Analysis of China's Textile Printing and Dyeing Industry Based on the Input-Output Method

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Keywords: Textile Printing and Dyeing Industry, Input-Output Method, Industry Affiliation, Industrial Ripple Effects.

Abstract: The textile printing and dyeing industry is an important part of the textile industry chain. The industry is linked upstream to production materials such as spinning and weaving, and downstream to finished products such as garments and home textiles. In 2021, in the face of complex and changeable domestic and foreign situations and various risks and challenges, China's printing and dyeing enterprises will actively adjust their development strategies. The output of printing and dyeing cloth has maintained a good growth trend. The export scale of main products will be further expanded than before the epidemic, and major economic indicators will continue to recover, the level of corporate profitability has improved significantly. Therefore, it is particularly important to study the current development of the textile dyeing and printing industry in China. In this paper, macroeconomic data are processed for "China's input-output table in 2018". The input-output model is used to study the textile printing and dyeing industry. From the perspective of industrial linkages and industrial fluctuation effects, the authors explore the relationship between China's textile printing and dyeing industry and other industrial sectors of the national economy. Through the measurement of six related indices, the analysis concludes that the textile printing and dyeing industry is a raw material-based industrial sector with low value-added characteristics. The results of the study indicate that the textile printing and dyeing industry has a strong pulling and driving effect on China's economy, and its contribution to social employment is at an intermediate level.

1 INTRODUCTION

The textile printing and dyeing industry is an important part of the textile industry, for clothing, home textiles, technical textiles, and other downstream industries to provide important technical support, to meet the new consumer demand for textile products, leading the new trend of green fashion to provide important protection. Although the transformation and upgrading of the textile printing and dyeing industry have achieved remarkable results in recent years, there are still many problems that attract attention. This paper will explore the current situation and development of the textile printing and dyeing industry from the perspective of input and output for the first time. The paper will mainly measure and analyze the complete consumption coefficient, intermediate demand rate, intermediate input rate, impact coefficient, inductivity coefficient,

and complete employment contribution model, and finally come up with more practical suggestions for development.

2 OVERVIEW OF TEXTILE PRINTING AND DYEING INDUSTRY

In recent years, the transformation and upgrading of the textile printing and dyeing industry have been promoted in-depth, the level of innovation has been steadily improved, green development has achieved excellent results, and the industry has further developed towards the goal of high quality. the printing and dyeing industry has been running smoothly overall between 2015 and 2019, with indicators such as scale and efficiency remaining

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within a reasonable range. The output of printing and dyeing fabric of enterprises above the scale increased by 1.4% annually, the sales profit margin increased from 5.2% to 5.6%, the export quantity of eight major products of textile printing and dyeing increased by 6.8% annually, and the export value increased by 3.0% annually. 2020, the operating income of enterprises above the scale of the textile printing and dyeing industry was 254.13 billion yuan, and the total profit was 12.67 billion yuan, the operating income accounted for 5.6% of the whole textile industry. 5.6%. 2021 green laws and regulations are implemented to make sustainable development more important, and enterprises in the industry increase energy saving and emission reduction.

In this paper, according to the National Economic Classification of Industries (GB/T 4754-2017), the main products of the printing and dyeing industry include cotton textile and dyeing finishing (C171), wool textile and dyeing finishing (C172), hemp textile and dyeing finishing (C173), silk and silk textile and dyeing finishing (C174), chemical fiber weaving and dyeing finishing (C175). In the "2018 Input-Output Table" the textile industry is subdivided into 8 categories, and since only two of the 8 categories in aggregate fall within the scope defined in this paper, the data explored in this paper are taken only from the 2 categories in aggregate for cotton, chemical fiber textile and printing, and dyeing finishing products and wool textile and dyeing and finishing products. The following section will analyze the current situation of the industry development through the input-output method, to put forward reasonable suggestions in a more scientific and targeted manner.

3 TEXTILE PRINTING AND DYEING INDUSTRY INPUT AND OUTPUT INDICATOR CONSTRUCTION

The data in this paper use the Input-Output Tables 2018 published by the National Bureau of Statistics, in which 153 national economic sectors are published. To be able to study the relationship between the sector and other industries more clearly, this paper collectively integrates 153 subdivision categories into 92 major categories according to the National Economic Classification of Industries (GB/T 4754-2017), according to which subsequent studies will be more integrated output table for measurement.

