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Did InsurTech Promote the Development of Insurance Inclusion? Empirical Evidence from China's Rural Areas

Jian WU, Jie SHAO

Abstract

Against the backdrop of digital technology driving the development of the finance industry, this paper endeavours to address the following question: can InsurTech significantly promote the development of insurance inclusion? Based on the (Peking University) Digital Financial Inclusion Index and the Rural Development Index of Insurance Inclusion from 2011 to 2017, this study empirically examines the impact of InsurTech on the development of insurance inclusion in rural China. The research findings demonstrate that InsurTech significantly promotes the development level of insurance inclusion in rural China; however, regional heterogeneity exists, with the strongest effect of promoting the insurance inclusion development observed in western rural China, followed by eastern rural China, and the weakest effect in central rural China. This paper argues that the government should adopt regionalized support policies for InsurTech companies and differentiated social security for individuals, the involvement of traditional insurance industry should also be enhanced. We believe this paper provides theoretical support for the application of FinTech in the field of insurance inclusion in rural areas.

I. Introduction

With rapid development of digital economy, InsurTech has become an important means to promote insurance inclusion in rural areas(1). As a subset of FinTech, InsurTech encompasses all beneficial technological advancements and innovative activities related to insurance (Sun, 2020), aiding in the

enhancement of insurance outreach and service coverage. Despite its significant role in advancing overall social protection levels across multiple insurance sectors, there are certain groups that remain excluded from the benefits of InsurTech due to their limited access to digital technologies (Koh et al., 2018). The application of InsurTech presents both opportunities and challenges for the development of insurance inclusion, particularly for those vulnerable groups residing in rural areas (Sun et al., 2019).

In China, there is currently a significant disparity in digital literacy between urban and rural residents, with many rural inhabitants lacking the fundamental requirements to utilize InsurTech. A survey by the Center for Informatization Study (CIS) in 2021 revealed that rural residents scored lower than their urban counterparts in all assessed areas, particularly in cyber security awareness, computer usage, digital income generation, digital tool development, and mobile tool development, with respective gaps of 43.2%, 31.7%, 27.7%, 25.6%, and 23.8% between two groups.(2) These findings indicate that the rapid development of the digital economy alongside the lag in digital literacy among rural residents presents a significant challenge, potentially impeding the realization of the desire to reduce the cost of insurance inclusion services through digital means such as InsurTech. Therefore, whether the application of InsurTech can effectively contribute to the development of insurance inclusion in rural areas is a key issue that the government, industry, and academia must address when advocating for, researching, and implementing InsurTech. Its answer carries implications for the efficiency and equity of empowering rural insurance through InsurTech, as well as the technological means, actual outcomes, and implementation pathways of leveraging rural inclusive insurance to support rural revitalization.

However, there is a dearth of research within the insurance academic community regarding the impact of InsurTech on the development of insurance inclusion in rural China. On one hand, this is due to the limited number of researchers currently focusing on insurance inclusion (Sun et al., 2019; Wu, Sun, 2020; Yin et al., 2020; Xu, Chen, 2021; Zhang, Jiang, 2021). On the other

hand, the continuously evolving landscape of InsurTech, ranging from internet, big data, remote sensing technology to blockchain and artificial intelligence, and even virtual reality and metaverse, constantly enriches the concept of InsurTech and expands its scope, which has made it challenging for researchers to keep up, learn, surpass, and conduct targeted research.

Researchers can choose specific technological hotspots within InsurTech to focus on, depending on the specific research subjects. The primary target group for insurance inclusion is the rural population, predominantly involving agricultural insurance and rural micro-insurance. Given the current level of digital literacy among rural famers, the application of InsurTech includes leveraging the internet, mobile terminals, and convenient payment methods to provide famers with access to a wider range of insurance product information, facilitating their understanding of insurance, enrollment, premium payment, and claim settlements. In this study, the Rural Development Index of Insurance Inclusion is combined with the Digital Financial Inclusion Index to empirically examine the impact of InsurTech on the development of insurance inclusion in rural China. The novelty and contribution of this research lie in two aspects: firstly, in contrast to qualitative studies exploring the impact of InsurTech on general insurance development, this study focuses on the potential effects of InsurTech on insurance inclusion specific to the rural population, utilizing empirical research methods to test its impact; secondly, this study investigates the regional heterogeneity of the potential impact of InsurTech on the development of insurance inclusion in rural China, providing policy insights to empower insurance inclusion in rural areas through InsurTech and promote its high-quality development.

