The 6th International Conference on Economic Management and Green Development (ICEMGD 2022)
DOI: 10.54254/2754-1169/4/20221029

Digital Economy Development and Residents' Income

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Abstract: The digital economy has become a new engine for high-quality economic development, with a profound impact on economic, social, and residents' welfare. The data from the China Family Panel Studies (CFPS) are used to analyze the function and effects of the digital economy on residents' income growth and income disparity using the "Broadband China" strategic program as a natural experiment. The results of the empirical analysis confirm the role of digital economy development in promoting residents' income; the heterogeneity analysis shows that the positive impact of digital economy development on residents' income is greater for households in developed eastern regions, and non-agricultural households, and households with high years of education. The mechanism analysis shows that enhancing human capital investment and widening social networks through increased spending on education and human gifts, respectively, and increasing income from working outside the home significantly increase residents' income. The results of this study have significant ramifications for the development of the digital economy, steady income growth among inhabitants, and consequently, the closing of the income gap.

Keywords: Digital Economy, Income growth, Income gap, Social networks, Human capital.

1. Introduction

The problem of income distribution has long been a hot topic of research, and the increase in income disparity is not conducive to achieving common prosperity. The fundamental prerequisite for socialism and a key aspect of development in China is common prosperity. How to proactively promote prosperity for everybody while ensuring a stable increase in the income of the residents is an issue that must be addressed in the current economy and society. With the in-depth development and wide application of digital technology, social production and people's way of life have undergone profound changes, and the digital economy has become a new engine for the current high-quality economic development. But concurrently, the digital economy also has the problem of unbalanced and insufficient development. What effect does the growth of the digital economy have on inhabitants' incomes? How does the development of the digital economy affect residents' income? Does the development of the digital economy alleviate regional development imbalance and promote the reduction of the income gap, or does it aggravate the polarization of development through the "digital divide"? The answers to these questions have attracted widespread attention from both theoretical and practical communities.

Existing studies have extensively discussed ramifications of the digital economy development on economic, social, and residential welfare. Several studies have focused on the redistribution of

DOI: 10.54254/2754-1169/4/20221029

economic benefits from digital economic development within countries, particularly between urban and rural areas, and have reached inconsistent conclusions: some studies have argued that the greatest beneficiaries of digital technologies and data are large urban areas and that the mechanisms by which cities benefit depend on agglomeration effects [1]; however, some studies point out that lower communication costs make the digital economy more beneficial for isolated individuals and rural areas [2-3]. Other studies have explored the impact of the development of the Internet on income inequality between cities, but have also reached different conclusions [4].

The "Broadband Strategy" has evolved from a sectoral action to a national strategy, and broadband has for the first time become a strategic national public infrastructure, according to the State Council's release of the "Broadband China" strategy's implementation plan in 2013. Taking this as the node, the domestic broadband network was generally speeded up, the Internet development entered a new stage, and China officially entered the digital economy era [5]. This study uses China's deployment of the broadband strategy as a kind of natural experiment. and analyzes the overall impact of digital economy development on residents' income, the differentiated impact on urban and rural areas and different regions' income using micro research data; and analyzes the micro mechanisms of the digital economy affecting residents' income from three perspectives: social network, human capital, and employment search cost. Based on this, this article examines and evaluates the effects of the development of the digital economy on the distribution of income among citizens. This paper's two key contributions are as follows: First, it conducts an empirical analysis of how the growth of the digital economy affects citizens' income and the use of micro-influencers mechanism; second, it explores the impact of digital economy development on income distribution in the context of the micro mechanism.

The structure of this study is organized as follows: First, we review the relevant literature and proposes theoretical hypotheses; Second, we introduce data sources, variable descriptions and model settings; Third, we conduct empirical tests; Then we conduct robustness tests and analyze the mechanism of the digital economy affecting residents' income; Finally, we discuss our results and their implications for theory and policy.

2. Literature Review and Theoretical Hypothesis

2.1. Literature Review

The impact of the digital economy on economic development and population income has been widely discussed in theoretical circles. Dahlman et al. state that the digital economy can be used to achieve inclusive and sustainable growth [6]. Digital technologies make the lives of citizens and consumers easier, increase the productivity of workers and businesses, and help governments extend critical services to those who need them most. Zhang et al. discovered that digital infrastructure, digital industry, and digital convergence all have a strong beneficial impact on regional total factor productivity using panel data from 30 Chinese cities from 2015 to 2019 [7].

