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Research on optimized path of labor skill structure based on fsQCA method

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Abstract

Under the background of globalization and rapid technological development, the optimization of labor skill structure has become the core factor to enhance national competitiveness and achieve sustainable economic development. In this paper, the advanced fuzzy set qualitative comparative analysis (fsQCA) method is used to analyze the multi-dimensional influencing factors and the complex interaction mechanism of Chinese labor skill structure optimization. Through a detailed case analysis of 30 provinces in China, this study reveals the important role of key condition variables such as technological progress, trade openness, urbanization, and aging in the optimization of labor skill structure, and draws three paths for the optimization of labor skill structure.

Keywords

Labor, skill structure, optimized path, fsQCA.

1. Introduction

As the cornerstone of national and regional economic development, the optimization degree of labor skill structure is directly related to sustained economic growth and social stability and prosperity. With the continuous emergence of cutting-edge technologies such as artificial intelligence, big data, and cloud computing, the demand for skills in the labor market has undergone profound changes. Highly skilled personnel have become a key force in promoting industrial upgrading and economic growth. However, the skill structure of the Chinese labor force is facing many challenges. How to optimize the skill structure of the labor force effectively has become an important issue to be solved urgently. Fuzzy set Qualitative comparative Analysis (fsQCA), as a new case-oriented research method, can surpass the traditional single variable analysis framework and reveal the complex interaction between multiple factors. Using fsQCA method, this study aims to systematically explore the influencing factors and optimization paths of China's labor force skill structure optimization, provide scientific basis for policy formulation, and promote the continuous optimization and upgrading of labor force skill structure.

2. Literature Review

The current research on labor skill structure mainly focuses on the exploration of influencing factors and the changing trend. Autor believes that the U.S. labor market is undergoing a

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profound transformation, showing a significant increase in the demand for highly skilled personnel [1]. Based on a detailed analysis of the migration decisions of full-time employees in 326 German regions between 1997 and 2013, Prenzel (2021) proved that the aging process drives the geographic mobility of highly skilled labor force, thus reshaping the skill structure of regional labor force [2]. Driven by the wave of economic globalization, the labor market of not only developed countries, but also some developing countries including Colombia, Mexico and Chile in South America, began to show the characteristics of "polarization" of labor skill structure, and this trend was reflected in different time periods [3-4]. The prosperity and development of cities promote the relative migration of population, among which, the "high-level development" of cities attract a large number of high-skilled talents; At the same time, in the more economically developed regions, the demand for skilled labor is relatively greater. [5-6]. In China, the phenomenon of "polarization" in the skill structure of the labor force shows diversified manifestations due to regional differences: Yan Shiping et al believe that the vigorous development of the digital economy not only promotes the significant growth of the demand for high-skilled labor force, but also leads to the general decline of the demand for middle-skilled labor force; Specifically, the coastal areas and the northeast show the characteristics of "polarization at both ends", while the southwest shows a one-way "polarization" trend of increasing demand for higher education and decreasing demand for lower education [7]. Zhao Chunyan and Zhang Wei et al. found that the aging population has a differentiated "polarization" effect on the labor market. The southwest economic zone tends to promote low-skilled employment, while the southern economic zone focuses on the promotion of high-skilled employment. The impact in the eastern region exceeds the national average level. In the central and western regions, the share of low-skilled employment increased and the share of medium-skilled employment decreased [8-9]. From the perspective of environmental regulation, Shen Hongliang and Jin Da found that formal environmental regulation has a direct and indirect positive impact on the optimization of industrial employment skill structure in the eastern, central and western regions. In contrast, such effects of informal environmental regulations are limited to the eastern and central regions, and no significant effects have been observed in the western region [10].

3. Research Methods and Data Construction

3.1. Research Method

FsQCA is a research method that combines qualitative and quantitative analysis. It examines the relationship between antecedent conditions and their combinations and results through Boolean algebra operations. Compared with the traditional regression analysis, structural equation model and other methods, fsQCA has a unique advantage in processing small and medium-sized sample data and analyzing the combined effects of multiple causal relationships. It can reveal the complex combination of causes that lead to specific outcomes and provide a new perspective for understanding complex social phenomena.

