Original Paper

The Impact of Digital Economy on Middle-Income Groups: An Empirical Study in China

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Abstract

This paper explores the impact and mechanism of the digital economy on middle-income groups. In theory, the digital economy can empower middle-income groups by increasing entrepreneurial activity. Empirically, based on the data of CFPS database from 2010 to 2018, this paper measures the proportion of middle-income groups and the development level of digital economy in 25 provinces in China, uses the number of new registrations of private enterprises to describe the entrepreneurial activity, and established a two-way fixed effect model, intermediary mechanism model and heterogeneity analysis model to empirical analysis on this basis. It is found that the digital economy has a significant positive effect on middle-income groups and stimulating entrepreneurial activity is an important transmission mechanism for the digital economy to empower middle-income groups. When other factors remain unchanged, every 1 percentage point increase in the China's digital economy development index, the proportion of middle-income groups will increase by 0.14%, and the entrepreneurial activity will increase by 0.097%. Further studies have found that significant heterogeneity exists in the effect of middle-income groups empowering middle-income groups. The higher level of digital economy development, the lower impact on middle-income groups, which has the characteristics of diminishing marginal effects.

Keywords

digital economy, middle-income groups, entrepreneurial activity, influence mechanism

1. Introduction

The practice of reform and opening-up in China has showed the deepening development of my country's market economy, which has driven the continuous improvement of the income of Chinese residents, but the phenomenon of income differentiation has also become more serious. In 2021, the

"14th Five-Year Plan and 2035 Long-term Goal Outline" issued by China proposes to further formulate an action plan for common prosperity, and a significant sign of more obvious substantive progress in promoting common prosperity is "*expanding proportion of the middle-income group*". The middle-income group has great potential and is an important group for realizing Chinese-style modernization. The digital economy is one of the important development directions of the global future. Under the impact of the new crown epidemic and the global economic crisis, the total scale of China's digital economy will continue to grow in 2021, reaching 45.5 trillion yuan, and the penetration rates of the service industry, manufacturing industry, and agriculture will reach 40.7%, 21.0% and 8.9% respectively (China Academy of Information and Communications, 2022) [1], deeply integrated with various fields of economic and social development, creating a large number of new jobs. With the continuous advancement of Internet technology, the future discussion on the realization path of expanding the middle-income group must not be separated from the background of the digital economy. In order to systematically answer the core question of whether and how the digital economy empowers the middle-income group, this paper will empirically test the impact of the digital economy on the middle-income group on the basis of systematic analysis of the specific mechanism of the development of the digital economy on the middle-income group, and take the provincial panel data from 25 provinces in China from 2010 to 2018 as a sample.

2. Literature Review

As far as the research on the development of digital economy on middle-income groups is concerned, the existing research mainly discusses it theoretically, and can be roughly divided into two schools. On the one hand, Forman et al. (2005) [2] believe that the digital economy dividend can increase more employment opportunities for disadvantaged groups in rural areas and remote cities. Liu Cheng (2022) [3] believes that the digital economy plays a role in the three distribution processes, making the income distribution of different groups, regions, and urban and rural areas more balanced. Xiang Yun (2022) [4] concluded through empirical analysis that the digital economy can achieve the role of boosting common prosperity through upgrading the industrial structure. Li Lei (2021) [5] found that the use of robots expands the demand for labor and has a promotion effect on employment. On the other hand, some scholars believe that the digital economy will have a negative impact on the proportion of middle-income groups. Schor (2017) [6] believes that the development of the platform economy has weakened the power of the labor force and exacerbated the income gap of the bottom 80%. Goldfarb et al. (2019) [7] believe that the digital economy may have an impact on the employment of the poor and low-skilled population. Bai Peiwen et al. (2021) [8] believe that the development of the digital economy squeezes out the relative income rights of low- and medium-skilled workers, but improves the relative welfare effect of low- and medium-skilled workers.

Through these relevant literature researches, it can be found that there only exists little research on how the digital economy affects the middle-income group, especially the path through which the digital

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economy affects the proportion of the middle-income group, and previous studies have not provided a unified framework to answer this question, and there is a great lack of empirical research to accurately assess the role of the digital economy on the middle-income group. Entrepreneurial activity is an endogenous driving force of economic growth, playing an important role in expanding employment and improving people's livelihood, achieving equal opportunities and vertical social mobility. Therefore, this paper tries to systematically investigate the role of the digital economy on middle-income group through empirically analysis, and attempts to explore whether entrepreneurial activity plays a mediating role in the impact of the digital economy on middle-income groups.

