

An Analysis of the Impact of Digital Inclusive Finance on the Well-Being Index of Rural Residents in the Context of Rural Revitalization

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Abstract. The rural revitalization strategy, as an important foundation for China's modernization in a new stage and a new era, is a project of major concern to the Party and the state. Theoretically, rural revitalization can empower the agricultural industrial chain, integrate the credit system, and improve financial accessibility through digital inclusive finance, thereby increasing rural residents' income, narrowing the income gap, and ultimately raising farmers' well-being index. Therefore, while drawing on existing literature and analyzing and summarizing relevant classical theories, this study theoretically examines the mechanism through which digital inclusive finance affects the well-being index of rural residents. It collects specific indicators for measuring rural residents' well-being index from databases including the National Bureau of Statistics, the China Rural Statistical Yearbook, and the China Family Panel Studies, and comprehensively applies the entropy method to calculate the well-being index of rural residents before conducting an empirical study. The results show that: (1) digital inclusive finance and its three dimensions - breadth of coverage, depth of use, and degree of digitization - can all improve the well-being index of rural residents; (2) the development of digital inclusive finance can improve the well-being index of rural residents by narrowing the urban-rural income gap, while the urban-rural income gap and the level of urbanization have positive moderating effects; (3) digital inclusive finance and its three dimensional indices can promote the well-being index of rural residents in the eastern, central, and western regions, although the effects differ slightly; and (4) when the density of financial institutions in rural areas differs, the effect of digital inclusive finance on improving the well-being index of rural residents also differs. Based on the research conclusions, the following policy recommendations are proposed: (1) improve digital infrastructure and eliminate cognitive barriers; (2) enhance the adaptability of financial services and eliminate financial exclusion; (3) popularize financial knowledge and improve digital literacy; (4) promote development through multi-dimensional and multi-group collaboration; and (5) pay attention to residents' lives and improve rural well-being.

Keywords: Digital inclusive finance; rural residents' well-being index; entropy method; rural revitalization; mediating effect.

1. Introduction

1.1. Research Background and Significance

1.1.1. Research Background and Purpose

Rural Revitalization Strategy is a major national initiative proposed by General Secretary Xi Jinping in 2017 to address the issues of agriculture, rural areas, and farmers, which concern the national economy and people's livelihood. As a strategically important part of China's vast territory, the countryside has distinctive Chinese development characteristics. It covers a large area, has a large population, possesses abundant resources, and bears a major responsibility for the country's economic take-off. The principal contradiction at China's current stage is particularly prominent in rural areas. Unless rural development problems are resolved, national economic development will remain constrained. Therefore, rural development and rural revitalization are major themes of the present era. In the age of the Internet and big data, the construction of "smart villages" has broken through the basic model of traditional rural development, making its system and structure more diversified and

layered. At the intersection of the digital wave and the inheritance of rural culture, the innovative integration of the digital economy and traditional rural culture has generated multidimensional social changes, brought little-known but remarkable local cultures into public life, and broadened rural residents' sources of income. Digital media have created platforms for urban-rural dialogue, enabling urban residents to overcome geographical barriers and gain an in-depth understanding of the diverse landscapes of rural life and the quality of agricultural products through immersive experiences and precise cognition. In the flow of factors between urban and rural areas, such platforms build bridges of emotional resonance and value identification. Communication and interaction between the two groups have become more convenient and efficient; commodity circulation has accelerated; multiple production, supply, and consumption channels have been activated; the rural economy has been revitalized; and the driving force for interconnected urban-rural development has been strengthened. When the countryside prospers, the nation prospers. Under the leadership of the Communist Party of China, rural people are embracing the wave of digital and intelligent development, making full use of available resources, and placing rural revitalization on a new development track. The ultimate purpose of rural revitalization is to improve the well-being of the people, especially rural residents, by raising their sense of well-being through various development paths and means. Interpreting the meaning of well-being, however, is a difficult proposition.

What, then, does "happiness" mean? Happiness is an ancient and complex topic in human history. It is both the supreme beauty that scholars throughout history and across cultures have spent their lives contemplating without fully comprehending, and the ordinary possession that people suddenly realize they have always had. For Aristotle, it was self-perfection achieved through the practice of virtue; for Nietzsche, it was the strength achieved by overcoming adversity. Different understandings of happiness around the world have also formed cross-cultural views of well-being. The "Nordic model" emphasizes security and balance in life and has produced comprehensive systems in countries such as Denmark and Iceland that protect residents from birth to death. Chinese wisdom has generated the Confucian idea that "the benevolent are free from worry," while the African collective view of happiness - "I am because we are" - has fostered the solidarity of the Ubuntu spirit. Modern research divides well-being into subjective and objective dimensions. Subjective well-being is an individual's judgment derived from genuine experience of life, whereas objective well-being is measured through theoretical analysis and various indicators. Opinions differ as to which type is closer to reality and more accurate, because happiness is a highly flexible concept that varies across individuals and eras. Its concept and connotations continue to be enriched and refined, and research and exploration remain ongoing. From the perspective of this study, determining whether and to what extent rural residents' well-being has improved requires a measurement tool whose results are intuitive, comparable, and useful for further research. The well-being index of rural residents can therefore be used for this purpose.

Digital inclusive finance, a key component of the digital financial system, is not only an important financial path for implementing the Rural Revitalization Strategy but also a deepened extension and innovative breakthrough of traditional inclusive finance. It plays an irreplaceable role in improving rural residents' quality of life and well-being. Digital finance restructures the framework and organization of the traditional financial system and uses data, algorithms, and computational cases to construct a comprehensive transformation system distinct from traditional financial ecology. It changes operating paradigms in monetary dimensions, credit creation, risk pricing, and other areas, generating disruptive effects on global finance. Banks offering new digital services may surpass traditional banks and restructure financial power; changes in the way the economy operates may reorganize economic forms; and more social groups, including rural populations, may gain access to financial services, thereby producing social-equity effects. However, the rapid development of digital finance inevitably faces obstacles and challenges. Regulatory capacity may fail to keep pace with innovation; the rapid flow of data may not fully protect customer privacy; the system may depend heavily on Internet and computing speed without raising technical security to the same level; and although it may partly avoid monopolies created by traditional financial models, it may trigger new

forms of monopoly. If developed scientifically and prudently, digital inclusive finance can become an important driver of higher living standards among rural residents and can positively empower resource allocation and economic resilience. Nevertheless, the consequences of inappropriate development must always be guarded against. Although digital inclusive finance has made phased progress in improving financial availability for rural groups, a long path remains before genuine financial accessibility is achieved.

As a major national policy initiative, the Rural Revitalization Strategy is significant not only for its macro-level guidance of agricultural and rural modernization, but also for its far-reaching strategic and practical role in improving rural residents' quality of life. Within this strategic framework, digital inclusive finance has become a key technical support and policy instrument for implementing rural revitalization. Through transmission mechanisms such as optimizing the supply of financial services and reducing financial transaction costs, it can act directly on the core factors that improve rural residents' subjective well-being. Can digital inclusive finance become an effective instrument for improving rural residents' well-being? If so, through what paths and internal mechanisms does this positive effect operate? Does the effect exhibit significant heterogeneity across geographical spaces and stages of development? Exploring these deeper mechanisms helps clarify the significance of digital inclusive finance for current rural development, improves understanding of the connotations of the Rural Revitalization Strategy, and reveals the careful intentions behind national policy.

Existing research in this area has focused mainly on how digital inclusive finance narrows the urban-rural income gap [1], promotes industrial development [2], and affects consumption expenditure. Academic discussion of the relationship between digital inclusive finance and rural residents' well-being remains insufficient, and related empirical studies are relatively scarce. Against this background, this study systematically reviews the existing literature, focuses on the mechanism through which digital inclusive finance affects rural residents' subjective well-being index, and further examines whether the effect is heterogeneous across regions and influenced by policies, special periods, and other factors. By promoting the in-depth development of digital inclusive finance, the study seeks to provide key support for the comprehensive implementation of rural revitalization and ultimately contributes to the policy objective of improving rural residents' subjective well-being.

1.1.2. Research Significance

Investigating the mechanisms and effects through which digital inclusive finance influences rural residents' subjective well-being index has important value in both theoretical construction and practical application. At the theoretical level, its significance can be divided into three aspects.

(1) This study enriches the research paradigm of development economics. The reconstruction of the digital production function in Chinese practice is illustrated by the use of agricultural drones, which can reduce the cost of rice sowing by approximately five times. By optimizing production technologies and management models, crop-production efficiency in rural areas can be significantly improved, thereby steadily increasing the economic returns from crops.

(2) This study extends the framework of well-being theory. Traditional studies of well-being have not included digital inclusive finance as an important variable or consideration for quantification or control. Research shows that rural residents' ownership of digital accounts can reduce their psychological sense of relative deprivation by approximately 31%. Compared with cash credit, an increase of RMB 10,000 in digital credit produces a marginal utility of subjective well-being that differs by a factor of 0.7. These factors can be incorporated into models for detailed analysis, thereby revising traditional theoretical assumptions and the applicability of their conclusions. Research also shows that digital technology can break the "poverty trap." Kenya's most popular electronic payment wallet, M-Pesa, has reduced the local extreme-poverty rate by approximately 2%, breaking the previous cycle of poverty.

(3) This study enriches cases concerning the impact of digital trust on traditional social-capital theory. Traditional social capital and digital trust represent two trust mechanisms in the pre-digital era and the era of digital civilization. Traditional social capital accumulates through kinship, geographical ties, and occupational relationships and is widely used in transactions and credit in

traditional rural areas. Traditional markets, for example, depend on an "acquaintance economy" in which consumer trust is gained through the reputation accumulated by merchants over several generations. Lending may also take the form of joint-guarantee loans that depend on a family's local reputation. Once trust is violated, the offender may face family discipline or even removal from the family genealogy. Digital trust, by contrast, relies more heavily on smart contracts, which can efficiently verify and monitor identities and operating behavior within milliseconds and automatically execute penalties against violators. This greatly reduces unnecessary work and modularizes and separates transactions among customers, although it may also weaken some traditional family-linkage effects. Through a digital trust system, digital inclusive finance reconstructs rural residents' existing financial behavior patterns and expands the multiple paths through which their subjective well-being can be improved.

At the practical level, the significance can be divided into two aspects.

(1) A specific focus on rural residents enables relevant policies to provide precise guidance. Big-data surveys and statistics can be used to track rural residents' digital financial behavior, identify gaps between demand for and supply of digital finance in rural areas, and formulate one-to-one targeted plans to improve the supply side. The rationality and operability of policy formulation can also be monitored continuously to avoid "empty policies" and "empty guidance" that lack substantive content or feasible implementation space. Beyond accurately predicting demand, such efforts offer an opportunity for digital finance in rural areas to grow and improve independently. Continuous optimization of financial services can be used to monitor whether excessive penetration of digital finance itself produces counterproductive effects. Product design can comprehensively consider the drivers of rural residents' well-being, while channel innovation can be developed in greater depth to improve the completeness and stability of the digital financial framework and strengthen its capacity to withstand risks.

(2) The study helps reconstruct the development model and economic form of rural areas. Although the traditional social-capital mechanism described above is affected by emerging digital trust, the network of transactional relationships established in rural areas over a long period remains, to some extent, better suited to local trading habits. Digital finance does not completely abandon this relatively traditional method. Instead, it combines and bridges it with new mechanisms to create tools that are more readily accepted. A virtual credit circle on WeChat, for example, can reactivate traditional interpersonal lending in real society. According to surveys by other scholars, this new method can effectively reduce the rate of disputes.

At every level, this research has substantial significance and strong potential for continued investigation. It lies not only at the intersection of the Rural Revitalization Strategy and the revolution in digital financial technology, but also at the frontier where social psychology and development economics converge in the digital-intelligence era, and it may enrich and improve the bodies of knowledge in multiple disciplines.

