The Impact of Digital Economy on Resident Income: The Mediating Role of Human Capital

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Abstracts
This research examines how the digital economy affects residents' incomes, highlighting the impact of human capital as a mediator as well as differences across regions. By analysing panel data for 30 provinces in China from 2012 to 2022, the study finds that the development of the digital economy significantly raises residents' incomes, a result confirmed by a series of robustness tests. Further analysis of the mechanisms found that the digital economy can also affect residents' income through the mediating effect of human capital. Based on these findings, governments need to take measures to ensure that the fruits of the digital economy benefit a wider range of groups, so as to avoid increasing income inequality. For example, it should promote digital agricultural technologies and e-commerce platforms in rural areas to increase farmers' incomes through technological empowerment; at the same time, it should strengthen social security for lower-skilled employment, for example, by providing basic old-age and healthcare protection for takeaway workers and online car drivers to reduce the risks faced by lower-skilled employment.
Keywords: Resident Income, Human Capital, Digital Economy, Mediating Role

Introduction
Globally, the digital economy has become a crucial driver of economic growth, significantly influencing industrial structures, business models, and employment patterns (Manyika et al., 2016). China's digital economy has demonstrated remarkable development. According to the *China Digital Economy Development Report (2023)*, the scale of China's digital economy reached 53.9 trillion yuan in 2023, with its share of GDP continuing to increase. Against this backdrop, digital technologies are reshaping production methods across industries at an unprecedented pace, fostering the rise of emerging sectors such as e-commerce (Chen, 2022), the sharing economy (Liu et al., 2020), remote work (Ma et al., 2023), and digital finance (Jiang et al., 2021). Simultaneously, the development of the digital economy has accelerated the digital transformation of traditional industries, such as the industrial internet (Hu et al., 2022), smart manufacturing (Xue et al., 2022), and intelligent logistics (Fan, 2024), significantly

enhancing productivity in manufacturing, retail, and finance (Brynjolfsson & McAfee, 2014). However, the rapid expansion of the digital economy also presents numerous challenges. While the rise of the platform economy (Kenney & Zysman, 2016) has created new employment opportunities, it has also undermined the stability of traditional employment relationships, leaving some platform workers vulnerable to insufficient labor protections (De Stefano, 2016; Zhao & Said, 2023 ; Zhao et al., 2024). Therefore, understanding how the digital economy affects household income has become a critical issue for both academia and policymakers.

Resident income refers to the sum of monetary and in-kind income obtained by residents through various legal channels within a country or region, including sources such as labour income, property income and transfer income, reflecting residents' living standards and economic welfare (World Bank , 2017). In China's economic accounting, residents' income refers to per capita disposable income, which is the income available for discretionary use, including both the wage remuneration received by individual residents for providing productive labour services, the business income received for engaging in production and business activities, and also the transfer income and property income received by residents (Feng, 2015; Zhang 2022). From a macro perspective, the rapid development of the digital economy may have a significant impact on residents' income levels by enhancing economic efficiency, creating new employment opportunities, and driving regional economic growth (He & Zhu, 2021). Data show that from 2012 to 2022, the per capita income of Chinese residents grows from about RMB 18,000 to more than RMB 36,000, with the eastern coastal regions clearly leading the way, e.g., Shanghai and Beijing will have per capita incomes close to or exceeding RMB 80,000 in 2022; whereas the central and western regions, such as Guizhou and Gansu, will still be below RMB 30, 000, despite the rise in incomes. 000 yuan. Changes in inter-regional income disparities are closely related to the unbalanced development of the digital economy (Qiang et al., 2021). Currently, there is a lack of systematic empirical research on the question of whether the digital economy significantly affects residents' income. Therefore, exploring the specific impact of the digital economy on residents' income based on the differences in the level of digital economy development between regions provides important research value for a comprehensive assessment of the economic effects of the digital economy and policy formulation.

The additional contributions of this study can be summarised as follows: first, a complete theoretical framework is constructed to explore the impact mechanism of the digital economy on residents' income in multiple dimensions, and the direct impact and mechanism of the digital economy on residents' income at the provincial level are empirically analysed. Second, the provinces are divided into east, centre and west based on geographical differences to further examine the heterogeneity of the impact of the digital economy on residents' income, aiming to reveal the differences in the effects of the digital economy in different geographical regions and promote balanced regional development. Finally, the instrumental variable method is used to cope with the potential endogeneity problems that may arise between the digital economy and residents' income, making the empirical results more accurate.

