Journal of Human Resource and Sustainability Studies, 2024, 12, 878-886
https://www.scirp.org/journal/jhrss
ISSN Online: 2328-4870
ISSN Print: 2328-4862

The Impact of Population Aging Trends on Mongolia's Pension Insurance Fund

Ariun-Erdene Dashjamts, Ser-Od Bayaraa, Uuganbayar Budjav

School of Applied Sciences, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia
Email: serod_b@must.edu.mn

How to cite this paper: Dashjamts, A.-E., Bayaraa, S.-O., & Budjav, U. (2024). The Impact of Population Aging Trends on Mongolia's Pension Insurance Fund. *Journal of Human Resource and Sustainability Studies, 12,* 878-886.
https://doi.org/10.4236/jhrss.2024.124046

Received: November 25, 2024
Accepted: December 23, 2024
Published: December 26, 2024

Abstract

In the last twelve years, Mongolian pension insurance fund recorded a total loss of 2.7 trillion MNT. Meanwhile, the labor force is expected to gradually decrease, while the number of pensioners, the average life expectancy of the population, and the lifespan of pensioners will continue to rise, increasing pressure on the budget. To address these challenges, it is essential to estimate the fund's future income and expenses, evaluate long-term trends, expand the number of voluntary insured individuals, refine individual account information, and develop a methodology for determining income in the informal sector. The assessment of household income risks for informal sector workers and the current voluntary insurance premium rate remains insufficient. Therefore, to accurately calculate the population and income of the pension insurance fund, assess its risks, and address the challenges related to pension insurance, there is an urgent need to develop an optimal model based on scientific calculations and conduct a comprehensive analysis of insurance savings and fund assets. Implementing effective policy planning to reduce the pension insurance fund's losses and align its income and expenses is crucial. This study aims to analyze population growth and aging trends in relation to the pension insurance fund's income and expenditure balance, evaluate the current situation, identify future trends, and conduct experiments and simulations.

Keywords

Pension, Insurance Fund, Growth Dynamics, Model, Population Structure, Population Growth, Population Aging

1. Introduction

Pension systems worldwide are under pressure due to aging populations, longer life expectancies, and economic uncertainties. The Social Insurance Package Law was approved by Parliament in 1994 and implemented in 1995. This legislation

established Mongolia's state social insurance system, which operates on the principle of distribution and continues to provide social security for citizens today. While the pension determination method incorporates elements similar to the accumulation principle, only the old-age pension calculation was adjusted to apply to citizens of a specific age, maintaining the core concept of the distribution principle. The aging population and the growing strain on pension systems demand innovative and effective solutions. Several countries have successfully implemented policies that serve as valuable examples. Many have skillfully combined elements such as pension system sustainability, social protection strategies, and economic growth. For instance, Sweden and Germany have adopted a "balanced mix" in their pension systems, blending core social insurance programs with private savings schemes. Norway prioritizes a carefully planned approach to pension financing, which significantly contributes to national development and system stability. In Singapore, a government-supported private savings model addresses the challenges of an aging population, empowering citizens to save for their pensions while alleviating the system's burden. Similarly, Australia's "Superannuation" system encourages personal savings, fostering financial independence and responsibility.

Recently, countries have been developing and utilizing simulation models tailored to their unique social, economic, and environmental characteristics. From Millennium Institute (1994), the T21 model was developed. The model showed that the social sphere contains detailed population dynamics by sex and age cohort, health and education challenges and programs, basic infrastructure, employment, and poverty levels and income distribution. In the T21 model, the population is categorized by age and gender, enabling detailed analysis. It demonstrates how reducing environmental degradation and vulnerability can improve life expectancy. For Mongolia, the increase in life expectancy has altered the age structure of the population. This shift has reduced poverty among the working-age population and increased household income levels. However, it also poses challenges, such as placing additional pressure on the pension insurance fund. Mongolia's T21 macroeconomic model is among its earliest efforts to integrate such comprehensive tools. Researchers Gantulga Dashdelger, Ser-Od Bayaraa, and Battuvshin Gurbazar (2024) examined critical indicators, such as population size, labor force, and available land, to reflect labor market conditions and economic resources. Their study highlights the significant relationship between the population and the labor force. For developing 33 countries, Ser-Od Bayaraa, Khurelbaatar Batjargal & Tuul Ser-Od (2024) studied that the rapid decline in the number of workers in agriculture and animal husbandry and the transition to a sedentary lifestyle will affect the aging of the population.