3.1 Industry Linkages Analysis of Indicators

Equation 1 to Equation 5 are calculated using Lu A et al (Lu, 2013). The equations are as follows. b_{ij} denotes the coefficient of complete consumption. a_{ij} denotes the coefficient of complete consumption. $\sum_{k=1}^{n} b_{ik} a_{kj}$ is the indirect consumption coefficient, which indicates the total indirect consumption of product i buy production unit j formed by k intermediate products.

$$b_{ij} = a_{ij} + \sum_{k=1}^{n} b_{ik} a_{kj} \ (i,j = 1,2,\cdots,n) \quad (1)$$

G_i denotes the intermediate demand rate for industry sector i. $\sum_{j=1}^{n} x_{ij}$ denotes the sum of the intermediate demand for the product of industry sector i by each industry sector. $\sum_{j=1}^{n} x_{ij} + Y_i$ denotes the total output of products in industry sector i.

$$G_i = \frac{\sum_{j=1}^{n} x_{ij}}{\sum_{j=1}^{n} x_{ij} + Y_i} (i,j = 1,2,\ldots,n) \quad (2)$$

F_j denotes the intermediate input rate of industry sector j. D_j denotes the full depreciation cost of industrial sector j (1 year). N_j denotes the value created by industrial sector j.

$$F_j = \frac{\sum_{i=1}^{n} x_{ij}}{\sum_{i=1}^{n} x_{ij} + D_j + N_j} (i,j = 1,2,\ldots,n) \quad (3)$$

3.2 Industry Wave Analysis Indicators

Inductance Coefficient is the degree of ripple effect of production demand on various sectors of the national economy when a unit of final product is added to the textile printing and dyeing industry. e_j is the Inductance Coefficient of industry j; C_{ij} is the number in the Leontief inverse matrix table; i and j are the rows and columns in the input-output table respectively; n is the total number of sectors in the input-output table.

$$e_j = \frac{\sum_{i=1}^{n} C_{ij}}{\frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} C_{ij}} (i,j = 1,2,\ldots,n) \quad (4)$$

e_i is the Reaction Coefficient of industry i; i and j are the rows and columns in the input-output table; n is the number of industrial sectors in the input-output table; and C_{ij} is the element in the Leontief inverse matrix table C.

$$e_i = \frac{\sum_{j=1}^{n} C_{ij}}{\frac{1}{n} \sum_{i=1}^{n} \sum_{j=1}^{n} C_{ij}} (i,j = 1,2,\ldots,n) \quad (5)$$

In this paper, we use the employment contribution model of Yin F C et al (Yin, 2010), where the compensation received by workers is used to explore the contribution of the industry to society. $DL_i =$

$\frac{w_i}{x_i}$ $(i = 1,2,\cdots,n)$, DL_i represents the direct employment contribution. Its economic significance indicates the direct employment generated by sector i for the national economy. W_i denotes the total remuneration received by workers in sector i. The total input in sector i is X_i. H is a matrix consisting of h_{ij}, h_{ij} represents the ratio of the quantity of sector i's output that is used as intermediate goods by sector j to the total output of sector i. GL indicates the full contribution to employment.

$$GL = (1 - H)^{-1} \cdot DL \qquad (6)$$

4 EMPIRICAL ANALYSIS

4.1 Linkage Analysis of the Textile Printing and Dyeing Industry

4.1.1 Complete Consumption Factor

The top 5 coefficients of complete consumption in the textile printing and dyeing industry, calculated according to formula 1, as published in Table 1. The textile printing and dyeing industry has the highest coefficient of complete consumption at 0.51, which shows that the restructuring of the industry needs to start from its own internal structure and develop in a coordinated manner between industries. The next industries in the complete consumption coefficient table are agriculture (0.28), chemical raw material and chemical product manufacturing (0.19) and chemical fibre manufacturing (0.19), which indicates that the textile dyeing and printing industry is more dependent on these industries. It is therefore possible to focus on developing and structuring the primary and secondary industrial chains to create a linkage and optimistic effect.

Table 1: Complete consumption factor (partial).

