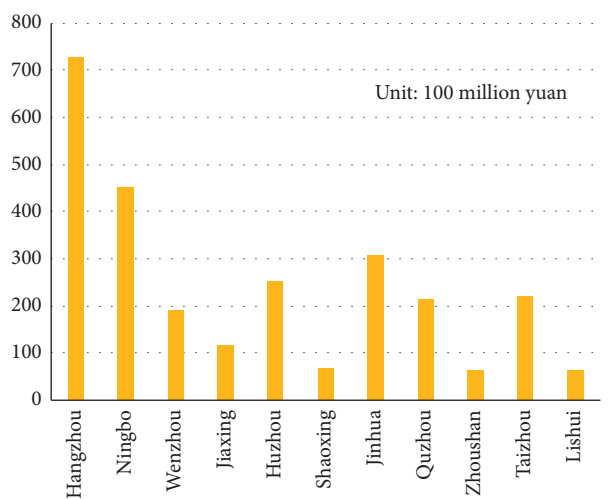

FIGURE 5: Comparison of structural shift component of tertiary industry.

competitiveness in tertiary industry. Quzhou and Huzhou were the first and second weakest, respectively.
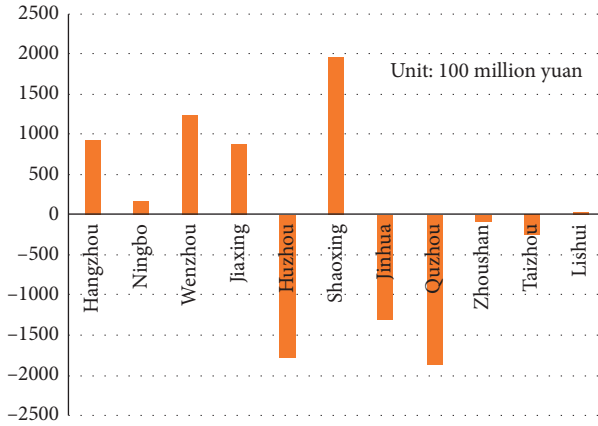
Figure 6: Comparison of competitiveness shift component of tertiary industry.

4.4. Identification of Competitive Industries in Each Prefecture. From Table 1, the total shifts of the three industries were calculated for each prefecture. Then, the authors judged whether each industry is competitive in each prefecture. The relevant results are recorded in Table 2.

The following conclusions can be drawn from Table 2.

(1) Hangzhou ranked the second in the share component of tertiary industry, indicating that it was competitive in tertiary industry.

(2) Ningbo ranked the fifth in the share component of tertiary industry, indicating that it was competitive in tertiary industry.

(3) Wenzhou ranked the third in the share components of secondary and tertiary industries, indicating that it was competitive in secondary and tertiary industries.

(4) Jiaxing ranked the second and fourth in the share components of secondary and tertiary industries, respectively, indicating that it was competitive in secondary and tertiary industries.

(5) Huzhou ranked the last, and the second to last in the share components of primary and secondary industries, and tertiary industries, respectively, indicating that it was not competitive in any of the three industries.

(6) Shaoxing ranked the first in the share components of all three industries, indicating that it was competitive in primary, secondary, and tertiary industries.

(7) Jinhua ranked the fourth, and ninth in the share components of primary industry, and secondary and tertiary industries, indicating that it was not competitive in any of the three industries.

(8) Quzhou ranked the second to last, and the last in the share components of primary and secondary industries, and tertiary industries, respectively, indicating that it was not competitive in any of the three industries.

(9) Zhoushan ranked the first in the share component of primary industry, indicating that it was competitive in primary industry.

(10) Taizhou ranked the fourth in the share component of secondary industry, indicating that it was competitive in secondary industry.

(11) Lishui ranked the sixth in the share component of tertiary industry, indicating that it was competitive in tertiary industry.

