

THE IMPACT OF DIGITAL LITERACY ON SUBJECTIVE WELL-BEING: EVIDENCE FROM CHINA

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Abstract. With the advancement of digital technology, digital literacy has gained prominence as a key determinant shaping individuals' subjective well-being; however, it has remained underexplored in academic literature. This research utilizes the POLS method to investigate the impact of digital literacy on individuals' subjective well-being, using data from the 2017 China General Social Survey (CGSS). To address potential endogeneity, we applied the instrumental variable approach, complemented by the Oprobit model and CMP estimation methods for robustness checks. The results demonstrate that digital literacy boosts both subjective happiness and life satisfaction, particularly among disadvantaged populations, such as women and low-income groups. Furthermore, digital literacy plays a significant role in reducing the well-being disparity between residents of underdeveloped and developed regions, as well as between urban and rural areas. The analysis also shows that digital literacy elevates residents' subjective well-being mainly by alleviating employment vulnerability, enhancing human and social capital accumulation. By revealing the role of digital literacy in individuals' subjective well-being, this study strengthens the formation mechanism of individual well-being perceptions in the context of technological advancement. This contributes to narrowing the digital gap and offers empirical support for public policies aimed at enhancing residents' subjective well-being in the digital era.

Keywords: digital literacy, subjective well-being, employment vulnerability, human capital, social capital.

JEL Classification: I31, J24, O33.

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1. Introduction

Amid the growing popularity of mobile internet and the expanding commercialization of fifth-generation (5G) mobile communications, human lifestyles have entered the stage of "digital existence". Fundamental digital technologies – such as artificial intelligence, big data, and cloud computing have opened up an information age of infinite possibilities, with an all-encompassing and multi-dimensional impact on human production, life, and social development. This effect influences the mode and structure of economic development and penetrates deeply into the level of public well-being in society.

According to the China Internet Development Report 2023 (China Cyberspace Research Institute, 2023), Internet penetration in China attained 75.6% in 2022, while the digital economy grew to 50.2 trillion Chinese yuan (CNY), constituting 41.5% of the nation's GDP, establishing the digital economy as a critical driver of China's economic expansion. The proliferation

of “new professions” and “new forms of business” has made the skills of online functioning essential to daily life. Moreover, as digital payment systems and platforms demand greater technical proficiency, digital literacy is gaining heightened significance. A prospective study states that digital literacy improves well-being overall (Vissenberg et al., 2022). Digitally skilled individuals can source information more effectively, obtain more affordable products and varied offerings, and achieve improved alignment with employment opportunities (Pénard et al., 2013). Such capabilities, valued both intrinsically and instrumentally, can improve individuals’ subjective well-being (Aker & Mbiti, 2010). Furthermore, workers with advanced digital literacy are better positioned to evolve from passive recipients of information into proactive seekers, increasing their ability to take control of their lives, thus improving the subjective well-being of the population (Graham & Nikolova, 2013).

With rapid economic and social development, living standards have improved, leading to increased concern for a spiritually enriched life. Subjective well-being serves as a key measure of the quality of residents’ cultural and spiritual lives. In contrast, existing studies on subjective well-being have primarily focused on factors such as education, income, social capital, public expenditure, and government quality, with limited attention to digital literacy. This raises important questions: Does digital literacy have an information welfare effect? How does it affect subjective well-being, and what are its mechanisms? Are there variations in how digital literacy influences subjective well-being across different demographic groups? Can improving digital literacy help reduce existing digital inequalities between different groups, as well as the gap in subjective well-being with the “advantaged groups”? Addressing these questions is essential to uncovering the new dimensions of the composition of individuals’ well-being in the information age, and to understand how to enhance social welfare through the optimal allocation of information resources. Therefore, this study utilises Chinese micro-survey data to investigate the role of digital literacy in shaping residents’ subjective well-being. Based on a comprehensive understanding, an accurate assessment of the levels and disparities in digital literacy among Chinese residents, we aim to provide empirical evidence for international research.

This study makes several key contributions. First, using the micro-survey data from the 2017 CGSS, this study applies the POLS method to cardinalize the ordered categorical dependent variable, and then examines the role of digital literacy in shaping residents’ subjective well-being. This methodological approach effectively addresses the limitations of traditional Probit regression in handling highly complex nonlinear problems, particularly in computational complexity and model fitting accuracy. Furthermore, an instrumental variables approach is employed to mitigate endogeneity concerns. The CMP method was used to estimate and enhance the reliability of regression outcomes. This research extends welfare economics research from traditional material well-being to information well-being in the digital age and enriches the theoretical framework of information economics. Furthermore, it deepens the understanding of how digital literacy shapes individual behaviours and perceptions to explain and predict the residents’ well-being in the information society. It also provides an analytical framework for subsequent research. Second, we empirically analyse the heterogeneous effects of digital literacy on the subjective well-being across urban and rural, regional, gender, and income dimensions. This enables a more accurate measurement and interpretation of disparities in residents’ subjective well-being among populations within the digital economy.

Such analysis helps narrow the digital gaps, provide more equitable distribution of information resources across groups, and enhance the social participation of disadvantaged groups, thereby promoting social equity and harmony. Third, we explore and test the mechanisms of employment vulnerability, human capital accumulation, and social capital in the relationship between digital literacy and subjective well-being. This deepens the theoretical understanding of how digital literacy enhances subjective well-being, provides empirical evidence for policymakers, and offers theoretical insights for promoting digitalization in countries with transitioning economies.

The structure of this paper is organized as follows. The first section introduces the background and research questions. The second section reviews the relevant academic literature. The third section outlines the data sources, variable definitions, and empirical strategy. The fourth section details the findings from the empirical analysis, while the fifth section discusses mechanism testing. Finally, the last section concludes the study.

2. Literature review

Digital literacy is a comparatively recent concept that arose in the 1990s alongside the evolution of the Internet; prior to this period, discussions more frequently centered on “computer literacy”. In 1997, Paul Gilster coined the term “digital literacy”, emphasizing that it transcended mere technical skills. He defined digital literacy as “the ability to understand and utilize information from diverse sources and in various formats when it is presented via computers” (Gilster, 1997). The concept of digital literacy has shown an evolutionary trend of complexity and systematisation along with technological innovations in the digital industry. The European Union considers digital literacy a new concept extracted from other literacies, covering information, media, cyber, computer, and Information and Communication Technology (ICT) literacy (Ala-Mutka, 2011). Within the Programme for the International Assessment of Adult Competencies, the Organisation for Economic Cooperation and Development [OECD] defines digital literacy as the use of digital technologies, communication tools, and networks to access and evaluate information, communicate with others and perform practical tasks (OECD, 2013). The New Media Consortium of America defines digital literacy as “the capability to interpret, process, comprehend and utilise digital resources as needed for human beings to access and create digital resources”, incorporating general, creative, and interdisciplinary competencies (Adams Becker et al., 2017). The United Nations Educational, Scientific and Cultural Organisation [UNESCO] describes digital literacy as the ability to securely and appropriately use digital technologies to obtain, handle, comprehend, integrate, present, evaluate and produce information, supporting objectives such as employment, securing decent work, and entrepreneurship (Law et al., 2018). In summary, this study defines digital literacy as an individual’s competence to appropriately and effectively operate digital tools and devices, and to safely and effectively retrieve, utilize, share, organize, assess, generate and apply information or data via digital technologies or through digital apparatus (DiMaggio & Bonikowski, 2008; Popov, 2023; Reddy et al., 2022).

As information infrastructure, service platforms, and resource systems continue to expand on the supply side, the full integration of digital technologies into various domains of production, daily life, and public governance (Reddy et al., 2023), the adoption of digital technologies

offers equitable access for residents. It has a positive impact on personal well-being. The advancement of digitalization has correspondingly increased the demand for digital literacy, capabilities, and skills, confirmed by several studies (OECD, 2014). The use of Internet information technology, which accelerates the transfer of information, positively affects individual well-being and serves a particularly crucial function as a bridge to the labour market. In contrast, digital literacy, as an antecedent to the cognitive behaviours of individuals in the use of information technology (Cetindamar et al., 2021), is a critical pillar of a country's sustainability (Radovanović et al., 2020), and is essential for improving the economic well-being of families (Jin et al., 2020). Digital literacy empowers people to effectively adjust to market changes, navigate complex digital landscapes, reduce the digital divide, particularly among elderly populations (Carrasco-Dajer et al., 2024; Jung et al., 2025; Lee & Bae, 2023). Therefore, greater digital literacy is associated with a higher level of participation in the digital empowerment process, the more one benefits from using information technology, which has a positive effect on subjective well-being. In summary, Hypothesis 1 is proposed:

H1: *Digital literacy can significantly contribute to individual subjective well-being; enhanced digital literacy correlates with elevated levels of subjective well-being and life satisfaction.*

The application of digital technology is a powerful help for people worldwide to access information about employment opportunities and job advertisements, especially increasing employment opportunities for women (James, 2022), which has brought a turnaround in the development of the labour market. Women with higher digital skills can be safer online and have more opportunities to learn, innovate, and contribute to the economy (U.S. Department of State [USDS], 2023). Digital literacy serves as a form of human capital as a carrier of digital technology. In terms of enterprises, an organisation's digital literacy is an important condition for its digital transformation (Cetindamar et al., 2024; Zhao et al., 2023), exerting a significant positive effect on business sustainability (Ibrahim & Aduah, 2025). Regarding micro-subjects, digital technology use has two meanings: accessibility, which reflects differences in access opportunities, and depth of use, reflected in differences in digital literacy. Even if people have the same access to digital resources, they may lack the necessary competencies to utilize these tools effectively. This disparity leads to different levels of use (Park & Lee, 2015), which in turn has a differentiated impact on subjective well-being. Relatively speaking, the dominant groups in towns, economically developed regions and higher incomes benefit more from their own access to quality resources in terms of subjective well-being, and digital literacy has a limited role to play in subjective well-being. Graham and Nikolova (2013) point out that information technology exhibits a higher marginal effect on the subjective well-being of disadvantaged groups, such as low-skilled and low-income groups. Furthermore, rural dwellers who are more digitally literate have a higher sense of well-being and cognitive functioning (Gong et al., 2024; Lee et al., 2022). Based on this, digital literacy is more conducive to compensating for the resource and information disadvantages of disadvantaged groups – such as women, low-income populations, rural areas, less-developed regions, and to increasing their subjective well-being. Therefore, Hypothesis 2 is proposed:

H2: *Digital literacy exerts a greater marginal effect on the subjective well-being of rural residents, less-developed regions, women, and low-income groups.*

Digital literacy stands as one of the most critical factors for accessing the benefits of the digital economy, contributing to both social and digital inclusion, enhancing individual employability, and fostering economic growth (European Commission, 2016; Ferrari, 2012). This impact can improve the well-being of individuals, families and societies by minimizing obstacles and intricacies within the marketplace, particularly for those traditionally marginalized (Prete, 2022; Xiao & Xin, 2022). On the one hand, digital literacy increases economic opportunities for residents. As the demand for digital literacy in the work sector continues to grow, the more digitally literate an individual becomes, the more competent and efficient they will be in new digital jobs (Prayitno et al., 2022). Access to efficient and diversified employment information through the platform economy, the sharing economy, and the “new” gig economy can help them enter formal employment, increase employment and entrepreneurial opportunities (Berger et al., 2019; Shatila et al., 2025), reduce employment vulnerability (Lewchuk, 2017), and enhance individual subjective well-being. On the other hand, digital literacy affects human capital accumulation. Retrieving the required resources for learning in digital platforms, such as teaching videos and experience sharing, can significantly lower the costs related to gaining knowledge and information for the residents, improve professional knowledge and build professional skills (Anthonysamy et al., 2020). The accumulation of human capital is conducive to the disadvantaged groups to increase employment opportunities and realise upward occupational mobility, increasing the wage income and thus enhancing the residents’ subjective well-being (Coley et al., 2007). Furthermore, many studies have shown that the development of the Internet has ironed out the barriers to information flow, reduced information asymmetry, and changed people’s socialisation patterns. Those with advanced digital literacy are able to communicate and share information online with the help of digital technology, effectively expanding social modes, social networks and increasing social frequency, which is conducive to accumulating social capital. This situation widens access to education, health care and living services, narrowing the opportunity gap in access to high-quality resources (Nguyen et al., 2022), thus having a positive effect on the enhancement of subjective well-being. Therefore, Hypothesis 3 is proposed:

H3a: *Digital literacy enhances happiness and life satisfaction by reducing employment vulnerability.*

H3b: *By increasing human capital accumulation, digital literacy enhances happiness and life satisfaction.*

H3c: *Digital literacy enhances well-being and life satisfaction by increasing social capital.*

3. Data sources, variable selection and model setting

3.1. Data source

This study obtained data from the 2017 China General Social Survey (CGSS), which covers households across 28 provinces, municipalities, and autonomous regions in China. The CGSS comprehensively gathers information on communities, households, and individuals, and has good representativeness. Valid samples between 16 and 60 were retained, resulting in cross-sectional data of 3,602 valid study samples.

3.2. Variable selection

3.2.1. *Dependent variable: subjective well-being*

Prior research has established that both Happiness and life satisfaction serve as reliable proxies for subjective well-being, and are associated with decision utility (Benjamin et al., 2012; Tella et al., 2003). This paper uses two indicators to measure subjective well-being: Subjective happiness and life satisfaction (Easterlin, 2004; Perez-Truglia, 2020). Subjective happiness and life satisfaction are different parts of the evaluation of happiness. The difference between the two is that subjective happiness is the direct feeling of happiness, which can be called perceptual happiness. At the same time, life satisfaction results from comparing expectations and reality perception, which is relatively more rational and can be called rational happiness (Graham & Nikolova, 2015). The item measuring happiness asked: "Do you feel happy in your life?" With response options including "very unhappy", "relatively unhappy", "neither happy nor unhappy", "relatively happy", and "very happy", these responses are assigned a value of 1–5 and are recorded as happiness. Similarly, life satisfaction was gauged through the question: "How satisfied are you with your overall life situation now?" Participants selected from: "very dissatisfied", "relatively dissatisfied", "indifferent to satisfied or dissatisfied", "relatively satisfied", and "very satisfied". Each response is assigned a value of 1–5, labelled life satisfaction.

3.2.2. *Independent variable: digital literacy*

The assessment of individual digital literacy is conducted in two stages. First, whether the resident can use digital tools and devices is determined by whether they employ a mobile phone or similar device to access the Internet independently. Second, drawing upon the Global Digital Literacy Framework proposed by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in 2018 (Law et al., 2018), a comprehensive evaluation framework for individual digital literacy is constructed from five key dimensions: information and data literacy, communication and collaboration literacy, digital content creation literacy, digital security literacy and problem-solving literacy. The scores of the 11 indexes are added to get the individual digital literacy (Table 1). Furthermore, this research additionally substitutes the core independent variables to examine the robustness and reliability of the empirical findings regarding the influence of digital literacy on happiness and life satisfaction; specifically, we use principal component analysis and entropy method to recalculate the digital literacy metric.

3.2.3. *Control variables*

This research also considers a range of additional variables that may affect an individual's subjective well-being, such as individual, family, and macroeconomic factors. The individual factors mainly include gender, age, nationality, education, health, political affiliation, household registration, and current social class (Demir, 2018; Kragten & Rozer, 2017). The family factors incorporate marital status, number of minors in the household, and family economic status. The macroeconomic factors include the regional internet penetration rate and GDP. Moreover, owing to disparities in regional development, and differences between urban and rural areas, this study also incorporates regional and urban-rural classification variables into the econometric model. The definitions of all key variables, along with their descriptive statistics, are presented in Table 2.

Table 1. Digital literacy indicator

Dimension	Description of indicators	Definition
Information and data	Q1: Can you use a computer to open a website?	1 = Yes; 0 = No
	Q2: It's not hard to find the information you want online	1 = Yes; 0 = No
	Q3: When I want to express myself online, I know how to do it	1 = Yes; 0 = No
	Q4: Accessing the Internet for information (e.g., searching for information, browsing news, etc.)	1 = Yes; 0 = No
Communication and collaboration	Q5: Socialising online	1 = Yes; 0 = No
	Q6: Business transactions (e.g., online transfers, payments, online shopping, etc.)	1 = Yes; 0 = No
Digital content creation	Q7: Going online for self-presentation (e.g., using the WeChat circle of friends, Qzone, Weibo, etc. as a platform for self-presentation, and recording and sharing one's mood)	1 = Yes; 0 = No
	Q8: Publishing information online by yourself	1 = Yes; 0 = No
Digital security	Q9: When making payments or transactions online, I will observe the usage environment to determine whether to use	1 = Yes; 0 = No
	Q10: I actively protect my personal privacy online	1 = Yes; 0 = No
Solving problem	Q11: Internet action while online (e.g., defending one's rights and interests or seeking justice for others through the Internet)	1 = Yes; 0 = No

Table 2. Definitions and descriptive statistics for the main variables (Data source: CGSS)

Variable type		Variable name	Variable definition	Mean (standard deviation)
Dependent variable	Happiness	Happiness	1–5 ordered discrete variables	3.919 (0.777)
	life satisfaction	Life satisfaction	1–5 ordered discrete variables	3.626 (0.924)
Independent variables	Digital literacy	Digital literacy	0–11 continuous variable	9.116 (2.608)
Individual factors	Gender	Gender	1 = male; 0 = female	0.493 (0.500)
	Age	Age	18–60 years old	39.480 (10.960)
	Age squared	Age_sq		1678.750 (890.712)
	Nationality	Nationality	1 = Han ethnic group; 0 = ethnic minorities	0.936 (0.245)
	Education level	Edu	0–19 continuous variable	12.306 (4.347)
	Health level	Health	5 = very healthy; 4 = relatively healthy; 3 = average; 2 = relatively unhealthy; 1 = very unhealthy	3.876 (0.916)
	Political affiliation	Political affiliation	1 = Communist Party member; 0 = other	0.154 (0.361)
	Household registration	Register	1 = non-agricultural; 0 = agricultural	0.642 (0.479)
	Current social class	Social class	0–10 continuous variable	4.489 (1.611)

End of Table 2

Variable type		Variable name	Variable definition	Mean (standard deviation)
Family factors	Marital status	Marriage	1 = unmarried; 2 = married with spouse; 3 = divorced and widowed	1.862 (0.461)
	Number of minors in the household	Child18	0–5 continuous variable	0.627 (0.777)
	Family economic level	Family festatus	5 = Much higher than the average level; 4 = Above the average level; 3 = Average level; 2 = below average; 1 = far below average	2.719 (0.716)
Macro factors	Internet penetration rate	Internet	Number of Internet users/Total population at the end of the year	0.603 (0.121)
	The economic development level	Lngdp	Regional GDP in logarithms	10.261 (0.668)
Other Control variables	Region	Region	2 = east; 1 = middle; 0 = west	1.396 (0.771)
	Urban	Urban	1 = city; 0 = rural	0.810 (0.392)

Table 3. Digital literacy characteristics and differences (Data source: CGSS)

	Urban		Gender		Region		
	City	Rural	Male	Female	East	Middle	West
Digital literacy	9.467	7.617	9.215	9.020	9.511	8.648	8.498

Based on Table 3, it can be found that urban residents exhibit higher levels of digital literacy compared to rural residents, the digital literacy of men is greater than that of women, which is in line with the findings of an Indonesian study on the gender gap in digital literacy across generations (Long et al., 2023). Moreover, individuals residing in eastern China demonstrate more advanced digital literacy than those in central regions, while residents from the western region show the lowest levels of digital literacy.

