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Impact of internet economy on employment structure in China: a pilot study

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Abstract. With the rapid progress of internet economy in China, its effectt on employment structure deserves attention. Based on the previous theories, our study primarily redefined and selected the concepts of polarization, upgrade and the corresponding statistical index. We then focused on the changes of employment structures, and analyzed the intrinsic mechanism. Finally, we provided some reference suggestions on the government's guidance and support, skill training and education reform.

Keywords: Employment structure; polarization and upgrading; employment downgrade; technological progress; Skill structure.

1. Introduction

Since China's access to the internet, the economic development has shown the characteristics of "Chinese scale" and "Chinese speed". According to the "Statistical Report on Internet Development in China" released by the official department, as of June 2022, China's Internet penetration rate has reached 74.4%, and there are 1.05 billion netizens in China, the huge population base provides fertile soil for the rapid development of Internet economy.

The new technological revolution must follow the discussion of employment and the Internet is no exception. In order to alleviate people's panic on unemployment due to technological progress and seize the opportunities offered by technological progress, our present study focused on exploring the characteristics and internal logic of the current employment structure change in China from the perspective of structural change, with the purpose of providing help for employment shock.

2. Statistical Indicators by Sector

2.1 Sector classification

Based on the different classification criteria, the analysis of employment structure mainly involved the industry structure, skill structure and the cross-analysis between them[1,2]. According to the statistical caliber of agricultural employment population in official data, industrial/agricultural workers were included in the farming population. Our study hold that it might cause large deviations when using tertiary industries to divide the various skilled groups, and we used "national economic category" (see "National Economic Industry Classification" for details) to carry out data statistics and analysis here. In addition, based on the availability and completeness of the data, "international organizations" were excluded from the industry categories covered in our study, and the 19 sector categories were mainly analyzed.

2.2 Labor force skills classification

From the perspective of the entire economy, employment structure is an important aspect of employment quality, and employment structure will upgrade with the development of the economy and society, and the advanced employment structure is an important manifestation of the degree of economy development. The literature studies mainly used the education level, salary factors, work

content, etc, as the referencein dividing the different skill groups in industry categories [3]. In our study, we defined college degree or above (including higher vocational education) as high education, high school (including secondary vocational education) as secondary education, and junior high school and below as primary education [4], the employed population was then divided into high-skilled labor, medium-skilled labor and low-skilled labor based on the education status.

2.3 Classification of employment polarization and upgrading

Considering the characteristics of data changes, the meaning of employment polarization and employment upgrading [2,5], we proposed the following classification criteria: (1) Employment polarization meant the proportion of high- and medium -skilled labor continued to increase, while the proportion of middle-skilled labor continued to decline. (2) Employment upgrading meant the proportion of low-skilled labor force had declined, and the sum of the proportion of high- and medium-skilled labor force had continued to rise. Further, according to the composition of the proportion of high-skilled labor, employment upgrading was refined into low-level employment upgrading and high-level employment upgrading. (3) Employment downgrading was defined that the proportion of low-skilled labor continued to increase, while the proportion of high- and medium-skilled labor had declined.

2.4 The Selection of Research Duration

In 2007, China Population Statistics Yearbook was officially renamed as China Population and Employment Statistics Yearbook, its statistical indicators and contents were refined and optimized. In addition, the latest available statistical data was China Population and Employment Statistical Yearbook in 2021. Therefore, our study adopted the statistical index of the " Educational Attainment of Employed Persons by Sector and Sex" in the Yearbook and the research period was determined to be from 2006 to 2020.

Based on the above concepts, index definition and statistical results, our study drew a table of changes in employment structure by sector (See Table 1 for details).

