A Study on the Impact of the Digital Economy on Female Employment

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Abstract: This paper develops an evaluation system for digital economy development comprising 5 primary indicators and 13 secondary indicators, and applies the entropy method to calculate the overall digital economy development index in China from 2014 to 2022. Simultaneously, female employment—including its quantity, structure, and quality—is incorporated into the evaluation framework for precise measurement. Theoretical and empirical analyses reveal that the digital economy exerts a significant positive impact on the quantity, structure, and quality of female employment. Moreover, digital economy development not only increases the number of female-friendly jobs but also enhances their quality. The degree of influence varies by education level, age, and industry, with highly educated and younger women benefiting the most. Overall, the impact of the digital economy on female employment exhibits diversity and differentiation.

Keywords: Digital Economy, Female Employment, Multidimensional Indicator System

1. Introduction

With the rapid development of the digital economy, its profound impact on the global employment market has become a focal point of research in both academia and policy-making. General Secretary Xi Jinping clearly stated in the report of the 20th National Congress of the Communist Party of China that "employment is the most fundamental livelihood issue," emphasizing the need to "promote high-quality and full employment." This important assertion provides a fundamental guideline for employment research in the new era. Globally, the digital economy, as a crucial driver of modern economic growth, is deeply reshaping the structure and dynamics of the labor market. According to the China Digital Economy Development Report (2023), the share of the digital economy in China's GDP is now comparable to the share of the secondary industry in the national economy, with its employment creation and substitution effects becoming increasingly significant. The digital economy not only offers unprecedented career opportunities for women by optimizing industrial structures, breaking down information barriers, and expanding employment channels but also reshapes the spatial and temporal patterns of women's career choices through remote work and flexible employment models. However, the widespread adoption of automation technologies and the widening digital skills gap may pose structural challenges to low-skilled female workers, exacerbating polarization in the employment market. Against this backdrop, realizing the "multiplier

effect" of female employment amid the digital economy wave has become a key issue in promoting gender equality and high-quality economic development.

This paper conducts a systematic study on the impact of the digital economy on female employment by proposing an innovative research framework. We construct a measurement system for the level of digital economy development that encompasses multidimensional characteristics such as digital infrastructure, industrial digitalization, and innovation environment. From the three dimensions of employment quantity, structure, and quality, the paper comprehensively analyzes the effects of the digital economy on female employment, finding that digital economy development can promote female employment by expanding the artificial intelligence market scale, with effects varying by industry, education level, and age.

The contributions of this study are multifaceted. First, at the theoretical level, it expands the existing labor economics framework by introducing a gender-focused perspective, thereby advancing in-depth research in the discipline. Second, unlike traditional economic indicators, this study adopts a multidimensional, hierarchical indicator system, including but not limited to the level of digital infrastructure construction, digital innovation environment, and talent potential—critical factors influencing digital economy development. This new indicator system comprehensively considers influencing factors from multiple dimensions, selecting the most representative indicators to ensure more accurate, scientific, and persuasive results. Finally, although considerable progress has been made in digital economy research, most studies focus on other aspects of the digital economy. This paper fills a research gap by exploring the specific impact of the digital economy on female employment in China, offering valuable references for policy formulation and practice. Therefore, the study not only makes theoretical contributions but also provides new perspectives and ideas for addressing real-world issues.

2. Literature review

Currently, research on the digital economy in China primarily examines its impact on overall economic development from two perspectives: changes in the economic environment and fundamental shifts in economic activities. Studies focused on the economic environment often draw on official data such as the China Statistical Yearbook to analyze changes in development levels, socioeconomic structures, and institutional arrangements. For example, Ren Baoping et al. found that the digital economy is growing faster in central and western regions compared to the east, with underdeveloped areas gradually benefiting from the spillover effects of more advanced regions and experiencing improvements in economic development [1]. Liu Xiaohe and colleagues introduced a mediation effect model to empirically demonstrate that the digital economy promotes industrial upgrading and affects employment structure [2]. Similarly, Sun Hui and Wan Lijun, using panel data from 30 provinces in the 2010s, showed that the digital economy has a positive effect on China's industrial upgrading [3]. Research examining economic activities has focused on the digital economy's impact on investment [4], export trade [5,6], and productivity, especially new types of productivity [7,8]. While scholars emphasize different aspects, there is broad consensus that digital economy development raises residents' income levels, adjusts industrial structures, and drives overall economic growth.