3.3. Empirical model

To analyze the impact of digital literacy on individual subjective well-being empirically, the basic analytical approach is to build an ordered probit/logit model, which is limited by the nonlinear characteristics of the ordered model in terms of variable endogeneity resolution, among other things. Considering that both subjective happiness and life satisfaction, which measure individuals' subjective well-being, are ordered categorical variables. Therefore, this paper draws on the studies of Perez-Truglia (2020), Origo and Pagani (2009) and uses the POLS (Probit OLS) method proposed by Van Praag and Ferrer-i-Carbonell (2006) for the cardinalization of the ordered categorical dependent variables. Moreover, to facilitate the

interpretation of the regression coefficients, we standardized happiness and life satisfaction to a mean of 0 and standard deviation of 1, and treated the variable as continuous afterward to account for the varying meanings of differences among satisfaction categories. The baseline specification is shown in Eq. (1):

$$SWB = \alpha_0 + \alpha_1 \text{Digital literacy} + \beta_i \text{Control} + \sum \gamma_i Z_i + C_i + \varepsilon. \quad (1)$$

SWB is a dependent variable, representing the individual's subjective well-being, and digital literacy is an independent variable. Z_i is the Control variables, includes a range of other variables that affect the subjective well-being, such as individuals, families and macro factors. α_0 is a constant term, C_i is an area-fixed effect and ε is a randomised perturbation term.

Digital literacy exerts a positive effect on subjective well-being. The benchmark regression includes as many control variables as possible; however, given that endogeneity issues such as omitted variables, selection bias, and unobservables may still exist in the benchmark regression. Therefore, looking for instrumental variables related to digital literacy that do not directly affect subjective well-being is common practice. In this study, based on the standardised treatment of the dependent variable, we applied the instrumental variable (IV) approach to address endogeneity. Specifically, the frequency of Internet access in free time is selected as an instrumental variable for evaluating the impact of digital literacy on happiness (Gnaldi & Del Sarto, 2018). Furthermore, we selected whether the Internet is the primary source of information as an instrumental variable for evaluating the relationship between digital literacy and life satisfaction. On one hand, the frequency of Internet access in free time reflects an individual's use of the Internet's information and entertainment functions in their free time. On the other hand, it indirectly affects happiness, satisfying the classic assumptions of relevance and exogenous validity.

Relying primarily on the Internet for information reflects the adoption and dissemination of ICT in life. This situation relates to individual digital literacy without exerting a direct effect on life satisfaction, thus satisfying the classical hypotheses of relevance and exogenous validity. The frequency of Internet access in free time (labelled as *Freq_Internet*) takes a value from 1 to 5. This range indicates five degrees of frequency, from never to very often, with higher values indicating more frequent free time Internet use. Whether the Internet is the primary information source (labelled as *Information_Internet*) is a binary variable. A value of 1 indicates that the primary news source is the Internet; otherwise, it takes a value of 0.

4. Empirical results

4.1. Benchmark regression results

Table 4 presents the estimation results of the POLS benchmark regression, analyzing the influence of digital literacy on subjective well-being. Three alternative measurement approaches – weighted, Principal Component Analysis (PCA), and an entropy method were employed to measure individuals' digital literacy.

Table 4. Benchmark regression of the effect of digital literacy on subjective well-being

Variables	(1)	(2)	(3)	(4)	(5)	(6)
	Weighted approach to measuring digital literacy		Principal component analysis to measuring digital literacy		Entropy methods to measuring digital literacy	
	Happiness	Life satisfaction	Happiness	Life satisfaction	Happiness	Life satisfaction
Digital literacy1	0.025*** (0.008)	0.042*** (0.009)				
Digital literacy2			0.064*** (0.019)	0.108*** (0.020)		
Digital literacy3					0.205*** (0.071)	0.582*** (0.071)
Gender	-0.077** (0.032)	-0.059* (0.032)	-0.077** (0.032)	-0.059* (0.032)	-0.077** (0.032)	-0.060* (0.032)
Age	-0.040*** (0.013)	-0.020 (0.013)	-0.040*** (0.013)	-0.020 (0.013)	-0.039*** (0.013)	-0.019 (0.013)
Age_sq	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)	0.001*** (0.001)
Nationality	-0.066 (0.065)	0.035 (0.066)	-0.067 (0.065)	0.033 (0.066)	-0.064 (0.065)	0.032 (0.065)
Edu	0.011** (0.005)	-0.005 (0.005)	0.011** (0.005)	-0.006 (0.005)	0.013** (0.005)	-0.009* (0.005)
Health	0.188*** (0.018)	0.138*** (0.019)	0.187*** (0.018)	0.137*** (0.019)	0.189*** (0.018)	0.138*** (0.018)
Political affiliation	0.069 (0.047)	0.002 (0.047)	0.069 (0.047)	0.002 (0.047)	0.070 (0.047)	0.005 (0.047)
Register	0.003 (0.043)	-0.030 (0.043)	0.003 (0.043)	-0.030 (0.043)	0.006 (0.043)	-0.031 (0.043)
Social class	0.079*** (0.011)	0.086*** (0.011)	0.079*** (0.011)	0.086*** (0.011)	0.078*** (0.011)	0.084*** (0.011)
Marriage	-0.007 (0.044)	-0.035 (0.044)	-0.008 (0.044)	-0.037 (0.044)	-0.006 (0.044)	-0.039 (0.044)
Child18	0.078*** (0.025)	0.129*** (0.025)	0.077*** (0.025)	0.128*** (0.025)	0.080*** (0.025)	0.128*** (0.025)
Family festatus	0.180*** (0.026)	0.209*** (0.026)	0.179*** (0.026)	0.208*** (0.026)	0.180*** (0.026)	0.204*** (0.026)
Internet	0.012 (0.214)	-0.399* (0.216)	0.007 (0.214)	-0.408* (0.216)	0.011 (0.214)	-0.410* (0.215)
Lngdp	-0.047* (0.028)	-0.021 (0.028)	-0.047* (0.028)	-0.021 (0.028)	-0.047* (0.028)	-0.022 (0.028)
Area	0.109*** (0.036)	0.066* (0.036)	0.109*** (0.036)	0.067* (0.036)	0.110*** (0.036)	0.071** (0.036)
Urban	-0.101** (0.047)	-0.121** (0.048)	-0.102** (0.047)	-0.123** (0.048)	-0.099** (0.047)	-0.127*** (0.048)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.136	0.120	0.136	0.122	0.136	0.131

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

The results show that regardless of the method used to measure individual digital literacy, digital literacy positively effects subjective happiness and life satisfaction (Oh & Bae, 2024; Bae, 2022) and is statistically significant at the 1% level. This result suggests that enhancing digital literacy can effectively increase individuals' subjective well-being. Hypothesis 1 is thus preliminarily verified, providing an initial conclusion that digital literacy positively influences residents' subjective well-being. On the one hand, in the era of the information economy, information has become a key factor of production. A higher level of digital literacy enables individuals to rapidly acquire information related to daily life and work, thus reducing information asymmetry and improving decision-making efficiency. On the other hand, improved digital literacy assists residents to optimize resource allocation, better participating in social activities, maximize personal utility, and further enhance their subjective well-being. It has been noted that higher subjective well-being is correlated with better health and longevity, social relationships, as well as greater occupational performance and creativity (Diener et al., 2018). Therefore, strengthening the provision of public services, such as digital infrastructure development, and enhancing the digital literacy of the population have important policy implications for improving social welfare.

Among the control variables, the gender regression coefficient is negative, indicating that subjective well-being is lower for men than for women (Becchetti & Conzo, 2022). The age-squared regression coefficient is significantly positive, indicating a U-shaped relationship between age and subjective well-being, i.e., happiness decreases and then increases with age, and the middle-aged group is the least happy. On the one hand, they have to bear the responsibility of child-rearing, household expenses, etc., as well as fulfilling the obligation to support their parents, and their well-being is lower, which is consistent with the results of the existing studies (Blanchflower, 2021; Blanchflower & Oswald, 2019). The higher the level of health, the higher the probability of higher happiness, mainly because health, as a kind of human capital, is the basis of all material wealth and spiritual fulfillment (Larsson et al., 2019). Education is positively associated with happiness and negatively associated with life satisfaction. The reason is that education, as an important way to enhance human capital, promotes income by improving the objective conditions of residents' socio-economic status, to improve individuals' subjective well-being (Ruiu & Ruiu, 2019). However, higher education generally has higher expectations of themselves, and when they fall short of those expectations, they will have self-doubt, which will negatively affect their subjective well-being (Chen et al., 2020; Kühner et al., 2021). At the same time, the higher the socio-economic status of the individual and the economic status of the family, the higher the probability of being happier, indicating that material wealth has a positive and significant influence on subjective well-being. In addition, number of minors in the household is also significantly and positively increases residents' subjective well-being and life satisfaction, mainly because intergenerational emotional support is the main source of subjective well-being (Lee et al., 2017; Pollmann-Schult, 2018).

4.2. Endogenous and IV estimation

Digital literacy becomes the antecedent of the cognitive behavior of individuals in utilizing cloud technology, and its impact on subjective well-being may be influenced by omitted variables. At the same time, subjective well-being symbolizes an attitude or mindset towards

life, and thus may also affect an individual's digital literacy, creating a reverse causation problem. To overcome this potential endogeneity issue, based on the modified dependent variables in Table 4, we used the instrumental variables method to improve the reliability of the results (Table 5).

