

A Review of Research on the Employment Effects of China's Digital Economy

-- Based on LDA Thematic Modeling

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Abstract

The development of digital economy has profoundly affected the scale, structure and quality of employment in China. Academic research around the employment effect of digital economy is increasing, but related studies are scattered and have not yet formed a clear research framework. In this paper, we take 94 Chinese literatures on the employment effect of China's digital economy as the research object, aggregate 14 research themes based on the LDA thematic model, and identify four main research contents, namely, characterization, antecedents, influence mechanism and effect results, by combining manual coding and the LDAvis visualization tool. Based on this, a comprehensive research framework on the employment effects of China's digital economy is constructed, and possible future research directions are pointed out in order to promote the development of related research.

Keywords

Digital economy, employment effects, thematic model, research framework, literature review.

1. Introduction

In recent years, digital technologies such as artificial intelligence, big data, and cloud computing have been constantly updated, and China's digital economy has ushered in a period of booming development. In 2023, the added value of China's core industries of digital economy (digital product manufacturing, digital product services, digital technology application, and digital factor-driven industries) is estimated to exceed 12 trillion yuan, accounting for about 10% of the gross domestic product (GDP), and becoming an important engine of economic development.

The development and growth of the digital economy has led to the transformation of "Made in China" to "Made in China", giving rise to a large number of new industries, new business forms and new modes, and bringing new opportunities for employment[1]. From April 2019 to May 2024, China's Ministry of Human Resources and Social Security, together with the General Administration of Market Supervision and Administration and the National Bureau of Statistics, released six batches of 93 new occupations, which include professional and technical personnel such as AI engineers and technicians, big data engineers and technicians, as well as social production and life service personnel such as Internet marketers and network anchors. These new employment opportunities spawned by the development of the digital economy have had a profound impact on the scale, structure, and quality of employment in China, triggering increasing attention and discussion in the academic community[2].

According to existing research, Tapscott[3]earlier mentioned the link between the "digital economy" and "employment", pointing out that computers and the Internet are creating high-paying jobs. In the 21st century, the accelerated innovation and application of digital technologies, such as artificial intelligence, big data and cloud computing, have promoted changes in production methods, industrial structure and business models, triggered changes in employment carriers, employment patterns and employment skills, and reshaped the job market[4]. Focusing on the theme of "employment effect of digital economy", existing studies mainly focus on the "quantity" and "quality" dimensions of employment, covering three aspects: employment scale, employment structure and employment quality. It covers three aspects: employment scale, employment structure and employment quality. In terms of employment scale, there are mainly three views on substitution effect[5], compensation effect and creation effect[6]; in terms of employment structure, there are mainly three views on employment quality from the perspective of industrial structure[7], skill structure[8], and gender structure[9].perspectives to explore the impact of the digital economy on the employment structure; in terms of employment quality, it emphasizes the working hours, salary income, rights and interests of workers, and job matching. Although a series of results have been achieved in the research related to the employment effect of digital economy, the research perspectives, influence mechanisms, antecedents and consequences have been scattered, resulting in the lack of clarity of the core research themes and the lack of a systematic research framework in the research on the employment effect of digital economy.

Based on this, this paper combines machine learning and manual coding to minimize the interference of human factors, systematically combs through the existing research literature on the employment effects of China's digital economy, and tries to construct a comprehensive research framework on the employment effects of China's digital economy, with a view to providing reference for future related research. Specifically, first, the existing research literature on the employment effect of China's digital economy is systematically collected and sorted out, and data preprocessing is carried out; second, 14 research themes are identified by applying the LDA (Latent Dirichlet Allocation) thematic model, and four categories of research content are identified by combining manual coding and thematic visualization mapping to refine the "Once again, we systematically sort out the relevant literature on the employment effect of China's digital economy around the characterization, antecedents, influence mechanisms and results of the employment effect of China's digital economy, and integrate and refine the comprehensive research framework; finally, we summarize and draw conclusions from the research, pointing out the limitations of the research on the employment effect of China's digital economy. Finally, it summarizes the research conclusions and points out the research limitations of the employment effect of China's digital economy and the future research prospects.

2. Theme Identification of LDA-based Studies on the Employment Effects of the Digital Economy

2.1. Research Methodology Combining Thematic Modeling and Manual Coding

In this paper, a combination of LDA topic modeling and manual coding is used to identify research topics on the employment effects of China's digital economy. LDA topic modeling is one of the popular topic models in the current field of management, which contains three levels: words, topics, and documents.LDA topic modeling is used to accurately and quickly cluster the text corpus through unsupervised learning algorithms and to identify potential topics, reducing human intervention and subjective presuppositions of researchers[10]; at the same time, compared with purely manual coding methods such as content text analysis and rootedness theory, the LDA topic model can dramatically improve research efficiency and accuracy.

However, the LDA topic model assumes that the topics obey the Dirichlet distribution, and the topics are independent of each other, ignoring the correlation between different topics and the temporal attributes of the text. Therefore, the keywords refined by the LDA topic model are encoded into more abstract and academic first-order and second-order topics through manual coding, so as to analyze the correlations among different topics and to have a continuous dialogue with the existing theories.

2.2. The Process of Identifying Themes in the Study of the Employment Effects of the Digital Economy

According to the process of analyzing topic models in management studies proposed by Hannigan et al. [11], this paper studies the topic identification process which mainly includes the following three stages: first, data collection and preprocessing stage, this stage is to define and screen the boundaries and contents of the text corpus, which will be used as the input data for topic modeling; second, topic generation stage, in which the LDA algorithm is applied to automatically identify the optimal number of topics in the text corpus and construct a topic model; third, topic presentation and manual coding stage, in which the results obtained based on the LDA topic model are combined with existing theories to be manually coded to realize topic classification.