In recent years, female employment has received increasing attention within the context of the digital economy and industrial structural transformation, with research centering on occupational change, gender differences, and sectoral advantages. While the tertiary sector's capacity to absorb female labor in China has gradually increased, it remains lower than that in developed countries [9]. Conversely, the secondary sector, with its high technological intensity and challenging

transformation, has a weak capacity to absorb female labor [10,11]. Moreover, digital technologies help women transition from family roles to social roles and facilitate their movement into higher-end industries [12]. Regarding gender differences, employment data from 2011 to 2020 show that male employment has consistently exceeded female employment, although the gap is narrowing. The share of female employment increased from 36.27% in 2011 to 39.79% in 2020, with an average annual growth rate (2.93%) significantly higher than that of males [13]. International studies also indicate that female employment is vulnerable to financial liberalization and family pressures, but foreign investment and the digital economy are creating new opportunities [14,15]. Nevertheless, gender bias persists in high-tech industries [16]. In terms of sectoral distribution, women have clear advantages in the tertiary industry. Shen Mao [17] found that wholesale and retail (25.75%), accommodation and catering (10.69%), and education (7.33%) are key employment fields for women, with the tertiary sector accounting for 69.71% of female employment among legal entities and 78.44% among the self-employed. In the secondary sector, female employment is mainly concentrated in low-skilled industries such as manufacturing (13.29%). Yu Meizhen's research further shows that over 90% of women in services are employed in childcare and early childhood education, indicating that the tertiary industry offers more equitable employment opportunities for women [18]. Additionally, many scholars have explored how the number of children affects the quality of female employment [19,20].

As for the relationship between the digital economy and female employment, scholars hold diverse views. On one hand, the digital economy creates employment opportunities by optimizing the gender employment structure, generating new job types, and breaking down traditional industry information barriers and geographic restrictions. Li Jian [21] found that the digital economy reduces gender discrimination and mitigates physical disadvantages for women, raising women's market wages relative to men and increasing their employment share. Yang Qing et al [22]. argued that digital platforms lower physical demands and knowledge thresholds, creating many jobs suitable for women. Qiu Hua and Yin Zhi [23], using data from the China Household Finance Survey, found that household digital transformation improves information acquisition, reduces information asymmetry, and enhances the quality of female employment. On the other hand, the digital economy can also have substitution effects on female employment. Industrial digitalization directly affects employment quantity and structure in China's manufacturing sector, crowding out much high-skilled and some low-skilled labor, leading to overall job reductions. Digital economy development also indirectly reshapes the labor structure, potentially resulting in structural unemployment and substitution effects [24].

In summary, although domestic and international research on the digital economy's impact on female employment is extensive, certain gaps remain. Existing studies often rely on theoretical analysis with limited empirical evidence. Heterogeneity analyses of employment structure tend to focus on regional or gender differences, with insufficient exploration of variation across female groups by education, industry, and age. Furthermore, the underlying mechanisms through which the digital economy affects female employment have not been fully elucidated. Building on prior research, this paper aims to conduct a more comprehensive and in-depth empirical analysis of the impact of the digital economy on female employment in China.

3. Theoretical analysis and research hypotheses

3.1. Mechanisms by which the digital economy creates employment opportunities for women

The digital economy enhances the quantity, quality, and structural diversity of female employment through four main pathways. First, the development of the digital economy strongly promotes industrial upgrading and the growth of new drivers of economic development. It fosters the emergence of new business forms and employment models, thereby generating a wide range of new jobs and providing women with increased employment opportunities. According to the China Academy of Information and Communications Technology (CAICT), the scale of China's digital economy reached 5.39 trillion yuan in 2023. This structural transformation has significantly increased demand for positions related to software and hardware development, technical architecture, e-commerce operations, and livestream marketing. Second, digital technologies facilitate more precise matching between labor supply and demand in the job market, improving the efficiency of resource allocation and employment structure. Recruitment platforms based on big data and artificial intelligence enable accurate alignment between job requirements and human capital, offering more suitable employment opportunities for women. Third, the digital economy broadens women's access to employment information and creates more income channels, thereby increasing their labor earnings. Fourth, the rise of digital labor platforms has expanded access to remote and global work opportunities, making flexible and home-based employment more feasible. This reduces employment pressures on women and promotes work–life balance. According to the latest statistics from China's Ministry of Human Resources and Social Security, the flexible employment population in China has continued to expand, surpassing 200 million. Among them, approximately 84 million new-type workers are employed via digital platforms, accounting for about 11% of the total employed population nationwide. Based on the above analysis, the following hypotheses are proposed:

