

The impact of digital economy development on the demand and supply of labor market

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Abstract. With the continuous development of the digital economy, the labor market has been affected to some extent. Therefore, in order to prevent employment problems caused by the changes, this paper will study the impact of the development of the digital economy on the supply and demand of the labor market. This paper will find out whether the market matches the supply and demand of labor by combining the analysis of how the digital economy affects the demand and supply of the labor market. Through the research, this paper finds that in the long term, the changes in labor supply roughly match the changes in demand affected by the digital economy; in the short term, the labor supply cannot match the demand for jobs in some fields in terms of quantity. This study helps to provide entry points and methods to solve employment problems in the context of digital economy development.

Keywords: Digital Economy, Demand of Labor Market, Supply of Labor Market.

1. Introduction

1.1 Research Background

In recent years, the Chinese government begin to focus on developing a digital economy. The *"14th Five-Year Plan"* and the *"2035 Visionary Outline"* (full text) propose that the country should embrace the digital era, activate the potential of data elements, promote the construction of a strong network country, accelerate the construction of a digital economy, a digital society and a digital government, and drive changes in the modes of production, life and governance with digital transformation as a whole. With the national emphasis and full development of the digital economy, the scale of China's digital economy gradually increases. China Academy of Information and Communications Technology (CAICT) released the China Digital Economy Development Report on July 8, 2022, stating that the size of the digital economy reached 45.5 trillion yuan in 2021, which was more than double the expansion at the beginning of the 13th Five-Year Plan, and its share of GDP reached 39.8%. In 2021, the added value of the national above-scale electronic information manufacturing industry grew by 15.7% over the previous year, a record growth rate of nearly 10 years; while the business revenue of software and information technology services, Internet and related services enterprises maintained a high growth rate of 17.7% and 16.9% [1].

With the rapid development of the digital economy, employment, as the foundation of people's livelihood, the basis for social stability, and a key factor in improving social productivity and driving economic development, is bound to be affected by the digital economy. The vigorous development of the digital economy let the new market rapidly grow, replace and create a large number of jobs, which drives more employment and largely protects the employment environment in China. However, there are still many unstable and uncertain factors, and the employment situation is still facing many challenges such as "new employment patterns", and legal and social security improvements. Therefore, it is important to study how the development of the digital economy affects the labor market and find solutions from the influencing factors.

1.2 Literature Review

In the current research, most scholars focus on the impact of the digital economy on the demand side of the labor market, which means how the digital economy affects the demand for labor. In terms of industrial structure, Kedong Wu et al. (2022) find that the estimated coefficients are significant at

the 1% level based on the Hausman test results and the estimation using a fixed effects model, proving that the digital economy reduces the demand for labor in the primary and secondary industries in the job market and increases the demand for labor in the tertiary industry, especially increasing the demand for labors in productive services and high-end services. Additionally, the demand for labor force in the production service and high-end service industries promotes the advanced industrial employment structure [2]. In terms of the demand for enterprise, Chen-Yu Zhao (2022), based on data from Chinese A-share listed manufacturing companies, argues that digital transformation has significantly boosted labor force employment and has become a strong driver for expanding labor demand and boosting employment in the digital economy [3]. Yeux et al. (2021), on the other hand, argue that the digital economy is more conducive to the creation of new types of digital jobs through digital penetration of traditional industries, and increases the demand for highly skilled personnel, as the digital economy continues to grow [4]. Shipping Yan et al. (2020) argue that the increased level of development of the digital economy has reduced the demand for labor with high school and middle school education and increased the demand for labor with elementary school and below, and college education and above [5].

