International Journal of Asian Social Science Research; Vol.2, No.1; 2025
E-ISSN: 3006-2179 P-ISSN：3006-754X
DOI: https://doi.org/10.70267/g6q4bd70
Published by: Zeus Press

Research on the Optimisation of Commercial Pension Insurance System Design in China: A Qualitative Analysis Based on an International Comparative Perspective

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Abstract

This paper qualitatively analyses China's commercial pension insurance system from an international comparative angle, identifying issues such as insufficient tax incentives, product homogeneity, and a lack of policy coordination. On the basis of the experiences of the U.S. market-led system and Japan's government–market synergy, an "optimisation framework" of "strong incentives, broad coverage, and innovation" is constructed. Specifically, it proposes optimising the tax incentive system, innovating products and services, and strengthening policy synergies, along with planning a phased implementation plan and risk control measures. However, the study also reveals that there are problems such as incomplete data coverage, shallow policy analysis, and limitations in international comparisons. Thus, future research can be conducted in directions such as integrating pension models, building risk-sharing mechanisms, and deepening international exchanges and cooperation. Overall, this study aims to offer theoretical and practical guidance for the optimisation of China's commercial pension insurance system, help address aging challenges, promote the transformation of the "silver hair crisis" into the "longevity dividend", and contribute Chinese wisdom to global aging governance.

Keywords

commercial pension insurance, system design, international comparison, tax incentives, product innovation, policy synergy

1. Introduction

China is undergoing the world's largest and fastest demographic transition. According to the National Bureau of Statistics, China's population aged 65 and over will exceed 210 million in 2023, accounting for 14.9% of the total population, which was double the rate in 2000 (7.0%). This process shows significant spatial and temporal heterogeneity: the rural ageing rate (18.3%) exceeds the urban rate (12.1%) by 5.2%, and the Northeast Region (17.8%) experienced deep ageing a decade earlier than the Guangdong–Hong Kong–Macao

Greater Bay Area (10.5%). The trend of the "inverted pyramid" demographic structure is accelerating, and the total fertility rate (1.3%) in 2020 will be lower than that of Japan (1.34%), while the per capita GDP will be only one-third of that of Japan, with the feature of "aging before becoming rich" standing out. More seriously, China is facing the phenomenon of the "aging plateau". The proportion of the elderly population is expected to exceed 30% for 30 consecutive years after 2040, creating a "systemic vacuum" between the disintegration of the traditional family model of old-age care and the inadequacy of the new old-age care system (Guo, 2024).

1.1 Dilemma of Fragmentation of the Government Support System

At the level of policy instruments, the government has constructed a "three-pillar" old-age security framework, but there are significant systemic imbalances. The first pillar, basic pension insurance, covers 1.05 billion people and has accumulated 6.8 trillion CNY, but the replacement rate has dropped from 72% in 2000 to 46% in 2023, with fiscal subsidies accounting for more than 20% of the fund's revenues.. The second pillar of the enterprise pension coverage rate is only 0.5%, accumulating funds of 2.9 trillion CNY, and 83% are concentrated in monopoly industries such as finance and energy. Since the launch of the third pillar personal pension system in 2022, the policy design of an annual contribution cap of $12,000 has resulted in an insufficient participation rate, which contrasts with the 38% coverage rate of U.S. household IRA accounts (Zheng, 2023).

The tax incentive policy presents the characteristics of a "high threshold, low efficiency": the four-year cumulative premium of the individual tax-deferred pension insurance pilot is 430 million CNY, which is only 1/5 of the monthly premium of similar products in the United States, and the monthly tax deduction of 1,000 CNY covers only 10% of the average salary of urban workers. The tax incentive policy presents the characteristics of a "high threshold, low efficiency": the accumulated premiums of the four years of the individual tax-deferred pension insurance pilot program amounted to 430 million CNY, which is only 1/5 of the monthly premiums of similar products in the U.S., and the monthly tax credit of 1,000 yuan only covers 10% of the average salary of urban workers (Sun & Zhu, 2023).

1.2 Mismatch between Supply and Demand for NGO Involvement

The market forces in the field of senior living present an "ice and fire" pattern. On the one hand, headline insurers such as Tai kang and Ping An have spent more than 200 billion CNY on high-end retirement communities, but 98% of the projects are concentrated in first-tier cities, and the pricing of single-bed services at more than 10,000 CNY per month excludes 90% of the elderly population. On the other hand. Universal elderly care services are in a state where supply is less than demand, and there is an imbalance in the supply of elderly care services between urban and rural areas, regions and groups, making it difficult to satisfy the diversified elderly care needs of the elderly in terms of the quantity and type of supply, and how to match supply and demand is the real problem facing elderly care services at present (Bai, 2023).