Table 1. Statistics of Changes in Employment Structure by Sector

Employment Structure	Sector Structure	Proportion of high-skilled labor (unit: %)
Low-level Employment Upgrading	Agriculture, Forestry, Animal Husbandry and Fishery	0.2-1.1
	Manufacturing	7.2-17.6
	Construction	5.3-11.1
	Transport, Storage and Post	8.1-20.7
	Information Transmission, Software and Information Technical Services (From 2011 to 2020)	14.3-19.0
	Mining	6.1-26.7
	Services to Households, Repair and Other Services	4.1-13.7
High-level Employment Upgrading	Financial Intermediation	52.3-71.7
	Public Management, Social Security and Social Organizations	54.8-66.0
	Leasing and Business Services	35.4-48.2
	Information Transmission, Software and Information Technical Services (From 20006 to 2010)	43.3-55.1
	Production and Supply of Electricity	27.8-45.3

	Power, Heat Power, Gas and Water	
	Scientific Research and Technical Services	50.0-75.1
	Health and Society	47.2-68.9
	Hotels and Catering Services	4.6-70.6
	Culture, Sports and Entertainment	32.3-46.2
Employment Polarization	Real Estate	28.9-39.2
	Wholesale and Retail Trades	8.4-10.1
	Education	67.0-74.4
Employment Downgrading	Management of Water Conservancy, Environment and Public Facilities	20.7-30.0

*Note: The " Information Transmission, Software and Information Technical Services " showed completely opposite characteristics of skill structure around 2011.Therefore, the sector was divided into two time intervals: 2006-2010 and 2011-2020. Data source: China Population and Employment Statistical Yearbook.

3. The Characteristics of Changes in China's Employment Structure

3.1 Characteristics of Changes in the Overall Employment Structure of Sector

The overall employment structure of the national economy was characterized by "high-level employment upgrading": The share of low-skilled labor proportion had declined， the sum of the proportion of high- and medium-skilled labor continued to rise and the proportion of high-skilled labor was at about 35.1%-49.6%. This illustrated the Internet technology and informationalized level in our country had continuously improved.

However, due to China's large population base, the "demographic dividend" still exists and will not disappear in a short time. Therefore, China's current economic development relies more on skill-based technological progress.

Further, combined with the data in Table 1, it showed that there existed a pattern of low-level employment upgrading, high-level employment upgrading, employment polarization and employment downgrading in some sectors in China's national sector.

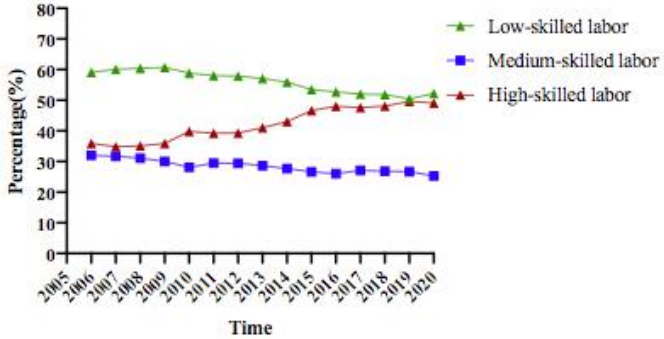

Fig. 1 The overall trend of the proportion of different skills

*Data source: China Population and Employment Statistical Yearbook.

3.2 Characteristics of Employment Structure by Sector

3.2.1 Analysis of the Phenomenon of "Employment Polarization"

There were three categories of employment polarization: Real Estate; Wholesale and Retail Trades; Education.

In the Real Estate, the proportion of high-skilled labor had risen from 32.8% in 2006 to 37%, increased by 12.8%. The proportion of middle-skilled labor had dropped from 32.5% to 27.5%,

decreased by15.4%. The proportion of low-skilled labor had risen from 34.6% to 35.5%, increased by 2.6%.

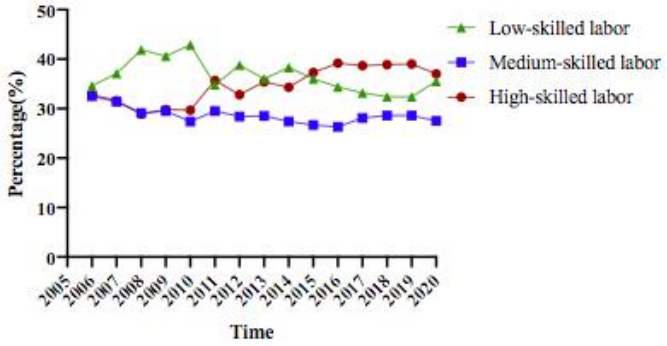

Fig. 2 Proportion of employment personnel by skill in Real Estate

*Data source: China Population and Employment Statistical Yearbook.