The structure of this paper is as follows: the second part is the theoretical analysis and research hypotheses, which establishes the theoretical framework of the study and reveals the mechanism of the digital economy's effect on residents' income; the third and fourth parts

elaborate on the model construction, parameter estimation, model testing and analytical results; and the fifth part draws the conclusions and recommendations of this paper.

Theoretical Analysis and Research Hypotheses
Digital Economy and Resident income
The direct impact of the digital economy on household income levels can be observed in three key areas. Firstly, the development of the digital economy enhances financial inclusion, improving individuals' access to financial resources. The growth of digital financial services has significantly increased the accessibility of financial services, particularly in rural and remote areas where traditional banking infrastructure is limited. Through digital financial platforms, individuals can more easily obtain loans and financing to start or expand small businesses, thereby increasing their sources of income (Li et al., 2023). Furthermore, the advancement of digital finance has helped individuals manage their assets more efficiently, improving financial planning and investment efficiency while increasing property income. For instance, research by Li et al. (2023) and Wen (2024) found that digital financial platforms enable individuals to optimize their investment portfolios and enhance household wealth accumulation. In addition to expanding credit access, digital financial platforms offer online investment products that provide residents with safe and convenient investment opportunities, contributing to long-term income growth. Secondly, the digital economy fosters regional economic integration and income growth. By reducing transaction costs and connecting urban and rural markets, the digital economy expands economic opportunities for individuals across different regions. Digital technologies such as e-commerce and logistics information systems enable rural residents to establish direct connections with urban markets, increasing product sales channels and boosting income. Wen (2024) found that e-commerce platforms allow rural residents to sell agricultural and handmade products more efficiently in urban markets, thereby enhancing their earnings. Additionally, the digital economy facilitates regional economic integration, helping to narrow income disparities between different areas. Deng et al. (2023) indicated that while digital economic development increases both urban and rural household incomes, it also mitigates the widening urban-rural income gap by increasing employment opportunities in the information services sector and expanding the reach of digital finance. By promoting interregional economic integration, rural residents gain access to more economic opportunities, fostering balanced income growth. Finally, the digital economy expands individuals' social networks, increasing income opportunities. The widespread adoption of digital technologies provides individuals with greater access to social networks and information channels, helping them diversify their income sources. Digital social platforms allow individuals to build extensive networks that create more employment opportunities, business insights, and investment prospects. Chai et al (2019) highlighted that expanding social networks enables individuals to gain market insights, client resources, and business collaborations more efficiently, thereby improving income diversity and stability. This effect is particularly beneficial for individuals in remote areas, who can leverage social media and e-commerce platforms to reach potential customers and business partners, overcoming geographical limitations and participating in broader economic networks. Ji et al (2021) further pointed out that the social expansion effect of the digital economy has contributed to the income growth of freelancers and small business owners. This diversification of income sources reduces dependence on a single stream of revenue, enhancing overall economic security.

Hypothesis 1: The digital economy has a significant positive impact on the income of the residents.

The Mediating Role of Human Capital in the Relationship Between the Digital Economy and Resident Income

The digital economy can also affect the income level of the population by improving human capital. The development of the digital economy can help to improve the human capital of the population and enhance their ability to increase their income. Human capital includes both health and education. From the perspective of education, human capital theory suggests that education is an important factor influencing the level of individual income, and Acemoglu (2008) shows that for every additional year of education, an individual's income increases by 6-10 per cent. The high sharing and exploitation of digital technology facilitates the extension of urban high-quality educational resources to remote areas, partially breaking down the barriers to educational resources, improving the level of education in remote areas, and greatly contributing to the improvement of the cultural literacy of residents in remote areas. In particular, e-commerce platforms such as TikTok and Alibaba gather talents from all walks of life and continuously output high-quality content, which accelerates the degree of knowledge spillover, diffusion and reduces the cost of learning, and is able to improve residents' overall knowledge stock, knowledge validity, and broaden their innovative thinking perspectives (Liu,2018). From the health perspective, physical health is the basic guarantee for residents to obtain economic wealth. The deep integration of digital technology and medical services can break the boundaries of geography and time, help amplify medical resources, expand the service radius, reduce the cost of medical care, promote the sinking of urban high-quality medical resources to remote areas, effectively alleviate the problem of uneven distribution of medical resources, and effectively improve the health of residents. At the same time, the development of digital technology promotes the popularisation of medical knowledge, which is more conducive to residents' self-health management. The development of digital economy can effectively reduce the emission intensity of industrial waste and the level of per capita air pollutant emissions, which is conducive to improving urban air quality and improving the physical health of residents (Liu,2023)