2.2.1. Data Collection and Pre-processing

In this paper, the core database of CNKI (China Knowledge Information Network) was used as the literature search database, and "new occupation", "occupation" and "employment" were combined with "digital economy" as the subject terms for advanced search (precise). Combining "new career", "career" and "employment" with "digital economy" as subject terms for advanced search (precise), the scope of literature search was set as "academic journals", and the category of literature source was set as "Beida Core", CSSCI (Chinese Social Science Citation Index), CSSD (Chinese Science Citation Database), AMI (Chinese Humanities and Social Sciences Journal Comprehensive Evaluation Index System). According to China's restart of new career release in 2019, the literature search timeframe was set to 2019-2024 (as of July 20, 2024), and a total of 888 Chinese-language documents were retrieved. Twenty-three irrelevant documents such as no author, table of contents, conference review, withdrawn manuscript, column host language, news reports and reviews, and special reports were manually eliminated, as well as 113 duplicated documents. So far, a total of 752 Chinese literatures were collected.

First, data collection. In the first round of screening, a research team consisting of three faculty members and graduate students in the field of management studies initially excluded the literature that had nothing to do with the research question of "the employment effect of China's digital economy" (e.g., vocational education, etc.) by reading the titles, abstracts, and some of the research conclusions, and then screened out a total of 139 articles in Chinese. In the second round of screening, the team members carefully read the introduction, findings and conclusions of the retained literature, and labeled the 47 literature with weak relevance, so that a total of 92 literature were retained. In the third round of screening, the team members exchanged the literature marked as less relevant to the research questions with each other for full-text reading, in order to weaken the influence of personal subjective judgment on the literature screening, and two of them were retained after full discussion. In the end, 94 Chinese literature were identified as the research samples of this paper.

Second, data preprocessing. On the basis of the deactivation word list of "Hagongda", the words without practical significance (based on, empirical evidence, impact, etc.) and the literature search words (new occupation, employment, etc.) are regarded as deactivation words. At the same time, combined with the research content of this paper, based on the jieba thesaurus in Python, the words closely related to the research content of this paper, such as digitalization, digital platforms, platform economy, labor relations, etc., are incorporated into the custom

dictionary, and the deactivated thesaurus and custom thesaurus reconstructed are utilized to complete the lexicon of the original text.

2.2.2. Theme Generation Phase

In this paper, we use LDA algorithm to analyze the topic of the document set, present the topic of each document in the form of probability, and perform topic clustering to form a topic collection. The LDA Model function of Gensim library in Python is used to realize LDA topic modeling based on 94 Chinese documents. When constructing the LDA topic model, the optimal number of topics is determined by combining the two metrics of Coherence Score and Perplexity Score with reference to existing studies such as Zou Bo[12]. Coherence evaluates the semantic coherence of high-probability words used by the model in generating topics, and a higher Coherence Score indicates a stronger explanatory power of the model. Confusion, on the other hand, measures the accuracy of the model in dividing the literature into themes, and a lower confusion score reflects a better fit between the model and the data. In this paper, LDA models were constructed one by one for a total of 21 models with the number of topics ranging from 5 to 25, and the consistency and perplexity of each model were scored to determine the optimal number of topics. The results are shown in Figures 2 and 3. When the number of topics is 14, the consistency score is the highest, and at the same time the perplexity index is at the inflection point (the perplexity has a small increase after the number of topics reaches 14, and the fluctuation of the perplexity score increases with the increase of the number of topics), so the number of topics is selected as 14.

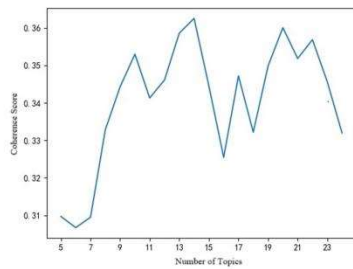


Figure 1. Coherence Score

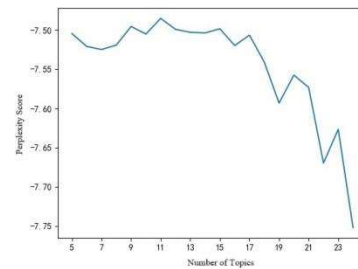


Figure 2. Perplexity Score

2.2.3. Thematic Presentation and Manual Coding Phase

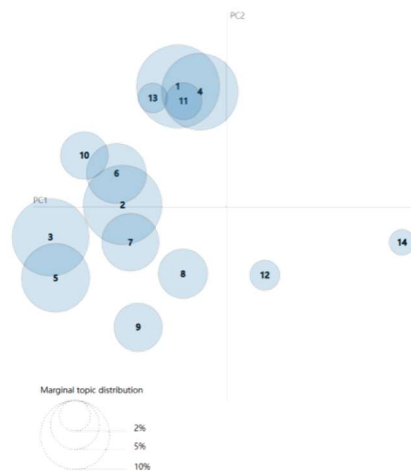


Figure 3. Thematic clustering visualization mapping[26]

In this paper, we use python's pyLDAvis package to present the results of the LDA topic model visually, and get the topic clustering visualization atlas for the study of the employment effect of the digital economy, as shown in Figure 3. In this atlas, the topics are represented by solid

circles, the size of solid circles represents the frequency of the topics, and the distance between the circles represents the degree of similarity between different topics.

Based on the pyLDAvis visualization mapping, combined with the consistency score and the perplexity score, it can be seen that there are 14 research themes on the employment effects of the digital economy, and the 14 themes were clustered again through manual coding, and 4 research themes were identified, namely, characterization, antecedents, influence mechanisms, and effect results. The results of theme clustering are shown in Table 1 (manual coding table) and Figure 3.

