Gender Disparities in Digital Employment in China

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Abstract: The rapid expansion of the digital economy has profoundly reshaped employment dynamics in China. Drawing on microdata from the China General Social Surveys (CGSS) conducted in 2010 and 2021, this study delves into the evolving gender gap within China's digital workforce. Through bivariate analyses and logistic regression, this research examines how gender intersects with various factors, including age, educational attainment, account status, number of children, internet usage, and geographical region, to elucidate disparities in digital employment. Findings indicate a shift towards greater gender parity in the digital sector, notwithstanding enduring challenges for women. The responsibilities of childbearing and childrearing have constrained women's engagement in digital occupations, although this impediment is diminishing. Educational achievements and internet usage emerge as pivotal determinants of digital employment for both genders. Workers in the more developed Eastern region exhibited higher likelihoods of digital employment than those in other regions. Diverse strategies are essential to tackle gender gaps in digital employment.

Keywords: Women, digital economy, CGSS, educational impact, internet usage
JEL classification: J1, J4, J7

1. Introduction

The rapid growth of China's digital economy has transformed the employment landscape within the country. The value contributed by China's digital economy surged from RMB2.6 trillion in 2005 to an astonishing RMB35.8 trillion in 2019. This surge was accompanied by a notable increase in the digital economy's share of China's gross domestic product (GDP), which rose from 14.2% to 36.2% during the same period. In 2020, China's digital economy grew at an impressive rate of 9.6%, the fastest in the world. As a result, China has emerged as a global digital economy powerhouse, with its digital economy valued at US$7.1 trillion in 2021, representing a significant 46% of

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the United States' digital economy (China Academy of Information and Communication Technology [CAICT], 2021).

The expansion of the digital economy has given rise to novel occupations. Since 2019, China has introduced 56 new occupations centred around high-tech, emerging and modern service industries characterised by digital, intelligent and informative attributes. The National Development and Reform Commission (2020) forecasts a surge in demand for new talents in online education, internet healthcare, and the unmanned economy. The latest revision of the Dictionary of Occupational Classification of the People's Republic of China by the Ministry of Human Resources and Social Security (2022) amalgamates 97 digital occupations under the category "S".

The exponential growth of the digital economy has created a surge in digital employment opportunities and a vast and diverse array of them. This rapid growth is characterised by the digital economy's scale and diversity of employment avenues. In China, for instance, the digital economy accounted for a substantial 191 million jobs in 2018, representing 24.6% of total employment (CAICT, 2019).

As digitalisation continues to permeate various industries, there is a notable shift in the composition of the workforce. High-skilled labour is gaining prominence while the demand for low-skilled labour is decreasing. Research indicates that this trend is primarily driven by the dual forces of scale expansion and enhanced productivity rather than digital technologies' significant displacement of low-skilled labour (Yunxia et al., 2023; Zhao & Said, 2023).

The rise of the digital economy is not just a shift in the employment landscape but a complete transformation of the sectoral distribution of jobs. Traditional sectors like agriculture and manufacturing are witnessing a decline in their share of total employment, while the services sector is experiencing a significant surge (Zhao & Said, 2023). This transformative shift underscores the profound impact of digitalisation on the nature and distribution of employment opportunities in contemporary economies, providing a new lens to understand the changing dynamics of the labour market. An important aspect to consider is the impact of these dynamics on female labour force participation.

China's female labour force participation rate (LFPR) has shown remarkable resilience despite declining from 73.0% in 1990 to 61.6% in 2021. This rate still surpasses the global average of just over 50%, and it is higher than that of some developed countries, such as the United States (56.8%) and Japan (54.8%) (International Labour Organization [ILO], 2023). The gender gap in LFPR in China has persisted at around 10% for an extended period, aligning closely with figures observed in some developed nations and significantly lower than those in many developing countries.

Generally, women are disadvantaged in the digital industry (Terjesen, 2005). This gender disparity in overall employment is mirrored in digital employment, stemming from three primary factors. Firstly, women in each age group are less likely to use the internet than men with the same education and family income, which has impeded their ability to acquire digital skills (Drezin, 2021). Secondly, women exhibit notably lower proficiency in digital skills than men, attributable to gender gaps in enrollment in information and communications technology (ICT) programmes (Wajcman et al., 2020). Thirdly, entrenched cultural norms pose significant obstacles for women,

as traditional gender roles and stereotypes continue to shape their involvement in digital employment and entrepreneurship, thereby perpetuating the gender gap within this sector.

Digitalisation has had a transformative impact on the female labour force, significantly improving women's employment opportunities. Despite persistent discrimination in recruitment and promotion (Bustelo et al., 2019; Maier & Nair-Reichert, 2007; Manyika et al., 2014; Nikulin, 2017; Parnami & Bisawa, 2015), the advent of modern digital technologies like Big Data has revolutionised the work landscape. These technologies have not only enabled the creation of extensive online networks, facilitating remote work and breaking down geographical and age barriers, but they have also empowered women to engage more efficiently and cost-effectively in production and innovation activities, transcending traditional industrial limitations.

