

Digital Economy and Employment Quality in China: The Mediating and Moderating Role of Educational Resource Allocation

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Abstract

Using provincial panel data from 30 Chinese provinces over the period 2011–2022, this paper employs fixed-effects models to examine the impact of digital economy development on employment quality. The results reveal that digital economy development significantly improves employment quality, with this effect remaining robust after addressing potential endogeneity and using different model specifications. Additionally, the study shows that investment in educational resources partially mediates the relationship between the digital economy and employment quality. Notably, the structure of educational resources, as measured by the average size of higher education institutions, exhibits a significant negative moderating effect, challenging conventional expectations. The findings further highlight that the positive effects of the digital economy on employment quality are stronger in the eastern and central regions than in the western and northeastern regions. However, it should be noted that the positive impact is mainly concentrated in the “work environment” subdimension, with no significant effects observed on work income and labor protection. Based on these findings, the study suggests that improving employment quality in the digital economy requires not only continued digital development but also increased investment in education and better alignment of higher education resource allocation with regional development needs.

Keywords: 1) Digital Economy 2) Employment Quality 3) Higher Education Resource Allocation 4) Fixed-Effects Panel 5) Labor Market Adjustment

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Introduction

Employment is one of the most fundamental livelihood issues in society, as it not only affects residents' well-being but also concerns the long-term stability and harmonious development of society and the nation. In the context of China entering the stage of high-quality development, simply increasing the number of jobs can no longer meet the needs of economic and social development. According to data from the National Bureau of Statistics, by 2024, China's employment scale has reached 734 million people, but the growth rate has turned negative, and the scale is gradually declining. As the demographic dividend fades, the transformation of human resources has become a pressing issue that needs to be addressed. Enhancing the quality of employment has become an urgent task. High-quality employment involves not only the stability of workers' income and the potential for career development but also serves as a key factor in measuring social fairness and inclusiveness. In recent years, the Chinese government has emphasized in several planning reports the importance of improving employment quality to promote high-quality economic development and ensure that workers have access to decent, stable, and development-oriented job opportunities.

The rapid development of the digital economy has had a profound impact on employment structure, employment methods, and labor supply and demand relationships. With the widespread application of digital technologies across industries, the labor market's demand has shifted from reliance

on traditional generic skills to a demand for higher-level digital skills, composite skills, and continuous learning capabilities. This change requires workers to continuously adapt to new technological developments and enhance their skills to remain competitive in the job market. Existing research suggests that the digital economy significantly enhances workers' market competitiveness by improving their skills, especially digital skills, thereby improving employment quality (Cai, Liu and Zhang, 2024, p. e26536). Additionally, the digital economy has improved employment quality by increasing income levels and benefits, especially in technology-intensive industries (Chen and Xiong, 2025, p. 127). At the same time, the digital economy has promoted industrial upgrading, optimized the employment structure, and created more high-skill, high-income positions (Huang, 2025, p. 22). It is evident that recent research has begun to focus on improving employment quality, but it mainly concentrates on how technological progress and industrial upgrading enhance employment quality.

According to human capital theory, education is a key means of improving workers' knowledge and skills, significantly enhancing their labor productivity and thus influencing their income levels. In theory, the enhancement of workers' human capital is closely related to the scale, structure, and quality of education: the scale of education determines the number of talents that can be cultivated, the structure of education determines the types of talents to be trained, and the quality of education is key to cultivating innovative, high-skilled talents (Lai, 2022, p. 136). However,

existing educational research largely simplifies educational factors and human capital into single indicators such as years of schooling or educational attainment. While these indicators reflect human capital accumulation to some extent, they fail to adequately consider the demand for emerging skills in the context of the continuous development of the digital economy. Years of schooling and educational attainment only partially reflect workers' knowledge accumulation and are insufficient to accurately capture the skills and adaptability required by the digital economy. Therefore, the impact of the digital economy on the labor market is not only mediated by years of schooling but, more importantly, by how the allocation of educational resources influences the quality and types of workers' skills.

The allocation of educational resources determines the supply of talent for the digital economy and influences workers' skills and employment quality. In this context, the digital economy reshapes labor demand by increasing the need for high-level and digital skills, while educational resource allocation determines the supply of such skills. Therefore, employment outcomes depend on the degree of matching between labor demand and supply, through which educational resource allocation serves as a key channel linking the digital economy and employment quality. Under the development of the digital economy, the allocation of educational resources needs to be dynamically adjusted in response to changes in industrial structure and technological progress, thereby enhancing workers' skill levels and enabling them to meet the demand for high-skilled and

composite talents. Therefore, optimizing the allocation of educational resources can not only improve the adaptability of educational scale and structure but also, by enhancing educational quality, cultivate more high-skilled talents that meet the requirements of the digital economy, directly impacting employment quality.