5. Comprehensive Evaluation of Industrial T&U Levels in Each Prefecture

This section establishes a comprehensive evaluation model to thoroughly assess the T&U levels of the three industries in each prefecture.

5.1. SMM-TOPSIS Model. The technique for order of preference by similarity to ideal solution (TOPSIS) is a widely used multiattribute decision method. The first step of TOPSIS is to select the benchmarks: positive ideal solution and negative solution. Then, the relative proximity of each object to the two benchmarks is calculated and used to rank all the objects [28, 29].

Let $A_1, A_2, \ldots, A_m$ be m prefectures, $C_1, C_2, \ldots, C_n$ be the n total industrial shifts of each prefecture, x_{ij} be the value of prefecture A_i under total industrial shift C_j $(i = 1, 2, \ldots, m; j = 1, 2, \ldots, n)$, and ω_j be the weight of total industrial shift C_j, $\omega_j \in [0, 1]$, $\sum_{j=1}^{n} \omega_j = 1$.

The SMM-TOPSIS model can be calculated as follows.

(1) Establish a nondimensionalized standardized matrix $Z = (z_{ij})_{m \times n}$:

$$z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \quad i = 1, 2, \ldots, m; j = 1, 2, \ldots, n. \quad (9)$$

(2) Compute the weighting matrix $R = (r_{ij})_{m \times n}$:

$$r_{ij} = \omega_j \times z_{ij}, \quad i = 1, 2, \ldots, m; j = 1, 2, \ldots, n. \quad (10)$$

(3) Determine the positive ideal solution S^+ and negative ideal solution S^-:

$$S^+ = \left\{ s_j^+ | j = 1, 2, \ldots, n \right\},$$
$$S^- = \left\{ s_j^- | j = 1, 2, \ldots, n \right\}, \quad (11)$$

$s_j^+ = \max_{1 \leq i \leq m} \left\{ r_{ij} \right\}$; $s_j^- = \min_{1 \leq i \leq m} \left\{ r_{ij} \right\}$.

(4) Compute the Euclidean distances of each prefecture to the positive and negative ideal solutions, respectively:

TABLE 2: Total shifts of the three industries in each prefecture and their competitiveness.

Serial number	Prefecture	Primary industry		Secondary industry		Tertiary industry		Competitive? (yes = 1; no = 0)		
		Total shift	Ranking	Total shift	Ranking	Total shift	Ranking	Primary industry	Secondary industry	Tertiary industry
1	Hangzhou	−92.6	9	−808.2	8	1,662.1	2	0	0	1
2	Ningbo	−91.9	8	−175.3	6	615.9	5	0	0	1
3	Wenzhou	−50.6	5	1,21.2	3	1,420.9	3	0	1	1
4	Jiaxing	−57.4	7	1,408	2	989.4	4	0	1	1
5	Huzhou	−155.4	11	−1680	11	−1,535.1	10	0	0	0
6	Shaoxing	46.6	1	2,117.3	1	2,028.2	1	1	1	1
7	Jinhua	−42.5	4	−1,107.5	9	−1004	9	0	0	0
8	Quzhou	−118.6	10	−1,601.2	10	−1,653.4	11	0	0	0
9	Zhoushan	23.7	2	−302.1	7	−16.3	7	1	0	0
10	Taizhou	−51.9	6	60.7	4	−41.5	8	0	1	0
11	Lishui	−32.8	3	−161.3	5	66.6	6	0	0	1

Note: (1) The share components of the three industries in every prefecture are positive; (2) the total shifts are in the unit of 100 million yuan.

$$d^+ = \sqrt{\sum_{j=1}^{n} \left(r_{ij} - s_j^+ \right)^2},$$

$$d^- = \sqrt{\sum_{j=1}^{n} \left(r_{ij} - s_j^- \right)^2}, \qquad (12)$$

$$i = 1, 2, \ldots, m.$$

(5) Compute the relative proximities of each prefecture to the ideal solutions:

$$c_i = \frac{d^-}{d^+ + d^-}, \quad i = 1, 2, \ldots, m. \qquad (13)$$

(6) Compute the contribution rate of each prefecture:

$$\delta_i = \frac{c_i}{\sum_{i=1}^{m} c_i}, \quad i = 1, 2, \ldots, m. \qquad (14)$$

The greater the δ_i value, the larger the contribution of prefecture A_i to the province. The m prefectures were ranked by the δ_i value.