Table 1. LDA model theme clustering results

Research subjects (Second-level coding)	Potential theme (First-level coding)	Keywords (Top 10)	Theme serial number
Topic 1: The representation of the employment effect of digital economy	technology, information, empowerment, skills, digitization	labor, numbers, matching, technology, labor, information, empowerment, skills, groups, digitization	12
	internet, flexibility, time, self- employment, way	internet, flexibility, labor, supply, use, employment, time, self-employment, methods, increase	14
Topic 2: The antecedents of the employment effect of the digital economy	digitization, elements, digital technology	labour force, digitization, factors, jobs, development, skills, informality, tasks, numbers, growth	8
	infrastructure, construction, development, broadband, policy, information	cities, infrastructure, construction, digital, labor, development, broadband, policies, promotion, information	9
Topic 3 : The influence mechanism of the employment effect of digital economy	platform, digitization, Internet, technology, industrial transformation and upgrading	development, platform, enterprise, digital, Internet, digital, China, technology, talent, industry	1
	technology, gig, platforms, production, society	digital, workers, labor, technology, development, enterprise, odd job, production, platform, society	4
	artificial intelligence, labor income, technicians, robot	digital, artificial intelligence, skills, technology, promotion, labor income, share, enhancement, technical personnel, robot	11
	industry, intelligentization, robots, technology, scale	industry, service sector, industry, intelligentization, manufacturing, robots, labor force, installation, technology, scale	13
Topic 4 : The results of the employment effect of the digital economy	high quality, scale, region	Development, quality, high quality, labor, worker, size, number, region, technology, data	2
	employment structure, industrial structure, upgrading	development, employment structure, industry, labor, region, industrial structure, industry, upgrading, digital, technology	3
	the change of labor demand caused by the digital transformation of enterprises,	enterprise, digital transformation, labor force, technology, demand, scale, digitization, enterprise digitization, inspection, digital	5
	digitalization, skill learning	technology, labor, progress, the Internet, industry, digital, industry, demand, skill, mobile	6
	urban employment, job creation	data, citie, development, factor, number, labor, worker, technology, promotion, scale, job	7
	impact on labor-intensive employment	manufacturing, digitization, technology, skill, industry, industry, labor, employment structure, investment, labor-intensive	10

Specifically, firstly, research topic 1 includes themes 12 and 14, and in the visualization of theme clustering in Fig. 3, theme 12 and theme 14 are located in the same quadrant, with a relatively close distance; and through the analysis of the theme keywords, it is found that theme 12 contains the keywords of "science and technology, information, empowerment, skills, digitization", and the high-frequency keywords of theme 14 are "Internet, flexibility, self-employment". The high-frequency keywords of theme 12 are "Internet, flexibility, self-employment", which are highly related to the characterization of the job creation effect of the digital economy. Therefore, Theme 12 and Theme 14 are grouped together and named "Characterization of the employment effect of the digital economy". Secondly, Research Topic 2 contains Themes 8 and 9, which are very close to each other from the visualization of Theme Clustering in Figure 3; the high-frequency keywords "digitalization, digital technology, broadband, infrastructure, and policy" are the important influencing factors of the employment effect of the digital economy. Therefore, Theme 8 and Theme 9 are categorized as "antecedents of the employment effects of the digital economy". Once again, Research Topic 3 contains Themes 1, 4, 11, and 13, which are nested and overlapped in the distribution of Themes 1, 4, 11, and 13 as shown in the Theme Clustering Visualization Mapping; Themes 1 and 4 include the keywords of "platform, digitization, Internet, and industry," while Themes 11 and 13 include the keywords of "artificial intelligence, intelligentization, and industrialization. Theme 1 and theme 4 include keywords such as "platform, digitalization, Internet, industry", and themes 11 and 13 include keywords such as "artificial intelligence, intelligence, robotics", which all reflect the influence mechanism of the digital economy on employment. Therefore, Themes 1, 4, 11, and 13 are categorized as "the influence mechanism of the employment effect of the digital economy". Finally, research topic 4 contains themes 2, 3, 5, 6, 7, 10. From the visualization map of theme clustering, the distribution of themes 2, 3, 5, 6, 7, 10 is more concentrated, and the themes are closely related to each other; from the viewpoint of high-frequency keywords, themes 2 and 3 contain keywords such as "high-quality, scale, employment structure", which are the keywords of the employment effect of digital economy in the digital economy, and are the keywords of the employment effect of digital economy in the digital economy in the digital economy. In terms of high-frequency keywords, Theme 2 and Theme 3 contain keywords such as "high quality, scale, employment structure", which is the result of the employment effect of the digital economy in terms of "quantity", "quality", and "structure"; Theme 5 and Theme 6 contain keywords such as "labor force, demand, digitalization, employment structure", and "employment structure". "labor force, demand, digitization, skills" and so on, which are highly relevant to the results of the employment creation effect of the digital economy on enterprises, individuals and other micro subjects; Theme 7 and Theme 10 contain keywords such as "cities, jobs, labor-intensive " and other keywords are the results of the employment effect of the digital economy at the macro-city level and the meso-industry level. Therefore, the above theme is clustered as "the results of the employment effect of the digital economy".

In summary, based on the thematic clustering results of the LDA model, combined with the research team's careful reading, screening and manual coding of the literature, this paper constructs a logical framework for the study of the employment effects of the digital economy as shown in Figure 4. This research framework systematizes and structures the research focus issues in the existing literature, which helps to systematically and clearly sort out and integrate the existing research, and provides possible directions for further research in the future. Next, this paper will conduct a literature review on the employment effects of the digital economy based on the logical framework of "characterization-antecedents-impact mechanism-outcome".

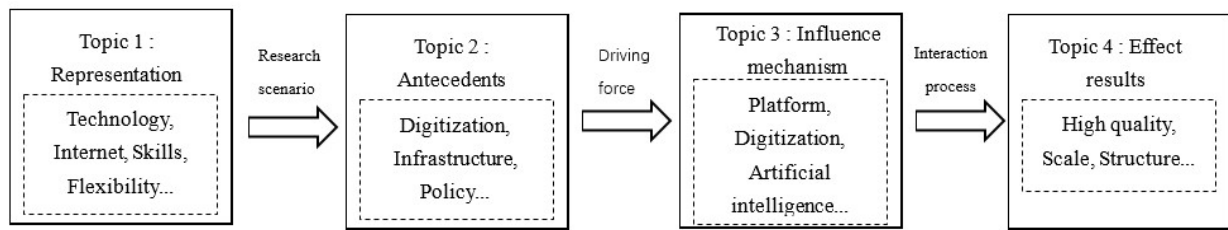


Figure 4. Logical framework for the study of the employment effects of the digital economy

