International Conference on Advances in Economics and Management Science (AEMS 2025)

Pension Insurance Coverage Problems under Gender and Rural-Urban Differences: An Empirical Study Based on China

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Abstract: The present study focuses on the relationship between gender and urban-rural differences in pension and health insurance coverage in China. The objective is to explore how gender inequality and urban-rural differences jointly affect the level of social security for individuals, especially rural women, in the context of China's rapid aging. Utilizing the China Health and Retirement Longitudinal Study (CHARLS) database, this study employs a range of econometric methods, including the two-way fixed effects model (TWFE) and the regression discontinuity model (RD), to empirically examine the participation rate and coverage level of pension and health insurance. The analysis reveals that the pension coverage rate for males exhibits a marked improvement following their retirement, while the corresponding rate for females does not demonstrate a similar enhancement, thereby underscoring substantial gender disparities. Additionally, the study highlights a pronounced imbalance between urban and rural regions with respect to pension and medical insurance coverage, placing rural residents at a disadvantage in terms of protection level and insurance participation. In light of the aforementioned empirical findings, this study proposes specific policy recommendations to enhance China's social security system and address the existing gender and urban-rural disparities. The primary objective of these recommendations is to contribute to the realization of the overarching goal of "common prosperity." The study contributes to extant theoretical research on gender and urban-rural differences in the pension system by providing data support and a theoretical foundation for the government to formulate more inclusive social security policies.

Keywords: China's Pension; Medical Insurance; Gender Differences; Urban-Rural Differences

1. Introduction

By the conclusion of 2024, the proportion of the population aged 65 and above had reached 15.6%, with the phenomenon of population aging becoming increasingly pronounced. In light of this, ensuring that the elderly have access to adequate pensions and medical care has become a critical component in the reform of the country's social security system. Historically, the coverage rate of urban workers' pension insurance has consistently exceeded that of rural residents, exacerbating the pronounced gender disparity in pension benefits. The gender gap in corporate pensions has widened from 10.18 to 23.15, with urban and rural female seniors receiving 23.54% and 37.07% lower monthly pensions compared to their male counterparts. Furthermore, due to the discrepancies in the retirement age system and social security policies between urban and rural areas and between genders, rural women encounter heightened challenges in receiving pensions and medical care, and their real-life difficulties have become more pronounced.

In view of the circumstances, a comprehensive investigation into the disparities in pension and medical insurance systems for the elderly, particularly rural women, is imperative. Such an investigation would not only unveil the specific inadequacies in the implementation of these systems but would also furnish an empirical foundation for the formulation of policies aimed at mitigating the urban-rural and gender disparities through reform. In recent years, the Chinese government has demonstrated a commitment to the reform and enhancement of the social security system. This commitment is evidenced by the "14th Five-Year Plan for the Development of the National Elderly Program and Elderly Service System," which explicitly acknowledges the necessity to upgrade the

fundamental insurance systems for the elderly, namely basic old-age insurance and basic medical insurance. The plan further emphasizes the promotion of personal pensions and the provision of substantial support for financial services catering to the elderly. The "Outline for the Development of Chinese Women (The Program for the Development of Chinese Women (2021-2030))" also proposes to enhance the social security system benefiting women's groups and reduce the gender protection gap. However, in practice, challenges related to gender and urban-rural disparities continue to impede the equitable participation of rural women in these systems. Consequently, systematic research on this issue is of great theoretical significance and practical value, as it can provide decision-making references and directions for improving rural women's pension and medical insurance levels and alleviating the practical difficulties they face. The present study employs two-way fixed-effects models and regression discontinuity models to systematically explore how gender and urban-rural factors jointly affect the level of social security. The analysis focuses on the double inequality faced by rural women in the process of insurance participation. This study addresses the call for action in the report of the to "improve a multi-level social security system that covers the entire population, integrates urban and rural areas, is fair and uniform, safe, standardized, and sustainable". It also aligns with the fundamental state policy of promoting gender equality.

2. Literature Review & Theoretical Analysis

2.1 Literature Review

The design of pension benefit models and issues of gender equity constitute a challenging area in which institutional arrangements and the impact of women's particular experiences in the labor market are intertwined to shape the pension gap. The existing employee pension system in China is rife with design flaws that serve to amplify existing imbalances between the genders. This suggests that the system could be optimized through the recalibration of contribution and benefit calculation formulae [1]. However, statistical analysis indicates that women's pension incomes are considerably lower than those of men, exhibiting variations across regions and age demographics. These findings provide empirical evidence in support of pension system reform and underscore the necessity for incorporating more gender-sensitive considerations into system design [2].