In line with an election promise, the government has decided to cover 50% the social insurance premiums of all herders through the state budget starting in 2024. Additionally, the number of government employees has increased by 20% over the past decade, resulting in a higher number of insured individuals whose pension

insurance premiums are also funded by the state. These changes are placing significant pressure on the pension fund. For Mongolia, ensuring pension system stability hinges on comprehensive reforms. Key measures include fostering private savings, strategically managing investment portfolios, and boosting workforce participation. These steps are essential for creating a sustainable and resilient pension framework.

Our model spans the period from 2010 to 2050. Using statistical data from 2010 to 2023, we forecasted the pension insurance fund's income, expenditures, and population growth factors for 2024-2050 through the system dynamics method. Aim of the research is to analyze age-related trends in the pension insurance fund and Mongolia's population using a combination of system dynamics and sample statistical methods.

2. Methodology for Estimating Population Growth

In the exponential population growth model, the population $P(t)$ at year t is calculated as the base population P_0 multiplied by the growth factor e^{kt}, where k represents the annual population growth rate. However, this estimate is overly simplistic, necessitating a more precise approach to modeling population growth. Given the significant impact of population growth on society and the economy, our research incorporates factors such as births, deaths, and migration. The cohort-component method takes into account births, deaths, and migration as key factors in determining future population trends. The aim is to minimize the impact of policy changes on these projections, particularly regarding birth rates and age distribution. Additionally, the analysis should provide conclusions based on extensive historical data on population and migration trends, allowing for the identification of states defined by actual patterns. We propose a model that accounts for population dynamics as a function of increases from births, decreases from deaths, and changes due to net migration. Here is,

$$\frac{dP(t)}{dt} = \left[W(t) - D(t) + I(t) - O(t)\right] \cdot P(t). \quad (1)$$

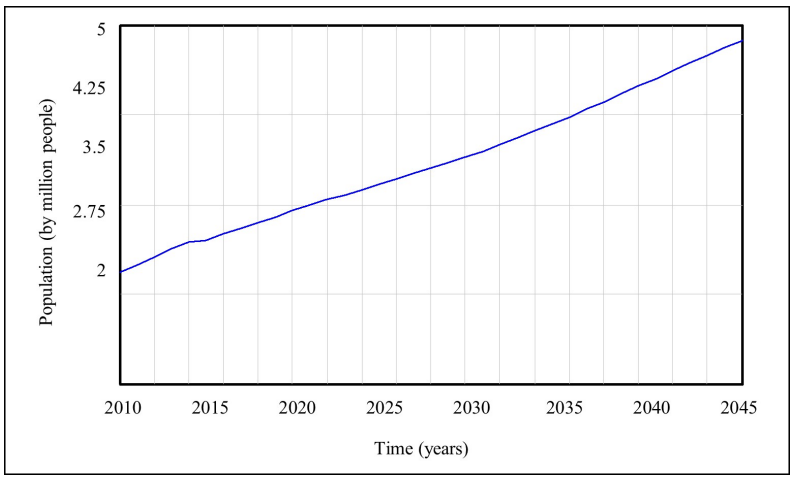

Figure 1. The dynamics of population growth in Mongolia.

In model (1), $P(t)$ is the population in year t, $W(t)$ is the number of new births in year t, $D(t)$ is the number of deaths in year t, $I(t)$ is the number of immigrants in year t, and $O(t)$ is the number of migrants in year t.

Net migration is the difference between inflows and outflows. In model (1), the base year for $t=1$ is 2010.

In our research, we used data from the National Statistics Committee (NSC) of Mongolia. Based on this data, Figure 1 presents the projected population of Mongolia. According to our model (1), the total population of Mongolia is expected to reach 5,171,000 by 2050. However, according to a report issued by the NSC in 2015, Mongolia's 4 millionth citizen was projected to be born in 2031, while a 2020 report revised this estimate to 2033. Based on the NSC's calculations, the population in 2050 was estimated to reach 5,196,917, reflecting a declining population growth rate. In our study, we modeled the population by age and sex, categorizing it into groups such as children (ages 0 - 18), adults, and those of retirement age, as shown in Figure 2.