Hypothesis 1a: The digital economy increases employment opportunities for women.
Hypothesis 1b: The digital economy optimizes the employment structure for women.
Hypothesis 1c: The digital economy enhances women's labor income.
Hypothesis 1d: The digital economy promotes flexible employment among women.

3.2. Mechanisms by which the digital economy substitutes female employment

While the digital economy creates new opportunities, it may also negatively impact female employment in several ways. First, with the advancement of digital technologies—particularly artificial intelligence and robotics—many traditional, repetitive, or low-skilled jobs may be replaced by more cost-effective automated devices or intelligent systems. This could lead to job displacement in certain sectors. Second, the digital economy may drive industrial restructuring. Some traditional labor-intensive industries may suffer under the pressure of innovation and upgrading, leading to large-scale unemployment in those sectors. Third, the digital economy imposes new skill requirements on the workforce. Due to societal and cultural biases, women may have insufficient access to digital education and training resources, exacerbating the digital gender divide. For female workers with low digital literacy, this can lead to employment difficulties and create a vicious cycle of a "skills gap–employment exclusion" trap. Based on this analysis, the following hypotheses are proposed:

Hypothesis 2a: The digital economy accelerates labor replacement through automation.
Hypothesis 2b: The digital economy leads to the decline of traditional industries.

Hypothesis 2c: The digital economy exacerbates the gender digital divide.

4. Research design

4.1. Data sources

This study selects the period from 2014 to 2022 as the sample time frame to examine the impact of the digital economy on female employment. In addition to data availability considerations, this period is representative because the widespread adoption of smartphones and mobile internet accelerated the development of the digital economy. The rise of various e-commerce platforms spurred explosive growth in online shopping and logistics, while the rapid expansion of the sharing economy and the flourishing of social media and content creation provided women with more flexible and diverse employment options. Therefore, choosing this time frame has important analytical significance. The data used in this paper are primarily sourced from the China Statistical Yearbook and the China Labor Statistical Yearbook. To reduce the influence of differences in measurement units, some of the data have been normalized.

4.2. Variable definitions

4.2.1. Dependent variables

The dependent variables include employment quantity (Amount), employment structure (Structure), and employment quality (Quality). Drawing on existing literature and research practices on employment measurement, this study adopts scientifically grounded and operationally feasible indicators to build an evaluation system that measures the effects of the digital economy on female employment across these three dimensions. The system includes seven secondary indicators designed to provide a rigorous assessment of female employment levels:

Table 1. System of indicators for evaluating female employment

Primary Indicator	Secondary Indicator	Indicator Code	Direction
Employment Quantity	Sex ratio of the population	AM_1	Neutral
	Number of women employed in non-private units	AM_2	+
Employment Structure	Proportion of women with higher education	ST_1	+
	Proportion of women in high-quality employment	ST_2	+
Employment Quality	Average weekly working hours for female employees	QU_1	−
	Share of women unemployed for more than 12 months	QU_2	−
	Average annual wages of female employees	QU_3	+

4.2.2. Core independent variables

The core independent variables are the Overall Index of Digital Economy Development Level (Level), Coverage of Digital Industrial Infrastructure (Coverage), Scale of Digital Industry Operations (Scale), and Digital Innovation Environment (Environment). Among these, the Overall Index of Digital Economy Development Level (Level) is the key explanatory variable. It is constructed using a system with 5 primary indicators and 13 secondary indicators, as shown below:

Table 2. System of indicators for the level of development of the digital economy

