STUDY ON THE MISMATCH OF LABOR SUPPY AND DEMAND AND THE PATH OF INDUSTRIAL UPGRADING IN THE CONTEXT OF DIGITAL ECONOMY

BY

YINGYUE WANG

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BY

YINGYUE WANG

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Chairman
(Associate Professor Peera Charoenporn, Ph.D.)

Member and Advisor
(Assistant Professor Pornthep Benyaapikul, Ph.D.)

Member
(Pathomwat Chantarasap, Ph.D.)

Dean
(Assistant Professor Supachai Srisuchart, Ph.D.)

Thesis Title	STUDY ON THE MISMATCH OF LABOR SUPPLY AND DEMAND AND THE PATH OF INDUSTRIAL UPGRADING IN THE CONTEXT OF DIGITAL ECONOMY
Author	Yingyue Wang
Degree	Master of Economics
Major	Faculty of Economics
field/faculty/university	Thammasat University
Thesis advisor	Assistant Professor Pornthep Benyaapikul, Ph.D.
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ABSTRACT

With the rapid development of digital economy, the mode of production has correspondingly changed a lot, resulting in a series of challenges in China's economy in recent years: deterioration of ecological environment, "bottleneck" of key technologies, blind competition for industrial transfer, mismatch between labor supply and demand and other problems. As an important factor of production in industrial development, labor force plays an important role in improving the mode of production and upgrading the industrial structure. In the new development stage, to explore the impact mechanism of the mismatch between labor supply and demand and the upgrading of industrial structure, as well as the adjustment effect mechanism of digital economy, is an effective way to solve the practical problems in China.

Under the background of digital economy, this paper mainly studies the influence of the mismatch of labor supply and demand and industrial structure upgrading in China, as well as the path of digital economy to adjust the mismatch of labor supply and demand and industrial structure upgrading. Firstly, the literature research of scholars all over the world is sorted out. Then it discusses the mechanism of labor mismatch affecting industrial structure upgrading and the adjustment path of digital economy. Then use statistical data to analyze China's current situation and existing problems. After reviewing relevant literature and combing related theories,

the paper obtains some enlightenments and puts forward several hypotheses in this paper: first, the mismatch of labor supply and demand will reduce the production efficiency of the industry and inhibit the upgrading of industrial structure; Second, the mismatch of labor supply and demand will inhibit the utilization efficiency of human capital, hinder the spillover effect of knowledge, and inhibit the rationalization of industrial structure. Third, the adjustment effect of digital economy can force the improvement of human capital, forcing the industry to replace labor with capital to improve the industrial structure, which is conducive to the upgrading of industrial structure. Fourth, digital economy can alleviate the negative impact of the mismatched industrial structure rationalization of labor supply and demand through innovative production mode, promoting industrial integration, creating effect and alleviating the asymmetric contradiction of information, so as to promote the upgrading of industrial structure. The empirical analysis results of this study show that, firstly, the mismatch of labor supply and demand in China has a direct inhibitory effect on the upgrading and rationalization of industrial structure; Second, China's digital economy, which has played an important role in adjusting the imbalance between labor supply and demand and improving the industrial structure; Third, there are significant differences in the degree of labor supply and demand mismatch among different regions in China, which have different impacts on the upgrading process of industrial structure in different regions.

Keywords: Labor supply-demand mismatch; Upgrading industrial structure; Digital economics; Regulation effect

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CHAPTER 1
INTRODUCTION

1.1 Introduction

The first chapter systematically introduces the research background and contribution of this thesis. I hope readers can understand the basis of the paper.

1.2 Research question

This paper mainly studies the impact of industrial structure upgrading of China’s labor supply and demand mismatch under the background of digital economy, as well as the path of digital economy regulating labor supply and demand mismatch and industrial structure upgrading. At present, with the rapid of the digital economy, China’s economic structure is in a period of transformation. This paper is devoted to finding out how to effectively deal with the problem of labor supply and demand mismatch, promote the upgrading of industrial structure, and maintain the steady growth of national economy.

1.3 Research background

In 2022, China's economy will face difficulties to achieve the goal of stable economic operation, and after 2023, China will still regard stable economic growth as the top priority. In this regard, it is necessary to achieve the goal of full employment as soon as possible and maintain the stability of the basic market of the national economy and ensure the stability of residents' lives.

To promote the steady growth of the national economy, China's economy should maintain high-quality development with industrial upgrading as the basic purpose. As one of the important ways to promote the transformation of economic and social development mode and the optimization of industrial structure, the upgrading of industrial structure is directly related to national economic security and sustainable

development. At present, China's economy has been in the middle and high speed of growth, but the problem of industrial structure is still prominent. With the development of economy, more and more factors have emerged that affect the upgrading of China's industrial structure. Among them, the problem of labor resource misallocation among provinces and regions is prominent. The low efficiency of labor resource allocation has caused the problem of labor resource misallocation among regions, industries and departments, which is the main obstacle restricting the upgrading of China's industrial structure. China's demographic dividend is decreasing, labor costs are rising, the labor market is fierce competition, enterprises need talents and labor market effective supply does not meet the key period of China's economic structural transformation, facing the severe situation of China's labor supply and demand mismatch, how to effectively deal with the mismatch of labor supply and demand, to find a solution to this problem, to achieve the goal of full employment, Promoting the upgrading of the industrial structure and maintaining the steady growth of the national economy are issues that China must solve as soon as possible.

1.4 Contribution of research

From the theoretical point of view, through the relevant literature research on labor supply and demand and industrial structure upgrading, the paper finds that the existing research on the specific impact mechanism of the two is not perfect. First of all, this paper will introduce digital economy as a moderating variable to study the correlation between labor supply and demand and industrial structure upgrading, specifically examine their mechanism and degree of action, and carefully sort out the impact of labor supply and demand mismatch in the process of industrial structure upgrading, as well as the role of digital economy on it, which has certain significance for enriching relevant theories. Secondly, this paper estimates the degree of upgrading and rationalization of industrial structure in various parts of China by referring to existing studies and constructs a comprehensive evaluation index of the development of digital economy by using entropy method. Through mechanism analysis and empirical test, this paper examines the specific role of digital economy in solving the problem of labor supply and demand mismatch and industrial structure upgrading.

Third, in order to further study the specific influence mechanism, this paper uses the fixed effect model of time and individual two-way fixed for analysis, and the research results have strong persuasion and credibility. Fourthly, China's industrial structure is unbalanced among regions, and there is a great difference between the development degree of digital economy and the mismatch degree of labor supply and demand. This paper considers relevant issues and analyzes the regional heterogeneity of major relationship studies and mechanism studies, which has certain significance for enriching relevant theories.

In reality, China's industry has achieved high-quality development. In today's rapid development of digital economy, in line with it, China's mode of production has undergone drastic changes, resulting in recent years, China's economy is facing a series of challenges: ecological environment degradation, key technology "bottleneck", industrial transfer blindly compete, labor supply and demand do not match and so on. Among them, the mismatch between labor supply and demand is prominent, and for a long time, China's labor market has been Mired in the dilemma of "difficult recruitment and extremely difficult employment". Labor is an important factor of production in industrial development, and its role in the upgrading of production mode and industrial structure cannot be ignored. This paper focuses its research on labor supply and demand and the upgrading path of industrial structure, which helps to systematically analyze and explain the above issues, and introduces digital economy as a key means to solve the problems. It is of practical significance to solve the problem of labor supply and demand mismatch and promote the upgrading of industrial structure.

In addition, this paper is innovative in the research perspective. It studies the mismatch of labor supply and demand, focuses on the relationship between labor supply and demand and industrial structure upgrading from the research perspective, introduces the role of digital economy, and puts forward relevant policy implications from the practical problems existing in China. Secondly, in the study of mechanism innovation, combined with the background of digital economy, there are few studies on how the mismatch of labor supply and demand affects the upgrading of industrial structure. This paper not only conducts a separate study on the impact of labor supply and demand on the upgrading of industrial structure, but also examines the mediating

and regulating role of digital economy in its influence. Finally, the empirical innovation is made. The two-way fixed effect model is used to analyze the relationship between the mismatch of labor supply and demand and the upgrading of industrial structure, and the digital economy is also introduced as a moderating variable.

1.5 Limitation of research

In this paper, the mismatch of labor supply and demand is considered comprehensively and comprehensively, and the influence of labor supply and demand on the upgrading of China's industrial structure under the background of digital economy is studied, but there are still some deficiencies. Specific shortcomings are as follows:

First, as a new form of economic development, the connotation of digital economy is still expanding. In the analysis of digital economy and the construction of comprehensive evaluation indicators of digital economy, there are still some ill-considered points.

Second, due to the availability of data, this paper did not deeply study the impact of digital economy on China's specific industries, but only analyzed the overall impact of the three industries. In this paper, heterogeneity analysis is carried out at the national level and in the eastern, central and western regions, but more research is not carried out on the specific situation at the city level in each region, and the conclusion that the mismatch of labor supply and demand affects the upgrading of industrial structure at the city level is lacking.

CHAPTER 2
INTRODUCTION

2.1 Introduction

Chapter two explains the vocabulary in the paper and reviews other relevant literature in the past.

2.1.1 Definition

2.1.1.1 Industrial classification of China's national economy

The primary industry mainly refers to the production of food and some other biological materials, including planting, forestry, animal husbandry, aquaculture and other industries directly based on natural objects of production (generally referred to agriculture). The secondary industry mainly refers to the processing and manufacturing industry (or manual manufacturing operations), using the basic materials provided by nature and the primary industry for processing. The tertiary industry refers to other industries other than the primary and secondary industries (modern service industry or commerce), with a wide range, mainly including transportation industry, communications industry, commerce, catering industry, financial industry, education, public service and other non-material production sectors.

2.1.1.2 Mismatch of labor supply and demand

In a broad sense, is the difficulty of employment in the labor market due to the discrepancy between the structure of labor supply and demand; In a narrow sense, it refers to the employment problems caused by the mismatch between the skills, human capital level, gender and age of workers and the labor demand at the industrial end due to technological progress and industrial change. In general, when the marginal substitution rate of labor factors in a certain industry or region is different from that in other industries or regions, the mismatch of labor supply and demand occurs.

2.1.1.3 TS and TL

TS means the advancement of industrial structure. It is the process of establishing and realizing the high-benefit industrial structure. This is a process of organizing the existing production factors as reasonably as possible through the adjustment of industrial structure under the established conditions of industrial productivity, so as to improve the economic benefits to a higher degree. And the TS is also reflected in the process of changing the proportion of output value, employment and national income among various industrial sectors.

TL is the rationalization of industrial structure. It means that in order to improve economic benefits, it is required to adjust the initially unreasonable industrial structure according to the level of science and technology, the structure of consumption demand, the basic quality of the population and the resource conditions at a certain stage of economic development, so as to realize the reasonable allocation of production factors and make the coordinated development of various industries.

The advancement of industrial structure is based on the rationalization of industrial structure. The process of rationalization of industrial structure makes the structural efficiency improve continuously, and then promotes the development of industrial structure to the high level.

2.2 Introduction

There are many factors affecting the upgrading of industrial structures. George S Chen et al. (2017). believe that foreign direct investment is a catalyst for industrial upgrading in the economy, and it is necessary to promote the establishment and development of joint ventures. Patampong Intarakumnerd et al. (2015) studied how Thailand's semiconductor industry transformed from low-added value to high-added value, and concluded that the lack of industrial policies limited industrial technology upgrading. Seth Pipkin and Alberto Fuentes (2017) concluded that local institutions and policies are the key factors for regional industrial structure upgrading. Kailan Tian et al. (Kailan Tian, 2019) provided influencing factors for industrial structure upgrading through factor analysis, including process upgrading, product upgrading, and skill upgrading.

Yang Liu (2022)come up with that as a booster of the high-quality development of the economy, the digital economy according to the “G20 Digital Economy Development and Cooperation Initiative” released at the G20 Summit in 2016, the digital economy refers to a series of economic activities with the use of digital knowledge and information as key production factors, modern information network as an important carrier and the effective use of information and communication technology as an important driving force for efficiency improvement and economic structure optimization has extended the industrial chain, spawned a series of new industries and upgraded (industrial upgrading is defined as the process that nations, firms, and workers, as economic actors, move from low-value to relatively high-value activities in global production networks traditional industries.