The digital economy has expanded women's job opportunities and created new employment spaces and fields. The proliferation of digital jobs, including those in digital trade, e-commerce, and live streaming, has significantly contributed to this shift. For instance, millions of women are now participating in digital trade and e-commerce, with a notable increase in female participation in industries like automatic sorting and digital logistics platforms (AliResearch, 2022).

Digitalisation has yielded significant dividends for women's employment and entrepreneurship through three primary mechanisms. First, digital technology has broken traditional time and space constraints, empowering women to balance work and family responsibilities more effectively. Second, digitalisation has narrowed the employment gap between urban and rural areas, offering opportunities for women in remote regions to join the workforce through digital employment. This development has allowed more rural women to work from home, constituting 62.3% of Alipay's Artificial Intelligence (AI) trainers, 72.0% of cloud customer service providers, and 53.0% of village e-commerce (AliResearch, 2022). Third, the digital economy leverages women's emotional strengths, such as empathy and communication skills, in enhancing their value and creating more job opportunities in sectors like online education, domestic service and online customer service.

Moreover, new ICT technologies have introduced job opportunities tailored to female strengths, such as community operations and short video creation, further enhancing women's participation in the digital workforce. Digitalisation has reduced women's employment barriers, diversified their income channels, and broadened their economic prospects.

Despite the rapid growth of digitalisation, China has seen a decline in female LFPR amid its digital boom, prompting an investigation into whether digitalisation negatively affects female employment. This study, utilising microdata from the Chinese General Social Surveys (CGSS) conducted in 2010 and 2021, examines the complex relationship between digitalisation and female employment, aiming to identify determinants of digital employment and offer recommendations for gender equality in the digital workforce. Specifically, the study comprehensively examines gender differences in digital employment and their evolution. Detailed analyses focus on male and female workers, employing both bivariate and multivariate methods to understand the impact of various factors on digital employment across demographics and regions.

China's advanced digitalisation makes it an ideal case study, and the availability of micro-survey data enables detailed exploration of gender gaps in digital employment. This research fills a critical gap by considering factors such as region, sector, account status, education, children and internet usage, revealing how these intersect to shape gender disparities in digital employment.

Theoretical contributions include a deeper understanding of gender disparities in the digital workforce and the role of intersectionality in labour market dynamics. Practically, the study informs evidence-based policies to promote gender equity in the digital economy. Insights can guide strategies to improve digital literacy, support childcare, and reduce regional disparities in digital opportunities, to foster inclusivity and diversity in the digital workforce.

2. Theoretical Perspectives in Understanding Gender Disparities in Digital Employment

Digital employment and the broader concept of the digital economy have been conceptualised and explored through various theoretical lenses in the literature. Understanding these theories can provide valuable insights into the dynamics of digital employment and its implications for gender disparities.

Several authors have contributed to the conceptualisation of the digital economy, focusing on aspects such as digital exchange methods, the economic value of information, and the transformative potential of digitised information (Kling & Lamb, 2000; Tapscott, 1996; Turcan et al., 2014). These perspectives align with theories such as the theory of wages (Hicks, 1963), which elucidates individuals' trade-offs between work and leisure in digital employment contexts.

The Ministry of Human Resources and Social Security of China (2022) and Ren (2022) offer perspectives on digital employment as an ecosystem where digital technology intertwines with labour activities, highlighting the central role of labour and data within digitalised environments. This perspective aligns with job search theory (Phelps, 1968), emphasising information asymmetry and opportunity costs in shaping labour market dynamics. Additionally, human capital theory (Becker, 1975) underscores the importance of education and training investments in enhancing productivity in digital employment settings.

In considering gender disparities in digital employment, theories such as the family economic theory (Becker & Tomes, 1986; Gronau, 1977) and social capital theory (Bourdieu, 1986; Coleman, 1988) offer valuable insights. The family economic theory explores how family dynamics influence employment decisions, particularly for women who may face constraints balancing work and family obligations in digital employment settings. Similarly, social capital theory underscores the significance of social networks in job procurement, which may play a crucial role in addressing gender disparities in digital employment opportunities. By integrating these theoretical perspectives, this study aims to comprehensively understand the complexities surrounding digital employment and gender disparities.

Intersectionality emphasises the interconnected nature of various social identities (e.g., gender, age, employment sector, geographical region) and how they intersect

to shape individuals' experiences of privilege and oppression (Bose, 2012; Fisher & Naidoo, 2016; McBride et al., 2015; Rosette et al., 2018). In this paper we consider how age, frequency of internet usage, and geographical regions intersect with gender to produce unique patterns of digital employment and disparities.

3. Data and Methods

The data utilised for this analysis were sourced from the Chinese General Social Survey (CGSS), available at http://cgss.ruc.edu.cn/. The CGSS, initiated in 2003, is not only the earliest but also the largest-scale national comprehensive survey to track social changes of theoretical and practical significance. Seven waves were conducted between 2010 and 2021.