II. Literature Review and Research Hypotheses

Currently, there is limited literature focusing on the impact of InsurTech on the development of insurance inclusion in rural areas. Research on the impact of InsurTech primarily revolves around issues related to insurance business operations and management. Firstly, it is recognized that InsurTech

can lower operational costs. Xu and Zhu (2020) pointed out that InsurTech can address sales misrepresentation issues, reduce sales costs, and improve service quality in the bancassurance business. Secondly, InsurTech can address information asymmetry problems. Areas such as remote information processing, wearable devices, and the Internet of Things provide insurance companies with ample consumer data, enabling more effective engagement with policyholders (Cortis et al., 2019). The integration of blockchain and big data technologies with insurance facilitates risk management, accurate identification of consumers' insurance needs, enhances efficiency during underwriting and claims settlement stages, and improves the relationship between policyholders and insurers (Xu, 2017). Thirdly, there is an elevation in regulatory standards. Wang and Zhou (2017) posited that blockchain technology can effectively discern the attributes of insurance market participants, particularly in specific scenarios within the property insurance sector, thereby enhancing operational efficiency, data security, service experience under new circumstances, and regulatory efficiency. Fourthly, there is an improvement of risk management in insurance companies. Wanyan and Suo (2019), utilizing the Digital Financial Inclusion Index, empirically examined the impact of InsurTech on liability and asset management as well as risk-taking behaviors, and found that InsurTech significantly promotes the development of China's insurance industry. Wang (2020) suggested that technologies such as the internet, big data, and blockchain will fundamentally transform the business models of agricultural insurance and enhance the risk control capabilities and operational efficiency of insurance companies. Lastly, there is an empowerment of product innovation. Sun et al. (2021), through their study utilizing insurance company data published by the Insurance Association of China, discovered that the development of InsurTech primarily enhances insurance enterprises' product innovation capabilities by expanding the application scenarios of insurance products. Evidently, through various transmission mechanisms, InsurTech plays a consequential role in the operational management of insurance companies. Therefore, we propose the

following hypothesis:

Hypothesis 1: InsurTech can enhance the development of insurance inclusion in rural areas.

Although researchers have reached a basic consensus on the role of InsurTech in enhancing operational efficiency, they hold different perspectives regarding its impact on customers. On one hand, InsurTech brings value-added services related to insurance, making insurance more appealing to customers. For instance, Chishti (2020) suggested that agricultural technology, human resources technology, and health technology can provide additional services to customers and create new opportunities for sales, data integration, and the establishment of insurance contracts. The utilization of big data and artificial intelligence in underwriting and claims processes improves the operational efficiency and service level of insurance companies. Through data analysis, insurance companies can participate in real-time risk mitigation, pay-per-use insurance, dynamic underwriting, and personalized premium calculations, thereby enhancing customers' satisfaction and increasing their willingness to purchase inclusive insurance products (Yan et al., 2018). On the other hand, Lin and Chen (2020) argued that the introduction of new technologies inherently presents corresponding challenges. InsurTech has its limitations, and some customers may still prefer face-to-face insurance transactions and value the human touch that required during the claims process. McFall and Moor (2018) contended that certain insurance technological devices rely too heavily on personal data to calculate risk for appraising fair claim payments without giving sufficient consideration to historical risk data. Thus, it can be observed that InsurTech brings new impetus to insurers, but the focus of empowering insurance operations with technology should be customer-centric, necessitating a comprehensive consideration of the integration of technology and insurance from the customer's perspective (Zhu, 2017). In the case of rural inclusive insurance, the customers are famers, and the level of development varies across different regions in China. Consequently, farmers in more developed areas may possess higher digital literacy and be more

receptive to and adept at utilizing InsurTech compared to their counterparts in less developed regions. Accordingly, the second hypothesis is proposed as follows:

Hypothesis 2: InsurTech significantly promotes the development of rural inclusive insurance in more developed regions, but insignificantly positively affects the development of rural inclusive insurance in less developed regions.

III. Data, Variables, and Models

(I) Data Sources

The main sources of data for this study are the measurement results of the development level of insurance inclusion by Sun et al. (2019) and other publicly available data. The time period covers the years from 2011 to 2017. The publicly available data include the Digital Financial Inclusion Index published by the Institute of Digital Finance Peking University, the 41st Statistical Report on China's Internet Development issued by the Cyberspace Administration of China,(3) and relevant data on social security from the official website of the Ministry of Civil Affairs.