Primary Indicator	Secondary Indicator	Indicator Code	Direction
Digital Infrastructure	Number of broadband internet access users	DIS_1	+
	Number of mobile phone users	DIS_2	+
	Number of broadband internet access ports	DIS_3	+
Digital Industrialization	Total volume of telecommunication services	DID_1	+
	Volume of postal delivery services	DID_2	+
	Revenue from information technology services	DID_3	+
Industrial Digitalization	Total value of national e-commerce transactions	DOI_1	+
	Proportion of enterprises engaged in e-commerce transactions	DOI_2	+
Digital Innovation Environment	Full-time equivalent R&D personnel in large industrial enterprises	DIE_1	+
	Ratio of R&D expenditure to main business income in large industrial enterprises	DIE_2	+
	Total social R&D expenditure	DIE_3	+
Talent Potential	Proportion of national public fiscal education spending in total fiscal expenditure	TP_1	+
	GDP of the tertiary industry	TP_2	+

This study uses the entropy method to calculate the Overall Index of Digital Economy Development Level. First, all indicators are normalized using the following approach:

$$x_i^{'} = (1 - \alpha) + \alpha \frac{x_i - min\{x_i\}}{max\{x_i\} - min\{x_i\}}$$

where 0<α<1 and, following prior research (Duan Yunlong et al., 2011), we set α=0.9\alpha = 0.9α=0.9. This shifts the normalized range to [0.1, 1] to avoid values of zero, which could distort subsequent calculations.

Next, the entropy method is applied to calculate the weights for each indicator. The process includes:

$$D_i = 1 - E_i$$

$$H_i = \frac{x_i}{\sum_{i=1}^{n} x_i}$$

$$E_i = -\frac{1}{ln(n)} \sum_{i=1}^{n} H_k ln(H_k)$$

$$W_{x_i} = \frac{G_i}{\sum_{k=1}^{n} G_k}$$

Once the weights are obtained, the overall index is constructed by multiplying the standardized values of each indicator by their respective weights and summing the results:

Digital Economy Development Level

$$Level = \sum W_i x_i^{'}$$

This completes the construction of the Overall Index of Digital Economy Development Level. The evaluation systems for the other explanatory variables follow a similar process.

4.2.3. Mediating variable

Artificial Intelligence Market Size (AIM). In examining the impact of the digital economy on female employment, this study selects the market size of artificial intelligence (AI) as a mediating variable because the development of AI technology is profoundly reshaping the structure and demand of the labor market. The rapid advancement of digital technologies has led enterprises to increasingly rely on intelligent solutions in their operations, directly influencing the supply–demand dynamics of the labor market, particularly in the context of female employment.

First, the widespread adoption of AI may increase demand for high-skilled labor—a challenge that women often face in the labor market. Therefore, analyzing how the size of the AI market mediates the relationship between the digital economy and female employment can help reveal gender differences in employment under the digital transformation. Second, the expansion of the AI market may also create new employment opportunities, especially in digital services and innovation-

driven sectors. Understanding how changes in AI market size act as a mediating mechanism in influencing female employment will provide policymakers with valuable insights for designing targeted interventions to promote gender equality and advance women's career development.

4.2.4. Control variable

Drawing on relevant research, this study includes population sex ratio as a control variable to account for other factors that may influence female employment.

Specifically, based on data from the China Statistical Yearbook, the population sex ratio for 2014–2022 is obtained. Given that the male population consistently exceeds the female population in China, this demographic imbalance may negatively affect female employment. Existing studies suggest that this effect is generally adverse. Therefore, the control variable in this study is defined as:

$$\text{Controls} = \frac{100}{\text{rate}}$$

4.3. Model specification

This study adopts a multiple linear regression model to analyze the impact of the digital economy on different dimensions of female employment. To examine how the overall development level of the digital economy influences female employment across its three dimensions (quantity, structure, and quality), the following baseline model is specified:

$$\text{Amount} = \alpha_{11} + \alpha_{12}\text{Level} + \alpha_{13}\text{controls} + \varepsilon_1$$

$$\text{Structure} = \alpha_{21} + \alpha_{22}\text{Level} + \alpha_{23}\text{controls} + \varepsilon_2$$

$$\text{Quality} = \alpha_{31} + \alpha_{32}\text{Level} + \alpha_{33}\text{controls} + \varepsilon_3$$

Where ε_i (i=1,2,3) represents the random error term.