In addition, there are some scholars who study the impact of the digital economy on the supply side of the labor market. Yiqing Zhou et al. (2022) find that digital economy development is still effective in promoting labor resource allocation even after additional consideration of endogeneity, and is significant at the 10% level [6]. Using survey data from the China Academy of Personnel Science 2019 in Jiangxi Province, Yongpo Tian and Wang Qi (2022) find that there are 2,937.7 million job postings and 3,916.6 million job search postings through the Internet, which means that the digital economy provides a variety of job information placement methods, labor supply, and demand information delivery methods, and job seeker-enterprise communication methods that enrich the diversity of work channels [7].

1.3 Research Content and Significance

However, through the previous analysis of the labor market, it can be found that few scholars have analyzed and discussed the labor market from both the demand and supply aspects together. Thus, this paper will analyze and discuss jointly based on the supply and demand of the labor market. First, this paper will analyze how the digital economy affects the changes in demand in the primary, secondary and tertiary sectors from an industrial structure perspective by analyzing the various factors that affect labor market demand. Secondly, this paper will also analyze the factors affecting the supply side of the labor market, and discuss and analyze the impact of the digital economy on the current labor supply from the perspective of the incremental supply (how the current education resources affect the future labor supply) and the stock (how the digital economy affects the labor force's choice of jobs). Finally, this paper will combine the supply and demand in the labor market to more comprehensively figure out the changes in the labor market under the development of the digital economy, and identify the factors that are detrimental to employment by finding the imbalance between the quantity of demand and supply. Thus, this paper can help to suggest solutions in the field of employment.

2. Relevance Theory

2.1 Concepts of Digital Economy

The term "digital economy" first appeared in Don Tapscott's 1994 book *"The Digital Economy: Promise and Peril in The Age of Networked Intelligence,"* in which he describes the digital economy as "a new type of economy based on the networking of human intelligence, driven by interactive multimedia, the information superhighway, and the Internet". This paper decided to choose the definition from the G20 Initiative on Digital Economy Development and Cooperation: "Digital economy refers to a series of economic activities in which the use of digital knowledge and information is the key factor of production, modern information network is the important carrier, and

the effective use of information and communication technology is an important driving force for efficiency improvement and economic structure optimization." In addition, The G20 Initiative on Digital Economy Development and Cooperation mentions that the digital economy is characterized by four elements, that is, data becomes a factor of production, the digital economy consists of digital industrialization and industrial digitization, the infrastructure is a "cloud-net-end" trinity, and the organization form presents platform, sharing, multi-far and miniaturization.

2.2 Relationship Between the Demand and Supply on Labor Market

The labor market refers to a mechanism to allocate labor resources through two-way options between labor supply and demand under the role of market economy law. In the labor market, the buyers (demand side of the labor market) are generally various types of industrial and commercial enterprises, state-owned enterprises, governments, and so on. These demands are derived from the commodity market, for example, when the consumers of the buyers such as enterprises have a greater demand for buyers' products and a larger marketing scale, the enterprises have a greater demand for labor. The sellers (the supply side of the labor market) are the potential workers who have reached the legal working age and have certain working abilities [8]. These supply sides provide their own labor and create more labor value. Therefore, the labor market has a demand side (buyers) and a supply side (sellers). If the supply side of the labor market is greater than the demand side, it will lead to unemployment, and social stability will be threatened as the unemployment rate increases. If the supply is greater than the demand in the market, it will lead to a labor shortage, which will be detrimental to the economic development of the country. It follows that supply and demand need to be roughly matched in terms of quantity.