Table 5. Instrumental variable regression results

	(1)	(2)	(3)	(4)
Variables	Digital literacy	Happiness	Digital literacy	Life satisfaction
Digital literacy		0.062*** (0.021)		0.099*** (0.029)
Freq-Internet	0.826*** (0.044)			
Information_Internet			1.665*** (0.112)	
Control variables	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
R-squared	0.591	0.131	0.557	0.054
First-stage F-value	352.31***		219.29***	
KP rk LM	257.55***		221.90***	
CD Wald-F	739.76		385.93	
KP Wald-F	352.31		219.29	

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

Table 5 reports the regression outcomes from the instrumental variables (IV) approach. Both the F-value from the first-stage regression and the KP rk LM statistic for the under-identification test of the instrumental variables are statistically significant at the 1% level. The CD Wald-F and KP Wald-F statistics of the weak instrumental variables test exceed the Stock–Yogo critical threshold of 16.38 at the 10% level, indicating that there is no weak instrumental variables issue. In addition, the over-identification test Hansen J statistic is significant at the 1% level, indicating that the equation is fully identified and there is no over-identification, thereby proving the validity of the selected instrumental variables in this study. The instrumental variables regression results show that columns (1) and (3) present the first-stage estimation results. The results show that both the frequency of Internet access in free time and the Internet as the primary source of information positively affect personal digital literacy, thus confirming that the instrumental variables in this paper satisfy the correlation hypothesis. Columns (2) and (4) are listed as the results of the second-stage regression.

After accounting for endogeneity via instrumental variables, we observe that personal digital literacy exerts a positive and statistically significant effect (at the 1% level) on both happiness and life satisfaction. That is to say, improving digital literacy significantly enhances subjective well-being, which is consistent with the benchmark regression results (Table 4), suggesting robustness of the benchmark regression. Further support for Hypothesis 1.

4.3. Robustness tests

To obtain robust conclusions that digital literacy affects individual happiness and life satisfaction, this paper further validates the robustness of the benchmark regression results by substituting the original measures of happiness and life satisfaction with ordered discrete variables. While using the Oprobit model and CMP estimation method proposed by Roodman (2011). The first-stage equations of the CMP are shown in Eqs. (2)–(3), and the results are shown in Table 6.

$$\text{Digital literacy} = \alpha_i + \beta_1 \text{Freq-Internet} + \sum \gamma_i Z_i + C_i + \varepsilon; \quad (2)$$

$$\text{Digital literacy} = \alpha_i + \gamma_1 \text{Information_Internet} + \sum \gamma_i Z_i + C_i + \varepsilon. \quad (3)$$

Table 6. Robustness test results of the effect of digital literacy on the subjective well-being

	Happiness				Life Satisfaction			
	Oprobit	Oprobit	CMP first-stage	CMP Second-stage	Oprobit	Oprobit	CMP first-stage	CMP Second-stage
Digital literacy	0.062*** (0.007)	0.025** (0.010)		0.075*** (0.024)	0.036*** (0.007)	0.045*** (0.010)		0.093*** (0.030)
Freq-Internet			0.842*** (0.030)					
Information_ Internet							1.689*** (0.085)	
atanhrho_12			-0.074* (0.044)				0.303*** (0.057)	
Control variables	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Area	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

According to Table 6, the results of the ordered probit (Oprobit) model show that digital literacy exerts a consistently positive effect on individuals' subjective well-being, consistent with the benchmark regression findings presented in Table 4. In the first stage results of CMP, the sign of the coefficient of instrumental variables is positive, consistent with the regression results in Table 5. It indicates that digital literacy is higher among those who have a higher frequency of Internet access in their free time, and whether the Internet is the primary source of information. In addition, the coefficient of *atanhrho_12* passes the significance test, indicating that the CMP regression results are more effective relative to the ordered Probit model after considering endogeneity issues such as omitted variables, measurement errors, and so on. Meanwhile, it can be found that the CMP estimates are consistent with the ordered probit model, as well as the sign of the digital literacy coefficients from the regression results using the POLS method in Table 3, further validating the robustness of the conclusion that digital literacy positively enhances residents' subjective well-being. Hypothesis 1 holds.

Table 7. Marginal effects based on CMP estimates

	Happiness					Life Satisfaction				
	1	2	3	4	5	1	2	3	4	5
Digital literacy	-0.001*** (0.001)	-0.003*** (0.001)	-0.006*** (0.001)	0.001 (0.001)	0.010*** (0.003)	-0.001** (0.001)	-0.003*** (0.001)	-0.009*** (0.001)	0.009*** (0.002)	0.009*** (0.002)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

Table 7 shows the marginal effects of the CMP estimation, and it can be found that the main path of digital literacy to improve happiness is that it makes the probability of being very unhappy, relatively unhappy, and unable to say if they are happy or unhappy decrease by 0.1%, 0.3%, and 0.6%. Furthermore, the probability of feeling very happy increases significantly by 1%. Similarly, there is a two-directional effect of digital literacy on life satisfaction. The probability of being very dissatisfied, relatively dissatisfied, and indifferent to being satisfied or dissatisfied decreases by 0.1%, 0.3%, and 0.9%, and the probability of being more satisfied and very satisfied both increased by 0.9%.

4.4. Heterogeneity analysis

Digital literacy improves the subjective well-being of the population, with happiness and life satisfaction being higher among those who are more digitally literate; however, Graham and Nikolova (2013) found a law of marginal diminution in the impact of information technology on subjective well-being. Furthermore, the marginal effect on improving the well-being of disadvantaged groups is greater, compensating for their informational disadvantages, increasing subjective well-being and reducing the differences in the subjective well-being of disadvantaged and advantaged groups. Then, has digital literacy, as an individual's ability to apply information technology, widened the "digital divide" between the "advantaged" and the "disadvantaged", or has it brought more "information benefits" to the "disadvantaged"? We test the heterogeneity of the groups based on the four dimensions: urban/rural, region, gender, and income, where income is divided into high-income and low-income according to whether the family's economic level is higher than the average. This study uses CMP estimation to test the heterogeneity of the impact between digital literacy and individual subjective well-being. The results are delineated in Figures 1–4.

Figures 1–4 show group differences regarding the influence of digital literacy on subjective well-being. The marginal effect of digital literacy on enhancing the rural residents' subjective well-being is greater than that of urban residents, and digital literacy promotes women's subjective well-being more than men's. Additionally, Digital literacy exerts a greater influence in enhancing subjective well-being for residents from lower-income households than those from high-income households. In addition, the marginal effect of digital literacy on enhancing subjective well-being is largest for residents in less-developed western regions, followed by the central regions, and is not significant in the eastern developed regions. In other words, this implies that the enhancement effect of digital literacy in elevating residents' subjective

well-being is particularly evident among disadvantaged groups, which helps them share the dividends of digital economic development. This finding further supports the studies of Wang et al. (2022) and Graham and Nikolova (2013). Hypothesis 2 is confirmed. Therefore, improving digital literacy has a large information welfare effect and can narrow the “digital divide”. This situation helps to reduce the difference in subjective well-being between disadvantaged and advantaged groups.

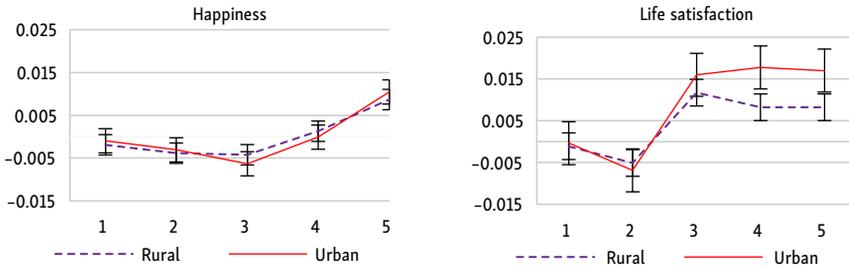


Figure 1. Urban-rural differences in the impact of digital literacy on subjective well-being

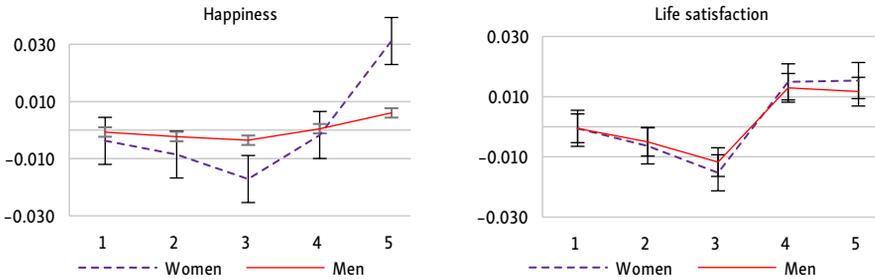


Figure 2. Gender differences in the impact of digital literacy on subjective well-being

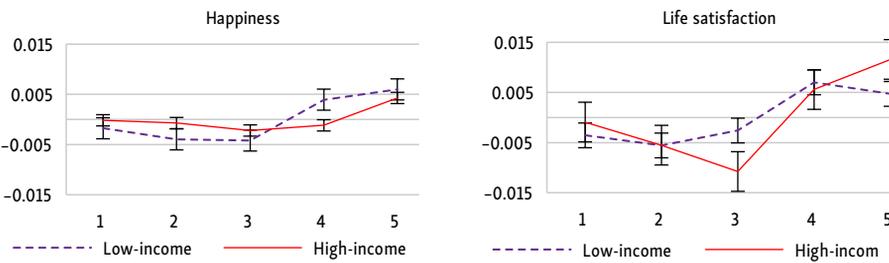


Figure 3. Impact of digital literacy on subjective well-being across income households