3.2. Data Source and Sample Selection

This study selected 30 provinces in China (except Tibet and Hong Kong, Macao and Taiwan) as research samples, and the data came from China Statistical Yearbook and China Labor Statistics Yearbook 2022.

3.3. Variable Measurement and Calibration

According to the research purpose, four conditional variables of urbanization, technological progress, trade openness, urbanization and aging are defined in this study, and the skill structure of the labor force is taken as the result variable. The specific definition and calibration method are as follows:

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(1) Condition variables:

Technological progress: measured by the number of domestic patent applications accepted. Trade openness: Measured by the ratio of total imports and exports to GDP. Urbanization: Measured by the ratio of the urban population to the total population. Aging: Measured by the dependency ratio of the elderly population.

(2) Result variables:

Labor skill structure: As an outcome variable, it reflects the distribution and structure of the regional labor skill level. It is measured by the ratio of the number of highly skilled workers to the number of low-skilled workers in each province. Among them, high-skilled labor refers to the labor force with a high school education or above, and low-skilled labor refers to the labor force with a high school education or below.

Data calibration: Each variable is calibrated according to the quartile, and the results are shown in Table 1.

Table 1: Variable Calibration

Types of Variables	Variable Name	Calibration		
		Completely Subordinate Point	Intersection Point	Completely non-subordinate Point
Conditional Variable	Technological Advancement	193865.00	94553.50	41046.75
	Trade Openness	0.32	0.19	0.12
	Urbanization	70.75	63.99	60.19
	Aging	24.51	21.09	18.89
Dependent Variable	Skill Structure of the Labor Force	0.37	0.32	0.25

4. Empirical Analysis

4.1. Necessary Condition Analysis

Through the analysis of fsQCA4.0 software, it is found that the consistency level of each condition variable is less than 0.9, so it is considered that there are no necessary conditions. The specific results are shown in Table 2.

Table 2. Necessary Condition Analysis

	Consistency	Coverage
JS	0.555706	0.55272
~JS	0.550979	0.54004
MY	0.620527	0.641312
~MY	0.471303	0.445437
CZ	0.835247	0.856055
~CZ	0.313302	0.298392
OLD	0.558407	0.523418
~OLD	0.513842	0.535915

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4.2. Configuration Analysis

FsQCA4.0 software was used to set the consistency to 0.8 and PRI to 0.7, and the following truth table was constructed. Three optimization paths H1, H2 and H3 for labor skill structure were generated altogether. The solution consistency is 0.9, the solution coverage is 0.73, and the interpretation is high. The specific results are shown in Table 3.

Table 3. The Analysis of Optimal Configuration of Labor Skill Structure

Preceding conditions	H1	H2	H3
Technological Advancement	●		⊗
Trade Openness	●	●	⊗
Urbanization	●	●	●
Aging		●	⊗
Consistency	0.88	0.90	0.95
Raw Coverage	0.48	0.40	0.20
Unique Coverage	0.16	0.09	0.19
Solution Consistency		0.90	
Solution Coverage		0.73	

Note: ●indicates that the core condition exists, ●indicates that the auxiliary condition exists, ⊗ndicates that the core condition does not exist, and ⊗ndicates that the auxiliary condition does not exist.

In path H1, the optimization of labor skill structure mainly depends on technological progress, trade openness and urbanization. In the context of open trade and high urbanization, the optimization of the skill structure of the labor force can be achieved even if technological progress is not the core condition. This may mean that in these regions, trade openness and urbanization are the main drivers for the optimization of the skills structure of the labor force. As a key force to promote industrial upgrading and economic transformation, technological progress requires the labor force to have higher professional skills and innovation ability to adapt to the development needs of new technologies and new industries. Trade openness has promoted the connectivity of domestic and foreign markets and provided a broader employment space and development opportunities for the labor force. At the same time, it also requires the labor force to have the skills and qualities that are in line with international standards. The accelerated process of urbanization provides an important environment for the optimization of labor skill structure. Urbanization has promoted the adjustment of industrial structure and the reform of labor market, and has had a profound impact on the skill structure of labor force.

