# Research on the Sustainability Risk and Countermeasures of Pension Fund under Negative Population Growth

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**Abstract**

This study examines the sustainability of China's pension funds in a context of negative population growth, analyzing how demographic shifts, economic fluctuations, and institutional flaws impact fund operations. The research reveals that declining working-age populations and accelerating aging are causing imbalances in fund revenues and expenditures. Slower economic growth and inflation further erode contribution capacity and investment returns, while the drawbacks of the Pay-as-you-go system and provincial-level pooling models exacerbate regional risks. Pension funds face multiple challenges including revenue-expenditure imbalances, investment volatility, systemic design flaws, and population mobility-induced risks. The study proposes comprehensive optimization strategies encompassing population structure improvement, diversified funding channels, expenditure control, enhanced investment management, and institutional reforms. These measures aim to provide theoretical and practical references for addressing the sustainability challenges of pension funds under negative population growth.

**Keywords:** Negative Population Growth, Pension Fund, Sustainability, Income Balance, System Optimization

**Competing interests:**

The author declares that there is no conflict of interest.

## 1. Introduction

In the global demographic transformation, negative population growth has become a pressing challenge for many countries. Japan and Germany, among others, are grappling with public pension payment crises exacerbated by aging populations and declining birth rates. By the end of 2024, China's population aged 65 and above accounted for 15.6% of the total, significantly exceeding international standards for an aging society. This proportion is projected to surpass 21% around 2035, marking China's entry into a stage of severe aging. By 2040, the country's aging population will outpace that of most developed nations. This demographic shift not only signals a shrinking labor market but also directly threatens the financial balance of pension funds. As the cornerstone of social security systems, the sustainability of pension funds directly impacts the retirement livelihoods of hundreds of millions of citizens. The shrinking contribution base and expanding beneficiary groups caused by negative population growth are eroding the foundation of stable fund operations, sparking widespread societal concerns about the survival and development of pension systems.

Theoretically, the study of fund sustainability risk under this situation can fill the theoretical gap and promote the development of social security theory and interdisciplinary development; practically, the identification of risks and countermeasures are conducive to optimizing the system, improving management, enhancing the ability to resist risks, and safeguarding the rights and interests of the insured and social stability.

Based on this, this paper comprehensively uses the literature research method to sort out the relevant achievements at home and abroad and grasp the research trend; adopts the qualitative analysis method to carry out logical deduction and theoretical analysis on the relationship between negative population growth and the sustainability risk of pension insurance fund, and deeply analyze the risk mechanism and coping strategies.

## 2. Literature Review

Against the background of slowing global population growth, the negative population growth driven by long-term low fertility and low mortality (2021) has exacerbated the challenge of aging, which not only profoundly affects the social production process, but also poses severe pressure on the sustainability of pension funds.

In view of the labor shortage problem, Clark et al. (2010) advocated to alleviate the economic impact by encouraging young and middle-aged women and the elderly over 60 years old to re-employment, while Zhang Chunxiao et al. (2023) emphasized the dual promoting role of improving population quality in economic growth and the sustainability of pension funds.

In the research on pension insurance sustainability, from the perspective of financial sustainability, domestic scholars such as Gao Chengyu et al.(2023) have found through actuarial models that reducing contribution rates and base amounts can improve the revenue and

expenditure of urban employee pension funds. International studies focus on mechanism innovation: Godinez et al.(2016) proposed an automatic balancing mechanism to optimize contribution rates and retirement age, while Jaafar et al.(2019) argued that trends like increased life expectancy, declining birth rates, and population aging would pose sustainability challenges for existing pension systems. From the institutional sustainability angle, European countries generally transition from defined-benefit pay-as-you-go pension systems to defined-nominal contribution systems to reduce pension expenditures and enhance institutional sustainability. Coda et al.(2009) suggested introducing flexible retirement mechanisms to mitigate reform risks. China's pension research started relatively late, with limited studies on pension reform measures. Tuo Hongwu et al.(2020) revealed deep-seated issues in China's pension system, including structural imbalances, insufficient fund sustainability, and obstacles to national coordination.

In summary, existing studies predominantly focus on population growth scenarios, emphasizing micro-level actuarial analyses or macro-level mechanism investigations. However, they have yet to systematically deconstruct the sustainability risks of pension funds under negative population growth. This paper examines the fund sustainability crisis triggered by negative population growth from a risk management perspective, proposing actionable optimization strategies to bridge the research gap in practical implementation.