5.2. Comprehensive Evaluation Results on Industrial T&U Levels in Each Prefecture. The SMM-TOPSIS was applied to process the total shifts of the three industries in all 11 prefectures, with $m = 11$ and $n = 3$. Since the three industries are equally important in I&U, we set $\omega_1 = \omega_2 = \omega_3 = (1/3)$. The normalized weighting matrix was obtained by formulas (9) and (10) (Table 3).

The positive and negative ideal solutions were obtained by formula (11) (Table 4).

The relative proximities of each prefecture were computed by formulas (12) and (13) (Table 5).

The contribution rate and ranking of each preference were obtained by formula (14) (Table 6).

Table 7 presents the histogram of the contribution rate of each prefecture (Table 6).

As shown in Table 6 and Figure 7, from 2016 to 2020, Shaoxing made the greatest contribution to the industrial

T&U in Zhejiang Province (19.7%), followed in turn by Jiaxing (13.6%) and Wenzhou (11.8%). The contributions of Huzhou, Quzhou, and Jinhua were relatively small, which were, respectively, 0.4%, 1.7%, and 5.7%.

5.3. Robustness Analysis. To test the robustness of the comprehensive evaluation results of SMM-TOPSIS on the industrial T&U levels in each prefecture, these levels were evaluated by another method, and the evaluation results of the two approaches were compared in detail.

The direction index (4) was selected as the contrastive metric. The direction indices of all prefectures and their rankings are recorded in Table 7.

Comparing Tables 6 and 7, the top three and bottom three prefectures were the same, and the other five prefectures had slight changes in ranking. On average, the ranking change of the 11 prefectures was as small as 1.1, indicating the robustness of the evaluation results of SMM-TOPSIS [30].

Comparatively, SMM-TOPSIS achieved relatively complete and reliable evaluation results. The reason is that the direction index merely depicts the T&U trend from a single angle: industrial structure. Meanwhile, SMM-TOPSIS illustrates the T&U trend from both industrial structure and regional competitiveness. In the field of evaluation, a common sense is that more independent evaluation indices mean more reliable results.

6. Results and Discussion

6.1. Results. After exploring the T&U levels of the three industries in each prefecture of Zhejiang in 2016–2019, the following conclusions were put forward:

(1) In terms of primary industry, none of the 11 prefectures had structural advantage, but 3 had regional competitiveness, with Shaoxing as the leader.

(2) In terms of secondary industry, none of the 11 prefectures had structural advantage, but 5 had regional competitiveness, with Shaoxing as the leader.

TABLE 3: Normalized weighting matrix.

Prefecture	Hangzhou	Ningbo	Wenzhou	Jiaxing	Huzhou	Shaoxing	Jinhua	Quzhou	Zhoushan	Taizhou	Lishui
Primary industry	−0.117	−0.116	−0.064	−0.073	−0.197	0.059	−0.054	−0.150	0.030	−0.066	−0.042
Secondary industry	−0.072	−0.016	0.011	0.126	−0.150	0.189	−0.099	−0.143	−0.027	0.005	−0.014
Tertiary industry	0.137	0.051	0.117	0.082	−0.127	0.167	−0.083	−0.136	−0.001	−0.003	0.006

TABLE 4: Positive and negative ideal solutions.

Industry	Primary industry	Secondary industry	Tertiary industry
Positive ideal solution	0.0590	0.1893	0.1672
Negative ideal solution	−0.1966	−0.1502	−0.1363

TABLE 5: Relative proximities of each prefecture.