3. Literature Review of the Employment Effects of the Digital Economy

3.1. Characterizing the Employment Effects of the Digital Economy

"Representation" refers to identifiers or substitutes that are artificially constructed to facilitate the identification of cognitive objects. The digital economy has profoundly affected the labor market through technological innovation and business model change, and has been characterized in terms of employment form, time and mode, and skill requirements. First, in terms of employment patterns, the rapid development of fifth-generation mobile communication technology (5G) and mobile Internet has broken the temporal and spatial boundaries of the employment market, and new forms of labor such as telecommuting and online office have emerged, challenging the traditional employment relationship and giving rise to the de-employerization of "cooperation" relying on digital platforms, "crowdsourcing", "sharing" and other new forms of employment relying on digital platforms and de-employerization. Secondly, in terms of employment time and mode, data as a new type of labor factor has accelerated the integration of the digital economy and the real economy, shaped many platform-type organizational forms, broken the labor relationship of standardized employment, and presented a new type of flexible employment trend, which exhibits the characteristics of low employment thresholds, flexible working hours, diversified working modes, and the combination of offline and online[13]. Finally, for employment skills requirements, the application of artificial intelligence and robots has replaced most assembly-line labor, and the breadth and depth of digital transformation of traditional positions have gradually accelerated and deepened, with the main work of people changing from labor parties to intelligent equipment manipulators, requiring workers to have higher digital literacy and skills and to master diversified knowledge and skills.

Although the employment effects of the digital economy have shown many new manifestations. However, the real problems and challenges hidden behind these manifestations also deserve further attention and research from the academic community. For example, the new flexible employment is a kind of non-standardized employment labor relationship, which means that workers cannot obtain the insurance, welfare and various labor rights and interests protection, etc., in the traditional employment-based labor relationship; then, for example, the advancement of digital technology replaces a considerable portion of low-skilled labor, which triggers technological unemployment to a certain extent [14], and at the same time, the inability of labor skills cannot match the job demand also exacerbates the risk of structural unemployment.

3.2. Antecedents of the Employment Effects of the Digital Economy

It has been shown that economic development and technological revolution are the main factors affecting employment. The rapid development of digital economy represented by 5G, big data and artificial intelligence is profoundly changing the labor employment market. Existing literature mainly explores the theoretical basis of the employment effect of digital

economy from three aspects: digital transformation, platform economy, and digital infrastructure construction.

3.2.1. Digital Transformation and Employment

Digital transformation mainly affects employment through technological progress that improves the production efficiency of enterprises, "squeezes out" low-skilled labor, and changes the allocation of human capital in enterprises. First, in the process of digital transformation, the application of artificial intelligence, robots and other intelligent equipment helps optimize resource allocation, reduce production costs, improve production efficiency, promote the expansion of production scale and create more new jobs. Secondly, the popularization of the application of automation and intelligent equipment has gradually replaced many repetitive jobs, resulting in the unemployment of low-skilled workers and triggering technological unemployment. Finally, digital transformation reduces the demand for low-skilled and low-education laborers and increases the demand for highly educated and innovative digital talents and can provide them with high compensation, changing the human resource allocation of enterprises.

3.2.2. The Platform Economy and Employment

Digital technological innovation has accelerated changes in organizational forms, and the platform economy based on Internet platforms has developed rapidly, becoming a new "reservoir" for absorbing employment. First, the platform economy has changed the tasks, forms and nature of labor, promoted the transformation of work to online, broadened flexible employment scenarios, and provided a large number of "zero-work" jobs. Second, the platform economy redefines entrepreneurship and promotes entrepreneurship-led employment. Workers relying on platform employment have higher autonomy and flexibility, and will pursue higher-level development such as entrepreneurship after meeting their basic needs; at the same time, flexible jobs provide entrepreneurs with a "way out", reducing low-quality, high-risk survival or self-employment entrepreneurship, and providing more choices of employment for the labor force. Finally, platform enterprises incubate the growth of SMEs, provide appropriate technical, financial and equipment support for SME production, accelerate the development of SMEs, and indirectly create a large number of jobs[15].

3.2.3. Digital Infrastructure Development and Employment

Existing studies in the literature on the impact of digital infrastructure construction on employment can be divided into two categories. The first category of literature considers digital infrastructure construction as a kind of public infrastructure, and analyzes the impact of digital infrastructure construction on urban and regional employment at the macro-city or regional level. This type of research argues that there is non-exclusivity in digital infrastructure construction, which helps to release the entrepreneurial vitality of enterprises, and attracts enterprise agglomeration and labor transfer, thus increasing the level of regional employment. The second type of literature is to view digital infrastructure development as a generalized technology and study the employment effects of digital infrastructure development based on the micro-firm and individual levels. This type of research shows that digital infrastructure construction has both "creation" and "destruction" effects on employment, with the "creation effect" manifesting itself in the fact that enterprises are able to increase employment through digital infrastructure construction by releasing the mass effect and improving production efficiency. The "creation effect" is manifested in the fact that enterprises expand labor demand through digital infrastructure construction by increasing the large-scale effect and improving production efficiency, and individuals search for employment opportunities and increase labor income by relying on infrastructure such as the mobile Internet, increasing organic composition of firms' capital and decreasing demand for low-skilled labor, which leads to layoffs and triggers structural unemployment.

3.3. Mechanisms for Influencing the Employment Effects of the Digital Economy

The digital economy is an economic form resulting from the development of digital technology and its widespread application. The China Institute of Information and Communication Technology (CIICT) has put forward a framework for the "dualization" of the digital economy from the perspective of productivity, i.e., the digital economy consists of two core components: the industrialization of the digital industry and the digitalization of the industry. In addition, according to a report by the U.S. Bureau of Economic Analysis, the digital economy includes digital infrastructure, e-commerce activities, and digital media. Many studies have constructed the digital economy development index system from the three dimensions of digital industrialization, industrial digitization and digital infrastructure. Based on this, this paper will analyze the influence mechanism of the employment effect of digital economy from the three dimensions of digital industrialization, industrial digitization and digital infrastructure.