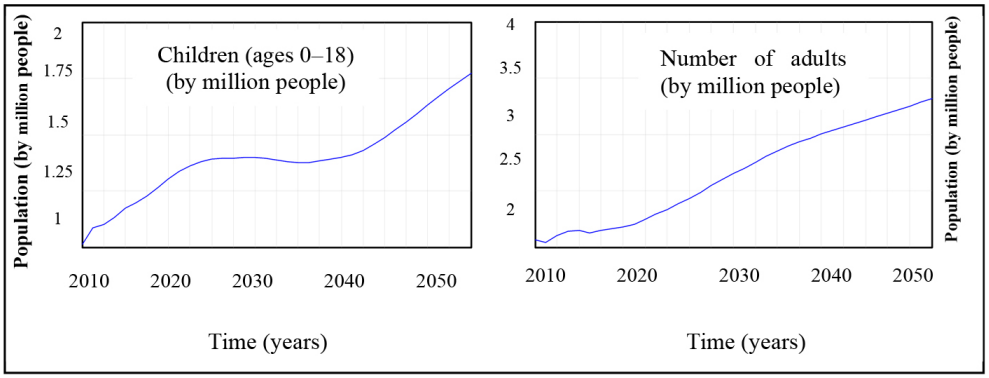

Figure 2. Dynamics of population growth by age structure.

Therefore, we estimate that by 2050, the number of children aged 0 to 18 will reach 1,773,000 (see Figure 2(a)), while the adult population will total 3,320,000 (see Figure 2(b)). Additionally, in the income structure of PIF, there are significant differences between the premiums paid by male and female insured individuals and the periods for receiving pensions (see Figure 3).

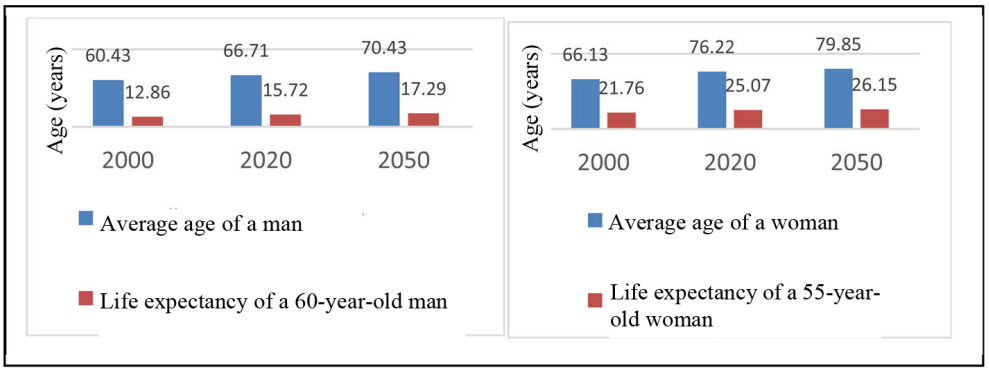

Figure 3. Dynamics of population growth by sex structure.

3. Methodology for Estimating the Pension Insurance Fund Account

The expenses of the PIF are covered by factors such as the number of pensioners, the average pension amount, the number of state-funded pensioners, welfare pensions, and pensions for occupational diseases. On the other hand, the income of the PIF is calculated based on factors including the pension insurance rate, average salary, and the number of both compulsory and voluntary insured individuals. A tree graph representation of the PIF is provided in Figure 4.

By evaluating the dynamics of the number of insured individuals in the PIF using labor force projections from the NSO, we estimate that by 2050, the number of compulsory insured persons will reach 1,823,000, while the number of voluntary insured persons will total 398,700.