## 3. The Impact of Negative Population Growth on the Sustainability of Pension Insurance Fund

### 3.1 The impact of demographic change

Demographic shifts profoundly impact the sustainability of pension funds. China's accelerating aging population and rising dependency ratios mean more seniors are receiving pensions while fewer young workers contribute to pension insurance. Under the pay-as-you-go model, this creates a funding gap where income growth stagnates while expenditure pressures mount, potentially leading to insolvency. The declining birth rate further weakens workforce replenishment, exacerbating pension fund depletion. With extended life expectancy, retirees' pension durations are lengthening, adding to the financial strain on pension systems.

### 3.2 The impact of changes in the economic environment

When economic growth slows, corporate profitability declines and employee income growth becomes constrained, directly hindering the increase of pension insurance contribution bases and weakening fund revenue growth. Meanwhile, enterprises may reduce insured personnel or lower contribution levels to cut costs, further eroding funding sources. From a fiscal perspective, slowing economic growth reduces government revenue growth. Since pension funds heavily rely on fiscal subsidies for operations, declining subsidy capacity poses challenges to fund balance. For instance, China's enterprise employee basic pension fund faces

significant funding gaps after excluding fiscal subsidies. During economic slowdowns, governments struggle to sustain large-scale subsidies to maintain fund operations. Additionally, inflation erodes the real purchasing power of pension funds. To preserve pension value, increased benefit payments strain fund expenditures. Interest rate fluctuations also impact investment returns: low-interest environments diminish fund returns, undermining their accumulation and preservation capabilities – ultimately threatening the sustainability of pension funds.

### 3.3 Institutional influence

Under the pay-as-you-go system, pension contributions from today's workforce primarily fund current retirees' pensions, serving as a powerful mechanism for redistribution and social solidarity. However, demographic shifts have increasingly exposed this system's sustainability challenges. China's rapidly aging population, marked by a continuously rising old-age dependency ratio, means more seniors are receiving pensions while fewer young workers contribute to the system. This creates a paradoxical situation where fund revenues stagnate while expenditure pressures mount. Projections indicate that by 2035, the proportion of people aged 65 and above will exceed 21% of the total population. Such demographic changes risk causing the system's revenue-to-expenditure growth rate to reverse, severely threatening its viability. The system also exacerbates intergenerational pension inequality: young contributors today may face reduced benefits in retirement due to dwindling contributors, creating mismatched compensation. Moreover, the pay-as-you-go model crowds out private savings, hindering capital accumulation and economic growth. Compounding these issues, increased fiscal burdens and higher labor costs further undermine the economic foundation for maintaining pension fund sustainability.

## 4. Types of Risks Facing the Sustainability of Pension Insurance Fund

### 4.1 Risk of income and expenditure imbalance

From the income side, the aging population leads to a decline in the proportion of contributors, and the trend of fewer children further reduces the future labor supply, directly weakening the fund contribution base; economic fluctuations may lead to insufficient contributions or shrinking coverage of insurance due to declining corporate profits, while irregular determination of contribution bases in some regions will also cause loss of fund revenue.

From the expenditure perspective, extended life expectancy has significantly increased pension benefit durations. The normalization of benefit adjustment mechanisms and the concentrated release of retirees during the peak aging period have created sustained spending pressures. Meanwhile, inadequate coordination mechanisms in institutional design limit inter-regional fund allocation capacity, while the need to resolve historical liabilities for certain

groups further exacerbates revenue-expenditure alignment challenges. Without effective regulatory mechanisms, this could trigger local fund depletion or even systemic payment crises.

### 4.2 Risk in investment

The investment risks of pension funds permeate the entire capital operation process, posing multiple challenges to their value preservation and appreciation. In terms of market conditions, interest rate fluctuations directly impact the stability of fixed-income assets 'returns. Low-interest cycles compress interest income margins, while severe volatility in equity markets may cause significant net asset value (NAV) declines in stocks and funds. For instance, global capital market turbulence in 2022 led to short-term losses in some pension portfolios. Regarding investment channels, China's pension funds still face limitations in investment scope. The high proportion of highly liquid assets strains long-term returns, while alternative investments like infrastructure and private equity, though promising, suffer from liquidity constraints and valuation complexities that may affect immediate payment capabilities. Additionally, imperfect investment management mechanisms and information asymmetry in principal-agent relationships could trigger moral hazards. Some institutions over-leverage risks for short-term gains, while inadequate cross-cycle investment capacity makes them vulnerable to economic cycles. These factors collectively heighten uncertainties in pension funds' value preservation and appreciation processes, potentially threatening their long-term sustainability.