Zhihui Dai(2022) sums up some ideas about the quantity of employment, some scholars have argued that industrial upgrading has inhibited the quantity of employment. Banerji found that in the 1950s–1970s, Taiwan’s emphasis on the development of labor-intensive industries contributed to the rate of employment growth and economic development in Taiwan, while India’s preference for capital-intensive industries hindered economic development and labor specialization. Hicks came to the consistent conclusion that developing countries that rely too much on capital-intensive industries and technologies may lead to enhanced employment suppression capacity in emerging industries, which is not conducive to employment Upendranadh et al., by further comparing the industrial development and employment structures of manufacturing industries in different regions of India, found that there was a reducing effect on employment, due to the gradual capital deepening of capital-intensive industries that put demands on education levels. However, some scholars have found that industrial upgrading has had a positive effect on the quantity of employment. As early as 1990, Pissarides argued that there is a clear boost to economic growth from industrial upgrading, with economic growth creating new jobs, and thus, employment growth. Later, Gali focusing on labor-intensive industries, found that the process of capital deepening could lead to employment growth by expanding the capital stock. With the rise of new energy industries, some scholars have begun to focus on employment in new energy industries. Wei and Patadia in their study of the employment absorption capacity of the newest and traditional energy

industries in the US, found that the emerging renewable and low-carbon energy industries would absorb more people in employment than the traditional industries. Lehr and Lutz also conducted a similar study in Germany and came to the same conclusion. Other scholars have focused on regional employment. He Zixin empirically analyzed the relationship between industry and employment in resource-based cities, and they concluded that an increase in the share of the tertiary industry has a significant positive effect on the increase in total employment in resource-based cities. With the rapid development and the widespread application of digital technology, the digital economy is new, a new dynamic, and a new business model, which has triggered profound social and economic changes. As a result, some scholars have begun to study the relationship between the development of the digital economy and the quality of employment. Scholars have argued that the development of the digital economy has improved the quality of employment. Autor found that digital technological advances have raised productivity levels and have increased the demand for highly skilled labor, thus contributing to overall income growth. Si Xiaofei and Chen Maishou also found that the development of the digital economy triggered a change in the demand for labor with different skills, increasing the demand for high-skilled personnel while reducing the demand for low-skilled labor, and this change in demand pushed low-skilled workers to continuously learn new knowledge and skills and improve their employability, thus driving up the quality of employment.

CHAPTER 3
RESERCH METHODOLOGY

3.1 Methodology

The third chapter introduces the basic research methods related to this paper, which is the theoretical basis for my reference when writing this paper.

3.1.1 Related theories of the digital economy

Three laws govern the digital economy. The first law is Metcalfe's law: the value of a network is equal to the square of its number of nodes. Therefore, the more computers networked on a network, the more valuable each computer is, and the "value-added" keeps increasing exponentially; the second law is Moore's law: the processing power of computer silicon chips doubles every 18 months, and the price has fallen by half; the third law is Davido's law: the first generation of products entering the market can automatically obtain 50% of the market share, so any company in the industry must be the first to eliminate its products. Davido's law embodies the Matthew effect in the network economy. These three laws determine that the digital economy has the following essential characteristics:

The first is quickness and convenience. The Internet breaks through the traditional boundaries of countries and regions and is connected by a network to connect the whole world closely. It also breaks through time constraints so people's information transmission and economic transactions can be carried out quickly. The second is high permeability, the rapid development of information technology, which has the same permeability function, makes the information service industry rapidly expand to the primary and secondary industries, and makes the relationship between the three major industries. The boundaries are blurred, and there is a trend of mutual integration of the primary, secondary, and tertiary industries; the third is self-expansion. In the digital economy, due to people's psychological reactions and behavioral inertia, under certain conditions, once advantages or disadvantages appear and to a certain extent, it will lead to continuous aggravation and self-strengthening.

There will be a "winner takes all" monopoly situation where "the strong are more substantial, and the weak are weaker" Cumulative value-added; the fifth is an external economy, the more the number of users, the higher the utility of each user; the sixth is sustainability, the digital economy can effectively eliminate the impact of traditional industrial production on tangible resources, The excessive consumption of energy causes environmental pollution, ecological deterioration, and other hazards, and realizes the sustainable development of the social economy; the seventh is directness. Due to the development of the network, the economic organization structure tends to be flat, and producers and consumers at the end of the network can be directly contacted, which reduces the necessity of the existence of the traditional intermediary level, thereby significantly reducing transaction costs and improving economic benefits.

3.1.2 Related theories of industrial upgrading

3.1.2.1 Pegdi-Clark theorem

William Petty was the first economist to study the law of industrial structure evolution. In 1691, Petty analyzed Britain's social and economic development and observed that the industry's added value was usually higher than that of agriculture. The added value of commerce was usually higher than that of industry. It also points out that the difference in industrial structure will lead to a difference in the level of national income. Subsequently, Colin Clark summarized Petty's ideas according to Fisher's three-industry division standard, further analyzed the law of movement of labor force among the three industries, and proposed that with the continuous improvement of national economic development and per capita income level, the labor force first flows from the primary industry to the secondary industry to the tertiary industry. The Petty-Clark theorem reveals the primary direction of industrial structure evolution for the first time, which has important theoretical significance for this paper to analyze the proportion of China's three major industries in GDP and the changes in labor force structure.

3.1.2.2 Kuznets theory of the impact of income per capita

Simon Kuznets analyzed the data of more than 20 countries and revealed the relationship between per capita national income and three industrial structure changes. It is found that per capita national income changes will affect

industrial structure changes. That is, with the growth of the country's per capita national income, the proportion of the primary industry in national income will gradually decrease, and the proportion of the number of the labor force in the primary industry will also gradually decrease; meanwhile, the status of the primary industry in economic development will be reduced. The proportion of the secondary industry in the national income will gradually increase, the proportion of the secondary industry labor will remain roughly unchanged or slightly increase, and the status of the secondary industry in the economic development will gradually improve. The proportion of the labor force in the tertiary industry continued to rise. However, the proportion of the secondary industry in the national income did not show an upward trend synchronized with the proportion of the labor force. Kuznets' theory of the impact of per capita income reveals the trend of industrial structure evolving to a higher level.

3.1.2.3 Rostow's dominant industry theory

Rostow's economic growth stage theory holds that the social and economic development of a country needs to go through six growth stages, which are the traditional social stage, the preparation stage to create the premise for economic take-off, the economic take-off stage, the stage of advancing to maturity, and the stage of high public consumption and the stage of people's pursuit of quality of life. According to Rostow's leading industry selection theory and industrial diffusion effect theory, it is the main characteristic of the evolution of economic growth stages to select industries with strong forward, retrospective, and lateral diffusion effects as the leading industries. Different economic growth stages need to have an industrial sector as the leading industry to transmit the development advantages of the leading industries to related industries. Drive the upgrading of the overall industrial structure, thus promoting the development of the whole social economy.

Rostow's theory of leading industries clarifies the importance of leading industries in upgrading industrial structure. Leading industry sectors cannot be replaced randomly but should be selected according to the actual economic development of a country. Technological innovation and orderly replacement of leading industry sectors promote the evolution of industrial structure. Under the background of the digital economy, China actively develops the information and

communication industry and takes such emerging industries as the leading industries to promote the optimization and upgrading of the overall industrial structure, which lays a theoretical foundation for the analysis of the development of digital economy and the upgrading of industrial structure in this paper.

3.1.3 Related Theories of labor supply and Demand

The matching of labor supply and demand is an important research content of economics, traced back to the era of classical economics. In the book "A Study of the Nature and Causes of National Wealth," published in 1776, Adam Smith proposed the vital role of the "invisible hand" of the market in allocating resources. He believed that the supply and demand of the labor force determined the labor remuneration, and the wage resulted from the interaction between the supply and demand of the labor force. Subsequent economists enriched and developed the theory of wage and employment decisions by loosening the classical economics assumption of a perfectly competitive market hypothesis.

Neoclassical economics is based on the maximization of individual utility and the maximization of corporate profit. Its theory on the determination of wages and employment inherits the main ideas of the classical economic school of thought, such as Adam Smith, which emphasizes that competitive market forces will bring labor supply and demand to equilibrium. Increasing labor demand will lead to a wage rise when the labor supply is constant. In contrast, when labor demand is unavoidable, an expansion in labor supply will lead to, Eventually, the two opposing forces will push wages closer to the equilibrium level. Marshall and Clark, as two representative figures of the neoclassical school of economics, have profoundly elaborated on the evolution of the supply and demand relationship in the labor market. Marshall considered wages as the remuneration of labor and as the equilibrium price of labor. The demand price of labor is determined by the marginal productivity of labor (marginal output), and the supply price depends on "the cost of the effort to develop, train, and maintain efficient labor."

In contrast, the equilibrium wage is determined by the intersection of the labor demand and supply curves. Clark, on the other hand, based on the marginal school of thought, put forward his famous theory of productivity distribution, pointing out that factors of production, such as labor and capital, are governed by the

law of diminishing marginal returns so that Clark obtained a downward-sloping labor demand curve that overlaps with the marginal output curve of labor. Later, Hicks, a representative of the neoclassical synthesis school, examined the determinants of wages and employment in terms of the labor market structure. He incorporated the non-market concept of labor unions based on classical economic theory and analyzed the effect of the existence of labor unions on workers' wages.

CHAPTER 4
DATA

4.1 Data summary

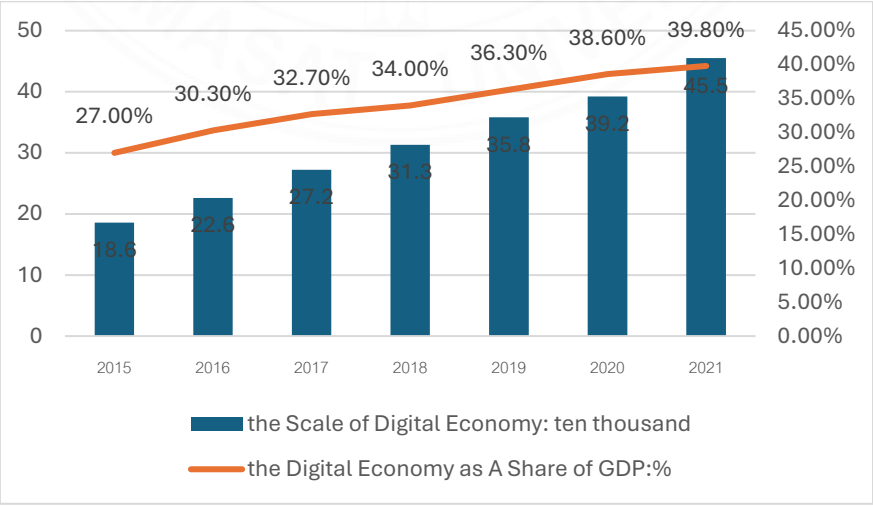
The sixth chapter introduces the data needed for the paper, including the current situation of China's labor market and economic development.

4.2 Current situation of China's digital economy

The development scale of China's digital economy will reach 45.5 trillion yuan in 2021, more than double the expansion at the beginning of the 13th Five-Year Plan. This represents more than double the size of China's digital economy in 2021 compared to the beginning of the 13th Five-Year Plan, with nominal growth of 16.2%. From the perspective of the digital economy to total output, the contribution of the digital economy to total output is becoming more and more prominent, with the share of the digital economy in GDP rising by 12.8 percentage points from 2015 to 2021.

Figure 4.1

The changing trend of China's digital economy scale



Note: From *White Paper on China's Digital Economy Development China Academy,* by Information and Communications Technology, July(2022).

4.2.1 Comparison of digital economy in different cities in China

This paper calculates the digital economy development level of 277 cities in China from 2011 to 2019. According to the calculation results, at the national level, the development of digital economy in different regions is unbalanced, showing a pattern of higher eastern than central and western regions. It is not difficult to see that there is a correlation between digital economy and regional development level, and the development level of digital economy in different cities is quite different. The top five cities in terms of digital economy are Shanghai (Eastern), Shenzhen (Eastern) and Guangzhou (Eastern), Hangzhou (Eastern) and Xiamen (Eastern). The five cities with a low level of digital economy development are Bijie (Western), Haidong (Western) and Zhaotong (Western), Dazhou (Western) and Suihua (Eastern). From the perspective of various indicators, except for capital investment, the rest are positively correlated with the development level of digital economy, indicating that digital economy has a role in promoting the economic growth of various cities in China. On the whole, the cities with a relatively high level of digital economy development mostly belong to the eastern region or central cities, indicating that the level of digital economy development of prefecture-level cities in the country is significantly different.

Figure 4.2

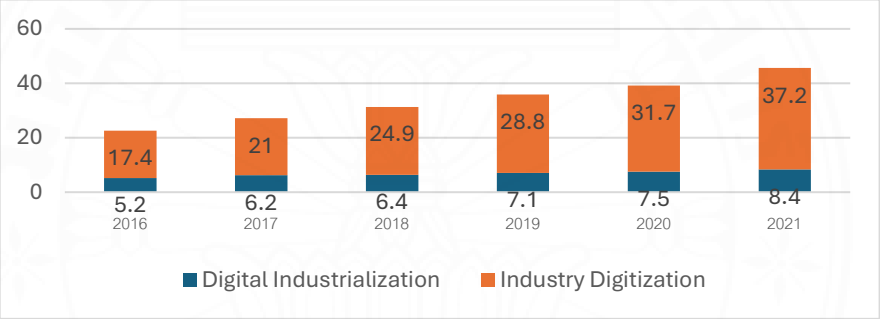
Scatter chart of digital economy level of different cities in China in 2019

Note: From *China Urban Statistical Yearbook,* by Bureau of Statistics of China Lifang (2019).