In the Wholesale and Retail Trades, the proportion of high-skilled labor had risen from 8.4% in 2006 to 9.9%, increased by 17.9%. The proportion of medium-skilled labor had risen from 26.8% in 2006 to 23.2%, increased by 13.4%. The proportion of low-skilled labor had risen from 64.8% to 67.0%, increased by 3.4%.

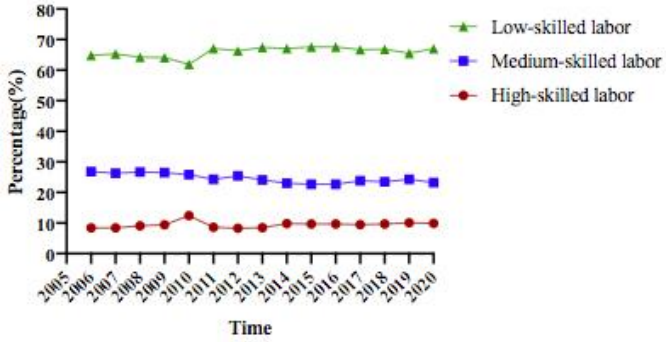

Fig. 3 Proportion of employment personnel by skill in Wholesale and Retail Trades

*Data source: China Population and Employment Statistical Yearbook.

In the Education, the proportion of high-skilled labor had risen from 67.0% in 2006 to 74.3%, increased by 10.9%; The proportion of medium-skilled labor force had risen from 22.9% in 2006 to 13.4%, increased by 41.5%; The proportion of low-skilled labor had risen from 10.2% to 12.4%, increased by 21.6%.

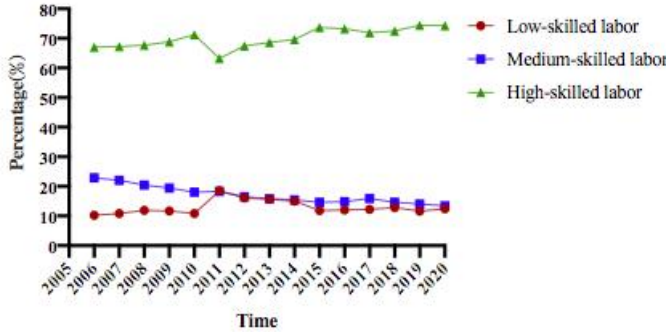

Fig. 4 Proportion of employment personnel by skill in Education

*Data source: China Population and Employment Statistical Yearbook.

3.2.2 Analysis of the Phenomenon of "Employment Upgrading"

Based on the proportion of high-skilled labor exceeded 33.3% or not, our study further divided employment upgrading into low-level employment upgrades and high-level industrial upgrading.

There are 7 sectors included in low-level employment upgrading, and 9 sectors in high-level employment upgrading (See Table 1 for details). It was worth noting that the Information

Transmission, Software and Information Technical Services showed opposite employment upgrading features during the period from 2006 to 2010 and 2011 to 2020.

Based on the proportion of output value of each sector in GDP, the Manufacturing was the highest, we then took it as an example for analysis. The proportion of high-skilled labor had risen from 7.6% in 2006 to 17.1%, up 9.5 percentage points; The proportion of middle-skilled labor force had risen from 21.0% to 29.0%, up 8 percentage points; The share of low-skilled labor had fallen from 71.4% to 67.0%, down 4.4 percentage points. In addition, the proportion of high-skilled labor did not exceed 33.3%. Therefore, the Manufacturing belonged to the low level employment upgrading.