3. Theoretical Mechanisms and Research Hypotheses

3.1 The Impact of the Digital Economy on Middle-Income Groups

The digital economy shows a powerful dynamic mechanism of "make the economic pie bigger". First, the development of the digital economy not only contributes to regional economic growth, but also contributes to the inclusive development of the region (Zhang Xun, 2019) [9]. The integration of digital industry and other industries has promoted the transformation of traditional labor-intensive and capital-intensive industries into digital-intensive industries, enabling low-end industries to enjoy the dividends of digital industrialization spillovers (Li Jinchang, 2022) [10], which provides new momentum for regional economic growth (Yang Wenpu, 2022) [11]. Second, the advancement of digital technology is conducive to the improvement of enterprise production efficiency and the expansion of output scale (JEFF, 2017; Li Lei, 2022) [5,12], and the popularization and application of the Internet has become an important channel for job creation (Hu Angang et al., 2016; He Zongyue & Song Xuguang, 2020) [13,14], the number of job opportunities triggered is very considerable.

The digital economy also has a sharing mechanism of "dividing the big economic pie". First, new elements such as data and technology have the characteristics of sharing and cross-border equilibrium (Ouyang Rihui, 2022) [15], especially the development of e-commerce has broadened the sales channels of agricultural and sideline products, benefiting rural areas and remote cities (Forman, 2005; Peng Jie, 2021) [2,16], creating more income for rural people and low-skilled laborers. Second, the popularization of the Internet has changed the way people work. For example, cloud customer service has broken the restrictions on working time and location of traditional occupations, lowered the employment threshold for the required labor force, and helped a lot of disabled people to obtain income (Liu Cheng, 2022) [3].

Research hypothesis 1: The development of the digital economy will help expand the size of middle-income groups.

3.2 The Mediating Role of Entrepreneurial Activity

In addition to affecting the middle-income group by its own characteristics and essence, the development of the digital economy may also have an indirect impact on the proportion of the middle-income group by affecting regional entrepreneurial activities. The digital economy can foster more entrepreneurial opportunities by influencing market size, knowledge spillovers, and factor

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combinations, and it can also enrich entrepreneurial resources by accelerating information interaction and thought dissemination, thereby promoting the city's entrepreneurial activity (Zhao Tao, 2020) [17]. The digital economy provides entrepreneurs with a convenient information exchange and communication platform, whether it is the grasp of business opportunities before entrepreneurial decision-making or the information communication in the entrepreneurial process, which can meet the information acquisition needs of entrepreneurs.

At the same time, the enhancement of entrepreneurial activities has positive effects on residents' poverty reduction and income increase (Shi Xiaofu et al., 2020) [18], employment creation (Han Liangliang, 2022) [19], and shared development (Zhang Xun, 2019) [9] important impetus, thereby helping to expand the size of the middle-income group.

Research hypothesis 2: The digital economy has a positive effect on middle-income groups by increasing entrepreneurial activity.

4. Panel Data Model Descriptions

4.1 Panel Data Model Settings

In order to explore the direct impact of the digital economy on middle-income groups, this paper constructs the following basic model:

$$Middle-Class_{i,t} = \alpha_0 + \alpha_1 Digital_{i,t} + \alpha_i Z_{i,t} + \mu_i + \delta_i + \varepsilon_{i,t} \tag{1}$$

Among them, is $Middle-Class_{i,t}$ the proportion of the middle-income group of $Digital_{i,t}$ province *i*

in year *t* , *is* the digital economy development index of $Z_{i,t}$ province *i* in year *t* , *and the vector* is the

control variable. μ_i represents the individual fixed effect, δ_i and represents the time fixed effect,

$\varepsilon_{i,t}$ which is a random disturbance term.

This paper also argues that the digital economy can have an indirect impact on middle-income groups by increasing entrepreneurial activity. The mediation effect model is set as follows:

$$Entrep_{i,t} = \beta_0 + \beta_1 Digital_{i,t} + \beta_i Z_{i,t} + \mu_i + \delta_i + \varepsilon_{i,t} \tag{2}$$

$$Middle-Class_{i,t} = \gamma_0 + \gamma_1 Digital_{i,t} + \gamma_2 Entrep_{i,t} + \gamma_i Z_{i,t} + \mu_i + \delta_i + \varepsilon_{i,t} \tag{3}$$

Among them, Entrep is an intermediary variable, representing entrepreneurial activity

4.2 Variable Measurements

4.2.1 Explained Variable

The explained variable in this paper is the proportion of middle-income groups in each province in China (*Middle - Class*). Drawing on the practice of the China Bureau of Statistics, in 2018, a family of

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three with an average annual total income of 100,000 to 500,000 yuan is defined as a middle-income family, that is, an individual with an average annual total income in the range of 33,300 to 166,700 yuan is regarded as middle-income groups, and use the CPI index to adjust it. The adjusted division standard is shown in Table 4.1.