This paper fills the gap in existing literature where educational factors have been overly simplified, providing a new theoretical explanation for understanding the mechanisms behind employment quality differences in the context of the digital economy. It also offers empirical evidence through a systematic analysis of how the allocation of educational resources affects different dimensions of employment quality, providing insights into how the education system can more effectively respond to the digital economy's demand for talent structure.

Literature Review

1) An Overview of the Impact of the Digital Economy on Employment Quality

In recent years, with the rapid development of digital technologies, academic research on the relationship between the digital economy and employment quality has continued to deepen. Overall, the existing literature generally agrees that the digital economy has a significant impact on employment quality; however, the direction and mechanisms of this impact are complex and multifaceted (Li, 2022, pp. 37-42). And, digital transformation enhances labor productivity, enabling workers to obtain higher income returns (Zhou, Lyu and Li,



2025, p. e0325484). Third, the digital economy promotes industrial upgrading (Guan, Guo and Zhang, 2022, p. 11378) and facilitates the movement of labor toward high value-added sectors, thereby enabling upward occupational mobility. (Xiaole, Qiang and Yang, 2023, pp. 86-100)

On the other hand, some scholars argue that the digital economy may have negative effects on employment quality. First, the technological substitution effect reduces low-skilled jobs, increasing employment instability for some workers (Manning, 2004, pp. 581-608). Second, the rise of the platform economy has strengthened flexible employment. While it increases job access, it often comes with weaker social protection and labor rights (Behrendt, Nguyen and Rani, 2019, pp. 17-41). Third, algorithmic management and digital monitoring may reduce workers' autonomy, thereby affecting job satisfaction and decent work conditions (Rani and Furrer, 2021, pp. 212-236).

Building on this, an increasing number of studies have begun to focus on the non-linear characteristics of the digital economy's impact on employment quality (Tao, Zhi and Shangkun, 2020, p. 393). Some scholars have found that, in the early stages of digital economy development, employment inequality may worsen, but as it reaches a certain level of development, its positive effects gradually emerge (Bai, Li and Song, 2023, pp. 38-50). Moreover, the impact of the digital economy varies significantly across different groups, with high-skilled workers typically benefiting more, while low-skilled workers are more vulnerable to substitution shocks (Lee and Clarke, 2019, p.

103803; Yang, Yao and Dong, 2023, p. 7).

2) Mechanism Analysis of the Impact of the Digital Economy on Employment Quality

Currently, research on the mechanisms through which the digital economy impacts employment quality is still evolving. Existing literature primarily focuses on changes in industrial structure, labor market structure, and the enhancement of human capital.

The digital economy accelerates the upgrading and transformation of traditional industries, shifting low-value-added labor positions to higher-value-added ones (Liu, et al., 2023, p. 14176). It drives the digitalization of industries and the industrialization of digital technologies, fundamentally changing the operation models of traditional industries (Hao, Zhu and Zhang, 2023, pp. 1025-1036).

The digital economy affects not only industrial structures but also the employment structure. The transformation of the employment structure, as one of the key mechanisms in the relationship between the digital economy and employment quality. The digital economy has driven the growth of high-skilled positions, particularly in technology-intensive industries such as data analytics, artificial intelligence, and programming, while the demand for traditional low-skilled positions has decreased. The digital economy has driven the growth of high-skilled positions, while the demand for traditional low-skilled positions has decreased. On the one hand, flexible employment provides more job opportunities, especially for those seeking flexible working hours or locations (Wang, Li and Gao, 2024,

p. e24654). On the other hand, the instability and lack of protection associated with flexible jobs place some workers in low-income and unstable work situations, leading to a decline in employment quality (Jahn, Riphahn and Schnabel, 2012, pp. F115-F124).

And digital economy enhances employment quality by raising human capital levels and salary conditions. The digital economy drives improvements in labor skills through training, education, and the application of digital technologies. As workers' skill levels increase, they gain access to higher-skill and higher-paying jobs, thereby improving overall employment quality (Liu, et al., 2023, p. 14176).

3) The Role of Human Capital and Educational Resource Allocation in the Impact of the Digital Economy on Employment Quality

This study is grounded in Human Capital Theory, this theory views individuals as a form of capital, as education, training, and health contribute to the accumulation of knowledge, skills, and abilities, which enhance employability and work capacity and thus affect income levels (Mincer, 1974). In studies on the employment effects of digital economy development, mechanism analysis has focused mainly on labor demand, while employment outcomes depend not only on job availability but also on the supply of talent. From the perspective of talent supply, it is therefore necessary to examine employment outcomes through the lens of human capital.

Currently, human capital is typically measured by average years of schooling.