In 2021, China's digital industrialization scale reached 8.35 trillion RMB, with a year-on-year nominal growth of 11.9%, accounting for 18.3% of the digital economy and 7.3% of GDP. The development of digital industrialization is transforming quantity expansion into quality improvement. By 2021, China's industrial digital scale will reach 37.18 trillion RMB, with nominal growth of 17.2% year-on-year, accounting for 81.7% of the digital economy and 32.5% of GDP, and the digital transformation of the industry continues to accelerate in depth.

Figure 4.3

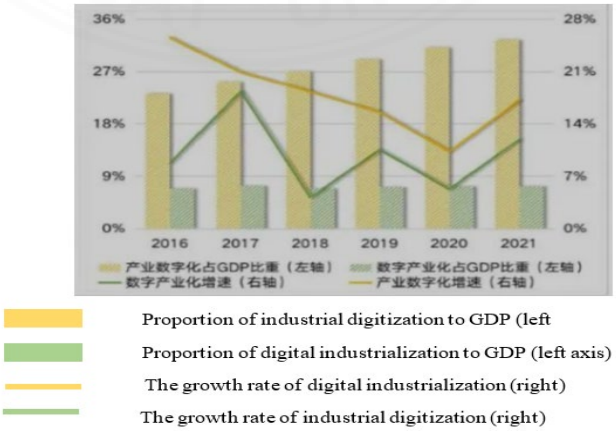
Figure name (Data change map of the internal structure of the digital economy from 2016 to 2021)



Note: Form *White Paper on China's Digital Economy Development,* by China Academy of Information and Communications Technology, July(2022).

Figure 4.4

Data change map of the internal structure of the digital economy from 2016 to 2021

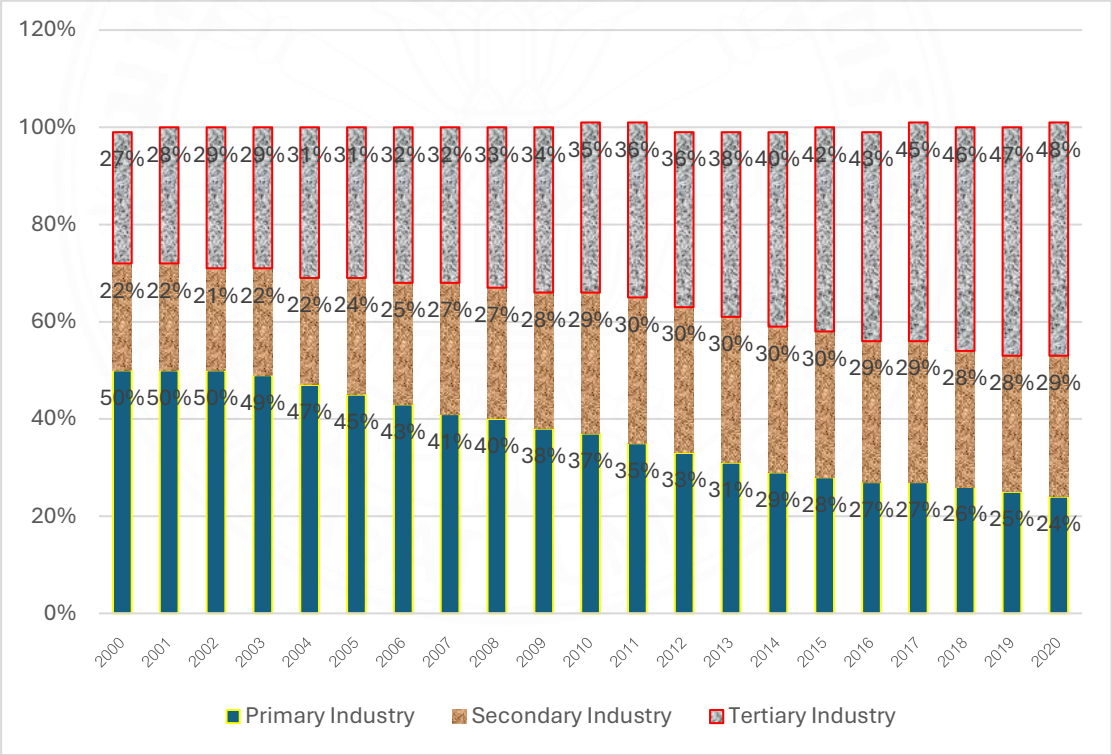


Note: Form *White Paper on China's Digital Economy Development,* by China Academy of Information and Communications Technology, July (2022).

Regarding China's employment structure, from the primary industry, China's labor force is constantly flowing out: 50% of the labor force was engaged in agricultural production in 2000, while only 24% of the labor force will be involved in agricultural production in 2020, a drop of 26 percentage points; the proportion of the labor force in the secondary industry showed some fluctuations between 2000 and 2020, but in general, there is an upward trend, from 22% to 29% between 20 The proportion of the workforce in the tertiary sector has increased the most, from 27% to 48% from 2000 to 2020, with a rise of 73%. Referring to the experience of developed countries, the proportion of employment in the tertiary sector is generally above 70%.

Figure 4.5

Employment structure changes in three industries from 2000 to 2020



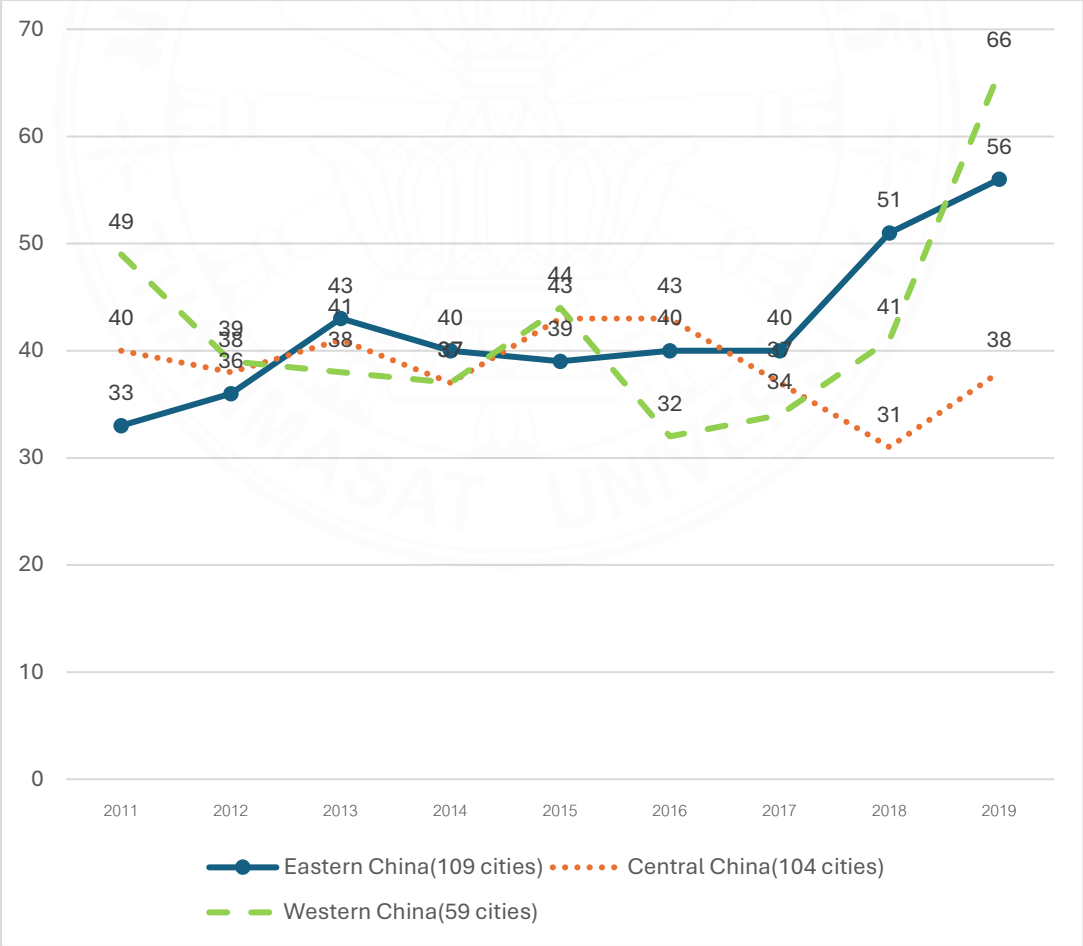
Note: From *China Statistical Yearbook,* by Bureau of Statistics of China*(2020).*

4.3 The mismatch of labor supply and demand across China

The data shows that during 2012-2017, the mismatch between labor supply and demand in each region of China changed by relatively minor, and all fluctuated around the mismatch index of 40. From 2017 to 2019, the mismatch between labor supply and demand in the eastern and western regions increased significantly, while the situation in the central region was better and has not improved significantly. By 2019, China's most serious labor supply and demand mismatch is in the western region, followed by the Eastern region, and the Central region is better maintained at a lower level.

Figure 4.6

Chart of mismatch between supply and demand of labor in Chinese region from 2011 to 2019

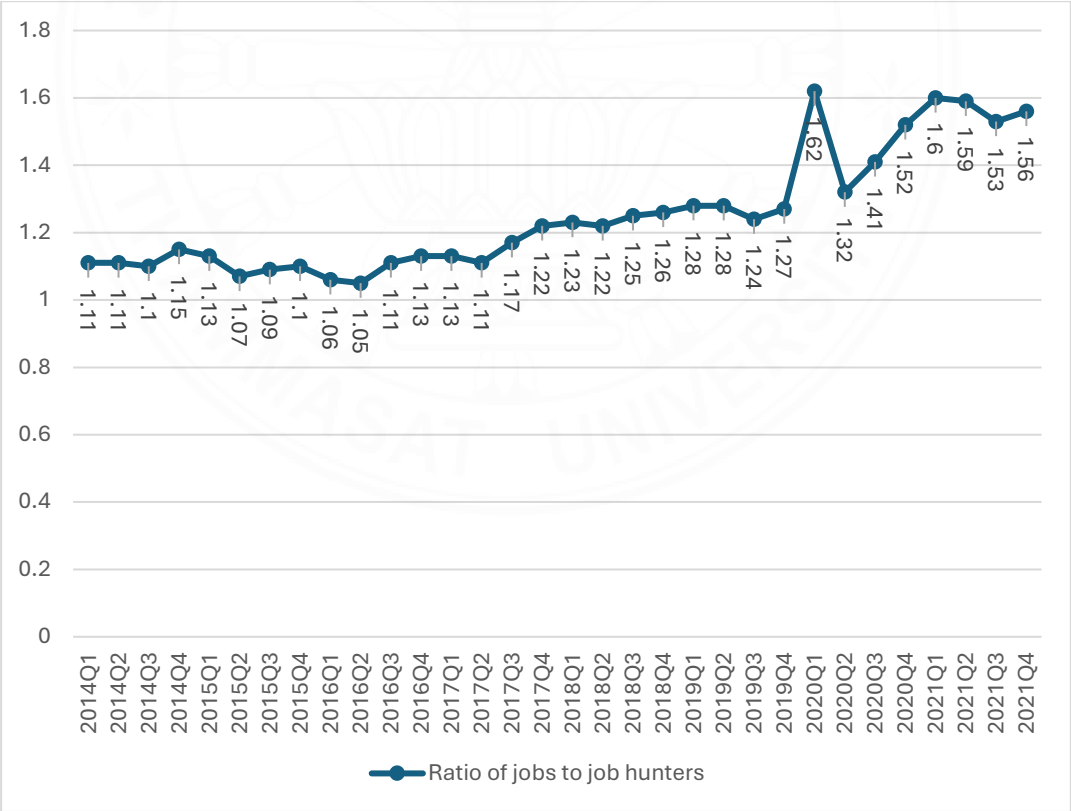


Note: From *China Statistical Yearbook,* by Bureau of Statistics of China*(2020)*.

Since the "digital economy" was included in the report of the Nineteenth National Congress of the Communist Party of China in 2017, the ratio of jobs to job hunters of Chinese employers has increased. Since the ratio of jobs to job hunters in the fourth quarter of 2017 broke through the original stable trend and reached 1.22, China's ratio of jobs to job hunters. The overall trend has been rising. By the first quarter of 2020, China's ratio of jobs to job hunters surged to 1.62. Although there was a significant relaxation after that, until the fourth quarter of 2021, the ratio of jobs to job hunters remained at a high level of 1.56. The ratio of jobs to job hunters in Chinese employers continues to rise, indicating a severe mismatch between the supply and demand of China's labor force.