Table 4.1 Adjustment of Absolute Income Standards for Middle-Income Groups in 2010-2018

years	CPI index (%)	Upper and lower limits of absolute family income (10,000 yuan)	personal absolute income (10,000 yuan)
2010	103.3	8.23-41.18	2.74-13.73
2011	105.4	8.68-43.40	2.89-14.47
2012	102.6	8.91-44.53	2.97-14.85
2013	102.6	9.14-45.69	3.05-15.24
2014	102.0	9.32-46.60	3.10-15.54
2015	101.4	9.45-47.30	3.14-15.76
2016	102.0	9.64-48.26	3.21-16.07
2017	101.6	9.79-48.97	3.26-16.32
2018	102.1	10-50	3.33-16.67

4.2.2 Explanatory Variable

The explanatory variable in this paper is the level of China's digital economy development (*Digital*), which is measured by referring to the research of White Paper on the Development of China's Digital Economy (2022) [1] and Bai Peiwen et al. (2021) [8]. See Table 4.2 for details. In this paper, the CRITIC method is used to comprehensively measure the weight value of indicators.

Table 4.2 Evaluation Index of Provincial Digital Economy Development Level

First-level indicator name	Secondary indicator name
Level of digital infrastructure construction	Penetration rate of mobile phones, number of Internet broadband access ports per capita, length of long-distance optical cable lines
digital transactions	Software Business Revenue (Note 1), Information Transmission, Computer Services and Software Industry Employment Proportion, Express Volume
digital innovation	Technology market turnover, number of domestic invention patent applications and authorizations

4.3 Intermediary Variable

The intermediary variable in this paper is entrepreneurial activity (*Entrep*). Drawing on the method of Zhao Tao et al. (2020) [17], the proxy variable is divided by the number of new registrations of private enterprises in different years in each province divided by the labor force aged 15-64.

4.3.1 Control Variables

Referring to relevant documents such as Xiang Yun et al. (2022) [4] and Han Liangliang et al. (2022) [19], this paper selects the following control variables: (1) Industrial structure (*IS*), using the added value of the tertiary industry and the value of the secondary industry Ratio of added value; (2) degree of opening to the outside world (*FDI*), using the ratio of total foreign trade import and export to regional GDP; (3) financial development (*FIN*), using the ratio of the balance of deposits and loans of financial institutions at the end of the year to regional GDP; (4) The degree of marketization (*MI)*, using the marketization index.

4.4 The Data Source

The data of the middle-income group in this paper comes from the China Family Panel Studies (CFPS, 2010-2018), the digital economy data comes from the "*China Statistical Yearbook*", and other data come from the China Marketization Index Database and the China Bureau of Statistics.

5. Empirical Analysis of Digital Economy on Middle-Income Groups

5.1 Analysis of Model Regression Results

This paper uses a two-way fixed effect model to conduct regression on the relationship between the digital economy and the proportion of middle-income groups. The results are shown in Table 5.1. Column (1) without control variables shows that the digital economy has a significant positive impact on the proportion of middle-income groups. Column (2) adding control variables shows that the positive impact of the digital economy on the proportion of middle-income groups is always significant at the level of 1%, and for every 1percentage point increase in the China's digital economy development index, the proportion of middle-income groups increases by 0.179%. Hypothesis 1 was confirmed.

Table 5.1 Two-Way Fixed Effect Regression Results of the Impact of the Digital Economy on Middle-Income Groups

variable	Middle - Class	
	(1)	(2)
Digital	0.191***	0.179***
	(0.055)	(0.061)
Constant term	0.119***	0.139
	(0.006)	(0.124)

control variable	no	yes
Province fixed effect	no	yes
year fixed effect	no	yes
R^2	0.8477	0.8547
N	125	125

Note: The brackets are robust standard errors, ***, ** and * indicate that the regression results are significant at the 1%, 5% and 10% statistical levels, respectively. The following table is the same.

5.2 Intermediary Mechanism Test

Columns (1) to (3) of Table 5.2 show the regression results of entrepreneurial activity as a mediator variable. Column (2) shows that the digital economy has a significant positive impact on entrepreneurial activity. Column (3) shows that after adding the intermediary variable, the influence coefficient of digital economy development on the middle-income group has decreased, and there is a partial intermediary effect. Hypothesis 2 is confirmed. And when other factors remain unchanged, for every 1 percentage point increase in the China's digital economy development index, the proportion of middle-income groups will increase by 0.14%, and the entrepreneurial activity will increase by 0.097%.