3. The Impact of Digital Economy Development on the Demand of Labor Market

3.1 Mechanization Increases the Demand for Digital Talents in the Primary Industry

With the development of the digital economy, agricultural mechanization has been further applied to the primary industry sector to make agriculture more scalable. Many agricultural machines now use the technology brought by the digital economy. For example, agricultural enterprises in Nanhu District, Jiaxing City, Zhejiang Province, actively use 5G, Internet of Things (IoT) devices, and cloud computing to provide real-time supervision of air, water quality, soil moisture, and pests, and to provide digital management of pesticides and fertilizers to achieve precise fertilization, irrigation, and pest control [9]. With the development of agricultural machines and digital technologies brought about by the digital economy, the agricultural business has less need for primary sector personnel. Because agricultural machinery integrated with the digital economy can better improve the efficiency of primary industry production, for example, from streamlining the collection process of agricultural products to simplifying the inspection and distribution of fertilizers, Internet of Things systems (IoT) and sensors can help agricultural businesses in a variety of possible ways. Most farmers simply place IoT sensors and cameras in key locations on the farm and then view and then monitor crops with the click of a mouse [10]. The use of such IoT devices is more convenient than manual monitoring. As a result, the average farm worker will be replaced by agricultural machinery. According to the predictions of McKinsey & Company, 3.31 farm workers or 22% to 40% of the job content will be replaced by 2030. As Figure 1 shows, there is a trend of decreasing employment in the primary sector, depending on the data provided by the CEIC website.

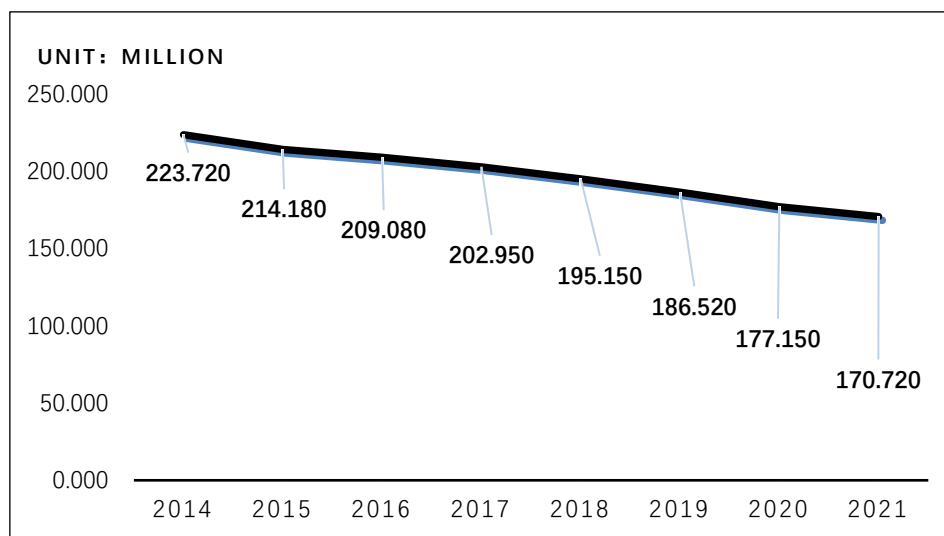


Figure 1. Employment in the primary industry [11]

Accordingly, the primary industry-type enterprises are more in need of digital talents. Digital agriculture is still developing, and the digital transformation of Chinese agriculture faces shortcomings in infrastructure, application services, and digital skills. It is urgent to reconfigure the allocation efficiency of existing agricultural factors through data as a new factor of production, and to form the digital transformation and innovation of agricultural digital transformation with data production factor reconfiguration efficiency, so as to promote the fundamental change of agricultural intensification and organizational efficiency [12]. Therefore, agricultural companies need more research-based and digital talents to help better transform agriculture digitally.