3.3.1. Mechanisms of the Impact of Digital Industrialization on Employment

First, digital industrialization has created new industries such as big data and cloud computing services, expanding employment demand and improving employment quality. Digital technology innovation and widespread application have given rise to emerging technology-intensive manufacturing industries and productive service industries such as the Internet, artificial intelligence, and intelligent manufacturing, creating a large number of new jobs and broadening the employment space. In addition, digital industrialization takes digital technology and digital equipment as the main inputs, and the work content is highly related to digital technology, with strong R&D-driven characteristics, requiring workers to have a high level of education and digital skills, and relatively high salary and compensation, which, to a certain extent, promotes the optimization of the employment structure and improves labor income[16]. Secondly, digital industrialization uses data as the main linkage, linking with traditional factors, promoting the upgrading of industrial structure and facilitating high-quality full employment. The data elements created by digital industrialization can integrate and link with other traditional factors of production and flow efficiently in the industrial chain, promote the deep integration of the industrial chain and the innovation chain, drive the transformation and upgrading of traditional industries through industrial association and technology diffusion, and create high-quality employment opportunities. For example, digital technology can significantly empower the capital elements, enhance the intelligent equipment input of the manufacturing industry through linking capital, improve the production and management efficiency of the manufacturing industry, enhance the capital-intensive attributes of the manufacturing industry, promote the transformation and upgrading of the industrial structure, and provide a series of jobs with high skill requirements and high pay returns.

Third, digital industrialization has shaped new modes of business such as the platform economy and sharing economy, which have become an important engine for promoting employment. The platform economy relying on Internet technology has created a variety of flexible jobs such as network anchors and takeaway riders, breaking the time and space limitations in traditional employment patterns and providing more diversified and inclusive employment options for key groups such as women, farmers, and the disabled. In addition, the role of digital technology-based platforms in alleviating information asymmetry, breaking down resource barriers, and gathering talent has become increasingly significant, accelerating the empowerment of the development of real enterprises, promoting the flattening of organizational forms, blurring industrial boundaries, and the emergence of many cross-border related corporate entrepreneurship, which not only creates new jobs, but also offers new employment options for the "creator" group[17]. This not only creates new jobs, but also provides new entrepreneurial choices for "creators" and amplifies the driving effect of entrepreneurship on employment.

3.3.2. Mechanisms of Industrial Digitization on Employment

First, the digital transformation of industries promotes the improvement of production efficiency, but its employment effect is not an absolute "expansion" or "contraction", but depends on the strength of the "creation effect" and the "substitution effect" of employment brought about by the digital transformation of industries. But its employment effect is not an absolute "expansion" or "contraction", but depends on the contrast between the "creation effect" and the "substitution effect" of employment brought about by the digital transformation of industries. On the one hand, industrial digitalization applies digital technology to the process of traditional industries to improve production efficiency and reduce production costs, which in turn generates scale effects, expands labor demand, and raises workers' incomes. On the other hand, the advancement of digital technology improves production efficiency, which reduces the number of laborers needed for the same output, thus reducing the employment opportunities in the labor market and causing "creative destruction" to employment. Moreover, the digitization of industries will inevitably lead to the phenomenon of "machine for man", upgrading the structure of employment skills and exacerbating the risk of technological unemployment.

Second, the deep integration and development of digital technology and traditional industries have both transformed the original industrial sectors and created new industrial sectors, increasing employment demand and optimizing the employment structure. The operation and maintenance of intelligent equipment and the research and development management of digital technology have created a large number of new technical positions, such as digital solution designers and robotics engineers and technicians, increasing the market demand for high-skilled digital technology talents. In addition, industrial digitalization promotes the continuous intelligence and servicization of traditional manufacturing industries, triggering the reallocation of labor factors between new and old industrial sectors, which may trigger frictional unemployment in the short term, but in the long term, the employment "creation effect" of industrial digital transformation is still greater than the employment "substitution effect". "substitution effect"[18].

Thirdly, digital technology, as a core element of industrial digitization, is characterized by diffusion, universality and spillover, and has a "compensatory effect" and an indirect "creation effect" on employment. Advances in digital technology will replace a large number of repetitive jobs, which will easily lead to technological unemployment in the short term. However, when replacing some traditional jobs, technological progress will also create a number of new production sectors and provide new jobs, thus absorbing labor force employment and generating a "compensation effect" on employment. In addition, the universality and spillover of digital technology can be widely applied to various industries, facilitating the flow of resources, information, technology and other factors of production among different industries, resulting in technological convergence, and driving the active or passive digital transformation of similar and upstream related industries, thus indirectly creating a large number of new employment opportunities.

3.3.3. Mechanisms of the Impact of Digital Infrastructure on Employment

First, digital infrastructure construction with Internet infrastructure construction as the main technical route has increased Internet penetration and coverage, which, on the one hand, helps to break down the information barriers in the labor market, accelerate the cross-regional reorganization of labor factors, reduce the cost of workers' information acquisition and employment search, and increase the success rate of employment[19]. On the other hand, the construction of digital infrastructure, with the construction of the Internet as its core task, creates new forms and modes of business such as the platform economy and the zero-worker economy, releasing a large number of zero-worker employment opportunities, and significantly

promoting the employment of key groups such as farmers and women. However, the renewal of digital infrastructure has accelerated the digital transformation of traditional industries, replacing many routine jobs and reducing the market demand for non-digital-skilled workers, resulting in a "disruptive effect" on employment. Secondly, digital infrastructure, as a kind of infrastructure with strong public nature, can play a network effect, reduce the cost of resource acquisition and market transaction, promote innovation and entrepreneurship, and show more employment "creation effect". The improvement and popularization of digital infrastructure promotes the development of digital financial inclusion, eases information asymmetry in the financial market, and increases the success rate of individual innovation and entrepreneurship. On the other hand, corporate entrepreneurship is another form of innovation and entrepreneurship. The construction of digital infrastructure promotes the development of digital financial inclusion, which is conducive to enterprises to get rid of financing difficulties and expensive financing, strengthens the financial support for enterprise technology research and development and product innovation, encourages enterprises to expand the boundaries of enterprise innovation and entrepreneurship, and creates more employment demand through corporate entrepreneurship.