Recent years have seen a surge in research attention on the disparities in pension insurance coverage between urban and rural regions. These disparities have brought to light both the unequal distribution of income and the institutional challenges posed by differences in economic structure and labor markets. The integration of public pensions has contributed to narrowing the gap; however, its practical implementation continues to encounter significant challenges[3]. The advent of digital finance has enhanced financial accessibility for rural residents, thereby indirectly expanding pension coverage [4]. Drawing from the context of the common wealth, an empirical analysis of the differences in old-age entitlements between urban workers and urban and rural residents has been conducted. The results of the study show that the pension treatment of urban and rural residents is generally lower than that of urban workers, and this gap is not conducive to the realization of the goal of common wealth[5].

2.2 Theoretical Analysis and Hypothesis Formulation

In the context of population aging, the equity of pensions and health insurance is related to the economic security and accessibility of health care for the elderly. In an ideal scenario, all individuals would enjoy equal protection. However, in practice, women's pension contributions and accumulations are significantly lower than men's due to factors such as marriage and childbearing responsibilities, lower incomes, and career interruptions. Concurrently, despite women's higher healthcare needs, the prevailing health insurance system frequently falls short of adequately addressing their unique requirements. This discrepancy results in a disadvantageous position for women in terms of coverage, reimbursement ratios, and access to healthcare resources. The long-standing gender division of labor and income inequality engenders a situation in which women are disadvantaged with respect to pensions and health insurance.

Hypothesis 1: There are gender inequalities in the pension and health insurance markets, i.e., women's pension coverage and cumulative pension levels are lower than men's, while

women are less covered by the health insurance system than men.

China's historical urban-rural dual structure has resulted in considerable disparities between urban and rural regions with regard to economics, education, healthcare, infrastructure, and social security. Urban residents, as a demographic, enjoy superior protection through higher incomes and comprehensive enterprise pension insurance. In contrast, rural residents primarily rely on urban and rural residents' pension insurance, which provides significantly lower levels of protection and accumulated pensions. The weak economic base, limited contribution capacity, and information asymmetry in rural areas create a disadvantage in terms of access to public services and result in a heightened risk for rural populations.

Hypothesis 2: Rural population participation in the pension and health insurance systems is low.

From the perspective of gender and urban-rural interaction, it is challenging to fully elucidate the multiple disadvantages faced by rural women by examining only a single factor. Rural women face a dual challenge of underinsurance in terms of pensions and healthcare due to gender-related factors, including interrupted careers and lower incomes. Additionally, they are more marginalized within the social security system due to the disproportionate allocation of public services and resources in rural areas. The rural-urban disparity engenders a scenario wherein social security coverage and the quality of services in rural areas are found to be inferior to those in urban areas. This inequality is further compounded by rural women's constrained access to policy information and their limited engagement in decision-making processes. An in-depth exploration of this interaction can help reveal the multiple mechanisms of disadvantage and provide a theoretical and practical basis for more targeted policymaking.

Hypothesis 3: The interplay of gender and rural-urban contexts further exacerbates the inequalities faced by rural women in social security systems.

3. Data

3.1 Sample Selection & Data Source

The present study is based on data from the China Health and Retirement Longitudinal Study (CHARLS) for the period of 2011-2020.

The CHARLS database is notable for its comprehensive coverage of information pertinent to the study's subject matter, offering detailed data on a wide range of aspects, including individual pension receipt, health status, socioeconomic characteristics, and family support. This comprehensive set of data offers sufficient statistical power to undertake rigorous analyses of the interplay between household characteristics, gender disparities, and pension coverage. The external validity of the findings is ensured by the national representativeness of the CHARLS database and the multilevel sampling design, which employs a stratified multistage sampling methodology to randomly select communities and households within China and collects data by means of computer-assisted face-to-face interviews (CAPI). The sample is notable for its heterogeneity, encompassing individuals from diverse regions, urban and rural areas, and a range of socioeconomic backgrounds. This comprehensive sample ensures the study's representation of the middle-aged and elderly population in China[6].

3.2 Variables

The present study focuses on key variables that affect pension and health insurance participation. These include gender, household type, income level, health status, and education level. The selection of these variables is grounded in the extant literature on the subject, as well as the realities of China's pension financial system. The objective is to conduct a thorough analysis of how gender differences and urban-rural differences interact to influence pension coverage and its equity.