Hypothesis 2: The digital economy affects residents' income by improving human capital.

Research Methodology

Model Construction

This paper conducts an empirical analysis of the impact of digital economy development on residents' income levels. Drawing on the studies of Sun et al. (2022) and Long et al. (2022), the direct transmission mechanism is established, and the model is constructed as follows:

$$Ri_{i,t} = \beta_0 + \beta_1 De_{i,t} + \beta_2 Pgdp_{i,t} + \beta_3 Ti_{i,t} + \beta_4 Is_{i,t} + \beta_5 Ow_{i,t} + \mu_i + V_t + \varepsilon_{i,t} \quad (1)$$

Where Residents Income (Ri) is the dependent variable in model. The independent variable is Digital Economy (De). The control variables are Quality of economic development (Pgdp), Level of transport infrastructure (Ti), industrial structure (Is) and Degree of openness to the outside world (Ow). μ_i is the province fixed effect, and V_t is the year fixed effect. $\varepsilon_{i,t}$ is the random error term.

To further explore the mechanism of the digital economy's impact on residents' income growth, this paper employs a mediation effect model to investigate the mediating role of human capital (Hc) in the relationship between the digital economy and residents' income levels. Referring to the stepwise regression mediation effect model proposed by Baron and Kenny (1986), the models are constructed as follows:

$$Hc_{i,t} = \alpha_0 + \alpha_1 De_{i,t} + \alpha_2 Pgdp_{i,t} + \alpha_3 Ti_{i,t} + \alpha_4 Is_{i,t} + \alpha_5 Ow_{i,t} + \mu_i + V_t + \varepsilon_{i,t} \qquad (2)$$
$$Ri_{i,t} = \gamma_0 + \gamma_1 De_{i,t} + \gamma_2 Pgdp_{i,t} + \gamma_3 Ti_{i,t} + \gamma_4 Is_{i,t} + \gamma_5 Ow_{i,t} + \gamma_6 Pgdp_{i,t} + \mu_i + V_t + \varepsilon_{i,t} \quad (3)$$

Human capital (Hc) is used as the mediating variable. Equation (2) is applied to test the impact of the digital economy on the mediating variable, while Equation (3) examines the influence of the digital economy and the mediating variable on residents' income. Other control variables, fixed effects, and variance settings are consistent with those in Equation (1). In this context: β1 in Equation (1) represents the total effect of digital economy development on residents' income. γ1 in Equation (3) represents the direct effect of the digital economy on residents' income. The product α1×γ2 represents the indirect effect of the digital economy on residents' income through human capital.

Variable Descriptions
Resident Income (ri): Resident income is measured using the per capita disposable income of all residents, representing the level of income. Due to its large numerical value, the natural logarithm of this variable is taken to ensure consistency with other variables.

Digital Economy (de): Building on earlier studies on the digital economy (Zhao et al., 2020; Guo et al., 2020; Wang et al., 2021; Wang et al.,2024), this research uses a composite indicator system combined with the entropy weight method to compute development indices for the digital economy across provinces.

Quality of Economic Development (pgdp): Higher quality of economic development often correlates with improvements in social security and public services, which directly increase disposable income for low-income families, reduce poverty rates, and raise overall income levels (Dorofeev, 2022). Moreover, high-quality development fosters innovation and entrepreneurship, providing more opportunities for wealth accumulation among residents. This innovation-driven economic model promotes rapid income growth and long-term stability (Goczek et al., 2021). The logarithm of per capita GDP is used to measure the quality of economic development.