To more comprehensively analyze the effects of different dimensions of digital economy development on various aspects of female employment, the following extended model is constructed:

$$\text{Amount} = \beta_{11} + \beta_{12}\text{coverage} + \beta_{13}\text{scale} + \beta_{14}\text{Environment} + \beta_{15}\text{controls} + \delta_1$$

$$\text{Structure} = \beta_{21} + \beta_{22}\text{coverage} + \beta_{23}\text{scale} + \beta_{24}\text{Environment} + \beta_{25}\text{controls} + \delta_2$$

$$\text{Quality}=\beta_{31} + \beta_{32}\text{coverage}+\beta_{33}\text{scale}+\beta_{34}\text{Environment}+\beta_{35}\text{controls}+\delta_3$$

Where δ_i (i=1,2,3) represents the random error term.

5. Empirical results and analysis

5.1. Baseline regression analysis

The overall impact of the digital economy development level on the different dimensions of female employment is summarized in Table 3, which tests and supports this study's hypotheses. The three rows of Table 3 report the regression results for the Overall Digital Economy Development Index (Level) on female employment quantity (Amount), female employment structure (Structure), and female employment quality (Quality). As shown, the estimated coefficients for the explanatory variable are all positive across the three regressions. This indicates that the overall level of digital economy development has a significant positive effect on female employment, improving opportunities and conditions across all dimensions. This finding reflects not only the increase in emerging occupations and flexible work forms enabled by the digital economy but also the growing recognition and career development space that women are achieving in the labor market. Overall, the development of the digital economy has created a more equal and diverse employment environment for women, advancing the process of gender equality.

Table 3. Effects of overall digital economy development on female employment

Variable	Overall Digital Economy Development Index	Control Variable	Constant Term
Amount	0.093***	−5.170	6.045**
Structure	1.014***	11.196	−10.557
Quality	1.727***	14.541	−12.845

*Note: *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Regarding the effects of different dimensions of digital economy development on female employment, the regression results are summarized in Table 4. This table presents the regression coefficients of Coverage of Digital Industrial Infrastructure (Coverage), Scale of Digital Industry Operations (Scale), and Digital Innovation Environment (Environment) on the three dimensions of female employment. The results show that none of the regression coefficients achieve statistical significance. This may be due to issues of multicollinearity, suggesting the need for further analysis to explore underlying influencing factors.

Table 4. Effects of different dimensions of the digital economy on female employment

Variable	Coverage	Scale	Environment	Control Variable	Constant Term
Amount	-0.201	0.063	0.041	-2.970	3.856
Structure	-0.792	0.330	0.407	0.591	-0.961
Quality	0.347	0.288	0.000	-9.519	9.670

5.2. Multicollinearity analysis

Based on the results above, the improvement of digital economy development is expected to have a positive impact on the different dimensions of female employment. However, the regression results show that the effects of individual dimensions of digital economy development on female employment were not statistically significant, which contradicts expectations. Therefore, it is necessary to conduct further tests on the multiple linear regression model to evaluate whether multicollinearity may be causing these discrepancies. First, the Variance Inflation Factors (VIFs) for the different dimensions of digital economy development were calculated and are summarized in Table 5. The results show that the VIF values for these dimensions are all significantly greater than 5, indicating severe multicollinearity. As a result, it is necessary to examine the independent effects of each dimension of digital economy development on each dimension of female employment. To address this, the following nine separate regression models were constructed:

$$Factor_i = a_{i1} + a_{i2}coverage + a_{i3}controls \ + \ a_i$$

$$Factor_i = b_{i1} + b_{i2}scale + a_{i3}controls \ + \ b_i$$

$$Factor_i = c_{i1} + c_{i2}environment + c_{i3}controls \ + \ c_i$$

where $Factor_i$ (i=1,2,3) respectively denote female employment quantity (Amount), female employment structure (Structure), and female employment quality (Quality); and a_i, b_i, c_i (i=1,2,3) represents the random error terms.

Table 5. Variance inflation factors for different dimensions of digital economy development

Factor	Variance Inflation Factor
Coverage	83.616
Scale	44.097
Environment	12.472

The results of independently considering the effects of each dimension of digital economy development on the dimensions of female employment are summarized in Table 6. The analysis shows that the regression coefficients for all dimensions of digital economy development are positive, indicating that each dimension has a significant positive effect on female employment when multicollinearity is controlled. This suggests that the previously constructed multiple regression models suffered from severe multicollinearity, leading to high correlations among explanatory variables and distorting the accuracy and significance of the estimated coefficients. After appropriate model correction and adjustment, the re-estimated regression results confirm that the different dimensions of digital economy development have significant positive impacts on all dimensions of female employment. For example, the widespread adoption of digital tools and platforms enables women to choose work times and locations more flexibly, allowing better work–life balance. Additionally, the digital economy promotes the emergence of new industries, offering women more career options and advancement opportunities, thus optimizing employment structure. In sum, the development of the digital economy has had a positive and far-reaching impact on the quantity, quality, and structure of female employment, providing new opportunities for gender equality in the modern economy and confirming the "creation mechanism" hypothesis proposed in this study.

