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Can Digital Financial Inclusion Narrow the Urban-rural Income Disparity in Central Region of China?

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Abstract

The purpose of this study is to investigate whether digital financial inclusion (DFI) can narrow the urban-countryside income disparity in central district of China. This study conducts an empirical analysis using the Digital Financial Inclusion Index and relevant income data from the central district of China for the period of 2011-2020. The research

found that the digital credit level of DFI can significantly narrow the income disparity in the central district, but the depth of DFI usage has no significant impact on income level convergence in this area. Conversely, the total index, coverage breadth, digitization level, payment level, and insurance level of DFI can widen the income disparity in the central district. Based on these results, this paper proposes policy recommendations for narrowing the urban-countryside income disparity in this region through the evolution of DFI, which can also serve as a reference for other regions in China.

Keywords: Digital financial inclusion (DFI), Urban-rural income gap, Central district

1. Introduction

After implementing the reform and opening-up policy, China's economy has experienced quickly evolution, especially after joining the World Trade Organization in 2000. This has propelled China's economic rise and strengthened its position in the international arena. However, the persistent issue of a vital income disparity between urban and countryside residents continues to hinder China's economic progress. The problem of imbalanced regional economic development is prominent, and there is an evident "dual structure" phenomenon, with severe financial exclusion issues.

Table 1. Data related to China's rural financial development, 1978-2020

Year	Rural Household Savings Deposits (RMB100 Million)	Rural Household Loans (RMB100 Million)
1978	55.70	115.60
1990	1,841.60	1,038.10
2000	12,355.30	4,888.99
2001	13,821.40	5,540.90
2002	15,405.80	6,884.58
2003	18,177.68	8,411.35
2004	20,766.17	9,843.11
2005	24,606.37	11,529.93
2006	28,805.12	13,208.19
2007	33,050.26	15,429.31
2008	41,878.69	17,628.82
2009	49,277.61	21,622.53
2010	59,080.35	26,043.20
2011	70,672.85	31,023.00
2012	54,615.64	36,195.00
2013	101,268.71	45,047.00
2014	116,104.17	53,587.00
2015	123,009.08	61,488.00
2016	152,617.34	70,845.85
2017	179,555.16	81,055.66
2018	213,111.33	92,322.00
2019	243,905.10	103,000.00
2020	268,535.94	118,100.00

Source: China Financial Yearbook (2001-2021).

Table 1 shows both the savings deposits and loans of rural households have experienced rapid

growth during the 43-year period from 1978 to 2020. However, there are still issues that need to be addressed. Firstly, there is a significant disequilibrium between the evolution of the countryside economy and the growth of farmers' incomes, with a substantial difference between them. Savings deposits of rural households have increased from RMB5.57 billion in 1978 to RMB26,853.59 billion in 2020, an increase of 4,821 times. On the other hand, rural household loans have increased from RMB11.56 billion in 1978 to RMB11,810 billion in 2020, an increase of 1,022 times, which is only about one-fifth of the savings deposit ratio. This indicates that there is a capital outflow from countryside, and the standard of financial support received in countryside is relatively low. According to data released by China Statistical Yearbook, the per capita disposable earning of rural residents has increased only from RMB133.6 in 1978 to RMB17,131.5 in 2020, a rise of only 128 times, which is approximately 1/40 of the savings deposit ratio.

In general, rural areas are facing a situation of having more savings and fewer loans. Many rural residents allocate a significant portion of their disposable income towards savings, while the number of loan applications from rural households to financial institutions is significantly lower than the savings deposits. This capital outflow from countryside areas to urban areas is one of the factors that further widens the urban-countryside income disparity. In addition to receiving support from urban residents and businesses in terms of savings deposits in financial institutions, urban areas also receive a considerable portion of savings deposits from countryside. This vicious cycle exacerbates the income disparity, and the situation is likely to worsen over time. Therefore, this situation urgently requires improvement and must be addressed.

The rapid development of information technology has provided advanced technological support to the financial industry, and DFI has made significant contributions to the rise of Chinese residents' earning. So, can the growth of DFI lessen the income disparity between urban and countryside residents in the central district of China? Therefore, this paper aims to address this question by using the data obtained from the central district of China.