However, in today's rapidly evolving digital economy, the labor force needs not only a basic educational background but also digital skills, technical innovation capabilities, and the ability to adapt to constantly changing job requirements (Wang and Wang, 2012). Using years of schooling as a measure neglects differences in the content of education and the specific professional skills required in the workforce, which limits its applicability in the context of the digital economy (Yun, Huang and Zhu, 2025, p. 10). Furthermore, according to World Bank data, China's higher education enrollment rate has reached 77%, indicating that more people are gaining access to higher education. To more accurately assess the capabilities of the labor force and employment quality in the digital economy, it is essential to consider educational as a crucial variable in human capital analysis (Min and Zhang, 2025, pp. 75-93). High-quality educational resource allocation not only helps the workforce improve existing skills but also enables them to adapt to rapidly changing industry demands, thereby enhancing employment quality.

Educational resource allocation acts as a mediating factor between the digital economy and employment quality. First, investments in digital infrastructure and technical training enhance workers' digital skills, enabling them to adapt to new industry demands and secure high-skill, high-paying positions (Songwathana, 2025, pp. 648-652). Second, educational resource allocation determines whether the education system can adjust its curriculum to align with market needs, helping the labor force access better job opportunities



and career development (Wicht, et al., 2019, pp. 254-269). Finally, equitable distribution of educational resources plays a key role in promoting social fairness (Omoeva, C., Cunha, N. M. and Moussa, 2021, p. 102492). Particularly in remote areas and low-income groups, inadequate educational resources may lead to skill gaps, thus affecting overall employment quality. Therefore, educational resource allocation not only enhances labor force skills but also fosters social equity, making it a crucial mediating factor in the digital economy's impact on employment quality.

4) Hypothesis

Based on the above discussion, this study proposes the following hypotheses:

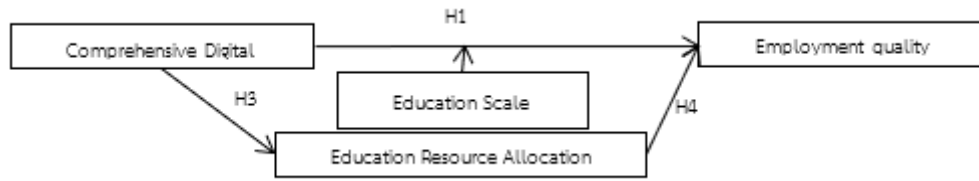


Figure 1 conceptual framework

Data and Methodology

1) Methodology

This study uses panel data for 30 Chinese provinces, excluding Tibet, Hong Kong, Macao, and Taiwan, from 2011 to 2022, and conducts empirical analysis using fixed effects model.

Estimation Model:

$$EmQ_{it} = \alpha_1 DE_{it} + \alpha_2 C_{it} + Y_i + v_t + \varepsilon_{it} \quad (1)$$

In this equation, EmQ_{it} : Employment quality in province i during year t . DE_{it} : Digital economy development level in province i during year t . Y_i : Fixed effects. v_t : Year Fixed Effects. ε_{it} : Error term. C_{it} : Control variables.

Mediating Effect Model:

$$ERA(I)_{it} = \gamma_1 DE_{it} + \gamma_2 C_{it} + Y_i + v_t + \mu_{it}$$

H1: The development of the digital economy has a positive impact on the quality of employment.

H2: The development of the digital economy has a positive impact on education resource allocation.

H3: The level of educational resource investment plays a mediating role in the relationship between digital economy development and employment quality

H4: Educational resource structural differences moderate the impact of the digital economy on employment quality.

$$EmQ_{it} = \beta_1 DE_{it} + \beta_2 ERA(I)_{it} + \beta_3 C_{it} + Y_i + v_t + \varepsilon_{it} \quad (2)$$

$ERA(I)_{it}$ is the mediating variable, representing the allocation of educational resources in province i in year t . It consists of two dimensions: education expenditure input and computer investment related to digital literacy.

Moderating Effect Model:

$$EmQ_{it} = \gamma_0 + \gamma_1 DE_{it} + \gamma_2 ERA(s)_{it} + \gamma_3 (DE_{it} \times ERA(s)_{it}) + \gamma_4 C_{it} + Y_i + v_t + \varepsilon_{it} \quad (3)$$

$ERA(s)_{it}$: is the moderating variable, The structural dimension of educational resource allocation in Province i and year t , reflecting the organizational structure and concentration of educational resources, measured by average enrollment per school.

2) Variable definitions

In this study, the digital economy is measured using the composite index proposed by Zhao, et al. (2022, p. 393) and calculated with the entropy method (Tao, Zhi and Shangkun, 2020, p. 393). Employment quality is measured using the composite index constructed by Qi, Liu and Ding (2020, pp. 17-35), also calculated with the entropy method (Qi, Liu and Ding, 2020, pp. 17-35). Educational resource allocation is captured along two dimensions, namely input intensity and scale structure. Input intensity is measured by per student higher education expenditure and the number of digital terminals per student, which reflect the level of resource provision for talent cultivation in the higher education system. The structure of higher education resources is measured by the average number of enrolled students per higher education institution in

each province, which reflects organizational capacity and the distribution of institutional scale.