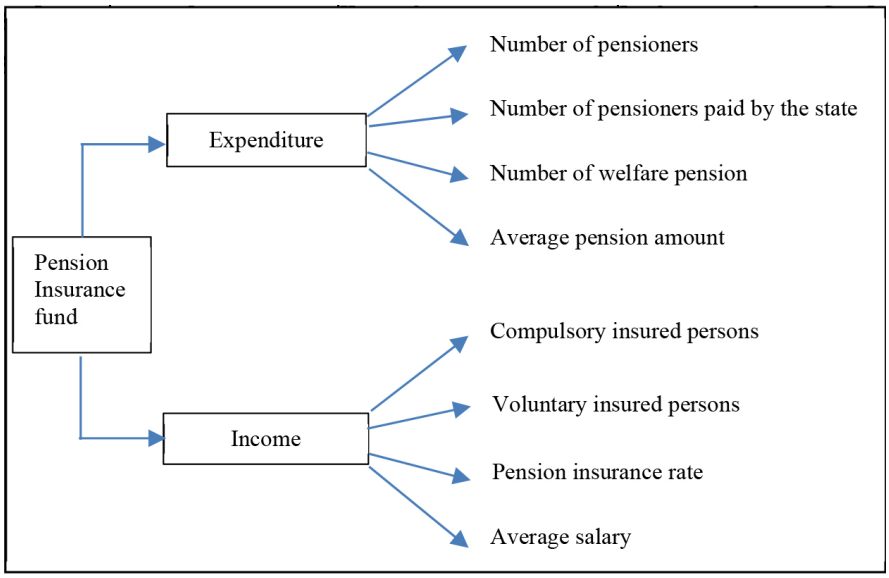

Figure 4. The structure of Pension Insurance Fund in Mongolia.

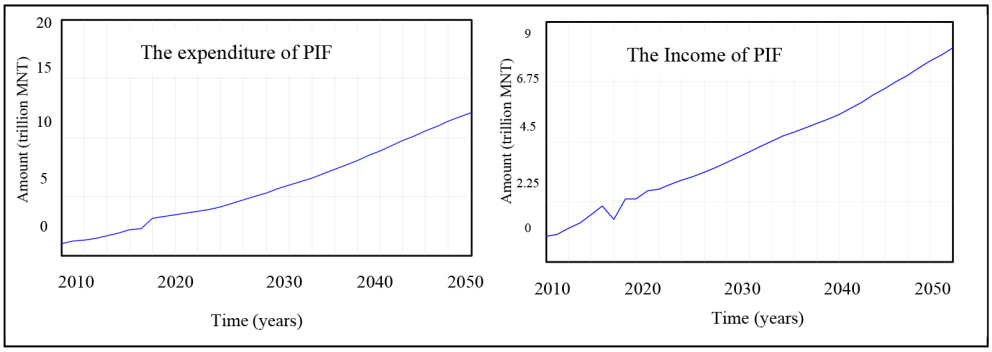

Figure 5. The dynamics on Income and Expenditure of the PIF in Mongolia.

Additionally, the income of the pension insurance fund is projected to reach 8.01 trillion MNT in 2050 (see Figure 5).

When calculating pension fund expenses, we considered factors such as the

number of pensioners, the number of state-funded pensioners, and the number of welfare pensioners. According to our calculations, the total number of pensioners in 2050 will reach 871,100, with 83 percent being old-age pensioners, 13 percent being welfare pensioners, and 4 percent being survivors. The expenditure of the PIF is projected to reach 12.47 trillion MNT in 2050 (see **Figure 5**).

In 2018, the government of Mongolia decided to increase the full retirement period by three months and raise the minimum mandatory pension period to 25 years. As a result of this decision, the loss of the PIF reached 5 percent of GDP, but it was reduced to 4 percent. If, starting in 2025, provisions for early retirement due to abnormal working conditions are eliminated, the fund's expenses will decrease by 200 billion MNT. However, if the retirement age is reduced from 7 consecutive years to 5 years starting in 2024, the fund's costs will increase by an average of 3 percent. Based on our calculations, under the current law, the PIF will operate at a loss by 2050.