### 4.3 Institutional risks

At the coordination level, although nationwide pooling has been progressively implemented, regional policy disparities remain unresolved. Some provinces still rely on central government adjustment funds to fill funding gaps, while unclear delineation of responsibilities between local governments in fund collection and expenditure management fosters a "free-rider mentality," undermining pooled fund efficiency. Regarding institutional alignment, the conversion channels between urban employee pension insurance and rural-urban resident pension systems are inadequate. When insured individuals cross-systems, their benefits face incomplete continuity, reducing contribution willingness among certain groups and jeopardizing fund sustainability. Moreover, pension benefit adjustment mechanisms and distribution methods lack dynamic linkage with life expectancy and economic growth rates, leading to passive expansion of expenditures as aging accelerates. Insufficient incentive mechanisms for contributions further exacerbate fund imbalance by encouraging some flexible workers to choose minimum contribution bases, threatening the long-term stable operation of pension funds.

### 4.4 Population mobility risks

The impact of population mobility on pension fund sustainability primarily manifests through structural imbalances in inter-regional fund revenues and expenditures. The massive

migration of young and middle-aged workers from underdeveloped regions to economically active areas like eastern coastal zones has led to a sharp decline in contributors in source areas while concentrating pension recipients in destination regions. This creates compounded pressures of shrinking fund income and mounting expenditure, with some central and western provinces already experiencing rapid depletion of accumulated fund balances. Although destination areas temporarily benefit from increased labor supply expanding contribution bases, long-term consequences emerge: as migrant populations age and return home or retire locally, they gradually become pension recipients, significantly increasing future funding burdens. Furthermore, cumbersome procedures for transferring pension insurance relationships and fragmented benefit records exacerbate issues. Some individuals interrupt contributions or opt out during cross-regional migrations, undermining continuous fund accumulation and weakening institutional engagement. These factors collectively amplify the sustainability risks posed by population mobility.

## 5. Suggestions on Improving the Sustainability of Pension Insurance Fund

### 5.1 Optimize the population structure and alleviate the pressure of negative population growth

By implementing proactive fertility support policies—including enhanced childbirth subsidies and childcare services—these measures can gradually reverse the declining birth rate trend. This will increase future labor supply, expand the pension insurance contribution base over the long term, and ensure a steady income stream for the fund. Simultaneously, moderately raising the statutory retirement age would extend workers' contribution periods while shortening pension withdrawal cycles. This approach not only eases current fund expenditure pressures but also maximizes the utilization of elderly human resources to boost fund revenue capacity. Building on this foundation, guiding population distribution through industrial upgrading and regional coordinated development can reduce regional fund imbalances caused by excessive migration. Combined with streamlined reforms for transferring social security relationships among migrant populations, these measures enhance institutional participation retention, prevent fund losses from interrupted contributions or policy cancellations, and consolidate the sustainability of pension insurance funds from multiple perspectives of population structure optimization.

### 5.2 Expand the income channels of funds

To optimize pension fund channels, efforts should focus on both revenue expansion and value-added initiatives. On the funding front, this can be achieved by elevating the pooling level of pension insurance funds, expanding coverage to include flexible employment personnel and new business models, while establishing long-term fiscal investment mechanisms such as

moderately increasing state capital allocation to social security funds to bolster fund reserves. On the investment side, diversifying fund channels is crucial. Under strict risk control, increased allocation to high-quality equities, infrastructure, real estate, and other alternative assets will enhance long-term returns through diversified portfolios. Simultaneously, improving investment supervision systems will help mitigate losses from market fluctuations. Enterprises can also boost operational efficiency by introducing market-oriented management institutions and utilizing professional investment tools, achieving a balance between fund preservation, appreciation, and risk control – thereby providing solid support for the sustainable operation of pension funds.

### 5.3 Reasonable control of fund expenditure

First, it is crucial to establish a dynamic adjustment mechanism for pension benefits that aligns with economic development levels, price fluctuations, and fiscal capacity. This prevents benefit increases from becoming disconnected from fund sustainability. While ensuring basic living standards for retirees, we should moderately slow benefit growth rates by implementing scientific adjustment coefficients based on price indices and average wage growth rates. Second, strict regulations must be enforced to standardize pension eligibility criteria and combat fraudulent claims. Through big data verification, we can eliminate duplicate enrollments and fraudulent withdrawals to reduce fund leakage. Given the reality of extended life expectancy, we should gradually optimize pension calculation periods to match benefit distribution with longevity trends, thereby avoiding excessive fund pressure caused by prolonged benefit periods. Additionally, developing a multi-tiered pension system could guide individuals and enterprises to participate in commercial insurance and occupational annuities. This would shift the burden of basic pension expenditures, structurally alleviate fund payment pressures, and establish a robust safeguard for the long-term stable operation of pension funds.