1.2. Literature Review

1.2.1. Research on Digital Inclusive Finance

Although the field of digital inclusive finance is currently closely connected with the national policy system, no authoritative core research community focused on the topic has yet emerged. Internationally, many countries are developing digital inclusive finance, but frequent cooperation and exchange among them remain limited [3]. As a model and pioneer in the development of digital inclusive finance, China has concentrated related research on closing the urban-rural income-distribution gap, poverty-alleviation mechanisms, and the upgrading of household consumption [4]. Although China's digital inclusive finance began only around 2015 and therefore started relatively late, it continues to display strong momentum and rapid growth, with enormous potential. Greater cooperation among stakeholders could deepen discussion of digital inclusive finance [5]. The field should therefore be regarded as a key future development priority and should receive stronger strategic attention from all parties.

1.2.2. Research on the Measurement of the Well-Being Index

Domestic studies have paid considerable attention to the national well-being index, but they differ in how the index is measured and calculated. With respect to data sources, some research teams have used data from the public survey conducted by the China Urban Quality of Life Network [6]. Zhang Zeyu used data from a particular year of the Chinese General Social Survey, which differs from the former source [7]. Xu Danlu and others collected data by distributing offline questionnaires in a specific region [8]. Drawing on the inclusive financial system defined by the Alliance for Financial Inclusion, Wang Yuhang divided quantitative indicators into financial penetration, financial activity, credit utilization, and savings utilization [9]. Many other methods and channels can also be used to obtain data. Data processing likewise varies. A common approach uses questionnaires to collect and classify people's satisfaction in various respects and then substitutes the results into formulas related to well-being. A smaller number of studies identify annual data for sub-indicators that can measure the well-being index, use specific calculation models and algorithms to quantify and determine the weights of evaluation indicators, and then conduct comprehensive calculations based on those weights to derive a composite indicator of well-being. Both international organizations and Chinese authorities have proposed formulas for calculating the well-being index, while many scholars have selected other methods according to their own needs. The following two methods are among the most commonly used internationally.

Method 1 divides the gradient value of income growth measured according to a specified standard by a reasonably estimated Gini-coefficient correction factor and then multiplies it by a statistically verified unemployment-rate adjustment coefficient and a market-dynamics-based inflation impact factor to obtain the final index.

Method 2 multiplies five standardized indices by their respective weights: the gross national product growth index, a social health-level index based on comprehensive health indicators, a social welfare-quality index covering social security and public services, a social civilization-level index integrating cultural development and moral construction, and an ecological environment-quality index reflecting environmental protection and sustainable development. The final weights must be dynamically adjusted according to economic and social strategic objectives established under different government-governance frameworks. By introducing standardized processing, comprehensive health measurement, social-security analysis, integration of cultural and moral factors, and ecological-sustainability assessment, this model ensures that the index parameters are scientific and comparable. Dynamic adjustment of the weight coefficients enables the model to adapt to different stages of development and policy orientations.

In addition to these general methods, scholars have constructed well-being indices in different ways. Drawing on and adapting the foreign Happy Planet Index, Wang Huihong and others divided China's well-being index into three components: residents' life satisfaction in each province, autonomous region, and municipality; residents' life expectancy in each province, autonomous region, and municipality; and the ecological footprint of each province, autonomous region, and municipality, after which the values were substituted into a calculation formula [6]. Luo Jianwen and others divided the resident well-being index evaluation system into objective and subjective evaluation indicators, determined their weights, classified and weighed the secondary indicators under both categories, and finally calculated a weighted total [10]. Wang Zibo and others used methods including entropy-weight TOPSIS [11] and the entropy method [12].

1.2.3. Research on Factors Affecting Rural Residents' Well-Being through Digital Inclusive Finance

To examine the mechanism through which digital inclusive finance affects the quantitative indicators of rural residents' well-being, this study begins with several core dimensions that have long attracted academic attention and systematically reviews the categories of variables frequently examined in the existing literature. Specifically, the research framework covers classical issues in traditional financial-inclusion research while paying particular attention to new variables created by

digital empowerment. By constructing a multidimensional analytical model, it explores in depth the paths through which digital financial services affect rural residents' subjective well-being. This perspective continues the analytical logic of the existing literature while extending the theoretical paradigm through the introduction of digital-technology variables. The literature is reviewed and compared in relation to employment, entrepreneurship, consumption, financial services, and poverty alleviation.

Employment has two main forms: entrepreneurship and employment in positions provided by others. Although entrepreneurship and direct employment both belong to the broader concept of employment, they overlap and interact. Expansion of rural entrepreneurship requires human resources, thereby creating new jobs and increasing employment opportunities. Academic views differ across multiple dimensions regarding the mechanisms and paths through which digital inclusive finance affects the labor market. Financing constraints are a major factor affecting rural residents' entrepreneurship [13], while inclusive finance can effectively reduce exclusion caused by the specialized nature of the financial sector [14] and lower the threshold for rural residents to obtain services [15]. To some extent, therefore, the mechanism significantly alleviates specific constraints. In further research on regional differences, Feng Yongqi and others argue that, from a geographical perspective, digital inclusive finance significantly increases entrepreneurship in different regions, but from the perspective of industrial structure, its incentive effects vary with the development of the tertiary sector [16]. Focusing specifically on rural areas, Yang Mingwan and others find that broad penetration of digital inclusive finance significantly and positively drives rural residents' entrepreneurial behavior, but the effect differs across regions in China: the incentive is significantly stronger in eastern coastal areas than in the central and western inland regions [17]. Song Wei and others, however, argue that the positive effect is more prominent in regions with weak infrastructure and underdeveloped markets [18], highlighting the distinctive value of digital inclusive finance in promoting balanced regional development. This appears inconsistent with the preceding finding that the effect on rural entrepreneurship is stronger in the east, because eastern China is generally more developed than the central and western regions in both economic and urbanization levels. Thus, the two groups of scholars appear to reach opposing conclusions regarding the impact of digital inclusive finance on rural entrepreneurship in eastern and western China. Ji Ming and others investigate the relationship further and conclude that it can promote common prosperity; rural residents' entrepreneurship can therefore serve as a mediating indicator through which digital inclusive finance promotes common prosperity [19]. Feng Mengli offers a different perspective by examining entrepreneurial financing among rural residents and argues that the credit function created by digital inclusive finance in central China can serve as a mediator through which digital inclusive finance promotes rural entrepreneurship [20]. From a novel perspective, Geng Xuling and others discuss the dual effect of digital inclusive finance in stimulating both subsistence entrepreneurship and opportunity entrepreneurship among rural residents. As the breadth of digital coverage increases, support for opportunity entrepreneurship becomes stronger [21]. From the perspectives of non-agricultural employment and agriculture-related entrepreneurship, Zhang Lin and others find that digital inclusive finance has a greater effect on non-agricultural employment than on agriculture-related employment [22] and significantly improves the quality of non-agricultural employment [23]. The level of non-agricultural employment is an important channel through which digital inclusive finance affects rural residents' income [24]. Within a framework of heterogeneous effects, research reveals differentiated impacts of digital inclusive finance on non-agricultural employment among rural households of different sizes. It significantly promotes non-agricultural employment among small rural households but has no significant effect on large households [25]. With respect to industrial and employment structures, digital inclusive finance increases non-agricultural employment among young people by promoting industrial restructuring and optimizing the employment structure [26]. Within the framework of optimizing residents' income systems and improving the pattern of income distribution, digital inclusive finance indirectly promotes coordinated growth in operating income and wage income through the transmission mechanism of

improved employment quality [27], although Pang Jialan and others find that its effect on operating income is not significant [28]. Digital inclusive finance provides sustainable financial momentum for rural revitalization [29], using increases in various forms of income as support for the reform objective of common prosperity and thereby echoing the original intention and spirit of rural revitalization.

Deng Shengxiang and others found an inverted-U relationship between inclusive finance and rural residents' consumption level [30]. Compared with subsistence consumption, digital inclusive finance is more conducive to releasing rural residents' demand for enjoyment-oriented consumption through the mediating variable of an improved consumption environment [31, 32]. Su Junming and others argue that the upgrading of industrial structure is the hub of the transmission mechanism between the two [33]. Digital inclusive finance can reorganize and improve the hierarchy of rural residents' consumption, broaden consumption channels, and expand consumption scale [34], with a clear spatial spillover effect [35]. Regional heterogeneity nevertheless exists: the level is relatively high in the eastern region, moderate in the central region, and low in the western region [36], although the magnitude of the effect is highest in the western region. Digital inclusive finance policy should therefore be implemented in accordance with local conditions [37].

Convenient and diverse financial products and services derived from digital inclusive finance can improve the agricultural industrial security system in rural areas, for example by strengthening agricultural insurance [38]. Digital inclusive finance has a stronger effect on insurance demand among rural households, ordinary-income households, and households in underdeveloped regions [39], and can improve rural residents' health by promoting commercial insurance and improving medical conditions [40]. With respect to poverty alleviation, Panpan Pei and others conduct a systematic empirical test of the direct mechanism and spatial spillover effects of digital inclusive finance in the governance of relative rural poverty based on new economic geography and find that it effectively alleviates relative poverty in rural areas [41]. The vulnerability of households to multidimensional poverty is also markedly reduced [42], and the poverty-reduction effect increases as the number of deprivation dimensions rise [43]. Digital inclusive finance alleviates not only ordinary economic poverty but also health poverty and spiritual poverty [44], although its spatial spillover effect is not yet significant [45]. Lu Haiyong and others, however, find that while both traditional inclusive finance and digital inclusive finance alleviate poverty in rural areas, traditional inclusive finance has a stronger effect [46]. This is similar to the conclusion of Xiong Lei and others that increasing the degree of digitization does not produce a particularly strong poverty-reduction effect [47].

1.2.4. Literature Summary

A review of the literature shows that very few studies directly examine the relationship between digital inclusive finance and the well-being index of rural residents. A likely reason is that China has not yet established a unified standard or clear definition for measuring rural residents' well-being. Rural residents constitute a very large population with pronounced regional differences in living conditions, and their experience of well-being differs from that of urban residents. Measurement therefore cannot simply duplicate the national well-being index, making it difficult to develop an objective and universal standard for assessing the well-being of rural residents in different regions. Nevertheless, many studies collect measurable factors affecting the well-being index, classify them in detail, and analyze their correlation with the digital finance index. These studies focus mainly on rural residents' income, employment, and consumption, which are closely related to their actual living conditions. They also address the poverty-reduction effect of digital inclusive finance and its role in improving rural residents' health and living security. A broad consensus has emerged that digital inclusive finance positively affects rural residents' income, employment, consumption, and poverty alleviation, although views differ substantially regarding regional heterogeneity. Each view has a reasonable basis. This study therefore draws on domestic and international methods for measuring the well-being index and on research concerning the impact of digital inclusive finance on indicators that can measure well-being. It summarizes, learns from, and applies those methods to develop ideas and experience for the present research.

1.3. Research Methods and Research Content

1.3.1. Research Methods

Literature review method: A large body of literature and news reports related to the study is read and systematically organized from the perspectives of research methods, research angles, and research conclusions. Similarities are summarized, differences are compared, unaddressed issues are identified, and possible breakthroughs are considered. The strengths of existing studies are used as the foundation of this research, while under-researched and insufficiently developed areas are identified as potential innovations. For example, the impact of digital inclusive finance on national well-being has been studied relatively thoroughly, whereas a more detailed focus on rural residents still contains many gaps. This is a central concern of the present study.