4. Analysis of the Pension Insurance Fund

To calculate the accumulated income from 2010 to 2049 and determine the difference between the income and expenses of the PIF, a mathematical model was developed. The calculations were performed using MS Excel. During this period, the total income of the PIF was calculated using the following formula. Here is,

$$S_{2010}^{2049} = \sum_{j=1}^{40}\left(\sum_{i=0}^{10+j} a_{(35+j-i)-(36+j-i)}^{1973+i} + a_{25}^{1984+j}\right)x_{2009+j}. \tag{2}$$

In model (2), S_{2010}^{2049} is the amount of total pension insurance income to be accumulated in the years 2010 to 2049, a_{25}^{1984+j} is the number of people born in $1984+j$ who will be 25 years old in $2009+j$, $a_{(35+j-i)-(36+j-i)}^{1973+i}$ is the numbers of people born in $1973+i$ and transitioning from age $35+j-i$ to age $36+j-i$ in $2009+j$, and x_{2009+j} is the amount of annual insurance premiums payable in $2009+j$.

We calculated the income of the PIF from 2010 to 2049 by formula (2). A regression model was constructed using these estimated values.

$$Y_1 = 415.73x^3 + 26496x^2 - 253786x + 673096 \tag{3}$$

In Model 3, x indicates the years since the baseline. For example, $x=1$ (2010), $x=2$ (2011), $\cdots$, $x=40$ (2049), and Y_1 is the income of the PIF. We used the model (3) and calculated the income of PIF.

People who began contributing to the PIF in 2010 will start retiring in 2033, with an average of 16 years of pension benefits. Therefore, the total expenses for 2030-2046 were calculated based on factors such as the interest rate on savings, mortality rates, minimum subsistence level, population, and the number of people of retirement age. This model was developed and the calculations were performed in MS Excel. The total expenditure of the PIF for 2033-2049 will be calculated using the following formula.

$$C_{2010}^{2039} = c_{1973}b_{2033} + \sum_{j=1}^{16}\left(\sum_{i=1}^{j} c_{(60+j-i)-(61+j-i)}^{1972+i} + c_{1973+j}\right)b_{2033+j} \tag{4}$$

In model (4), C_{2010}^{2049} is the total expenditure of the PIF between 2033 and 2049, c_{1973+j} is the number of people who were born in $1973+j$ and will retire at the age of 60 in $2033+j$, $c_{(60+j-i)-(61+j-i)}^{1972+i}$ is the number of people who were born in $1972+i$ and will live from the age of $60+j-i$ to the age of $61+j-i$ in $2032+j$ ($i, j=1,2,\cdots,16$), and b_{2033+j} is the amount of pension payable in $2033+j$.

Table 1. Estimation of expenditure of PIF (million MNT).

Years	Total expenditure (by MNT)	Years	Total expenditure (by MNT)
2033	118.133	2041	1.239.107
2034	237.832	2042	1.369.193
2035	358.673	2043	1.709.774
2036	479.661	2044	1.852.049
2037	599.290	2045	1.954.168
2038	836.264	2046	2.066.953
2039	973.398	2047	2.183.756
2040	1.107.068	2048	2.278.938

Using formula (4), we calculated the annual expenditure of the PIF between 2033 and 2048 (see Table 1). With these calculated values, the cost curve of the PIF was modeled.

$$Y_2 = 5\times10^6 \ln x - 2\times10^7 \tag{5}$$

In model (5), Y_2 is the estimated value of the PIF costs and $x=1$ (2010), $x=2$ (2011), $\cdots$, $x=40$ (2049). If model (5) is expressed as an exponential function, it becomes $Y_2 = 3953.7\mathrm{e}^{0.1731x}$. According to the exponential version of model (5), the annual average growth of the PIF costs was 17 percent.

5. Discussion

Countries are addressing aging populations and pension pressures by raising retirement ages, reforming pension systems, boosting workforce participation, encouraging labor migration, and improving elderly services to ensure sustainable pensions.

To analyze the future balance of the pension fund, the income and expenditure curves were plotted on the same graph, and their growth patterns were expressed as functions to determine their trends. It is evident that the fund has accumulated since 2010, with expenses projected to begin in 2033. To determine whether the pension insurance fund's balance will become negative, the break-even point—where income (Y_1) and expenditure (Y_2) are equal—was identified. Here,

$$415.73x^3 + 26496x^2 - 253786x + 673096 = 3953.7\mathrm{e}^{0.1731x} \tag{6}$$

The solution to equation (6) was $x=76.3$, corresponding to the year 2085.