Several papers have examined the heterogeneous impact of the digital economy on residents' income from intercity, rural urban, and regional perspectives. Broadband Internet, according to Qiu et al., can close the wealth gap between large and small cities [4]. Using Swedish microdata from 2007 to 2015, de Vos et al. find that broadband Internet can help smaller cities enjoy the labor market gains of larger cities. Smaller communities close to bigger metropolitan areas can benefit from aggregation without paying the expenses of doing so, which are mostly determined by how widely broadband is used in a community rather than by its accessibility [3]. Chen Yang et al. used data from 285 prefecture-level and above cities in China from 2005-2018 and used the Broadband China strategy as a quasi-natural experiment, finding that the Broadband China strategy significantly reduced broadband availability at the 5% [8]. To measure the effect of e-commerce on domestic trade

DOI: 10.54254/2754-1169/4/20221029

and welfare, Fan et al. developed a multiregional general equilibrium model. They discovered that the welfare gains from e-commerce averaged 1.6 percent, which was about 30 percent higher for cities in the smallest quintile of population and market potential [2]. Zhang Xun et al. find that the development of digital finance driven by the Internet revolution significantly boosts household income, especially for rural low-income groups [9].

2.2. Hypothesis formulation

Three components are needed for the digital economy to promote the increase of residents' income, which are information infrastructure or platform construction, information tools end-use, and information utilization. First, the construction of information infrastructure and platforms promotes economic growth. In the era of the digital economy, on the one hand, small companies within the platform economy take advantage of the information infrastructure of the platform enterprises to reduce operating costs and broaden the market thus sharing the fruits of the digital economy. The development outcomes of the digital economy, on the other hand, extend to less economically developed regions, and digital information products use the Internet as a carrier to integrate with traditional industries using digital technology, which promotes the improvement of efficiency and volume of traditional industries, and also stimulates entrepreneurial enthusiasm, thus increasing the income of residents [10]. The second way is the use of information terminal tools. In the context of the development of the digital economy, the division of labor and collaboration among various participating subjects is non-compulsory, and it is a spontaneous division of labor and collaboration based on their idle resource surplus and shortage situation as well as the concept of shared consumption and green consumption. Residents can therefore exchange their unused resources over network channels to increase the effectiveness of resource allocation and obtain corresponding income at the same time. The third way is the use of information. The development of the digital economy can optimize resource allocation through information mining. Based on the above analysis, this paper proposes the following research hypothesis.

Hypothesis 1: The digital economy has a boosting effect on residents' income.

The digital economy acts on urban-rural structural transformation through economic activities, the rights of economic agents, and institutional arrangements, which in turn has the dual effect of widening or narrowing the income gap: on the one hand, the digital economy enables rural residents to fully utilize digital technologies to drive the modernization and upgradation of rural industries as well as the recombination of land, labor, and capital, increasing agricultural production efficiency and reducing the gap between the urban and rural worlds [11]; On the other hand, the income disparity between urban and rural areas is getting wider as a result of the digital divide. Although Internet penetration can significantly reduce the overall income gap in China, this effect is heterogeneous between urban and rural areas, with internet usage has a further boost to persons with middle-class and higher incomes in terms of their income in urban areas compared to rural areas [12]. Forman et al. find that Internet technology is associated with significant wage growth in only 6% of U.S. counties that are already very wealthy and have overall high levels of education, large populations, and IT-intensive industries. But elsewhere, Internet technology does not appear to be associated with wage growth, suggesting that the proliferation of the Internet has affected interregional wage inequality [13]. Based on CGSS data, Mao Yufei et al. found that the Internet has a significant positive impact on the wage income of those employed in different household registration, and the impact is greater for urban workers than for migrant workers, thus further widening the household wage gap [14]. Yin et al. found that the negative impact of the digital divide index on household income is greater in rural areas because rural households are less capable of generating income and have a single way to earn income, which may cut off other sources of household income once they cannot enjoy the digital dividend, thus reducing total household income [15]. Wen Xiaohong et al. analyzed the

DOI: 10.54254/2754-1169/4/20221029

urban-rural differences in wage returns from Internet use and found that urban household workers had significantly higher wage returns from Internet use than rural household workers, and that differences in human capital levels as well as in the content of Internet use may account for this result [16]. In conclusion, employees in developed countries will gain more from the increase in income brought on by broadband Internet since they have higher levels of human capital and broadband penetration than less developed regions. Meanwhile, for individual residents, groups with higher education levels can better utilize digital economy resources and therefore enjoy the dividends of the digital economy more. The following research hypotheses are suggested in this work based on the analysis presented above.

Hypothesis 2: The impact of the digital economy on income growth is regionally heterogeneous, with a greater income pulling effect on residents of developed regions

Hypothesis 3: Urban and rural residents experience different effects of the digital economy on income growth, with urban residents experiencing a bigger income-booster.

Hypothesis 4: The digital economy has a higher income-boosting effect for more educated residents.