The subsequent Table 1 offers a comprehensive overview of the variables and their respective values.

The results of the descriptive statistics analysis for these key variables are presented in Table 2, providing a more intuitive picture of the data distribution and variable characteristics.

3.3 Descriptive Statistics

The descriptive statistics of the variables related to the study were saved in Table 2:

selected were Vgact c, Income total, Hospital, and Edu. The utilization of these control variables is predicated on their ability to curtail confounding interference, enhance the reliability of causal inference, and ensure that the analytical results accurately reflect the factors influencing pension insurance coverage. This, in

turn, serves to enhance the validity and credibility of the study, thereby facilitating a more comprehensive control of individual characteristics that may influence insurance coverage and external factors.

Table 1. Variables

	Variable	illustrate	Value
Independent Variables	Gender	Gender	1: male; 0: female
	Rural	Household registration type	1: rural household registration; 0: urban household registration
Control Variables	Vgact c	Do you exercise every day?	1: Yes; 0: No
	Income total	Total household income	Numeric variables
	Edu	Education level (years of education or highest degree)	Score 1-4, higher values indicate a higher education level
	Hospital	Hospitalization	1: hospitalization experience; 0: no hospitalization experience
	Srh	Self-assessed health status	Subjective evaluations such as "very good" and "average"
	Livere	Do you have liver disease?	1: have; 0: not have
	Cancre	Whether you have cancer	1: have; 0: not have
	Diabe	Whether you have diabetes	1: have; 0: not have
	Dyslipe	Do you have dyslipidemia?	1: have; 0: not have
	Stroke	Whether you have had a stroke	1: have; 0: not have

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gender	96621	.475	.499	0	1
Rural	96628	.596	.491	0	1
Vgact c	61936	.34	.474	0	1
Income total	59086	37705.885	189481.57	-2985090	39059568
Hospital	95899	.147	.354	0	1
Edu	96489	2.019	1.056	1	4
Sr	90716	3.045	.986	1	5
Livere	91130	.057	.233	0	1
Cancer	91286	.018	.132	0	1
Diabe	90976	.104	.305	0	1
Dyslipe	90085	.184	.387	0	1
Stroke	91451	.05	.217	0	1

In the regression analysis, the control variables Vgact c (the decision to continue daily exercise) reflects that individuals in better health may delay enrollment, while those in poorer health may rely more on the protection features provided by pension insurance. Income total (total household income) shows that the high-income group may opt for commercial pension insurance or save on their own, while the low-income group may ignore the need for enrollment due to financial pressures. The variable Hospital (Hospitalization) indicates that individuals who have experienced hospitalization, particularly those with major illnesses, may place greater emphasis on pension insurance coverage. The variable Edu (Education) demonstrates that individuals with higher education levels are more likely to recognize the importance of pension insurance and actively engage in the system, while those with lower levels of education may exhibit lower participation rates due to asymmetric information or a lack of understanding of the system.

4. Empirical Design

4.1 Two-Way Fixed Effects Model

In future research we would like to investigate, for example, the demand for insurance/pensions by age (among others), so we need to construct individual and city fixed-effects models to identify a range of causal inferences.

$$Insurance_i=\beta_0+\beta_1 age_i+\Sigma X_i+\tau_i+\varepsilon_i \quad (1)$$

$Insuranc_i$ is the dependent variable, indicating the share of insurance purchased by individual i.

Ages are the individual's age. β_1 it captures the amount of change in insurance status when age changes by one unit.

$\sum X_i$ this represents a series of control variables (X_i), including income level, education level, etc.

τ_i it is a city-fixed effect, which reduces identification bias caused by problems such as omitted variables by clustering individuals at the city level.

$\varepsilon_i$this is the error term, which represents the part that cannot be explained by the model and includes all random fluctuations that cannot be captured by known explanatory variables (such as age, control variables, etc.).

In the regression analysis, unobservable differences between individuals and systematic differences between cities can be controlled by introducing individual and city fixed effects, respectively. This improvement in model accuracy and the reliability of causal inference is achieved by addressing these differences. Concurrently, the implementation of city-level clustering standard errors can adjust the potential error correlation between individuals within the same city, thereby enhancing the robustness of the regression results.