In Route H2, the dual linkage of trade opening and urbanization drives the optimization of labor skill structure. Compared with path H1, the biggest difference of path H2 lies in the appearance of aging. Trade openness not only provides a broader market vision and competitive pressure for the optimization of labor skill structure, but also promotes international technical exchanges and cooperation, and provides more possibilities for the improvement of labor skill and innovation. Both constitute the core conditions of this configuration, reflecting the changing trend of the labor market in the context of globalization and urbanization. Urbanization, on the other hand, promotes the restructuring of labor market and the improvement of labor skills. This path emphasizes that the openness and competition of the external market promote the improvement of labor skills, while the supporting role of internal factors is still significant.

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In path H3, urbanization and non-aging as the core conditions of this configuration drive the optimization of labor skill structure. It shows that urbanization itself has a strong internal driving force in promoting the optimization of labor skill structure. Reasonable population structure is also crucial to the optimization of labor skill structure, and the young generation with high education level is more adaptable in the contemporary era of rapid development of science and technology, which is more conducive to the optimization of labor skill structure.

5. Conclusion and Suggestion

5.1. Conclusion

Taking 30 provinces in China (except Tibet and Hong Kong, Macao and Taiwan) as a case study, fsQCA4.0 software identifies three main optimization paths for labor force skill structure: Path H1: Under the dual drive of trade opening and urbanization, labor force skill structure can be effectively optimized. The opening of trade has brought the pressure of international competition and the demand for new skills, while urbanization, as an important driving force for social and economic development, technological progress has provided the demand and motivation for skill upgrading, creating a favorable environment for skill upgrading. Path H2: This configuration reflects that under the dual role of trade opening and urbanization, the aging problem has become a important factor in the optimization of labor force skill structure. Although technological progress does not appear as a core condition, it may still have a positive impact on skills upgrading. Path H3: Urbanization and non-aging can drive the optimization of labor skill structure. It shows that urbanization itself has a strong internal power in promoting the optimization of labor skill structure, and reasonable population structure is also crucial to the optimization of labor skill structure.

5.2. Suggestion

Based on the above research, the following suggestions are put forward for the optimization of labor skill structure:

(1) Strengthen technological innovation and R&D investment. The government should increase support for scientific and technological research and development, encourage enterprises to increase investment in research and development, and promote technological innovation, so as to promote the improvement of labor skills. We will establish an industry-university-research cooperation mechanism to promote the transformation of scientific and technological achievements into actual productive forces and provide more high-skilled job opportunities for the labor force.

(2) Deepen trade openness and international cooperation. To further open up, attract foreign investment and technology, and enhance the international competitiveness of local enterprises; Strengthen the contact with the international market, understand the trend of international skills demand, timely adjust and optimize the direction of labor skills training.

(3) Promote urbanization and labor market reform. Accelerate urbanization to make labor markets more flexible and inclusive and create more opportunities for skills upgrading and employment; We will reform the household registration system and the employment system, break down barriers to labor flow, and promote the optimal allocation of labor resources.

(4) Promoting industrial transformation, upgrading and diversified development. We will promote the transformation and upgrading of traditional industries, develop high-tech industries and modern service industries, and create more high-skilled jobs. We will encourage innovation and entrepreneurship, support the development of small and micro businesses and emerging industries, and inject new vitality into the labor market.

(5) Formulate policies for personnel training and introduction. According to the local economic development and industrial layout, formulate targeted personnel training and introduction

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policies; Strengthen cooperation with universities, vocational colleges and other educational institutions to jointly train high-quality and skilled talents that meet the market demand; Perfect the skill evaluation system and establish a sound vocational skill certification system; We will establish a skills incentive mechanism, commend and reward workers who have significantly improved their skills, and motivate them to learn and upgrade their skills.

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