GDP, population density, and financial development all influence regional economy, labor markets, and educational resource allocation, and controlling for them helps eliminate their potential impact on employment quality (Tao, Zhi and Shangkun, 2020, p.393). Road area per capita reflects infrastructure level, which reduces costs and improves employment quality. Similarly, per capita education expenditure enhances human capital, thereby boosting employment quality. These variables are included to control for their effects (Lai, 2022, p.136). Government intervention affects regional education and employment policies, therefore it is included as a control variable. (Ge and Wu, 2022, p.643)

Table 1 Variable Definitions Table

	Variable	Secondary indicator	Variable Definition	Unit	variable symbol	Data Source
Independent Variable	Comprehensive Digital Economy Development	-	Comprehensive Digital Economy Development Index	-	DE	The composite index was constructed and calculated following Zhao tao (Tao et al., 2020)
Dependent Variable	Employment Quality	-	Comprehensive Employment Quality Index	-	EmQ	The composite index was constructed and calculated following Qi Yudong, Liu Cuihua, and Shu Lei (2020)



	Variable	Secondary indicator	Variable Definition	Unit	variable symbol	Data Source
Mediator Variable	Education Resource Allocation Investment Level	Higher Education Investment Level	per-student higher education expenditure	10,000 yuan.	HIL	Educational Statistics Yearbook China Educational Finance Statistical Yearbook
		Digital Literacy	number of computers per student	units	QL	
Moderation Variable	Education Resource Allocation Structural	Higher Education Scale	average number of enrolled students per higher education institution	units	ERA(S)	
Control Variable	GDP	-	The GDP of the province in the given year after being processed by the natural logarithm.	ln(million CNY)	GDP	National Bureau of Statistics of China (NBS) Official Website
	Population Density	-	Population Density	People per square kilometer	PD	
	Urban road area per capita	-	Urban road area / Population	%	Area	
	Per capita education funding	-	Total Education Funding / Total Population	-	EdI	
	Level of financial development		Balance of RMB loans / Regional GDP	%	Fin	
	Government intervention	-	Fiscal expenditure / Regional GDP	%	Gov	

The Employment Quality Composite Index is constructed using the entropy method to calculate the weights for each indicator. The weights for the indicators in the Employment Quality Composite Index are as follows: (1) Average Labor Productivity is 0.0767. (2) GDP Growth is 0.0126. (3) Share of Employment in

the Tertiary Sector is 0.0324. (4) Urbanization Rate is 0.0285. (5) Transportation Accessibility is 0.2120. (6) Years of Education is 0.0111. (7) Share of Workers with a College Degree is 0.0524. (8) Labor Force Receiving Training is 0.1023. (9) Employment in High-Skilled Occupations is 0.1097.

Table 2 Employment Quality Index

Objective Level	Primary Indicator	Secondary indicator	Indicator type
Employment Quality	Employment Environment	Per Capita Real Gdp Level	Positively (+)
		Per Capita Real Gdp Growth Rate	Positively (+)
		Proportion of Employment in The Tertiary Industry	Positively (+)
		Proportion of Urban Employment	Positively (+)
		Urban Registered Unemployment Rate	Negative (-)
		Transportation Accessibility	Positively (+)
	Employment Ability	Average Years of Education for the Labor Force	Positively (+)
		Proportion of Employees with A College Degree or Higher	Positively (+)
		Proportion of The Labor Force Receiving Training	Positively (+)
		Proportion of Skilled Workers	Positively (+)
	Labor Remuneration	Average Wage of Urban Unit Employees	Positively (+)
		Growth Rate of The Average Wage of Urban Unit Employees	Positively (+)
		Coverage Rate of Urban Employee Medical Insurance	Positively (+)



Objective Level	Primary Indicator	Secondary indicator	Indicator type
Employment Quality	Labor Remuneration	Coverage Rate of Urban Employee Pension Insurance	Positively (+)
		Urban-Rural Income Gap	Negative (-)
		Wage Disparity Between Sectors	Negative (-)
		Union Participation Rate	Positively (+)
	Labor Protection	Severity of Labor Disputes	Negative (-)
		Work-Related Injury Incidence Rate	Negative (-)
		Occupational Disease Incidence Rate	Negative (-)

The entropy method was used to calculate the weights for both the Digital Economy and Employment Quality Composite Indices. First, each indicator was standardized, and then its entropy was calculated. Indicators with lower entropy, meaning more variation, were

given higher weights. Positive indicators were assigned positive weights. Negative indicators were assigned negative weights. These weights were then used to create the composite indices.