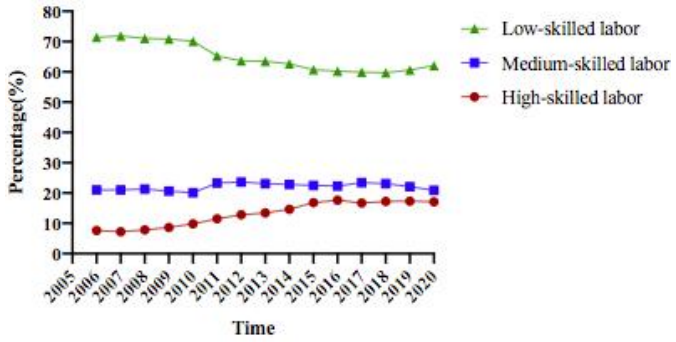

Fig.5 Proportion of employment personnel by skill in Manufacturing

*Data source: China Population and Employment Statistical Yearbook.

With the advancement of technology, the logistics industry was booming. Taking the Transport, Storage and Post for instance, the proportion of high-skilled labor had risen from 8.2% in 2006 to 20.2%, up 12 percentage points; The proportion of middle-skilled labor force had risen from 25.5% to 27.3%, up1.8 percentage points; The share of low-skilled labor had fallen from 66.3% to 52.1%, down 14.2 percentage points. Due to its highest proportion of high-skilled labor force was only 20.2%, the Transport, Storage and Post still belonged to the low level employment upgrade.

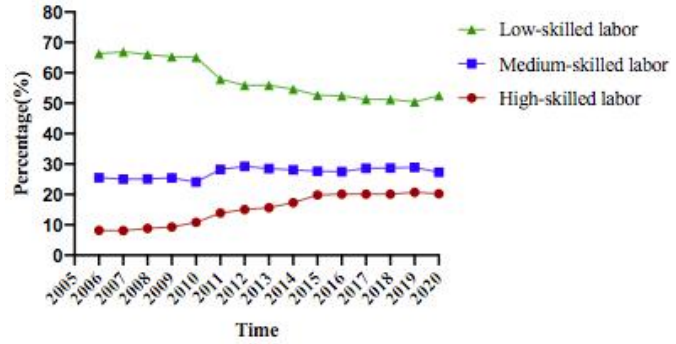

Fig.6 Proportion of employment personnel by skill in Transport, Storage and Post

*Data source: China Population and Employment Statistical Yearbook.

The platform economy had broken the traditional business model of the Hotels and Catering Services and created new jobs. In the Hotels and Catering Services, the proportion of high-skilled labor had risen from 5.0% in 2006 to 70.6%, up 65.6 percentage points; The proportion of middle-skilled labor had dropped from 22.9% to 17.5%, down 5.4 percentage points; The proportion of low-skilled labor had dropped from 72.1% to 11.9%, down 6.5 percentage points. According to the variation characteristics of the data, he Hotels and Catering Services belonged to the high-level employment upgrading.

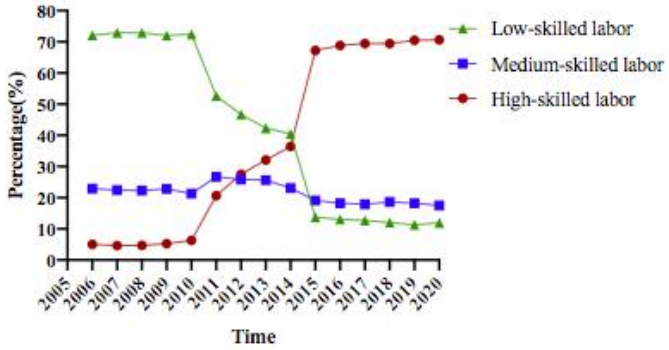

Fig. 7 Proportion of employment personnel by skill in Hotels and Catering Services

*Data source: China Population and Employment Statistical Yearbook.

Financial practitioners had higher educational levels, so it was necessary to analyze the changes of skill structure. In the Financial Intermediation, the proportion of high-skilled labor had risen from 58.1% in 2006 to 71.3%, up 13.2 percentage points; The proportion of middle-skilled labor had dropped from 28.1% to 17.2%, down 10.9 percentage points; The proportion of low-skilled labor had dropped from 13.8% to 11.1%, down 2.7 percentage points. And it was consistent with the characteristics of high-level employment upgrading.