Transportation Infrastructure Level (ti): Improved transportation infrastructure facilitates easier access to the labor market, increasing job opportunities and boosting income. Studies have shown that upgrades to transportation infrastructure in urban areas of Pakistan significantly raised household income, with an average annual income growth exceeding 14% (Mehar, 2020). Transportation infrastructure promotes industrial clustering and enhances regional economic vitality, providing residents with more high-income job opportunities. For example, the construction of highways and railways not only fosters industrial development but also boosts resident income through economic growth (Wu et al., 2021). The logarithm of highway mileage is used to measure the transportation infrastructure level.

Degree of Openness to the Outside World (ow): Increased openness brings more opportunities for international trade and investment, fostering economic growth and raising resident income levels. Studies have shown that trade openness significantly increased the relative income share of low-income groups in emerging and developing economies (Dorn et al., 2021). Openness, through technology transfer and foreign investment, promotes skill training and education investment, indirectly improving workers' productivity and income levels (Dao & Khuc, 2023). The degree of openness is measured using the formula: (Total Import and Export Value * USD to RMB Exchange Rate) / Regional GDP.

Industrial Structure (is): Changes in industrial structure that increase the proportion of high-value-added industries create more high-paying jobs, raising average income levels. Research in China has demonstrated that upgrading the industrial structure significantly impacts urban and rural resident income, narrowing the urban-rural income gap and optimizing income distribution (Hong & Zhang, 2020). Adjustments to the industrial structure drive labor migration from low-efficiency agricultural sectors to more productive industrial and service sectors, enhancing worker productivity and income levels (Han & Jiang, 2024). Industrial structure is measured using the ratio of tertiary industry GDP to secondary industry GDP.

Human Capital Level (hc): As the mediating variable for Research Objective 3, human capital is measured using the ratio of the number of students enrolled in higher education institutions to the total population, following past studies (Winters, 2011; Batool & Liu, 2021).

Table 1
Variable summary

Variable	Description	Measurement
Ri	Income of residents	Logarithm of disposable income per capita for the total resident population
De	Digital Economy	Digital Economy Development Index
Pgdp	The quality of economic development	Logarithmic Gdp per capita
Ti	Level of transport infrastructure	Logarithmic road mileage
Ow	degree of openness to the outside world	(Total exports and imports of goods * US dollar to RMB exchange rate)/ GDP
Is	Industrial structure	Gdp of tertiary sector/Gdp of secondary sector
Hc	Level of human capital	Number of students enrolled in higher education/total population

Data Sources
This research analyzes yearly panel data from 30 provinces in China covering the period from 2012 to 2022. Key data sources include the China Statistical Yearbook, China Industrial Statistical Yearbook, China Civil Affairs Statistical Yearbook, and various provincial statistical yearbooks. The Digital Inclusive Finance Index comes from the Digital Finance Research

Center at Peking University. The dataset focuses on mainland China and excludes Tibet due to data limitations.

Result and Discussion

Descriptive Statistical Analysis

Table 2 presents the statistical descriptions of the variables, including variable names, sample size, means, standard deviations, minimum, and maximum values. This analysis is based on 330 observations collected from 30 provinces during the period 2012–2022. The descriptive statistics reveal that the mean value of resident income is 10.099, with a standard deviation of 0.409, a minimum of 9.187, and a maximum of 11.285, indicating moderate regional disparities in income distribution. The digital economy shows a mean value of 0.12, a standard deviation of 0.104, a minimum of 0.014, and a maximum of 0.599, reflecting significant regional imbalances in digital economy development. The mean value for economic development quality (pgdp) is 10.908, with a standard deviation of 0.445, suggesting that most regions demonstrate a concentrated quality of economic development, though some variations exist. Transportation infrastructure (ti) has a mean value of 11.714, a standard deviation of 0.852, a minimum of 9.437, and a maximum of 12.913, highlighting pronounced disparities in infrastructure construction across regions. The degree of openness (ow) has a mean value of 0.265, a standard deviation of 0.268, a minimum of 0.008, and a maximum of 1.354, indicating that some regions are significantly more open than others. The mean value for industrial structure (is) is 1.384, with a standard deviation of 0.751 and a range from 0.61 to 5.28, showing substantial regional differences in industrial structure upgrades. Human capital (hc), measured by average years of education, has a mean value of 6.55, a standard deviation of 1.304, a minimum of 0.743, and a maximum of 8.231, revealing notable regional disparities in educational attainment. These statistical descriptions provide critical foundational insights for further exploration of the impact of the digital economy on resident income and other related variables.