(II) Definition of Variables

1. Dependent variable

The development index of rural insurance inclusion is selected as the dependent variable. This variable, measured from the dimensions of insurance penetration, coverage, and efficiency of use, reflects the changes in the level of insurance inclusion development in rural China. This index has been used in previous studies by Sun et al. (2019), Wu and Sun (2020), and Yin et al. (2020). In this study, the logarithmic form of this index is utilized to smooth out the development fluctuations of insurance inclusion in rural China.

2. Independent variable

Following the approach of Wanyan and Suo (2019), the insurance index from the Digital Financial Inclusion Index is chosen as the core independent

variable to depict the level of InsurTech development.(4) The Digital Financial Inclusion Index, published by the research team at Peking University, provides a comprehensive assessment of China's FinTech development from various perspectives (Qiu et al., 2018). The insurance index, as an important dimension within the Digital Financial Inclusion Index, reflects the level of digital technology development in the insurance sector. It captures the fairness and timeliness of financial services obtained through mobile devices, computers, and other digital platforms. Consequently, it represents the contribution of digital inclusiveness in InsurTech, aligning with the research objective of this study to investigate the impact of InsurTech on the development of rural insurance inclusion. Therefore, this study employs this index to measure the development of InsurTech.

3. Control variables

To control for the variations in social security levels and insurance industry development across different provinces, and the resulting differences in the development of rural insurance inclusion, this study selects average rural subsistence allowance standard, expenditures on the Five Guarantees program,(5) and expenditures on subsistence allowance as control variables to account for the alternative differences brought about by varying levels of social security across provinces. Concerning the control of insurance industry development levels across provinces, this study employs the development index of the overall insurance industry as a representative measure(6). Table 1 presents the descriptive statistics of the main variables considered in this study.

(III) Empirical Model

This study adopts a fixed effects model for empirical analysis, following the approach of Wanyan and Suo (2019). The model specification is as follows:

$$lnRawlsiid_{it} = \alpha + \beta_1 InInsurtech_{it} + \beta_2 X_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (1)$$

where $lnRawlsiid_{it}$ represents the logarithm of development index of insurance inclusion in rural areas; $lnInsurtech_{it}$ represents the logarithm of the

development index of InsurTech. The logarithms are mainly used to smooth the data magnitude and reduce heteroskedasticity, the comparison between the logarized and original data can also be found in Table 1. X represents the control variables in this study, primarily capturing differences in the commercial insurance industry and social security. The control variables include:

Table 1. Definitions and descriptive statistics of main variables

Symbol	Definition of variables	Obs	Mean	SD	Median	Min	Max
Rawlsiid	Development of insurance inclusion in rural areas. A higher value indicates a higher development level	217	0.114	0.122	0.071	0.007	0.626
Insurtech	Development level of InsurTech. A higher value indicates a higher development level	217	386.296	198.527	434.79	0.25	785.39
Benthiid	Development index of the overall insurance industry. A higher value indicates a higher development level	217	0.191	0.118	0.159	0.057	0.723
Mintake	Average rural subsistence allowance standard in each province (in ten thousand yuan per person)	217	0.315	0.187	0.27	0.09	1.12
Fivinsur	Expenditures on the Five Guarantees program in each province (in billion yuan per year)	217	6.197	5.397	4.88	0.15	21.84
Mincost	Expenditures on rural subsistence allowance in each province (in billion yuan per year)	217	27.297	18.67	25.97	1.28	81.007
lnInsurance	Logarithm of InsurTech development level	217	5.664	1.032	6.075	-1.386	6.666
lnRawlsiid	Logarithm of development of insurance inclusion in rural areas	217	-2.563	0.868	-2.641	-4.997	-0.469

$Benthiid_{it}$: development index of the overall insurance industry; $Mintake_{it}$: average rural subsistence allowance standard in each province; $Fivinsur_{it}$: expenditures on the Five Guarantees program in the rural areas of each province; and $Mincost_{it}$: expenditures on rural subsistence allowance in each province, where, the subscripts i and t correspond to provinces and years, respectively. μ_i represents the individual effects, ν_t represents the time effects, and ε_{it} represents the assumed independently and identically distributed error term.