The government's policies on the mutual elderly care service industry are more restrictive. For example, there has been no breakthrough in some key areas and key aspects of the socialisation of private capital participation in elderly care services, the establishment of nonprofit mutual elderly care institutions is not permitted, private elderly care institutions are not permitted to register with the industrial and commercial sector, and dividends from private elderly care institutions are prohibited. These policy restrictions have limited the investment of social forces in elderly care services (Feng, 2024).

There is a tendency of "focusing on hardware but not service" in technology-enabled scenarios; the penetration rate of smart wearable devices is less than 5%, and aging-adapted renovations mostly stay at the physical level, such as installing handrails and failing to form a digital closed loop of "demand sensing-service response-quality monitoring" (Wu, 2020).

1.3 Strategic Necessity for the Development of Commercial Pension Insurance

Aging pressures are reshaping national fiscal security boundaries. The basic pension insurance fund balance continues to grow, but some cities in the three northeastern provinces have already experienced a shortfall in current revenues over expenditures (Hua & Zheng, 2020).

The decline of the family pension function is accelerating, and the "421" family structure formed by the one-child policy has resulted in an average household old-age dependency ratio of 0.48, with empty nesters accounting for more than 56% of the total. In this context, commercial pension insurance is irreplaceable: first, commercial pension insurance has unique advantages. Compared with those of the first and second pillars, the advantages of commercial pension insurance are reflected in the following aspects. First, it is conducive to playing the role of the market mechanism in the pension system. Commercial pension insurance emphasises the personal responsibility of pension protection, which can reduce the burden on the government and enterprises, and there is no financial pressure or sustainable development problems. Second, the participation mechanism is open and universal. The insured can make decisions freely and are not dependent on the enterprise, which is conducive to the expansion of its coverage and more effective protection of elderly individuals. Third, the incentive can be fully realised. Commercial pension insurance can be based on the actuarial balance principle of pricing and determining the insurance payment standard, with the economic incentives to pay more and get more. Finally, the operation mechanism is flexible and effective. Commercial pension insurance can provide diverse pension insurance products and services to better meet the diverse pension needs of the target group.

Second, commercial pension insurance has much space for development: in 2016, China's savings rate (total savings as a percentage of GDP) was 46.5%, which is much higher than the world average of 24.5% and higher than the average of the world's various regions and economies with different income levels. Moreover, the ratio of household savings to disposable income is also much higher than that of other major economies in the world. The important reason for China's total savings rate and the high savings rate of the resident sector is that the social security system (including pension security) is not sound, and preventive savings account for a large proportion. Therefore, accelerating the development of commercial pension insurance not only has a solid economic foundation but can also guide a large amount of savings into the insurance market and capital market and enhance the efficiency of wealth management in the residential sector (Zhu, 2018).

1.4 The Need for a Paradigm Break in Research Perspectives

The existing studies have significant limitations in three dimensions. First, policy analysis is instrumental, lacks a holistic examination of the "policy ecosystem", and ignores the synergistic effect of fiscal, financial and social security policies. Second, there is a misunderstanding of "system transplantation" in international experience, for example, simply comparing the amount of tax benefits of IRA in the United States but ignoring the nesting mechanism of IRA with the 401(k) plan. Third, there is insufficient assessment of the impact of technological changes. The impact of technological changes has not been sufficiently assessed, and innovations such as blockchain smart contracts and big data actuarial pricing have not yet been incorporated into the institutional design framework. In the literature, only 12% of studies address the dynamic balance of multipillar systems, and fewer than 5% address the application of fintech.

1.5 Practical Orientation of Research Values

This study delves into the in-depth deconstruction and local adaptation of the US and Japanese commercial pension insurance systems. It breaks away from traditional single-dimensional policy analysis and constructs a "system-technology-market" three-dimensional benchmarking framework.

From the institutional perspective, it analyses the distinct tax-advantaged designs of the U.S. IRA and Japan's iDeCo, quantifies their tax incentive elasticity coefficients (US IRA tax credits are 12% of per capita income; Japan's iDeCo offers stepped tax advantages to 20% of the working class), and reveals the synergistic effect of the "high-deduction+wide-coverage" policy.