Figure 4.7

Changing trend of the ratio of jobs to job hunters of Chinese employers from 2014 to 2021



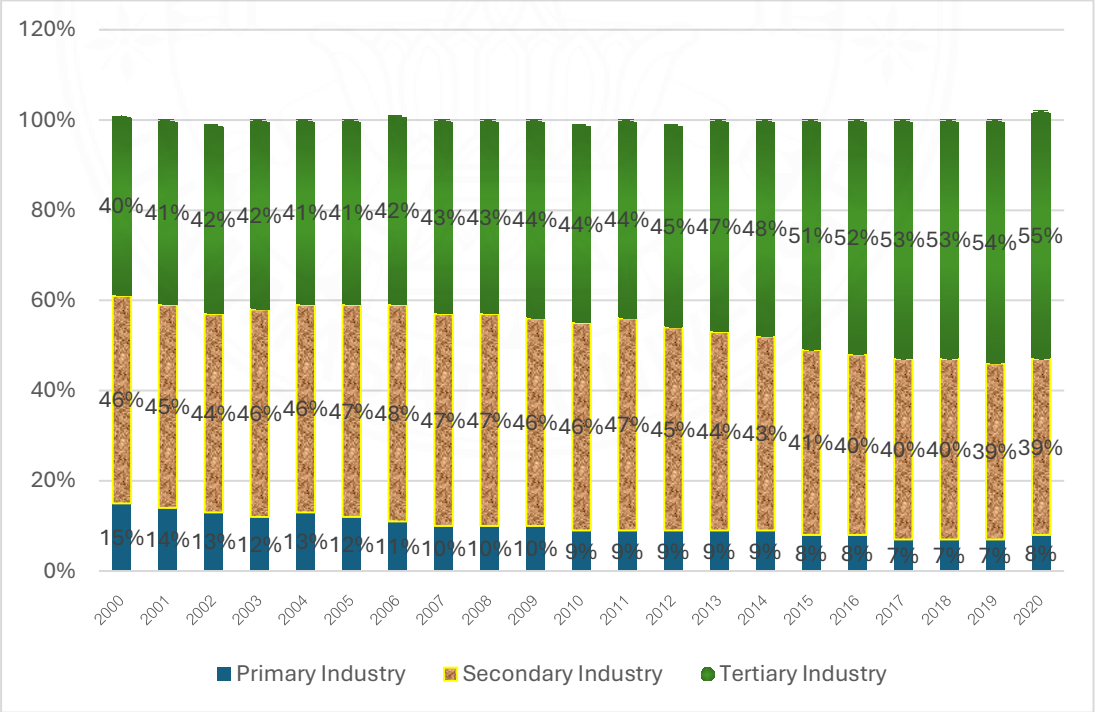
Note: From *Analysis of market supply and demand of public employment service agencies in some cities published,* by the Ministry of Human Resources and Social Security of China (2021).

4.4 Current situation of China's industrial structure

From 2000 to 2020, the proportion of the output value of the primary industry dropped from 15% in 2000 to 8% in 2020, showing a continuous downward trend. Since 2000, the output value ratio of the secondary industry has dropped from 46% to 38%, a drop of 16.9%, and the range of change is not extensive. The proportion of the output value of the tertiary industry has been rising, and it has increased by 15 percentage points from 2000 to 2020, an increase of 37%. Developed countries experience the proportion output value of the primary industry in developed countries generally accounts for about 1%, and the output value of the tertiary industry accounts for more than 70%. Therefore, there is still much room for improvement in the level of advanced industrial structure in China.

Figure 4.8

Structure change of China's industrial output value from 2000 to 2020



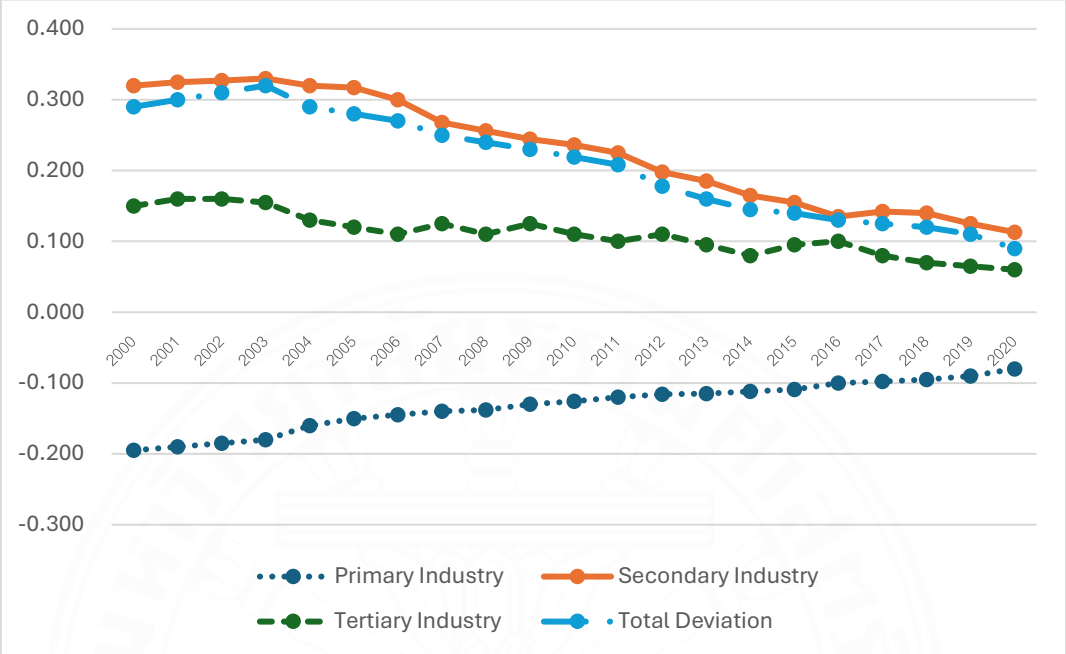
Note: From *China Urban Statistical Yearbook,* by Bureau of Statistics of China, 2020.

Based on the data released by the National Bureau of Statistics from 2000 to 2020, the Theil coefficient is used in this paper to characterize the degree of deviation of China's industrial structure, as shown in Figure 4.9. The degree of deviation of China's industrial structure showed a slow increase in 2000-2003, from 0.29 to 0.32, and a slight increase in 2016-2018, from 0.12 to 0.121, with a flat increase. Nevertheless, in general, there is a trend of delisting, which shows that the deviation between China's employment structure and output value structure has been significantly improved, which means that the level of coordination among the three industries in China is improving.

First of all, the Theil coefficient of the primary industry is less than zero, indicating that the labor productivity of the primary industry is lower than that of China as a whole, reflecting the growth of the primary industry. The employment ratio is more important than the output value ratio, and the use efficiency of labor production factors is low. However, according to the diagram, it can be seen that the curve of the primary industry is approaching the abscissa, indicating that the Theil coefficient of the primary industry is gradually approaching zero, and the industrial deviation has been improved; then, the Theil coefficients of the secondary industry and the tertiary industry Both are greater than zero, which means that the labor productivity of the secondary industry and the tertiary industry is greater than the overall level. According to the figure, the Theil index of the tertiary industry is smaller than that of the secondary industry, indicating that the degree of deviation of the tertiary industry is slightly smaller than that of the secondary industry. Finally, from the trend point of view, the curves of the secondary and tertiary industries are both approaching the abscissa, indicating that the level of structural deviation is decreasing, and the development trend of the three industries in China is good.

Figure 4.9

The change chart of industrial structure deviation degree of China from 2000 to 2020



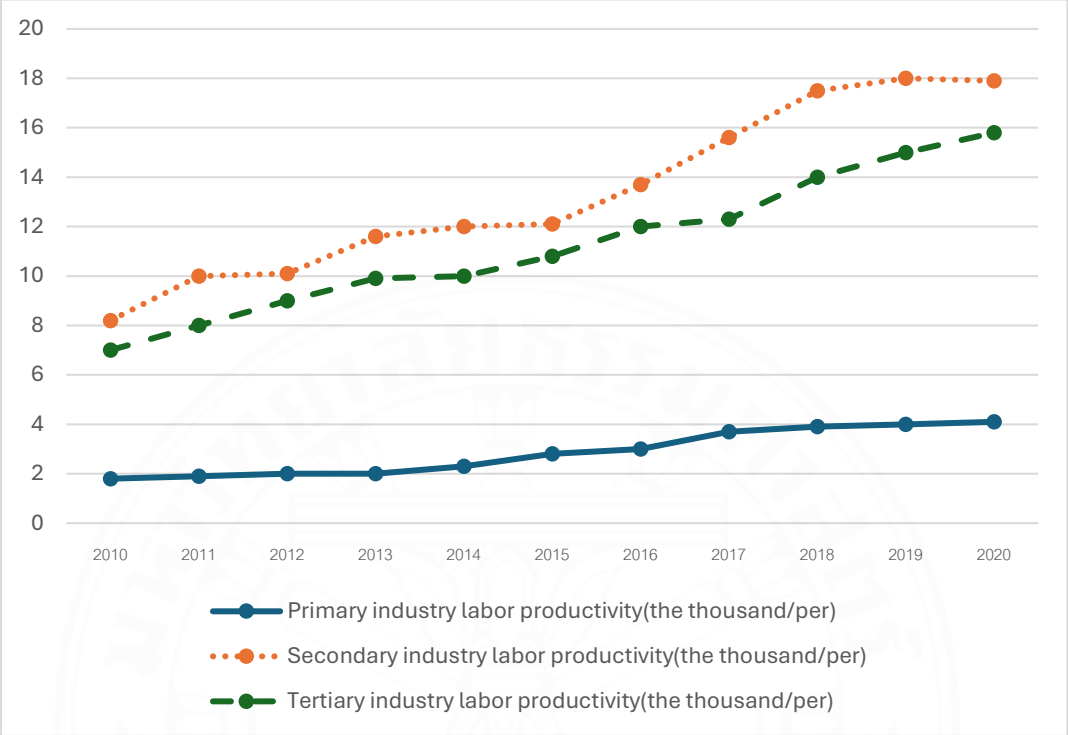
Note: From *China Urban Statistical Yearbook,* by Bureau of Statistics of China, (2020).

Kuznets believed that there were productivity differences among industries. The flow of production factors would create the trend of convergence of production efficiency, and productivity convergence was the productivity improvement process. That is, factors of production will flow to industrial sectors with higher production efficiency. Whether the flow of factors of production follows this rule can be used to judge whether the industrial structure is healthy.

In 2010, the labor productivity ratio of China's tertiary industry to the secondary industry was about 79%, and in 2020, the ratio will rise to about 87%. This indicates that the gap between the production efficiency of the tertiary industry and secondary industries' production efficiency is narrowing continuously. It also indicates that in the calculation of the deviation degree of the tertiary industry structure in Figure 3-9, the low deviation degree of the tertiary industry not only indicates that the tertiary industry has a more reasonable development but also indicates that the labor productivity of the tertiary industry is lower than that of the secondary industry.

Figure 4.10

Labor productivity trends of China's three industries during 2010-2020



Note: From *China Urban Statistical Yearbook,* by Bureau of Statistics of China, (2020).

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Model and Results

The fourth chapter introduces the analysis mechanism of this paper, the design of regression model, the analysis of regression results and the test of results.

5.1.1 Mechanism research

5.1.1.1 The impact of the digital economy on industrial structure upgrading

The data factor has become one of the essential factors of production. The digital economy is closely related to advanced technologies such as big data, the Internet of Things, and artificial intelligence. Its influence on the upgrading of our industrial structure can be analyzed from the following four aspects:

First, the digital economy creates new industries and new modes of production. As the introductory part of the digital economy, digital industrialization has developed many emerging industries through digital technology innovation, such as electronic information manufacturing, software and information technology services and the Internet of Things, big data, cloud computing, artificial intelligence, and other industries. After decades of development of information technology, these new industries have led the way in developing the digital economy, and these new industries have enriched the connotation of the industrial structure. Industrial digitization has given rise to perceptible models. In terms of the production process, additive manufacturing technology based on digital technology and industrial software has broken through the constraint that traditional subtractive manufacturing technology is difficult to produce complex structural parts; in terms of production tools, industrial robots are developing rapidly and even gradually have self-perception, judgment and decision-making capabilities, and their wide application has replaced a large amount of repetitive human labor. In addition, compared with the traditional business model centered on enterprise value creation, the application of digital

technology has given rise to a business model centered on customer value creation and Internet-based innovation, which has alleviated the problems of inefficient resource allocation and unnecessary loss of social welfare caused by information asymmetry, increased business profits and stimulated business vitality, and thus developed into a new industrial form. The new technologies, products, and services represented by 5G, big data, cloud computing, blockchain, and artificial intelligence can not only accelerate the pace of the traditional manufacturing industry to the middle and high-end manufacturing industry but also promote the deep integration of manufacturing and service industries, thus helping to upgrade the industrial structure.