IV. Empirical Analysis

(I) Insurance Inclusion and InsurTech in Rural China

Table 2 presents the estimation results of the fixed effects regression. In columns (1) to (4), the fitted coefficients of the core explanatory variable, InsurTech, are consistently significant and positive. This indicates that InsurTech significantly promotes the development of insurance inclusion in rural areas, thus validating hypothesis 1. For further analysis, we focus on column (2), where an increase of 1% in the InsurTech development index leads to a significant 0.176% increase in the development of insurance inclusion index. One possible explanation is that the use of InsurTech reduces the operating costs for insurers (both public and private) in providing rural inclusive insurance (Xue and Hu, 2020). In China, insurers often establish their branch offices at the county level(7), primarily in urban areas, while the target beneficiaries of rural inclusive insurance are mainly located in rural areas. This geographical disparity leads to high transportation costs for insurance providers to serve rural households. Some insurance providers address this issue by employing "field agents"(8) (Zhang, 2018) or distributing rural inclusive insurance through rural commercial banks. However, with the application of InsurTech, product information regarding rural inclusive insurance can be efficiently delivered to farmers through mobile apps. Farmers can access and understand this information online, reducing the operating costs for insurers in providing rural inclusive insurance. Moreover, InsurTech

Table 2. The Impact of InsurTech on the development of insurance inclusion in rural areas

	(1)	(2)	(3)	(4)
	Development of insurance inclusion	Development of insurance inclusion	Development of insurance inclusion	Development of insurance inclusion
Development of InsurTech	0.176***	0.176***	0.172***	0.189***
	(4.10)	(4.10)	(3.99)	(4.35)
Development of the insurance industry	-0.762	-0.739	-0.623	-1.479**
	(-0.95)	(-0.93)	(-0.78)	(-2.00)
Average rural subsistence allowance standard	-0.985***	-0.965***	-0.920***	
	(-2.83)	(-2.80)	(-2.67)	
Expenditures on the Five Guarantees program	-0.0153	-0.0165*		
	(-1.49)	(-1.69)		
Expenditures on rural subsistence allowance	-0.00170			
	(-0.41)			
Individual fixed effect	YES	YES	YES	YES
Time fixed effect	YES	YES	YES	YES
Constant term	-3.486***	-3.521***	-3.595***	-3.703***
	(-15.81)	(-17.29)	(-17.98)	(-18.60)
Sample size	217	217	217	217
Adjusted R^2	0.73	0.73	0.73	0.72

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively; Figures in parentheses are t-statistics. The same applies to the following table.

reduces the information asymmetry in the rural inclusive insurance market thus enhancing market transparency. This in turn helps insurance providers gain a more efficient and accurate understanding of their customer profile, enabling them to provide insurance products and loan services to rural households more effectively (Fu et al., 2019).

In terms of the control variables, the fitted coefficients of the average rural subsistence allowance standard and expenditures on the Five Guarantees program are both significant and negative. This indicates that these

variables have certain inhibitory effects on the development of insurance inclusion in rural areas. One possible explanation is that the increase in the average rural subsistence allowance standard raises farmers' income and leads to an increase in their savings. The function of savings itself provides a certain level of risk protection, which may partially replace the demand for rural inclusive insurance. On the other hand, expenditures on the Five Guarantees program provide basic protection for the "Five-Guarantee households" in rural areas, thus reducing their need for risk protection. Therefore, the average rural subsistence allowance standard and expenditures on the Five Guarantees program represent the alternative effect of government social security welfare on rural inclusive insurance. In this context, they exhibit an inhibitory effect on the development of insurance inclusion in rural areas.

(II) Identification of Heterogeneity

There are significant differences in economic development and income levels between eastern, central, and western China. This has resulted in the eastern region having higher levels of social security, insurance industry development, and digitalization compared to the central and western regions.