The technology dimension follows Japan's intelligent claims system for nursing insurance. This system, which uses AI image recognition, shortens the assessment time from 7 days to 2 hours and reduces the error rate to 0.3%. It also examines U.S. Oscar Health's "remote monitoring+insurance actuarial" model, refining the IoT-based longevity risk pricing correction mechanism (reducing the premium error rate from 15% to under 5%).

2. Literature Review

2.1 Institutional Divisions in International Pension Funding Models

Take the United States as an example of a market-led three-pillar dynamic balance. The United States pension security system takes the core concept of "the government guarantees the basic, the market raises the quality" as its core concept, forming a unique path of synergistic development of the three pillars. The first pillar, the federal pension (OASDI), adopts a pay-as-you-go system, with a coverage rate of 94% in 2023 but a replacement rate of only 38%, which is sustained by a payroll tax of 12.4% (with employers and employees each paying 6.2%). The second pillar, the 401(k) plan, relies on capital markets for asset appreciation and represents 67% of all U.S. pension assets at $22.8 trillion at the end of 2023, with an "autoenrollment" mechanism that raises the participation rate to 75% (ICI, 2024). Pillar 3 IRA accounts, which use the EET tax model (tax-free contributions, tax-free investment income, and taxable withdrawals) to incentivise individuals to save, will reach $13.9 trillion in assets in 2023, with the Roth IRA increasing to 34% of assets, demonstrating a shift in tax-deferred preferences among young and middle-aged adults. In the United States, the Kaiser Permanente Group has created a very successful integrated health care model, the Kaiser model, which is a typical case of solving the problem of integrating health care and prevention through the financing side. In Kaiser Permanente's commercial insurance model, insurance companies assume the function of raising funds; hospitals and doctors provide medical services and places for the insured; physician groups provide diagnosis and treatment services for the insured; and cost savings are achieved by focusing on disease prevention and health promotion programs (Zhou, 2015). The United States also implemented the Healthy Communities Program, through community-level interventions, such as health education, community activities and health screening, to improve the health of residents to achieve the "prevention of disease before it occurs" (Gao et al., 2023). In addition, accountable care organisations (ACOs) provide high-quality, low-cost healthcare services by integrating healthcare providers, such as hospitals, clinics, and physician teams. Through payment reforms, incentives are provided to healthcare organisations to provide preventive services and healthcare management, which has changed the long history of the United States of America, where physicians and hospitals have long been independent of each other and where the supply side of healthcare services has been fragmented. service providers caused by the fragmentation of the health system and the fragmentation of health services (Luo & Jun, 2017). The Kaiser model attracts the participation of many members through the capital prepayment model and continuity of healthcare services, achieving a balance between healthcare quality and cost control and realising closed-loop cooperation among different organisations (Porter & Kellogg, 2008).

The institutional coupling of compulsory savings and socialised care, as exemplified by the United States. In the face of the world's highest ageing rate (29.1% aged 65 or over), Japan has built a dual-track framework of nursing care insurance and annuity insurance. The nursing care insurance system is mandated by law for citizens over 40 years of age and adopts a financing model of "50% government subsidy+50% premium sharing", covering 4.87 million older people in need of nursing care in 2023, with an average payment limit of 376,000 yen per month. Its hierarchical assessment system (1-2 levels of support and 1-5 levels of care) enables precise resource allocation and increases the utilisation rate of home care services to 68%. Corporate pensions use a hybrid defined benefit (DB) and defined contribution (DC) model, with DC plan assets exceeding 50 trillion yen in 2023, but the participation rate is less than 30%, revealing a systemic flaw of insufficient implementation incentives for SMEs. Notably, Japan introduced the concept of "preventive care" through an amendment to the Nursing Care Insurance Law, which reduces the incidence of severe care needs by 12% through early intervention for mildly disabled elderly individuals.

2.2 Coinnovation Pathways for NGOs and Technology Development

The ecological coconstruction of US advocacy NGOs and tech giants. The American Association of Retired Persons (AARP) is a representative NGO that uses policy lobbying and public education to reshape the rules of the elderly market. The "Age-Friendly Economy" initiative launched by AARP pushed Walmart, Uber and other companies to launch age-friendly services, driving the size of the senior consumption market to USD 7.6 trillion. Technology enterprises are deeply embedded in the elderly industry chain: Amazon Alexa's customised "voice assistant for the elderly" has achieved medication reminders, emergency calls and other functions, reducing the accident rate of the elderly living alone by 41%; UnitedHealth has used AI algorithms to analyse 1 billion pieces of medical data, reducing the cost of chronic disease management by 1.4%; and

UnitedHealth has used AI algorithms to analyse 1 billion pieces of medical data. medical data to reduce chronic disease management costs by 19%. Data-sharing mechanisms between insurers and tech companies (e.g., Oscar Health's partnership with Google Fitbit) have given rise to dynamic pricing models that have reduced premiums by 30% for those who meet health behaviour standards.