3.2 Automation Displaces a Large Number of Jobs in Secondary Industry

The Industrial Internet, that is, the combination of industry and the digital economy, is also evolving. The China Academy of Information and Communication Technology (CAICT) shows in the China Digital Economy Development Report (2022) that "the use of the digital economy for the industry is deepening, extending from equipment management and production process control to complex aspects such as product development and design, manufacturing and process optimization, and supply chain management of the industrial chain." The numerical control rate of key processes in industrial enterprises above the scale in China reached 55.7%, and the penetration rate of digital R&D tools reached 75.1%." In combination with the digital economy, secondary industries have become more automated. For example, with less manual participation, the ubiquitous connectivity and data collection functions of the industrial Internet platform help manufacturing enterprises to obtain comprehensive data on the operational status of production equipment, production processes, product quality inspection, etc., and help manufacturing enterprises to conduct real-time monitoring of internal production business processes, etc [13]. Employees only need to process some parts or indirectly take care of and supervise the machines for production, so automation gradually replaces most of the jobs in the secondary industry, in other words, manufacturing companies no longer need a large amount of labor for processing and production. For example, the Industrial Internet Industry Demonstration Base in Bao'an District, Shenzhen, mentioned by the China Academy of Information and Communications Technology (CAICT) in the China Digital Economy Development Report (2022), shows that in terms of human resources, the enterprises' labor productivity increased by an average of 13% under the guarantee of an average 16% reduction in production site employees. From Figure 2, it can be seen that the percentage of employed persons in the secondary industry is on a decreasing trend.

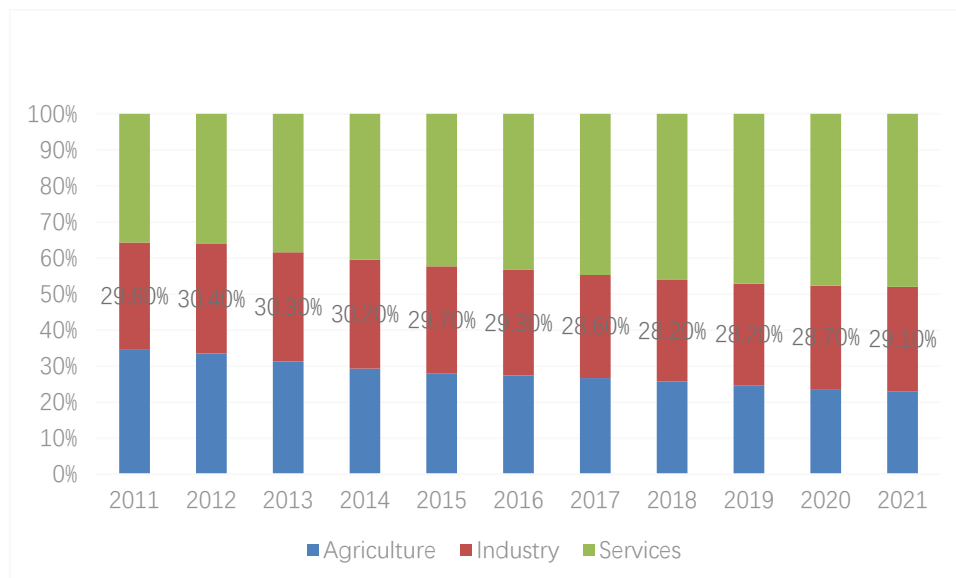


Figure 2. Labor force distribution by industry in China, 2011 - 2021 [14]

3.3 The Digital Economy Increases the Demand for Labors in the Tertiary Sector

3.3.1 The Digitization of the Service Sector Increases the Demand for Tertiary Employment

Under the continuous development of digitization of the service industry, the economic scale of tertiary industry enterprises has gradually increased. For example, in the tourism industry, scenic spots have made great efforts in digitalization, such as information display, online reservation, online payment, electronic ticketing, and passenger flow control, which have led to the unprecedented application of digital technology and increased domestic tourism revenue, with a total of 115 million domestic tourists during the May Day holiday in 2020. In the first four months of 2020, the online retail sales of physical goods increased by 8.6%, accounting for 24.1% of the total retail sales of social consumer goods, despite a 7.5% year-on-year decline in total retail sales of social consumer goods [15]. Therefore, as the economic scale of the tertiary sector increases, the number of people employed in the tertiary sector also increases. As shown in Figure 3, the number of people employed in the tertiary sector has increased year by year.