From Table 3, it can be observed that the coefficients of InsurTech are positively significant in eastern, central, and western China. A 1% increase in InsurTech level in these regions would lead to a 0.238%, 0.155%, and 0.414% increase, respectively, in the development of insurance inclusion in rural areas. This indicates that the development of InsurTech in these regions significantly, but to different degrees, promotes the development of insurance inclusion in different regions of China. Possible explanations include the heterogeneity transmission mechanism of InsurTech and the imbalance in regional economic development in China. In the economically developed eastern region, people have a higher acceptance of InsurTech, enabling its effective utilization to drive the development of insurance inclusion in rural areas. The central region has a weaker economic development level compared to the eastern region but stronger than the western region, resulting

Table 3. Regional Heterogeneity of InsurTech

	Development of insurance inclusion in rural areas		
	Eastern	Central	Western
Development of InsurTech	0.238*	0.155***	0.414***
	(1.90)	(4.23)	(3.33)
Development of the insurance industry	-1.400	2.587*	0.849
	(-1.40)	(1.79)	(0.49)
Average rural subsistence allowance standard	-0.164	0.360	-3.098
	(-0.42)	(0.18)	(-1.31)
Expenditures on the Five Guarantees program	0.0186	-0.0295	-0.0670**
	(0.88)	(-1.67)	(-2.42)
Expenditures on rural subsistence allowance	0.00802	-0.0217***	0.000952
	(0.70)	(-3.12)	(0.16)
Individual fixed effect	YES	YES	YES
Time fixed effect	YES	YES	YES
Constant term	-3.693***	-3.630***	-4.422***
	(-7.25)	(-8.41)	(-7.59)
Sample size	91	42	84
Adjusted R^2	0.70	0.88	0.77

in a lower utilization level of InsurTech and subsequently a weaker promotion of insurance inclusion in rural areas compared to the eastern region. In contrast, in the western region the role of InsurTech in promoting the development of insurance inclusion in rural areas is most pronounced. In the western region, where many rural areas, such as those in Chongqing and Sichuan, are located in remote mountainous areas, hindrances to the development of insurance inclusion in rural areas exist due to transportation difficulties. However, InsurTech plays a crucial role in addressing the issue of high transaction costs in the western region, leading to a significant improvement in the development level of insurance inclusion in rural areas.

In terms of control variables, the coefficient of overall insurance develop-

ment level in the central region is significantly positive, while the coefficients for the eastern and western regions are insignificant. This indicates that the development level of traditional industry (non-InsurTech, because InsurTech business only takes a very small portion in the overall industry) has a certain promotion effect on the development of insurance inclusion in the central rural areas, while this effect in the eastern and western regions is insignificant. This may be due to the fact that traditional insurance services in the eastern region have already reached a relatively high level and are relatively saturated (Yu et al., 2017). In the western region, where the rural areas are relatively underdeveloped, the existing various issues in the development of insurance inclusion consequently are difficult to be addressed through traditional insurance methods. In the central region, there is still room for the development of traditional insurance. The awareness and acceptance of rural inclusive insurance by farmers can be enhanced with a more developed traditional insurance market. It is also worth noting that the coefficients of the expenditures on rural subsistence allowance in the central region and the expenditures on the Five Guarantees program in the rural areas in the western region are both significantly negative, while they are insignificant in the eastern region. This suggests that the increase in the expenditures on rural subsistence allowance by the government in the central region inhibits the development of rural insurance inclusion, and the increase in the expenditures on the Five Guarantees program by the government in the rural areas in the western region also inhibits the development of insurance inclusion. A possible explanation is that the increase in the expenditures on subsistence allowance or the expenditures on the Five Guarantees program by government authorities in the rural areas of central and western regions enhances the social security level of farmers. As a result, social security substitutes for inclusive insurance (Marquis and Long, 2003), thus lowering the development level of insurance inclusion. In contrast, the eastern region has better economic development and relatively well-established social security systems. Therefore, the increase in government social security expenditure has a

lower marginal substitution effect on commercial insurance, and the substitution effect is insignificant.

(III) Robustness Test

In order to test the robustness of the results, this study replaces the core explanatory variables with alternative variables. Table 4 presents the results when the core explanatory variable, InsurTech, is replaced by the digitization

Table 4. Robustness test of the impact of InsurTech on insurance inclusion in rural areas -- replacement of explanatory variables