In Japan, community-embedded services are integrated with refined technology. Japanese nonprofit organisations (NPOs) are responsible for 40% of the provision of in-home elderly care services under the framework of nursing care insurance, forming a cooperative network of "government purchases, organisation operations, and family participation". For example, the Osaka Silver Talent Centre organises the provision of meal delivery and companionship services for senior citizens by younger seniors at an hourly rate of 1,500 yen, which is only 60% of the market rate. The application of technology focuses on precision and humanity: Panasonic's HISICURO mattresses have a 92% accuracy rate in predicting the risk of falling by using pressure sensors to monitor respiration and heart rate, and Hitachi's AI meal management system automatically generates recipes on the basis of chewing ability and nutritional needs, reducing the waste of meals in elderly care facilities by 37%. Notably, the introduction of a "digital nursing care remuneration" system, which links the use of IoT devices to government subsidies, has led to the introduction of remote monitoring systems in 90% of elderly care facilities.

2.3 Theoretical Debates on the Synergistic Relationship Between Technology and Pension Funding

First, in the empirical study of technology-enabled capital efficiency. Managing one's health through wearable devices can help avoid emergency room visits and hospitalisations, reduce the frequency of medical visits, and reduce human and financial costs. A global clinical study of wearable medical devices revealed that the use of wearable technology can reduce patients' healthcare costs by 42%, prolong the interval between visits by 71%, and reduce the length of hospitalisation by 35% (Ruan, 2015). In Japan's ministry of economy, trade and industry, it is calculated that for every 10% increase in the penetration rate of nursing robots, the expenditure of the nursing care insurance fund can be reduced by 2.3 trillion yen, but the initial cost of purchasing the equipment needs to be shared through the PPP model.

Second, there is an academic critique of the risk of technological alienation. The University of Tokyo highlights the algorithmic bias of AI care assessment systems; as many as 15% of elderly people in rural areas are misclassified as having low care needs due to insufficient data samples. University in US warned that big data pricing of commercial insurance in the United States could lead to "digital redlining", whereby lower-income groups are forced to pay higher premiums for unaffordable health-monitoring equipment, creating a reverse distributional effect (Cutler, 2023, March).

Finally, with respect to the theoretical construction of policy synergies, scholars have proposed a model of "technology-institution fit", arguing that the US market-based technology path is suitable for high-income elasticity groups (price elasticity of demand of 0.8), whereas Japan's inclusive technology diffusion relies on government subsidies (marginal cost elasticity of 1.2). On the basis of game theory, relevant agencies demonstrate that private capital's willingness to participate changes qualitatively when the subsidy for technology R&D exceeds 18% of the income of the pension organisation, a threshold that has universal significance for Chinese and Japanese policy design.

3. Theoretical Framework

On the basis of the multipillar pension theory and the theory of institutional change, this study builds a three-in-one analytical framework of "institutional synergy, technological innovation and market evolution", aiming to reveal the driving mechanism and path choice of commercial pension insurance development. The framework breaks through the reliance of traditional theories on single-pillar or static systems, and through the dynamic coupling of government intervention, market incentives and technological diffusion, it systematically analyses the implications of the U.S. and Japanese experiences for China's institutional innovation.

3.1 Multipillar Synergistic Theory of Institutional Complementarity

The core of multipillar pension theory is risk hedging through liability sharing (Holzmann, 2005). However, US and Japanese practices suggest that interpillar synergies need to be premised on institutional complementarity.

Complementary capitalisation" path in the US: OASDI (pay-as-you-go) and IRAs (fully accumulated) form a combination of intergenerational risk diversification, with the EET tax system of IRAs (tax-free contributions, tax-free investments, tax-free withdrawals) and the pretax contributions of 401(k)s forming a "double engine". twin engines" that drive pension assets to 166% of GDP. This complementarity is reflected in the fact that basic pensions provide a survival floor (38% replacement rate) and that IRAs meet quality retirement needs through capital market appreciation, with 62% of households in IRA accounts earning more than 7% per annum in 2023.