Table 3 Digital Economy Development Index

Objective Level	Primary Indicator	Secondary indicator	Indicator type
Comprehensive Digital Economy Development Index	Internet Penetration Rate	Number of Internet Users per 100 people	Positively (+)
	Number of Internet-Related Employees	Proportion of Employees in Computer Services and Software	Positively (+)
	Internet-Related Output	Per Capita Total Telecommunications service volume	Positively (+)
	Number of Mobile Internet Users	Number of mobile phone users per 100 people	Positively (+)
	Digital Financial Inclusion development	China Digital Financial Inclusion Index	Positively (+)

Results and Discussions

Table 4 reports the correlation coefficients among the main variables. The results show a significant positive correlation between the digital economy (DE) and employment quality (EmQ), providing preliminary evidence that digital economy development is closely associated with improvements in employment quality. Further variance inflation factor tests show that all values are below 10, with an average VIF of 3.13, indicating that there is no multicollinearity problem in the model. To

verify the validity of the model specification, this study conducts the necessary diagnostic tests. The F-test strongly rejects the pooled OLS model in favor of fixed effects ($F(29, 312) = 17.37, p < 0.001$). The Breusch–Pagan Lagrange Multiplier test supports the use of a panel data model ($p < 0.001$). The Hausman test ($\chi^2 = 90.20, p < 0.001$) favors the fixed-effects specification over random effects. Overall, these tests confirm the appropriateness of the fixed-effects panel model.

Table 4 Correlation analysis.

	EmQ	DE	GDP	PD	Area	EdI	Fin	Gov
EmQ	1							
DE	.896***	1						
GDP	.331***	.393***	1					
PD	-.074	-.027	.038	1				
Area	.259***	.329***	.048	-.312***	1			
EdI	-.014	-.091*	-.626***	-.090*	.135**	1		
Fin	.568***	.571***	-.258***	-.101*	.229***	.313***	1	
Gov	-.180***	-.181***	-.841***	.047	-.043	.613***	.401***	1

1) Descriptive Statistics

The descriptive statistics reported in Table 4 show a total of 360 observations. The core variable, the employment quality index (EmQ), indicates substantial variation in employment quality across regions, with a slightly right skewed but generally stable dis-

tribution. The digital economy variable reveals large regional disparities in the level of digital economy development. In terms of educational resource allocation, pronounced regional differences suggest uneven distribution of educational resources, while the structure of educational resources appears relatively stable.

Table 5 Descriptive statistics.

	count	mean	sd	min	max	skewness	kurtosis
EmQ	360	0.278	0.093	0.112	0.619	0.777	3.779
DE	360	0.323	0.164	0.022	0.871	0.304	2.647
HIL	360	3.746	3.076	1.232	22.550	3.703	18.000
QL	360	0.413	0.199	0.131	1.375	2.673	11.253



	count	mean	sd	min	max	skewness	kurtosis
ERA(S)	360	1.026	0.244	0.441	1.810	0.354	3.105
GDP	360	9.864	0.895	7.223	11.772	-0.516	3.224
PD	360	7.908	0.398	6.639	8.669	-0.217	2.486
Area	360	9.621	2.938	3.140	17.164	0.440	2.698
EdI	360	0.781	1.152	0.009	9.660	4.206	26.267
Fin	360	1.466	0.422	0.665	2.691	0.565	2.797
Gov	360	0.258	0.111	0.104	0.758	1.740	7.420

2) Baseline regression results

Based on Model (1), Table 6 reports the estimation results. Columns (1) to (4) sequentially add control variables, fixed effects, and province level robust standard errors. The results in columns (1) to (3) show a positive effect of the digital economy on employment quality. After the inclusion of fixed effects, the coefficient decreases, indicating the presence of regional heterogeneity that warrants further

analysis. After controlling for robust standard errors, the final coefficient of the digital economy (DE) is 0.325 and remains positive and significant at the 5% level. This implies that a one-unit increase in DE is associated with an average increase of 0.325 units in employment quality (EmQ), reflecting a broad enhancement in employment conditions, including better wages, job stability, and improved social benefits.

Table 6 EmQ Baseline regression results.

	(1)	(2)	(3)	(4)
DE	0.452***	0.604***	0.325***	0.325**
	-0.011	-0.024	-0.058	-0.126
cons	0.132***	0.710***	-0.133	-0.133
	-0.006	-0.104	-0.185	-0.285
Control	No	Yes	Yes	Yes
ID FE	No	No	Yes	Yes
Year FE	No	No	Yes	Yes
Clustered	No	No	No	Yes
Observations	360	360	360	360
R ²	0.8384	0.8724	0.9403	0.9403

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

3) Endogeneity analysis

There is an endogeneity issue because digital economy development and employment quality may mutually influence each

other, creating a potential reverse causality problem. Following Huang (Huang, YongzeYu and Zhang, 2019, pp. 5-23) and Zhao Tao, Zhi and Shangkun, 2020, p. 393), the digital

economy may be endogenous. To address this concern, an instrumental variable approach is employed following Nunn and Qian (2014, p. 1630-1666). The instrument is constructed as the interaction between regional telephone penetration in 1984 and the lagged national internet penetration rate. Historical communication infrastructure is strongly correlated with digital economy development through its effect on internet diffusion, while it does not directly affect employment quality after controlling for region and year fixed effects.