Based on the projected income of the pension insurance fund, it was determined that if pension expenses increase by 17 percent annually starting from 2049, the expenses will surpass the fund's income by 2085. However, if the annual increase in pension expenses is less than 17 percent, the fund will experience a negative balance by 2073. For example, let's calculate the increase in pension expenditure in $x = 44$ (2053).

$$MC(44) = \frac{5 \times 10^6}{x} = \frac{5000000}{44} = 113636.4 \quad \text{(million MNT)}.$$

Therefore, at the assumed level of income, it is better not to increase the pension sharply from 2053, in which case there will always be positive savings.

Table 2. Calculating the low level of pension.

Years	Average salary (by MNT)	Minimum pension (by MNT)	Years	Average salary (by MNT)	Minimum pension (by MNT)
2020	1.660.000	320.000	2028	2.980.000	802.000
2021	1.850.000	370.000	2029	3.200.000	854.000
2022	2.150.000	498.000	2030	3.850.000	990.000
2023	2.350.000	550.000	2031	4.120.000	1.080.000
2024	2.560.000	580.000	2032	5.140.000	1.150.000
2025	2.620.000	690.000	2033	5.500.000	1.210.000
2026	2.730.000	725.000	2034	5.700.000	1.380.000
2027	2.750.000	760.000	2035	6.450.000	1.420.000

The government has legislated that the pension amount, or the minimum pension an insured person who meets retirement conditions will receive, must not be less than 20 percent of the average salary of all state employees. The minimum pension amount calculated in our study meets these requirements (see **Table 2**).

6. Conclusion

According to our research, the PIF deficit is projected to average 3.7 percent of GDP by 2050. However, based on the NSO's projections, if the pension system continues as it is today, the deficit is estimated to reach approximately 5 percent by 2050. Additionally, the number of old-age pensioners in 2050 is expected to be nearly three times higher than in 2020. This increase is attributed to the growth in population and life expectancy, but it is closely related to the projected life expectancy after retirement. According to our model, the life expectancy of a 60-year-old man in 2050 will be 17.29 years, while the life expectancy of a 55-year-old woman will be 26.15 years. In 2050, the number of compulsory and voluntary insured individuals is expected to reach 2.22 million, while the number of pensioners receiving benefits from the pension insurance fund will total 914,700. The main contributing factor to this increase is the rise in life expectancy, with a 60-year-old man living an average of 17.29 more years, and a 55-year-old woman

living an average of 26.15 more years.

If legal reforms to the pension fund are not implemented, significant pressure will be placed on the fund due to changes in the population's age structure. If the current system remains unchanged, the PIF is projected to incur a loss of at least 1.06 percent of GDP by 2030, 2.22 percent by 2040, and 3.12 percent by 2050. According to our calculations, the income of the PIF will reach 8.01 trillion MNT in 2050, while expenditures are projected to reach 12.47 trillion MNT. Our analysis of the PIF also shows that expenses have been increasing at an average rate of 17 percent per year. It is important to note that if pension expenditures continue to increase by 17 percent annually starting from 2049, at the current income level, the fund's income will be exhausted by 2086, resulting in a negative balance. Additionally, according to the income structure of the fund, male policyholders contribute higher premiums than female policyholders, yet their average pension period is shorter. In contrast, female policyholders contribute lower premiums but have a longer average pension period. Therefore, it is crucial for the government to implement specific policies aimed at addressing the disparity in life expectancy between male and female insured individuals after retirement.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Bayaraa, S.-O., Batjargal, K., & Ser-Od, T. (2024). The Estimating of Public Service Delivery Using Fuzzy Base. *Journal of Human Resource and Sustainability Studies, 12,* 803-810. https://doi.org/10.4236/jhrss.2024.124042

Dashdelger, G., Bayaraa, S.-O., & Gurbazar, B. (2024). Modeling the Efficiency of Public Service Delivery Using GDP Indicators. *Journal of Human Resource and Sustainability Studies, 12,* 439-455. https://doi.org/10.4236/jhrss.2024.123025

Millennium Institute (1994). *T21-Integrated Development Model, Recent Evolution.* https://globalclimateactionpartnership.org/app/uploads/2015/10/T21Overview1.pdf