Table 6. Corrected effects of different dimensions of the digital economy on female employment

Variable	Coverage	Scale	Environment	Control Variable	Constant Term
	0.072**			−7.673**	8.432**
Amount		0.020*		−5.993*	6.800**
			0.046*	−7.261	8.049*
	0.854***			−20.535	19.660
Structure		0.233***		0.909	−1.105
			0.610***	−21.165	20.337
	1.372***			−33.993*	33.416*
Quality		0.383***		−0.761	1.189
			0.887**	−26.324	26.291

5.3. Heterogeneity analysis

This study further explores the impact of the digital economy on female employment by conducting heterogeneity analyses based on industry, education level, and age. First, regarding industry heterogeneity, women's distribution in the labor market is uneven, with higher proportions in frontline positions and lower representation in management roles. To examine this, the female employment sample is divided into frontline positions and management positions, and the overall Digital Economy Development Index is used to analyze the differential effects of the digital economy in these industry contexts. Second, in the education-level heterogeneity analysis, women with different educational backgrounds face significant differences in employment opportunities, job quality, and compensation. Accordingly, the sample is divided into three groups: junior secondary school and below, senior secondary school (high school), and college and above. The study analyzes how the digital economy affects the employment outcomes of women with different levels of education. Finally, in the age heterogeneity analysis, women at different life stages encounter distinct employment challenges and opportunities. The sample is divided into three age groups: young women (16–29 years old), middle-aged women (30–49 years old), and older women (50–59 years old). The analysis investigates how the digital economy affects employment outcomes across these age groups. Below is the table defining the variables used in the heterogeneity analysis:

Table 7. Variable definitions and descriptions for heterogeneity analysis

Dimension	Indicator	Indicator Symbol
	Professional and technical staff	BAS_1
	Clerical staff	BAS_2
Frontline Positions	Commercial and service workers	BAS_3
	Agriculture, forestry, animal husbandry, and fishery-related	BAS_4
	Production equipment operators	BAS_5
Management Positions	Unit leaders / managers	ADM_1
Junior Secondary and Below	Share of high-quality employment	QR_1
Senior Secondary	Share of high-quality employment	QR_2
College and Above	Share of high-quality employment	QR_3
Age 16–29	Share of employment in digital economy-related roles	AR_1
Age 30–49	Share of employment in digital economy-related roles	AR_2
Age 50–59	Share of employment in digital economy-related roles	AR_3

Based on the results in Table 8, the impact of the digital economy development level on women's employment outcomes shows some heterogeneity across industries, though overall the effect is relatively limited. This suggests that factors beyond digital economy development—such as social and cultural factors—may also play important roles in explaining differences in women's employment across industries. For example, social norms and expectations may influence women's participation in certain sectors. Additionally, policy support, such as professional training and employment services, may play a positive role in promoting women's employment. The impact of digital economy development on female employment also exhibits heterogeneity across education levels. The results indicate that the digital economy has a significant positive effect on the

employment outcomes of women with higher education, especially those with college-level education or above. This suggests that the development of the digital economy creates more job opportunities and career development space for highly educated women. Employment among women with junior secondary education and below is also influenced by digital economy development. This may reflect the potential of the digital economy to create low-skilled job opportunities. However, for women with senior secondary (high school) education, the effect of the digital economy is not significant. This could be due to greater limitations in job choices for this group, or because they have not effectively leveraged digital technologies to improve their competitiveness during the transition to the digital economy.

Under the broader backdrop of digital economy development, age-based differences in women's employment outcomes also emerge. The results show that digital economy development has a significant positive effect on the employment of young women (16–29 years old). This may be because younger women are more adaptable to new technologies and work models, enabling them to find more employment opportunities in the digital economy. In contrast, the employment of middle-aged (30–49 years old) and older women (50–59 years old) does not show a significant response to digital economy development. This may be related to factors such as their accumulated work experience, skills matching, or varying levels of willingness to change jobs or adopt new technologies.