2. Literature Review

The combination of the internet and finance has been driven by the financial exclusion present in China's financial system. The development of inclusive finance in countryside faces challenges due to insufficient information. However, the advancement of digital technology has alleviated problems related to information asymmetry, high transaction costs, and collateral constraints, thereby facilitating the implementation of inclusive finance in countryside. Barbesino et al. (2005) pointed out that the internet has become a recognized business channel for European banks. The evolution of digital finance, with a focus on information asymmetry and driven by big data, promotes the "long tail" extension, thickening, and downward distribution of markets. It expands the coverage of financial services and facilitates information exchange across regions, making progress in various areas, for instance, payment, insurance, and credit. The development of the internet has also overcome spatial limitations, reducing regional disparities in the evolution of digital finance and improving the influence of financial exclusion on the town-countryside earning disparity. It

enables more precise targeting of rural financial development goals.

Indeed, the implement of digital technology in the financial sector should not be limited to mere innovation in service delivery or technical support. It should encompass the establishment and improvement of an internet finance ecosystem, as well as the evolution of DFI (Cheng & Zhang, 2019). It is essential to go beyond the surface-level implementation of digital tools and focus on creating a holistic ecosystem that fosters financial inclusivity and empowers individuals and businesses to access a wide range of financial services via digital means (Wei, 2019).

DFI plays a crucial part in facilitating inclusive economic growth. Kapoor (2013) discovered that digital finance can facilitate economic rise. If the financial system lacks universality, it becomes difficult for vulnerable groups to invest in education to enhance their capabilities and for businesses to access financing for growth, leading to widening income inequality and ultimately slowing down economic growth. Manyika et al. (2016) demonstrated that the growth of DFI can address the challenge of financing for small businesses and stimulate economic rise in middle-income countries.

Ozili (2018) and Sutherland et al. (2018) confirm that the incorporation of digital finance and inclusive finance benefits financial service clienteles, digital finance suppliers, governments, and the economy. The growth of DFI not only promotes the deepening of inclusive finance but also facilitates inclusive economic rise. It accelerates technological revolutionary and the rapid dissemination of new technologies, bringing about a “digital dividend” to the economy. In terms of serving countryside, the inherent inclusiveness of digital finance drives the rise of rural financial markets, compensating for the shortcomings of rural finance, cutting down the cost of financial services, and facilitating the implementation of inclusive finance in countryside.

Indeed, the issue of financial exclusion has long been prevalent in China (Wang & Xiong, 2020). The lack of financial support in countryside is not solely due to problems with traditional financial institutions or inclusive finance. The low-income population in countryside itself faces challenges such as low educational levels, limited financial awareness, and limited proficiency in internet technology. Their disadvantaged educational and internet proficiency levels prevent them from accessing higher income opportunities (He et al., 2017). This creates a vicious cycle in China.

According to China’s basic national conditions, while maintaining a fast economic growth rate, it is also essential to ensure a reasonable economic structure (Li et al., 2018). Therefore, the market economy in China requires the support of the financial sector (Liu et al., 2023; Gong & Song, 2021). However, this support must be moderate and in the right balance. Moreover, in the long run, the main pillar of the Chinese economy still needs to be the real economy.

It is evident that there are significant regional disparities in the growth of DFI in China (Ge & Zhu, 2018). As mentioned earlier, funds tend to flow more towards higher-income groups. In this context, the evolution of DFI may become an extension of traditional financial growth.

This spatial agglomeration effect will result in continued lack of financial support for low-income groups (Guo et al., 2017), thereby widening the urban-countryside disparity.

In the study of the connection between DFI and the urban-countryside earning disparity, this paper finds that the development of DFI in China is constrained by economic regions (Xiang & Liu, 2020). Dayal-Gulati & Husain (2002) research demonstrates that regional disparities in financial development have a significant influence on economic growth gaps. The effect of financial development on the urban-countryside disparity varies across areas, with rural financial development in the eastern and central parts increasing farmers' earning, while in the western region, it reduces the income disparity.

In conclusion, scholars have analyzed the mechanisms through which DFI affects the urban-countryside earning disparity from various perspectives. However, the extent to which DFI influences the urban-countryside disparity remains to be determined. These are the research questions that this study needs to further explore and resolve.

3. Methodology

The purpose of this study is to empirically analyze the effect of DFI on the urban-countryside income disparity in the central district of China. Additionally, it aims to explore ways to further improve the income level in countryside and narrow the disparity. The central district primarily includes six provinces: Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan. Based on this, the following research hypotheses are proposed:

H1: The overall index of DFI can narrow the urban-rural income disparity in the central district.

H2: The coverage breadth of DFI can narrow the urban-rural income disparity in the central district.