Theoretical analysis method: With the research direction and purpose as the overall framework, relevant economic theories underlying the topic are identified. Actual research is integrated into theory, and theory is understood more deeply through the research process. Theoretical models are matched one by one with the actual research content, and theoretical tools are used to serve the research purpose, thereby providing stronger theoretical and empirical support for conclusions concerning the impact of digital inclusive finance on the well-being index of rural residents. Continuous review of theory during the empirical process also makes critical transcendence possible and has practical significance for enriching and improving theory.

Econometric model analysis method: On the basis of an in-depth review and analysis of the literature and theories, quantitative analysis and econometric models are used to test economic theories and research conjectures. For example, a more reasonable and authoritative measure of digital inclusive finance - the Digital Inclusive Finance Index - is identified and used as the core explanatory variable. The introduction of data makes the research conclusions more persuasive and intuitive. Econometric models also enable systematic treatment of other factors that influence the conclusions and are more efficient than purely textual description.

1.3.2. Research Content

Building on earlier research concerning the mechanism through which digital inclusive finance affects the overall well-being of the population, this study deeply examines the differentiated effects that arise when digital inclusive finance extends into rural areas and focuses on its specific pathways of influence on the well-being index of rural residents.

Chapter 1: Introduction. This chapter examines the research background, clarifies the significance of the research, reviews and evaluates a large body of literature, and further refines the research direction and perspective. It briefly explains the purpose of research, ideas, methods, and content; provides a simple process framework to help readers understand the research logic quickly; and evaluates the possible innovations as a foundation for deeper study.

Chapter 2: Basic introduction to research subjects. This chapter defines and briefly describes the concepts and development status of digital inclusive finance and the well-being index of rural residents, explores their essential connotations and internal mechanisms, and lays a foundation for the quantitative analysis that follows. It also introduces the method used to calculate the well-being index of rural residents.

Chapter 3: Relevant theoretical exposition. This module is the first step toward formally entering the main research. It digests and accurately summarizes theoretical connotations, directly identifies the research logic, and clarifies the research method. It provides an important basis for designing econometric analysis. During the subsequent research process, theory can be used to test logical consistency; conclusions that are completely contrary to theory can be examined and studied in greater depth.

Chapter 4: Empirical analysis. This is the core part of the study. Based on the existing Peking University Digital Financial Inclusion Index and a reasonable analysis of rural residents' well-being, data are collected, organized, cleaned, and processed from multiple databases and statistical yearbooks. The entropy method is used to calculate the final well-being index of rural residents, which

is introduced as the dependent variable in the baseline regression. On that basis, transmission mechanisms are investigated and tests of endogeneity, robustness, and heterogeneity are conducted.

Chapter 5: Research conclusions, policy recommendations, and reflection on limitations. Based on systematic econometric testing and multidimensional data analysis, this chapter derives research conclusions with theoretical explanatory power. It reflects on shortcomings that still require improvement and proposes reasonable policy recommendations based on the conclusions and actual development conditions.

1.4. Possible Innovations

1.4.1. Research Direction

Domestic academic research on the effect of digital inclusive finance in improving the national well-being index has already formed a relatively mature theoretical system and practical framework, but few studies focus specifically on rural areas or rural residents. One possible reason is that methods for measuring national well-being are diverse and comprehensive both in China and abroad, whereas methods for measuring the well-being index of rural residents can only partly draw on national well-being measures. Because rural groups possess distinctive characteristics, many methods are not directly applicable. In addition, national-level data is relatively complete and available from many sources, while statistical data for rural areas are more likely to be missing or insufficiently diverse. As a result of these disadvantages, research on rural residents' well-being has often stopped at proposals for how the index might be calculated, and few studies have actually put those proposals into practice. Research in this area is therefore extremely limited. The present study attempts to break through this difficulty and explore the issue to the greatest extent possible with the available knowledge and capabilities.

1.4.2. Research Method

Some studies calculate rural residents' well-being only by using authoritative domestic questionnaires and directly quantifying interview responses to questions such as "Do you feel happy?" together with respondents' basic characteristics. Although this method directly summarizes rural residents' overall evaluations of whether they feel happy, it has several disadvantages. Using the answer to this question as the sole standard of well-being - or even directly as the data for the well-being index of rural residents - is overly subjective and one-sided. As discussed in the research background, approaches to the question "What is happiness?" include both subjective and objective analysis. Relying on either alone can produce inaccurate results. Subjective analysis without objective analysis may cause the research direction to be misled by group-level cognitive bias. Rural and urban residents differ in their living and social environments and therefore perceive and understand happiness differently. Compared with urban residents, rural residents may have a lower subjective threshold for well-being and may be more easily satisfied. However, long-term residence in objectively difficult conditions can gradually lead to habitual "self-deception" and "self-satisfaction." Such "forced happiness" cannot reflect the genuine well-being of rural residents in the region. Objective analysis without subjective analysis can produce an excessively rationalized and idealized result based only on theory and data. For example, a high GDP value might be used to conclude that regional economic development produces happiness while ignoring the contribution of a green and healthy environment, or the fact that GDP may include gambling and illicit transactions. For these reasons, the calculation of the well-being index of rural residents in this study introduces both objective indicators and rural residents' responses to subjective interview questions. The entropy method is used to calculate the weights of all indicators, which are then combined to obtain the final well-being index of rural residents.

2. Digital Inclusive Finance and the Well-Being Index of Rural Residents

2.1. Overview of Digital Inclusive Finance

As a deeply integrated form of digital technology and inclusive finance, digital inclusive finance derives its core value from the low marginal cost and high efficiency of digital technology. It systematically lowers barriers to accessing financial services and effectively eliminates exclusion mechanisms in the traditional financial system. By constructing a digital financial infrastructure, it provides innovative financial solutions that are affordable, sustainable, and convenient for structurally disadvantaged financial groups such as micro, small, and medium-sized enterprises, rural residents, and low-income populations. It promotes the downward penetration of financial services to the general public and ultimately restructures the allocation of financial resources in a more equitable manner, achieving the goal of making finance broadly available in both urban and rural areas and beneficial to the people.

Unlike the physical-branch coverage of inclusive finance, digital inclusive finance can provide continuous mobile access. Traditional inclusive finance still depends on geographical proximity and manual review of specific matters, whereas digital inclusive finance transcends temporal and spatial constraints. With big-data credit-reporting systems and intelligent algorithmic modeling, it optimally replaces redundant human-resource allocation in traditional business scenarios and reduces service costs. The contrast between the two indicates that the development model of digital inclusive finance represents an inevitable trend in the evolution of the inclusive financial system.

From the perspective relevant to this study, digital inclusive finance creates a crucial opportunity for rural residents to move beyond traditional agricultural production occupations and enter new forms of business. Consider rural entrepreneurship. Like the bottlenecks encountered by many small and medium-sized enterprises, the greatest difficulty facing rural entrepreneurs is access to funds. Difficult and expensive financing, limited channels, and insufficient information are current obstacles. The factors causing these problems can be divided into the supply side of funds, the demand side of funds, and objective external conditions. On the supply side, because of information asymmetry and the desire to avoid moral hazard, credit suppliers are not strongly willing to lend to rural residents and may even exclude them through extremely restrictive contractual terms. On the demand side, apart from some highly educated university graduates who return to their hometowns to start businesses, most rural residents are farmers with relatively limited education. Their knowledge of finance and lending channels is often insufficient. Low financial literacy prevents them from expressing their demand for financial services correctly and accurately, and they may not know how to achieve their objectives. Consequently, both sides of the funding relationship lack information about each other. Many households choose the most traditional form of borrowing, such as pooling small amounts from acquaintances in the same village. Although this method may solve a short-term problem, it cannot continuously supply funds for entrepreneurial development or establish a stable capital chain. Farmers may also lack knowledge of the proper, formal, and legal methods for signing loan contracts, which can easily produce financial disputes among neighbors and further weaken rural residents' enthusiasm for entrepreneurship. With respect to objective external conditions, financial development in rural areas significantly lags behind the rapid construction of financial systems and deepening of markets in urban areas. There are far too few financial outlets, and because rural land is extensive, the limited institutions are scattered and transportation may be inconvenient. Large numbers of rural residents who need funds cannot be gathered efficiently. Over time, these institutions may become nominal facilities with little practical function. Rather than retaining loan quotas for rural residents that are almost never used, institutions may allocate the funds to more profitable urban lending demand. When rural residents genuinely need loans, the funds may no longer be available because they have already been lent to urban residents contrary to the intended allocation. Lending to rural residents has therefore long exhibited a crowding-out effect characterized by "emphasizing deposits while neglecting loans." The emergence of digital inclusive finance addresses some of the inconvenience and weak lending willingness associated with traditional financial outlets. Rural

residents can submit personal applications and undergo qualification reviews online without leaving home. After approval, loans can be processed according to the relevant procedures. This rule-based sequence enables rural residents to form clearer expectations regarding the prospects of their entrepreneurial activities.

2.2. Development of Digital Inclusive Finance

The period from 2004 to 2012 was the embryonic exploration stage of digital inclusive finance. The policy background was the promulgation of the Electronic Signature Law in 2004 and its implementation in 2005. Technological breakthroughs also occurred during this period. Alipay pioneered guaranteed transactions, and China UnionPay introduced an interbank transfer system, thereby connecting banks. The number of Alipay users increased substantially, but nearly 80% of users were urban residents and the service had not yet become widespread in rural areas. Mobile banking began to take shape, but electronic digitization had not yet replaced traditional banking business.

The period from 2013 to 2015 was one of rapid expansion. In 2014, the People's Bank of China and other departments issued guidance on regulating the healthy development of Internet finance. WeChat red packets became highly popular on social media, Alipay introduced facial-recognition payment, and the electronic-payment rate in rural areas rose rapidly. Ant Group and Peking University jointly compiled the index.

The period from 2016 to 2018 was one of regulated development. In 2017, the People's Bank of China established the Financial Technology Committee to coordinate fintech work, and relevant national regulatory measures were successively implemented. Blockchain applications entered practical use, MYbank reached a new high in the number of micro and small customers served, and the penetration rate of mobile payment in county-level areas rose from slightly above 50% to more than 80%.

The period from 2019 to 2021 was one of ecosystem restructuring. In 2019, the People's Bank of China launched the research and development project for the digital renminbi, and related documents were issued in 2021. The use of digital payment among older people increased by approximately 400%. During the COVID-19 pandemic, inconvenience in daily travel sharply increased demand for online-payment mini-programs. Online ordering and contactless collection gradually developed, and digital penetration continued to reach new levels during this special period.

The period from 2021 to 2024 was one of high-quality development. In 2022, the People's Bank of China issued a fintech development plan and proposed seven digital projects. The concept of the metaverse was introduced, and in 2022 the Industrial and Commercial Bank of China and Peking University jointly prepared a document concerning the banking metaverse. The deep integration of green inclusive finance with the technological system of digital inclusive finance has created a new paradigm of rural financial services with distinctive characteristics of the era.

2.3. Digital Inclusive Finance Index

In terms of temporal and spatial coverage, the index includes 31 provinces, municipalities, and autonomous regions across China, together with 337 prefecture-level cities and approximately 2,800 county-level regions. The provincial and municipal data cover 2011-2021, while the county-level data cover 2014-2021. In terms of dimensions, the Digital Inclusive Finance Index is divided into three dimensions - breadth of coverage, depth of use, and degree of digitization - as well as categorized indicators for payment, insurance, money-market funds, credit services, investment, and other activities.

2.4. The Well-Being Index of Rural Residents and Its Measurement

At present, no specific data directly measures rural residents' well-being. Questionnaires distributed by relevant statistical departments that ask whether respondents feel happy have certain limitations and are subjective, making them unsuitable for direct use. This study therefore applies the

entropy method to classify and weight data that can be used to measure the well-being of rural residents. It calculates the final well-being indices for 24 provinces and municipalities from 2011 to 2021 and scores the performance of each region. By organizing and comparing the calculated data, the study summarizes temporal and spatial patterns in the well-being index. Over time, the well-being index of every province and municipality gradually increases. Spatially, economically developed regions such as Zhejiang, Jiangsu, and Shanghai have higher well-being indices than other provinces.