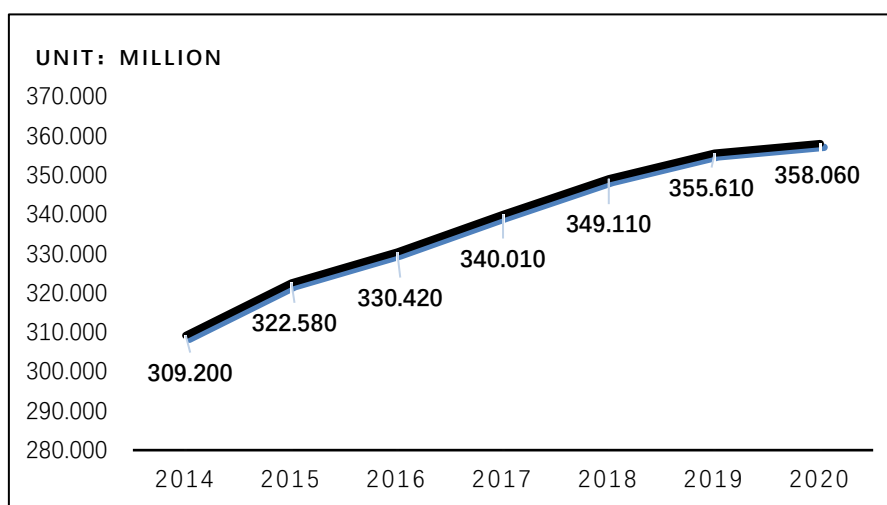


Figure 3. Employment in the tertiary industry [16]

3.3.2 Digital Industrialization Creates New Jobs

Digital industrialization adds more new types of jobs by creating many new industries. Digital industrialization refers to the transformation of digital knowledge and information into production

factors through the market-oriented application of modern information technology, which constantly gives rise to new industries, new business models, and new modes. The electronic information manufacturing industry, information and communication industry, software and information technology service industry, Internet industry, etc. appear in the public view. The operation of China's digital industrialization industry announced by the Ministry of Industry and Information Technology (Figure 4) basically shows a growth trend. For example, in 2020, the national software industry comprehensive development index value reached 138.4, an increase of 9.5 over the previous year, showing that the comprehensive development of China's software and information technology services industry has shown a continued positive development trend.

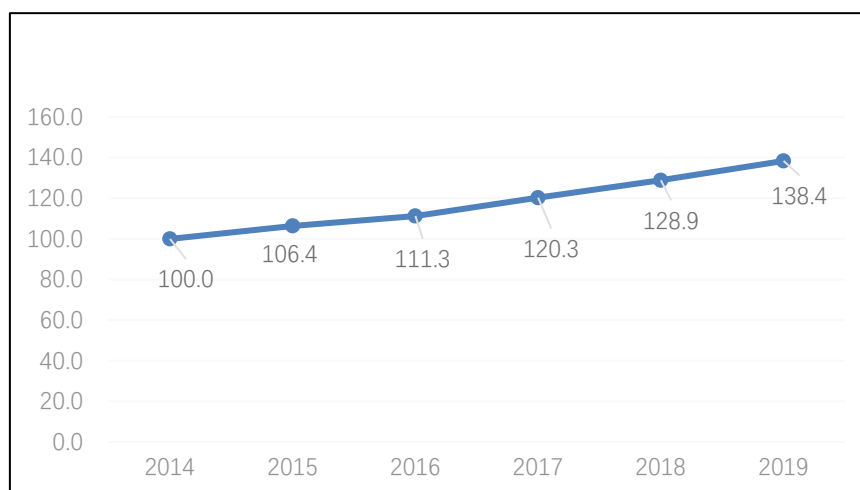


Figure 4. National Software Industry Composite Development Index since 2014 [17]

When a new industry emerges, the new industry will also create new job demands. For example, the Internet industry needs back-end/front-end development, testing, operation and maintenance, architecture, User Interface (UI) designers, visual designers, web designers, etc.; cloud computing in the information manufacturing industry needs operation and maintenance engineers, platform development cloud architects and other talents. These new positions further increase the demand for tertiary industry employment staff.