Table 8. Effects of digital economy development on female employment across industry, education, and age groups

Heterogeneity Dimension	Variable	Digital Economy Development Index	Control Variable	Constant Term
Industry Heterogeneity	BAS	8.272^*	-520.830	581.228
	ADM	8.272^*	-520.830	581.228
Education Heterogeneity	$EDUBG_1$	-30.660^*	-1508.428	1475.659
	$EDUBG_2$	2.539	-1125.374^*	1079.502^*
	$EDUBG_3$	25.307^{***}	-188.496	190.919
Age Heterogeneity	AGE_1	14.096^{***}	100.034	-94.310
	AGE_2	5.484^*	402.726	-379.992
	AGE_3	-2.768	-130.363	127.633

6. Mediation effect analysis

The rapid development of the digital economy—especially the widespread application of artificial intelligence (AI) technologies—is profoundly reshaping the traditional labor market and can have important implications for female employment.

First, from the perspective of employment quantity, the boom in the digital economy has created a large number of new job opportunities for women. In particular, in fields such as information technology and e-commerce, women can engage in flexible employment through online platforms. Compared to traditional industries, the flexibility of the digital economy enables women to better balance work and family life, thereby increasing their labor force participation rate. However, the realization of this trend is closely tied to the scale of the AI market. As the AI sector continues to expand, demand for female labor in related industries is also increasing. Second, employment quality is another critical dimension. The digital economy generally offers relatively higher wages and better career development opportunities, especially in high-tech and innovation-driven sectors. However, women's participation in these fields still faces numerous challenges, such as gender discrimination and career advancement bottlenecks. Therefore, although the digital economy provides women with higher-quality employment opportunities, the extent to which they benefit can vary depending on socio-cultural contexts and industry structures. The expansion of the AI market may help alleviate some of these inequalities by increasing women's representation in high-quality positions.

In summary, the growth of the digital economy and AI markets brings both opportunities and challenges for women's employment. Mediation effect analysis enables a deeper exploration of how the AI market size (AIM) influences the relationship between the digital economy and both the quantity and quality of female employment. This section empirically tests these proposed mechanisms using the following mediation effect models:

$$Factor_i = m_{i1} + m_{i2}level + m_i$$

$$Factor_i = n_{i1} + n_{i2}level + n_{i3}aim + n_i$$

$$AIM = p_1 + p_2 Level + p_3$$

where $Factor_i$ (i=1,2) respectively denote female employment quantity (Amount) and female employment structure (Structure); and AIM ; m_i , n_i (i=1,2) p_3 represent the random error terms.

Table 9 presents the regression results for the mediation effect of AI market size on female employment quantity. Column (1) shows that the coefficient of Level on Amount is 0.109, which is significant at the 1% level. This indicates that a one-unit increase in the overall level of digital economy development is associated with a 10.9% increase in employment quantity, confirming that digital economy development effectively promotes employment quantity. Column (2) shows that the coefficient of Level on AIM is 3388.6, also significant at the 1% level, suggesting that a one-unit increase in digital economy development leads to a 3388.6-unit increase in AI market size, demonstrating that the digital economy effectively drives the expansion of the AI market. Column (3) includes both Level and AIM in the regression on Amount, and both coefficients are significantly

positive. This result supports the existence of a mediation effect, indicating that the development of the digital economy not only transforms the global economy but also creates more employment opportunities, particularly for women in the growing AI sector as technology advances and application scenarios expand.