Employing a stratified multi-stage cluster sampling design, the CGSS covers all provinces, municipalities and autonomous regions except Xinjiang and Tibet. CGSS collected economic, social and demographic information through personal interviews, including employment status and occupation. The analysis in this study focuses on data from the CGSS in 2010 and 2021, confined to respondents aged 18 to 64. The selected sample for detailed analysis comprised 3765 male and 3186 female workers in 2010 and 1831 male and 1746 female workers in 2021.

3.1 Study Variables

Dependent Variable

The CGSS encompassed a comprehensive array of variables regarding respondents' employment status, delineated by their primary occupation and sector of employment. The survey defines "work" as individuals who devoted more than one hour in the previous week to earning income or were on paid or unpaid leave. Respondents active in the labour force were classified into four distinct sectors: i) agricultural, ii) non-agricultural and non-digital, self-employed, iii) non-agricultural and non-digital, non-self-employed, and iv) digital.

Central to this analysis is the primary dependent variable, which is binary and indicates whether the respondent is engaged in digital employment. Respondents are categorised into digital or non-digital employment, with "1" denoting digital workers and "0" representing non-digital workers. This dichotomous classification enables a clear delineation between individuals involved in digital-centric occupations and those employed in other sectors, facilitating a focused examination of the determinants and dynamics specific to digital employment within the dataset.

Independent Variables

Gender: This key independent variable holds immense socio-cultural significance and is associated with documented disparities in employment opportunities. Theoretical frameworks, including gender theory and feminist economics, suggest that gender norms and discrimination may influence access to and participation in digital employment. By examining the differential impact of gender on digital employment, this study

aims to illuminate potential gender inequalities within the digital workforce, a topic of significant importance in today's evolving labour market.

Age: Age is a pivotal variable reflecting life stage, experience and technological adaptation. Research suggests that older individuals may encounter barriers to digital employment due to technological literacy and skill gaps. Conversely, younger cohorts might exhibit higher digital adoption rates but could face challenges related to job market competition. By incorporating age as a control variable, we aim to discern how age dynamics intersect with gender in digital employment.

Education Level: Education is a proxy for human capital, encompassing skills, knowledge and cognitive abilities crucial for navigating digital work environments. Theoretical models, such as human capital theory, posit that higher levels of education correlate with enhanced employability and earnings potential, including in digital sectors. Thus, education level is expected to influence digital employment outcomes significantly.

Type of Account: This variable captures the nature of employment relationships, distinguishing between self-employment and non-self-employment arrangements. Theoretical frameworks, including labour market segmentation theory, suggest that employment type may shape individuals' access to digital opportunities, with self-employed individuals potentially leveraging greater autonomy and flexibility in digital work spheres.

Internet Usage: Theoretical models, such as the digital divide framework, highlight disparities in internet access and usage patterns as critical barriers to digital participation. Therefore, understanding the relationship between internet usage behaviour and digital employment is imperative for discerning access barriers and facilitating inclusivity. Moreover, it also holds the potential for informing policy interventions and strategies to bridge the digital divide.

Number of Children: Family dynamics, including the number of children, can influence individuals' employment decisions and capacity to engage in digital work. Theoretical perspectives, including household labour allocation theory, suggest that childcare responsibilities affect individuals' time availability and work arrangements. This study aims to capture the interplay between familial obligations and digital employment participation by accounting for the number of children as a control variable.

Region: Regional disparities in economic development, infrastructure and job opportunities may shape individuals' access to digital employment. Theoretical frameworks, such as regional economics and spatial mismatch theory, underscore the importance of geographical context in shaping employment outcomes. By including region as a control variable, this study seeks to elucidate how regional factors interact with individual characteristics to influence digital employment patterns.

3.2 Data Analysis Techniques

Bivariate analyses, including crosstabulations, delineate differences in digital employment based on gender, age, education level, internet usage, number of children and region. Independence tests, the chi-square test and Fisher's exact test, are conducted to examine the significance of the bivariate relationship between digital employment

and each independent variable. Multivariate analyses, specifically binary logistic regression, are employed to assess the relative importance of various factors affecting digital employment for the total sample and for male and female workers separately. The regression analysis includes the parameters' odds ratios, significance tests and 95% confidence intervals.

4. Results

4.1 Profiles of Working Respondents

Table 1 provides the descriptive statistics illustrating shifts in employment dynamics among respondents over the 2010–2021 period. A discernible trend emerges, notably marked by the decline of agricultural employment from 36% in 2010 to 24% in 2021. This decline mirrors broader patterns of urbanisation and modernisation, drawing workers away from agriculture towards non-agricultural and digital sectors. Conversely, there has been a remarkable surge in digital employment, soaring from 7.7% in 2010 to 31.9% in 2021. This dramatic increase, fueled by declines in agricultural and non-agricultural, non-digital employment, underscores the escalating significance of the digital sector within the employment landscape.