NO.	Industry	Textile printing and dyeing industry
1	Textile printing and dyeing industry	0.514241
2	Agriculture	0.278538
3	Chemical raw materials and chemical products manufacturing	0.19458
4	Chemical fiber manufacturing	0.187906
5	Agriculture, forestry, animal husbandry, and fishery services	0.088117

4.1.2 Intermediate Demand Rate and Intermediate Input Rate

For reasons of space, only the relevant indices for the relevant sub-sectors of the textile industry are disclosed in this article. The intermediate demand rate for the textile printing and dyeing industry, calculated according to formula 2, is 0.92, ranking 9th out of all industries with an intermediate demand rate of less than 1, indicating that more of the textile printing and dyeing industry's products are used in the production of other sectors. It is thus clear that the textile printing and dyeing industry is a sector with the nature of a raw material industry. At present, the export market share of textile printing and dyeing products in the world remains basically stable, and the industry should speed up the transformation from a quantitative scale to a quality and efficiency one.

Table 2: Intermediate demand and intermediate input indicators (partial).

Industry	Intermediate demand rate	Intermediate input rate
Textile printing and dyeing industry	0.925838	0.823406
Hemp, silk, and silk textiles and processed products	0.962609	0.803244
Knitting or crochet and its products	0.619587	0.865804
Textile finished products	0.442756	0.818988
Leather, fur, feathers, and their products and footwear industry	0.426331	0.801408
Textile clothing apparel	0.416231	0.824878

Using formula 3, the textile printing and dyeing industry (0.82) is ranked 5th out of 92 industry sectors, which is a relatively high ranking and represents a low value added rate for the industry. This leads to the conclusion that the textile printing and dyeing industry should optimize its product structure, improve its ability to supply high quality products and enhance its product value and market control.

4.1.3 Summary

According to the results of the above empirical analysis, it is indicated that although the textile printing and dyeing industry has a closer relationship with other industries, this dependency is much smaller than its dependency with its own industry. This

reveals that we should strengthen the optimization and upgrading within the industry, extend the industrial chain and help deepen the coordinated development with other industrial sectors. The intermediate demand rate of textile printing and dyeing industry is in the middle and upstream position, because the textile printing and dyeing industry has certain characteristics of raw material industry sector, often as raw materials into other industrial sectors industry chain. China's textile printing and dyeing industry is still in the stage of low value-added, but the textile printing and dyeing industry wants to break the low value-added situation needs to face a huge transformation challenge.

4.2 Empirical Analysis of the Ripple Effect of Textile Printing and Dyeing Industry

4.2.1 Reaction Coefficient and Inductance Coefficient

The textile dyeing and printing industry has an impact factor of 1.246402, ranking 16th out of the 92 industry sectors studied. This indicates that the industry has a higher influence on other industrial sectors than the social average (the social average is 1) and has a greater pull on the economy. Textile printing and dyeing are in the middle of the textile industry chain structure, the upstream of which is dominated by weaving fabric, dyestuff, and dyeing auxiliaries, while the downstream is concentrated in apparel, home textile, and auto textile fields. China is the world's largest producer and exporter of textiles and garments, of which the demand for raw materials is also large. In 2021, in the face of complex and changing domestic and international situations and various risk challenges, China's printing and dyeing enterprises actively adjusted their development strategies, printing and dyeing fabric production maintained a good growth trend. This background makes the textile printing and dyeing industry also has an important influence in China.

The inductivity coefficient of the textile printing and dyeing industry is 1.898089, which is higher than the social average level of 1 and ranks 11th. The degree of sensitivity to the demand for economic development is greater, so the industry has a pillar role in the industrial sector of the national economy and has a greater role in promoting the development of the national economy. From the results of the coefficient of complete consumption, we can analyze that the industries such as agriculture, chemical fiber manufacturing, and self-consumption within the industry account for a larger proportion of the demand

for textile printing and dyeing. These industries account for a relatively large share of GDP, so their consumption is also large, which laterally explains the large inductivity coefficient of the textile printing and dyeing industry.

Table 3: Reaction Coefficient and Influence Coefficient (partial).