Second, the digital economy empowers traditional industries. Industrial digitization takes data as the critical element, value release as the core, and data empowerment as the main line to digitally upgrade, transform and reengineer the whole elements of the upstream and downstream of the industrial chain. Traditional industries integrate factor resources with new technologies such as the Internet, Internet of Things, and big data, improve the efficiency of factor resource allocation, and realize the digital transformation of industries. In addition, digital technology empowers traditional industries to realize the automation and intelligence of production processes, adopt a production model that benefits the whole situation, make the shortest time and optimal cost for the production and manufacturing link, and help improve enterprise management efficiency and production efficiency. As a platform and carrier for digital technology to empower traditional industries, the industrial Internet has realized the networking of producers, consumers, suppliers, equipment, and products, built a framework for dialogue among people, machines, and things, and become a "pooling pool" of information and a "matcher" of resources. "matchmaker" of resources. Each participating subject can not only know the partners with whom they have direct business relations but also identify various subjects with whom they have indirect relations while monitoring the operation of physical equipment in real-time to make accurate strategic decisions and promote operational optimization. The intelligence of digital technology can continuously innovate and learn, which can help humans to complete the work that may not be completed in a long time, shorten the time of industrial upgrading and improve the efficiency of industrial upgrading. The digital economy can also create value-added space through

continuous innovation, continuously empowering traditional industries and achieving industrial structure upgrading.

Third, the digital economy promotes industrial integration. The digital economy has the characteristics of solid permeability and comprehensive coverage. The application of digital technology is borderless and barrier-free, which can support opening sectoral barriers, extending the industrial chain, blurring the industrial boundaries, and correlating all industries with other industries. The digital economy blurs industrial integration, which has three primary forms of realization: the first form is the penetration of the digital economy in other industries, mainly the unilateral penetration and integration of high-tech industries into traditional industries. E-commerce, as the product of digital economy penetration into traditional retail industries, is a typical example. This penetration is reflected in the online transaction at the consumer end and the enterprise information management system (ERP) application at the production end. The second form is the cross-integration between industries. With the progress of technology, the natural complementarity and extension between the originally unrelated industries due to business expansion needs have resulted in the cross-integration of businesses, such as the Internet of Things and high-performance integrated circuits. The third form is the restructuring of industries, which occurs when the boundaries between highly connected industries are broken down, and new economic forms are created, such as video games and other industries. The digital economy promotes the integration of innovation resources and power changes. The integration of the whole industrial chain effectively promotes the extension and expansion of the industrial chain and improves the core competitiveness of enterprises. The digital economy promotes industrial integration and helps alleviate the problems faced by industrial development, such as vital resource and environmental constraints and the lack of key core technologies. Taking agriculture, manufacturing, and service industry as examples, developing a digital economy can effectively promote the integration of agriculture, manufacturing, and service industry, innovate, enrich green product supply, improve resource use efficiency, and form a green manufacturing system.

Fourth, the digital economy resolves the contradiction of information asymmetry. With the booming development of China's information and communication technology(ICT) industry, data can give full play to its characteristics of being efficient and clean, low-cost, replicable and accessible in large quantities, thus overcoming the inherent defects of traditional factors of production; the digital economy is integrated into all aspects of production lines, reducing information costs, time costs and space costs, which can essentially promote the effective use of resources, improve the efficiency and products accuracy, promoting the integration of upstream producers and suppliers, midstream channel traders and downstream industrial economy can play a role in promoting the upgrading of industrial structures in all aspects of production, operation and sales; the fairness and openness of digital platforms allow industries to compete in the market in an orderly manner, reducing the search cost and transaction cost of information for producers and consumers, and allowing industries to continuously improve their internal structure, while reducing information asymmetry between industrial sectors, which helps industries avoid inter-sectoral moral hazard and eliminate adverse selection problems.

The sum of everything that's been staged so far, this thesis put forward Hypothesis 1: China's digital economy promotes upgrading industrial structure.

5.1.1.2 The impact of the mismatch of labor supply and demand on industrial structure upgrading

Labor has always been an important production factor in the production process and a sufficient condition for industrial and economic development. Even though booming digitalization and intelligence have transformed production methods, the unique characteristics of the labor factor still need to be replaced entirely by the capital and data factors. The two crucial labor supply and demand theories, "the law of Clark and the law of Kuznets," focus on labor transfer among the three major industries. They concluded that labor would shift from primary to secondary industries over time. Their joint conclusion is that the labor force will shift from the primary industry to the secondary industry and further to the tertiary industry over time. In the above theoretical studies, the change in labor supply and demand is generally regarded as a symptom of the change in industrial structure; that is, the change in labor supply

and demand is caused by the change in industrial structure. The study on the influence of traditional labor supply and demand mismatch on industrial structure upgrading argues that with the rising labor cost, traditional labor-intensive industries will face labor shortage and rising production costs, leading to the substitution of capital for labor. In this context, capital or technology-intensive industries will be developed more rapidly, which eventually induces industrial structure upgrading.

In addition to the above effects, the impact of labor supply and demand mismatch on industrial structure upgrading can be analyzed from the following three aspects.

Firstly, the labor supply and demand mismatch will reduce the industrial production efficiency and inhibit upgrading the industrial structure. Different industrial sectors have different demands for labor. In the industrial sectors, where there is an enormous surplus of labor resources, the surplus labor may be idle, resulting in decreased labor value. As a result, the advantages of labor resource endowment still need to be fully utilized, which hinders the production efficiency of industries, affects the normal economic activities among industries, and hurts the upgrading of the industrial structure. When there is a shortage of labor resources, it will lead to an increase in labor factor prices in labor shortage areas. From the perspective of enterprises, the increase in labor cost makes enterprises stop investing limited resources in productive activities (such as equipment upgrading, technological innovation, employee skills training, Etc.) and use them for rent-seeking and other non-productive activities, which has a "crowding-out effect" on physical investment in industries and makes it difficult to improve the productivity of enterprises further. This behavior has a "crowding-out effect" on the actual investment in the industry, which makes it challenging to improve the productivity of enterprises further and thus hinders the optimization of the whole industrial structure. When the labor market is distorted due to the misallocation of labor, some excellent enterprises cannot expand due to the limitation of production materials and cannot give full play to their comparative advantages, thus losing the opportunity to improve production efficiency through the scale effect.

Secondly, the mismatch of labor supply and demand inhibits the utilization efficiency of human capital and the upgrading of industrial structure. In other words, the "quality" and "quantity" of human capital are important factors affecting the industrial structure of a region or even a country, and the human capital level of a region determines its economic development level. The quality of production factors determines their marginal productivity. The higher the marginal productivity of production factors, the greater the benefit. To maximize profits, enterprises will replace factors of low marginal productivity with factors of high marginal productivity. That is, enterprises are more willing to choose high-quality human capital. In this way, sectors with high productivity will gradually replace those with low productivity. High-quality human capital will flow continuously to capital-intensive and technology-intensive industries, thus promoting the optimization and upgrading of regional industrial structure. On the contrary, when the mismatch of labor resources occurs, the flow of high-quality human capital is hindered, the productivity improvement of high-tech industry is hindered, the labor production efficiency becomes low, and the upgrading of industrial structure is correspondingly hindered.

Thirdly, the mismatch of labor supply and demand hinders the knowledge spillover effect, thus inhibiting the upgrading of the industrial structure. Human capital accumulation has a strong externality. Labor obtains new knowledge and skills through continuous learning and accumulation so that human capital is accumulated to a certain extent and a knowledge spillover effect is generated. At the same time, knowledge spillovers can bring more human capital together again. Therefore, the accumulation of human capital can not only improve the overall labor quality of a region but also improve the industrial innovation ability of the region to a certain extent. The existence of the knowledge spillover effect will change the labor productivity of different industries and improve the overall technical efficiency of industrial production. Due to the different human capital stock in each region, there will be a big gap between each other's labor efficiency, which will lead to the different industrial layouts and division of labor in different regions, changing the industrial structure of different regions and regions promote the upgrading of industrial structure. However, when there is a mismatch of labor resources, the accumulation of human capital will be inhibited, thus inhibiting the generation of knowledge spillover effect.

Generally, the closer the knowledge spillover subject is to the knowledge spillover receptor, the more pronounced the knowledge spillover effect is. The mismatch of the labor force obstructs the free flow of the labor force. It enlarges the distance between the receiving place of knowledge spillover and the place of knowledge spillover, thus obstructing the knowledge spillover effect, and the labor productivity of the industry cannot be improved, which further affects the pace of industrial structure upgrading.

The sum of everything that's been staged so far, this thesis put forward Hypothesis 2: China's labor mismatch inhibits upgrading the industrial structure.

5.1.1.3 The interactive effects of the digital economy and labor mismatch on industrial structure upgrading

Existing literature studies on the relationship between the digital economy and labor supply and demand have shown that the development of the digital economy and the mismatch of labor supply and demand restrict and promote each other, and the two have interactive effects on the upgrading of industrial structure. Specifically, this paper will analyze the following three aspects:

First, the digital economy aggravates the mismatch of labor supply and demand, forcing the improvement of human capital, compensating for the loss of human capital utilization efficiency, restraining the negative effect of the mismatch of labor supply and demand on the upgrading of industrial structure, and promoting the upgrading of industrial structure. First of all, the emerging information and communication technology (ICT) industry, the digital transformation of traditional industries, and the transformation of production modes have raised the requirements of enterprises on labor skills and quality, resulting in a mismatch between the original labor supply and the existing labor demand. Secondly, the transformation of traditional talents and the improvement of skills are forced due to the improvement of the requirement of the quality of talents. From the perspective of education structure, innovation is highly correlated with the human capital of higher education. Improving enterprise innovation ability requires highly educated innovative talents as support. Therefore, the digital economy will optimize enterprise education structure and increase the proportion of highly educated personnel. From the perspective of skill structure, enterprises' digitalization and intellectual development will replace the

conventional, repetitive, and productive low-skilled labor force and promote the unconventional, non-repetitive, and creative high-skilled labor force. Finally, developing the digital economy industry can improve the mismatch of resources and education by improving information friction, saving resources through integration, and reducing financial repression. The rapid development of information technologies such as the Internet and mobile Internet has reduced the cost of information acquisition to zero, providing more choices and channels for residents to improve their knowledge and human capital. The development of new technology breaks the time and space limitations of knowledge acquisition, makes the learning mode of interpersonal communication more convenient, and provides opportunities for learners to improve their abilities. The new learning mode based on online education has brought more abundant educational resources to the less developed areas, enabling students in poor areas to receive the guidance and help of high-level teachers in the developed areas, which to some extent makes the equal development of educational resources, and then comprehensively improves the level of human capital in different areas.

Second, the mismatch of labor supply and demand leads to the substitution of capital for labor, the development of a digital economy, and the upgrading of industrial structure. With the increasing scale of the digital economy, to cope with the rapid growth of human cost and reduce low-value labor, exploring cost reduction and efficiency increase through digital transformation has become the direction of enterprises to improve human capital management and stimulate the value of human capital. The digital labor force based on integrating RPA (robot process automation technology) and AI (artificial intelligence) technology has emerged. With the maturity of RPA robot process automation technology and the acceleration of AI artificial intelligence application scenarios, all industries have accelerated the layout of a digital labor force of RPA+AI and completed many procedural works by applying a digital labor force instead of manual labor. In the context of the rapid iteration of emerging technologies such as artificial intelligence, big data, and the Internet of Things, the digital labor force is gradually extending from auxiliary to intelligent, playing more roles in various new business forms spawned by digitalization. With the development of the digital labor force, the utilization efficiency of human resources has also improved significantly.

Third, the creative effect of the digital economy and the improvement of human resource allocation efficiency have alleviated the mismatch between labor supply and demand and promoted the upgrading of industrial structure. The rise of the information and communication technology (ICT) industry and the integration of traditional and ICT industries have a creative effect on the number of jobs. The creative effect means that the digital economy will create many new jobs. With the steady growth of the digital economy, the primary supporting role of the telecommunications industry is continuously enhanced, the software and information technology service industry is growing steadily and rapidly, and the Internet and related service industry are innovating vigorously, which accelerates the speed of information flow, breaks geographical boundaries, promotes the more convenient and effective communication between talents and enterprises, and improves the efficiency of enterprises to match talents.

The sum of everything that's been staged so far, this thesis put forward Hypothesis 3: The interactive effect of the digital economy and the mismatch of labor supply and demand plays a positive role in promoting upgrading industrial structure.

5.1.2 Design of model

This paper incorporates the digital economy and the labor supply and demand mismatch into the industrial structure upgrading analytical framework. After the Hausmann test, the paper selects the time and individual two-way fixed effect model for estimation, and the benchmark regression model is constructed as follows:

$$TS_{i,t} = \alpha_0 + \alpha_1 lnS_{i,t} + \alpha_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.1)$$

$$TL_{i,t} = \beta_0 + \beta_1 lnS_{i,t} + \beta_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.2)$$

In equations, $TS_{i,t}$ represents the high level of upgrading of industrial structure in the city i in period t. $TL_{i,t}$ represents the general level of industrial structure rationalization and upgrading of the city i in period t. $S_{i,t}$ represents the mismatch index of labor supply and demand for the city i in period t. The vector

$Z_{i,t}$ represents a set of control variables. μ_i represents the individual fixed effect of the ith city that does not change with time; δ_t represents the fixed effect of control time; $\varepsilon_{i,t}$ represents the random disturbance term.