### 5.4 Strengthen fund investment management

Strengthening pension fund investment management is crucial for enhancing the sustainability of pension insurance funds, with the core focus on preserving and increasing capital value while maintaining risk control. On one hand, it's essential to broaden investment channels. While consolidating fixed-income asset allocations, we should moderately increase investments in high-quality equities, real estate, infrastructure, and other alternative assets. Diversified portfolios can help mitigate market risks and identify long-term growth opportunities, such as participating in national major projects to share the dividends of economic development. On the other hand, we need to improve the investment risk management system by establishing dynamic risk assessment mechanisms. Utilizing big data and quantitative models to monitor market fluctuations, setting strict stop-loss lines and risk reserve systems can prevent systemic risks from eroding principal values. Introducing

professional investment management institutions and refining market-oriented incentive mechanisms will enhance decision-making scientific rigor and efficiency, avoiding administrative interference that may lead to inefficient investments. Additionally, transparent information disclosure systems should be implemented to strengthen public oversight, ensuring compliant and prudent investment practices. This approach not only achieves fund appreciation but also provides solid financial support for stable pension benefit disbursements, fundamentally strengthening the sustainable operation capacity of pension funds.

### 5.5 Improve the design of the old-age insurance system

Refining the pension system design is a fundamental measure to enhance fund sustainability. At the coordination level, deepening national pooling reforms can break down regional barriers in pension funds. By unifying contribution bases, benefit calculation standards, and adjustment mechanisms, this approach balances regional revenue-expenditure disparities, prevents provinces from falling into financial distress due to accelerated aging or economic fluctuations, and strengthens the system's overall risk resilience.

In terms of payment and benefit mechanism, we will establish an incentive mechanism of "the more you pay, the more you get; the longer you pay, the more you get", appropriately raise the minimum payment period, and dynamically link pension benefits adjustment with price increases, wage increases and fund income and expenditure conditions to avoid rigid increase of benefits and the disconnect between fund support capacity.

Meanwhile, we need to further improve the multi-tiered pension insurance system and optimize the transfer and continuation rules for social security relationships of migrant populations. It is essential to clarify the foundational role of basic pension insurance, while recognizing the supplementary functions of enterprise annuities and individual pensions. By implementing tax incentives to guide private capital participation, we can alleviate the financial pressure on basic funds. We must eliminate policy barriers to cross-system and cross-regional enrollment, enhance institutional coverage and ensure continuous participation. These measures will fundamentally optimize the fund's revenue-expenditure structure, laying a solid institutional foundation for the long-term stable operation of pension insurance funds.

## References

[1] Tao Tao, Jin Guangzhao, Guo Yalong. Comparison of two types of population decline: connotation definition, demographic significance and economic impact. Population Research, 2021(6):14-28.

[2] Clark R L,Ogawa N,Kondo M,. Population decline,labor force stability,and the future of the Japanese economy[J]. European Journal of Population,2010,26(3): 207-227.

[3] Zhai Zhenwu, Jin Guangzhao. China's Population Negative Growth: Characteristics, Challenges and Responses [J]. Population Research, 2023(2):11-20.

[4] Gao Dengyu, Li Peng. Research on Actuarial Balance and Sustainability of China's Pension Insurance Fund [J]. Financial Supervision Research, 2023(5):54-77.

[5] Godínez O H,Carmen D,Boado P M,Haberman S.Optimal strategies for pay-as-you-go pension finance: Asustainability framework[J]. Insurance: Mathematics and Economics, 2016, 69(2): 117-126

[6] Jaafar R,Daly K J,Mishra A V. Challenges facing Malaysia pension scheme in an era of ageing population[J].Finance Research Letters,2019,30(3):334-340.

[7] Coda M F,Fornero E. How to strengthen the credibility of the Italian pension reform [J]. The Geneva Papers on Risk and Insurance Issues and Practice,2009,34(4):591-601.

[8] Tuo Hongwu, Yang Yansui. Pension System and Its Reform: Analysis Based on Different Welfare Models [J]. Economic System Reform, 2020(2):11-16.