Third, digital infrastructure is a skill-biased technological progress, which can screen the labor force, adjust the allocation of human capital among different industries, and thus act on labor employment. On the one hand, the construction of digital infrastructure has given rise to a series of high-tech industries, increasing the demand for high-skilled workers and crowding out low-skilled workers, resulting in the phenomenon of employment "polarization". On the other hand, digital infrastructure promotes the "reverse integration" of digital technology and the three industries, improves the employment absorption capacity of the technology-intensive manufacturing industry and the digital service industry, and prompts the labor force to gradually transfer from the primary industry to the secondary and tertiary industries, thus promoting the seniorization of the employment structure. However, as the process of workers' skills training and human capital enhancement is relatively long and lags far behind the speed of technological progress in creating new jobs, it may lead to a mismatch between workers' existing employment skills and the skills demand of new jobs, reducing the efficiency of human capital adjustment, thus exacerbating the labor mismatch to a certain extent, which is not conducive to the realization of full and high-quality employment in the short term.

3.4. Outcomes of the Employment Effects of the Digital Economy

3.4.1. Results of the Role of the Digital Economy on the Size of Employment

The booming development of the digital economy is characterized by big data, artificial intelligence and other digital technological innovations, which have obvious attributes of technological progress and have a double impact on the scale of employment, mainly manifested as the "creation effect" and "compensation effect" of promoting employment; the "substitution effect" of reducing employment, which, depending on the causes, is subdivided into the "destruction effect" or "crowding out effect" and the "creative destruction effect". The "substitution effect" of employment is subdivided into the "destruction effect" or "crowding out effect", "creative destruction effect" and so on, according to different causes. The "substitution effect" of employment reduction is subdivided into the "destructive effect" or "crowding out effect" and "creative destruction effect" according to different causes.

First, the digital economy has a "creation effect" on the scale of employment. The digitization of industries and digital industrialization have created new industries and sectors such as the Internet and artificial intelligence, expanding new space for employment. At the same time, the application of digital technology to traditional industries and the promotion of cost reduction and efficiency in traditional industries not only help to expand the scale of production and create more new jobs, but also the price effect and income effect brought about by technological

progress can expand market demand and stimulate enterprises to expand the scale of employment, thus generating more jobs.

Second, the deep integration of digital technology and traditional industries has reduced the demand for low-skilled labor. For one thing, the use of mechanized and intelligent production equipment has risen, and most of the highly repetitive and procedural jobs have been replaced by machines, resulting in the technical unemployment of low-skilled labor, which is known as the employment "crowding-out effect" or the "destructive effect". Secondly, the application of digital technology improves production efficiency and reduces the labor demand of enterprises, resulting in layoffs; on the other hand, jobs creating new products may replace those of past or current products, resulting in a "creative destruction effect" on employment.

Finally, the rapid development of digital technology has given rise to new modes of business such as platform economy and odd-job economy. Relying on Internet platforms, a large number of low-threshold, large-capacity flexible employment occupations such as network anchors and takeaway riders have been derived, which have become a new "reservoir" for absorbing employment[20], and have mitigated the impact of the development of digital technology on the employment of low-skilled labor. The impact of the development of digital technology on the employment of low-skilled laborers has been mitigated, forming an employment "compensation effect".

3.4.2. Results of the Role of the Digital Economy on the Structure of Employment

The upgrading of industrial structure and the enhancement of human capital are closely related to the adjustment of employment structure. Through digital industrialization, industrial digitization and digital infrastructure construction, the digital economy has greatly promoted the upgrading of China's industrial structure, and also led to a corresponding transformation of the employment structure, which is reflected in the optimization of the employment structure and the "polarization" of the employment structure.

On the one hand, the progress of digital technology accelerates the upgrading of industrial structure and drives the evolution of advanced employment structure. First, automated and mechanized equipment is widely used in the primary industry, promoting the realization of non-agricultural employment for rural laborers and reducing the number of people employed in the primary industry; second, the advanced technologies of the Internet, artificial intelligence, and robotics promote the digital transformation of traditional industries, prompting enterprises to cut down on highly repetitive and low-skill jobs and increase the demand for high-skill laborers, which has gradually "advanced" the skills of workers in the secondary industry. Secondly, advanced technologies of the Internet and artificial intelligence and robotics promote the digital transformation of traditional industries, prompting enterprises to cut down on highly repetitive and low-skill jobs, increasing the demand for high-skilled labor, and leading to the gradual "advancedization" of the skills of workers in the secondary industry. Finally, the rapid development of the digital economy has created many new digital service industries, increasing the supply of jobs with high education and digital literacy requirements, which not only provides employment opportunities for high-skilled workers, but also pushes some workers to take the initiative to learn new knowledge and improve their own skills, thus increasing the proportion of tertiary employment and promoting the optimization of the employment structure[21].

On the other hand, the digital economy will have a "polarization" effect on the employment structure, including the "unipolarization" that squeezes out low-skilled workers, the "counter-polarization" that raises the employment level of middle-skilled labor, and "polarization" that reduces the employment share of middle-skilled labor. First, the innovation and application of digital technologies such as big data and artificial intelligence have created many high-tech industries, which have an obvious technological bias towards non-programmed middle- and

high-skilled labor, pushing the employment structure to show the development trend of "unipolarization". Secondly, a large part of middle-skill jobs have been replaced by information technology in the last round of information technology revolution, and there are few middle-skill jobs that can be replaced by digital technology but not by information technology. However, a large number of low-skill and high-skill jobs with complex labor characteristics cannot be replaced by information technology but can be replaced by digital technology such as big data and artificial intelligence, and these low-skill and high-skill jobs have been replaced by digital technology, and these low-skill and high-skill jobs have been replaced by digital technology. The risk of these low-skilled and high-skilled jobs being replaced by digital technology is much higher than the risk of medium-skilled labor being replaced, and thus may produce the phenomenon of employment "antipolarity". Finally, digital technology substitutes for routinized and procedural medium-skilled labor, expanding the demand for high-skilled workers based on technology bias. In addition, based on the theory of task bias, there may be some non-routine low-skilled manual labor and highly interactive manual labor that cannot be replaced by digital technology, or because some middle-skilled labor is in the technological "wind gap" and is more obviously affected by the technological impact, thus showing the employment polarization phenomenon of "hollowing out in the middle".

3.4.3. Results of the Role of the Digital Economy on the Quality of Employment

Employment quality is an important reference indicator for measuring the well-being and satisfaction of workers' employment, which contains multiple dimensions such as working environment, employment skills, labor relations, salary and compensation, and labor security[22]. The digital economy does not have an absolute positive impact on employment quality, and there are equally creation and shock effects. In this paper, we will summarize the results of the dual impact of the digital economy on employment quality from the payroll income dimension and the non-payroll income dimension.