To further analyze the impact of the interaction between the digital economy and the mismatch of labor supply and demand on the upgrading of industrial structure, this paper introduces the interaction terms of the two based on the benchmark regression model:

$$TS_{i,t} = a_0 + a_1 lnS_{i,t} + a_2 lnDige_{i,t} + a_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.3)$$

$$TS_{i,t} = b_0 + b_1 lnS_{i,t} + b_2 lnDige_{i,t} + b_3 lnS_{i,t} \times lnDige_{i,t} + b_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.4)$$

$$TL_{i,t} = c_0 + c_1 lnS_{i,t} + c_2 lnDige_{i,t} + c_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.5)$$

$$TL_{i,t} = d_0 + d_1 lnS_{i,t} + d_2 lnDige_{i,t} + d_3 lnS_{i,t} \times lnDige_{i,t} + d_c Z_{i,t} + \mu_i + \delta_t + \varepsilon_{i,t} \quad (5.6)$$

To avoid the multicollinearity problem after the interaction term is introduced into the model, this paper first conducted centralized processing on the two variables of labor supply and demand mismatch ($\ln S$) and digital economy ($\ln Dige$)and then multiplied to obtain the interaction term ($\ln S \times \ln Dige$).

5.1.3 Variable and specification

5.1.3.1 Explained-variable

This paper incorporates the digital economy and the labor supply and demand mismatch into the industrial structure upgrading analytical framework. After the Hausmann test, the paper selects the time and individual two-way fixed effect model for estimation, and the benchmark regression model is constructed as follows:

(1) The advancement of industrial structure (TS)

Yonghui et al. (2016) believe that the change in the industrial ratio relationship and labor productivity improvement highlights the theoretical connotation of industrial structure upgrading. On the one hand, it refers to the sequential transformation of industrial structure from labor-intensive to capital-intensive and then to knowledge and technology-intensive industries. On the other hand, it is the continuous upgrading and innovation of traditional industrial production technology or the improvement of product technology content. Based on the existing literature and the availability of data on prefecture-level cities, this paper uses Hang (2022) practice for reference to calculate the industrial structure elevation level of the quality dimension by using the weighted product value of the share ratio of three industries and the labor productivity of each industry. The calculation formula is as follows:

$$TS = \sum_1^m y_{i,m,t} \times lp_{i,m,t}, \text{ m=1,2,3} \quad (5.7)$$

In equation 5.7, the $y_{i,m,t}$ represents the reportion of the m industry in the gross domestic product of region i in period t. $lp_{i,m,t}$ represents the labor productivity of industry m in region i during period t. So, the calculation formula is:

$$lp_{i,m,t} = {Y_{i,m,t}}\Big/{L_{i,m,t}} \quad (5.8)$$

In equation 5.8, $Y_{i,m,t}$ represents the added value of the m industry in period t of region i, $L_{i,m,t}$ represents the number of employed people in the m industry in region i, during the t period. In equation 4, the proportion of output value $Y_{i,m,t}$ has no dimension, while labor productivity $L_{i,m,t}$ has a dimension. Therefore, this paper adopts the method of averaging to carry out dimensionless processing on the industrial structure elevation index.

(2) The rationalization of industrial structure (TL)

Yonghui et al. (2016) believe that the change in the industrial ratio relationship and labor productivity improvement highlights the theoretical connotation of industrial structure upgrading. On the one hand, it refers to the sequential transformation of industrial structure from labor-intensive to capital-

intensive and then to knowledge and technology-intensive industries. On the other hand, it is the continuous upgrading and innovation of traditional industrial production technology or the improvement of product technology content. Based on the existing literature and the availability of data on prefecture-level cities, this paper uses Hang (2022) practice for reference to calculate the industrial structure elevation level of the quality dimension by using the weighted product value of the share ratio of three industries and the labor productivity of each industry. The calculation formula is as follows:

$$TL = \sum_1^m y_{i,m,t,} \ln\left(y_{i,m,t}/l_{i,m,t}\right), \text{m=1,2,3} \quad (5.9)$$

Therein, $l_{i,m,t}$ represents the weight of the employees in the m industry during t period in the total employment in region i.

The Thiel Index is a statistic primarily used to measure economic inequality and other economic phenomena, and is an important tool for analyzing regional differences in income levels. Theil index is used as an index to measure the degree of inequality, which is derived from the concept of entropy and discriminant information: the entropy of random variables is used to measure the average uncertainty of random trials, and the greater the entropy value, the greater the uncertainty of random variables. Through the decomposition of the Thiel index, the contribution of the intra-group gap and the inter-group gap to the total gap can be measured.

5.1.3.2 Core explanatory-variable the index of mismatch of labor supply and demand

Scholars have six methods to measure the mismatch of labor supply and demand: production function method, friction coefficient method, matching function method, benchmarking analysis (market index method), production frontier analysis method, cost function method, Etc. The production function method is adopted in this paper to learn from Shibin (Shibin Sheng, 1999), and the degree of mismatch between labor supply and demand is represented by the deviation degree of labor marginal output and the average wage of employees. The specific performance is as follows:

$$S = MPL_t \div w_t \quad (5.10)$$

Therein, MPL_t represents the marginal product of labor at time t, w_t represents the average salary of the employee in period t. The greater the value of S, the greater the deviation of labor marginal product from the average wage of employees.

5.1.3.3 Regulated-variable digital economy index (Dige)

To accurately measure the digital economy index of more than 200 prefecture-level cities, this paper draws on the practice of Tao(Tao Zhao, 2020), constructs the digital economy evaluation index system, and uses the entropy weight method to measure the digital economy index. In addition, concerning Jun et al.(Jun Liu, 2020), the development of the Internet is taken as the center of measurement, and the assumption of the construction of a digital transaction index system is added. Combined with the availability of relevant data at the city level, the development degree of the digital economy is comprehensively examined from the perspective of Internet development and digital inclusive finance. To measure the degree of Internet development at the city level, the experience of Qunhui et al. (2019), and four indicators are used, including the prevalence of the Internet, the situation of relevant practitioners, the relevant output, and the prevalence of mobile phones. The original data of the above indicators can be found in China City Statistical Yearbook. After standardizing these data, the index values of each region are obtained. For the development of digital financial inclusion, we adopt the China Digital Financial Inclusion Index (2020) jointly compiled by the Research Center for Digital Finance of Peking University and Ant Financial Services Group.

Table 5.1

Evaluation index system of the digital economy

The first-grade index	The second-grade index	The third-grade index	Attribute of index
Comprehensive development index of the digital economy	Internet penetration rate	Broadband internet access per 100 people	+
	Information of internet related employees	Proportion of employees in computer service and software industry	+
	Related output of internet	Total number of telecom services per capita	+
	Number of mobile internet users	Mobile phone subscriptions per 100 people	+
	Inclusive development of digital finance	Digital financial inclusion index of China	+

Note: From *Digital Economy, entrepreneurial Activity and Quality Development by Tao Zhao, Z. Z., Shangkun Liang, (2020). Empirical evidence from Chinese cities. Journal of Manage the world, 10, 12.*

In general, there are two kinds of weighting methods: the subjective weighting method and the objective weighting method. For the subjective weighting method, the corresponding weights are assigned to indicators according to the relative importance of indicators, such as principal component analysis (Jun Wang, 2018), Delphi, AHP, Etc. However, objective weighting methods are based on the original index information weighting, such as cluster analysis, standard deviation method, entropy method, and range method. Zhixiang (Zhixiang Xu, 2019) believes that the subjective weighting method has the risk of being influenced by subjective people and is biased in the index weight assignment, so it cannot reflect the index composite index well. Therefore, after careful consideration, to avoid the inaccurate index measurement caused by subjective weighting, this paper adopts the approach of Jun (2018) and uses the objective weighting-entropy method to assign weights to indicators.

The entropy weight method has the following steps in the calculation of digital economy indicators of prefecture-level cities:

Step one: Standardize metrics. Because of the different index units, the index data must be standardized. All the indicators are positive in the index system constructed in this study. The standardization process for positive indicators is as follows:

$$Z_{ij}=\frac{X_{ij}-Min\{X_{1j},X_{2j},\ldots X_{nj}\}}{Max\{X_{1j},X_{2j},\ldots X_{nj}\}-Min\{X_{1j},X_{2j},\ldots X_{nj}\}},\ i=1,\ldots n,\ j=1,\ldots k \quad (5.11)$$

In equation 5.11, Z_{ij} represents the index value after standardization of index j in region i, X_{ij} represents the original value of index j in region i, $Min\{X_{1j},X_{2j},\ldots X_{nj}\}$ represents the minimum value of the original j index value in all regions, represents the maximum value of the original j index value in all regions.

Step two: Determine the weight of each indicator. Calculate the specific gravity P_{ij} after standardization of each index

$$P_{ij}=\frac{Z_{ij}}{\sum_1^n Z_{ij}},\ i=1,\ldots,n,\ j=1,\ldots,k \quad (5.12)$$

Calculate the information entropy $E_j$of the index:

$$E_j=-\frac{1}{\ln n}\sum_{i=1}^{n}P_{ij}\ln(P_{ij}),j=1,\ldots,k \quad (5.13)$$

Calculate the redundancy D_j of information entropy:

$$D_j=1-E_j,j=1,\ldots,k \quad (5.14)$$

Calculate the weight W_j of each indicator:

$$W_j=\frac{D_j}{\sum_{j=1}^{k}D_j},j=1,\ldots k \quad (5.15)$$

Step three: To calculate the comprehensive score and scores of each dimension, the comprehensive score calculation formula is:

$$T_i=\sum_{j=1}^{k}W_j\,Z_{ij},\ i=1,\ldots n,\ j=1,\ldots,k \quad (5.16)$$

Finally, the weighted summation of the secondary indicators belonging to each dimension according to Equation (5.16) can obtain the indicators of each dimension.

5.1.4 Control variable

To comprehensively analyze the role of labor mismatch in upgrading industrial structure, it is necessary to set control variables that may affect the upgrading of industrial structure. Concerning the methods of relevant issues in existing literature, seven control variables are selected in this paper for data availability in prefecture-level cities.

Economic development level (grow). On the one hand, the rise of per capita income will lead to the transfer of labor force among the three industries, impacting the development of the industrial structure. On the other hand, in the specific stage of social and economic development, the whole economic structure will be more and more "service-oriented." At the same time, the demand for the high-tech industry will gradually increase, thus promoting the upgrading of industrial structure. This paper takes the GDP growth rate as the measure of economic development level.

Foreign investment (FDI) uses foreign direct investment through the transfer of science and technology, capital, and others to enhance their resource allocation ability and effectively promote their industrial structure upgrading level. However, on the other hand, Yuanhai et al.(Yuanhai Fu, 2018) proposed that foreign direct investment hinders technology spillover and whether it is reasonable to impact the domestic industrial structure because foreign direct investment is mainly concentrated in the secondary industry. Therefore, the role of foreign direct investment in China's industrial structure is uncertain, but it is the most important factor affecting the upgrading degree of China's industrial structure. In this paper, the level of foreign investment is expressed by the ratio of actual utilization of foreign investment to regional gross domestic product.

Government intervention (gov), on the one hand, the government industrial policy will promote or restrict the development of a particular industry in the region and then have an impact on the whole industrial structure; On the other hand, the government's macro-control behavior will directly guide the direction of industrial structure upgrading. Therefore, the proportion of local government fiscal

expenditure in the gross regional product represents the degree of government intervention.

Human capital level (hum). According to Qiwen et al. (Qiwen Dai, 2007), an increase of one percentage point in the growth rate of human capital level will accelerate the rate of industrial structure upgrading by 1.5 percentage points in the next three years. Haiyin (Zhou, 2014) pointed out that the improvement of the human capital level plays an important role in the upgrading of industrial structure and the increase of the proportion of the service industry. In recent years, most relevant studies measured the urban human capital level by the proportion of college students. Referring to the practice of scholars, this paper takes the proportion of the general higher education population (including the general undergraduate and junior college) in the total resident population of each region as an index to measure the level of urban human capital.

The level of investment in fixed assets (invest), Xiulin (Geng, 2010) through the activities of building and acquiring fixed assets, the national economy continues to use advanced technology and equipment to develop and establish new industries, to further adjust the economic structure. To optimize and promote the industrial structure, it is necessary to combine the overall social and economic development plan and focus on supporting some key industries. In this process, a good arrangement of fixed asset investment is a very important factor. In this paper, the ratio of fixed assets investment to gross regional product is taken as a measure index.

Financial development level (fin), the level of financial development will affect the cost of industrial financing and then affect the upgrading of the industrial structure. This paper expresses the institutional deposits and loans ratio to a gross regional product.