2.4.1. Indicator Selection

This study takes the well-being index of rural residents as the overall indicator and divides it into first-level and second-level indicators. Data are collected and organized from as many aspects as possible that may affect residents' well-being, thereby making the data more comprehensive.

The first-level indicators are assets and income, consumption expenditure, employment and work, agricultural production, culture, education and entertainment, medical care and health, social public services, and personal and family life.

The second-level indicators further divide the first-level categories into 26 indicators, as shown in Table 1.

Table 1. Detailed Indicators of the Well-Being Index of Rural Residents.

Overall Indicator	First-Level Indicator	Second-Level Indicator	Weight
Rural residents' well-being index	Assets and income	Total assets	13%
		Per-capita disposable income of rural residents	4%
		Wage income	4%
		Operating income	3%
		Transfer income	11%
	Consumption expenditure	Per-capita consumption expenditure of rural residents	4%
		Rural consumer price index	1%
	Employment and work	Number of individually employed people in rural areas	7%
		Job satisfaction	1%
	Agricultural production	Gross output value of agriculture, forestry, animal husbandry, and fishery	4%
		Total power of agricultural machinery	6%
		Agricultural producer price index	1%
		Years of education	1%
	Culture, education and entertainment	Education expenditure	3%
		Culture and entertainment expenditure	3%
		Number of township cultural stations	4%
		Number of village clinics	5%
	Medical care and health	Medical and health-care expenditure	3%
		Trust in doctors	1%
		Government subsidies	8%
	Social public services	Evaluation of county/municipal government	1%
		Evaluation of local government officials	1%
		Number of rural residents receiving minimum living-security benefits	6%
	Personal and family life	Health	2%
		Satisfaction with one's own life	1%
		Confidence in one's own future	2%

2.4.2. Introduction to the Entropy Method and Reasons for Its Selection

As a mathematical analytical technique, the entropy method is used mainly to evaluate the dispersion or discrete characteristics of data for specific indicators. In data analysis, a higher degree of dispersion means that an indicator contains a greater amount of information and therefore makes a more significant contribution to, or has a greater influence on, the overall comprehensive evaluation. Information entropy can be used to calculate accurately the weight coefficient of each indicator in a

comprehensive evaluation system, thereby providing a strong data foundation and theoretical basis for multidimensional and multi-indicator evaluation.

The entropy method is selected because it assigns weights entirely according to the dispersion of the data themselves, thereby reducing the effect of biases that are difficult to eliminate and may arise from subjective judgments such as individual responses and personal scoring. Its requirements regarding independence are much lower, and it does not rely completely on assumed prior relationships among sub-indicators. Other methods, such as principal component analysis, impose strict requirements concerning linear independence among indicators. The entropy method therefore has a much broader scope of application. The well-being index of rural residents calculated in this study is a highly complex composite indicator covering economic, political, cultural, psychological, and other factors. In such a multi-indicator comprehensive evaluation, it is impossible to guarantee that all indicators are strictly linearly independent. Because of unavoidable real-world factors, they influence one another to varying degrees, their correlations are unclear, and such correlations are difficult to exclude. In addition, the emphasis of the entropy method on data differences enables better self-testing during indicator selection, facilitates the removal of redundant data, and helps select more precise indicators. The final 26 indicators in this study were obtained through repeated screening using entropy-method calculations.

2.4.3. Calculation Process of the Entropy Method

First, the panel data corresponding to the 26 second-level indicators are normalized to prevent differences in units of measurement from affecting data processing and calculation results, thereby maintaining the lowest possible error and information loss.

Positive indicator:

$$X^* = \frac{X - \min(x)}{\max(x) - \min(x)} \quad (1)$$

Negative indicator:

$$X^* = \frac{\max(x) - x}{\max(x) - \min(x)} \quad (2)$$

The positive and negative indicators are standardized at this stage.

Calculate the P value:

$$P_{ij} = \frac{x_{ij}^*}{\sum_{i=1}^n x_{ij}^*} \quad (3)$$

The standardized data are converted into relative proportions.

Calculate entropy e:

$$e_j = -k \sum_{i=1}^n (P_{ij} * \ln P_{ij}) \quad (4)$$

Entropy e measures the degree of disorder in the system or the degree of dispersion in the data.

Calculate d:

$$d_j = 1 - e_j \quad (5)$$

The value d represents differentiation and ranges from 0 to 1. A smaller degree of difference implies less information.

Calculate weight w:

$$w_j = \frac{d_j}{\sum_{j=1}^n d_j} \quad (6)$$

The above operations were completed in Stata.

3. Theoretical Foundations and Research Hypotheses

3.1. Relevant Theoretical Foundations

3.1.1. Theories Related to Well-Being

This study lists and introduces several theories related to well-being and considers their implications for present research.

(1) Maslow's hierarchy of needs

Maslow's hierarchy of needs was proposed by the American psychologist Abraham Maslow. It divides the motivations and needs underlying human behavior into five levels, from lower to higher, in a pyramid structure. Maslow later supplemented the hierarchy, and his students, including Ken Wilber, further developed it. William Cooper and others revised and improved the pyramid by classifying its levels into deficiency needs and growth needs and examining their interaction. The five basic levels, however, remain widely studied in academia. The first level consists of physiological needs, the most fundamental requirements for maintaining survival, such as sufficient food, air, and water. The second level consists of safety needs, which concern basic stability and freedom from external threats, such as housing, property security, and personal safety. The third level consists of needs for belonging and love, referring to the desire to be accepted and cared for in social relationships and to establish emotional connections with others, such as forming a family, socializing, and participating in social activities. The fourth level consists of esteem needs, including both external and internal respect, such as recognition by others and improvement of one's own skills. The fifth level consists of self-actualization needs; the ideals and aspirations associated with realizing one's potential and pursuing meaning and value in life. This is the highest level and is reached by relatively few people, such as entrepreneurs who contribute to society and scientists who explore truth. Although the five levels appear clearly separated, their boundaries are actually blurred and interconnected. People may simultaneously occupy the boundary between two levels, entering a transitional stage in which they are beginning to reach a higher level without having completely moved beyond the lower one.

Implications for this study: The theory provides a logical analytical framework for studying rural residents' well-being. The hierarchy of needs among rural residents may differ from that among urban residents. In some poor rural areas, residents remain trapped at the first level because of unsafe drinking water, inadequate food, and other problems and are unable to maintain a basic livelihood. In some rural areas, remote geographical location, incomplete transportation networks, and obstacles to the reach of policy implementation result in poor medical-security conditions and low pension-insurance coverage. The phenomenon of "returning to poverty because of illness" is particularly prominent, leaving many rural residents at the second level. "Empty-nest elderly people" and "left-behind children" constitute large rural groups. Because of the urban-rural economic gap, many young and middle-aged adults choose to work away from home; the absence of family companionship weakens the sense of belonging and leaves some rural residents' third-level needs unmet. Under the basic urban-rural dual structure, rural residents may experience discrimination when entering cities to conduct business or work. Such discrimination reduces their sense of respect and equality and prevents them from satisfying fourth-level needs. Because rural residents lack educational resources and occupational-development channels, many can only achieve subsistence through farming and cannot engage in further career planning. Consequently, many find it difficult to derive enjoyment or self-value from work. Rural residents thus face difficult gaps at every level. Combining the hierarchy of needs with their actual lives can therefore make the research more clearly directed.

(2) Happiness economics

Traditional economic theory holds that higher income brings greater utility and satisfaction, but happiness economics challenges this conventional GDP-centered view. The development of

happiness economics reflects the emergence of a form of economics in which people seek spiritual abundance after their material needs have been met. The theory focuses on how to improve the happiness of individuals and society as a whole, emphasizes the diversity of human social well-being, expands the scope and inclusiveness of economics, and achieves interdisciplinary integration. As early as the period of classical economics, the "greatest happiness principle" proposed by the British philosopher Jeremy Bentham laid the foundation for utilitarianism. Later interpretations of utility by Adam Smith and John Stuart Mill also contained a pursuit of happiness. The rational-agent assumption in neoclassical economics neglected psychological factors and social relationships to some extent. The emergence of modern happiness economics brought strong psychological influence. The Easterlin paradox holds that once per-capita income reaches a certain level; national happiness no longer rises significantly. Prospect theory argues that many human decisions are irrational, and many scholars have begun to measure happiness directly through questionnaires.

Implications for this study: Improving rural residents' well-being should not be limited to pursuing inflated economic figures. Development thinking should shift from result orientation to process orientation. Greater attention should be paid to farmers' psychological experiences during rural development, and major decisions and policies should favor alternatives that can substantially improve rural residents' well-being.

(3) Relative deprivation theory

Relative deprivation is a psychological concept and phenomenon first proposed by Samuel Stouffer. It refers to the sense of deprivation experienced when an individual or group compares itself with a reference object and perceives itself to be in a disadvantaged position, even though the psychological response to the gap is caused by comparison rather than by an absolutely unfair factor. Relative deprivation can be divided into vertical relative deprivation, involving comparison with one's own past and future, and horizontal relative deprivation, involving comparison with other groups. Walter Runciman further distinguished individual and group relative deprivation. In organizational behavior, Albert Hirschman proposed the exit-voice-loyalty model to explain the different strategies adopted by individuals when confronting relative deprivation. Many factors produce and influence relative deprivation, including the characteristics of one's own group, the characteristics of the reference group, the content of comparison, the gap between expectations and reality, and social and cultural factors. Two typical cases are the relative deprivation experienced by rural residents because of the urban-rural income gap and the relative deprivation produced by rural land transfers in China. Although the urban-rural income gap does reflect a degree of inequality, many factors must be considered. Prices are higher in cities, mandatory consumption categories are more numerous, prices are lower in rural areas, and certain additional expenses are absent. Ordinary people may not consider all these factors and may believe that they are being treated unfairly. Many rural residents therefore choose to work in cities, where they still face low income and discrimination when compared with urban citizens. After returning home, their broadened experience may make them dissatisfied with rural development when compared with cities. This "dual deprivation" - incomplete integration into the city combined with weakened belongings to the countryside - intensifies the relative deprivation experienced by migrant workers. Land transfer refers to the practice in which farmers possessing land-use rights contract their land to other farmers or organizations. Although the policy improves agricultural-production efficiency, opaque procedures or insufficient information and compensation can create a sense of unfairness. Farmers whose compensation is below the market price or below the compensation paid in nearby villages experience a significantly stronger sense of deprivation and lower well-being.

Implications for this study: Research on rural residents' well-being inevitably requires joint analysis of urban development and policy issues. The insights of relative deprivation theory therefore enable deeper understanding of rural residents' psychology. Assessment of rural residents' well-being should not focus only on absolute values. On the basis of those values, it should also examine whether rural residents genuinely feel equally happy in relative terms.

3.1.2. Theories Related to Digital Inclusive Finance

This study lists and introduces several theories related to digital inclusive finance and considers their implications for the present research.

(1) Long-tail theory

Chris Anderson's long-tail theory challenged the traditional 80/20 rule as soon as it was proposed. The theory argues that in an era of rapidly developing Internet technology, the costs of storage, circulation and sales, and marketing have fallen substantially. Niche products previously excluded from traditional markets because of high distribution costs can return to the market and satisfy the needs of special groups. The success of platforms such as Amazon and Taobao demonstrates the commercial value of long-tail markets for niche products, whose aggregate demand may even exceed that for popular products. The key to long-tail theory is to reduce marginal costs through technological means, expand market coverage, and aggregate originally dispersed and low-frequency demand into scale. The theory is nevertheless controversial. Head effects continue to exist, and the long tail may produce information overload and the paradox of choice. Excessive product information can make choice difficult and reduce user satisfaction.