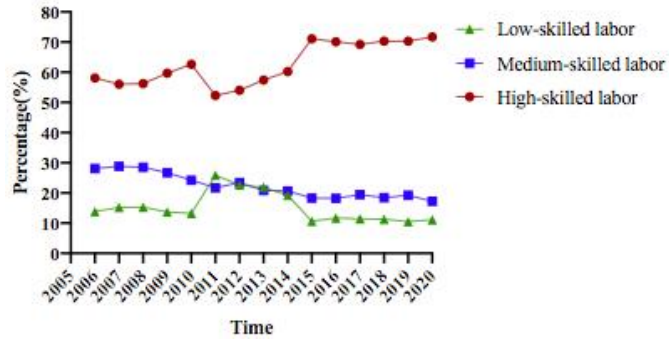

Fig. 8 Proportion of employment personnel by skill in Financial Intermediation

*Data source: China Population and Employment Statistical Yearbook.

The Information Transmission, Software and Information Technical Services showed completely opposite skill structure characteristics around 2011. Therefore, it was divided into two time intervals for analysis. From 2006 to 2010, the proportion of high-skilled labor had risen from 47.3% in 2006 to 55.1%, up 7.8 percentage points; The proportion of middle-skilled labor force f had fallen from 30.2% to 24.3%, down 5.9 percentage points; The share of low-skilled workers had fallen from 22.4% to 20.6%, down 1.8 percentage points. According to the characteristics of the data, it belonged to the high-level employment upgrading. From 2011 to 2020, the proportion of high-skilled labor had risen from 15.6% in 2006 to 19.0%, up 3.4 percentage points; The proportion of middle-skilled labor force had fallen from 25.9% to 24.3%, down 1.6 percentage points; The share of low-skilled workers had fallen from 58.6% to 56.7%, down 1.9 percentage points. And it belonged to the low-level employment upgrade.

The information transmission, software and information technical services showed diametrically opposite employment structure characteristics in different time periods. The reason might be related to the industry's rapid technological update iterations, strong practicality, and long talent training cycle. In addition, the current higher education institutions generally had some problems such as long course iteration cycle, insufficient practical experience of teachers in the industry, and lack of experience of students in practical projects. And the talents they cultivated were out of touch with technology and outdated in knowledge, and couldn't adapt to the ever-changing technological progress technological progress.

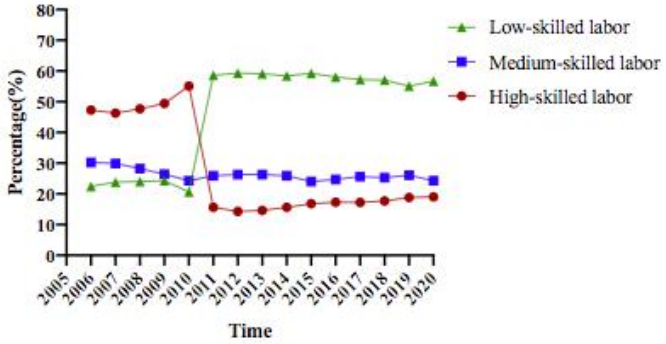

Fig. 9 Proportion of employment personnel by skill in Information Transmission, Software and Information Technical Services

*Data source: China Population and Employment Statistical Yearbook.

In order to study the relationship between different employment structures and wages, we selected the average wage and the proportion of high-skilled labor in sector involved in employment upgrading in 2020 to draw a scatter diagram (See Figure 10 for details). Compared with low-level employment upgrading, the average wage of industries with high-level employment upgrading was relatively higher, which showed that the level of employment upgrades and average wages were generally positively proportional.

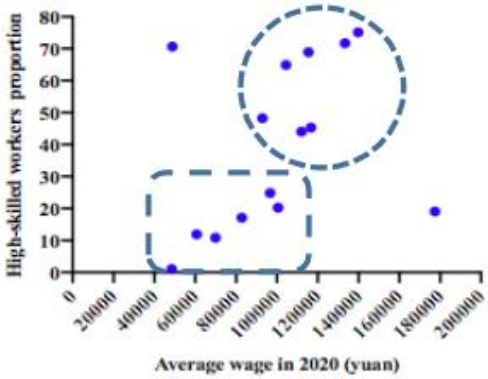

Fig.10 The relationship between salary level and academic qualifications in the employment upgrading industry in 2020

*Data source: China Population and Employment Statistical Yearbook.

