

# A Study of the Rate of Long-term Care Insurance<sup>1</sup>

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## Abstract

*As the first region in China that joins the aging society family, Shanghai now faces a very serious long-term care problem. One of the most grievous challenges of Aging is the large amount of people who are at advanced age or disabled. All of those make the demands of long-term care increase swiftly. But at present, the supply of long-term care apparently can't meet the demands. This contradiction between supply and demand has now become the issue that effects the development of Shanghai. While we are working hard to build a harmonious society and satisfy the old people's demand, to establish LTCI system is now an important way to ease long-term care services pressure. Mechanism is the key point of designing LTCI. In the previous study, we use actuarial models to calculate the rate of LTCI, but as the first several years after the system was established there must be some insured that pay less. The rate of LTCI fund must be adjusted appropriately during the transition to the arrival of the peak of aging. This paper takes the operation condition of LTCI fund before the arrival of peak of aging as the entry point and establish SD model for simulation of financial operations. At last, we give some proposals of optimizing the rate system of LTCI.*

**Keywords:** LTCI; actuarial; rate; SD Model

## 1. Introduction

According to the previous calculation, we can balance the income and payment of the LTCI fund if the rate keeps 4.6%. But since the calculation is based on the personal saving model and the development of social LTCI system needs a transition period which there is some "old people" who have no payment and some "middle people" whose payment are insufficient. In considering the hidden costs of the system, the rate required appropriate adjustments.

System Dynamics is an approach which is used to analysis complex information feedback system. It's been widely proposed in the social, economic, technological, industrial and other field. The causal diagram of System Dynamics reflects the link between system elements through basic and simple relationship between the loops of interaction. It can quantitatively predict and modeling the interaction and feedback process of various elements in the system through description of the flow chart. Using the system dynamics method to adjust the LTCI rate ensure the safely operation of LTCI fund under the risk of "hidden costs" before the arrival of aging.

## 2. Simulation and Optimization for the Payment Based on SD

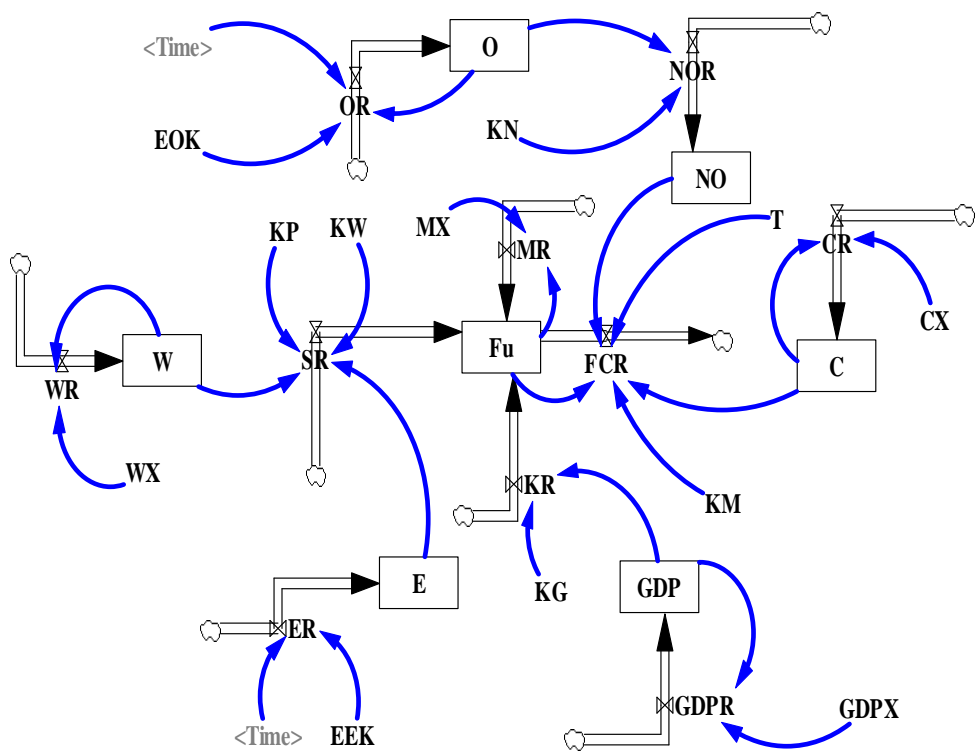
In the previous study, we've preliminarily estimated the LTCI rate with actuarial models. The study of actuarial model was based on a single individual and the payment period was assumed 31 years. In the actuarial model, we ignored the existence of a large number of people who did not fully pay 31 years in the first several years when LTCI start to be implied. Take the operation of LTCI fund as a starting point to establish SD model, adjusting LTCI rate via simulation of operating of LTCI fund.