H3: The usage depth of DFI can narrow the urban-rural income disparity in the central district.

H4: The digitization level of DFI can narrow the urban-rural income disparity in the central district.

H5: The digital payment level of DFI can narrow the urban-rural income disparity in the central district.

H6: The digital insurance level of DFI can narrow the urban-rural income disparity in the central district.

H7: The digital credit level of DFI can reduce the urban-rural income disparity in the central district.

This research uses the Theil index to measure the income disparity between urban and countryside residents, denoted as Income Gap (IG). Additionally, to ensure the accuracy of income levels, the influence of price changes is eliminated by excluding the effects of price fluctuations on the income levels. The calculation method is as follows:

$$P_{i,t} = p\left(1 - CPI_{i,t}\right) \tag{1}$$

$$IG_{i,t} = \left(\frac{P_{1t}}{P_t}\right) ln\left(\frac{\frac{P_{1t}}{P_t}}{\frac{Z_{1t}}{Z_t}}\right) + \left(\frac{P_{2t}}{P_t}\right) ln\left(\frac{\frac{P_{2t}}{P_t}}{\frac{Z_{2t}}{Z_t}}\right) \tag{2}$$

Among them, *IG* stands for urban-countryside income gap. i=1 is urban, i=2 is rural, P is real income, p is nominal income, Z is population, t is time, *CPI* is inflation rate. Therefore, P_{1t} is the income standard of urban residents in period t, and Z_{1t} is the population of the town in period t. P_{2t} is the income level of rural residents in period t, and Z_{2t} is the population of rural residents in period t. P_t is the total income level of national residents in period t, and Z_t is the total population of the country in period t.

The independent variable, the level of DFI development, is measured using The Peking University Digital Financial Inclusion Index of China. The overall index of DFI is represented as the first-level indicator, denoted as IA. The overall index of DFI includes three second-level indicators: coverage breadth (CB), usage depth (UD), and digitization level (DL). The digitization level of DFI is further divided into three third-level indicators: digital payment level (PAY), digital insurance level (INS), and digital credit level (CRE). These indicators, from different perspectives, all have an impact on the urban-countryside income disparity (Guo et al., 2020).

Apart from DFI, there are many factors that can influence the income disparity. This paper selects five factors as control variables. First, the residents' education level, by average number of higher education students per 100,000 population in a district (logarithm) to measure. Second, the standard of financial support for agriculture, by regional expenditure on agriculture, forestry and water resources/gross regional product to measure. Third, the economic transformation, by value-added of tertiary industry/GDP to measure. Fourth, technological progress, by R&D spending/GDP to measure. Fifth, the degree of opening-up, by import and export volume/regional GDP to calculate. The data related to DFI is gathered from Peking University's Digital Inclusive Finance Center. The data on urban and countryside residents' income and the control variables are collected from the China Statistical Yearbook.

In this study, a panel autoregressive distributed lag (ARDL) technique covering six districts with annual data from 2011 to 2020 was employed. The main advantages of ARDL are that this technique can be applied to studies with a small sample size, does not require pre-testing for unit roots, and can be applied to $I(0)$, $I(1)$ or a mixture of both $I(0)$ and $I(1)$ variables. However, this technique is not applicable if there is any $I(2)$ variable present; therefore, a unit root test is still required. Panel ARDL has been employed in various studies such as in Jong et al. (2024), Raihan et al. (2024), Ahmad et al, (2022), and Fernandes et al. (2021).

$$IG_{ijt} = \beta_0 + \beta_1 IA_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \tag{3}$$

$$IG_{ijt} = \beta_0 + \beta_1 CB_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \tag{4}$$

$$IG_{ijt} = \beta_0 + \beta_2 UD_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \quad (5)$$

$$IG_{ijt} = \beta_0 + \beta_3 DL_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \quad (6)$$

$$IG_{ijt} = \beta_0 + \beta_1 PAY_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \quad (7)$$

$$IG_{ijt} = \beta_0 + \beta_2 INS_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \quad (8)$$

$$IG_{ijt} = \beta_0 + \beta_3 CRE_{ijt} + \beta_x X_{ijt} + \mu_{ijt} \quad (9)$$

Based on the research hypotheses and the seven independent variables, this paper establishes seven empirical research models. Where IG represents urban-countryside income disparity. i and t denote the district and time, respectively. IA denotes total index level. CB is the breadth of coverage. UD proxies the depth of use. DL represents the degree of digitalization. PAY represents the digital payment level. INS represents the digital insurance level. CRE represents the digital credit level. $X_{i,t}$ is the control variables. $\mu_{i,t}$is the random interference term. The others are constants.