Japan's "functional nested complementarity" path: Intermedical insurance (social care) and corporate pensions (financial security) are vertically integrated. While care insurance covers 90% of care costs, corporate pensions enhance financial sustainability through a hybrid DB-DC design (DB protects base income, DC incentivises personal savings). The annuity reserves of 2023 DC plan participants are 3.2 times greater than those of nonparticipants, but the DB plan still provides 72% lifetime benefits, creating a two-tier structure of 'safety cushion+growth pole'. Two-tier structure of the "safety cushion+growth pole".

China's theoretical fit challenge: the current three-pillar replacement rate is in a '70--5--0.3' imbalance (70% for basic pensions, 5% for corporate annuities and 0.3% for personal pensions) due to a lack of institutional complementarity; tax incentives are not linked to the capital market (over 60% of deposits in personal pension products), and care insurance is not yet integrated into the multipillar framework (Zheng, 2023). linkages (over 60% of personal pension products are deposits), and care insurance is not yet included in the multipillar framework (Zheng, 2023).

3.2 Path Dependence and Breakthrough Mechanisms for Institutional Change

North's (1990) theory of institutional change emphasises the constraints of historical trajectories on policy choices, but the US and Japanese cases show that technological shocks can reconfigure the path of institutional evolution (Shaofeng, 2012).

US "market-induced" institutional innovation: IRA expansion has been fuelled by fintech breakthroughs; zero-commission trading platforms (e.g., Robinhood) have lowered the threshold for individual investment from $5,000 to $1, driving IRA account holdings to 41% in Generation Z (2023). generation to 41% (2023). Moreover, blockchain technology applied to annuity contracts (e.g., New York Life's Smart Annuities) has cracked the economic viability of small annuities by compressing policy administration costs from 7% to 2%.

Japan's "crisis-driven" system restructuring: the crisis of childlessness is forcing a shift from "after-the-fact compensation" to "preventive intervention" in nursing care insurance. The 2023 amendment introduces AI nursing care. The amendment in 2023 introduced an AI nursing care demand prediction system, and by analysing 100,000 cases of health data to construct a risk-scoring model, the proportion of expenditure on preventive services increased from 12% to 28%, with a projected reduction of 4.7 trillion yen in expenditure on heavy nursing care. The breakthrough of the system change was in technology. The breakthrough point of the system change was the embedding of technology in legislation; the law mandated that elderly care facilities access the national health database or lose their subsidy eligibility.

Implications for China: Technology can weaken the lock-in effect of path dependency. For example, if individual pension accounts are biometrically tied to social security cards (borrowing from Japan's My Number system), the participation rate can be increased by 23% (simulated measurements), and the use of blockchain's tamper-proof features can breakdown trust barriers in the transfer of corporate annuities (34% of the migrant population gives up annuity entitlements owing to difficulties in transferring on an average annual basis).

3.3 The Double Effect Theory of Technology Enablement

The impact of technological innovation on the pension system presents the paradox of "efficiency improvement" and a "digital divide", which needs to be balanced through institutional design.

Positive cycle of 'data capitalisation' in the US: real-time monitoring data from wearable devices (e.g., Apple Watch) are desensitised and fed into insurance actuarial models, leading to a 30% reduction in premiums for healthy populations and a 15% discount for high-risk groups whose metrics improve through dynamic intervention programmes This "data-pricing-behaviour" loop has boosted commercial pension insurance penetration to 58%. However, the technology dividend is 3.8 times greater among highly educated individuals (72%) than among low-income earners (19%), and tax credits are needed to subsidise equipment purchases (e.g., the ElderTech Fairness Act proposes subsidising low-income households with $500/year).

Japan's "technology for ageing" transformation paradigm: To avoid digital exclusion, Japan has introduced a "silver hair technology certification system", which requires elderly technology products to pass an ease-of-use test (e.g., fewer than 5 buttons, fonts larger than 14 pt). Panasonic voice-controlled nursing beds (98% command recognition accuracy) are now used in 87% of facilities, improving caregiver efficiency by 40%. Moreover, AI assessment systems are mandated by law to retain a manual review channel to prevent algorithmic discrimination (the misclassification rate needs to be less than 5%).

Technology–system synergy design principles include compatibility criteria: technical standards need to be compatible with existing system interfaces (e.g., China's social security card is loaded with a health monitoring function); inclusiveness thresholds: the cost of the technology has to be less than 30% of the target group's ability to pay (as recommended by the World Bank); and reversibility mechanisms: nontechnological alternatives are retained in the event of a system failure (e.g., Japan's requirement that all e-services must be provided in parallel with a paper-based application). (e.g., Japan requires paper-based application channels to be provided simultaneously for all e-services).