3. Data sources, variable descriptions and basic models

3.1. Data sources

Data from the China Family Panel Studies (CFPS) are used in this essay. The CFPS sampling method is scientific in two ways: first, it uses a probability sampling approach proportional to population size that is implicitly stratified, multi-stage, and multi-level; second, considering that the official division between rural and urban areas no longer reflects the reality of China's rapid urbanization, instead of using the traditional way of sampling rural and urban areas separately, CFPS sampling takes Chinese society as a whole.

Five areas make up the CFPS's main questionnaire: the questions about the village, family members, households, kids, and adults. The core explanatory variable of this paper is the question about Internet use in the CFPS adult questionnaire, i.e., "Do you access the Internet?" At the same time, since the CFPS database in 2012 does not contain any questions about the Internet, the data before and after the implementation of the broadband China strategy, i.e., 2010 and 2014, are chosen. In addition, this paper also obtains data on the age of the household head and other characteristics, such as gender, age, marital status, household registration status, and years of education, from the CFPS adult questionnaire. To further control for household-level effects on the results, this paper merges CFPS household data and adult data through household head codes to obtain household-level data of household heads, including the explanatory variable of this paper: household net income per capita, and other household-level control variables: household net worth, household debt status.

3.2. Variable description

This paper investigates the impact of the digital economy on income, and the net income per capita of households is selected as the explanatory variable. Li Shi and Gao Xia argue that although a non-employed person in a household does not receive income directly from the labor market, he or she receives income through transfers among members within the household, so personal income is usually linked to household income [17]. Therefore, a more reasonable way to obtain personal income is to divide the net household income by the household size, that is, to use the net household income per capita instead of the net personal income to calculate the level of the income distribution of the population. On the other hand. The price level will have an impact on the income level, so this paper uses the net household income per capita after price adjustment according to the base period of 2010 so that the data are more comparable.

DOI: 10.54254/2754-1169/4/20221029

The explanatory variable did represents the cross-term $\mathrm{treat_i} \times \mathrm{time_t}$ of $\mathrm{treat_i}$ and $\mathrm{time_t}$. Drawing on the study by Luo Mingzhong and Liu Ziyu, $\mathrm{treat_i}$ indicates whether or not to go online, and 1 indicates online and 0 indicates no Internet access. did indicates whether it is affected by the "Broadband China" policy [18], 0 indicates that it was not affected before the policy was implemented, and 1 indicates affected after the implementation of the policy. The coefficient in front of did indicates that the income of residents is affected by the "broadband China" policy.

3.3. Descriptive statistics

The outcomes of the descriptive statistics for the variables in this study are displayed in Table 1. It can be found that the mean net household income per capita is 12,286.75 yuan for 2010 and 2014, and the income gap among residents is large. The mean value of agricultural households (hukou) is 0.697, which shows that the proportion of agricultural households is higher than the proportion of the non-agricultural population, and the distribution of agricultural households, non-agricultural households in CFPS data is quite close to that of the census.

Table 1: Descriptive statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max
y1	26362	12286.75	19313.7	0.25	1000000
did	26775	0.115	0.319	0	1
lnasset	26422	11.832	1.538	0	17.217
debit_other	28434	4424.985	32048.03	0	2000000
age	26776	49.747	13.653	16	95
gender	26776	0.372	0.483	0	1
marital	26915	0.861	0.346	0	1
health	26765	5.186	1.442	0	7
hukou	26413	0.697	0.46	0	1
education	26772	7.161	4.675	0	22
migrant	9073	20278.78	23737.38	0	200000
eec	27684	3804.564	9203.062	0	350000
gift	23623	3109.169	4695.333	0	104000

3.4. Basic model

The broadband China strategy is utilized in this study as an exogenous shock to represent the state of the digital economy's development, and the effect of the digital economy on residents' income is determined using the Differences-in-differences approach. In real life, what can often be observed is the effect after being subjected to a policy shock, and those subjected to a policy or experimental shock are called the experimental group, while those not subjected to a policy shock during the same period are difficult to observe, which is tested by setting up a control group for the counterfactual. The Differences-in-differences technique, on the other hand, determines the net effect of the shock caused by the policy by subtracting the experimental group from the control group after first removing the change in effect over time by removing before and after the occurrence of the policy. This paper's fundamental model is presented as follows.

$$y1_{i,t} = \partial_0 + \beta_1 did + \lambda control_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \quad (1)$$

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The explanatory variable $y1_{i,t}$denotes the per capita net household income of household head i in period t; the core explanatory variable is did, did is 1 for those affected by the broadband China strategy and 0 for those not affected, so the coefficient β_1 indicates the actual impacts of broadband China strategy on residents' income level. γ_t and μ_i denote time fixed effects and individual fixed effects, respectively. $control_{i,t}$ are control variables, including household head characteristics variables and household characteristics variables, and $\varepsilon_{i,t}$is the residual term.