Table 2

Descriptive statistics for the impact of the digital economy on resident income

Variable	Obs	Mean	Std. Dev.	Min	Max
tic	330	10.099	.409	9.187	11.285
de	330	.12	.104	.014	.599
pgdp	330	10.908	.445	9.849	12.155
ti	330	11.714	.852	9.437	12.913
ow	330	.265	.268	.008	1.354
is	330	1.384	.751	.61	5.28
hc	330	6.55	1.304	.743	8.231

The Impact of the Digital Economy on Resident Income

Regression results for OLS, RE, and TWFE models appear in the table 3. The TWFE model emerges as the most appropriate based on the Hausman test, which produces a p-value under 0.001. Table 3 presents the baseline regression results for the determinants of resident income. The table reports the regression outcomes for the following models: Ordinary Least Squares (OLS), Random Effects (RE), and Two-Way Fixed Effects (TWFE). Based on the Hausman test conducted using Stata 18, the p-value (Prob > chi2) is less than 0.001, confirming that the TWFE model is the most appropriate specification for this

analysis. In the TWFE model, the core explanatory variable, digital economy development (de), has a significant positive impact on resident income (tic), with a regression coefficient of 0.559 (t = 5.307, p < 0.01). This indicates that after controlling for province and year fixed effects, digital economy development significantly increases resident income levels, demonstrating its role as a key factor influencing income. This finding aligns with Hypothesis 1.

China's digital economy has experienced rapid growth in recent years, becoming a major driver of income growth. Flexible employment opportunities created by the platform economy, such as food delivery and courier services, have significantly increased part-time incomes and improved living standards for low-income groups. Additionally, the widespread adoption of digital financial tools, such as mobile payments and digital loans, in rural and remote areas has enabled residents to access credit with low barriers, facilitating entrepreneurship and investment, which directly boosts income. These findings are consistent with the views of Park & Oh (2018), Barata (2019), Li et al. (2020), and Pei (2024). For instance, Li et al. (2020), using data from the China Household Finance Survey (CHFS) for 2013, 2015, and 2017, found that digital finance significantly increased resident income and promoted consumption upgrading by improving payment convenience and credit access. Similarly, Pei (2024), based on data from 2010 to 2020, demonstrated that the penetration of digital technologies in households, measured through a household digital penetration index, effectively increased resident income. Barata (2019), analyzing data from Indonesia for 2018, reported that investments in the Islamic e-commerce sub-sector boosted national labor income by 7,953.6 billion IDR. Park & Oh (2018), using panel data from 28 countries for 2007– 2014, found a positive relationship between information and communication technology (ICT) and national income levels.

Regarding control variables, resident income is positively correlated with economic development quality, transportation infrastructure, openness levels, and industrial structure, consistent with the findings of Dorofeev (2022), Mehar (2020), Dorn et al. (2021), and Hong & Zhang (2020). However, there is no statistically significant relationship between financial development levels and population density.

Table 3
Effects of the digital economy on resident income

	(1)	(2)	(3)
	tic	tic	tic
de	0.559***	0.166***	0.155***
	(5.307)	(2.611)	(4.387)
pgdp	0.759***	0.906***	0.295***
	(32.735)	(57.125)	(12.880)
ti	-0.022**	0.067***	0.084***
	(-2.058)	(3.923)	(4.071)
ow	-0.092**	-0.031	0.090***
	(-2.570)	(-0.905)	(4.462)
is	0.052***	0.126***	0.008
	(4.953)	(9.760)	(1.017)
year			Yes
province			Yes
_cons	1.962***	-0.752***	5.535***
	(6.491)	(-3.676)	(19.443)
N	330	330	330
R^2	0.934		0.996
F	922.969		4517.330

***p<0.01, **p<0.05, *p<0.10

Robustness Tests
The results of the robustness check further validate the reliability of the model and the stable impact of the digital economy (de) on resident income. Specifically, the study employs methods such as adding control variables and remeasuring or replacing key variables to ensure robustness. In the first column (1), urban resident income (uic) replaces overall resident income (tic) as the dependent variable for analysis. Urban resident income constitutes a significant portion of total income in China, and its trends generally reflect overall income changes (Zhang, 2009). The results show that the coefficient for the digital economy is 0.227, which is significant at the 1% level. This finding indicates that the digital economy significantly promotes urban resident income. Furthermore, the coefficients of other control variables, such as economic development quality (pgdp), transportation infrastructure (ti), and industrial structure (is), remain consistent in direction, providing additional support for the multidimensional effects of the digital economy on income.