At the level of salary and income, the digital economy will have two results on the quality of employment: raising labor income and aggravating the income gap. On the one hand, the widespread application of digital technology has increased the market demand for high-skilled labor, generating a large number of high-skilled talent gaps in various industries, directly forcing enterprises to raise the wage level and benefits of high-skilled personnel. At the same time, the digital economy, based on the Internet platform, has spawned new modes of business such as platform economy, sharing economy, and zero-work economy, creating many low-threshold, low-skill, highly flexible jobs, which allow one person to hold several jobs and realize multiple employment for laborers[23], which has broadened the source of income of laborers to a certain extent. In addition, the digital economy accelerates the development of digital inclusive finance, promotes the growth of innovation and entrepreneurship, and increases labor income. On the other hand, the digital economy has an obvious technological bias, which enhances the market competitiveness of high-skilled labor and pushes the income of high-skilled labor groups to continue to grow. In contrast, middle- and low-skilled laborers face the risk of being replaced by digital technology, and their wages are difficult to increase, and they may even lose their jobs[24], exacerbating the income gap within the labor market. In addition, digital technology replaces a large number of middle- and low-skilled jobs, reducing the non-farm employment opportunities and wage income of rural transfer laborers, and widening the income gap between urban and rural areas of the labor force.

At the level of non-salary income, the digital economy can improve the labor environment, enhance employment skills, and establish new types of labor relations, as well as weaken labor security. First, the digital economy has spawned a series of Internet platforms, creating both online telecommuting jobs such as Netflix bloggers and online education instructors, as well as flexible jobs such as takeaway riders and online car drivers, breaking the time and space constraints of traditional jobs and improving the labor work environment. Second, while

creating new jobs, the digital economy continues to promote the improvement of labor employment skills. For example, individual laborers learn new skills and enterprises train their employees. Once again, the development of the digital economy has impacted the traditional standardized employment labor relations, and production activities characterized by platforms, sharing, and crowdsourcing have emerged, promoting the formation of a new type of production relations of cooperation and sharing[25]. However, this new type of labor relations based on the Internet platform also has a negative impact on the quality of employment, for example, workers have a strong attachment to digital platforms and are easily "controlled" by algorithms. Finally, new flexible jobs and non-standardized labor relations have led to more decentralized employment and a gradual tendency towards "atomization", weakening the power of trade unions and labor groups; moreover, workers in flexible and platform employment often do not have formal labor contracts, and their job stability is poor, which is not conducive to the realization of labor rights and interests protection.

4. Conclusion of the Study and Future Outlook

4.1. Findings and Research Framework

In recent years, the total volume and scale of China's digital economy have been growing, giving rise to a series of new industries and new business models, and creating a large number of new employment opportunities. In this paper, through the combination of thematic modeling and manual coding, LDA thematic modeling is carried out on 94 Chinese literatures on the employment effect of digital economy, and according to the results of thematic modeling, manual coding yields four types of core research topics on the employment effect of digital economy, which are the characterization, antecedents, influence mechanism and results of the employment effect of digital economy, and a systematic theoretical compendium is carried out on the above four core research topics, which is shown in Fig. 5, and a comprehensive research framework is constructed for the employment effect of digital economy in China. A comprehensive research framework on the employment effect of China's digital economy is constructed, as shown in Figure 5. Specifically, this paper has the following four main research conclusions:

This paper summarizes the key features of China's digital economy's employment effects, highlighting unique characteristics and practical challenges. These effects are marked by: platformization and non-standardization of employment forms, flexibility in time and mode, skill diversification and advancement, the need for stronger labor rights protection, and the accompanying issue of unemployment. While existing studies describe new occupations and employment forms from various perspectives, there is a lack of synthesis on the digital economy's employment impacts. This paper distills these critical characteristics, making the abstract concept of "digital economy employment effects" more comprehensible and facilitating further research.

Second, this paper systematizes the antecedents of the employment effects of China's digital economy. The employment effects of the digital economy are jointly influenced by economic development and technological progress, with antecedents due to digital transformation, platform economy and digital infrastructure construction. Most of the existing literature only studies the individual antecedents of the employment effects of the digital economy without systematically sorting them out. This paper comprehensively analyzes the antecedents of the employment effects of the digital economy to provide a more systematic knowledge and understanding of the antecedents of the employment effects of the digital economy in China.

Thirdly, this paper analyzes in depth the influence mechanism of the employment effect of China's digital economy. The digital economy mainly works on employment through three influence mechanisms: digital industrialization, industrial digitization and digital

infrastructure construction. Existing studies have mainly constructed a digital economy development index system from the three dimensions of digital industrialization, industrial digitization and digital infrastructure to conduct empirical research, lacking in-depth theoretical interpretation. This paper deeply analyzes the impact mechanism of digital industrialization, industrial digitization and digital infrastructure on the employment effect of the digital economy, which helps to clarify the underlying logic of whether the digital economy creates employment or substitutes for employment.

Fourthly, this paper refines the employment effects of China's digital economy, examining "creation," "compensation," and "substitution" effects through three mechanisms: digital industrialization, industrial digitization, and digital infrastructure construction. These effects impact employment scale, structure, and quality, resulting in: new job creation, technical unemployment for low-skilled labor, growth in flexible employment, employment structure optimization or "polarization," improved employment quality, widening income gaps, and weakened labor rights protection. While existing research emphasizes positive outcomes, it overlooks negative impacts. This paper addresses both, offering a more comprehensive understanding of the digital economy's employment effects.