	(1)	(2)	(3)
	Development of insurance inclusion	Development of insurance inclusion	Development of insurance inclusion
Digitization of deposits	0.359***		
	(4.25)		
Digitization of loans		0.274***	
		(3.79)	
Digitization of finance			0.376***
			(4.51)
Development index of traditional insurance	-0.641	-1.038	-0.828
	(-0.80)	(-1.29)	(-1.05)
Average rural subsistence allowance standard	-0.584	-0.600	-0.490
	(-1.57)	(-1.58)	(-1.31)
Expenditures on the Five Guarantees program	-0.0124	-0.00897	-0.0113
	(-1.21)	(-0.86)	(-1.11)
Expenditures on rural subsistence allowance	-0.00226	-0.00119	-0.00189
	(-0.55)	(-0.29)	(-0.46)
Individual effect	YES	YES	YES
Time effect	YES	YES	YES
Constant term	-4.817***	-4.160***	-5.065***
	(-9.80)	(-10.85)	(-9.77)
Sample size	217	217	217
Adjusted R2	0.73	0.73	0.74

of deposits, digitization of loans, and digitization of financial services, which are calculated as the log-transformed ratio of deposits, loans, and total amount of deposits and loans, to the digitalization level, respectively.(9) The coefficients in columns (1)-(3) are all significantly positive, consistent with the findings of the previous analysis, thereby indicating the robustness of the original regression results.

V. Conclusion and Policy Recommendations

With the advancement of technology, the realm of InsurTech has become increasingly extensive. This study employs an empirical approach to explore the impact of InsurTech on the development of insurance inclusion in rural China. The following conclusions have been drawn:

Firstly, InsurTech promotes the overall development level of insurance inclusion in rural China, but its effect varies significantly across regions. For every 1% increase in InsurTech level, the overall level of insurance inclusion development rises by 0.176%. The strongest impact of InsurTech on insurance inclusion development is observed in western China, where a 1% increase in InsurTech level leads to a 0.414% increase in the level of insurance inclusion development. The comparable figures for the eastern and central regions are 0.238% and 0.155% respectively, indicating a relatively weaker impact.

Secondly, the average rural subsistence allowance standard and the expenditures on the Five Guarantees program have inhibitory effects on the development of insurance inclusion in rural areas. The inhibitory effect of rural social security on the development of insurance inclusion is more pronounced in western and central China. However, this inhibitory effect in eastern China is insignificant.

Thirdly, the development level of the overall insurance industry (mainly traditional insurance business) has a limited positive effect on the development level of insurance inclusion in rural areas. The overall improvement of the traditional insurance industry only partially promotes the development of

rural insurance inclusion in central China. The impact of the development level of insurance inclusion in the eastern and western rural regions is not significant.

The following policy recommendations are proposed to promote the development of insurance inclusion in rural areas through InsurTech:

First, implement regional support policies to enhance the application of InsurTech in rural areas. Government authorities can adopt regional policies and measures to encourage and support InsurTech companies in expanding their business in the western regions. This can be achieved through providing tax incentives, innovation funds, research and development subsidies, and other policies that foster InsurTech innovation and development in the western region. Moreover, InsurTech companies should be encouraged to expand the coverage of inclusive insurance in rural areas nationwide. By utilizing various InsurTech methods, they can provide more convenient modes of insurance enrollment and claims settlement for rural households, thereby enhancing the overall development of insurance inclusion in rural areas across the country.

Second, adopt differentiated social security policies to enhance the added value of insurance inclusion. The government can consider differentiated policies by formulating social security policies based on the specific circumstances of different regions. For instance, measures implemented for the central and western regions should ensure that increased social security expenditure does not significantly inhibit the development of insurance inclusion in rural areas. The government and the insurance industry can jointly strive to enhance the added value of inclusive insurance services, catering to the unique needs of rural households in different regions. This can be achieved by introducing more customized insurance products based on the local lifestyle, providing faster claims services and customer support, and reducing insurance operation costs.

Third, increase the involvement of the traditional insurance industry and collaboration with the government on insurance literacy and promotional

activities. Insurance companies could conduct market research to better understand the needs and risk profiles of rural households; and develop insurance products suitable for rural residents, taking into account their financial situation, such as installment payment options, in order to increase the appeal of insurance inclusion. The government and insurance companies can collaborate on organizing insurance education and promotional campaigns to improve rural residents' understanding of insurance, which includes explaining the differences between social security and commercial insurance to dispel misconceptions that rural farmers may have about the two, etc.

Notes:

(1) Insurance inclusion, as an integral part of financial inclusion, aims to effectively provide insurance products and services to individuals who are unable to access sufficient insurance services in the market. In this paper, inclusive insurance mainly refers to the basic protection services sold in rural areas of China, with lenient underwriting conditions and affordable premiums.