4. The Impact of Digital Economy Development on the Supply of Labor Market

4.1 Current Education Resources Cultivate More Digital Talent

Specialties are the basis for the development of colleges and universities. The scale and quality of enrollment and employment of specialties determine the social level and status of colleges and also determine the economic income of colleges and universities. Therefore, due to the pursuit of their own economic benefits, more universities will choose popular majors with high social demand and good employment prospects when setting and adjusting their majors, such as e-commerce, engineering cost, electrical engineering and automation, business administration, computer science and technology, artificial intelligence, etc. In addition, Universities have also added a number of new majors, such as intelligent perception engineering, entrepreneurship management, and digital economy. These series of majors have a tendency to cultivate more digital talents as a way to adapt to the transformation of the digital economy.

Of course, because more colleges and universities tend to choose popular majors with high social demand and good employment prospects, it also leads to the homogeneity of colleges and universities, which results in the oversupply of graduates, causing explicit or implicit unemployment of human resources, thus wasting human resources, college resources, and social resources to a certain extent, and causing the phenomenon of "involution" [18]. In the Blue Book of *Higher Education: Report on the Development of Higher Education in China (2020-2021)* jointly published by Guangdong

University of Foreign Studies and Social Science Literature Publishing House, it is mentioned that "there is a lack of overall planning in the setting of majors, and schools are keen to open 'popular' majors, and they attach importance to short-term benefits, and blindly follow the trend even though the faculty strength and funding cannot meet the requirements".

4.2 The Digital Economy Influences Labors' Career Choices

With the development of the digital economy, much-shared information is available to most of the workforce through the Internet. For example, articles and videos on the Internet can also influence the workforce's choice of different occupations to some extent. For example, according to the recent 2022 *College Students' Employment Prospect Research and College Entrance Examination Volunteer Strategy* by the company Zhaopin, 57% of the workforce's channels to learn about volunteering are through the official websites of colleges and universities, the website of the Ministry of Education, and the media or self-media. Under the influence of this Internet, most of the workforce tends to choose the information technology industry, Internet industry, cultural industry, media industry, and so on. According to statistics, 2022 freshmen tend to choose IT, Internet, electronic communication, and other industries. These freshmen account for 24.1% and cultural industries account for 10.0%, ranking first [19]. These selection tendencies all overlap with a large number of multimedia articles, videos, and other recommendations with analysis of industry information and so on.

However, the Internet technology brought by the digital economy can also negatively affect the career choices of the workforce, taking away more applied and complex high-level talents. Nowadays, the Internet allows more information to be shared. The workforce is aware of a large amount of information in the form of media articles, videos, etc., including factual reports on employment forms under the impact of the epidemic; the higher requirements of major companies for the educational level of the workforce have increased under the transformation of the digital economy, etc. With more people learning about the high employment pressure in recent years, more people are choosing to go to graduate school and pursue higher education to avoid employment, ease employment pressure or increase competitiveness, or are choosing to go to state-owned enterprises for more stable job positions. According to the 2022 China College Student Employment Report released by the MyCOS Research Institute, the number of students enrolled in master's degree programs nationwide in 2021 increased by 239,400 compared to 2019. 17.2% of the 2021 class of undergraduates studied in China, an increase of 13% compared to the 2019 class (15.2%). The proportion of fresh senior graduates going for bachelor's degrees continued to grow to 19.3% in the class of 2021, based on the doubling of the proportion in the class of 2020. Meanwhile, the number of applicants for the civil service examination in 2022 will also exceed 2 million, which is a record high, with an increase of 28% compared to 2018. With the year-on-year increase in the number of applicants for graduate school and civil service exams, etc., the number of people seeking employment in the labor market has also begun to decrease. To the Ministry of Human Resources and Social Security of the People's Republic of China released in the second quarter of 2021, the ranking of the 100 occupations with the greatest shortage of jobs shows that in 2021, the number of job seekers decreased from 609,000 in the first quarter to 517,000 (a drop of 15.11%).