Prefecture	Hangzhou	Ningbo	Wenzhou	Jiaxing	Huzhou	Shaoxing	Jinhua	Quzhou	Zhoushan	Taizhou	Lishui
Distance to positive ideal solution	0.317	0.294	0.222	0.169	0.517	0.000	0.398	0.496	0.276	0.280	0.279
Distance to negative ideal solution	0.295	0.244	0.328	0.373	0.010	0.522	0.161	0.047	0.291	0.243	0.250
Relative proximity	0.482	0.454	0.596	0.688	0.019	1.000	0.288	0.087	0.514	0.465	0.473

TABLE 6: Contribution rate and ranking of each preference.

Prefecture	Hangzhou	Ningbo	Wenzhou	Jiaxing	Huzhou	Shaoxing	Jinhua	Quzhou	Zhoushan	Taizhou	Lishui
Contribution rate (%)	9.5	9.0	11.8	13.6	0.4	19.7	5.7	1.7	10.1	9.2	9.3
Ranking	5	8	3	2	11	1	9	10	4	7	6

TABLE 7: Direction indices of all prefectures and their rankings.

Prefecture	Hangzhou	Ningbo	Wenzhou	Jiaxing	Huzhou	Shaoxing	Jinhua	Quzhou	Zhoushan	Taizhou	Lishui
Direction index	7.244	6.865	11.350	19.588	−2.547	51.575	0.851	−5.337	3.319	6.242	4.989
Ranking	4	5	3	2	10	1	9	11	8	6	7

(3) In terms of tertiary industry, all of the 11 prefectures had structural advantage, and 6 had regional competitiveness, with Shaoxing as the leader.

(4) Shaoxing had competitiveness in primary, secondary, and tertiary industries, ranking the first in the share component of all three industries. It had the highest comprehensive T&U level of the three industries.

(5) Huzhou, Quzhou, and Jinhua were not competitive in any of the three industries and had relatively backward comprehensive T&U level of the three industries.
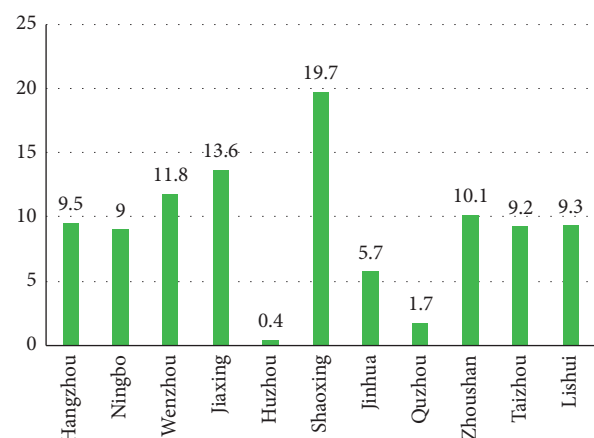
6.2. Vertical Comparison. According to the Petty-Clark theorem, the growth of per-capita national income and national economy propels the flow of labor from the primary industry to the secondary and tertiary industries. Meanwhile, the dominance of the industrial structure will shift from the primary industry, to the secondary industry, and then to the tertiary industry [31]. In China, the industrial structure generally evolves from "primary-secondary-

FIGURE 7: Contribution rate of each prefecture (%).

tertiary" pattern, "secondary-primary-tertiary" pattern, "secondary-tertiary-primary" pattern, to "tertiary-secondary-primary" pattern [32–34]. Table 8 presents the industrial structure patterns in the 11 prefectures of Zhejiang since 2016.

TABLE 8: Industrial structure patterns in the 11 prefectures of Zhejiang.