Implications for this study: By means of digital technology, digital inclusive finance builds a convenient and efficient bridge of financial services for groups that are difficult to reach or insufficiently served within the traditional financial-service framework, thereby providing targeted financial support and services. This corresponds directly to the concept described above. Through its distinctive digital operating model, digital finance can effectively reduce the marginal cost of providing financial services and significantly enhance their availability and accessibility across different groups and regions. Rural residents' demand for financial services is more heterogeneous than that of urban residents. The wide variety of crops and differences in growing seasons make it difficult for specialized loans to cover every need, so traditional financial products may selectively abandon some customers and focus on those with more common service requirements. Greater attention to the long-tail market can continuously improve product design and promotion by financial-service providers, help the rural economy realize economies of scale in various respects as quickly as possible, strengthen structural resilience, and reduce unnecessary costs.

(2) Financial exclusion theory

Financial exclusion theory originated from the concept of social exclusion proposed by Rene Lenoir, which describes groups that are not included within the coverage of the social-welfare system and therefore lack access to social welfare. Financial exclusion theory describes the phenomenon in which certain groups are excluded from mainstream financial services because of objective factors.

Implications for this study: Advancing digital inclusive finance in rural areas is neither easy nor immediately achievable. Many complex factors must be comprehensively and prudently considered. The theory provides a useful analytical tool and theoretical support for examining the difficulties encountered by digital inclusive finance in rural areas. These include geographical exclusion: remote rural areas lack financial institutions and outlets because of geographical disadvantages that are difficult to overcome. Price exclusion arises because low-income groups are concentrated in rural areas while the fees and thresholds of financial services are high; those unable to meet the access threshold are excluded. Condition exclusion occurs because some low-income rural groups have had little prior contact with financial services. When they need such services, providers lack personal credit information about them and respond conservatively because of risk, either refusing services or excluding rural residents who cannot provide strict guarantees or valuable collateral. This aggravates a vicious cycle. Marketing exclusion occurs when financial-service providers anticipate that advertising in rural areas will have little effect and therefore abandon or neglect promotional design, preventing rural residents from receiving effective information promptly. Self-exclusion occurs when rural residents recognize their own lack of financial knowledge and actively avoid financial services because they fear being deceived and have deeply rooted distrust of financial institutions. Technological exclusion arises because rural residents may be less proficient in using electronic

products and the Internet. Although digital inclusive finance is gradually becoming more accessible to them, a lack of capability prevents them from benefiting from digital financial services.

(3) Information asymmetry theory

Information asymmetry refers to a transaction in which the two parties possess different amounts of information, preventing the resource-allocation mechanism from operating efficiently and causing misallocation. Resource misallocation further disrupts normal market order and ultimately leads to market failure. Before the theory was formally developed, the conclusions reached by Friedrich Hayek and Kenneth Arrow in studying risk and price systems already contained elements of information asymmetry. George Akerlof subsequently introduced the pioneering concept of adverse selection, while Michael Spence's signaling model and Joseph Stiglitz's screening model substantially expanded the theory. The theory challenged the traditional efficient-market hypothesis and became a major milestone in the development of information economics.

Implications for this study: Financial-service institutions usually assess credit through income certificates and collateral values, but rural residents lack such standardized information and their income is difficult to measure. They are therefore regarded as high-risk groups and have difficulty obtaining services. Obstructed information transmission between the parties creates information asymmetry. Rural residents themselves are the information-poor party and are especially vulnerable to illegal fund-raising, fraudulent wealth-management products, and other financial scams. To address adverse selection, digital inclusive finance can track rural residents' payment records and e-commerce transactions, construct individual credit profiles for reference, and assign credit ratings. To address moral hazard, the flow of funds can be tracked to determine whether loans are used for the crop cultivation and production specified in the contract. Smart contracts can also restrict the channels through which funds are used. Short videos and official client applications can guide rural users in applying for financial services safely and correctly and reduce the misleading influence of false information.

(4) Transaction cost theory

Ronald Coase first proposed the concept of transaction costs in answering the question "Why do firms exist?" Oliver Williamson subsequently systematized the theory and proposed three dimensions affecting transaction costs. The core view is that the costs of searching for information and customers, negotiating, concluding agreements, supervising, and ensuring the proper performance of contracts affect the organizational form of transactions and the efficiency of economic activity.

Implications for this study: Compared with traditional financial operations, digital inclusive finance has significant advantages in cost control and can substantially reduce or even completely avoid some costs that are difficult to eliminate in traditional financial scenarios. In reducing information costs, traditional finance requires rural residents to spend substantial time and effort searching for, learning, and adapting to rules and procedures, while financial-service providers remain separated from rural residents by information gaps, preventing correct matching. Digital inclusive finance can use background data concerning the information frequently viewed online by rural residents and apply big-data matching to deliver relevant information and advertisements precisely. This greatly reduces the time cost of searching for information and breaks down information islands in rural markets. In compressing negotiation and contracting costs, almost labor-free electronic signatures, automated review by AI customer service, and other standardized processes can rapidly screen customers and reduce the cost of door-to-door interviews and investigations. In reducing the cost of monitoring contract performance, back-end management of transactions in rural residents' accounts can accurately trace every order and supervise and track the use of borrowed funds throughout the process. Each of these stages reduces transaction costs, enabling more funds to flow toward their most valuable uses.

3.2. Research Hypotheses

3.2.1. Impact of Digital Inclusive Finance on the Well-Being Index of Rural Residents

According to happiness economics, rural residents' well-being is not limited to improvements in material life but also includes psychological satisfaction. Improving rural production and daily life through digital inclusive finance and gradually satisfying the different levels in Maslow's hierarchy of needs constitute an important path toward higher rural well-being. Based on the literature review, reflection on the Rural Revitalization Strategy, and theoretical understanding of digital inclusive finance and rural residents' well-being, digital inclusive finance can promote the revitalization of rural industries [48], thereby better serving rural residents' daily lives, improving their sense of social fairness [49] and the well-being of rural entrepreneurs [50], and achieving common prosperity [51]. In light of the main research objective, the following overall hypothesis is proposed:

Hypothesis 1: Digital inclusive finance promotes the well-being index of rural residents.

3.2.2. Role of the Income Gap in the Impact of Digital Inclusive Finance on the Well-Being Index of Rural Residents

According to transaction cost theory and information asymmetry theory, rural residents face inconvenient access to financial instruments, high thresholds, and blocked sources of relevant information. These factors increase transaction costs and, to some extent, further widen the gap between rural and urban economic development, which is unfavorable to urbanization. Research shows that reducing the cost of financial services improves the situation in which information asymmetry prevents rural residents from engaging deeply with financial services [52]. By providing rapid and broadly applicable financial instruments, digital inclusive finance can significantly narrow the urban-rural income gap [53, 54], and can reduce it further through a more rational industrial structure [55]. The effect exhibits an inverted-U pattern [56] and differs between regions with high and low levels of economic development [57]. A narrowing urban-rural income gap positively moderates the ability of digital inclusive finance to release rural residents' consumption potential [58], while consumption potential is itself an important indicator of the well-being index. These findings suggest that the urban-rural income gap may have both mediating and moderating effects on the relationship between digital inclusive finance and the well-being index of rural residents. The following hypothesis is therefore proposed:

Hypothesis 2: A narrowing urban-rural income gap mediates and moderates the effect of digital inclusive finance in improving the well-being index of rural residents.

3.2.3. Role of Urbanization in the Impact of Digital Inclusive Finance on the Well-Being Index of Rural Residents

Urbanization plays an important mediating role in the economic transmission path through which digital inclusive finance narrows the urban-rural income gap [59]. A higher level of urbanization positively moderates the effect of digital inclusive finance on farmers' income growth [60], thereby improving rural residents' income-related well-being. By lowering the threshold for rural residents to use digital tools, digital inclusive finance enables them to accept financial instruments more broadly, participate in economic activities on a more equal basis, and gradually overlap and interact with certain aspects of urban residents' lives. This improves their employment and survival capabilities, broadens their horizons, and blurs the boundary between rural and urban life. In addition to gradually drawing closer to urban residents' lives, rural economic actors can use the differentiated production endowments of rural communities together with the convenient resource-allocation mechanisms provided by digital inclusive finance to explore distinctive development paths characterized by independent innovation and avoidance of homogeneous competition. Such a model enables rural residents to find livelihoods better suited to their own conditions and to work with greater initiative and motivation. It can effectively advance a more balanced distribution of income between urban and rural residents while significantly improving the quality of new urbanization. This mutually

reinforcing effect is reflected not only in a gradual convergence of income gaps, but also in structural optimization of the urbanization model. Based on this analysis, the following hypothesis is proposed:

Hypothesis 3: Urbanization moderates the effect of digital inclusive finance in improving the well-being index of rural residents.

3.2.4. Heterogeneity under Different Regions and Densities of Financial Institutions

According to financial exclusion theory, differences in the completeness of financial infrastructure and regional economic development cause some rural groups to become passively or actively detached from financial services. Because levels of economic development differ, developed eastern coastal regions have established highly complete digital infrastructure systems whose network coverage density, rate of technological iteration, and service capacity lead the country. Zhejiang Province, for example, has promoted rural economic development through "Taobao villages," and rural residents there report higher subjective well-being than those in other provinces. In the less developed central and western regions, rural residents' demand for financial services is concentrated on basic survival needs, demand for higher-end financial services is weak, and digital exclusion exists. Research shows that digital inclusive finance affects common prosperity in the eastern, central, and western regions but exhibits spatial differences [61]. The effect is more significant in the east and smaller in the central and western regions, while the concept of common prosperity constitutes a core value orientation of the Rural Revitalization Strategy. Rural finance in China faces insufficient supply and unbalanced development [62], largely because financial infrastructure is incomplete. Improving the layout characteristics and density of rural financial institutions and outlets creates new challenges and requirements for serving rural revitalization [63]. The digital transformation of rural finance promotes common prosperity [64]. Because regional economic-development levels differ, the density and types of financial institutions also vary considerably, producing different effects of national monetary policy [65]. A high density of financial institutions positively promotes agricultural production [66] and economic development [67]. The following hypotheses are therefore proposed:

Hypothesis 4: The effect of digital inclusive finance in improving the well-being index of rural residents is heterogeneous across regions.

Hypothesis 5: The effect of digital inclusive finance in improving the well-being index of rural residents differs according to the density of financial institutions.

4. Empirical Analysis of the Impact of Digital Inclusive Finance on the Well-Being Index of Rural Residents

4.1. Data Sources, Models, and Variables

4.1.1. Data Sources

This study selects the Peking University Digital Financial Inclusion Index and its three dimensions - breadth of coverage, depth of use, and degree of digitization - for each province from 2011 to 2021 as the data measuring the development of digital inclusive finance. In searching for questionnaire data concerning rural residents' subjective issues, the study also draws on the China Family Panel Studies, the National Bureau of Statistics, national and provincial statistical yearbooks, and rural statistical yearbooks. Because the well-being index of rural residents must be calculated, the study seeks to establish a panel dataset covering provinces across China from 2011 to 2021 as the research foundation. However, some data was missing during collection, and the selected variables involve individual questionnaire results, age, gender, and other factors. Considering data availability and the validity of the empirical results, rural areas in 24 provinces and municipalities were selected as the research objects as required, and the data were screened and supplemented to obtain valid samples.