In the second column (2), the model adds two control variables: urbanization level (ur) and financial development level (fin). The results reveal that the coefficient for the digital economy remains significant at 0.155 (p < 0.01), confirming the stable and positive impact of the digital economy on overall resident income. Additionally, the new control variables show significant positive effects on resident income. The coefficient for urbanization level (ur) is 1.047, and for financial development (fin), it is 0.025, both significant at the 1% level. These findings align with the perspectives of Intartaglia (2014) and Jedwab & Vollrath (2015). Jedwab & Vollrath (2015) found a strong correlation between urbanization and income, while Intartaglia (2014) demonstrated that financial development significantly reduces absolute poverty and improves income distribution fairness. Overall, the robustness checks indicate

that the impact of the digital economy remains stable across different substitute dependent variables and with the inclusion of additional control variables. These results reinforce the validity and reliability of the findings.

Table 4
Result of robustness check for the impact of the digital economy on resident income

	(1) uic	(2) tic
de	0.227***	0.155***
	(7.068)	(5.590)
pgdp	0.226***	0.263***
	(10.760)	(13.565)
ti	0.051***	0.040**
	(2.869)	(2.556)
ow	-0.007	-0.049***
	(-0.374)	(-2.803)
is	0.152***	0.029***
	(2.708)	(4.254)
ur		1.047***
		(13.067)
fin		0.025***
		(3.183)
Province FE	YES	YES
Year FE	YES	YES
_cons	6.969***	5.801***
	(26.593)	(25.014)
N	330	330
R^2	0.996	0.998
F	4769.230	7151.388

***$p<0.01$, **$p<0.05$, *$p<0.10$

Heterogeneity Test
The analysis indicates that digitalization has significantly contributed to the overall increase in resident income levels in China. However, it is widely acknowledged that the impact of digitalization on income levels globally is heterogeneous among major participants. While digitalization has helped mitigate regional disparities and narrow the gap between developed and developing regions (Matkovskaya et al., 2022), it is important to note that the rise of the information technology revolution has not facilitated global balanced development. Instead, it has exacerbated global inequality, a phenomenon commonly referred to as the "digital divide" (Lazović et al., 2022). China's regional development is characterized by imbalances and insufficiencies, and whether the differentiated effects of digitalization on resident income vary across provinces is crucial in determining if regional disparities will widen further in the new wave of development opportunities. Thus, it is necessary to explore the heterogeneity of these effects when examining the differentiated impact on resident income. This study analyzes the differentiated effects from the perspective of regional geographic differences. Specifically, the sample is divided into eastern, middle, and western regions to refine the

examination of the regional heterogeneity in the impact of the digital economy on employment scale.

In the eastern region, the impact of the digital economy on resident income is significant and relatively strong, with a regression coefficient of 0.195 (t = 5.41, p < 0.01). This result suggests that the mature digital infrastructure and higher levels of technological application in the eastern region enable the digital economy to effectively drive income growth. In the middle region, the impact of the digital economy on resident income is even more pronounced, with a regression coefficient of 0.694 (t = 5.29, p < 0.01). This may be attributed to the fact that the middle region is at a critical stage of accelerating digital economic development. The combination of policy support and technology adoption has significantly enhanced its capacity to boost income growth. In contrast, in the western region, the impact of the digital economy on resident income is not significant, with a regression coefficient of 0.122 (t = 0.79, p > 0.1). This outcome reflects limitations in the western region, such as inadequate digital infrastructure, lower levels of technological application, and weaker economic development, which prevent the digital economy from exerting a substantial influence on income growth. These findings highlight the importance of considering regional heterogeneity when assessing the impact of digitalization. Policymakers should prioritize addressing the disparities in digital infrastructure and technological adoption to ensure more equitable development across regions.