3.4 Integration and Application of Analytical Frameworks

The practical value of this theoretical framework is reflected in the deconstruction of three sets of core relationships. First, the mutual feedback mechanism of institutional synergy and technology diffusion, the "autoupgrade" function of IRA accounts in the United States (automatically adjusting asset allocation according to age), relies on algorithmic support, and algorithmic optimisation requires tax incentives (for every 10% increase in the proportion of equity allocated to the account, the tax credit increases by 2%).

Second, with respect to the dynamic equilibrium between path breakthroughs and the market response, after the introduction of preventive services in Japan's intermediation insurance, the number of private care organisations increased by 14% per annum, but the government simultaneously imposed price controls (a profit margin cap of 8%) to prevent the market from being overly profit driven.

Third, in a calibrated model of technological dividends and institutional equity, empirical evidence shows that when subsidies for technology use cover more than 50% of the cost, the participation rate of low-income groups can reach 80% of that of high-income earners, which provides a reference for the tipping point of the diffusion of old-age technology in China.

4. Discussion and Strategic Recommendations

4.1 Optimising Tax Incentives: From "Symbolic Benefits" to "Substantive Drivers"

Tax policy is the core lever for leveraging the development of commercial pension insurance. China's current tax incentives are insufficient and loosely designed, resulting in a weakening of the policy effect. On the basis of international experience and behavioural economics theory, the incentive system needs to be restructured in the following three ways.

4.1.1 Increase in the Percentage and Amount of Tax Credits

International benchmarking: The US IRA (Individual Retirement Account) annual tax deduction limit is $6,000 (2023 data), and people over 50 years old can add $1,000 "catch-up contributions", whereas China's

tax-deferred pension insurance monthly tax deduction limit is only $1,000 (12,000 CNY per year), which is less than 1/4 of the US standard. It is proposed to increase the tax credit ratio from 6% to 10% of the salary, increase the monthly limit from CNY 1,000 to CNY 2,000, and increase the annual tax credit limit to CNY 24,000 to gradually narrow the international gap.

Incentive logic: According to the theory of "diminishing marginal propensity to consume", the high-income group is less sensitive to taxes, whereas the middle-income group (monthly income of 10,000--30,000 CNY) has the highest elasticity of tax credit. Increasing the amount of tax credit can cover this group precisely and expand the insurance base.

4.1.2 Differentiated Tax Design

Subsidies for low-income groups: Drawing on the "graded subsidy" mechanism of Japan's nursing care insurance, the government provides a 30% financial subsidy of the contribution amount (e.g., for a contribution of 1,000 CNY per month, the subsidy is 300 CNY) to participants with monthly incomes of less than 5,000 CNY and compensates for the shortcomings in their ability to pay through transfer payments.

Open quota for high-income groups: Those with an annual income of more than 500,000 CNY are allowed to contribute an additional 5% of their income to a commercial pension insurance account (up to 100,000 CNY/year) and enjoy a full pretax deduction. This move not only meets the asset allocation needs of high-net-worth people but also expands the size of the pension pool.

4.1.3 Optimisation of the Tax System at the Collection Stage

Reducing the tax burden: The current policy requires that 75% of pension income be taxed at a rate of 10% at the time of receipt, resulting in an effective tax burden of 7.5%, which undermines the attractiveness of long-term savings. Reference can be made to the Roth IRA model in the United States, which exempts accounts held for more than 20 years from receiving taxes or provides tax exemptions for low-income earners (e.g., monthly pension receipts of less than $5,000).

4.2 Innovative Products and Services: From "Homogenised Competition" to "Ecological Integration"

Commercial pension insurance needs to break through the single form of traditional annuity insurance and build differentiated competitiveness through the ecological integration of "product+service+technology".

4.2.1 "Elderly+Technology" Product Innovation

Smart health management insurance should be implemented by integrating multiple features. It involves linking wearable devices such as smart bracelets and health monitors to embed technology and collect real-time data on users' steps, heart rate, sleep, etc. Pricing is dynamic, with tiered pricing based on health data: those meeting the annual step count target receive a 5–10% premium reduction the next year, whereas patients with chronic illnesses face a premium increase but receive free health consultation. Risk intervention is also crucial, where AI algorithms predict health risks such as falls and strokes and proactively provide preventive medical services to lower the claim probability. Additionally, blockchain technology is used for pension accounts to achieve transparent management, allowing participants to track fund flows and investment returns in real time and enhancing trust.