4. Empirical Analysis

4.1. The impact on the income of the population

First, the combined effect of the "broadband China" strategy on residents' income levels is estimated to test hypothesis 1, and Table 2 displays the results of the regression. In Table 2, column (1) is the basic regression result, and column (2) is the result after adding control variables. It can be seen that controlling for time effects and individual fixed effects, the coefficients of the former (positive promotion effect of broadband China strategy on residents' income) are significantly positive at the level of p<1% and the coefficients are 5366.3 and 5124.6. Column (3) is the result by replacing the explanatory variable with household per capita income ($y2$) which is total household income divided by household size. These findings provide credence to the proposition 1 that the growth of the digital economy has a considerable beneficial influence on the rise in household income.

Table 2: The impact of broadband China strategy on residents' income growth.

Explanatory variables	(1)	(2)	(3)
did	5366.326***	5124.615***	5514.870***
	(6.75)	(5.98)	-6.55
lnasset		1039.827***	1459.328***
		(4.45)	-6.4
debit_other		0.040***	0.043***
		(3.78)	-3.61
age		-718.910	-990.609
		(-0.69)	(-0.96)
gender		530.496	-5534.446
		(0.06)	(-0.64)
marital		-2020.041	-3585.341**
		(-1.42)	(-2.57)
health		132.045	154.796
		(0.63)	-0.75
Constant term	9787.382***	33288.318	45682.677
	(54.64)	(0.66)	-0.91
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	24855	23767	24134
R^2	0.05	0.06	0.06

Note: Numbers in parentheses represent standard errors, *, **, and *** represent 10%, 5%, and 1% significance levels, respectively. The following are the same.

DOI: 10.54254/2754-1169/4/20221029

4.2. Heterogeneity analysis

Like many developing countries, there are obvious geographical imbalances in China's economic development. The eastern areas are significantly ahead of the central and western regions in terms of building infrastructure, education levels, capital accumulation, and technical efficiency. And such regional differences are gradually expanding, thus the way the digital economy develops will affect local residents' incomes is also likely to vary. It is also necessary to conduct further research on the regional variability of the effect of the digital economy on citizens' income(the outcomes are displayed in Table 3), and the empirical results show that the broadband China strategy has a significant positive contribution to residents' income in the eastern, central and western regions, significant at the p<5%, p<1% and p<5% levels, respectively. However, the coefficient before the did variable is 7513.8 in the eastern region, 2307.1 in the central region and 2881.7 in the western region, which shows that the eastern region is more affected by the broadband China strategy's positive income-booster effects than the central and western regions. Hypothesis 2 of this study is supported.

Table 3: Regression results of regional heterogeneity.

variables	(1)	(2)	(3)
	Eastern Region	Central Region	Western Region
did	7513.795**	2307.109***	2881.697**
	(2.46)	(2.66)	(2.47)
lnasset	1087.635***	1035.064***	1190.823***
	(2.61)	(4.03)	(3.79)
debit_other	0.065**	0.018	0.029
	(2.19)	(1.27)	(1.07)
age	-799.974	2122.167	-2589.680
	(-0.99)	(1.16)	(-1.21)
gender	2792.623	-3448.497	9150.728***
	(0.28)	(-1.59)	(25.01)
marital	-1097.540	-1553.390	-4905.111**
	(-0.91)	(-1.31)	(-2.13)
health	17.158	226.351	191.496
	(0.07)	(0.87)	(1.41)
Constant term	38346.268	-104151.215	114717.204
	(0.96)	(-1.17)	(1.17)
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	10945	7027	5795
R^2	0.05	0.06	0.16

Further, the impact of the digital economy on inhabitants' income is evaluated for disparities between urban and rural areas. In this paper, we measure household differences by whether one is an agricultural household and include the variable whether one is an agricultural household ($hukou$) and its interaction term with the explanatory variable (did × hukou) in the model. The results are presented in column (1) of Table 4. In column (1), the coefficient of $did \times hukou$ is significantly negative, indicating that the broadband China strategy is more effective in promoting income growth for residents of non-farm households compared to agricultural households. This is due to the fact that the

DOI: 10.54254/2754-1169/4/20221029

Internet-based digital economy is skill-biased, and urban household workers have higher skill levels overall and receive greater income gains from Internet use compared to rural household workers. Thus, the difference in wage returns from Internet use among urban and rural household workers is, in turn, manifested in the fact that Internet use behaviour widens the urban-rural wage gap. Hypothesis 3 of this study is supported.

Table 4: Heterogeneity regression results for household registration and education level.