4.2 Regression Discontinuity Model

Given the observed discrepancy in retirement age between genders, the objective is to ascertain whether this disparity results in differences in pension insurance ownership between the sexes. To this end, we intend to construct a Regression Discontinuity (RD) model, employing an explicit RDD design in this study to explore the potential impacts of gender-specific retirement age discontinuities.

$$\text{pension}_\text{r}\text{esidual}_\text{i} = \gamma_1 \text{I}(\text{age} \geq c_\text{i}) + \gamma_2 \text{f}(\text{age} - c_\text{i}) + \gamma_3 \text{I}(\text{age} \geq c_\text{i}) \cdot \text{f}(\text{age} - c_\text{i}) + \Sigma X_\text{i} + u_\text{i} \quad (2)$$

The regression analysis employed in this study utilizes a method that effectively overcomes the bias problems that may exist with traditional methods, especially when there is potential heteroskedasticity and nonlinearity in the data. The method employs a more accurate design of regression discontinuities with adaptive bandwidth, which makes the estimates more robust and more reliable. Consequently, the implementation of this method enhances the precision and reliability of our analytical outcomes.

Initially, we estimated the fixed effect model based on formula (1) and extracted the residual of the model, that $\text{pension}_\text{r}\text{esidual}_\text{i}$. This step aims to control for the effects of the variables through the fixed effects model and incorporate city fixed effects to capture the unexplained component more precisely. In the subsequent step, we utilize $\text{pension}_\text{r}\text{esidual}_\text{i}$ as the dependent variable and categorize the male and female samples separately. We establish the breakpoints (age) to 60 and 55 years of age for each sample group to analyze the regression discontinuity (RD) independently. This is due to the fact that the national legal retirement age for enterprise workers is 60 years of age or older for males, 50 years of age or older for female workers, and 55 years of age or older for female cadres. Additionally, $\text{I}(\text{age} \geq c_\text{i})$it is an indicator variable, which assumes the value of 1 when the sample age exceeds the threshold; $\text{f}(\text{age} - c_\text{i})$ it signifies the distance of the sample age from the threshold, and it is a running variable. Meanwhile, ΣX_i represents a series of control variables, consistent with the previous setting; indicates the error term.

5. Results

5.1 Individual Cognitive Abilities and Disease Status do Differ between Genders

Before formally presenting the regression results, the effect of gender on disease incidence and health perception was verified. To comprehensively reflect individual health status, we selected individual health perception, liver disease, cancer, diabetes, dyslipidemia, and stroke as indicators. These common diseases are representative and applied to ensure the robustness and generalizability of the regression results. To this end, we employed equation (1) to regress these variables, the results of which are presented in Table 3.

Table 3. Individual's Cognitive Ability and Disease Status Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
	srh	livere	cancre	diabe	dyslipe	stroke
gender	0.105***	0.011***	-0.005***	-0.015***	-0.029***	0.017***
	(0.012)	(0.004)	(0.002)	(0.005)	(0.006)	(0.003)

rural	-0.105***	-0.003	-0.007**	-0.040***	-0.069***	-0.009*
	(0.025)	(0.005)	(0.003)	(0.006)	(0.009)	(0.005)
vgact_c	0.126***	0.003	-0.008***	-0.023***	-0.016***	-0.029***
	(0.013)	(0.003)	(0.002)	(0.004)	(0.005)	(0.003)
income_total	0.000*	0.000	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
hospital	-0.570***	0.049***	0.034***	0.107***	0.141***	0.086***
	(0.016)	(0.005)	(0.003)	(0.007)	(0.006)	(0.006)
edu	0.064***	0.005**	0.000	-0.002	0.019***	-0.008***
	(0.007)	(0.002)	(0.001)	(0.002)	(0.003)	(0.002)
_cons	2.955***	0.042***	0.025***	0.149***	0.220***	0.070***
	(0.022)	(0.005)	(0.003)	(0.006)	(0.009)	(0.005)
N	40149	42168	42213	42142	41951	42238
r2	0.105	0.031	0.018	0.039	0.075	0.037
Year	Yes	Yes	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes	Yes	Yes

Notes. Dependent variables: (1) srh=self-rated health (1=good+,0=poor), (2) livere=liver disease (1 = yes; 0 = no), (3) cancre=cancer (1 = yes; 0 = no), (4) diabe=diabetes (1 = yes; 0 = no), (5) dyslipe=dyslipidemia (1 = yes; 0 = no), (6) stroke=stroke (1 = yes; 0 = no).

Key IV: gender(1 = female, 0 = male);

Controls:(1)rural: rural household registration (1 = rural; 0 = urban) (2)vgact_c: frequency of social activities (standardized) (3)income_total: monthly per capita household income (yuan) (4)hospital: number of hospitalizations in the past year (5)edu: years of education

Robust SE in parentheses; *** p < 0.01, ** p < 0.05, * p < 0.10.