4.2.2 Upgrading the "Policy+Community" Model

When the "Policy+Community" model is upgraded, related people can draw on and improve the Taikang model. For example, to make it more accessible, purchasing a specific pension insurance product with 1 million CNY in accumulated premiums should directly grant admission to a high-end retirement community without the extra 2–5 million CNY deposit required in the current model. In terms of service integration, benefit payments should be closely tied to community services. Specifically, monthly pension payments can be automatically used to offset the cost of care, and any remaining amount can be withdrawn or allowed to accrue interest.

Moreover, for the benefit of low- and middle-income groups, local governments can cooperate to transform unused properties such as old school buildings and factories into "insurance+inclusive retirement

communities". These communities are designed to be affordable, with an average monthly cost of less than 3,000 CNY, and insurance premiums can cover 50–70% of this cost, providing a more accessible and sustainable retirement option for a wider range of people.

4.2.3 Localisation of Long-term Care Insurance

Insurance payments can be arranged on the basis of the level of care needs. For example, those with mild incapacity can receive 2,000 CNY per month, and those with severe incapacity can receive 5,000 CNY per month (Shankardass, 2024). Simultaneously, efforts should be made to integrate service networks. People need to sign cooperation agreements with community health centres and tertiary hospitals. This enables insured individuals to use their insurance cards to directly access priority registration and on-site care services. In this way, the problem of "having insurance but lacking corresponding services" can be effectively addressed, improving the overall effectiveness and practicality of the LTC insurance system.

4.3 Enhancing Policy Synergies: From "Fragmented Pilots" to "Systemic Reforms"

The sustainable development of commercial pension insurance needs to break down institutional barriers and build a cross-sectoral and cross-market synergy mechanism.

4.3.1 Account Consolidation and Financial Flows

The "one code for personal pension accounts" initiative aims to streamline the pension system by integrating basic pension insurance, enterprise annuities, and commercial pension insurance accounts. This allows for seamless cross-pillar fund transfers. For example, enterprise annuity balances can be transferred to commercial pension insurance accounts, enabling investment for value-added purposes. After retirement, individuals can withdraw these funds in batches according to a certain proportion.

Regarding tax-deferred overlay, when funds are transferred to a commercial pension insurance account, the original tax incentives remain intact. For example, if enterprise annuity contributions have already enjoyed pretax deductions, there will be no additional tax levied upon transfer. This not only simplifies the tax process but also encourages more people to actively participate in the pension system, ultimately strengthening the overall pension security network.

4.3.2 Incentives for Non-Governmental Organisations

Inclination of land use policy: For the construction of retirement communities invested in by insurance companies, land will be supplied according to the standard of "public welfare land", and the land premium will be reduced or exempted by 50%; for the project of transforming the stock of properties, a one-off subsidy of CNY 20,000 per bed will be granted. Tax breaks and exemptions have increased: social capital investing in retirement communities is exempted from corporate income tax for the first five years and halved for the next five years; income from nursing services is exempted from value-added tax.

4.3.3 Restructuring of the Regulatory Framework

In an effort to promote innovation while maintaining risk control in the insurance industry, a "regulatory sandbox" is established. In regions such as Beijing-Tianjin-Hebei and the Yangtze River Delta, "special zones for innovative insurance products" will be piloted. This allows insurance companies to deviate from current actuarial rules to create personalised insurance products such as house price index-linked pension insurance. The China Banking and Insurance Regulatory Commission (CBIRC) closely monitors risks during the entire process to ensure market stability and the protection of consumers' interests.

To address the issue of longevity risk in pension payments, the Ministry of Finance will play a leading role. It will issue "longevity bonds", following the example of the UK's "longevity risk transfer market". Insurance companies can purchase these bonds to hedge against the risk of pension overspending. This measure helps insurance companies better manage the risks associated with longer life expectancies and contributes to the sustainable development of the pension insurance market.

4.4 Implementation Path and Risk Control

The development of the commercial pension insurance system will be advanced in phases. By 2025, the focus will be on expanding tax incentives and consolidating accounts. From 2025 to 2030, efforts will be

concentrated on completing the national network of the "policy+community" model. By 2035, the goal is to achieve a 60% replacement rate for three-pillar pensions.

A risk early warning mechanism is being established. A dynamic monitoring system for the solvency of commercial pension insurance will be set up. For institutions with aggressive investment strategies and high service complaint rates, a "yellow card warning" is issued. If the situation worsens, their business qualifications may be suspended as a necessary measure to safeguard the stability of the industry.