Year	Hangzhou	Ningbo	Wenzhou	Jiaxing	Huzhou	Shaoxing	Jinhua	Quzhou	Zhoushan	Taizhou	Lishui
2016	4	3	3	3	3	4	4	4	4	4	4
2017	4	3	4	3	4	3	4	4	4	4	4
2018	4	3	4	3	4	3	4	4	4	4	4
2019	4	4	4	3	3	4	4	4	4	4	4

1–4 denote "primary-secondary-tertiary" pattern, "secondary-primary-tertiary" pattern, "secondary-tertiary-primary" pattern, and "tertiary-secondary-primary" pattern, respectively.

As shown in Table 8, since 2016, the industrial structures of all 11 prefectures in Zhejiang belonged to the slightly advanced pattern of "secondary-tertiary-primary" or the strongly advanced pattern of "tertiary-secondary-primary." In 2019, the industrial structure of every prefecture belonged to the strongly advanced pattern of "tertiary-secondary-primary," except for Jiaxing and Huzhou. This explains why all the prefectures lacked structural advantage in primary and secondary industries but had structural advantage in tertiary industry.

Take Wenzhou for example. In 2017, tertiary industry output in Wenzhou surpassed secondary industry output and remained above the latter in the following years. In 2016, the total retail sales of social consumer goods increased by 12.3% and ranked the first place in the province. The city's fixed asset investment increased by 13.0%, faster than the provincial mean rate by 2.1%. These achievements inject vitality into the economic sustainability of Wenzhou.

From the perspective of structural adjustment, high-tech industry, equipment manufacturing, and strategic emerging industry accounted for 39.3%, 44.5%, and 9.0% of the added value of industrial enterprises above designated size in 2016, respectively, up by 0.8%, 0.7%, and 0.1% from the previous year. This means the economy of Wenzhou has advanced to the stage of high-quality development. In the meantime, the industrial added value of eight high energy industries only increased by 5.4%, down by 0.1% from the previous year.

From the perspective of innovation driving effect, the new product output of industrial enterprises above designated size increased by 13.8% in 2016, 2.2% above the provincial mean rate; the investment in high-tech industry grew by 19.3%, faster than the provincial mean by 6.3%; the online retail sales increased by 37.1%, online consumption by 26.2%, and total amount of express delivery by 55.8%. The fast growth continued, providing a strong support for the industrial structure in Wenzhou to transform from "secondary-tertiary-primary" in 2016 to "tertiary-secondary-primary" in 2017.

6.3. Horizontal Comparison.
With 2015 as the base period and 2019 as the report period, the growth rates of the three industries in each prefecture were calculated (Table 9).

As shown in Table 9, Shaoxing ranked the first among all prefectures in terms of the growth rates of primary industry (87.4%), secondary industry (516.3%), and tertiary industry (426.5%), which is consistent with the results of SSM results. On the Golden South Wing of the Yangtze River Delta, the most developed region in China, Shaoxing is situated on the crossroads between Hangzhou, Ningbo, and Shanghai. In

the pursuit of open-up and development, the prefecture has actively participated in the integrated development of the Yangtze River Delta, deepened its connections with Shanghai, and strived to build a demonstration zone of integration with Hangzhou and Ningbo. In 2019, Shaoxing completed its first Three-Year Plan for the T&U of traditional industries, creating a "3 + 2 + 4" industrial system, which includes three traditional industries (textile, chemical, and metal processing), two historical industries (yellow rice wine and pearls), and four emerging industries (high-end equipment, electronic information, modern medicine, and new material). In 2018, Shaoxing realized a GDP of 540 billion yuan, ranking 36th in China. In 2019, the GDP of the prefecture rose to 578.074 billion yuan.

In addition, Quzhou ranked at the bottom, whether in the growth rate of primary, secondary, or tertiary industry output; Huzhou ranked at the second to last in the growth rate of the output of each industry; Jinhua ranked the sixth, eighth, and ninth in the growth rate of primary, secondary, and tertiary industry outputs. The results show that the three prefectures were not competitive in any of the three industries, which echoes with the findings of the SSM results.