5. Suggestion

In terms of labor market demand, the development of the digital economy has substitution and promotion effects on labor market demand. Whether in the primary industry, with the development of agricultural machinery, the market demand for many general agricultural workers decreases and the demand for digital talents increases; in the secondary industry, industrial automation replaces more jobs in manufacturing; or in the tertiary industry, the digitization of service industry and digital industrialization increase the demand for labor by enhancing the scale and creating new industries and jobs, especially increasing the demand for In particular, the demand for digital and highly

educated workers has increased. In general, the demand for labor is gradually shifting from primary and secondary industries to tertiary industries, and the demand for digital talents is increasing. In terms of labor market supply, the adjustment of universities to "popular" majors has cultivated more digital talents, but it has also led to a labor surplus in some professional fields. The number of job seekers is also decreasing. To summarize the supply and demand, in the long term, more and more people choose the tertiary industry and digital economy-related professions, which generally fit the adjustment of demand for the development of the digital economy; however, in the short term, the type and number of talents in the current market do not match well with the overall labor market demand. By adjusting the structure and allocation of college majors and reducing the pressure on labor force employment in the market as the starting point, the tension between supply and demand can be reduced. Based on this entry point, this paper makes several suggestions.

5.1 Building an Internet Platform For Adjusting the Major Settings of Universities

As mentioned above, the professional settings of colleges and universities cannot be well planned rationally and there is some mismatch with the labor market demand. Therefore, in order to avoid the homogenization phenomenon of major universities and the uneven configuration of majors and the labor market, government departments can build a platform for adjusting college major settings oriented by economic and industrial structure. This platform has complete information on market demand and related legal information of major setting, approval procedure of major setting in colleges and universities, more perfect mechanism of major elimination, and guidance for colleges and universities to allocate majors according to their own resources, characteristics, and market demand.

5.2 Changing Business Recruitment Requirement

Due to the economic transformation, employers have also raised the recruitment threshold and the requirements for education and vocational skills. However, given the high employment pressure and competitiveness, the highly skilled labor force tends to choose to take the graduate school to get better employment opportunities, or tends to seek stability and apply for civil service and career programs. Therefore, in order to alleviate employment pressure and competition, it is recommended that the government should strengthen the supervision of enterprises to change the admission requirements from "requiring candidates with prestigious schools and academic qualifications" to "character and ability as the admission criteria".

5.3 Conducting More Vocational Skills Training

This has led to difficulties in employment for ordinary college graduates, older low-skilled workers, etc. because employers have raised the recruitment threshold. To help them better find employment and adapt to the current demand for labor, the government can open more vocational skills training with the service industry or information technology, and issue one-time training subsidies for small and medium-sized enterprises that are affected by the epidemic and temporarily unable to operate normally to stay in the workforce.

6. Conclusions

This paper has been inspired by reading the works of scholars on the development of the digital economy and employment in recent years. In the research process, this paper analyzes the demand and supply in the labor market. The study shows that, on the one hand, in the long term, more and more laborers choose the tertiary industry and occupations related to the digital economy, and the labor supply tends to match the market demand for labor under the transformation of the digital economy. On the other hand, in the short term, the homogeneity of professional settings, and more people taking graduate school and applying for civil service. The current supply is not yet able to match the demand well. Therefore, this paper argues that the employment problem can be improved in the future by both adjusting the professional structure and reducing employment pressure, such as

building a platform for adjusting the professional settings of universities, changing the recruitment conditions of enterprises, and conducting more vocational skills training.