Column (1) reports the first stage results, showing a significant positive relationship between the instrumental variable and digital

economy development (DE), indicating strong instrument relevance. The Kleibergen Paap LM statistic is significant, rejecting the null hypothesis of underidentification. In addition, the Kleibergen Paap Wald F statistic exceeds the conventional threshold of 16.38, suggesting that weak instrument concerns are unlikely. Column (2) reports the second stage results. After addressing endogeneity, digital economy development (DE_S) remains positively and significantly associated with employment quality (EmQ), supporting the study hypothesis and indicating a causal effect of the digital economy on employment quality.

Table 7 Instrumental Variable.

Variables	(1) DE	(2) EmQ
IV	0.001*** (4.48)	
DE		0.638** (2.53)
control	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Observations	360	360
Kleibergen–Paap rk LM	8.52***	
Kleibergen–Paap rk Wald F	20.08 (P = 0.000)	
Cragg–Donald Wald F	26.16(Threshold = 16.38)	

4) Robustness checks

To examine the robustness of the baseline results, this study re measures the level of digital economy development using principal component analysis and replaces the digital economy indicator in the baseline regressions. The results show that the

direction and significance of the effect of the digital economy on employment quality and employment quantity remain unchanged, indicating that the baseline conclusions are robust.

**Table 8** Robustness checks

	(1)	(2)
DE	0.325**	
	-0.126	
DE(P)		0.598**
		-0.271
cons	-0.133	-0.571*
	-0.285	-0.286
Control	No	Yes
ID FE	Yes	Yes
Year FE	Yes	Yes
Clustered	Yes	Yes
R2	0.8384	0.8724

* p < 0.1, ** p < 0.05, *** p < 0.01, N=360

5) Further analysis

To further identify which aspects of overall employment quality are improved by the digital economy, this study examines the four dimensions of the composite employment quality index, namely work environment, work ability, work income, and employment protection. The results reported in Table 9 show that digital economy development has a significant and positive effect on the work environment dimension. Specifically, the digital economy coefficient is positive and significant at the 1 percent level, indicating that

regions with higher levels of digital economy development tend to exhibit better working conditions, higher job matching efficiency, and a more favorable employment environment. Based on the results, the development of the digital economy has a significant and positive impact only on the work environment. This suggests that the digital economy's effect on employment quality primarily occurs through the improvement of the work environment. As the digital economy grows rapidly, it provides more flexible job opportunities, enhances job matching, and increases workplace efficiency.

Table 9 Effects of the digital economy on sub-dimensions of employment quality

	Jobenv	Jobability	Jobincome	Jobprotect
DE	0.350***	(0.05)	0.01	0.01
	(0.09)	(0.08)	(0.06)	(0.04)
Obs.	360	360	360	360
Control	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes
R ²	0.9445	0.0442	0.8937	0.372

6) Heterogeneity Analysis

Table 10 reports the regional heterogeneity in the effect of the digital economy on employment quality. The regression results show substantial regional differences in this effect. Digital economy development significantly improves employment quality in the eastern and central regions, with estimated coefficients of 0.587 in the eastern region ($p < 0.01$) and 0.644 in the central region ($p < 0.05$). In contrast, the estimated coefficients for the western region (0.058) and the northeastern region (0.184) are not statistically significant. More specifically, the eastern and central regions benefit from stronger economic foundations,

more advanced digital infrastructure, and higher levels of human capital accumulation. As a result, the digital economy can be more easily integrated with existing industrial systems and labor markets, thereby improving job structure and employment matching conditions, enhancing the employment environment, and ultimately raising overall employment quality. By contrast, in the western and northeastern regions, constraints such as weaker digital infrastructure, insufficient industrial support, and limited capacity to attract talent hinder the effective transformation of digital economy development into high-quality employment opportunities.