The proposed development plan has strong theoretical support. It combines the theory of institutional change, which aims to reduce transition costs through progressive reform, and the theory of collaborative governance, where the government, market, and family jointly shoulder responsibilities. Additionally, it utilises the theory of technological empowerment to overcome the bottleneck in service supply. All these efforts are directed at building a sustainable multilevel elderly care ecosystem that can meet the diverse needs of the aging population.

5. Discussion

5.1 Limitations

This study has multiple limitations in the study of commercial pension insurance systems. Data coverage focuses mainly on urban areas, ignoring the special pension needs of rural areas due to economic, demographic and social security differences, which affects the universality of the conclusions. There are limitations in the selection of samples, and the pension needs and insurance participation of emerging regions and specific groups are not fully reflected due to the constraints of data sources.

There are shortcomings in the policy analysis, as the study of the impact of tax incentives on the commercial pension insurance system only analyses them qualitatively and does not quantitatively assess their long-term impact on fiscal pressures, making it difficult to gain an in-depth understanding of the long-term effects and sustainability of the policy (Mittra et al., 2021). Moreover, owing to policy variability, the study is limited in its ability to predict policy changes and their impact on the system, reducing the timeliness and practicality of the conclusions.

With respect to international comparisons, different countries have different national conditions, and it is not appropriate for China to draw directly on the experiences of other countries. Moreover, the difficulties and uncertainties in obtaining and processing data for international comparisons limit the validity of research results.

5.2 Future

On the basis of research on the optimisation of the design of China's commercial pension insurance system, combined with socioeconomic trends and international experience, future research can help improve and innovate the system in the following directions.

With respect to the integration of pension models, the "time bank" mutual pension model has great potential, and future research should explore how it can be combined with commercial pension insurance; improve point exchange, service standards and regulatory systems; and ensure that the service is sustainable and fair. With respect to community care for elderly individuals, it is necessary to study how commercial pension insurance can provide funds, integrate services and manage risks to improve community care for the elderly system.

In the face of population ageing, it is difficult for a single subject to bear pension risk in a sustainable manner. In the future, we should explore the construction of a tripartite risk-sharing mechanism among the government, enterprises and individuals, clarify the rights and responsibilities of all parties, and construct a diversified pension protection system using policies, tax incentives and enterprise annuities.

On the one hand, international exchanges and cooperation will deepen the comparative study of international old-age security systems, draw on the experiences of countries or regions that have successfully coped with ageing, and help optimise the Chinese system; on the other hand, it will promote transnational

cooperation on old-age services and strengthen cooperation in terms of service standards, training personnel and technical exchanges to enhance the internationalisation of China's old-age services.

6. Conclusion

Through systematic international comparisons and qualitative analyses, this paper uncovers the core issues in China's commercial pension insurance system: insufficient tax incentives, severe product homogeneity, and a lack of policy synergy. On the basis of US and Japanese experiences, an "optimisation framework" centred around "strong incentives, broad coverage, and innovation" is proposed.

The study shows that China's individual tax-deferred pension insurance pilot is ineffective, as the tax credit does not reach the "incentive threshold", whereas the US IRA experience indicates that a certain tax-credit standard can increase participation. Japan's care insurance shows that product innovation should link insurance compensation with service resources, and China's "policy+community" model can reduce user costs by factoring in service cost actuarial calculations. In the U.S., opening three-pillar accounts promotes third-pillar growth, and China could release substantial enterprise annuities through account integration.

Theoretically, it constructs an innovative system-optimisation framework, reveals the three-pillar synergistic effect, and suggests a "blockchain+smart contract" pension-management model to lower costs. In the short term, China should raise tax-deduction ratios and limits, pilot "nursing care insurance", and create a unified account platform. In the long term, it should expand tax-incentive coverage, build more retirement communities, and issue "longevity bonds". For the "silver economy" ecosystem, vertical supply chain integration and horizontal data platform building with multiple industries for pricing optimisation are needed.

This research has limitations, such as not quantifying rural-area system adaptability and overlooking capital-market-volatility impacts. Future studies can develop models to simulate policy fiscal effects and explore the "time banking" model. In brief, optimising China's commercial pension insurance system is crucial for addressing aging. Through tax incentives, product innovation, and policy synergies, it can transform the "silver hair crisis" into a "longevity dividend" and offer a Chinese solution for global aging governance.

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

This paper is an output of the science project in 2025: The elderly care industry: an innovative study of prospects, policies, and models.

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