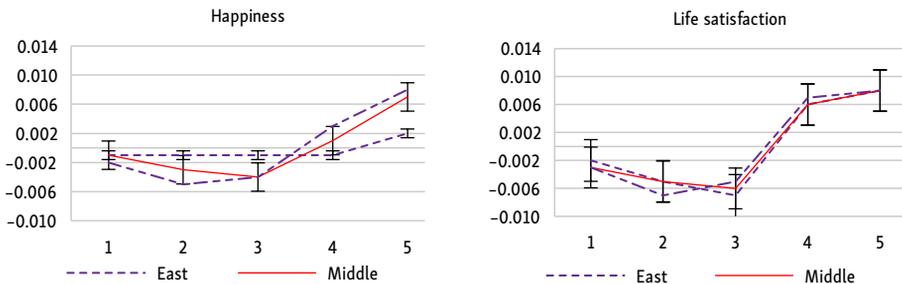


Figure 4. Regional differences in the impact of digital literacy on subjective well-being

5. Mechanism testing

Based on the benchmark regression, endogeneity treatment and robustness test in Part 3, it is found that digital literacy positively improves residents' happiness and life satisfaction. Analytical tests are conducted to explore the mechanism of the impact of digital literacy on residents' subjective well-being based on the theoretical analysis of the three dimensions of employment vulnerability, human capital accumulation and social capital. The CMP method is used for mechanism testing, and the model settings are shown in Eqs. (4)–(5).

$$M = \alpha_2 \text{Digital literacy} + \sum \gamma_i Z_i + C_i + \varepsilon; \quad (4)$$

$$SWB = \alpha_3 \text{Digital literacy} + \beta_i M + \sum \gamma_i Z_i + C_i + \varepsilon. \quad (5)$$

M is the mechanism variable in Eqs. (4)–(5).

5.1. Employment vulnerability

The digital economy continues to subvert our perception of traditional employment, and digital literacy triggers changes in the labour market structure (Bejaković & Mrnjavac, 2020). Along with the rapid advancement of Information and Communication Technology (ICT) and the global digital economy, the popularity of the Internet has greatly increased. People's use of digital technology in their work and life has become increasingly extensive, and it has become progressively common to use the Internet to find information and look for jobs (Gürtzgen et al., 2021). On the one hand, highly digitally literate workers' online search channels are more diverse, and the cost of searching for jobs is greatly reduced (Green, 2017). On the other hand, communicating with enterprises is more efficient, and job-matching efficiency increases significantly, which is conducive to reducing employment vulnerability and improving individual subjective well-being. Employment vulnerability is an important indicator of employment quality, directly impacting individuals' subjective well-being (Julià et al., 2017). Therefore, this research takes an employment perspective and refers to the study of Bocquier et al. (2010), which measures employment vulnerability regarding employment conditions, employability and employment security (Table 8), to examine the potential pathway of which digital literacy may enhance subjective well-being by reducing employment vulnerability. The results are presented in Table 9.

The results in Table 9 show that personal digital literacy positively affects happiness and life satisfaction by reducing employment vulnerability. Contemporary business ecosystems and platform economies, underpinned by technologies such as "Internet Plus", 5G, artificial intelligence, and big data, have reshaped the structure of the labour market and led to the emergence of new trends in employment patterns, with digital flexible employment gradually becoming a trend of flexible employment in the labour market (Lu et al., 2023). Therefore, individuals with higher levels of digital literacy are better equipped to effectively access information and more external resources through the Internet platform. This situation reduces the vulnerability of residents to employment in the labour market and increases income (Chen et al., 2024), thus improving their sense of happiness and life satisfaction. Hypothesis 3a is confirmed.

Table 8. System of indicators for measuring vulnerability to employment

Dimension	Variable	Variable description	Definition
Environment: employment conditions	Work stability	Length of time in current job (years)	1 for less than 1 year of employment, 0 otherwise
	Working intensity	Average weekly working hours	1 for working more than 56 hours per week, 0 otherwise
	Workplace	Whether or not they have a fixed place of work	1 for no fixed workplace, 0 otherwise
Individual: employment competencies	Education	education	1 for primary and below, otherwise 0
	Health	Very healthy, healthy, average, relatively unhealthy, very unhealthy	1 for relatively unhealthy or very unhealthy, 0 otherwise
Social: employment security	Labour contract	Whether or not a labour contract has been signed	1 for no labour contract signed, 0 for signed
	Medical insurance	Whether participated in medical insurance	1 for not participated in health insurance, 0 for participated
	Pension insurance	Whether participated in pension insurance	1 for not participated in pension insurance, 0 for participated

Table 9. Regression results for employment vulnerability mediation

	(1)	(2)	(3)	(4)
Variables	Employment vulnerability	Happiness	Employment vulnerability	Life Satisfaction
Digital literacy	-0.158*** (0.023)	0.050** (0.024)	-0.132*** (0.030)	0.113*** (0.029)
Employment vulnerability		-0.162*** (0.048)		-0.144*** (0.016)
atanhrho_12	-0.055 (0.044)	0.035 (0.053)	0.058 (0.053)	0.316* (0.057)
Control variables	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

5.2. Human capital accumulation

Advances in ICT have enabled the development of online platforms that have dramatically changed the landscape of e-commerce (Fahmy, 2020), making online learning and skills training more widespread with the help of the Internet and digital technologies (Spante et al., 2018; Weninger, 2017). Digital literacy has an apparent human capital accumulation effect (DiMaggio & Bonikowski, 2008). Highly digitally literate workers learn new knowledge and skills independently through various online platforms to promote the human capital accumulation, and the knowledge-learning effect it produces will be conducive to enhancing subjective well-being. Therefore, this study chooses learning frequency to reflect individuals'

human capital accumulation and verifies whether the level of digital literacy affects individuals' subjective well-being by influencing human capital accumulation. The indicator's value is from 1 to 5, with the larger number representing the higher learning frequency, and the regression results are shown in Table 10.

Table 10. Results of the intermediary regression on human capital accumulation

	(1)	(2)	(3)	(4)
Variables	Human capital	Happiness	Human capital	Life satisfaction
Digital literacy	0.134*** (0.025)	0.068*** (0.024)	0.123*** (0.025)	0.062*** (0.023)
Human capital		0.098*** (0.020)		0.547*** (0.089)
atanrho_12	-0.095 (0.046)	-0.040 (0.042)	-0.114 (0.058)	-0.081* (0.045)
Control variables	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

Table 10 shows that digital literacy significantly enhances residents' happiness and life satisfaction by increasing human capital accumulation. The development of digital networks creates opportunities for residents to improve themselves. For example, enterprises can improve employees' work skills and efficiency by organising online training and learning (Purcell et al., 2013). The findings point out a positive correlation between workers' digital literacy and the adoption of cloud technologies within firms (Cetindamar et al., 2021), which has important implications for the digitalisation of the organisation (Lei et al., 2024; Zahoor et al., 2023). Therefore, it can be found that digital literacy serves as the antecedent to employees' cognitive behavior in utilizing cloud technology at companies. The higher the individual's digital literacy, the higher the frequency and ability to use the Internet to share learning resources. For one thing, this promotes non-agricultural labour employment by augmenting human capital and expanding information accessibility (Wang et al., 2023), which helps to enhance the employment competitiveness and self-efficacy of the employed in the labour market. Moreover, it allows for a better work-life balance (Duan & Deng, 2024), thus increasing individuals' happiness and life satisfaction. Hypothesis 3b is confirmed.

5.3. Social capital

The Internet has dramatically changed how people communicate, expanding the limitations of traditional face-to-face socialisation in time and space (Sabatini & Sarracino, 2017) and improving the frequency, flexibility and freedom of socialisation. Coleman et al. (2022) believe that the social capital created through interaction activities can significantly affect people's subjective well-being (Coleman et al., 2022). Highly digitally literate people often use the information technology the Internet represents to diversify social interactions and accumulate social capital (Chan, 2022), enhancing happiness and life satisfaction. Therefore,

this study selects social frequency as a proxy variable for social capital, assigning a value of 1 to 5, with larger numbers representing higher social frequency. The regression results are shown in Table 11.

Table 11. Social capital mediation regression results

	(1)	(2)	(3)	(4)
Variables	Social capital	Happiness	Social capital	Life satisfaction
Digital literacy	0.042* (0.023)	0.072*** (0.024)	0.042* (0.023)	0.093*** (0.030)
Social capital		0.096*** (0.020)		0.083*** (0.018)
atanhrho_12	-0.040 (0.042)	-0.070 (0.044)	-0.040 (0.042)	0.301* (0.057)
Control variables	Yes	Yes	Yes	Yes
Area	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses; *** = $p < 0.01$, ** = $p < 0.05$, and * = $p < 0.1$.

The findings presented in Table 11 indicate that digital literacy significantly increases the level of social capital of the population, which in turn significantly increases personal well-being and life satisfaction. The main reason is that social capital, as a non-market force that increases the welfare of residents and contributes to economic growth, is prevalent in families, friends and neighbours, as well as in various workplaces and “virtual communities” on the Internet (Arechavala et al., 2022; Cox, 2017). Social capital allows individuals to gain positive subjective perceptions of belonging, trust, and approval, which can effectively stimulate positive psychological emotions (Mair, 2019). At the same time, through communication and collaboration to obtain economic resources, individuals gain more life satisfaction, especially in China’s typically relational society (Tian, 2020). Therefore, whether from the perspective of emotional interaction or mutual resource support, digital literacy exerts a positive influence on residents’ subjective well-being by strengthening their social capital accumulation. Hypothesis 3c is tested.

6. Discussion and conclusions

6.1. Discussion

Traditionally, digital literacy may be viewed more as a practical skill or an economic competitiveness tool. This study directly relates it to subjective well-being, revealing a deeper meaning of digital literacy as not only a tool, but also a key factor in enhancing the quality of life and promoting subjective well-being.