Variables	(1)	(2)
did×hukou	-8355.790***	
	(-3.25)	
hukou	865.251	
	(0.97)	
did×eduy_best		1140.607*
		(1.76)
eduy_best		-100.291
		(-0.72)
did	8018.381***	-7611.704
	(3.38)	(-1.23)
lnasset	1071.660***	1059.142***
	(4.52)	(4.46)
debit_other	0.041***	0.039***
	(2.79)	(2.73)
age	-673.980	-709.457
	(-1.07)	(-1.10)
gender	631.623	410.519
	(0.13)	(0.09)
marital	-2025.386**	-2145.781***
	(-2.51)	(-2.61)
health	161.584	146.204
	(1.24)	(1.14)
Constant term	30098.103	33432.749
	(0.99)	(1.07)
Time fixed effects	Yes	Yes
Individual fixed effects	Yes	Yes
Observations	23744	23766
R^2	0.06	0.06

The Internet has an additional positive effect on the income of people with middle and high-income levels [12], and middle and high-income groups tend to have higher levels of education, therefore, the impact of the digital economy on people' incomes at various educational levels is further examined in this study. Years of education are used to measure individual education levels, and years of education (eduy_best) and its interaction term with explanatory variables (did × eduy_best) are added to the model, and the results are shown in column (2) of Table 4. The results show that the boosting effect of the digital economy on residents' income is influenced by their years of education. The longer the years of education of the residents, the greater the positive effect of income growth from the broadband China strategy, which confirms that the positive boosting effect of the digital

DOI: 10.54254/2754-1169/4/20221029

economy on the income of those with higher education is greater, and hypothesis 4 of this study is supported.

The results of the above heterogeneity analysis show that digital economy development has a greater positive contribution to the income of developed eastern regions, urban workers, and residents with higher education levels. This suggests that the income gap between inhabitants of different educational levels and between residents of urban and rural areas would increase as the digital economy develops.

5. Robustness test

5.1. Parallel trend test

The Differences-in-differences method (DID) is used on the premise that the parallel trend assumption is satisfied, so this paper first conducts the parallel trend test. By charting the temporal trajectories of the treatment and control groups, it can be seen from **Fig. 1** that before the policy point in time, the treatment and control groups still have a certain degree of similarity, and y1 maintain a similar growth trend. Therefore, it can be preliminary determined that the time trend assumptions between the two groups prior to the policy implementation year are essentially satisfied, and that the differences in the trend line following the policy implementation year are fundamentally determined to be brought on by the "broadband China" strategy.

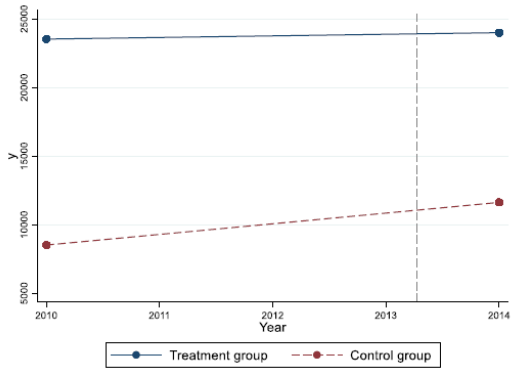

Figure 2: Time trend graph.

5.2. PSM-DID results

To verify the results of the empirical analysis, the propensity score matching Differences-in-differences method (PSM-DID) is further used to enhance the comparability of the experimental and control groups. In this paper, we use PSM-DID nearest neighbor matching, nearest neighbor caliper matching and radius caliper matching, and then use the Differences-in-differences method to analyze the baseline results of the impact of "broadband China" strategy on residents' income for robustness testing. Columns (1) and (2) of Table 5 show the estimation results of PSM-DID nearest neighbor matching, nearest neighbor caliper matching and radius caliper matching, respectively, and it can be seen that the coefficients of the explanatory variables are positive and significant at 1%, and the coefficients differ little from the benchmark test outcomes in Table 2, indicating that the previous estimation is very robust.

DOI: 10.54254/2754-1169/4/20221029

Table 5: Replacement matching method.