Coefficients are marginal effects.

A review of the regression results presented in Table 2 reveals several noteworthy findings. Firstly, the findings in column (1) suggest that males exhibit elevated levels of self-perceived health and a stronger propensity to perceive themselves as healthy. Conversely, the results in columns (3), (4), and (5) reveal that women exhibit a significantly higher propensity to develop cancer, diabetes, and dyslipidemia compared to men. Secondly, the results in columns (2) and (6) demonstrate that men exhibit a higher propensity for developing liver disease and stroke compared to women. These findings serve to further validate the hypothesis that gender differences are indeed heterogeneous in terms of health perceptions and disease manifestation. They also provide a critical foundation for our subsequent gender-based studies.

5.2 Baseline regression - RD results

The present study employs model (2) to evaluate the ownership of pension insurance for men and women at varying retirement ages (60 and 55). The regression results are detailed in Table 4 below.

Table 4. Pension Insurance Regression Results for Men and Women at Different Retirement Ages

	(1)	(2)
	Pension_residual	Pension_residual
RD_Estimate	0.171***	-0.013
	(0.038)	(0.032)
N	18821	20051
Sample	Male	Female
Controls	Yes	Yes
City	Yes	Yes

As illustrated by the findings presented in the initial column of Table 4, the regression outcomes for the specified breakpoint, indicating men retiring at age 60, persist in holding significance at the 1% level of statistical significance, subsequent to controlling for an array of control variables and city fixed effects. This finding indicates that the probability of pension and insurance ownership experiences a substantial increase for men following their retirement. Conversely, for women, the probability of possessing a pension after retirement does not exhibit a significant change, which may reflect gender-related inequalities in social security policies. The findings indicate that while male retirees receive more substantial pension and insurance coverage, female retirees do not experience comparable enhancements in these benefits.

The initial finding indicates the presence of gender inequalities in the domains of pension

and health insurance. Specifically, the analysis reveals that women exhibit lower levels of pension coverage and accumulated pension amounts in comparison to their male counterparts. Additionally, women demonstrate less comprehensive coverage by the health insurance system compared to men.

A more visual representation of these results is provided in Figure 1, which clearly demonstrates that the breakpoints are more pronounced in the male sample, though less so in the female sample.

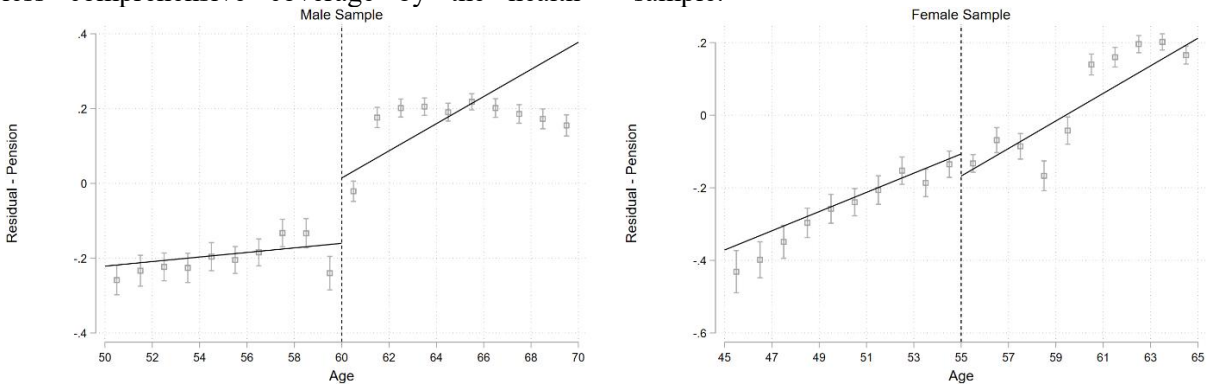

Figure 1. RD Result

5.3 Robustness Tests

Table 5. Robustness Test Results

	(1)	(2)	(3)
	Ins	pension	pension
gender	0.002	0.011**	-0.008
	(0.002)	(0.005)	(0.006)
rural	0.004	-0.099***	-0.114***
	(0.004)	(0.016)	(0.016)
vgact_c	0.013***	-0.114***	-0.115***
	(0.002)	(0.007)	(0.007)
income_total	0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)
hospital	0.016***	0.105***	0.105***
	(0.003)	(0.006)	(0.006)
edu	0.012***	-0.012***	-0.012***
	(0.001)	(0.004)	(0.004)
rural_male			0.031***
			(0.008)
_cons	0.920***	0.784***	0.794***
	(0.004)	(0.011)	(0.011)
N	42272	38912	38912
r2	0.021	0.072	0.072
Year	Yes	Yes	Yes
City	Yes	Yes	Yes