Infrastructure level (infra), whether the infrastructure within the region is sound, reflects whether the economic development between regions is close. The higher the level of infrastructure development, the more effectively it can enhance the development connection of various industries within the region and other regions to use resources efficiently, rationally allocate production factors, enhance the coupling degree between industries, and promote the upgrading level of industrial

structure. This paper refers to the practice of Guoqiang (Zheng, 2021), and the level of infrastructure is represented by per capita road area.

5.2 Descriptive statistics

In this paper, Chinese cities were selected as research samples. Due to the availability and completeness of data, 277 cities at the prefecture level and above were selected as research samples in the last nine years, from 2011 to 2019, with 2,472 observations or more.

Table 5.2

The results of descriptive statistics

Variable	Number of observations	Mean	Variance	Min	Median	Max
TS	2502	6.5188	0.346	5.52	6.50	7.84
TL	2511	0.2745	0.196	0.00	0.24	1.72
lnS	2472	3.1966	0.951	0.87	3.11	6.95
lnDige	2510	-2.4756	0.484	-4.58	-2.46	-0.20
gov	2511	0.1991	0.101	0.04	0.17	0.92
hum	2502	1.7524	2.029	0.01	1.03	12.76
invest	2506	0.0001	0.000	0.00	0.00	0.01
infra	2511	17.2205	7.179	0.00	15.79	60.07
fin	2511	1.4308	0.711	0.37	1.29	20.10
grow	2509	8.6478	4.211	-19.38	8.30	109.00
FDI	2511	0.0212	0.060	0.00	0.01	1.28

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China,(2020).

5.3 Reference regression results and analysis

5.3.1 Empirical results and analysis of labor supply and demand mismatch industrial structure upgrading

Table 5.3

The estimation result of labor supply and demand mismatch of industrial structure is advanced and rationalized

	(1)		(2)	
	TS	TS	TL	TL
lnS	-0.0173***	-0.0164**	0.1422***	0.1443***
	(-2.6548)	(-2.5149)	(15.1657)	(15.4453)
grow		-0.0003		-0.0001
		(-0.5805)		(-0.2359)
FDI		0.0540		-0.0877**
		(0.6028)		(-1.9871)
hum		0.0010		0.0061*
		(0.1630)		(1.6749)
gov		0.0951		0.3246***
		(0.8936)		(4.6710)
invest		1.6282		4.0075
		(0.1534)		(1.2895)
fin		0.0066		0.0161***
		(1.4777)		(5.0752)
infra		0.0016		-0.0007
		(1.6430)		(-1.2202)
_cons	6.4193***	6.3697***	-0.1842***	-0.2607***
	(302.1542)	(196.6101)	(-6.5432)	(-8.3573)
Urban fixed	YES	YES	YES	YES
Time fixed	YES	YES	YES	YES
Number of cities	2463	2458	2472	2467
Number of periods	9	9	9	9
R^2	0.741	0.743	0.488	0.513

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020).

In Table 5.3, the regression results before and after adding control variables are listed respectively. It can be seen that the mismatch coefficient of labor supply and demand is relatively significant before and after the addition of control variables. Moreover, the labor supply and demand mismatch industrial structure upgrading coefficient is significantly negative, indicating that the labor supply and demand mismatch industrial structure upgrading has a restraining effect. However, the rationalization coefficient of industrial structure is significantly positive when the mismatch of labor supply and demand is mismatched. Since the Thiel index of industrial structure rationalization in this paper is a negative indicator, when the rationalization coefficient of industrial structure is positive, it indicates that the

mismatch of labor supply and demand significantly inhibits the rationalization of industrial structure. The above verifies hypothesis 1 and hypothesis 2 in this paper.

5.3.2 The test of the adjustment effect of digital economy on the upgrading of industrial structure

Table 5.4

The results of estimating the adjustment effect of digital economy on the upgrading of industrial structure

	(1)	(3)	(4)
	TS	TS	TS
lnS	-0.0164**	-0.0173***	-0.0401***
	(-2.5149)	(-2.6786)	(-4.5124)
lnDige		-0.2288**	-0.2912***
		(-2.2013)	(-2.8529)
lnS×lnDige			0.0039***
			(3.7093)
grow	-0.0003	-0.0002	-0.0002
	(-0.5805)	(-0.5158)	(-0.4422)
FDI	0.0540	0.0510	0.0732
	(0.6028)	(0.5814)	(0.7407)
hum	0.0010	0.0009	0.0002
	(0.1630)	(0.1365)	(0.0250)
gov	0.0951	0.0799	0.0821
	(0.8936)	(0.7476)	(0.7841)
invest	1.6282	0.6690	0.9592
	(0.1534)	(0.0638)	(0.0922)
fin	0.0066	0.0061	0.0059
	(1.4777)	(1.4365)	(1.4900)
infra	0.0016	0.0015	0.0015
	(1.6430)	(1.5728)	(1.6135)
_cons	6.3697***	6.3879***	6.4572***
	(196.6101)	(190.4565)	(170.1177)
Urban fixed	YES	YES	YES
Time fixed	YES	YES	YES
Number of cities	2458	2458	2458
Number of periods	9	9	9
R^2	0.743	0.744	0.748

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020).

It can be seen that after adding the digital economy as an instrumental variable, the mismatch coefficient of labor supply and demand is still obvious and does not change much. After further addition of the two interaction terms, it can be seen that the mismatch of labor supply and demand is still significantly

negative, and the coefficient of the interaction term is significantly positive, and the coefficient of the interaction term is opposite to the mismatch coefficient of labor supply and demand, and the $R^2$is significantly increased, which explains the influence of digital economy on the mismatch of labor supply and demand and the upgrading of industrial structure, that is, hypothesis 3 of this study is verified.

5.3.3 The test of the adjustment effect of digital economy on the rationalization of industrial structure

Table 5.5

The results of estimating the regulatory effect of digital economy on the rationalization of industrial structure

	(2)	(5)	(6)
	TL	TL	TL
lnS	0.1443***	0.1451***	0.1597***
	(15.4453)	(15.6473)	(12.3764)
lnDige		0.2188***	0.2589***
		(3.0012)	(3.6279)
lnS×lnDige			-0.0025**
			(-1.9998)
grow	-0.0001	-0.0002	-0.0002
	(-0.2359)	(-0.3095)	(-0.3600)
FDI	-0.0877**	-0.0848**	-0.0990**
	(-1.9871)	(-2.0230)	(-2.2090)
hum	0.0061*	0.0062*	0.0067*
	(1.6749)	(1.7186)	(1.9151)
gov	0.3246***	0.3390***	0.3376***
	(4.6710)	(4.8059)	(4.7324)
invest	4.0075	4.9233	4.7388
	(1.2895)	(1.6214)	(1.5988)
fin	0.0161***	0.0165***	0.0166***
	(5.0752)	(4.8925)	(4.6094)
infra	-0.0007	-0.0006	-0.0007
invest	4.0075	4.9233	4.7388
	(-1.2202)	(-1.0790)	(-1.1095)
_cons	-0.2607***	-0.2780***	-0.3225***
	(-8.3573)	(-8.6114)	(-7.7927)
Urban fixed	YES	YES	YES
Time fixed	YES	YES	YES
Number of cities	2467	2467	2467
Number of periods	9	9	9
R^2	0.513	0.516	0.521

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China (2020).

Before and after the addition of digital economy variables, the mismatch coefficient of labor supply and demand does not change significantly and is significantly positive. After the two interaction terms are added, their R^2 increases

significantly, and the coefficient of the interaction term is opposite to the mismatch coefficient of labor supply and demand, indicating that the digital economy also significantly weakens the mismatch of labor supply and demand and inhibits the rationalization of industrial structure, that is, hypothesis 4 of this study is verified.

5.4 Heterogeneity analysis

Significant differences exist in resource endowment characteristics between different regions and city levels in China. Therefore, industrial structure upgrading affected by digital economy and labor supply and demand mismatch varies by region, this paper analyzes the impact of industrial structure upgrading from the perspective of geographical location. Referring to Bai Junhong (2018), 277 prefecture-level cities in China are divided into three regional cities, namely eastern city, central city and western city, and the empirical research is conducted in groups. The impact on industrial structure upgrading is explained in two parts, with the results shown in Table 5.6 and Table 5.7.

5.4.1 The analysis result of heterogeneity analysis of industrial structure advancement

It can be seen that there is a significant difference between the mismatch of labor supply and demand and the upgrading of industrial structure among different regions. The mismatch coefficient of labor supply and demand in eastern and central regions is not obvious, while in western regions, the mismatch coefficient of labor supply and demand is significantly negative, indicating that in western regions, the mismatch of labor supply and demand inhibits the upgrading of industrial structure more significantly. The reason may be that the mismatch of labor supply and demand in the western region is serious, and the industrial structure in the western region is backward, and it is still mainly concentrated in labor-intensive industries, resulting in the mismatch of labor supply and demand and hindering the upgrading of industrial structure. In the eastern and central regions, the mismatch of labor supply and demand has no obvious effect on the upgrading of industrial structure. The possible reason is that the mismatch of labor supply and demand in the eastern and central regions is

lighter than that in the western regions. The mismatch of labor supply and demand in the eastern and central regions can be compensated by capital, so its influence coefficient on the upgrading of industrial structure is smaller than that in the western regions.

As for the regulatory role of the digital economy, it can be seen that it is more significant in the central and western regions, and it is not obvious in the eastern region, indicating that the regulatory effect of the digital economy in the central and western regions is more conducive to the upgrading of the industrial structure. Perhaps because the development of the digital economy in the central and western regions is still in the initial stage, the coverage of the digital economy is not wide enough, so with the development of the digital economy in the future, the regulatory role will play a more powerful effect. The digital economy in the eastern region has been well developed, and it is more necessary to promote the development of the digital economy in the central and western regions, so that it can play a greater role in regulation.

Table 5.6

The analysis result of heterogeneity analysis of industrial structure advancement

	East		Central		West	
	TS	TS	TS	TS	TS	TS
lnS	-0.0035	-0.0158	-0.0130	-0.0461***	-0.0280**	-0.0627***
	(-0.4322)	(-1.2151)	(-1.3920)	(-3.9814)	(-2.0583)	(-3.3812)
lnDige		0.0080		-0.5117*		-0.3659
		(0.0956)		(-1.8139)		(-0.8372)
lnS×lnDige		0.0018		0.0071***		0.0054***
		(1.5475)		(3.1792)		(2.7605)
Control variable	YES	YES	YES	YES	YES	YES
Urban fixed	YES	YES	YES	YES	YES	YES
Time fixed	YES	YES	YES	YES	YES	YES
Number of cities	966	966	918	918	529	529
Number of periods	9	9	9	9	9	9
R^2	0.730	0.731	0.813	0.820	0.739	0.748

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020).

5.4.2 The analysis results of the heterogeneity of rationalization of industrial structure

It can be seen that the mismatch coefficients of labor supply and demand in the three regions are obviously positive. In the eastern region, it shows that the mismatch of labor supply and demand in the western region is stronger than other regions in inhibiting the rationalization of industrial structure, and it also shows that the western region is dominated by labor-intensive industries, and the mismatch of labor supply and demand has a greater impact on inhibiting the upgrading of industrial structure in the western region. In the eastern and central regions, the mismatch of labor supply and demand also plays a significant role in the rationalization of industrial structure, indicating that all regions should pay attention to the negative effects of labor mismatch.

The adjustment effect played by the digital economy is also in it, and the western region's coefficient is obviously negative, which explains that the digital economy is developing, and the western region can play an inhibitory role in regulating, weakening the mismatch of labor supply and demand, and inhibiting the rationalization of industrial structure. However, in the eastern region, its regulatory effect is not obvious, and the reasons are similar to the above, indicating that the digital economy's regulatory effect on the economy is better in the regions where the mismatch of labor supply and demand is more serious and the level of digital economy is lower.

Table 5.7

The analysis results of the heterogeneity of rationalization of industrial structure

	East		Central		West	
	TL	TL	TL	TL	TL	TL
lnS	0.1190***	0.1207***	0.1363***	0.1584***	0.1925***	0.2301***
	(11.9719)	(8.7353)	(10.9496)	(7.8721)	(6.6365)	(6.2288)
lnDige		0.0643		0.3993**		1.0605**
		(0.8572)		(2.4226)		(2.1009)
lnS×lnDige		-0.0002		-0.0048**		-0.0052*
		(-0.1594)		(-2.1974)		(-1.8334)
Control variable	YES	YES	YES	YES	YES	YES
Urban fixed	YES	YES	YES	YES	YES	YES

Table 5.7

The analysis results of the heterogeneity of rationalization of industrial structure (cont.)

Time fixed	YES	YES	YES	YES	YES	YES
Number of cities	975	975	918	918	529	529
Number of periods	9	9	9	9	9	9
R^2	0.500	0.500	0.613	0.628	0.531	0.558

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020).