### 2.1 Flow Chart of SD Model of LTCI Fund Operation

Selected elements which effect LTCI fund operation for studying, such as Employees pay subsystem, financial subsidies subsystem, Fund's investment income subsystem and Expenses subsystem. Flow chart of SD model of LTCI fund operation shown in Figure 1.

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**Figure 1: Flow Chart of SD model of LTCI Fund Operation**

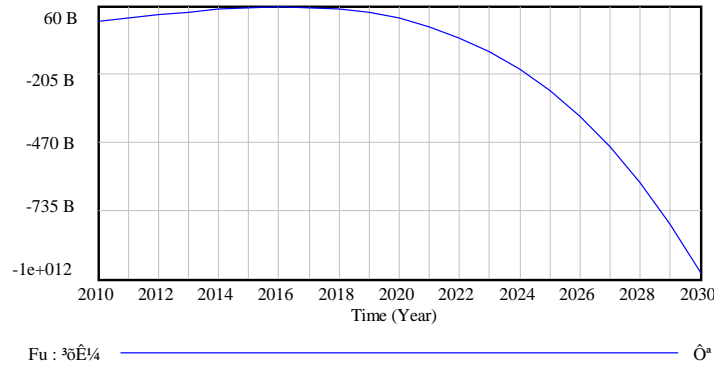
- O—Population of old people
- OR —Growth rate of the elderly population (persons / year)
- DT —Time interval (years)
- EOK —Form function of Elderly population growth rate
- Time —Shadow variable of time
- NO — Number of disabled older
- NOR —Rate of change of disabled elderly (persons / year)
- $NOR.KL=O.JK*KN$
- KN — Proportion of disability
- C —Care costs per capita (Yuan / month)
- CR —Care costs per capita monthly rate of change (Yuan / year)
- CX —Care costs per capita monthly rate of change
- GDP —at current prices of Shanghai's GDP (\$ billions)
- GDPR —GDP growth rate (\$ billion / year)
- GDPX —in current prices the GDP growth rate
- E —Number of insured (person)
- EEK <Time> —the number of insurance rate table function
- W —Average wage (Yuan)
- WR —Average wage growth rate (dollars / year)
- WX —Average wage rate
- Fu — LTCI fund surplus (million)
- SR — LTCI fund rate of change (Yuan / year)
- KR — Financial subsidy rate of change (Yuan / year)
- MR — LTCI fund earnings rate of change (Yuan / year)
- FCR — LTCI, the rate of change of capital expenditure (yuan / year)

$KR = GDP * KG$   
 $MR = Fu * MX, \text{ when } Fu > 0; MR = 0, \text{ when } Fu < 0$   
 $FCR = F * KM + NO * T * C$

- KP — an individual's rate
- KW — unit rate
- KG — the proportion of financial subsidies
- MX — investment rate of return
- T — Nursing time
- KM — rake than the management fees

**2.2 LTCI Fund Operations Simulation**

As shown in Figure 2, changes of LTCI fund surplus trend keeps a relatively stable trend of slow growth at the beginning of the implement of LTCI. After that, it showed a sharp decline. While the peak of aging arrives, greater gap of LTCI fund surplus appear.

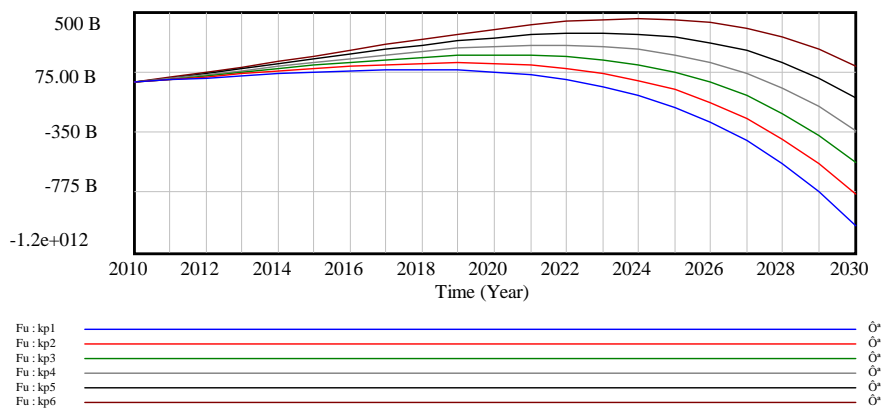


**Figure2: Changes in Long-Term Care Insurance Fundsurplustrend Forecast**

In the initial assumptions, funding gap which is about \$ 20 billion of LTCI fund surplus appeared in the 2021. In 2030, the arrival of the peak of aging, LTCI fund surplus will be up to 9806 trillion. The reason why this happen is that the pre-calculation is based on the assumption that all the individual has pay 31years. But actually, there are too much people who are retired and cannot fully pay 31years. All of this increased financial pressure of LTCI fund.