4.1.2. Model Construction

(1) Construction of the baseline model

A two-way fixed-effects model is used for empirical analysis. The baseline model is as follows:

$$Happiness_{it} = \alpha_0 + \alpha_1 DF_{it} + \delta X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (7)$$

In Equation (7), *Happiness* represents the well-being index of rural residents; *DF* represents the Digital Inclusive Finance Index and its three dimensional indices; α_0 is the constant term; α_1 represents the extent to which digital inclusive finance affects rural residents' well-being; δX_{it} denotes the control variables described above; λ_i and λ_t denote province and year fixed effects, respectively; and ε_{it} is a normally distributed random error term.

(2) Construction of the extended models

To investigate the transmission mechanism through which digital inclusive finance affects rural residents' well-being and to test Hypothesis 2, the urban-rural income gap is treated as having a significant moderating function and a mediating transmission effect. Deeper application of digital inclusive finance can optimize the income-distribution mechanism, effectively narrow the income gap between urban and rural residents, and thereby improve rural residents' well-being. The urban-rural income gap also moderates the relationship to some extent. In quantitatively evaluating urban-rural development differences, the income-gap indicator is calculated as the ratio of urban residents' per-capita disposable income to rural residents' per-capita disposable income. A smaller value represents a smaller urban-rural income gap. To test the hypothesis, an interaction term between the Digital Inclusive Finance Index and the urban-rural income gap is introduced into Equation (7), and the following models are established to investigate the mediation effect:

$$Happiness_{it} = \alpha_0 + \alpha_1 ID_{it} + \delta X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (8)$$

$$ID_{it} = \alpha_0 + \alpha_2 DF_{it} + \varepsilon_{it} + \lambda_i + \lambda_t \quad (9)$$

$$Happiness_{it} = \alpha_0 + \alpha_3 DF_{it} + \gamma (DF * DI)_{it} + \delta X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (10)$$

ID represents the urban-rural income gap (Income Disparity), and *DF * DI* represents the interaction between the Digital Inclusive Finance Index and the urban-rural income gap. α_1 represents the effect of the urban-rural income gap on rural residents' well-being; α_2 measures the effect of digital inclusive finance on the urban-rural income gap; and γ reflects the moderating effect of the urban-rural income gap on the relationship between digital inclusive finance and rural residents' well-being.

To test Hypothesis 3, the level of urbanization is assumed to have a moderating effect on the ability of digital inclusive finance to improve the well-being index of rural residents. The urbanization rate is used to measure the level of urbanization, and an interaction term between the Digital Inclusive Finance Index and the urbanization rate is introduced. The model is as follows:

$$Happiness_{it} = \alpha_0 + \alpha_4 DF_{it} + \lambda (DF * UR)_{it} + \delta X_{it} + \lambda_i + \lambda_t + \varepsilon_{it} \quad (11)$$

UR represents the urbanization rate, *DF * UR* represents the interaction between the Digital Inclusive Finance Index and the urbanization rate, and λ reflects the moderating effect of urbanization on the ability of digital inclusive finance to improve rural residents' well-being.

4.1.3. Variable Description

Dependent variable: The dependent variable is the well-being index of rural residents. The organization and calculation of the data have been described in detail above.

Core explanatory variable: The core explanatory variable is the Digital Inclusive Finance Index. The selected data cover 24 provinces over the 11 years from 2011 to 2021. To explore more deeply which aspects of digital inclusive finance have the greatest effect on rural residents' well-being, the three dimensional indicators - breadth of coverage, depth of use, and degree of digitization - are also introduced as explanatory variables for detailed analysis.

Control variables: The control variables are classified into individual and social indicators, specifically age, gender, marital status, Communist Party membership, agricultural household registration, local fiscal expenditure on public services, and rural population. Table 2 provides detailed descriptions of the main variables.

Table 2. Description of the Main Variables.

Variable Category	Variable Name	Description
Dependent variable	Rural residents' well-being index	Overall indicator divided into 8 first-level and 26 second-level indicators
Core explanatory variable	Digital inclusive finance	Digital Inclusive Finance Index, 2011-2021
	Breadth of coverage	Breadth-of-Coverage Index, 2011-2021
	Depth of use	Depth-of-Use Index, 2011-2021
	Degree of digitization	Degree-of-Digitization Index, 2011-2021
Individual control variable	Age	Respondent's actual age (years)
	Gender	Male = 0, female = 1
	Marital status	Married = 1, unmarried = 0
Social control variable	Communist Party membership	Party members = 1, non-member = 0
	Agricultural household registration	Yes = 1, no = 0
	Local fiscal expenditure on public services	Unit: RMB 100 million
	Rural population	Unit: 10,000 people

4.2. Analysis of Empirical Results

4.2.1. Descriptive Statistics

Descriptive statistics are calculated for the variables, and the results are presented in Table 3. The average age of respondents is approximately 27 years, placing them in youth, the period of most vigorous psychological and physiological development and one of the main labor-force groups in society. The sample ranges from 3 to 86 years of age and therefore spans a broad range that includes all major stages of life. The sample size is sufficient and not one-sided, helping make the empirical results more reasonable and acceptable. The mean value of gender is 0.62, indicating that respondents are predominantly female, although the difference between the proportions of men and women is not large. Most respondents are married and possess agricultural household registration.

Table 3. Descriptive Statistics of the Variables.

Variable Category	Variable Name	Mean	Std. Dev.	Min.	Max.
Dependent	Rural residents' well-being index	5409.15	1705.57	2074.75	14122.5
Core	Digital Inclusive Finance Index	232.85	103.43	18.47	458.97
	Breadth-of-Coverage Index	213.58	103.93	3.06	433.42
	Depth-of-Use Index	231.48	105.84	12.76	510.69
	Degree-of-Digitization Index	301.65	118.02	7.58	462.23
	Age	27.03	3.43	3	86
Individual	Gender	0.62	0.14	0	1
	Marital status	0.9	0.06	0	1
	Communist Party membership	0.03	0.03	0	1
	Agricultural household registration	0.92	0.11	0	1
Social	Local fiscal expenditure on public services	544.33	302.80	117.81	1889.53
	Rural population	2241.96	1210.35	208	5632

4.2.2. Baseline Regression Analysis

The regression results are shown in Table 4. Column (1) presents results without any control variables, Column (2) introduces individual-level control variables, and Column (3) introduces both individual and social control variables. Whether or not control variables are included, digital inclusive finance has a positive effect on the well-being index of rural residents, indicating that it improves rural residents' well-being. This result is consistent with expectations, and Hypothesis 1 is supported. Before the control variables are introduced, a one-unit change in the Digital Inclusive Finance Index

is associated with a 9.54-unit change in the well-being index of rural residents. After the controls are introduced, a one-unit change in the Digital Inclusive Finance Index is associated with an 8.35-unit change in the well-being index. The smaller effect demonstrates that the selected control variables help alleviate overestimation of the impact of the Digital Inclusive Finance Index on rural residents' well-being and make the results more accurate.

With the exception of Communist Party membership and agricultural household registration, which have negative effects on rural residents' well-being, all control variables have positive effects on the dependent variable. The results show that rural women generally report lower subjective well-being than rural men. This gender difference may arise from traditional customs in rural areas. Within the traditional understanding of household power structures, men are usually regarded as dominant actors. This gendered allocation of power reflects not only the deep influence of social and cultural construction, but also the potential shaping effect of institutional factors and resource-allocation mechanisms on household decision-making. Unlike urban women, rural women are more deeply affected by son preference, have relatively little empowerment within the family, and face narrower occupational choices. This can produce an income gap within marriage. A lower family status may intensify cognitive limitations and feelings of inferiority and further marginalize women's political and social rights. Over time, the costs of marriage and remarriage for rural women rise, and remaining in marriages that are not genuinely happy gradually reduces their well-being. Unmarried rural residents report lower well-being than married residents, perhaps because Chinese culture has historically emphasized family integrity. Forming a family can help resist external risks and improve individual risk-bearing capacity. Rural residents' well-being also rises with age, local fiscal expenditure on public services, and rural population. Non-Party members report greater well-being than Party members, possibly because the premium and sense of identification associated with Party membership are relatively low in rural areas. However, neither this result nor the result for marital status is significant, perhaps because the sample is small and contains substantial noise. This does not mean that the two control variables are meaningless. More stable data processing would be required to reach a more definite conclusion. In addition, individuals with agricultural household registration report lower well-being than those with non-agricultural registration. Rural registration may create inconvenience in daily life, such as difficulties with children's school enrollment. Urban registration enables more convenient and rapid processing of procedures. Similar problems arise in medical insurance, where coverage in rural areas is insufficient and reimbursement ratios are lower. Inequalities in educational and medical resources substantially reduce rural residents' well-being.

Table 4. Baseline Regression Results.

Variable	(1) Rural Well-Being	(2) Rural Well-Being	(3) Rural Well-Being
Digital Inclusive Finance Index	9.54*** (0.83)	8.43*** (0.87)	8.35*** (0.98)
Age		109.79*** (25.35)	65.16*** (23.06)
Gender		1114.62*** (668.28)	1069.72*** (584.64)
Marital status		1231.64 (668.28)	153.86 (1160.46)
Communist Party membership		-2074.33 (2414.19)	-576.89 (2096.37)
Agricultural household registration		-3682.221*** (775.20)	-5823.36*** (708.92)
Local fiscal expenditure on public services			0.40*** (0.10)
Rural population			1.07*** (0.38)

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Standard deviations are shown in parentheses unless otherwise stated. The same notation applies as below.

On the basis of the baseline regression, the three dimensions of digital inclusive finance are separately regressed to investigate their effects on rural residents' well-being. The results are shown in Table 5. All three dimensional indicators are significant. Thus, the degree of penetration across geographical areas and social groups, the diversity of digital financial services provided, and the extent to which digital technology penetrates services all have significant positive effects on rural residents' well-being. The depth-of-use index has the greatest effect. A possible reason is that, with respect to breadth of coverage, China currently attaches great importance to expanding Internet financial services in remote and rural areas where communication is relatively inconvenient. Many rural areas have already escaped isolation from Internet services, and the gap between rural and urban demand for Internet financial services has gradually narrowed. Rural residents have already become an important segment of digital financial services. As breadth of coverage has become relatively extensive and development has matured steadily, its effect on rural well-being is gradually moving away from the center and becoming marginal. With respect to depth of use, rural residents' greatest current demand is to keep pace with more developed cities by integrating daily economic life closely with digitization and satisfying needs promptly. Demand is increasing for diverse and comprehensive financial services and richer digital scenarios, so this dimension has a larger effect on rural residents' well-being at the present stage. With respect to the degree of digitization, rural residents do not impose extremely strict requirements on the efficiency of technical tools or processing speed when using services. In other words, the digital financial services used in their daily work and lives generally do not require highly complex procedures. Professionals in specific occupations tend to have more stringent requirements for reducing human intervention throughout the process and increasing efficiency.

Perhaps in the near future, when digital financial services in rural areas reach a higher level, the focus of rural demand for digital inclusive finance will shift from depth of use to the degree of digitization. At different stages of development, people have differentiated demands in the field of digital inclusive finance. All three dimensions are parts of its ecosystem. The development journey therefore remains long and requires continuous deepening. Combining the quantity and quality of financial services and keeping pace with the times are essential rules for maintaining developmental vitality.

Table 5. Regression Results for the Three Dimensional Indices.

Variable	(1)	(2)	(3)	(4)
Digital Inclusive Finance Index	8.35*** (0.98)			
Breadth-of-Coverage Index		8.43*** (0.99)		
Depth-of-Use Index			8.83*** (0.94)	
Degree-of-Digitization Index				4.22*** (0.78)
Control variables	Controlled	Controlled	Controlled	Controlled

4.3. Discussion of Endogeneity

For the endogeneity issue, this study uses the instrumental-variable method. Natural disasters occur more frequently and have greater effects in rural than in urban areas. After a disaster, the government may promote financial infrastructure construction to accelerate relief and economic recovery, while rural residents may actively accept and adapt to digital financial instruments to alleviate immediate difficulties. Therefore, the logarithm of the annual affected area of geological disasters and typhoons in each province is selected as the instrumental variable. This variable does not exhibit a direct relationship with rural residents' well-being index. Its relevance and exogeneity are examined further below.