We provide evidence that digital literacy improves well-being and life satisfaction, a finding that remains robust after addressing endogeneity and conducting a series of robustness tests (Tables 4–7), thereby confirming Hypothesis 1. Amid the swift advancement of the digital economy and the growing adoption of digital technologies, new occupations have emerged,

raising the digital literacy requirements in the workplace. This is conducive to optimising resource allocation, maximising personal utility, and reaping higher dividends from the digital economy (Park et al., 2020), thus further enhancing subjective well-being.

Actually, improving residents' digital literacy has an information welfare effect, which can narrow the digital divide and help disadvantaged populations reduce the difference in subjective well-being from advantaged populations. As depicted in Figures 1–4, the marginal effect of digital literacy on the subjective well-being of rural areas, less-developed regions, women, and low-income groups is greater. In other words, the positive impact of digital literacy on residents' subjective well-being is more prominent among these disadvantaged populations. Hypothesis 2 is confirmed. This finding is consistent with earlier research by He et al. (2025) and Wang et al. (2022). Studies indicate that the digital skills gap still exists (Beaunoyer et al., 2020), and coupled with the existence of labour market segmentation, the development of the digital economy may further furnish the phenomenon of labour structure polarisation. Furthermore, parents with lower family status or lower levels of education have children with lower levels of digital literacy (Siddiq et al., 2017).

Furthermore, the results of the mechanism test in Tables 9–11 indicate that digital literacy exerts a positive influence on the subjective well-being of the population by reducing employment vulnerability, as well as increasing human capital accumulation and social capital, which enhances the quality of employment while contributing to the realisation of personal values. It confirms Hypothesis 3. In the digital economy era, digital literacy affects individuals' behavioural decisions (Wang et al., 2025). Workers with higher digital literacy can more quickly adjust to technological changes and changes in occupational demand, thus reducing the risk of unemployment due to outdated skills and lowering employment vulnerability. This contributes to a positive effect on maintaining the stability of the social employment structure. At the same time, highly digitally literate workers learn independently and broaden their social circles through various online platforms. This increases work efficiency and labour output. The increase in labour output directly enhances the economic efficiency of enterprises and brings higher economic returns to workers (Zhang et al., 2024), helping to improve the quality of life of residents and thus enhancing subjective well-being.

Digital literacy acts as the micro-foundation essential for the functioning of the digital economy and its potential welfare effects. This study investigates the impact of non-material factors, including digital literacy, on individual subjective well-being, contributing to the refinement of welfare evaluation systems and the development of strategies for welfare improvement. It demonstrates how enhancing digital literacy can increase subjective well-being, offering a new perspective for advancing public welfare. We recommend that both the extent and quality of digital technology penetration be prioritized to ensure that its benefits reach the public effectively. Public policies should focus on guiding individuals in the appropriate use of digital technology through targeted education and training programs, thereby enhancing digital literacy and skills across society. This approach will enable the population to keep pace with digital advancements and fully share in the dividends and positive impacts of the digital economy.

6.2. Conclusions

The growth of the digital economy and the advancement of digital technologies have made digital literacy an essential factor for accessing the benefits of the digital economy. It has become increasingly important to the labour market and individual work life. Using data from the 2017 China General Social Survey, this study applies the POLS method to empirically analyze the impact of digital literacy on individuals' subjective well-being. To address potential endogeneity, we apply the instrumental variables approach, complemented by the Oprobit model and CMP estimation methods for robustness checks, drawing three key conclusions. First, digital literacy significantly enhances individuals' subjective well-being. Second, digital literacy is more conducive to increasing the subjective well-being of rural residents, less-developed regions, women, and low-income groups. Third, digital literacy elevates individuals' subjective well-being by reducing employment vulnerability and increasing the accumulation of both human and social capital. Therefore, this study argues that digital literacy is a critical factor influencing subjective well-being in the digital economy era. Enhancing digital literacy represents a key strategy for improving overall societal welfare and restructuring the labour market, providing important insights for public policy formulation and evaluation.

Our findings reveal the multiple positive effects of digital literacy in enhancing subjective well-being and promoting social equity. This provides important insights for policymaking at different levels. Firstly, focus on intra-regional differences. This study finds that even within the same region, the level of digital literacy and the resulting increase in subjective well-being may vary significantly across populations. Public policies need to prioritize the digital inclusion of disadvantaged groups, improve digital infrastructure in less developed regions, provide digital skills training, and focus on improving the digital literacy of disadvantaged groups, such as women, low-income groups, less-developed regions, and rural residents. This will avoid the solidification of disadvantage. Furthermore, it is an important means of narrowing the digital gap, reducing inequality of opportunity, and raising the overall subjective well-being of society, as well as an inevitable choice for achieving common prosperity.

Secondly, digital literacy enhancement is integrated into development strategies. Studies have pointed out that digital literacy enhances subjective well-being through the accumulation of human and social capital. Therefore, this study suggests enriching the supply of high-quality digital resources, stimulating the vitality of digital innovation, strengthening the investment in human capital in the digital era, continuously improving human capital using online education and digital training, and enhancing the ability to work digitally in a highly efficient manner. Such actions can make the workers' access to information more secure, their expectations of risk more reasonable, and their ways of accumulating social capital more abundant. These improvements reinforce the importance of digital literacy in facilitating the realisation of the goal of high-quality employment and promoting the healthy development of the labour market, as well as for enhancing social welfare.

Furthermore, promoting global digital inclusion. The findings of this paper provide a new perspective on the global digital divide, where digital literacy is not only a matter of access, but also a matter of capacity, and has a far-reaching impact on welfare. International organizations and countries should strengthen their cooperation and jointly promote the enhancement of

digital literacy in developing countries, especially in less developed regions and among disadvantaged groups, as an important means of reducing global poverty and promoting sustainable development. They should also jointly address the challenges posed by the digital age.

Although the findings of this paper deepen our understanding of the factors influencing individual well-being in the digital age, certain limitations remain. First, owing to the lack of international individual micro-data, future research should conduct comparative analyses and empirical studies with international data to draw more robust and reliable conclusions. Second, the elements and mechanisms affecting individual subjective well-being are complex; therefore, it is recommended that future researchers adopt a causal model, and comparative analysis with empirical evidence from other countries or across cultures to enrich the findings for developing appropriate strategies and policies toward the development of the digital economy.

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Author contributions

Lu Kangyin and Jia Liwen jointly conceived the study and were responsible for the design and development of the data analysis. Shi Chen and Liang Xiaocheng contributed to data collection. Jia Liwen independently carried out data processing, statistical analysis, and data interpretation, and drafted the manuscript.

Disclosure statement

The authors declare that they do not have any competing financial, professional, or personal interests from other parties.

References

- Adams Becker, S. A., Pasquini, L. A., & Zentner, A. (2017). 2017 digital literacy impact study: An NMC horizon project strategic brief. *The New Media Consortium*, 3.5. Retrieved February 25, 2024 from <https://www.learntechlib.org/p/182080/>
- Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232. <https://doi.org/10.1257/jep.24.3.207>
- Ala-Mutka, K. (2011). *Mapping digital competence: Towards a conceptual understanding* (Technical Report No. JRC67075). European Union. <https://doi.org/10.13140/RG.2.2.18046.00322>
- Anthonyamy, L., Koo, A. C., & Hew, S. H. (2020). Self-regulated learning strategies in higher education: Fostering digital literacy for sustainable lifelong learning. *Education And Information Technologies*, 25, 2393–2414. <https://doi.org/10.1007/s10639-020-10201-8>