7. Countermeasures

7.1. Optimize Industrial Structure and Layout.
Step up the efforts to promote the intelligent transformation of traditional manufacturing, support strategic emerging industries with modern service industry, and push forward the optimization and upgrading of the economic system, in the pursuit of high-quality development. Relying on scientific discoveries, technical inventions, process enhancements, and original results, open new industries, form a tertiary industry cluster, and optimize industrial structure with the increments of tertiary industry. Develop enterprises into carriers of innovation, protect the legitimate rights and interests of innovative enterprises, and build a series of industrial innovation service complexes, which integrates R&D, test and inspection, results transformation, and education and training. Construct a comprehensive evaluation index system and a composite index for the T&U level of manufacturing, carry out overall planning and clearly define the focuses of regional industrial planning, and develop industries with optimal resource allocation and global core competitiveness [35].

7.2. Strengthen Intellectual Property Protection.
Gradually improve the intellectual property protection system, strengthen the administrative and judicial law enforcement

TABLE 9: Growth rates of the three industries in each prefecture and their rankings.

Serial number	Prefecture	Growth rate (%)			Ranking		
		Primary industry	Secondary industry	Tertiary industry	Primary industry	Secondary industry	Tertiary industry
1	Hangzhou	13.2	24.7	73.8	4	6	4
2	Ningbo	13.1	41.1	62.4	5	5	5
3	Wenzhou	9.1	51.9	138.4	8	3	3
4	Jiaxing	−1.4	183.3	150.6	9	2	2
5	Huzhou	−32.7	−29.2	−30.8	10	10	10
6	Shaoxing	87.4	516.3	426.5	1	1	1
7	Jinhua	12.5	−9.4	4.7	6	8	9
8	Quzhou	−38.7	−58.0	−51.2	11	11	11
9	Zhoushan	73.3	−11.1	42.3	2	9	8
10	Taizhou	22.8	49.3	43.0	3	4	7
11	Lishui	9.5	13.4	58.5	7	7	6

for intellectual property protection, ensure the effectiveness of the administrative and judicial protection of intellectual properties, and reinforce the cooperation and synergy between administrative and judicial departments. Meanwhile, build a unified and high-quality law enforcement team for intellectual property protection, which involves such departments as Intellectual Property Office, public security bureaus, courts, customs, etc. Improve the institutional mechanism to stimulate the vitality of private economy, encourage and protect the undertakings of outstanding entrepreneurs, and upscale the efforts of intellectual property protection. At the same time, increase the publicity of intellectual property protection, and enhance the public awareness of intellectual property protection.

7.3. Build a Team of Innovative Talents. Focusing on the T&U of traditional manufacturing, construct R&D centers of the engineering technologies that drive the development and solve the common problems of the strategic industries and sectors, and attract outstanding talents by building sound scientific innovation platforms. In association with well-known engineering universities and institutions at home and abroad, set up training bases for technicians, and cultivate a batch of highly innovative and adaptive engineering talents. Divert more resources to vocational education, and train a group of high-skilled, adaptive, and practical talents.

7.4. Enhance Regional Innovation Capabilities. Continue to optimize the business environment, and inject vitality to the market. Streamline administration and delegate power, improve regulation, and upgrade services. Focusing on major market players, understand the needs of enterprises, and provide them with customized services. Apart from supervising the credit of enterprises, facilitate the formation of a new model for high and new regions of marketized and enterprise-oriented operations. Improve the service framework, and enhance the supporting mechanism. Incentivize the transformation of scientific results, and build an internationally recognized service framework, which provides governance, regulatory, financial, legal, and multimodal transport services. Upgrade incubators and public service

platforms, and thus better the supporting mechanisms like tariffs, insurance, and logistics. Finally, increase financial subsidies, and invest more in scientific research.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

Acknowledgments

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