References

- [1] People's Daily. The scale of China's digital economy exceeded 45 trillion yuan [EB/OL]. http://www.gov.cn/xinwen/2022-07/03/content_5699000.htm, 2022.7.23
- [2] Kedong Wu, Mengchun Zhu, Shiping Yan. Impact of the level of digital economy development on the structure of labor force employment [J]. *Statistics & Decision*, 2022, 38(10) : 106-111.
- [3] Chenyu Zhao. Researching on the impact of digital transformation on enterprise labor employment [J]. *Studies in Science of Science*, 2022 :
- [4] Ye Xu, Yunhan Du, Wenjun He. The effect of employment structure in digital economy development [J]. *Finance and Trade Research*, 2021, 32(04) : 1-13.
- [5] Shiping Yan, Kedong Wu, Zhuangyu Wei. The development of digital economy and the evolution of labor force structure in China [J]. *Economic Review Journal*, 2020(10): 96-105.
- [6] Yiqing Zhou, Yang Dan, Wang Lin. The Impact of Digital Economy on Labor Resource Allocation in China - Based on Mechanisms and Empirical Analysis [J]. *Inquiry into Economic Issues*, 2022, (04) : 154-163.
- [7] Yongpo Tian, Wang Qi. Online recruitment policy and search channel selection in digital economy era [J]. *Journal of Beijing Technology and Business University(Social Sciences)*, 2022, 37(02) : 1-12.
- [8] Fucui Lu, Xiaohua Zhang. Implement the scientific outlook on development and establish a unified urban and rural labor market [C]//. *Research on Scientific Development View and labor security.*, 2005:138-143.
- [9] Xinhua News Agency. Jiaying: digital agricultural technology to help farmers resist high temperatures and ensure income growth [EB/OL]. http://www.gov.cn/xinwen/2022-07/27/content_5703151.htm#1. 2022.6.30.
- [10] A U Mentsiev, Mentsiev A U, Amirova E F, Afanasev N V. Digitalization and mechanization in agriculture industry [J]. *IOP Conference Series: Earth and Environmental Science*, 2020, (3) : 548.
- [11] CEIC. China Employment: Primary Industry [EB/OL]. <https://www.ceicdata.com/en/china/employment/employment-primary-industry>. 2022.6.30.
- [12] Xie Kang, Faming Yi, Feiting Gu. Big data-driven digital transformation and innovation in agriculture [J]. *Issues in Agricultural Economy*, 2022, (05) : 37-48.
- [13] Yonghua Zheng, Yanming Sun, Jianfeng Yi. Industrial Internet platform data empowerment, absorptive capacity and digital transformation of manufacturing enterprises [J]. *Science & Technology Progress and Policy*, 2022,
- [14] Statista. Distribution of the workforce across economic sectors in China from 2011 to 2021 [EB/OL]. <https://www.statista.com/statistics/270327/distribution-of-the-workforce-across-economic-sectors-in-china/>. 2022.6.30.
- [15] People's Daily. The "2020 Report on the Digital Development of China's Household Service Industry" was released which press the "fast forward" button for digital life [EB/OL]. http://www.cac.gov.cn/2020-06/08/c_1593164140515167.htm. 2022.6.30.
- [16] CEIC. China Employment: Industry and Region [EB/OL]. <https://www.ceicdata.com/en/china/employment/employment-tertiary-industry>. 2022.6.30
- [17] Ministry of Industry and Information Technology. 2020 China Software and Information Technology Services Comprehensive Development Index report [EB/OL]. https://www.miit.gov.cn/gxsj/tjfx/rjy/art/2021/art_e5c12100377646b69df045de28ac9806.html 2020. 2022.6.30.
- [18] Yuxiang Ba, Xiaoting Fan, Guiran Huang. The mechanism and path of professional structure adjustment in colleges and universities- from the perspective of industrial structure evolution [J]. *China University Science & Technology*, 2021, (12) : 73-78.
- [19] Zhaopin. 2022 College students employability research report [R]. Beijing, 2022.