Industry	Reaction Coefficient	Influence Coefficient
Textile printing and dyeing industry	1.898089	1.246402
Hemp, silk, and silk textiles and processed products	0.572981	1.145388
Knitting or crochet and its products	0.503255	1.411436
Textile finished products	0.481902	1.339618
Textile clothing apparel	0.776402	1.350662
Leather, fur, feathers, and their products and footwear industry	0.6166	1.264972

4.3 Full Employment Contribution Rate

In our study of the compensation of labor in the textile industry in the input-output table over the years, we found that the overall compensation of labor in the textile industry declined from 2015 onwards. The study found that the decline in overall labor compensation against the backdrop of a gradual rise in labor wages indicates that the number of workers is shrinking. According to the China Printing and Dyeing Industry Association, the construction of intelligent production lines has achieved obvious results. The construction of intelligent workshops has reduced the number of employees, helped solve the problem of large-scale personalization, and enabled further optimization of production efficiency and quality.
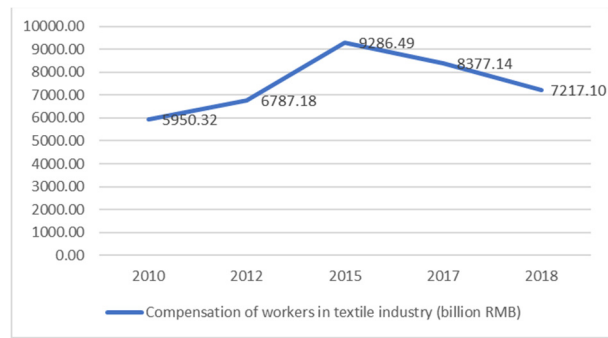
Figure 1: Summary of labor compensation in the textile industry in the input-output table over the years.

The full employment contribution coefficient of the textile printing and dyeing industry ranks 69th out of 92 national economy industries, and the overall employment contribution to society is at an intermediate level. The coefficient indicates that when the textile and dyeing industry invests RMB10,000, the contribution to the employment of society will increase by 0.4287. The overall trend of labor compensation in the textile industry is decreasing. This is mainly related to the digital development of the industry, which makes high-tech equipment replace the previous low labor force gradually become the main production force.

Table 4: Employment contribution of the main sectors of the textile industry.

Contribution rate index	Direct employment contribution rate	NO.	Full employment contribution rate	NO.
Textile printing and dyeing industry	0.0954	69	0.4287	57
Hemp, silk and silk textiles and processed products	0.0830	78	0.4295	56
Textile clothing apparel	0.1180	61	0.3230	80
Textile finished products	0.1084	65	0.3129	81
Knitting or crochet and its products	0.0763	69	0.2735	85
Leather, fur, feathers and their products and footwear industry	0.1155	62	0.2423	86

5 CONCLUSIONS

The intermediate input rate and intermediate demand rate of textile printing and dyeing industry are greater than 0.5, so it belongs to the intermediate product sector (Ning, 2004). Generally speaking, the higher the intermediate input rate is, the lower its added value is. From the value point of view, China's textile printing and dyeing industry is still in the stage of low added value. From the Reaction Coefficient and Influence Coefficient, it has strong pulling and driving characteristics to economic growth. From the measurement result of employment contribution rate, the full employment contribution rate of textile printing and dyeing industry is in the middle and lower status quo.

It can be concluded that the textile printing and dyeing industry is a major pillar industry in China, and its ripple effect on various sectors is more obvious. Although the textile printing and dyeing industry has a closer relationship with other industries, this dependency is much smaller than its dependency with

its own industry. This reveals that we should strengthen the optimization and upgrading within the industry, extend the industrial chain and help deepen the coordinated development with other industrial sectors (Li, 2018).

In the future, the government can build innovative production parks to promote the effective connection between the upper and lower industrial chains of the printing and dyeing industry. And they take the lead in providing an exchange platform for enterprises and universities to promote the rate of transformation of the results of technological research and development of universities and broaden the access of enterprises to high technology. Enterprises should increase investment in technology research and development to set up special funds to encourage technological innovation of R&D personnel. The product side through sufficient preliminary market research, clear user portrait and consumer needs, targeted product design and accurate market segmentation, timely grasp of consumer needs and preferences. Promote the quality and efficiency of the industry to achieve industrial value chain upgrading.

ACKNOWLEDGMENT

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