**2.3 Rate Sensitivity Analysis**

If the rate for LTCI keeps 1.15%, Enterprise and individuals will totally pay about 82 Yuan a month. There is improvement space for such payment level is a little low. Figure 3 shows the changes of LTCI fund while the rate gradually increases with 0.5%.



**Figure 3: Under Various LTCI Rate Changes in Fund Surplus Trend Forecast**

With different rate, LTCI fund will go through a downward trend up to the changes. With the rate increase, the year which the gap appears postponed. However, in these types of rate level, the turning point of LTCI fund will also exists and the fund surplus will reduce more rapidly after the inflection point. LTCI fund surplus forecasts are shown in Table 4.

**Table 4: The Rate for the Impact of Long-Term Care Insurance Fund Surplus (Unit: Billion)**

| year | rate              |                   |                   |                   |                   |                   |
|------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|      | KW1/KP1<br>=1.65% | KW2/KP2<br>=2.15% | KW3/KP3<br>=2.65% | KW4/KP4<br>=3.15% | KW5/KP5<br>=3.65% | KW6/KP6<br>=4.15% |
| 2010 | 0.00              | 0.00              | 0.00              | 0.00              | 0.00              | 0.00              |
| 2011 | 171.25            | 206.26            | 241.27            | 276.28            | 311.29            | 346.30            |
| 2012 | 337.52            | 411.99            | 486.45            | 560.92            | 635.38            | 709.85            |
| 2013 | 494.61            | 613.41            | 732.20            | 850.99            | 969.79            | 1088.58           |
| 2014 | 637.37            | 805.83            | 974.28            | 1142.74           | 1311.20           | 1479.65           |
| 2015 | 759.53            | 983.49            | 1207.44           | 1431.40           | 1655.35           | 1879.31           |
| 2016 | 853.51            | 1139.35           | 1425.18           | 1711.02           | 1996.85           | 2282.69           |
| 2017 | 910.15            | 1264.84           | 1619.53           | 1974.22           | 2328.91           | 2683.59           |
| 2018 | 918.45            | 1349.60           | 1780.76           | 2211.91           | 2643.07           | 3074.22           |
| 2019 | 865.52            | 1381.45           | 1897.37           | 2413.30           | 2929.22           | 3445.15           |
| 2020 | 736.35            | 1346.11           | 1955.86           | 2565.62           | 3175.37           | 3785.13           |
| 2021 | 513.53            | 1226.98           | 1940.44           | 2653.90           | 3367.36           | 4080.82           |
| 2022 | 176.93            | 1004.85           | 1832.77           | 2660.69           | 3488.61           | 4316.52           |
| 2023 | -296.58           | 657.51            | 1611.60           | 2565.69           | 3519.78           | 4473.87           |
| 2024 | -909.70           | 159.58            | 1252.58           | 2345.59           | 3438.59           | 4531.60           |
| 2025 | -1665.86          | -517.88           | 727.91            | 1973.69           | 3219.47           | 4465.26           |
| 2026 | -2584.88          | -1366.27          | 5.94              | 1419.58           | 2833.22           | 4246.85           |
| 2027 | -3688.64          | -2394.01          | -949.14           | 648.74            | 2246.62           | 3844.49           |
| 2028 | -5001.15          | -3624.72          | -2101.82          | -377.84           | 1422.08           | 3221.99           |
| 2029 | -6548.87          | -5084.48          | -3477.27          | -1674.01          | 317.05            | 2338.33           |
| 2030 | -8360.89          | -6801.92          | -5103.72          | -3214.35          | -1116.52          | 1147.12           |

As shown in the table, the rate of 4.15% is reasonable if we want to maintain the payment on a constant level and make sure there is a certain fund surplus in 2030.

### 3. Conclusions

In the initial assumptions, if we want the LTCI fund maintain normal operation before the arrival peak aging, the rate of individuals and enterprises is 4.15%. Take the average wage of workers of 2009 in Shanghai for example. While the wage is 42,789 Yuan, the individuals should pay 148 Yuan a month. 2009 Shanghai residents per capita disposable income of 28,838 Yuan a year, i.e. 2403 Yuan a month; minimum wage is 1120 Yuan a month. Suppose the minimum wage of Shanghai residents to maintain basic standards of living standards, the maximum fee amount of LTCI accounted for in addition to maintaining basic living outside the 11.5% of disposable income.

We set a fixed rate and fixed rate financial investment in the SD Model. In order to popularize of the system, we can adjust the payment rate to maintain the safe operation of the LTCI Fund.

On the one hand, it will take some time for people to understand it after the insurance firstly established. During this period, we need the government to play a guiding role and also keep high financial subsidies as well as low rates. These will make it easier for public to accept LTCI. With continuous improvement of the system and people's consciousness, we can increase in the rate and lower the financial subsidies to reduce the burden of government.

Last but not least, as the economic development continuously improved, appropriate adjustment of the rate of will lower the risk of inflation and improve the level of insurance as well.

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