(2) Report on the Survey of Digital Literacy in Rural China, Source: http://iqte.cssn.cn/yjjg/fstyjzx/xxhyjzx/xsdt/202103/P020210311318247184884.pdf (retrieved on November 29, 2021).

(3) Cyberspace Administration of China. Http://www.cac.gov.cn/2018-01/31/c_1122347026.htm (retrieved on October 15, 2020).

(4) This paper adopts a logarithmic transformation to provide a smoothed classification index for the development level of InsurTech, thereby reducing heteroscedasticity.

(5) Expenditures on the Five Guarantees program refers to the allowance distributed by provincial governments to support the livelihood of individuals eligible for the Five Guarantees, or the centralized funding transferred to institutions providing care for such individuals. The central government's Five Guarantees program primarily includes the following aspects: guaranteed food, clothing, medical care, housing, and funeral expenses (with education being guaranteed for orphans). The beneficiaries of the Five Guarantees mainly consist of elderly, disabled, and underage individuals in rural areas who lack the ability to work, a source of income, or legally obligated caregivers with the means to fulfill their support obligations.

(6) The development index of overall insurance industry measures the overall level of insurance development in both rural and urban areas in a specific region, as evaluated by Sun et al. (2019). In this study, we utilize their measurement results (refer to Appendix Table 2).

(7) The administrative divisions of China have consisted of five levels in practice: the provincial (province, autonomous region, municipality, and special administrative region), prefecture, **county**, township, and village. There are currently 2843 counties in mainland China with aver-

agely 449 thousand population. Source: https://www.gov.cn/guoqing/2005-09/13/content_5043917.htm (retrieved on 10/23/2023).

(8) Due to a shortage of insurance agents available to visit dispersed rural households for promotional activities and claims settlement, insurance companies often enlist the assistance of village officials as well as agricultural technicians to organize and mobilize individual households for inclusive insurance. Insurance companies enter into contracts with these village officials or relevant departments of the village-level government. As per the agreement outlined in the contract, they receive a certain remuneration (not commission), typically not exceeding 3.5% to 5% of the premium, as compensation for their efforts.

(9) The total amount of deposits and loans refers to the combined sum of savings and short-term loans of both urban and rural residents in banking institutions. The data is sourced from the Economy Prediction System (EPS). The digitalization level is derived from the Digital Financial Inclusion Index of China (2018), published by the Institute of Digital Finance Peking University.

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Author Biography

Jian Wu, Ph.D., Lecturer at the School of Finance, Chongqing Technology and Business University, M.S. Supervisor, and Director of the Digital Financial Inclusion Research Institute, the Chongqing New Finance Research Center. Research interests: FinTech, insurance inclusion. Email: 263096834@qq.com.

Jie Shao, Ph.D., Assistant Professor at the School of Commerce, Waseda University.

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Appendix

Appendix Table 1 Development index of rural insurance inclusion

Province \ Year	2011	2012	2013	2014	2015	2016	2017
Beijing	0.390	0.447	0.441	0.427	0.499	0.617	0.626
Tianjin	0.057	0.075	0.163	0.171	0.248	0.247	0.359
Hebei	0.018	0.032	0.042	0.049	0.075	0.071	0.082
Shanxi	0.020	0.035	0.050	0.056	0.078	0.097	0.138
Inner Mongolia	0.145	0.149	0.204	0.231	0.246	0.273	0.333
Liaoning	0.043	0.080	0.104	0.127	0.157	0.122	0.141
Jilin	0.071	0.073	0.092	0.095	0.102	0.138	0.171
Heilongjiang	0.080	0.110	0.162	0.139	0.164	0.256	0.205
Shanghai	0.500	0.439	0.507	0.500	0.540	0.521	0.537
Jiangsu	0.038	0.050	0.061	0.068	0.077	0.078	0.094
Zhejiang	0.053	0.079	0.086	0.097	0.104	0.073	0.082
Anhui	0.051	0.062	0.076	0.072	0.083	0.103	0.101
Fujian	0.028	0.045	0.045	0.057	0.060	0.064	0.069
Jiangxi	0.030	0.037	0.042	0.052	0.052	0.050	0.062
Shandong	0.011	0.029	0.035	0.029	0.049	0.047	0.075
Henan	0.014	0.029	0.037	0.038	0.053	0.060	0.097
Hubei	0.022	0.028	0.036	0.038	0.037	0.046	0.057
Hunan	0.041	0.051	0.061	0.070	0.078	0.069	0.111
Guangdong	0.013	0.025	0.033	0.032	0.040	0.035	0.053
Guangxi	0.010	0.012	0.019	0.030	0.036	0.028	0.057
Hainan	0.093	0.101	0.108	0.132	0.123	0.122	0.160
Chongqing	0.049	0.058	0.048	0.052	0.069	0.077	0.081
Sichuan	0.043	0.057	0.071	0.070	0.082	0.080	0.099
Guizhou	0.007	0.013	0.020	0.039	0.045	0.033	0.058
Yunnan	0.036	0.043	0.063	0.066	0.067	0.065	0.068
Tibet	0.075	0.078	0.079	0.074	0.118	0.215	0.352
Shaanxi	0.011	0.019	0.047	0.047	0.068	0.068	0.088
Gansu	0.016	0.036	0.051	0.064	0.078	0.102	0.126
Qinghai	0.039	0.056	0.065	0.066	0.100	0.139	0.194
Ningxia	0.042	0.076	0.102	0.157	0.174	0.264	0.314
Xinjiang	0.121	0.147	0.189	0.223	0.226	0.249	0.264