Equally significant is the substantial narrowing of the gender gap within digital employment observed over the same period. The modal age group among working individuals shifted from 40–49 in 2010 to 50–59 in 2021, indicating evolving demographics within the workforce. Moreover, the data reveal encouraging advancements in educational attainment among workers. The proportion of individuals with no formal education or primary education decreased from 30.5% in 2010 to 20.6% in 2021, and a corresponding increase in those with university education, rising from 19.0% to 28.9%. Particularly noteworthy is the convergence of female workers with their male counterparts in university education by 2021, signaling progress towards gender parity in the workplace.

There has been a notable rise in the frequency of internet usage among workers. Additionally, there is a growing trend of childlessness, while families with more than two children are becoming less prevalent. In 2021, 45.5% of the nation's workforce was concentrated in the eastern region, underscoring enduring regional disparities in employment opportunities. Nevertheless, there has been little change in account status during this period.

4.2 Working Individuals Engaging in Digital Employment

This section examines the profound gender disparities in digital employment across various socio-demographic and economic factors (Table 2). The Chi-square/Fisher's exact tests underscore the significant association of all these variables with digital employment for both genders ($p<0.001$) (table not shown). Notably, men were generally more likely than women to be engaged in digital employment across different socio-demographic variables, highlighting the urgency and importance of addressing these disparities.

Table 1. Percentage distribution of working adults by selected variables, 2010 and 2021

	2010			2021		
	Total	Male	Female	Total	Male	Female
No. of observations	6951	3765	3186	3577	1831	1746
Employment sector						
Agricultural employed	36.1	30.7	42.5	24.0	21.4	26.7
Non-agricultural and non-digital self-employed	13.2	13.9	12.4	15.3	15.8	14.7
Non-agricultural and non-digital non-self-employed	43.0	45.9	39.6	28.9	29.0	28.7
Digital employed	7.7	9.5	5.5	31.9	33.8	29.8
Age						
18–29	15.9	15.4	16.6	14.1	14.5	13.7
30–39	26.0	24.6	27.6	24.9	23.0	26.7
40–49	32.8	31.2	34.6	24.7	23.5	25.9
50–59	19.8	22.4	16.6	29.5	30.5	28.5
60–64	5.6	6.3	4.6	6.8	8.4	5.2
Education						
No schooling/primary school	30.5	24.7	37.3	20.6	16.3	25.1
Junior high school	31.4	34.0	28.2	31.0	31.6	30.3
High school	19.1	21.3	16.5	19.5	23.9	14.9
University	19.0	20.0	17.9	28.9	28.2	29.7
Account status						
Non-agricultural	41.9	43.9	39.6	38.6	40.3	36.8
Agricultural or no account	58.1	56.1	60.4	61.4	59.7	63.2
Internet usage						
Never/Rarely	66.3	63.7	69.3	17.2	16.8	17.6
Sometimes	8.1	8.6	7.4	7.9	7.3	8.5
Often/Very often	25.7	27.7	23.2	74.9	75.9	73.9
Number of children						
0	13.0	14.5	11.3	18.1	20.9	15.1
1	43.7	43.9	43.3	37.6	35.9	39.3
2	29.8	28.9	30.9	34.5	33.7	35.4
3 or more	13.5	12.7	14.5	9.8	9.4	10.1
Region						
Eastern	42.6	44.1	40.8	45.4	47.4	43.4
Central	35.2	34.5	36.0	34.0	33.9	34.2
Western	22.2	21.3	23.2	20.5	18.8	22.4

Note: The Eastern region is the most developed and the Western region is the least developed. The Eastern region includes Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi, and Hainan provinces; the Central region includes Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan provinces; and the Western region includes Sichuan, Chongqing, Guizhou, Yunnan, Shaanxi, Gansu, Ningxia, and Qinghai provinces.

Table 2. Percent of working individuals engaging in digital employment by socio-demographic and economic variables

	2010			2021		
	Total	Male	Female	Total	Male	Female
Total	7.7	9.5	5.5	31.9	33.8	29.8
Age						
18–29	11.2	14.5	7.6	50.1	46.6	54.0
30–39	9.9	12.8	6.8	41.3	43.6	39.2
40–49	6.8	7.9	5.5	34.2	36.9	31.6
50–59	4.4	5.6	2.6	19.0	24.4	12.9
60–64	4.1	6.3	0.7	7.3	10.4	2.2
Education						
No schooling/Primary school	1.1	2.0	0.3	8.0	10.4	6.4
Junior high school	5.0	5.7	4.0	15.9	22.3	16.4
High school	11.8	12.8	10.3	33.1	32.7	33.7
University	18.5	21.7	14.4	61.3	61.1	61.4
Account status						
Agricultural/no account	3.3	4.5	1.9	20.6	22.7	18.5
Non-agricultural account	13.7	15.8	11.0	49.8	50.3	49.3
Internet usage						
Never/Rarely	3.2	4.2	2.2	8.9	10.1	7.8
Sometimes	10.9	11.5	10.1	19.2	21.8	16.9
Often/Very often	18.2	21.2	13.9	38.4	40.1	36.6
Number of children						
0	13.4	15.1	10.9	49.9	46.2	55.3
1	10.6	12.4	8.5	36.5	38.1	34.9
2	3.7	5.5	1.7	22.8	26.3	19.3
3 or more	1.3	2.5	0.0	12.9	16.8	9.0
Region						
Eastern	12.5	15.3	8.9	42.0	44.3	39.3
Central	4.2	4.7	3.7	25.1	26.8	23.5
Western	4.0	5.4	2.6	20.7	20.1	21.2

Note: See note to Table 1 for definitions of the three regions.