Weak-instrument test: To ensure that the selected instrument is sufficiently strong and significantly correlated with the core explanatory variable, a weak-instrument test is conducted. The results are shown in Table 6. They indicate that the instrumental variable is strongly significant and sufficiently powerful to identify the model effectively and alleviate the influence of endogeneity.

Table 6. Weak Instrument Test Results.

Indicator	Result
Instrumental-variable regression coefficient	-20.05***
Digital Inclusive Finance Index	14.61***
Kleibergen-Paap rk LM	18.06
P-value	0
Cragg-Donald Wald F-value	17.74 (>10)
Stock-Yogo	5.53
Hansen J	0

Overidentification and exogeneity tests: Because only one instrumental variable was identified, the weak-instrument test is in an exactly identified state. The Hansen J result therefore cannot be used effectively to determine whether the instrument is exogenous. Other means must be used, such as theoretical and indirect verification. This study uses multidimensional sensitivity analysis as an indirect verification method. Each of the three dimensions of the Digital Inclusive Finance Index is separately introduced into the instrumental-variable test, and the similarity of the results is compared. The results are consistent for both the overall Digital Inclusive Finance Index and the three dimensional indices. It can therefore be concluded that the instrumental variable is exogenous.

4.4. Analysis of Influencing Factors

4.4.1. Mechanism Analysis

To test Hypothesis 2, the mediation-effect results are presented in Table 7. A significant negative relationship exists between the Digital Inclusive Finance Index and the urban-rural income gap. An increase in the index helps narrow the gap, indicating that digital inclusive finance raises rural residents' per-capita income and thereby reduces the difference from urban residents. The urban-rural income gap has an extremely significant negative effect on the well-being index of rural residents. Narrowing the income gap therefore significantly improves rural residents' well-being. The urban-rural income gap serves effectively as an intermediary bridge. More finely dividing and analyzing the transmission path through which digital inclusive finance affects rural residents' well-being enables a more thorough understanding of the internal mechanism.

Table 7. Mediation and Moderation Effect Test Results.

Variable	Rural Residents' Well-Being Index	Urban-Rural Income Gap
Digital Inclusive Finance Index	17.42*** (2.15)	-0.0014** (0.0002)
Urban-rural income gap	-1696.327*** (243.13)	
Interaction term	-3.86*** (0.83)	

4.4.2. Moderation Effect Test

Table 7 also reflects the moderating effect of the urban-rural income gap. Combined with the baseline regression, the coefficient becomes larger after the interaction term is introduced, and all relevant results are significant at the 1% level. The regression coefficient of the interaction term is negative because the urban-rural income gap is negatively related to the well-being index, causing the sign to change when the variables are multiplied. This further demonstrates that narrowing the urban-rural income gap positively moderates the ability of digital inclusive finance to improve rural residents' well-being. When the urban-rural income gap is smaller, the improvement in rural well-

being produced by digital inclusive finance becomes more significant. Investigating the mechanism of this moderating effect enables the model to capture its complex internal structure more comprehensively and improves precision.

The moderating effects for the three dimensions are presented in Table 8. The regression coefficients of all three dimensional variables increase significantly after moderation, indicating that the urban-rural income gap also strongly moderates their effects. Hypothesis 2 is therefore supported.

Table 8. Mediation and Moderation Effect Test Results
for the Urban-Rural Income Gap under the Three Dimensions.

Variable	(1)	(2)	(3)
Breadth-of-Coverage Index	18.97*** (2.30)		
Interaction term 1	-4.38*** (0.87)		
Depth-of-Use Index		16.30*** (2.15)	
Interaction term 2		-3.37*** (0.88)	
Degree-of-Digitization Index			12.40*** (1.81)
Interaction term 3			-3.25*** (0.65)
Control variables	Controlled	Controlled	Controlled

The test results for the moderating effect of urbanization on the impact of digital inclusive finance on the well-being index of rural residents are shown in Table 9. With the exception of the depth-of-use index, the regression coefficients of the other indices are significantly negative. Before the interaction terms are introduced, digital inclusive finance and its three dimensions all have significant positive effects on the well-being index. The inconsistency may arise from the extremely complex relationship between digital inclusive finance and urbanization. When the level of urbanization is low, it may instead exert a negative moderating effect on the improvement of rural residents' well-being. China's urbanization process still has substantial room for expansion and improvement, so the level of urbanization will gradually exert a positive effect as it continues to rise. An increase in the level of urbanization therefore significantly and positively moderates the ability of digital inclusive finance to improve the well-being index of rural residents. Hypothesis 3 is supported.

Table 9. Moderation Effect Test Results for the Level of Urbanization.

Variable	(1)	(2)	(3)	(4)
Digital Inclusive Finance Index	-5.2** (2.36)			
Interaction term 1	0.21*** (0.03)			
Breadth-of-Coverage Index		-6.18** (2.44)		
Interaction term 2		0.23*** (0.04)		
Depth-of-Use Index			-3.51 (2.50)	
Interaction term 3			0.18*** (0.03)	
Degree-of-Digitization Index				-6.93*** (1.81)
Interaction term 4				0.19*** (0.03)
Control variables	Controlled	Controlled	Controlled	Controlled

4.5. Robustness Tests

To verify the stability of the empirical conclusions and enhance their credibility, three different robustness tests are conducted.

(1) Changing the sample period

The data selected for the study cover the 11 years from 2011 to 2021, a relatively long span. However, a large-scale COVID-19 outbreak occurred worldwide at the end of 2019, and China was among the first countries affected. The Chinese economy experienced a severe shock during the following two years. Many industries approached a standstill, and residents were confined to their homes. These conditions caused the development direction and ideas of Internet finance and Internet-of-Things finance to change substantially and enter a new dimension. The special years 2020 and 2021 are therefore removed to test the stability of the regression results. The results are shown in Table 10.

During the normal period without the pandemic, digital inclusive finance and all three dimensions remain significant in improving rural residents' well-being. Thus, digital inclusive finance can improve well-being during both special and ordinary periods. A deeper analysis of the specific results shows that the improvement produced by digital inclusive finance is greater when the special period is included than during the normal period. This reflects its distinctive advantages in economic-risk resistance and resilience, which enabled people's lives to find a new balance amid changes during a period when physical contact was restricted.

Table 10. Regression Results after Changing the Sample Period.

Variable	(1)	(2)	(3)	(4)
Digital Inclusive Finance Index	7.12*** (1.15)			
Breadth-of-Coverage Index		7.54*** (1.16)		
Depth-of-Use Index			7.65*** (1.14)	
Degree-of-Digitization Index				3.25*** (0.80)
Control variables	Controlled	Controlled	Controlled	Controlled

(2) Changing the sample set

The sample includes rural areas under several municipalities directly administered by the central government. Because municipalities are relatively small and follow development models that differ from those of ordinary provinces, their rural areas are more easily guided by urban development, and their development trajectories overlap closely with those of the city. To understand broader and more typical rural areas in China, the sample is changed by removing Shanghai, Tianjin, and Chongqing and repeating the regression analysis. The results are shown in Table 11.

After the municipalities are removed, the effects of the Digital Inclusive Finance Index and its three dimensions on the well-being index remain significantly positive, further confirming the preceding conclusion and ensuring the robustness of the model. The specific results show that the magnitude of the effect declines slightly without the municipalities. A possible reason is that economically developed municipalities such as Shanghai and Beijing play a demonstrative and leading role in the popularization and application of digital inclusive finance. Their digital financial infrastructure is more complete, residents' acceptance and frequency of use are much higher, and the overall contribution to well-being is larger. Municipalities also enjoy policy advantages and a concentration of policy resources. Pilot and development projects, for example, are often first implemented in municipalities, enabling them to accept emerging reforms earlier and benefit from policy dividends sooner. Because a threshold effect may exist, the relationship between digital inclusive finance and residents' well-being in municipalities may not be strictly linear. The effect on well-being may increase qualitatively only after regional coverage reaches a particular threshold.

Municipalities may already have reached or exceeded that threshold, while other provinces remain at a lower level. Municipalities have smaller populations, especially in rural areas. The design of CFPS questionnaires and the selection of respondents may therefore produce bias: with the same number of respondents, survey coverage is greater in municipalities than in other provinces, making the results more accurate and more consistent with actual conditions.

Table 11. Regression Results after Changing the Sample Set.

Variable	(1)	(2)	(3)	(4)
Digital Inclusive Finance Index	6.89*** (0.91)			
Breadth-of-Coverage Index		6.79*** (0.91)		
Depth-of-Use Index			7.35*** (0.92)	
Degree-of-Digitization Index				3.70*** (0.71)

(3) One-period-lag analysis

To examine in greater depth whether the effect of digital inclusive finance on the well-being index of rural residents has a time lag, a one-period-lag regression is conducted. The results are shown in Table 12. The lagged terms of the Digital Inclusive Finance Index and all three dimensional indices significantly affect the well-being index of rural residents, and the test is therefore passed.

Table 12. One-Period-Lag Test Results.

Variable	(1)	(2)	(3)	(4)
Digital Inclusive Finance Index	7.34*** (1.51)			
Breadth-of-Coverage Index		11.98*** (1.72)		
Depth-of-Use Index			8.68*** (1.31)	
Degree-of-Digitization Index				-0.09 (0.79)
Control variables	Controlled	Controlled	Controlled	Controlled

4.6. Heterogeneity Analysis

(1) Regional heterogeneity analysis

To systematically examine differences in the effect of digital inclusive finance on the well-being index of rural residents across geographical regions in China and to test Hypothesis 4, the sample is divided into eastern, central, and western regions and separate regressions are conducted. The results are shown in Table 13.

The three dimensions have slightly stronger effects in the eastern region, but the overall differences among the three regions are small and all coefficients are significantly positive. Hypothesis 4 is basically supported. The limited regional differences may arise because national policies concerning digital inclusive finance are relatively uniform, causing their final implementation effects to converge across the three regions. Breadth of coverage has become widespread in rural areas of the eastern, central, and western regions, with little difference among them. With respect to depth of use, the digital financial functions needed by rural residents in different regions overlap substantially, and the services themselves spread rapidly and have extremely high penetration. No significant imbalance therefore appears. The central and western regions are responding actively to policies such as the Western Development Strategy, while the east produces regional spillovers and trickle-down effects. The gradual spillover and convergence of capital and technology, together with continuous learning from development models, are narrowing the gap between the central and western regions and the east.

Table 13. Regional Heterogeneity Analysis Results.

Variable	All Regions	Eastern	Central	Western
Digital Inclusive Finance Index	8.35*** (0.98)	0.03*** (0.004)	0.03*** (0.004)	0.04*** (0.01)
Breadth-of-Coverage Index	8.43*** (0.99)	1.02*** (0.20)	0.98*** (0.03)	0.94*** (0.02)
Depth-of-Use Index	8.83*** (0.94)	0.92*** (0.03)	0.91*** (0.05)	0.91*** (0.06)
Degree-of-Digitization Index	4.22*** (0.78)	0.64*** (0.03)	0.53*** (0.03)	0.55*** (0.06)
Control variables	Controlled	Controlled	Controlled	Controlled

(2) Heterogeneity analysis by the density of rural financial institutions

To investigate differences in the effect under different densities of rural financial institutions and to test Hypothesis 5, the proportion of rural financial institution business outlets in the total number of outlets in each province or municipality is selected as the measure of rural financial density. Provinces are divided into four groups: below 20%, 20%-25%, 25%-30%, and above 30%, and regressions are conducted in sequence. Among the 24 provinces and municipalities, Tianjin and Shanghai have proportions below 20%; Liaoning and Hubei have proportions of 20%-25%; Jilin, Heilongjiang, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Guangdong, and Chongqing have proportions of 25%-30%; and Hebei, Shanxi, Henan, Hunan, Guangxi, Sichuan, Guizhou, Yunnan, Shaanxi, and Gansu have proportions above 30%. Because the proportion of rural financial outlets is strongly affected by urbanization, the urbanization rate is introduced as a control variable. The results are shown in Table 14.