Variables	(1)	(2)	(3)
did	5128.284***	5140.768***	5140.768***
	(5.98)	(3.31)	(3.31)
lnasset	1038.675***	1095.127***	1095.127***
	(4.45)	(4.82)	(4.82)
debit_other	0.040***	0.042**	0.042**
	(3.78)	(2.37)	(2.37)
age	-718.631	-726.926	-726.926
	(-0.69)	(-1.10)	(-1.10)
gender	533.244	470.947	470.947
	(0.06)	(0.10)	(0.10)
marital	-2006.729	-2065.493**	-2065.493**
	(-1.40)	(-2.52)	(-2.52)
health	131.698	128.192	128.192
	(-0.63)	(0.98)	(0.98)
Constant term	33278.994	33132.524	33132.524
	(0.66)	(1.04)	(1.04)
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	23765	23710	23710
R^2	0.06	0.06	0.06

5.3. Increase the control variables at the provincial level

Policy intensity may vary across regions with different levels of economic development, which may have an unobserved impact on the estimation of the "broadband China" strategy. Since the CFPS data cover survey information from 25 provinces, cities, and autonomous regions, a new set of control variables is added to test the robustness of the benchmark results by matching the information from these 25 provinces, cities, and autonomous regions with provincial-level data. Drawing on the study by Yin Zhichao et al., the province GDP per capita (gdp) is used to account for the impact of economic development level; the number of general higher education schools (sch) to control for the effect of local education level, Internet penetration rate (ict) to control for the level of local information and communication infrastructure, the number of industrial enterprises above the scale to control for the level of local industrialization (loc), and total import and export (exc) to control for local openness to the outside world level [15]. Table 6 demonstrates this result, with column (1) of Table 6 for DID and column (2) for PSM-DID. Both columns (1) and (2) show that with the inclusion of control variables, and controlling for time effects and individual fixed effects, the coefficients before the core explanatory variables are still positive and significant at the p<1% level when provincial-level control variables are included.

DOI: 10.54254/2754-1169/4/20221029

Table 6: Addition of provincial-level control variables.

Variables	(1)	(2)
did	4296.080***	4285.906***
	-5	-4.98
lnasset	1108.125***	1110.444***
	-4.76	-4.76
debit_other	0.038***	0.038***
	-3.6	-3.6
age	-513.161	-1772.512
	(-0.50)	(-0.87)
gender	951.734	783.797
	-0.11	-0.09
marital	-2184.791	-2202.572
	(-1.54)	(-1.54)
health	163.745	171.764
	-0.79	-0.82
gdp	-132.504**	-135.541**
	(-2.50)	(-2.54)
sch	-233.791***	-232.343***
	(-2.63)	(-2.61)
ict	0.237***	0.237***
	-3.1	-3.09
loc	0.308***	0.303***
	-4.14	-4.05
exc	0.000*	0.000*
	-1.7	-1.74
Constant term	27362.576	88391.185
	-0.54	-0.9
Time fixed effects	Yes	Yes
Individual fixed effects	Yes	Yes
Observations	23767	23714
R^2	0.07	0.07

6. Mechanism analysis

Correspondingly, consider how the broadband China strategy may have an impact on the increase in resident income. To test the mediating mechanism of the impact of the broadband China strategy on residents' income, this paper uses the most commonly used method to test the mediating effects, stepwise test regression coefficients. The specific procedure of the test is as follows: first, the basic regression of the effect of the broadband China strategy on residents' income is estimated, and the existence of this main effect has been verified in the previous paper, so the next step of the test is conducted. Then the regression test of the effect of broadband China strategy on the effect of mechanism variables is conducted. Finally, the regression of broadband China strategy and mechanism variables are simultaneously considered as core explanatory variables on residents' income. The following model is constructed.

$$y1_{i,t} = \partial_0 + \beta_1 did + \lambda control_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \quad (2)$$

DOI: 10.54254/2754-1169/4/20221029

$$way_{i,t} = \partial_0 + \beta_2 did + \lambda control_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \quad (3)$$

$$income_{net_{i,t}} = \partial_0 + \beta_3 did + \theta way_{i,t} + \lambda control_{i,t} + \gamma_t + \mu_i + \varepsilon_{i,t} \quad (4)$$

Residents may increase their attention to information, improve their knowledge, or expand their social networks as a result of broadband construction, and the information residents obtain from it can lead to gains in labor efficiency and access to jobs and thus increased income. Social networks are generally considered a dimension of social capital, and the commonly accepted definition in economics comes from Boix and Posner: "Social capital is the social networks, trust, and social norms that can improve economic efficiency through coordinated action". Social networks as a form of social capital play an important role in the daily life of developing countries [19]. According to Yuan Zhang and Ming Lu , the large amount of information or resources embedded in social networks makes it a function of information transfer and information sharing, providing assistance in rationing jobs, financing, and entrepreneurship [20]. It has been shown that social networks can increase the income of residents. Wang Chunchao and Zhou Xianbo confirmed that network members are able to obtain economic or non-economic benefits from social networks [21].