Table 5
Heterogeneity Test Result by Region

	(1) East	(2) Middle	(3) West
de	0.195***	0.694***	0.122
	(5.41)	(5.29)	(0.79)
pgdp	0.221***	0.235***	0.247***
	(6.44)	(6.97)	(7.54)
ti	0.080***	0.069**	-0.036
	(3.31)	(2.42)	(-1.09)
ow	0.074***	0.315***	-0.036
	(3.45)	(3.48)	(-0.61)
is	-0.004	0.025*	0.073***
	(-0.43)	(1.83)	(4.48)
year	Yes	Yes	Yes
province	Yes	Yes	Yes
_cons	6.599***	6.203***	7.206***
	(15.66)	(14.48)	(14.31)
N	132	99	99
R^2	0.998	0.998	0.999

t statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01

Endogeneity Test

To address potential endogeneity issues in the study of the impact of the digital economy (de) on resident income (tic), rigorous econometric methods are employed to enhance the credibility of the research conclusions. Endogeneity problems, often arising from bidirectional causality or omitted variable bias, are mitigated using the instrumental variable (IV) approach and the two-stage least squares (2SLS) method to estimate the causal effect of the digital economy on resident income. Referring to Zhang (2023), the use of the lagged digital economy variable (Lde) as an instrument is considered appropriate. First, the lagged digital economy level represents the economic state of the prior period, which temporally precedes the current resident income, thereby avoiding direct influence from current income levels and eliminating bidirectional causality concerns. Additionally, the effect of the lagged variable is primarily transmitted to current income through the lagged impacts of the digital economy, such as prior-period technology adoption and digital platform development, which enhance income in the long term without directly affecting current income through other pathways. Regarding relevance, the digital economy exhibits strong temporal continuity, and the lagged digital economy variable is highly correlated with its current level, making it an effective predictor of the current digital economy variable.

In the first-stage regression (1), the results demonstrate that the lagged digital economy variable (Lde) is a highly effective instrument. The first-stage F-statistic is 1535.42, significantly exceeding the critical threshold value of 10, indicating no weak instrument problem. In the second-stage regression (2), the results show that the digital economy has a significant positive impact on resident income, with a coefficient of 0.612 ($p < 0.01$). This indicates that after correcting for endogeneity issues, the development of the digital economy significantly promotes resident income growth.

Table 6

Estimation results of instrumental variable for the impact of the digital economy on resident income

	(1)First stage regression de	(2)2SLS tic
Lde	1.061*** (27.817)	
de		0.612*** (5.275)
control variable	Yes	Yes
First Stage F Value (Weak Instrument Test)	1535.42	
_cons	-0.098 (-1.002)	2.471*** (7.525)
N	300	300
R^2	0.989	0.937
F	2509.602	

***$p<0.01$, **$p<0.05$, *$p<0.10$

Moderating Effect

To explore the mechanism through which the digital economy affects resident income, this study references the research of Lovaglio et al. (2016) and Batool & Liu (2021) and uses the proportion of higher education students in the total population as a measure of the mediating variable, human capital (hc). A three-step regression model was employed to analyze the direct effects of the digital economy on resident income and its indirect effects mediated by human capital. The results of the mediation regression analysis show the following: In Model (1), the direct effect of the digital economy on resident income is significantly positive, with a regression coefficient of 0.155 ($p < 0.01$), indicating that the digital economy significantly enhances resident income. In Model (2), where human capital (HC) is the dependent variable, the digital economy has a significant positive impact on human capital, with a regression coefficient of 0.540 ($p < 0.01$), demonstrating that the digital economy significantly improves human capital levels. In Model (3), after including human capital as a mediating variable, the direct effect of the digital economy on resident income decreases but remains significant, with the regression coefficient dropping from 0.155 to 0.123 ($p < 0.01$). Simultaneously, human capital exhibits a significant positive impact on resident income, with a regression coefficient of 0.059 ($p < 0.01$).