- Arechavala, N. S., Espina, Z. P. & Pastor, A. T. L. (2022). The importance of the neighbourhood environment and social capital for happiness in a vulnerable district: The case of the Pajarillos district in Spain. *Journal of Happiness Studies*, 23(5), 1941–1965. <https://doi.org/10.1007/s10902-021-00479-x>
- Bae, S.-M. (2022). The mediating effect of digital literacy on the relationship between smartphone use motives and life satisfaction for senior citizens in Korea. *Iranian Journal of Public Health*, 51(2), 336–344. <https://doi.org/10.18502/ijph.v51i2.8686>
- Beaunoyer, E., Dupere, S. & Guittona, M. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behaviour*, 111, Article 106424. <https://doi.org/10.1016/j.chb.2020.106424>
- Becchetti, L., & Conzo, G. (2022). The gender life satisfaction/depression paradox. *Social Indicators Research*, 160, 35–113. <https://doi.org/10.1007/s11205-021-02740-5>
- Bejaković, P., & Mrnjavac, Z. (2020). The importance of digital literacy on the labour market. *Employee Relations*, 42(4), 921–932. <https://doi.org/10.1108/ER-07-2019-0274>
- Benjamin, D. J., Heffetz, O., Kimball, M. S., & Rees-Jones, A. (2012). What do you think would make you happier? What do you think you would choose? *American Economic Review*, 102(5), 2083–2110. <https://doi.org/10.1257/aer.102.5.2083>
- Berger, T., Frey, C. B., Levin, G., & Danda, S. R. (2019). Uber happy? Work and well-being in the 'Gig economy'. *Economic Policy*, 34(99), 429–477. <https://doi.org/10.1093/epolic/eiz007>
- Blanchflower, D. G. (2021). Is happiness U-shaped everywhere? Age and subjective well-being in 145 countries. *Journal of Population Economics*, 34, 575–624. <https://doi.org/10.1007/s00148-020-00797-z>
- Blanchflower, D. G., & Oswald, A. J. (2019). Do humans suffer a psychological low in midlife? Two approaches (with and without controls) in seven data sets. In M. Rojas (Ed.), *The economics of happiness* (pp. 439–453). Springer. https://doi.org/10.1007/978-3-030-15835-4_19
- Bocquier, P., Nordman, C. J., & Vescovo, A. (2010). Employment vulnerability and earnings in urban West Africa. *World Development*, 38(9), 1297–1314. <https://doi.org/10.1016/j.worlddev.2010.02.011>
- Carrasco-Dajer, C. M., Vera-Calzaretta, A. R., Ubillos-Landa, S., Oyanedel, J. C., & Díaz-Gorriti, V. (2024). Impact of a culturally adapted digital literacy intervention on older people and its relationship with health literacy, quality of life, and well-being. *Frontiers in Psychology*, 15, Article 1305569. <https://doi.org/10.3389/fpsyg.2024.1305569>
- Cetindamar, D., Abedin, B., & Shirahada, K. (2021). The role of employees in digital transformation: A preliminary study on how employees' digital literacy impacts use of digital technologies. *IEEE Transactions on Engineering Management*, 71, 7837–7848. <https://doi.org/10.1109/TEM.2021.3087724>
- Cetindamar, D., Abedin, B., Gedsri, N., & Shirahada, K. (2024). Editorial overview of digital literacy of employees and organizational transformation and innovation. *IEEE Transactions on Engineering Management*, 71, 7832–7836. <https://doi.org/10.1109/TEM.2023.3322182>
- Chan, G. H. (2022). The social capital accumulation in the contemporary era. *Internet Research*, 32(6), 1930–1951. <https://doi.org/10.1108/INTR-12-2020-0711>
- Chen, N. W., Chen, H. C. & Lin, S. Y. (2020). Effect of education-occupation mismatch on happiness. *International Journal of Social Economics*, 47(1), 86–110. <https://doi.org/10.1108/IJSE-04-2019-0283>
- Chen, Z. W., Cui, R., Tang, C., & Wang, Z. H. (2024). Can digital literacy improve individuals' incomes and narrow the income gap? *Technological Forecasting and Social Change*, 203, Article 123332. <https://doi.org/10.1016/j.techfore.2024.123332>
- China Cyberspace Research Institute. (2023). *China Internet Development Report 2023*. The Commercial Press.
- Coleman, M. E., Manchella, M. K., Roth, A. R., Peng, S., & Perry, B. L. (2022). What kinds of social networks protect older adults? health during a pandemic? The tradeoff between preventing infection and promoting mental health. *Social Networks*, 70, 393–402. <https://doi.org/10.1016/j.socnet.2022.05.004>

- Coley, R. L., Bachman, H. J., Votruba-Drzal, E., Lohman, B. J., & Li-Grinning, C. P. (2007). Maternal welfare and employment experiences and adolescent well-being: Do mothers' human capital characteristics matter? *Children And Youth Services Review, 29*(2), 193–215. <https://doi.org/10.1016/j.childyouth.2006.07.004>
- Cox, A. B. (2017). Cohorts, "siblings," and mentors: Organizational structures and the creation of social capital. *Sociology of Education, 90*(1), 47–63. <https://doi.org/10.1177/0038040716681053>
- Demir, B. (2018). Examining the perception of happiness and well-being at work in terms of demographic characteristics. *Journal of Social and Humanities Sciences Research, 24*(5), 1603–1611. <https://doi.org/10.26450/jshsr.549>
- Diener, E., Oishi, S., & Tay, L. (2018). Advances in subjective well-being research. *Nature Human Behaviour, 2*, 253–260. <https://doi.org/10.1038/s41562-018-0307-6>
- DiMaggio, P., & Bonikowski, B. (2008). Make money surfing the web? The impact of Internet use on the earnings of U.S. workers. *American Sociological Review, 73*(2), 227–250. <https://doi.org/10.1177/000312240807300203>
- Duan, S. X., & Deng, H. (2024). Intrinsic needs and job performance in digital work: The mediating role of work-life balance. *IEEE Transactions on Engineering Management, 71*, 7892–7900. <https://doi.org/10.1109/TEM.2022.3218925>
- Easterlin, R. A. (2004). The economics of happiness. *Daedalus, 133*(2), 26–33. <https://doi.org/10.1162/001152604323049361>
- European Commission. (2016). *Connectivity: Broadband market developments in the EU* (Europe's Digital Progress Report 2016). <https://www.astrid-online.it/static/upload/euro/europe-s-digital-progress-report-2016.pdf>
- Fahmy, H. (2020). How technological emergence, saturation, and rejuvenation are re-shaping the e-commerce landscape and disrupting consumption? A time series analysis. *Applied Economics, 53*(6), 742–759. <https://doi.org/10.1080/00036846.2020.1813249>
- Ferrari, A. (2012). *Digital competence in practice: An analysis of frameworks* (JRC Technical Report). European Commission. <https://www.ectel07.org/EURdoc/JRC68116.pdf>
- Gilster, P. (1997). *Digital literacy*. Wiley.
- Gnaldi, M., & Del Sarto, S. (2018). Time use habits of Italian generation Y: Dimensions of leisure preferences. *Social Indicators Research, 138*, 1187–1203. <https://doi.org/10.1007/s11205-017-1736-8>
- Gong, S., Sun, Z., Wang, B., Yu, Z. (2024). Could digital literacy contribute to the improvement of green production efficiency in agriculture? *Sage Open, 14*(1). <https://doi.org/10.1177/21582440241232789>
- Graham, C., & Nikolova, M. (2013). Does access to information technology make people happier? Insights from well-being surveys from around the world. *Journal of Socio-Economics, 44*, 126–139. <https://doi.org/10.1016/j.socec.2013.02.025>
- Graham, C., & Nikolova, M. (2015). Bentham or Aristotle in the development process? An empirical investigation of capabilities and subjective well-being. *World Development, 68*, 163–179. <https://doi.org/10.1016/j.worlddev.2014.11.018>
- Green, A. E. (2017). Implications of technological change and austerity for employability in urban labour markets. *Urban Studies, 54*(7), 1638–1654. <https://doi.org/10.1177/0042098016631906>
- Gürtzgen, N., Diegmann, A., Pohlan, L., & van der Berg, G. J. (2021). Do digital information technologies help unemployed job seekers find a job? Evidence from the broadband internet expansion in Germany. *European Economic Review, 132*, Article 103657. <https://doi.org/10.1016/j.euroecorev.2021.103657>
- He, C., Shi, R., Wen, H., & Chu, J. (2025). Impact of digital literacy on rural residents' subjective well-being: An empirical study in China. *Agriculture, 15*(6), Article 586. <https://doi.org/10.3390/agriculture15060586>

- Ibrahim, M., & Aduah, E. W. (2025). Digital literacy, digital intelligence and small and medium enterprises' (SMEs) sustainability: The mediating role of digital technology usage. *Information Development*. <https://doi.org/10.1177/02666669251335001>
- James, A. (2022). Women in the gig economy: Feminising digital labour. *Work in the Global Economy*, 2(1), 2–26. <https://doi.org/10.1332/273241721X16448410652000>
- Jin, K.-Y., Reichert, F., Cagasan, L. P., & de la Torre, J. (2020). Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance differences. *Computers & Education*, 157, Article 10396. <https://doi.org/10.1016/j.compedu.2020.103968>
- Julià, M., Vanroelen, C., Bosmans, K., Van Aerden, K., & Benach, J. (2017). Precarious employment and quality of employment in relation to health and well-being in Europe. *International Journal of Health Services*, 47(3), 389–409. <https://doi.org/10.1177/0020731417707491>
- Jung, J., You, J., & Kim, D. (2025). Effective but sustainable? A case of a digital literacy program for older adults. *Education and Information Technologies*, 30, 13309–13330. <https://doi.org/10.1007/s10639-025-13364-4>
- Kragten, N., & Rözer, J. (2017). The income inequality hypothesis revisited: Assessing the hypothesis using four methodological approaches. *Social Indicators Research*, 131, 1015–1033. <https://doi.org/10.1007/s11205-016-1283-8>
- Kühner, S., Jiang, J., Wen, Z., & Lau, M. (2021). Labour market experience, educational attainment and self-reported happiness: Crowding-out amongst young people in Hong Kong. *Journal of Education and Work*, 34(3), 275–291. <https://doi.org/10.1080/13639080.2021.1922622>
- Larsson, B., Dragioti, E., Gerdle, B., & Björk, J. (2019). Positive psychological well-being predicts lower severe pain in the general population: A 2-year follow-up study of the SwePain cohort. *Annals of General Psychiatry*, 18, Article 8. <https://doi.org/10.1186/s12991-019-0231-9>
- Law, N., Woo, D., De La Torre, J., & Wong, G. (2018). *A Global framework of reference on digital literacy Skills for Indicator 4.4.2* (Information Paper No. 51). UNESCO Institute for Statistics. <https://hub.hku.hk/bitstream/10722/262055/1/Content.pdf>
- Lee, C., Gleib, D. A., Goldman, N., & Weinstein, M. (2017). Children's education and parents' trajectories of depressive symptoms. *Journal of Health and Social Behavior*, 58(1), 86–101. <https://doi.org/10.1177/0022146517690200>
- Lee, H., Lim, J.-A., & Nam, H.-K. (2022). Effect of a digital literacy program on older adults' digital social behavior: A quasi-experimental study. *International Journal of Environmental Research and Public Health*, 19(19), Article 12404. <https://doi.org/10.3390/ijerph191912404>
- Lee, J. H., & Bae, S. M. (2023). The relationship between smartphone use motives, social capital, digital literacy, and life satisfaction in elderly Koreans. *Iranian Journal of Public Health*, 52(12), 2554–2562. <https://doi.org/10.18502/ijph.v52i12.14316>
- Lei, H., Tang, S., Zhao, Y., & Chen, S. (2024). Enterprise digitalization, employee digital literacy and R&D cooperation: The moderating role of organizational inertia. *Chinese Management Studies*, 18(2), 479–505. <https://doi.org/10.1108/CMS-10-2021-0456>
- Lewchuk, W. (2017). Precarious jobs: Where are they, and how do they affect well-being? *The Economic and Labour Relations Review*, 28(3), 402–419. <https://doi.org/10.1177/1035304617722943>
- Long, T. Q., Hoang, T.C., Simkins, B. (2023). Gender gap in digital literacy across generations: Evidence from Indonesia. *Finance Research Letters*, 58, Article 104588. <https://doi.org/10.1016/j.frl.2023.104588>
- Lu, K. Y., Jia, L., & Chen, S. (2023). Which employment mode is more competitive in a digital economy? A study on income differences of flexible employment. *Journal of Competitiveness*, 15(2), 36–53. <https://doi.org/10.7441/joc.2023.02.03>
- Mair, C. A. (2019). Alternatives to aging alone?: "Kinlessness" and the importance of friends across European contexts. *The Journals of Gerontology: Series B*, 74(8), 1416–1428. <https://doi.org/10.1093/geronb/gbz029>