The data reveal an inspiring trend where younger workers are increasingly embracing digital employment. In 2021, among workers under 30, half were engaged in digital employment, a significant rise from 11.2% in 2010. This surge was particularly rapid among females, soaring from 7.6% in 2010 to 54.0% in 2021, surpassing the increase among males from 14.5% to 46.6%. All other age groups also experienced a modest growth in digital employment. Even in 2021, males over 30 were more inclined towards digital employment than their female counterparts, indicating the potential for further change.

The digital sector is witnessing a surge in its workforce across all educational levels, especially among university-educated workers. In 2021, 61% of female and male university-educated workers were engaged in digital employment.

Workers with non-agricultural accounts consistently showed a higher inclination towards digital employment than their agricultural sector counterparts, regardless of gender. The data also show a positive correlation between the frequency of internet usage and digital employment for both male and female workers, with males consistently displaying higher likelihoods of digital employment across all levels of internet usage.

The number of children showed a negative association with digital employment, especially among females. This is likely attributed to older age, lower education levels, and living in the Western and Central regions – factors strongly correlated with reduced digital employment opportunities.

Across the years and gender, workers in the more developed Eastern region exhibited higher likelihoods of digital employment than those in other regions. Interestingly, in 2021, female workers in the Western region slightly surpassed their male counterparts in digital employment likelihood.

4.3 Binary Logistic Regression Analysis

Many interrelated factors, with confounding effects, influence digital employment. Hence, a multivariate analysis is needed to ascertain the net effect of each factor on digital employment. To intuitively demonstrate the significance of the regression results, this paper summarises the differences in overall, male and female logistic regression results between 2010 and 2021. Significant variables are indicated by different numbers of 'asterisks' and are marked with the regression odds ratio Exp(B).

4.3.1 Binary Logistic Regression Results for the Total Sample

Results from binary logistic regression for the total sample (Table 3) reveal that female workers were less likely than male workers to participate in the digital economy even after adjusting for other variables. However, the gender gap has narrowed over time, which is evident from the odds ratios of 0.600 in 2010 and 0.847 in 2021, and both are statistically significant. A ratio closer to 1 indicates a smaller disparity between genders.

In 2010, digital employment remained relatively high across age groups. However, by 2021, younger adults were much more likely than older ones to be engaged in the digital economy. Educational attainment significantly influenced digital employment in both periods, with a widening gap between educational levels. While each higher level of education correlated with increased odds of digital employment in 2010, a decade later, the gap between university-educated individuals and those with lower educational attainment widened considerably.

The odds of digital employment were notably higher among holders of non-agricultural accounts than those with agricultural accounts or no accounts, with this gap widening over the decade. As expected, internet usage strongly correlates with digital employment, highlighting the crucial role of technology in the digital employment

Table 3. Binary logistic regression for the total sample, 2010 and 2021

	2010			2021		
		95% C.I. for Exp(B)			95% C.I. for Exp(B)	
	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper
Gender	***			*		
Male (ref)	1			1		
Female	0.600***	0.492	0.731	0.847*	0.720	0.997
Age	*			***		
18–29 (ref)	1			1		
30–39	1.396*	1.057	1.845	1.014	0.778	1.322
40–49	1.352	0.989	1.847	1.083	0.811	1.445
50–59	1.116	0.754	1.652	0.715*	0.525	0.975
60–64	2.323**	1.224	4.410	0.363***	0.202	0.652
Education	***			***		
No schooling/Primary school (ref)	1			1		
Junior high school	3.153***	1.959	5.073	1.966***	1.430	2.702
High school	5.158***	3.129	8.505	3.157***	2.251	4.428
University	5.568***	3.285	9.437	7.401***	5.257	10.419
Account	*			***		
Agricultural or no account (ref)	1			1		
Non-agricultural account	1.344*	1.034	1.748	1.660***	1.388	1.986
Internet usage	***			**		
Never/Rarely (ref)	1			1		
Sometimes	1.695**	1.200	2.394	1.768*	1.142	2.736
Often/Very often	2.402***	1.810	3.189	1.796***	1.291	2.498
Number of children	0.853	0.725	1.003	0.900	0.801	1.012
Region	***			***		
Eastern (ref)	1			1		
Central	0.544***	0.427	0.693	0.613***	0.510	0.736
Western	0.599***	0.445	0.805	0.576***	0.456	0.726
Constant	0.019***			0.210***		

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. "ref" refers to the reference group. See note to Table 1 for definitions of the three regions.

landscape. This finding underscores the symbiotic relationship between technology and digital sector jobs. On the one hand, technology-savvy people are more likely to take up jobs in the digital sector. On the other hand, digital sector workers tend to use the internet to perform their tasks. Economically developed regions, particularly the Eastern region, provided more digital employment opportunities than the Central and Western regions. However, controlling for other variables, the number of children did not significantly impact digital employment.