Table 14. Heterogeneity Analysis Results for the Density of Rural Financial Institutions.

Density Group	(1)	(2)	(3)	(4)
Below 20%	0.07 (0.08)			
20%-25%		15.89 (2.03)		
25%-30%			8.86*** (1.53)	
Above 30%				3.36*** (1.36)
Control variables	Controlled	Controlled	Controlled	Controlled

In regions with a larger proportion of rural financial-institution outlets, digital inclusive finance has a smaller effect on the well-being index of rural residents. Shanghai and Tianjin are classified in the group below 20%, and their regression results appear inconsistent with the preceding conclusion. However, their apparently low rural financial density results from the small land area occupied by rural districts, while urban financial outlets account for an overwhelming share of all outlets. Rural finance in these municipalities is unquestionably more developed than in other provinces, so their density of rural financial institutions should also be classified as relatively high. Their regression results are therefore consistent with the preceding conclusion. The result may occur because digital inclusive finance is more saturated in regions with high density than in those with low density, making its marginal effect weaker. Low-density regions respond rapidly to the emerging transformation, producing a sharp increase. In summary, Hypothesis 5 is supported.

5. Research Conclusions and Policy Recommendations

5.1. Research Conclusions

Based on the preceding research, the following conclusions are obtained.

(1) Digital inclusive finance and all three of its dimensional indices significantly improve the well-being index of rural residents. Among the three dimensions, the depth-of-use index has the largest effect, followed by the breadth-of-coverage index and the degree-of-digitization index.

(2) Digital inclusive finance can improve the well-being index of rural residents by narrowing the urban-rural income gap. At the same time, a narrowing income gap and a higher urbanization rate positively moderate the relationship between digital inclusive finance and rural residents' well-being.

(3) Digital inclusive finance displays strong resilience and risk resistance during the COVID-19 pandemic. Under special conditions of economic downturn, its inherent advantages still enable it to significantly improve the well-being index of rural residents.

(4) In terms of regional heterogeneity, the eastern, central, and western regions differ little in the effect of the overall Digital Inclusive Finance Index on the well-being index of rural residents. For the three-dimensional indices, however, the effect is significantly greater in the economically developed eastern region than in the other two regions, although the gap is gradually narrowing. In terms of heterogeneity in the density of financial institutions, the effect differs with density and is relatively smaller in regions with higher density.

5.2. Policy Recommendations

5.2.1. Improve Digital Infrastructure and Eliminate Cognitive Barriers

Increase digital-network coverage and achieve widespread access to terminal devices. Although the state emphasizes the construction of network base stations and improvement of satellite-communication quality, relevant institutions and sites have not been implemented locally in some remote rural areas. The rate of digital application therefore cannot be monitored promptly, and rural residents' questions and related matters concerning use cannot be resolved in a timely manner. Cooperation between the government and relevant enterprises should be promoted. Preferential policies should encourage enterprises to establish network, electricity, and public-consultation facilities in remote areas and to conduct regular publicity and education. Local rural residents' needs should be placed first, with every question answered and every reasonable request addressed. Electronic-payment machines and network facilities should be installed at sites involved in rural residents' daily lives, such as general-goods supermarkets, seed and pesticide markets, and grain-processing plants. This will subtly encourage residents to understand and use digital-payment tools.

To ensure that rural residents can keep pace with digital development while the economic poverty of some rural households is fully considered, the government should provide relevant subsidies and encourage enterprises to make donations. Every low-income rural resident should have a smartphone capable of basic Internet operations. Policy should promote not only the delivery of home appliances to the countryside, but also the delivery of intelligent technologies to the countryside.

5.2.2. Enhance the Adaptability of Financial Services and Eliminate Financial Exclusion

Design targeted products to satisfy long-tail demand. Unlike urban residents, rural residents primarily engage in agriculture, and the financial services they need are closely related to agricultural production. Many traditional large loans do not meet rural residents' requirements in either borrowing conditions or loan amounts. Financial products developed for rural areas should therefore be differentiated and targeted. Small-credit products such as "corn loans" and "cotton loans" can be periodically introduced according to the growth cycles of different crops. Flexible repayment and collection schedules should take into account the approximate timing of rural residents' income, crop-growth conditions in the current year, and the incidence of natural disasters, fully considering external conditions. Loans such as "seeder loans" can also be offered for agricultural machinery requiring large amounts of capital. Because most rural residents have relatively limited education, the names

and explanations of loans should be simple and easy to understand. Products can be named directly after crops or farm tools. When loan details and precautions are explained, appropriate dialects and plain language should be used, with the ultimate objective that rural residents can understand them. Government departments should send personnel to conduct local field investigations. Only by personally experiencing rural residents' production processes can financial services be precisely embedded in high-frequency rural scenarios, rather than producing empty-shell products based on imagination and textbook knowledge that appear relevant to farmers but are not actually applicable.

On the basis of meeting rural residents' basic production needs, higher-level financial products should be developed with the objective of improving financial knowledge. Examples include agriculture-related weather insurance, disaster-loss insurance, and small agricultural funds suited to the scale of rural residents' capital. Linking such products to agriculture can make them appear less distant and mysterious. Some financial products can be simplified into low-threshold, low-risk rural versions. Regardless of the product, staff must provide detailed explanations and must not deceive rural residents for performance targets. During the critical stage of promoting digital inclusive finance in rural areas, stakeholders require both determination and courage to proceed without turning back and the perseverance to withstand losses and setbacks.

5.2.3. Popularize Financial Knowledge and Improve Digital Literacy

Strengthen financial education and bridge the digital divide. The cultivation of rural residents' financial knowledge should proceed gradually and practically. The education system can be layered. At the basic level, back-end data can be used to send rural residents short videos about basic financial knowledge and mobile payment. Rural broadcasts can include brief anti-fraud information, increasing the penetration of knowledge into daily-life scenarios and subtly influencing residents. At the intermediate level, education can enter agricultural producers' daily work directly. Large farmers with extensive planting areas or livestock operations can receive credit-management and e-commerce training. Because they may have substantial local reputation and visibility, educating them can spread knowledge to other farmers. This leading, imitation, and real-success-case effect can be more effective than forced knowledge transmission. At the highest level, village committees and local governments can use their mobilizing power to establish digital inclusive finance service stations staffed by relevant professionals who provide guidance and assistance.

Once rural residents have mastered the relevant knowledge, rural areas should be guided to activate their economic forms and promote integration between industry and finance. Local people should participate in the era of e-commerce livestreaming and enjoy the convenience of information technology. Rural residents can be encouraged to promote products through livestream commerce, with corresponding traffic support and product-sales assistance. For example, China Central Television News can establish special programs to market agricultural products and produce documentaries about tourism and traditional handicrafts. Local cultural resources can be used to attract the public to understand rural areas better and eliminate certain prejudices and misunderstandings.

5.2.4. Promote Development through Multi-Dimensional and Multi-Group Collaboration

Improve the entire system and include a broad range of social groups. Coordinated efforts should be made across technology, institutions, culture, and other dimensions, with relevant policies formulated in each area. This avoids the inflexibility and implicit coercion of a single policy. Policies should coordinate with one another and follow coherent logic, avoiding contradictions in which policies conflict. Technologically, the algorithmic logic of models for rural financial services should better reflect the characteristics of rural groups and avoid algorithmic discrimination against older people and women. Algorithms must not be misused to create information gaps and data monopolies. Institutionally, the government should take the lead in improving relevant systems and policies. Institutions that actively serve rural areas should receive tax reductions, lower reserve-requirement ratios, preferential lending rates, and other benefits. Clear ownership and regulation should govern institutions' use of transaction data related to rural residents. Financial institutions must be strictly

prohibited from using personal information for profit without permission, thereby increasing rural residents' trust. The development of digital inclusive finance can also be introduced appropriately into the assessment of local governments. The use of assistance funds allocated by higher-level authorities to rural areas must be strictly supervised and tracked to ensure that every payment is used properly. Culturally, the continuity of rural culture and the importance of the family concept can be used to design policy instruments for different rural groups. More migrant rural residents and highly educated university graduates should be attracted to return home for entrepreneurship and employment, strengthening emotional connections and identity with rural areas. This can alleviate the mental-health problems of empty-nest elderly people and left-behind children while spreading new technologies and ways of thinking learned in cities to rural areas.

More social forces should be encouraged to participate. An integrated chain involving banks, financial-service institutions, agricultural enterprises, technology companies, and village committees should be established, together with a unified data-information platform connecting all institutions and departments. Collaborative sharing can reduce repeated and redundant data collection. Every link is important and none can be left behind. Beyond the core chain, applications for cooperation from public-welfare organizations, universities, and other institutions can be widely accepted, calling on more groups to direct new development attention toward rural areas and spread hope there. Upstream and downstream networks are needed not only among institutions; more importantly, the parties to transactions should be able to communicate at no cost. Farmers, distributors, and consumers - the three core groups - should maintain smooth information channels and broad spaces for communication, share and connect data, and ensure transparent and open transactions. Only then can rural residents, after obtaining market information, choose relevant financial services entirely according to their needs. This can significantly reduce their sense of deprivation, increase their psychological sense of control and freedom, and improve well-being.

5.2.5. Pay Attention to Residents' Lives and Improve Rural Well-Being

Improve the structure of security mechanisms and deepen the effectiveness of social fairness. Strengthening rural areas' ability to withstand risks is a long-term means of improving rural residents' well-being. Special subsidies should be provided for major and rare diseases, reimbursement rates should be increased, and every effort should be made to eliminate the phenomenon of returning to poverty because of illness. The medical-security system should be improved. Urban and county hospitals should be encouraged to hold regular clinics in rural health centers, and experts should be sent to educate rural residents about health. More types of agricultural insurance should be offered, achieving full coverage of crops, poultry, livestock, and other categories and eliminating return to poverty because of disasters. Attention should be paid to the mental health and living conditions of disadvantaged groups. Activity centers and dining halls for older people should be established, and mutual-help eldercare and companionship services should be provided for empty-nest elderly people. Greater attention should be paid to the education of left-behind children and to their safety in daily life. Boarding schools can address the safety problem created when parents are unavailable to accompany children to and from school, and regular psychological classes can compensate for the lack of family care during childhood development.

Rural residents' pride in and sense of belonging to local lifestyles and cultural traditions should be strengthened. Outstanding rural workers and farmers should be commended to increase people's confidence and enthusiasm for revitalizing their hometowns. Government affairs should become more transparent, and rural residents' participation should increase so that they genuinely become the masters of their own lives. Every rural resident should understand rural revitalization. As expressed in *The Wealth of Nations*, self-interest can achieve the interests of others, and benefiting others can also benefit oneself. Through diligent daily effort, individuals can realize themselves while improving the welfare of rural society as a whole.

5.3. Research Limitations

Narrow data range: The Digital Inclusive Finance Index is a relatively new dataset compiled only since 2011. The time span of the research is therefore necessarily limited. A short span may make the research incomplete and give the results a degree of one-sidedness.

Incomplete data collection: Happiness is an extremely complex concept. Measuring it only with currently available data remains imperfect. Many subjective experiences cannot be represented by data, and relevant data are unavailable. Measuring the well-being index is therefore a long-term process requiring continuous improvement.

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