- Nguyen, M. H., Hunsaker, A., & Hargittai, E. (2022). Older adults' online social engagement and social capital: The moderating role of Internet skills. *Information Communication and Society*, 25(7), 942–958. <https://doi.org/10.1080/1369118X.2020.1804980>
- Organisation for Economic Co-operation and Development. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. OECD Publishing. <https://doi.org/10.1787/9789264204256-en>
- Organisation for Economic Co-operation and Development. (2014). *Skills and jobs in the internet economy* (OECD Digital Economy Papers No. 242). OECD Publishing. <https://doi.org/10.1787/5jxvbrjm9bns-en>
- Oh, E.-A., & Bae, S.-M. (2024). The relationship between the digital literacy and healthy aging of the elderly in Korea. *Current Psychology*, 43, 16160–16169. <https://doi.org/10.1007/s12144-023-05557-2>
- Origo, F., & Pagani, L. (2009). Flexicurity and job satisfaction in Europe: The importance of perceived and actual job stability for well-being at work. *Labour Economics*, 16(5), 547–555. <https://doi.org/10.1016/j.labeco.2009.02.003>
- Park, E.-A., & Lee, S. W. (2015). Multidimensionality: redefining the digital divide in the smartphone era. *Info*, 17(2), 80–96. <https://doi.org/10.1108/info-09-2014-0037>
- Park, H., Kim, H. S., & Park, H. W. (2020). A scientometric study of digital literacy, ICT literacy, information literacy, and media literacy. *Journal of Data and Information Science*, 6(2), 116–138. <https://doi.org/10.2478/jdis-2021-0001>
- Pénard, T., Poussing, N., & Suire, R. (2013). Does the Internet make people happier? *Journal of Socio-Economics*, 46(12), 105–116. <https://doi.org/10.1016/j.socec.2013.08.004>
- Perez-Truglia, R. (2020). The effects of income transparency on well-being: Evidence from a natural experiment. *American Economic Review*, 110(4), 1019–1054. <https://doi.org/10.1257/aer.20160256>
- Pollmann-Schult, M. (2018). Parenthood and life satisfaction in Europe: The role of family policies and working time flexibility. *European Journal of Population*, 34, 387–411. <https://doi.org/10.1007/s10680-017-9433-5>
- Popov, E. V. (2023). Features of digital literacy measurement in Russia. *Sotsiologicheskie Issledovaniya*, 11, 51–61. <https://doi.org/10.31857/S013216250028532-8>
- Prayitno, P. H., Sahid, S., & Hussin, M. (2022). Social capital and household economic welfare: Do entrepreneurship, financial and digital literacy matter? *Sustainability*, 14(24), Article 16970. <https://doi.org/10.3390/su142416970>
- Prete, A. L. (2022). Digital and financial literacy as determinants of digital payments and personal finance. *Economics Letters*, 213, Article 110378. <https://doi.org/10.1016/j.econlet.2022.110378>
- Purcell, K., Heaps, A., Buchanan, J., & Friedrich, L. (2013). *How teachers are using technology at home and in their classrooms*. Pew Research Center's Internet and American Life Project. <https://fiscalresearch-center.issuelab.org/resources/14773/14773.pdf>
- Radovanović, D., Holst, C., Belur, S. B., Srivastava, R., Houngbonon, G. V., Le Quentrec, E., Miliza, J., Winkler, A. S., & Noll, J. (2020). Digital literacy key performance indicators for sustainable development. *Social Inclusion*, 8(2), 151–162. <https://doi.org/10.17645/si.v8i2.2587>
- Reddy, P., Sharma, B., & Chaudhary, K. (2022). Digital literacy: a review in the South Pacific. *Journal of Computing in Higher Education*, 34, 83–108. <https://doi.org/10.1007/s12528-021-09280-4>
- Reddy, P., Chaudhary, K., Sharma, B., & Hussein, S. (2023). Essaying the design, development and validation processes of a new digital literacy scale. *Online Information Review*, 47(2), 371–397. <https://doi.org/10.1108/OIR-10-2021-0532>
- Roodman, D. (2011). Fitting fully observed recursive mixed-process models with cmp. *The Stata Journal*, 11(2), 159–206. <https://doi.org/10.1177/1536867X1101100202>
- Ruiu, G., & Ruiu, M. L. (2019). The complex relationship between education and happiness: The case of highly educated individuals in Italy. *Journal of Happiness Studies*, 20, 2631–2653. <https://doi.org/10.1007/s10902-018-0062-4>

- Sabatini, F., & Sarracino, F. (2017). Online networks and subjective well-being. *Kyklos*, 70(3), 456–480. <https://doi.org/10.1111/kykl.12145>
- Shatila, K., Aránega, A. Y., Soga, L. R., & Hernández-Lara, A. B. (2025). Digital literacy, digital accessibility, human capital, and entrepreneurial resilience: A case for dynamic business ecosystems. *Journal of Innovation & Knowledge*, 10(3), Article 100709. <https://doi.org/10.1016/j.jik.2025.100709>
- Siddiq, F., Gochyyev, P., & Wilson, M. (2017). Learning in digital networks – ICT literacy: A novel assessment of students' 21st century skills. *Computers & Education*, 109, 11–37. <https://doi.org/10.1016/j.compedu.2017.01.014>
- Spante, M., Hashemi, S. S., Lundin, M., & Algers, A. (2018). Digital competence and digital literacy in higher education research: Systematic review of concept use. *Cogent Education*, 5(1), Article 1519143. <https://doi.org/10.1080/2331186x.2018.1519143>
- Tella, R. D., MacCulloch, R. J., & Oswald, A. J. (2003). The macroeconomics of happiness. *The Review of Economics and Statistics*, 85(4), 809–827. <https://doi.org/10.1162/003465303772815745>
- Tian, X. (2020). QWL and related factors for migrant workers survey in Guangdong province, China. *Journal of Social Service Research*, 46(2), 160–169. <https://doi.org/10.1080/01488376.2018.1536629>
- U.S. Department of State. (2023). *United States strategy on global women's economic security*. <https://www.state.gov/wp-content/uploads/2023/01/U.S.-Strategy-on-Global-Womens-Economic-Security.pdf>
- Van Praag, B., & Ferrer-i-Carbonell, A. (2006). *An almost integration: Free approach to ordered response models* (Discussion Paper No. 06-047/3). Tinbergen Institute.
- Vissenberg, J., d'Haenens, L., & Livingstone, S. (2022). Digital literacy and online resilience as facilitators of young people's wellbeing? A systematic review. *European Psychologist*, 27(2), 76–85. <https://doi.org/10.1027/1016-9040/a000478>
- Wang, J., Liu, C., & Cai, Z. (2022). Digital literacy and subjective happiness of low-income groups: Evidence from rural China. *Frontiers in Psychology*, 13, Article 1045187. <https://doi.org/10.3389/fpsyg.2022.1045187>
- Wang, S., Qu, C., Yin, L. (2025). Digital literacy, labor migration and employment, and rural household income disparities. *International Review of Economics & Finance*, 99, Article 104040. <https://doi.org/10.1016/j.iref.2025.104040>
- Wang, X., Yi, F., & Yang, C. (2023). "Promoting employment, supporting intelligence first": The impact of digital literacy on non-farm employment of rural labour. *Applied Economics Letters*, 31(19), 2020–2025. <https://doi.org/10.1080/13504851.2023.2209306>
- Weninger, C. (2017). The "vernacularization" of global education policy: Media and digital literacy as twenty-first century skills in Singapore. *Asia Pacific Journal of Education*, 37(4), 500–516. <https://doi.org/10.1080/02188791.2017.1336429>
- Xiao, H., & Xin, Z. (2022). Financial literacy is better than income to predict happiness. *Journal of Neuroscience, Psychology, and Economics*, 15(3), 119–136. <https://doi.org/10.1037/npe0000161>
- Zahoor, N., Zopiatis, A., Adomako, S., & Lamprinakos, G. (2023) The micro-foundations of digitally transforming SMEs: How digital literacy and technology interact with managerial attributes. *Journal of Business Research*, 159, Article 113755. <https://doi.org/10.1016/j.jbusres.2023.113755>
- Zhang, J., Wang, D., Ji, M., Yu, K., Qi, M., & Wang, H. (2024). Digital literacy, relative poverty, and common prosperity for rural households. *International Review of Financial Analysis*, 96, Article 103739. <https://doi.org/10.1016/j.irfa.2024.103739>
- Zhao, L., He, Q. L., Guo, L., & Sarpong, D. (2023). Organizational digital literacy and enterprise digital transformation: Evidence from Chinese listed companies. *IEEE Transactions On Engineering Management*, 71, 11884–11897. <https://doi.org/10.1109/TEM.2023.3241411>