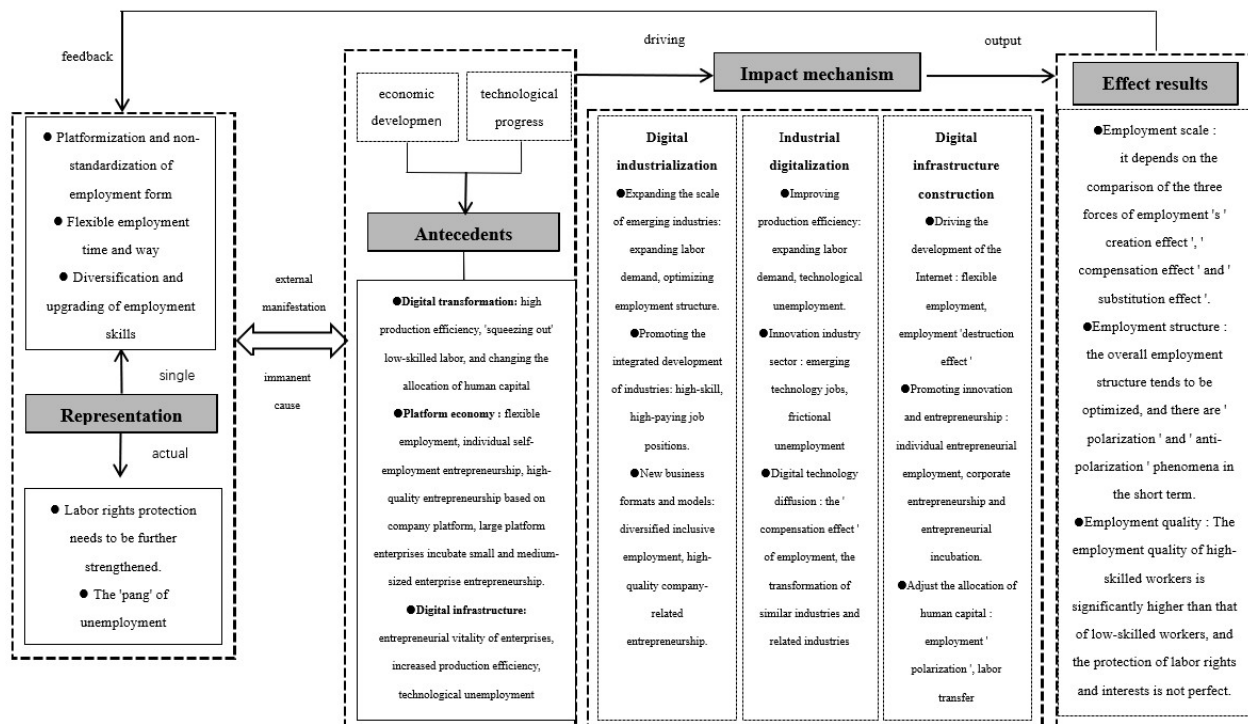


Figure 5. Framework for a comprehensive study of the employment effects of the digital economy

4.2. Theoretical Contributions

Through the research method of combining machine learning and manual coding, this paper extracts four core research topics from 94 documents, and conducts a systematic review and combing of each research topic, and finally constructs a comprehensive research framework for the employment effects of the digital economy, based on which this paper has the following two main theoretical contributions:

First, By constructing a comprehensive research framework, this paper enhances understanding of China's digital economy employment effects. It follows a "characterization - antecedents - impact mechanism - results" structure, ensuring both breadth and depth. This

systematic approach summarizes key features, analyzes underlying factors and mechanisms, and refines outcomes, providing a robust foundation for future research.

Secondly, This study strengthens the link between digital economy employment effects and enterprise innovation/entrepreneurship in China. Internet platform-driven innovation and entrepreneurship have created high-quality jobs, fueling high-quality, full employment. Leveraging these platforms enables firms to identify opportunities, expand innovation boundaries, and enter new markets, generating greater employment demand.

4.3. Outlook for Future Research Directions

Currently, while research on the employment effects of China's digital economy has yielded some results, there are still areas that warrant deeper exploration. This paper identifies future research directions based on four major themes derived from manual coding and existing research gaps, aiming to advance the field.

First, the characterization of the employment effect of the digital economy. Existing literature discusses the "creation" and "substitution" effects of digital economy employment from various perspectives, but it remains fragmented. This paper summarizes key aspects such as employment forms, time, mode, and skill requirements, highlighting practical challenges. However, the underlying logic of these effects lacks exploration, offering a potential focus for future research.

Second, the antecedents of the employment effects of the digital economy. Current studies often isolate single factors, leaving the relationships between antecedents underexplored. Future research could investigate the synergies among these factors. Additionally, analyses primarily focus on the meso-industry level, with limited attention to micro-level individuals and enterprises. Future work could delve into how individual traits and enterprise behaviors influence employment effects.

Third, the aspect of the influence mechanism of the employment effect of the digital economy. Existing research examines mechanisms like technological progress, digital transformation, and the platform economy. However, the interactions between these mechanisms are rarely studied. Future research could explore how these interactions shape the employment effects of the digital economy.

Fourth, the employment effect of the digital economy in terms of the outcome of the role. While the effects of the digital economy on employment are well-studied, the reverse impact-how employment outcomes influence digital economy development-remains underexplored. Future studies could analyze this relationship through the lenses of employment structure and quality.

4.4. Research Limitations

The research limitations of this paper mainly lie in the following: first, this paper only adopts the Chinese literature after 2019 as the textual information for LDA theme modeling and manual coding, the time span is shorter, and less textual information is obtained, and in the future, we will try to prolong the time span and obtain more textual information for theme modeling, which will complement each other with the conclusions of the research in this paper. Second, this paper uses the CNKI database as the source of literature for theme modeling, and the conclusions drawn will inevitably have certain Chinese characteristics. In the future, we will try to use both Chinese and English literature to conduct theme modeling research together, so as to enhance the universality of the research conclusions. Third, this paper belongs to the literature review type of article, only the core research topics of the employment effect of the digital economy have been systematized combining, and a comprehensive research framework has been constructed, so that empirical research methods can be used in the future to test the accuracy of the research conclusions.

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- [26] The size of the solid circles indicates the frequency of occurrence of the themes, and the themes are numbered according to the frequency order of occurrence; the distance between the solid circles indicates the proximity of different themes; the dashed ellipses are manually drawn based on the distance between the themes and the manual coding of the aggregation of larger themes. In addition, the overlap of the solid circles is formed by the projection of themes in n-dimensional space into 2-dimensional space, and does not represent the actual overlap of different themes.