Table 10 Heterogeneity Analysis

	Eastern	Central	Western	Northeastern
DE	0.587***	0.644**	0.058	0.184
	(0.17)	(0.23)	(0.22)	(0.22)
cons	-0.428	0.721	0.166	-1.513
	-0.762	-0.887	-0.486	-1.377
Obs.	120	72	132	36
Control	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes
R ²	0.9531	0.9806	0.9474	0.9889

7) Mediating effect

Columns (1) and (2) of Table 11 report the effects of digital economy development (DE) on indicators of higher education resource input. The results show that the digital economy has positive and significant effects on both indicators at the 5 percent level. Specifically, the coefficient of the digital economy on digital

education resource input in higher education (QL) is 0.432 ($p < 0.05$), and the coefficient on per student higher education expenditure (HIL) is 15.937 ($p < 0.05$), indicating that digital economy development promotes both digital investment and financial support in higher education. When digital education resources in higher education (QL) are included in the



model, column (4) shows that the coefficient of QL on employment quality is 0.109 and significant at the 5 percent level, suggesting that investment in digital educational resources such as digital terminals significantly improves employment quality. At the same time, the coefficient of DE decreases from 0.325 to 0.278 but remains significant, indicating a partial mediating effect of the number of digital terminals per student in higher education. After adding per student higher education expenditure (pre-HIL) to the model, column (5) shows that the coefficient of preHIL on employment quality is 0.004 and significant at the 10 percent level, while the coefficient of DE further declines to 0.255. This suggests that the mediating effect through education expenditure is relatively weaker. A comparison of columns (4) and (5)

shows that the effect of per student higher education expenditure is relatively weaker. The bootstrap test reveals a significant indirect effect, with the 95% confidence interval for the indirect effect ranging from [0.0138, 0.1842], confirming the statistical significance of the mediation. This suggests that, in the context of rapid digital economy development, improving digital teaching conditions in higher education and strengthening students digital skills and technological adaptability are more effective channels for enhancing employment quality. In contrast, a simple expansion of education expenditure has a limited impact on employment quality and may require more targeted allocation structures and higher use efficiency to generate stronger effects.

Table 11 Mediating effect

	(1)	(2)	(3)	(4)	(5)
	QL	HIL	EmQ	EmQ	EmQ
DE	0.432**	15.937**	0.325**	0.278**	0.255**
	(0.19)	-5.783	(0.13)	(0.12)	-0.118
QL				0.109**	
				(0.05)	
HIL					0.004*
					-0.003
cons	3.120***	28.617*	-0.133	-0.474*	-0.26
	(0.69)	-14.743	(0.29)	(0.27)	-0.261
Obs.	360	360	360	360	360
Control	Yes	Yes	Yes	Yes	Yes
ID FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Clustered	Yes	Yes	Yes	Yes	Yes
R ²	0.7646	0.5021	0.9403	0.9428	0.9426
Bootstrap Test (95% Confidence Interval)				[0.0138, 0.1842]	

8) Moderating effect

Column (2) of Table 12 shows that after introducing higher education institution size and its interaction with the digital economy, the coefficient of digital economy development increases to 0.459 and remains significant at the 1 percent level, indicating a robust positive effect of the digital economy on employment outcomes. Higher education institution size itself has a positive and significant effect on employment, with a coefficient of 0.069 ($p < 0.05$), suggesting that within a certain range, larger average institution size at the provincial level is associated with better employment outcomes. However, the inter-

action term between digital economy development and higher education institution size is negative and significant, with a coefficient of -0.167 at the 5 percent level, indicating a negative moderating effect of institution size on the relationship between the digital economy and employment. The moderating results suggest that when institution size is relatively large, the positive effect of the digital economy on employment outcomes is weakened. This finding implies that in the context of digital economy development, higher education systems need to place greater emphasis on coordination between institution size expansion and the structure of talent cultivation.

Table 12 Moderating effect

	(1)	(2)
DE	0.325**	0.459***
	(0.13)	(0.11)
ERA(S)		0.069**
		(0.03)
DE $\times$ ERA(S)		-0.167**
		(0.07)
Constant	-0.133	-0.353
	(0.29)	(0.26)
Observations	360	360
Control	Yes	Yes
ID FE	Yes	Yes
Year FE	Yes	Yes
Clustered	Yes	Yes
R ²	0.94	0.94

Discussion and Conclusions

(1) The baseline results show that digital economy development has a positive and significant effect on employment quality.

This finding remains robust after controlling for fixed effects, addressing endogeneity with instrumental variables, and reconstructing the digital economy index using principal compo-



ment analysis. Further analysis indicates that the effects differ across employment quality dimensions, with the strongest impact observed on the employment environment. This finding aligns with previous studies that emphasize the potential of the digital economy to enhance employment quality by improving job conditions such as wages, job security, and work environment Wang, Weng and Zhang, (2025). In this respect, our findings reinforce the view that digital economy development can create more opportunities for high-skilled workers, a key mechanism through which employment quality is enhanced.