5.5 Endogeneity test

Endogeneity problems are caused by a variety of factors, such as missing variables, measurement errors, and mutual causation. This study addresses the endogeneity problem in the following ways:

Endogeneity caused by measurement errors. In terms of data sources, data from the National Bureau of Statistics were selected. At the same time, a comprehensive index system for the development level of the digital economy was constructed, and entropy weight method was used to measure the development level of the digital economy, so as to reduce the impact of data quality on the estimation results.

Endogeneity caused by missing variables. In this paper, seven variables including economic development level, foreign investment level, government intervention, human capital level, fixed investment level, financial development level and infrastructure are included in the estimation process of the econometric model, and the individual and time two-way fixed effect model is used for regression analysis.

The endogeneity brought about by mutual causation is examined.In this paper, we refer to the approach of Guo Jiatang and Luo Piliang (2016) to deal with the endogenous problem. First, the logic of regression with explanatory variable lag time (DLS) as the core is that the explained variable in the current period is less affected by the lag time of explanatory variable. If the lag time of explanatory variable and the explained variable in the current period still has the corresponding relationship with the explained variable in the previous analysis, it can be shown that the result is robust.

Second, the regression of the explanatory variables of the current period is carried out by taking the explanatory variables of the lag period as the instrumental variables, and the result has no significant change compared with the above.

Table 5.8
Endogeneity test results

	TS	TS	TS	TS
DLS	-0.0054	0.0568*	0.3707***	-0.0570*
	(-0.1615)	(1.7400)	(5.5176)	(-1.9420)
lnS		-0.0217***		0.1496***
		(-3.0058)		(13.8340)
Control variable	YES	YES	YES	YES
Urban fixed	YES	YES	YES	YES
Time fixed	YES	YES	YES	YES
Number of cities	2458	2458	2467	2467
Number of periods	9	9	9	9
R^2	0.741	0.743	0.138	0.514

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020)

5.6 Robustness test

One of the robustness test methods in this paper is the substitution treatment of explained variables.

As for the replacement of industrial structure upgrading, Hong et al. (Hong Fu, 2013), Lamping et al.(Lanping Wang, 2020) use the industrial structure hierarchy coefficient to measure China's industrial structure upgrading. From the perspective of the evolution law of industrial structure, the proportion of the primary industry in the gross domestic product gradually decreases. In contrast, the proportion of secondary and tertiary industries gradually increases. Among them, the proportion of the tertiary industry has increased significantly. Weights 1, 2, and 3 are assigned to the three industries according to the level of "primary industry, secondary industry, and tertiary industry" Then, the output value after weighting is summed up. The specific calculation formula is as follows:

$$TSS = \sum_{1}^{m} Y_{i,m,t} \times m, \qquad m = 1,2,3 \tag{5.17}$$

For the replacement of industrial structure rationalization, this paper chooses Ando&Nassar (Nassar, 2017) practice to measure industrial structure rationalization. This measurement method can avoid subjective weight assignment, and take departmental productivity as the entry point to better measure the deviation degree of industrial structure and cross-time and cross-region comparison. It takes employment share and output share as the core to measure the distortion of industrial structure. Based on the definition of Euclidean distance proposed, the rational calculation formula of industrial structure in this paper is introduced, specifically as follows:

$$d_i = \frac{L_1}{L} - \frac{Y_1}{Y}, \text{TLL}=\sqrt{\sum_{the\ 1}^{n} {d_i}^2} \qquad (5.17)$$

In equation 5.18, d_i represents the gap between the employment share and the output share of sector i, while TLL is the Euclidean distance between the value-added share and the employment share of the whole economy, which is also the replacement index of the rationalization index of the industrial in this study. Similar to the Theil index, this index is also negative. The robustness test results of replacing the explained variables are shown in Table 5.9, which is consistent with the previous results, indicating that the estimated results are robust.

Table 5.9

Robustness test results: Replacement of explained variables

	(1)	(2)
	TSS	TLL
lnS	-0.0073**	-0.9285***
	(-2.5895)	(-2.8219)
_cons	2.2236***	-8.7943***
	(154.1109)	(-7.5375)
Control variable	YES	YES
Urban fixed	YES	YES
Time fixed	YES	YES
Number of cities	2467	2467
Number of periods	9	9
R^2	0.773	0.164

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China, (2020).

Table 5.10

Robustness test results: Tail shrinkage treatment

	(1)	(2)
	TS	TL
lnS	-0.0158**	0.1388***
	(-2.3850)	(18.5641)
cons	6.3686***	-0.2464***
	(197.0397)	(-9.0127)
Control variable	YES	YES
Urban fixed	YES	YES
Time fixed	YES	YES
Number of cities	2458	2467
Number of periods	9	9
R^2	0.756	0.553

Note: From *China Statistical Yearbook,* by Bureau of Statistics of China,(2020).

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

The fifth chapter summarizes the research situation of this paper, and puts forward some policy suggestions according to the research.

6.1.1 Summary of the theory

This paper studies the impact of the digital economy, labor supply, and demand mismatch on industrial structure upgrading in China. Firstly, it compares the relevant literature studies of domestic and foreign scholars; after that, it explores the mechanism of the impact of the digital economy, labor supply, and demand mismatch on industrial structure upgrading; secondly, it uses statistical data to analyze the current situation and problems in China; then it uses prefecture-level city panel data to test and analyze the mechanical hypothesis in the previous paper.In summary, the main findings of this paper are summarized as follows.

First, China's labor supply and demand mismatch inhibits industrial structure upgrading. On the one hand, the mismatch of labor supply and demand directly inhibits industrial structure upgrading. The advantages of labor resource endowment should be given full play, which hinders the improvement of industrial productivity, affects the normal economic activities among industries, and harms the industrial structure upgrading. On the other hand, the mismatch of labor supply and demand also significantly inhibits the rationalization of industrial structure. The mismatch of labor resources inhibits the accumulation of human capital, thus inhibiting the generation of knowledge spillover effect. The mismatch of labor impedes the free flow of labor, widening the distance between the knowledge spillover receiving place and the knowledge spillover place. Thus, the knowledge spillover effect is hindered, labor resources need to be fully utilized, and the industry harms the rationalization of industrial structure.

Second, the development of China's digital economy has played an indispensable role in promoting the upgrading industrial structure. On the one hand, the digital economy has a direct role in promoting the advanced industrial structure. The penetration of the digital economy in terms of coverage and high efficiency effectively enhances production efficiency and reduces production costs, promoting the advanced industrial structure. On the other hand, the digital economy has no apparent direct impact on rationalizing industrial structure, but it has a significant moderating effect. By integrating resources and improving the efficiency of resource allocation, the digital economy effectively weakens the inhibiting effect of labor supply and demand mismatch on industrial structure upgrading. At the same time, it also indicates that the development of China's digital economy is still in its primary stage, and the effect of the digital economy in promoting resource allocation and industrial integration has not yet been fully released, resulting in the digital economy not having a significant direct role in promoting the rationalization of industrial structure.

Third, the interactive effect of China's digital economy and labor supply and demand positively impacts promoting industrial structure upgrading. On the one hand, the interaction effect between the digital economy and labor supply and demand has a significant positive effect on industrial structure upgrading, which strengthens the promotion effect of the digital economy on industrial structure upgrading and weakens the inhibiting effect of labor supply and demand mismatch on industrial structure upgrading. On the other hand, the interaction effect of the digital economy and labor supply and demand significantly inhibits the rationalization of industrial structure, which significantly weakens the influence of labor supply and demand mismatch on the rationalization of an industrial structure under the regulation of the digital economy. It indicates that the effects of human capital enhancement, capital substitution for labor, and employment creation generated by the mismatch between the digital economy and labor supply and demand can effectively improve the efficiency of human resource allocation, innovate science and technology, develop modern production models and improve productivity, and thus promote the upgrading of industrial structure.

Fourth, the degree of digital economy development and labor supply-demand mismatch varies significantly among regions in China, and their effects on industrial structure upgrading vary. From the analysis of the current situation, we can find that the degree of digital economy development in China is: Eastern China > Central China > Western China. In contrast, the degree of mismatch between labor supply and demand is Western China > Eastern China > Central China. The empirical analysis can find that, except for the Western region, the digital economy indexes of both east and central China have a significant promotion effect on the advanced industrial structure, which indicates that the weak degree of digital economy development in the Western region cannot play the role of the digital economy on the development of industries in the western region, resulting in the insignificant effect of the digital economy in the western region. Furthermore, the digital economy indexes of all regions are insignificant to rationalizing industrial structure for reasons similar to those mentioned above. As for the mismatch of labor supply and demand, except for the central region, the mismatch of labor supply and demand in both the eastern and western regions has a significant inhibitory effect on the advanced industrial structure, indicating that the higher the degree of mismatch of labor supply and demand, the stronger the inhibitory effect on the advanced industrial structure in that region. Moreover, labor supply and demand mismatch in the three regions significantly inhibit industrial structure rationalization, indicating that labor supply and demand mismatch significantly negatively impacts industrial structure upgrading. However, its impact on industrial structure rationalization is more substantial.

6.2 Recommendation for policy

This paper proposes relevant policy implications for the above findings, hoping to play a beneficial role in developing China's digital economy, labor supply and demand mismatch problem, and industrial structure upgrading.

First, since industrial structure upgrading has a strong inertia, it is necessary to take a long-term perspective on the layout of the industrial structure. On the one hand, to ensure the stable development of the central productivity of industrial

development, local governments need to focus not only on economic quantity but also on economic quality, pay attention to the balance of long-term and short-term benefits, focus on cultivating advanced industries, and promote sustainable industrial development. Increase support for education and R&D, continuously improve research and development capabilities, and enhance the intrinsic power of industrial structure optimization and upgrading. On the other hand, when implementing expansionary fiscal policies and industrial adjustment and revitalization plans, we insist on economic development and employment expansion at the same time, prioritize industries and projects with solid employment absorption capacity in various investment and preferential policies, and encourage and support better development of labor-intensive industries and non-public economy.

Second, due to the unique nature of labor force elements, the government must pay attention to the balance of labor supply and demand. On the one hand, it should expand the scale of employment, strengthen the monitoring of employment and unemployment situation, and all departments and local governments at all levels should reduce the urban unemployment rate in response to the changes in the employment situation and keep employment growing in tandem with the economy. On the other hand, to adapt to China's industrial transformation and upgrading, the employment structure should be adjusted accordingly, improve the quality of labor supply, increase the supply of scarce talents, and match the industrial labor demand. From the education level, higher education institutions should be encouraged to expand the recruitment of scarce professional talents, encourage students to innovate and start businesses and contact new industries, broaden the employment channels of talents, and solve the employment problems for college graduates. From the enterprise level, we encourage enterprises to innovate, introduce new technologies, expand the scale of enterprises, increase profits, create more jobs, and solve the unemployment problem.

Third, give full play to resource integration and distribution of the digital economy to drive the rationalization of industrial structure. On the one hand, promoting the deep integration of digital technology and the real economy makes each step of the industrial chain more refined, the division of labor and coordination more efficient, improves production efficiency, reduces the flow of goods, saves sales costs,

promotes the efficient exchange of product information, improves production efficiency and accuracy, and makes the industry develop toward intelligence and digitalization. The use of network technology and network platform can pool the capital, talents, elements, and other resources in society, reduce the idleness and waste of resources, combine various traditional industries with modern industries for development with the help of digital technologies such as VR and CR, and promote the rationalization of industrial structure.

Fourth, optimize the regional development pattern of the digital economy, promote the coordinated development of the digital economy, pay attention to the heterogeneous impact of the digital economy on the optimization and upgrading of industrial structure, and do planning according to local conditions. First, the government needs to do an excellent job of planning in an integrated manner. In the western region, where the development of the digital economy is lagging, it should strengthen and improve the relevant infrastructure; in the eastern region, where the digital economy is more developed, it should guide the digital economy to overcome difficulties in technology and compete with international outstanding digital enterprises. In the central and northeastern regions, it should actively use the higher marginal rewards of the digital economy at this stage to develop industries.

Fifth, emphasis should be placed on regional talent resource allocation to promote coordinated regional development. Consideration can be given to transferring some labor-intensive industries in the central region to the central and western regions so that the labor resources in the three regions can converge to a balanced state. For the central region, it can look to the eastern region to build some high-tech industries while attracting innovation subjects with various preferential policies and establishing effective mechanisms to encourage and support the technological R&D activities of enterprises to optimize the distribution of innovation resources. For the remote areas in the West, first, it can give full play to its comparative advantages, vigorously develop primary industries and build high-tech agricultural production industries. This way, on the one hand, it can improve the modernization level of agriculture; on the other hand, it can transfer some labor resources out of the agricultural sector to engage in other jobs. Second, it can fully use its natural resource advantages to build industrial clusters with regional characteristics, such as vigorously developing tourism, building

pure green food processing plants, and other industries that can give full play to its strengths, thus driving the industrial development of the region. Accelerate the development of regional economic synergy and narrow the gap of economic development among regions.

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