Table 9. Mediation effect of AI market size on female employment quantity

	(1)	(2)	(3)
VARIABLES	Quality	AIM	Quality
Level	1.686***	3388.6***	0.845**
	(40.51)	(27.84)	(2.58)
AIM			0.000248**
			(2.59)
Constant	0.953***	-612.8***	1.106***
	(40.17)	(-8.83)	(18.00)
Observations	9	9	9
R-squared	0.996	0.991	0.998
AdjustedR-squared	0.995	0.990	0.997
F	1641.15***	775.22***	1490.67***

t-statistics in parentheses

***p<0.01,**p<0.05,*p<0.1

Table 10 shows the regression results for the mediation effect of AI market size on female employment quality. Column (1) indicates that the coefficient of Level on Quality is 1.686, significant at the 1% level. This implies that a one-unit increase in digital economy development is associated with a 1.686-unit increase in employment quality, confirming the digital economy's positive role in enhancing employment quality. Column (2) mirrors the results from Table 9 and is omitted here for brevity. Column (3), which includes both Level and AIM in the regression on Quality, shows that both variables have significantly positive effects. This confirms the mediation effect, suggesting that the digital economy's support for AI development has introduced flexible work formats and remote work opportunities, enabling women to better balance family and career. Moreover, AI innovation allows women to play a greater role in high-tech positions, enhancing their career competitiveness and creating higher-quality employment opportunities.

Table 10. Mediation effect of AI market size on female employment quality

VARIABLES	(1)	(2)	(3)
	Amount	AIM	Amount
Level	0.109***	3388.6***	0.0584***
	(54.52)	(27.84)	(6.16)
AIM			0.0000150***
			(5.37)
Constant	1.102***	-612.8***	1.111***
	(965.00)	(-8.83)	(623.41)
Observations	9	9	9
R-squared	0.998	0.991	0.999
Adjusted R-squared	0.997	0.990	0.999
F	2972.41***	775.22***	7417.72***

t-statistics in parentheses

***$p<0.01$,**$p<0.05$,*$p<0.1$

7. Conclusion

This paper constructs an evaluation index system for the level of digital economy development based on its core connotations, comprising 5 primary indicators and 13 secondary indicators, and calculates the overall Digital Economy Development Index for China from 2014 to 2022 using the entropy method. At the same time, it incorporates indicators of female employment quantity, structure, and quality into a comprehensive evaluation system to measure women's employment levels scientifically. Through theoretical and empirical analyses, this study explores the effects and mechanisms of the digital economy's impact on female employment. The main findings are as follows: First, the development of the digital economy has a significant positive effect on the quantity, structure, and quality of female employment. Even when replacing the overall index with individual sub-dimensions—such as digital infrastructure coverage, scale of digital industry operations, and level of digital innovation environment—the positive effects on women's employment remain significant. Second, the digital economy promotes female employment by expanding the scale of the artificial intelligence market, not only increasing the number of suitable jobs for women but also improving the quality of those jobs. Third, the positive effect of the digital economy on female employment shows heterogeneity across industries, education levels, and age groups. Overall, while industry-based differences exist, they are relatively limited. In terms of education, the digital economy benefits women with college education and above more than those with junior secondary education or below, while women with senior secondary (high school) education do not show significant improvement from digital economy development. Regarding age, young women (under 30) benefit significantly from the development of the digital economy, while women over 30 do not experience a significant impact.

Based on these findings, this paper offers the following policy recommendations on how to further promote female employment through the development of the digital economy: First, the government should increase investment in digital infrastructure in rural and underdeveloped areas,

such as expanding 5G networks, cloud computing platforms, and other information technology facilities. This would help bridge the digital divide between urban and rural regions while creating more employment opportunities for women.

By providing convenient internet access, women can more easily participate in online education, remote work, e-commerce, and other emerging sectors, thereby improving their employment rate and income levels. Additionally, the government should encourage private sector participation in infrastructure development through public-private partnerships, promoting the spread of digital technologies in remote areas so that more women can benefit from the growth of the digital economy. Second, it is important to expand the market scale of emerging industries such as artificial intelligence and optimize the employment structure of the digital economy, especially in technology, R&D, and management roles, by encouraging greater female participation. This can be achieved through the establishment of special funds, training programs, and career guidance to help women enhance their skills and strengthen their competitiveness. At the same time, companies should prioritize gender diversity, implement inclusive hiring policies, and create more equal employment environments to reduce gender disparities in wages and career advancement. Third, targeted talent development programs should be established to encourage women to pursue advanced studies in digital technologies, including scholarships and internship opportunities. The government can also partner with companies to launch more internship and employment projects tailored for young women to help them transition smoothly into the workforce. For older women, efforts should focus on vocational training and re-skilling, while offering flexible working hours and remote work options. Companies should be encouraged to adopt gender equality policies and support female entrepreneurship, thereby strengthening societal recognition and support for women's employment.

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