Note: The results are retained to three decimal places, as in the table below.

Source: Sun R, Wu J, Cui W W. Inclusive Insurance and Its Development Level Measurement [J]. Insurance Studies, 2019(01): 58-74.

Appendix Table 2 Development index of the overall insurance industry

Province \ Year	2011	2012	2013	2014	2015	2016	2017
Beijing	0.456	0.479	0.498	0.572	0.681	0.638	0.723
Tianjin	0.202	0.206	0.219	0.227	0.270	0.301	0.302
Hebei	0.119	0.126	0.148	0.172	0.209	0.247	0.256
Shanxi	0.152	0.155	0.174	0.205	0.244	0.289	0.278
Inner Mongolia	0.087	0.085	0.104	0.108	0.128	0.152	0.212
Liaoning	0.154	0.157	0.167	0.203	0.248	0.367	0.337
Jilin	0.086	0.083	0.104	0.109	0.153	0.197	0.223
Heilongjiang	0.120	0.109	0.136	0.166	0.200	0.229	0.279
Shanghai	0.482	0.492	0.496	0.544	0.622	0.615	0.714
Jiangsu	0.125	0.131	0.146	0.164	0.183	0.226	0.252
Zhejiang	0.156	0.169	0.194	0.206	0.222	0.258	0.269
Anhui	0.117	0.123	0.134	0.151	0.166	0.203	0.228
Fujian	0.124	0.131	0.148	0.164	0.176	0.193	0.216
Jiangxi	0.082	0.087	0.101	0.117	0.149	0.166	0.181
Shandong	0.095	0.101	0.115	0.127	0.159	0.107	0.205
Henan	0.109	0.102	0.123	0.133	0.165	0.100	0.224
Hubei	0.111	0.103	0.118	0.133	0.158	0.187	0.208
Hunan	0.099	0.097	0.108	0.119	0.151	0.146	0.169
Guangdong	0.140	0.145	0.160	0.182	0.212	0.252	0.267
Guangxi	0.057	0.064	0.072	0.083	0.102	0.061	0.147
Hainan	0.130	0.138	0.148	0.181	0.210	0.229	0.237
Chongqing	0.147	0.147	0.160	0.174	0.209	0.240	0.240
Sichuan	0.150	0.149	0.167	0.186	0.211	0.264	0.264
Guizhou	0.081	0.088	0.097	0.102	0.120	0.139	0.151
Yunnan	0.116	0.115	0.123	0.141	0.153	0.183	0.189
Tibet	0.066	0.077	0.093	0.099	0.117	0.086	0.173
Shaanxi	0.122	0.120	0.138	0.151	0.176	0.209	0.222
Gansu	0.110	0.117	0.135	0.143	0.188	0.223	0.247
Qinghai	0.087	0.102	0.124	0.143	0.155	0.116	0.211
Ningxia	0.154	0.170	0.182	0.214	0.256	0.290	0.326
Xinjiang	0.142	0.161	0.175	0.179	0.218	0.207	0.260

Source: Sun R, Wu J, Cui W W. Inclusive Insurance and Its Development Level Measurement [J]. Insurance Studies, 2019(01): 58-74.