(2) The regional heterogeneity analysis reveals that the employment quality enhancing effect of the digital economy is uneven across regions. The positive impact is significant in the eastern and central regions, while it is relatively weaker in the western and northeastern regions. The findings of Li (2022, pp. 37-42) and Cao (2025) align with our results, showing that the positive impact of digital advancements on employment quality is more pronounced in the eastern and central regions, while weaker in the western and northeastern regions. (Ma and Cao, 2025, p. 107924) This regional disparity is similar to the findings of Uddin, Ali and Siddik (2025, p. 103171), who note that the digital economy's benefits are more pronounced in developed, industrialized, and less urbanized countries (Uddin, Ali and Siddik, 2025, p. 103171). In China, the eastern and central regions, with better infrastructure and human capital, are better positioned to benefit from digital economic growth, while the western and northeastern regions, facing

infrastructure and human capital challenges, experience a more limited impact.

(3) The mediation analysis indicates that higher education investment in both funding and digital infrastructure partially mediates the effect of the digital economy on employment quality. Digital economy development indirectly improves employment quality by increasing per student higher education expenditure and investment in digital infrastructure, with a stronger mediating effect arising from digital infrastructure investment.

(4) The moderation analysis indicates that the structure of higher education resources exerts a significant negative moderating effect. As the average size of higher education institutions increases, the positive impact of the digital economy on employment quality weakens. As the average size of higher education institutions increases, the positive impact of the digital economy on employment quality weakens. This result is akin to the labor market consequences of China's higher education expansion during 1998–2008, which, as a natural experiment, caused a supply shock to the labor market. This shock led to a reduction in wages, an increase in unemployment, and a decrease in access to 'good jobs'—but primarily for the entry-year cohorts of graduates, particularly for university graduates. Similarly, in the context of larger higher education institutions, the rapid expansion of education may dilute the effectiveness of digital economy development in improving employment quality, especially for newer graduates entering the labor market. The size and scale of larger institutions limit their ability to quickly adapt and match the

rapidly changing demands of the digital economy. (Knight, Deng and Li, 2017, pp. 127-141)

The main finding of this study is that education resource allocation plays a crucial mediating and moderating role in the impact of the digital economy on employment quality. These findings have important theoretical and practical implications. First, they highlight the key role of education resource allocation, particularly digital infrastructure, in improving employment quality, emphasizing the close link between digital economy and education policy. This provides empirical support for future policy development. Second, the moderating effect of education resource scale suggests that more education resources are not always better; rather, a more refined allocation is needed. This offers valuable insights for higher education system reform and resource distribution.

Policies and suggestions

Based on these findings, this study presents the following policy implications. :

(1) Promote Digital Economy Development to Enhance Employment Quality. The government should ensure that digital economy development not only creates more job opportunities but also improves the quality of these jobs, particularly in terms of wages, job security, and work environment. Policies should focus on strengthening digital skills training to help workers adapt to emerging digital economy jobs, while also investing in digital infrastructure, especially in remote and rural areas, to ensure widespread access to digital technologies. Additionally, there should be increased support for the western

and rural regions to accelerate their digital transformation, creating more high-quality job opportunities. As flexible employment forms increase, the government should also improve the social security system and provide more comprehensive labor rights protection to ensure that all workers, particularly those in new digital platform jobs, have access to basic living security and rights protection. By strengthening infrastructure, promoting digital technology access, and providing developmental support, the digital economy can offer higher-quality employment opportunities for all social groups and contribute to the overall development of society.

(2) Optimizing educational resource allocation to enhance precision and efficiency. Based on the regression results, to ensure the digital economy enhances employment quality, the government must focus on optimizing the allocation of higher education resources. Higher education institutions must focus on improving the quality of education, rather than merely expanding the scale. This involves strengthening digital literacy and technological application skills among students to ensure they are equipped for the digital economy. Programs should also adapt dynamically to technological changes and shifts in industrial structures, preparing graduates for high-quality employment opportunities in both traditional and digital sectors. Additionally, policies should focus on targeted investment in education, particularly in regions like the western and northeastern provinces where digital economy development is relatively weak. These regions should receive sustained investments



in digital infrastructure, skill development, and educational resources to build the capacity necessary for these areas to fully benefit from digital economic growth. By improving the quality of education and digital capabilities in these regions, the government can foster more high-quality job opportunities, ensuring that digital economy benefits reach all regions equally. This approach will ensure that the digital economy improves not just employment quantity, but also employment quality across the country.

Limitations

This study has several limitations that should be considered. First, the findings are specific to China and may not be directly

applicable to other countries with different economic or institutional contexts. Second, the composite indices used in the analysis may be subject to measurement errors, which could affect the accuracy of the results. Third, the study does not examine individual-level employment outcomes, limiting its ability to capture micro-level dynamics. Finally, the relatively short panel period is insufficient to fully capture the long-term changes brought about by the digital economy. These limitations suggest directions for future research, such as cross-country comparisons, improvements in measurement methods, and exploring individual-level employment outcomes over longer periods.

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