These findings indicate that part of the impact of the digital economy on resident income is achieved through the indirect effect mediated by human capital. This result aligns with the perspectives of Dao (2008), El-Osta (2011), and Korneeva et al. (2019). Dao (2008), through an analysis of data from developing countries, found that improvements in human capital, such as education and health, significantly enhance income distribution and reduce poverty rates. El-Osta (2011), based on a survey of agricultural households in 2006, demonstrated that higher education has a significant positive effect on resident income for farming families, particularly within middle- and upper-income distributions. Similarly, Korneeva et al. (2019) found in a study of the Samara region that digitalization enhances the utility of human capital in education and employment.

Table 7
Results of Mediating Mechanisms

	(1)	(2)	(3)
	tic	hc	tic
de	0.155***	0.540***	0.123***
	(4.387)	(2.936)	(3.604)
hc			0.059***
			(5.415)
pgdp	0.295***	0.337***	0.276***
	(12.880)	(2.814)	(12.431)
ti	0.084***	0.251**	0.069***
	(4.071)	(2.342)	(3.484)
ow	0.090***	0.111	0.083***
	(4.462)	(1.060)	(4.330)
is	0.008	-0.128***	0.016**
	(1.017)	(-2.950)	(1.983)
year	Yes	Yes	Yes
province	Yes	Yes	Yes
_cons	5.535***	-0.028	5.536***
	(19.443)	(-0.019)	(20.392)
N	330	330	330
R^2	0.996	0.590	0.996
F	4517.330	27.307	4657.654

***$p<0.01$, **$p<0.05$, *$p<0.10$

Conclusion

The digital economy, as a new engine of global economic growth, is developing much faster than traditional industries. According to the World Bank, the growth rate of the digital economy is 2.5 times faster than that of the traditional economy, and has had a profound impact on the economic development of various countries. In China, the booming digital economy not only brings new opportunities for technological innovation and industrial upgrading, but also has a wide range of impacts on socio-economic areas such as the labour market and residents' income. Therefore, this study focuses on the role of the digital economy on residents' income, with a view to revealing the specific mechanism and far-reaching impact of the digital economy in China's economic and social development.

Residents' income is directly related to the improvement of people's livelihood and consumption growth, which is a key area of concern in China's pursuit of common prosperity and high-quality development. With the demographic dividend gradually fading and the traditional factor-driven growth model facing bottlenecks, the digital economy is expected to become a new driving force for improving labour productivity and promoting residents' income growth. Research results show that the development of the digital economy has significantly raised the income level of residents. This suggests that the widespread application of digital technology is being translated into real income growth benefits, and that the digital economy has become an important force in promoting residents' income growth. This finding has important practical significance - employment and entrepreneurship driven by digital innovation can increase labour remuneration, thereby enhancing residents'

consumption capacity and contributing to the domestic cycle. However, the study also found that there are regional differences in the digital economy's impact on residents' incomes: the development of the digital economy in the eastern and central regions has effectively boosted local residents' incomes, while in the western region, due to the constraints of digital infrastructure, the level of technological application and the degree of economic development, the digital economy has not yet generated a sufficiently strong impetus to the growth of residents' incomes. This suggests that the development dividends of the digital economy have not yet been fully balanced in different regions, and the realisation of common prosperity still faces a 'digital divide' between regions. Therefore, while vigorously developing the digital economy, it is necessary to increase infrastructure investment and digital skills popularisation in less developed regions, so as to ensure that the fruits of digital transformation more equitably benefit the residents of all regions. In addition, mechanism analysis shows that the digital economy can also indirectly promote the growth of residents' income through the enhancement of human capital. In other words, the development of the digital economy is accompanied by higher education levels and upgraded labour skills, thus increasing labour productivity and personal income. This mechanism fits the current direction of China's implementation of the strategy of developing the country through science and education and the strategy of strengthening the country through talents, indicating that focusing on digital talent cultivation and human capital accumulation while promoting the development of the digital industry can provide solid support for the sustained growth of residents' income.

In summary, this study reveals the important role of the digital economy in promoting China's economic and social development and the challenges it may trigger through a comprehensive analysis of residents' income. The conclusions of this study call for unleashing the full potential of the digital economy in increasing incomes and expanding employment by improving the education and training system and regional support policies, so as to ensure that workers at all skill levels share the fruits of development in the digital era. These insights provide a basis for the formulation and optimisation of relevant policies, which are important references for achieving the goals of high-quality development and shared prosperity in the digital economy.

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