3.2.3 Analysis of the Phenomenon of " Employment Downgrade "

It was noteworthy that, with the economic development, the Water Conservancy, Environment and Public Facilities had shown employment downgrade features: The proportion of high-skilled labor had dropped from 23.4% in 2006 to 22.5%, and its decline rate was 3.8%; The proportion of middle-skilled labor force had dropped from 30.9% to 15.8%, decreased by48.9%; The share of low-skilled labor had risen from 45.7% to 61.8%, increased by 35.2%.

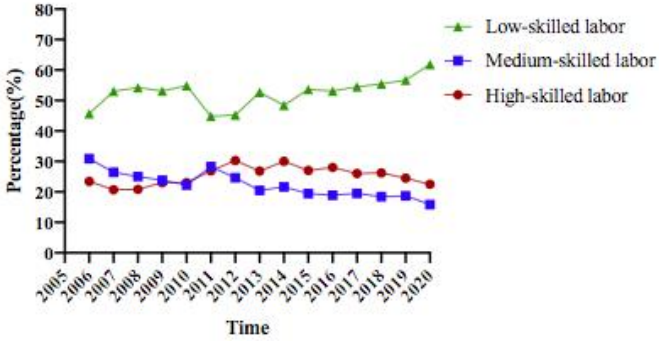

Fig.11 Proportion of employment personnel by skill in Management of Water Conservancy, Environment and Public Facilities

*Data source: China Population and Employment Statistical Yearbook.

3.2.4 Trend analysis of "skill premium"

Combined with the theory of "skill premium" and the classification of skill structure, we redefined the skill premium. The ratio of the average wages of high- and medium-skilled employment groups to the average wages of low-skilled employment groups was defined as the skill premium.

Based on the previous analysis, there were 18 industries in the national economic sector category that involved upgrading and polarization. With technological advancements such as informatization, medium-skilled workers were shifting to high- and low-skilled positions in industries with employment polarization. However, due to skill limitations, middle-skilled groups couldn't transfer to high-skilled positions, but only moved to low-skilled positions, which formed a squeeze on low-skilled groups. The consequence had been worsening incomes for middle - and low-skilled groups relative to high-skilled groups. In those industries, technological progress had a job substitution effect, so the skills premium would rise over time. In industries with employment upgrading, the employment substitution effect was obvious in the initial period, and the skill premium kept rising. But as time went on, the job creation effect began to take effect, and the income of high - and medium-skilled workers kept rising, so the skills premium kept falling. Therefore, theoretically, in an employment polarization industry, the skill premium would increase over time; In an employment upgrading industry, the skill premium would first increase and then decrease over time.

Our study selected the average wages of representative industries to analyze the trend of skill premium. The details were as follows: In employment-polarized industries, the Education accounted for the highest proportion of high-skilled employment (67.0%-74.4%), and the Real Estate Industry accounted for a relatively high proportion of low-skilled employment (60.8%-71.1%), so the ratio of the average wage of the Education to the average wage of the Real Estate Industry was taken as the skill premium. In the employment upgrading industries, the highest proportion of high-skilled workers was in Scientific Research and Technical Services (50.0-75.1%), and the highest proportion of medium-and low-skilled workers was in Agriculture, Forestry, Animal Husbandry and Fishery (98.9%-99.8%). Therefore, the ratio of the average wage of the Scientific Research and Technical Services to that of the Scientific Research and Technical Services was taken as the skills premium.

According to the trend charts in Figure 12 and Figure 13, the skill premium was roughly consistent with the previous theoretical analysis. In the employment polarization industry, the employment substitution effect was obvious, and technological progress such as informatization promoted the continuous increase of the skill premium, which led to the increase of income inequality; In the employment upgrading industry, the initial employment substitution effect was obvious, and the employment creation effect catched up from behind, causing the skill premium to first increase and then decrease.