In reality, social networks are important information access channels and the main means of interactive communication, which can be used as a complement or substitute for productive assets to improve residents' labor productivity and increase income, and the increase in income level can in turn strengthen residents' social skills and expand social networks, and this virtuous circle contributes to the increase in residents' income [22]. The adoption of digital technologies effectively lowers the cost of information communication within social networks, expands the size of social networks, which is defined by the number of actual interactions among social network members, and makes it easier for farmers to access immaterial capital to achieve common prosperity, which in turn increases their material capital [18]. Therefore, the broadband China strategy can promote residents' income increase by widening social networks. As shown in column (2) of Table 7, the regression results of did for gift are significantly positive at the $p<1\%$ level; then adding gift to the baseline regression, as shown in column (3), the regression results of gift and did for y1 are significant at the $p<1\%$ level and $p< 5\%$ level, respectively, but after adding gift to the baseline regression, the coefficients of did coefficients do not shrink, thus, it cannot indicate that social networks play a part in mediating the effect of broadband China strategy on residents' income growth.

Increase investment in human capital, such as raising spending on culture, education, and recreation to increase human capital levels. There is a strong relationship between human capital investment and income, and as human capital investment increases, it is generally assumed that individuals will achieve higher labor efficiency and thus income growth. Especially in the context of digitalization, human capital is gradually becoming a means of efficiency and growth and a key to sustainable development. According to Grigorescu et al., the digitalization of the economy and the growth of human capital would eventually boost population welfare [23]. As Internet information technology has advanced, more people are using the Internet to learn and gather information, which boosts their income and increases their ability to compete in the workforce.

DOI: 10.54254/2754-1169/4/20221029

Table 7: Mechanistic tests of the impact of broadband China on income: social networks.

Variables	(1)	(2)	(3)
	y1	gift	y1
did	5124.615***	765.758***	5176.510***
	(3.31)	(2.95)	(2.79)
gift			0.198**
			(2.14)
lnasset	1039.827***	185.164***	1469.644***
	(4.53)	(2.65)	(4.20)
debit_other	0.040***	0.004	0.034**
	(2.71)	(1.44)	(2.16)
age	-718.910	568.665	-3587.706*
	(-1.09)	(1.35)	(-1.73)
gender	530.496	-1041.305***	-5964.760***
	(0.11)	(-5.05)	(-6.36)
marital	-2020.041**	405.953*	-2420.337***
	(-2.48)	(1.75)	(-2.91)
health	132.045	68.726	62.151
	(1.01)	(1.46)	(0.38)
Constant term	33288.318	-27113.553	166925.214*
	(1.04)	(-1.36)	(1.69)
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	23767	20756	19946
R^2	0.06	0.10	0.06

The use of the Internet contributes to the accumulation of human capital, and individuals develop core competencies in the job market through online access to information, online learning and job search [24]. Fang Fuqian and Tian Gea found that the digital economy improves the quality of rural residents by making them more responsive to the new requirements of production in the digital economy, thus increasing their own income [25]. Using 793 Chinese farm household survey data, Hu Lun, and Lu Qian found that the use of Internet information technology by farm households can enhance their own learning ability and improve their technology, which is conducive to improving farm households' skill-based human capital [26]. In addition, farmers' use of Internet information technology to search for relevant health knowledge can also make farmers pay more attention to exercise and health care, which is conducive to health-oriented human capital accumulation. Both of these human capital enhancements can improve farmers' income levels. Thus, it can be seen that human capital plays an important role in the development of an innovative digital economy, and the broadband China strategy is an important factor in promoting the growth of residents' income by enhancing the investment of human capital to obtain the growth of the innovative economy. As shown in column (2) of Table 8, the regression results of did for eec are significantly positive at the level of p<1%; then adding eec to the baseline regression, as shown in column (3), the regression results of eec and did for $y1$ are significant at the level of p<1% and p< 5%, respectively, and after adding eec to the baseline regression, the coefficient of did is significantly smaller, indicating that human capital plays a partial mediating effect on residents' income growth in the digital economy development.

DOI: 10.54254/2754-1169/4/20221029

Table 8: Mechanistic tests of the impact of broadband China on income: human capital.

Variables	(1)	(2)	(3)
	y1	eec	y1
did	5124.615***	2466.572***	4143.292***
	(3.31)	(5.30)	(2.92)
eec			0.180**
			(2.12)
lnasset	1039.827***	139.018**	1050.220***
	(4.53)	(2.12)	(4.56)
debit_other	0.040***	0.002	0.039***
	(2.71)	(0.37)	(2.72)
age	-718.910	-45.944	-742.384
	(-1.09)	(-0.22)	(-1.12)
gender	530.496	509.458	388.301
	(0.11)	(0.46)	(0.08)
marital	-2020.041**	-37.932	-2047.948**
	(-2.48)	(-0.10)	(-2.50)
health	132.045	-53.357	161.989
	(1.01)	(-0.81)	(1.24)
Constant term	33288.318	3811.216	33671.262
	(1.04)	(0.37)	(1.05)
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	23767	24625	23550
R^2	0.06	0.03	0.06