4.3.2 Binary Logistic Regression Results for the Male and Female Samples

Given potential differences in factors affecting digital employment between male and female workers, regression results are presented separately in Table 4. Age differentiated digital employment only among male workers.

Consistently, education has emerged as a significant factor influencing male digital employment. The disparity across academic qualifications has widened, particularly in the odds ratio for tertiary-educated individuals compared to those with only primary education. Although variances among other education levels were minimal, this pattern underscores the pivotal role of higher education in digital employment.

Table 4. Binary logistic regression for males and females, 2021

	Males			Females		
		95% C.I. for Exp(B)			95% C.I. for Exp(B)	
	Exp(B)	Lower	Upper	Exp(B)	Lower	Upper
Age				***		
18–29 (ref)	1			1		
30–39	1.044	0.728	1.499	1.028	0.693	1.525
40–49	1.146	0.772	1.700	1.067	0.694	1.639
50–59	0.870	0.577	1.312	0.539*	0.334	0.872
60–64	0.512	0.259	1.015	0.127**	0.029	0.564
Education	***			***		
No schooling/Primary school (ref)	1			1		
Junior high school	1.833**	1.182	2.841	1.961**	1.225	3.139
High school	2.588***	1.639	4.088	3.716***	2.227	6.201
University	5.782***	3.607	9.266	8.684***	5.231	14.417
Account	***			***		
Agricultural or no account (ref)	1			1		
Non-agricultural account	1.677***	1.318	2.134	1.670***	1.274	2.189
Internet usage	**					
Never/Rarely (ref)	1			1		
Sometimes	2.033*	1.124	3.675	1.391	0.723	2.676
Often/Very often	2.250***	1.449	3.494	1.319	0.796	2.185
Number of children	0.948	0.812	1.107	0.816*	0.680	0.979
Region	***			*		
Eastern (ref)	1			1		
Central	0.555***	0.434	0.709	0.714*	0.540	0.944
Western	0.503***	0.362	0.698	0.671*	0.480	0.938
Constant	0.185***			0.237***		

Note: *** p < 0.001, ** p < 0.01, * p < 0.05. "ref" refers to the reference group. See note to Table 1 for definitions of the three regions.

The impact of account type on male digital employment was striking, with holders of non-agricultural accounts showing significantly higher odds of digital employment. This can be attributed to the dynamics of the urban labour market. As expected, internet usage was a strong predictor of male digital employment, while the number of children had no discernible effect. Similarly, males from the Eastern region had significantly higher odds of digital employment than those from other regions, mirroring the trends in the total sample.

Unlike male workers, older female workers aged 50 and above had significantly lower odds of digital employment than younger women. Compared to the males, education had a much more substantial impact on female digital employment at every level. As with the male workers, female non-agricultural account holders exhibited higher odds of digital employment, potentially due to urban financial sector dynamics, where women workers predominated.

While internet usage positively correlated with female digital employment, its impact was less pronounced than in male workers. In 2021, the odds ratio of digital employment for women who used the internet frequently or very frequently was only 1.3 times higher than those who never or rarely used the internet, and this is not statistically significant. Moreover, the number of children in the family posed a significant barrier to female digital employment. For each additional child, the probability of female digital employment decreased by about 18% in 2021. Regional differences also impacted female digital employment, but it was less pronounced than for the males.

4.4 Distribution of Digital Workers by Gender

The digital workforce has witnessed a notable surge in female participation across various roles, including software development, data analysis and digital marketing. Women's share in digital employment is examined in Table 5. Between 2010 and 2021, women's representation in digital employment escalated from 33.0% to 45.7%. Particularly striking is the rise among younger women, constituting half of digital workers in 2021.

Education is a pivotal factor influencing women's presence in the digital realm. In 2010, women across educational tiers beyond primary schooling comprised roughly one-third of the digital workforce. However, by 2021, there was a remarkable increase in female representation across all educational levels, attributed to evolving societal norms and escalating demand for digital competencies. Notably, women with only primary education saw a significant surge from 17.4% in 2010 to 47.5% in 2021, while those with university education comprised half of the digital workforce.

Regarding occupation, women's representation in the digital domain exhibits wide variance, ranging from 27% among industrial and agricultural workers to 75% among other sales and service roles in 2021. There was a notable increase in female representation in digital work among managers/administrators, professionals, and other sales and service personnel from 2010 to 2021.