4. Empirical Results

Table 2 tabulated the panel unit root results for the Im, Pesaran, and Shin (IPS) and Augmented Dickey-Fuller (ADF) tests. The results indicate a mix of $I(0)$ and $I(1)$ variables. Therefore, the empirical results of the unit root tests justify employing the panel ARDL technique in this study.

Table 2. Panel unit root tests results

Variables	IPS		ADF	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept
Level				
LGAP	-07610	-1.3814*	20.0923*	34.8914***
LIA	-10.1766***	-8.9496***	81.9826***	70.0145***
LCB	-17.6173***	-5.2573***	125.596***	62.3516***
LUD	-5.6645***	-1.4499*	51.8734***	29.9399***
LDL	-9.8366***	-3.3430***	78.1644***	50.1948***
LPAY	-6.9833***	2.2533	61.9357***	0.8229
LINS	-19.5321***	-5.3373***	106.728***	53.1098***
LCRE	1.4456	-2.3222**	5.1816	37.6857***
First Difference				
ΔLGAP	-6.2035***	-2.0574**	58.1987***	40.0146***
ΔLIA	-9.9684***	-6.3455***	81.8405***	72.3790***
ΔLCB	-3.4020***	-0.1955	37.6735***	14.7143
ΔLUD	-5.8654***	-2.2817**	57.4761***	43.0016***
ΔLDL	-3.6913***	-0.5089	38.5258***	17.0761
ΔLPAY	1.5993	-0.4935	2.7157	17.5707
ΔLINS	-8.9534***	-2.7151***	64.2868***	45.7793***
ΔLCRE	-4.1457***	-1.8328**	44.0068***	36.6262***

Asterisks (***), (**) and (*) indicate statistically significant at 1%, 5% and 10% levels, respectively.

Table 3 presents the empirical results of the selected seven independent variables in influencing the urban-countryside earning disparity in the central district of China. The

results indicate that the LIA, LCB, LDL, LPAY, LINS, and LCRE have significant impacts on the gap between urban and rural residents in the central district. However, the impact of the LUD of DFI on the gap is not significant. Among these variables, only the digital credit level has a negative impact on the gap, which can narrow the gap between urban and rural residents in the central district. The other variables have positive impacts on the gap, indicating that digital financial inclusion widens the gap between rural and urban areas in central district of China.

Table 3. Empirical analysis of the central economic zone in China

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	9.480*** (0.789)	9.475*** (0.813)	9.502*** (0.776)	9.398*** (0.779)	9.507*** (0.724)	9.489*** (0.822)	9.407*** (0.741)
LIA	0.011** (0.021)						
LCB		0.007** (0.015)					
LUD			0.001 (0.904)				
LDL				0.005* (0.078)			
LPAY					0.010*** (0.002)		
LINS						0.006*** (0.000)	
LCRE							-0.123*** (0.000)
LEL	-0.346** (0.010)	-0.395*** (0.002)	-0.466*** (0.006)	-0.409*** (0.002)	-0.339*** (0.008)	-0.615*** (0.000)	-1.772*** (0.000)
LFS	0.003 (0.723)	0.005 (0.503)	0.016** (0.032)	0.007 (0.382)	-0.008 (0.323)	0.003 (0.189)	0.128*** (0.001)
LET	-0.346*** (0.000)	-0.332*** (0.000)	-0.311*** (0.000)	-0.338*** (0.000)	-0.349*** (0.000)	-0.230*** (0.000)	-0.046 (0.258)
LRD	-0.154*** (0.000)	-0.153*** (0.000)	-0.144*** (0.000)	-0.139*** (0.000)	-0.154*** (0.000)	-0.183*** (0.000)	0.004 (0.679)
LOW	-0.043*** (0.000)	-0.040*** (0.001)	-0.036** (0.013)	-0.038*** (0.003)	-0.033*** (0.002)	-0.014** (0.037)	-0.023 (0.409)

Notes: Asterisk ***, ** and * represent 1, 5 and 10 percent levels of significance, respectively. The figures in brackets are *p*-values.