Table 5.2 Test Results of the Intermediary Mechanism of Entrepreneurial Activity

variable	*Middle - Class* (1)	*Entrep* (2)	*Middle - Class* (3)
Digital	0.179***	0.395**	0.140**
	(0.061)	(0.146)	(0.056)
Entrep			0.097 ***
			(0.030)
control variable	yes	yes	yes
Province fixed effect	yes	yes	yes
year fixed effect	yes	yes	yes
R^2	0.8547	0.7074	0.8665

5.3 Endogeneity and Robustness Tests

5.3.1 Endogeneity Test

Considering the possible endogeneity problems, referring to the method of Xiang Yun (2022) [4] the multiplication item of the number of Internet users in each province of China in the previous year and the historical fixed telephone data in 1990 as the digital economy index. Instrumental variables, using 2SLS regression. Column (1) of Table 5.3 shows that the p-value of the LM statistic is 0, and the

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instrumental variable is available; the Wald F statistic significantly exceeds the critical value, indicating that the instrumental variable is powerful; the coefficient of the instrumental variable is significantly positive, what shows that the development of the digital economy still contributes to the proportion of middle-income groups.

5.3.2 Robustness Test

In order to test the reliability of the regression results, two methods are adopted for robustness testing. First, samples from mega-provinces (Beijing, Shanghai, Guangdong) and remote provinces (Xinjiang, Tibet, Inner Mongolia, etc.) of China were excluded (Note 2). Second, shrink the explanatory variable by 1% before and after the explanatory variable digital economy development index. The results in columns (2) and (3) of Table 5.3 show that the regression coefficient is still positive and significant. Therefore, the result is robust.

5.4 Heterogeneity Analysis

From the perspective of development level, the number of employment and entrepreneurial positions created by the development stages of the digital economy is different, and the impact on middle-income groups may be heterogeneous. This paper uses a panel quantile regression model to test. Columns (4)-(6) of Table 5.3 show that the development of the digital economy at different levels has a significant positive effect on the middle-income group, and the higher the level of digital economy development, the smaller its positive impact on the middle-income group, showing its characteristic of diminishing marginal utility.

Table 5.3 Endogeneity, Robustness, and Heterogeneity Analysis Results

variable	Instrumental variable method (2SLS)	Excluding extra large and remote provinces and cities	Indentation	Heterogeneity of the development level of the digital economy		
	(1)	(2)	(3)	(4) 25 quintiles	(5) 50 quintiles	(6) 75 quintiles
Digital	0.135 *	0.229 **	0.188 ***	0.142***	0.131 ***	0.099 *
	(0.073)	(0.106)	(0.063)	(0.045)	(0.043)	(0.056)
Constant term	0.444 *	0.182	0.139	0.269	0.390	0.446
	(0.229)	(0.119)	(0.123)	(0.266)	(0.354)	(0.415)
control variable	yes	yes	yes	yes	yes	yes
Province fixed	yes	yes	yes	yes	yes	yes

effect						
year fixed effect	yes	yes	yes	yes	yes	yes
L M statistics	18.216 [0.0000]					
Wald F -statistic	34.293 {8.96}					
R^2	0.9616	0.8587	0.8556	0.7668	0.8104	0.8717

Note: ***, **, * represent the significance levels of 1%, 5%, and 10% respectively; the values in ( ) are robust standard errors, the values in [ ] are P values, and the values in { } are Stock-Yogo weak identification Test the critical value at the 10% level.

6. Conclusions and Policy Recommendations

Based on the panel data of 25 provinces in China, this paper established a two-way fixed effect model, intermediary mechanism model and heterogeneity analysis model empirically analyze the impact and mechanism of the digital economy on middle-income groups. The empirical results show that: Firstly, the digital economy has significantly promoted the growth of the proportion of the middle-income group, and this conclusion still holds after endogenous and robustness tests. Secondly, the development of the digital economy indirectly affects middle-income groups through entrepreneurial activity. Thirdly, the heterogeneity analysis found that the higher the development level of the digital economy, the smaller the positive impact on the middle-income group, which has the characteristics of diminishing marginal effects.

According to the above conclusions, this paper puts forward the following policy implications: Firstly, China's governments should accelerate the cultivation strategy of middle-income groups and improve the ability of low-income groups to obtain information and income through technological means. Secondly, strengthen the digital literacy of middle-income groups and provide them with more entrepreneurial assistance so that they can better grasp entrepreneurial opportunities. Thirdly, a differentiated digital economy development strategy must be implemented. Regions with a low-to-medium level of digital economy should speed up the construction of digital economy infrastructure to make up for the hardware shortcomings in rural areas; regions with a high level of digital economy development should strengthen digital economy supervision and be alert to the possible adverse effects of the digital divide.

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Notes

Note 1. Due to data limitations, at present we can only search for the software business income data of each province after 2012. For this reason, the data of 2010 are supplemented by using the annual mean replacement meth

Note 2. During CFPS data screening, the data of 6 provinces (autonomous regions) in remote provinces and cities Xinjiang, Tibet, Inner Mongolia, Ningxia, Qinghai, and Hainan have been deleted, and the deletion will not be repeated here.