In 2010, female workers with non-agricultural accounts comprised slightly over a third of digital workers, compared to 28% among those with agricultural or no account. However, by 2021, both groups shared a similar proportion, comprising around 45% to 46% of the digital workforce.

Table 5. Women's share (%) in the digital workforce by selected variables, 2010 and 2021

	2010	2021
Overall	33.0	45.7
Age		
18–29	32.3	51.0
30–39	33.5	49.9
40–49	39.6	47.4
50–59	23.0	32.0
60–64	6.3	11.1
Education		
No schooling/primary	17.4	47.5
Junior high school	33.0	40.3
High school	34.4	38.1
University	33.5	50.2
Occupation		
Managers/administrators	25.3	35.4
Professional	36.5	62.7
Clerks and administrative support workers	62.1	57.0
Other service workers (sales, transport, hotel and food)	46.9	74.5
Industrial/manufacturing and agricultural workers	29.1	27.1
Account type		
Non-agricultural	34.8	46.1
Agricultural/no account	27.8	45.1
Region		
Eastern	31.2	43.7
Central	40.8	45.8
Western	30.6	54.6

Note: See note to Table 1 for definitions of the three regions.

Geographically, women's representation in the digital workforce varies across regions. The Western region boasts the highest percentage, while the Eastern region lags. Nevertheless, all regions witnessed growth from 2010 to 2021, with the Western region experiencing the most significant surge, from 31% to 55%.

5. Discussion, Recommendations and Limitations of the Study

5.1 Comparison of Study Results with Previous Studies

The proportion of workers engaged in the digital economy, comprising about 32% of the total workforce, mirrors the figure reported by CAICT (2021). This study also aligns with numerous past studies indicating women trailing behind men in digital employment (Friemel, 2016; Khosrow-Pour, 2006; Piasna & Drahokoupil, 2017; Sovbetov, 2018). These observed gender disparities resonate with broader discussions surrounding

stereotypes and a digital gender divide within labour markets (Barabino et al., 2020; Belgorodskiy et al., 2012; Fatehkia et al., 2018; Greider et al., 2019; Kamberidou, 2020; Terjesen, 2005). Moreover, this study underscores the influence of personal attributes, family dynamics, and societal contexts on employment decisions and opportunities, consistent with various prior research (Chen et al., 2014; Fang et al., 2013; Fu et al., 2016; Ma, 2021; Sinha Mukherjee, 2015; Tong & Gong, 2020; Wang et al., 2020; Wei, 2011; Wu & Zhou, 2015; Xiao & Asadullah, 2020; Zhang et al., 2008).

Various factors influence digital employment differently for men and women. Educational attainment and internet usage consistently impact digital employment for both genders (Fatehkia et al., 2018; Gálvez et al., 2020; Tonkikh et al., 2019; Wei, 2011). Age, household composition and region variables exert varying effects (Blundell et al., 2016; Zhang et al., 2023). The number of children in the household significantly influences women's digital employment, similar to findings from a past study (Fang et al., 2013). Traditionally, women are responsible for caring of children and older parents. Conversely, men's digital employment is more sensitive to the economic development level of their region, reflecting traditional gender roles (Li & Liu, 2021). The account variable significantly impacted male and female digital employment in 2021, corroborating findings from past studies that job seekers with a non-agricultural account are more likely to enter the field of digital employment than those with an agricultural account or no account (Cheng & Zheng, 2023; Zhang et al., 2023).

The study also indicates a narrowing of the gender gap in digital employment over time, coinciding with the spread of digitalisation and higher education. The digital economy has created more flexible employment opportunities for women, enabling them to combine family and work (Gálvez et al., 2020; Tonkikh et al., 2019). The ascent of digital employment and the narrowing gender gap in this employment sector, manifested in this study, can be partly attributed to women's rapid rise in tertiary enrolment ratio from 13% in 2003 to 78% in 2022, surpassing that of men, from 16% to 67% (World Bank, 2023).

5.2 Theoretical Relevance of this Study

This study's findings resonate with several established theoretical frameworks. For instance, the personal labour supply theory posits that individuals optimise their work-life balance, with women often prioritising family responsibilities (Hicks, 1963). This framework aligns with our observation that women may face more significant challenges in digital employment due to caregiving duties (Greider et al., 2019). Similarly, family economic theory suggests that women's role in caregiving may disadvantage them in digital employment, a notion supported by past studies (Fang et al., 2013; Gronau, 1977; Zhang et al., 2008). The regression results in this paper demonstrate this phenomenon, where the number of children and age hinder women's employment in the digital sector.

Human capital theory emphasises the role of education in enhancing employability, with gender disparities stemming from unequal access to education (Becker, 1975; Romer, 1994). The present analysis reaffirms this theory, showing a positive correlation between educational attainment and digital employment likelihood, corroborating

the findings of past studies (Fenwick, 2008; Sinha Mukherjee, 2015; Wei, 2011). The primary manifestation is the difference in the level of educational development between different accounts and regions. Generally speaking, those who live in cities have access to higher-quality educational resources; the Eastern region is more economically developed and has a higher level of education (Qian, 2021). Digital employment opportunities are concentrated in large urban centres in the Eastern region. Job search theory (Phelps, 1968) and labour market discrimination theory also shed light on factors influencing digital employment, such as internet usage and gender-neutral job opportunities (Fatehkia et al., 2018; Gálvez et al., 2020).