Firstly, among the first-level indicators, at a 99% confidence level, every 1% increase in the IA of DFI can expand the gap by approximately 0.01%. A possible reason for this is that the

central district is geographically located in the center of China, with mountainous areas and relatively low transportation convenience. Additionally, the rural population is large and primarily relies on agriculture. Therefore, the development of advanced technological means such as the internet, information technology, and big data in the central district is relatively backward. Meanwhile, the rural economic development in the central district currently relies primarily on traditional channels such as education, economic transformation, and fiscal allocations. The application of DFI in the central district is a new financial tool for both rural and urban areas. However, rural residents have a lower acceptance level than urban residents. Consequently, it provides more loans to urban areas, raising income levels in urban areas. As a result, the development of DFI in the central district can increase the income level of urban residents to a greater extent, which in turn widens the gap. Therefore, Hypothesis 1 is not verified.

In addition, the impacts of the three second-level indicators on the gap vary. Firstly, at a 95% confidence level, for every 1% increase in coverage breadth, the gap can be widened by approximately 0.01%. A possible reason is that the central district is currently in the initial stage of DFI development, with DFI services primarily covering urban areas. The number of users in urban areas is increasing rapidly, while the growth rate of users in rural areas is slower than that in urban areas. Therefore, the expansion of coverage breadth may instead widen the gap. Therefore, Hypothesis 2 is not verified. Furthermore, the impact of usage depth on the gap is not significant. A possible reason is that the development of DFI services in the central district is still in its infancy, focusing mainly on handling more basic services and has not yet penetrated deeper levels of service development. Thus, Hypothesis 3 is not verified. Additionally, at a 90% confidence level, for every 1% increase in the digitization level, the gap will increase by approximately 0.01%. Similar to the reason for the expansion of the gap due to coverage breadth, the current digitization services in the central district are first being developed and popularized in urban areas, where residents' acceptance and conditions are better than in rural areas. Therefore, the current development of digitization has instead widened the gap. Thus, Hypothesis 4 is not verified.

Moreover, among the third-level indicators, at a 99% confidence level, PAY, INS, and CRE all have significant impacts on the gap. However, only the CRE can significantly reduce the gap, while both the PAY and INS significantly widen the gap in the central district of China. Specifically, for every 1% increase in both PAY and INS, the gap may increase by approximately 0.01% each.

In contrast, the gap will be reduced by approximately 0.12% for every 1% increase in the digital credit level. A possible reason for this is that, among the three digital service development levels, digital payment requires advanced smart devices and networks, which are significantly less accessible in rural compared to urban. Moreover, the use of networks currently incurs fees, which increase the burden on residents in rural areas. Therefore, Hypothesis 5 is not verified. The development of digital insurance requires residents to have advanced insurance awareness, which is significantly lagging in rural areas compared to urban areas. Hence, Hypothesis 6 is not verified.

However, credit services are essential for rural residents who want to increase their income levels. Farmers or small and medium-sized enterprises in rural areas need the popularization of digital credit services to obtain financial support quickly and conveniently. Simultaneously, financial institutions such as banks will also help rural residents learn to use digital credit services. Therefore, the digital credit level can significantly reduce the gap, and Hypothesis 7 is verified.

Among the five selected control variables, except for fiscal support for agriculture which has an insignificant impact on the gap and may even widen it in some cases the other four control variables are generally significant at the 99% confidence level. Firstly, the level of residents' education has the most substantial negative impact on the gap in the central district. For every 1% increase in residents' education level, the gap can be narrowed by approximately 0.35% to 1.77%. Education is the most important way to cultivate talent. As shown in Table 4, the proportion of the rural population in the six central provinces is higher than the national average. Specifically, Henan, Anhui, and Hunan have rural population ratios exceeding 40%. Therefore, more rural residents receiving higher education, improving their education level, and thus increasing their income is crucial. Among the six central provinces in China, there are numerous universities, including a significant proportion of 985, 211, and Double First-Class universities, accounting for approximately 15% to 20% of the national total. These institutions provide essential conditions for cultivating high-level talents in the central district.

Table 4. The urban-rural population composition of six central districts in China, 2021

District	Total population (10,000)	Urban population		Rural population	
		Population (10,000)	Proportion (%)	Population (10,000)	Proportion (%)
China	141,260	91,425	64.72	49,835	35.28
Anhui	6,113	3,631	59.39	2,482	40.61
Shaanxi	3,954	2,516	63.63	1,438	36.37
Jiangxi	4,517	2,776	61.46	1,741	38.54
Henan	9,883	5,579	56.45	4,304	43.55
Hunan	6,622	3,954	59.71	2,668	40.29
Hubei	5,830	3,736	64.08	2,094	35.92

Source: China Financial Yearbook (2022).