Despite the noteworthy findings of the RD model, concerns persist regarding the selection of the breakpoint age. Specifically, the possibility of early retirement by individuals opting to forgo a portion of their pension or due to health-related issues introduces an element of uncertainty to the results. In this section, we re-run the TWFE model based on equation (1), and the regression results are displayed in Table 5.

A result of 0.011 was obtained for the gender variable in column Table 5 (2). This indicates that the probability of having a pension is 1.1% higher for males than for females, and the regression results maintain significance at the 5% level of confidence, thereby substantiating the robustness of our benchmark regression results.

5.4 Heterogeneity Analysis

Furthermore, concerns have been raised regarding insurance equity in rural areas. The Heterogeneity Analysis section will explore whether rural residents face health insurance as well as pension insurance discrimination relative to urban residents.

Initially, the regression results in Table 5(1) column (Ins stands for whether or not one has health insurance) indicate that the regression coefficients of both the rural and gender variables are insignificant. This finding suggests that the Chinese government's vigorous promotion and popularization of health insurance policies has effectively mitigated the disparity in health insurance coverage between urban and rural residents. The government's policy intervention has effectively reduced the disparity in health insurance coverage between urban and rural areas as well as between genders. Secondly, as evidenced by the results presented in Table 5 (2) column, the regression coefficient of rural is -0.099, which is significant at the 1% level of confidence. This finding suggests that rural residents exhibit a substantially lower probability of possessing pension insurance compared to their urban counterparts, thereby

underscoring the persistent disparity in pension insurance coverage between urban and rural regions.

Conclusion 2: The rural population exhibits a lower level of engagement with pension and health insurance systems.

In column Table 5 (3), the interaction term between gender and rural is introduced to examine the pension insurance participation of rural females. The regression results for the rural_male term are positive and significant. This finding suggests that, despite the overall low rate of pension insurance coverage in rural areas, males still enjoy a significant advantage in accessing pension insurance. This further validates the gender discrimination issue for rural females in terms of pension insurance.

Conclusion 3: The interaction between gender and rural-urban contexts has the potential to further amplify existing inequalities experienced by rural women within the social security system.

6. Conclusion

This paper utilizes the China Health and Retirement Longitudinal Study (CHARLS) database to conduct an empirical investigation into the disparities in pension and medical insurance coverage between urban and rural populations. The analysis employs a two-way fixed effect model and a regression discontinuity model to examine the influence of gender and geographical location on insurance coverage. The study revealed that after attaining the stipulated retirement age, the pension participation rate of males exhibited a substantial increase, while that of females did not increase to the same extent. This finding suggests that the actual pension security obtained by females after retirement is inadequate. On the basis of the current payment period and calculation method, the payment period threshold for female employees should be appropriately lowered, and the gender cutoff coefficient in the pension calculation should be increased to narrow the pension gap between men and women after retirement. In the adjustment of pensions for retired employees of government agencies, institutions, and enterprises, a "special subsidy for women" should be established to provide additional fiscal transfers to low- and middle-income female retirees, so that their pension level can reach at least 85% of the local average. Concurrently, a discernible disparity exists between urban and rural regions with respect to participation rates and protection levels. Notably, the rural female demographic exhibits the most pronounced deficiencies in these areas. The incentive mechanism for rural social insurance participation must be improved, and payment subsidies or tax exemptions must be provided for rural women to encourage their active participation in insurance. Simultaneously, the registration and declaration process for insurance participation must be simplified to reduce institutional barriers. A "Rural Women's Health Pension Fund" is to be established at the national level. The utilization of central-local matching investment will be specifically allocated to the enhancement of the medical insurance reimbursement ratio for rural women, in conjunction with major disease pooling and long-term care insurance.

In summary, this study not only reveals the structural shortcomings of my country's social security system in terms of gender and urban-rural dimensions, but also proposes a precise policy adjustment path based on empirical results. Through differentiated payment and benefit design, special financial subsidies and system process optimization, it is expected that the level of pension and medical security for women, especially rural women, will be further improved in the future, and a more equitable and sustainable development of the social security system will be achieved.

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