5.3 Practical Implications and Recommendations

Addressing gender disparities in digital employment requires a multifaceted approach involving policymakers, educators, enterprises and individuals. Stakeholders can collectively work towards a more equitable and vibrant digital workforce by implementing specific inclusive policies such as gender quotas, flexible work arrangements and equal pay measures. These policies, along with fostering education and skill development, promoting workplace diversity, and challenging cultural norms, can contribute to a more balanced digital workforce.

Incorporating childcare solutions, like government-subsidised daycare centres and flexible work hours, can play a pivotal role in addressing China's fertility crisis. By alleviating the caregiving responsibilities that often hinder women's career progression, these measures enable women to engage more fully in the workforce, particularly in the digital sector. This, in turn, can contribute to a more diverse and robust labour force while creating a more supportive environment for women to consider having more children.

Skill development and education play a pivotal role in addressing gender disparities in digital employment. Gender-sensitive digital skills training programmes should be prioritised to empower women in this sector. Education initiatives should not only promote women's participation in science and technology but also actively foster interest in digital fields among young women. As crucial influencers, educators can organise workshops, mentorship programmes, and career guidance sessions to inspire and guide young women toward digital careers. Providing inclusive educational opportunities can empower girls to pursue careers in technology, bridging the gender gap in digital employment. More research should be conducted on the effectiveness of different skill development and training programmes aimed at reducing gender disparities in digital employment. There is also a need to explore how socio-economic background, educational opportunities and access to technology influence women's ability to acquire digital skills. Understanding which interventions are most effective and for whom is essential for designing targeted initiatives.

Comprehensive laws and regulations are essential at the policy level to promote gender equality and address barriers to women's workforce participation. Establishing a robust social service system, encouraging enterprise and individual participation in vocational education, and promoting women's access to higher-level training are critical steps.

Enterprises are critical stakeholders in fostering diversity and inclusion by lowering market entry barriers and providing on-the-job training courses. They can create

inclusive work environments, implement gender-sensitive recruitment strategies and ensure equal opportunities for career advancement regardless of gender.

People need to challenge traditional notions of employment and embrace flexible work arrangements. This cultural shift requires changing perceptions of job security and embracing diverse forms of employment. Women and men should also actively manage family responsibilities to balance participation in the labour market. The COVID-19 pandemic has accelerated the adoption of remote work, but its impact on gender disparities in digital employment is poorly understood. Research should explore how remote work arrangements affect women's participation, productivity and career progression in the digital workforce.

Geographical disparities in the digital economy affect female labour market participation, particularly in economically disadvantaged Western and Central regions. Research should explore these regional variations to develop context-specific interventions.

5.4 Limitations

This paper focuses on the factors influencing digital employment and does not examine digitalisation mechanisms affecting the labour market. In addition, this paper focuses on gender differences in digital employment. It does not explore the effect of occupational skill level and trade level on it, which is limited by the CGSS data. Future research could delve into these influencing factors to provide an in-depth analysis of the impact of digitalisation on the labour market. It could also draw in a broader dataset and various methodologies to delve into the nature of digital employment and gender differences, thereby providing more specific recommendations for policy development.

6. Conclusion

This study's findings are relevant to gender equality and digital employment initiatives. It underscores the persistent gender disparities within China's digital employment landscape and highlights the encouraging progress that has been made in narrowing the gap. While women's representation in digital roles has increased over the years, there remains a substantial divide between genders, reflecting systemic barriers and entrenched societal norms.

Bridging the gender gap in China's digital employment sector demands multifaceted solutions that address these underlying challenges. Beyond merely increasing female representation, efforts must focus on fostering an inclusive and supportive environment where women can thrive and contribute fully to the digital economy.

Achieving gender equality in digital employment requires concerted efforts and collaborative initiatives from various stakeholders, including government, businesses, academia and civil society. It necessitates urgent action in revisiting traditional notions of gender roles and promoting diversity and inclusion in hiring practices and workplace cultures.

Moreover, addressing regional disparities is crucial in ensuring that all segments of society have equal access to digital opportunities. This effort entails promoting digital

literacy and providing infrastructure support in underdeveloped areas, thus leveling the playing field and unlocking the untapped potential of women in these regions.

Additionally, advocating for gender-neutral digital employment practices, such as flexible work hours and remote work options, can help women achieve better work-life balance, enhancing their workforce participation and retention. Policymakers can leverage insights from this study to formulate targeted interventions to empower women in the digital realm. This initiative includes designing tailored training and education programmes to equip women with the skills and competencies demanded by the digital economy.

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