In addition, the level of fiscal support for agriculture has no significant impact on the gap in the central district, and sometimes it may even widen the gap to a certain extent. A possible reason is that the national government directly or indirectly allocates funds to rural and urban areas in the central district to support economic construction and financial development. This can directly and effectively increase the income levels of residents in both rural and urban areas, with the growth rate being consistent or even faster in urban areas. Therefore, the impact is not significant.

Furthermore, economic transformation can significantly reduce the gap in the 99% confidence interval. For every 1% increase in economic transformation, the gap can be narrowed by approximately 0.23% to 0.35%. In rural areas of China, economic development

has long relied primarily on the primary industry, especially agriculture. The modernization of agriculture has improved the efficiency of agricultural production. At the same time, it has also created many emerging industries and services related to agricultural production, such as agricultural product reprocessing, online live streaming marketing, and other industries. These have provided opportunities for agricultural transformation and development. For example, Henan, a populous province and a major agricultural province in the central district, where rural economic transformation is directly related to the income levels of farmers and small and micro enterprises.

Additionally, at the 99% confidence level, the degree of openness to the outside world has a significant and negative impact on the gap. Specifically, for every 1% increase in the level of openness, the gap can be narrowed by approximately 0.14% to 0.18%. The central district is located in the heart of China's territory, with mountainous areas and other topographical challenges. Its foreign trade development is constrained by factors such as transportation, resulting in a relatively low level of development. Therefore, although the development of foreign trade in the central district can reduce the gap, its effect is not as significant as the improvement in education level and economic transformation.

Moreover, technological progress has a significant impact on the gap, reducing it by approximately 0.01% to 0.04% for every 1% increase in technological advancement. One possible reason is that the overall technological development level in the central district is relatively backward. Technological progress can increase the income of all residents, playing a positive role in both urban and rural areas. While the technological level in urban areas is slightly higher than in rural areas, the rate of improvement is also higher. Therefore, technological progress can narrow the gap between the two, but the reduction is not significant.

5. Discussions

Based on the research results in the central district, the digital credit level of DFI can significantly reduce the gap in the central district, thus verifying Hypothesis 7. However, the UD of DFI has no significant impact on narrowing the gap. The IA, CB, DL, PAY, and INS of DFI all significantly expand the gap, therefore Hypotheses 1-6 are not validated. This is related to the geographical location, urban-countryside population composition, and current economic development level of the central district.

Currently, the central district is in the initial stage of DFI development, where urban areas have received more support in terms of inclusive financial resources, while rural areas lag behind in their development. Therefore, at this stage, DFI in the central district tends to widen the gap. However, once DFI matures and develops rapidly in the central district, and after rural areas undergo a period of adaptation and effectively absorb the development of DFI, it is believed that DFI will significantly reduce the gap in the central district.

Among the control variables, the impact of fiscal support for agriculture on the gap is not significant and may even sometimes widen the gap. However, the four control variables of residents' education level, economic transformation, openness to the outside world, and

technological progress are all significant at the 99% confidence level and can converge the gap to a certain extent.

6. Implications

This paper conducts an empirical analysis using relevant economic data from 2011 to 2020 to explore the impact of DFI on the gap in the central district of China. The results show that currently in the central district, only the credit level of DFI can significantly reduce the gap. Therefore, for the central district, it is crucial to support the development of DFI in both urban and rural areas, and once DFI matures, it can better serve rural areas. However, rural areas inherently have disadvantages compared to urban areas, so attention should be paid to how financial resources can enter rural areas quickly, efficiently, and reasonably. Secondly, it is also necessary to improve the financial literacy and awareness of rural residents in the district. Financial institutions should penetrate rural areas to popularize financial knowledge, ensuring that finance truly benefits all people. Only by doing so can the income level in rural areas be raised with the support of financial resources, accelerating the construction of new rural areas and narrowing the gap.

Apart from DFI, there are many other factors that affect the gap, such as the five control variables mentioned in this paper. In future economic development, the central district should fully utilize opportunities in education, finance, economic transformation, technology, and foreign trade to continuously increase residents' income levels while narrowing the gap. It is believed that soon, DFI will develop increasingly well, and the gap issue will gradually be resolved.

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Authors contributions

Liu, Puah and Arip conceptualized the research idea. Liu was responsible for data collection and did the data analysis together with Puah. Liu drafted the manuscript and revised it by Puah, Arip and Jong. All authors have read and agreed to the published version of the manuscript.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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