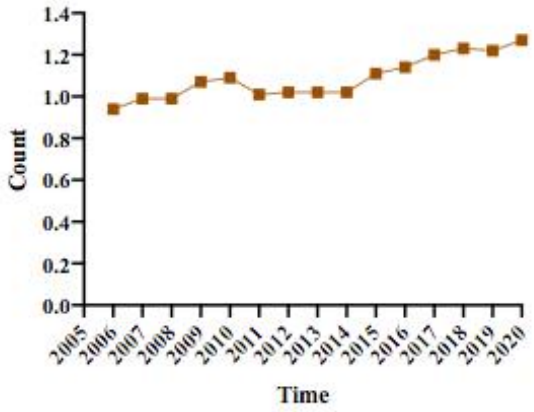

Fig.12 Technology premium trends in employment-polarized industries

*Note: Among the polarized industries, the wholesale and retail industry (87.6%-91.6%), which has the highest proportion of low-skilled employed people, had a more obvious job creation effect and couldn't be used as a

representative to analyze the trend of skill premiums in polarized industries. Data source: China Population and Employment Statistical Yearbook.

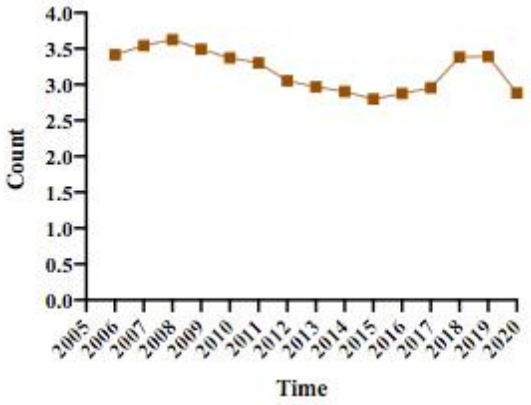

Fig.13 Technology premium trends in employment upgrading industries
*Data source: China Population and Employment Statistical Yearbook.

4. Conclusions and Recommendations

From the perspective of structural changes, our study focused on exploring the characteristics and internal logic of the current employment structure changes in China. It responded to the hot topic of employment impact caused by the development of Internet technology. Combined with the data, the overall employment structure of the national economy showed a high-level employment upgrade; In terms of the industries, the employment structure presented a pattern of coexistence of low-level employment upgrades, high-level employment upgrades, employment polarization, and employment downgrades in individual sectors. At the same time, the skill level was directly proportional to the wage level and showed a gradual upward trend. In order to alleviate people's unemployment panic and employment impact caused by technological progress, and to seize the opportunities from employment creation effect, our study suggested the following aspects:

Firstly, government departments should continue to improve the social security system, and simultaneously strengthen the protection of unemployment relief, so as to ensure that the welfare losses of those workers who were greatly impacted by information technology were minimized; At the same time, the government should guide and support the vocational skills training of employees to enhance their ability to resist the employment shock.

Secondly, the state should increase investment in the education and skills training for the intermediate skilled labor force. Combined with the industrial development path in developed countries, employment polarization might gradually spread from some industries to the others. The middle-skilled employment group was vulnerable to impact of skill-biased technological progress such as informatization. This group was limited by the skills, and it was difficult to move into high-skilled employment, it might even move into low-skilled employment, which would squeeze low-skilled employment, and cause massive unemployment and even increase income inequality. Therefore, in the era of Internet economy, the state should guide the middle-skilled employment population to improve their own quality, take the initiative to adapt to technological innovation and industrial upgrading, and form some skill reserves for transferring to skilled labor.

Thirdly, the universities should continue to deepen the reform of higher education, take the actual demand as the outline of talent training, and implement the concept of open education. Simultaneously, higher education institutions should keep pace with the times to optimize and adjust the discipline and professional structure of higher education, and actively cultivate multi-skilled comprehensive application-oriented talents who would have the skills related to informatization and the ability to solve practical problems more flexibly.

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