Residents go out to work in higher-income industries by accessing information online and leave the low income caused by the unreasonable industrial structure in the local area to obtain higher wage income, thus directly increasing residents' income. The income of households working outside the home mainly depends on the number of people working outside the home and the wage level of the workers in the place where they work. The gap between the local wage level of labor households and the wage level of working outside is the main driver of rural labor migration. The lower the local wage level or the higher the wage level of working outside and the larger the gap between the two, the more laborers work outside and vice versa. The cost of citizens' information searches has decreased as a result of the growth of information technology [27], which has led to greater use of the Internet as a channel for information, reducing to some extent the inequality of opportunity due to information asymmetry [28].

DOI: 10.54254/2754-1169/4/20221029

Table 9: Mechanistic tests of the impact of broadband China on income: factor mobility.

Variables	(1)	(2)	(3)
	y1	migrant	y1
did	5124.615***	8552.404*	322.113
	(3.31)	(1.86)	(0.24)
migrant			0.143***
			(7.91)
lnasset	1039.827***	2830.849***	656.994**
	(4.53)	(3.62)	(2.21)
debit_other	0.040***	0.233***	0.071**
	(2.71)	(3.11)	(2.04)
age	-718.910	3646.285	1974.929
	(-1.09)	(0.55)	(1.36)
gender	530.496		
	(0.11)		
marital	-2020.041**	-387.372	-3131.101*
	(-2.48)	(-0.08)	(-1.92)
health	132.045	-26.058	529.580
	(1.01)	(-0.05)	(1.32)
Constant term	33288.318	-193572.419	-91820.241
	(1.04)	(-0.64)	(-1.37)
Time fixed effects	Yes	Yes	Yes
Individual fixed effects	Yes	Yes	Yes
Observations	23767	7824	7580
R^2	0.06	0.47	0.16

By using the Internet for information search and comparison, the labor force tends to move to a higher income than the current actual income, choosing nonfarm employment to obtain a higher income compared to the previous one. Prior to labor mobility, a level of income is expected and compared to the current actual income. As rational economic people, family members will consider labor mobility when there is an expected income premium. In summary, when residents search and compare information through the Internet channel and choose to go to work in places with higher than current actual income, they can drive income growth. As shown in column (2) of Table 9, the regression result of did for a $migrant$ is significantly positive at the level of p<10%; then adding $migran$t to the baseline regression, as shown in column (3), $migran$t is significant at the level of p<1% for $y1$, while did is insignificant for $y1$ at this time. The above empirical results confirm the three mechanisms of the digital economy development to promote residents' income growth, and the digital economy development increases residents' income through the social network, human capital and working outside.

7. Conclusion and Discussion

This study, which is based on the China Family Panel Studies, uses the "Broadband China" strategy as a natural experiment to examine how the digital economy has affected per capita net household income and other types of income using the Differences-in-differences method. It also looks at potential pathways through which the growth of the digital economy may have increased residents' income. The main findings of this paper include: digital economy development significantly increases

DOI: 10.54254/2754-1169/4/20221029

residents' income; heterogeneity analysis shows that the positive effect of digital economy development on residents' income is greater in developed eastern regions, urban household residents, and groups with higher education levels; Through the expansion of social networks, the accumulation of human capital, and employment outside the home, the development of the digital economy may enhance income, according to a mechanism study. The aforementioned conclusions have significant ramifications for China's pursuit of a digital economy for shared prosperity. In general, it is necessary to consistently encourage the growth of the digital economy in order to enhance family wellbeing and "tailor" it to various locations and demographics.

First, reducing the disparity between urban and rural incomes in terms of information technology application lays a solid foundation for better achieving common prosperity. While promoting the construction of information and communication infrastructure, due to the existence of the urban-rural dichotomy, rural households may not have the same access to information and usage skills as urban households, which in turn leads to the income-generating effect of digital economy development on rural households not being fully utilized. It is necessary to improve the accessibility of digital tools for rural households, enhance the capacity of online education support services, promote the sustainable and healthy development of "Internet education", and fully rely on network channels to promote the coverage of high-quality educational resources in rural and remote schools and improve the Internet usage skills of rural households.

Second, network channels reduce inequality of opportunity. The free movement of production factors, especially population, needs to play the mechanism of voting with feet [27]. Only when the labor force is mobile can different regions develop a division of labor and cooperation among themselves. Policymakers can enable public services to be allocated according to the size of the resident population. Network channels can help the less educated population to improve their information application ability, enabling them to reduce the unequal opportunities brought by information asymmetry, expand their own development, and increase residents' income.

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