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Actuarial model and its application for implicit pension debt in China

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ABSTRACT

Whether the pension system transition is successful is closely related to the accurately accounted IPD amount and rationally solved scheme. China faces the problem of IPD with no exception. This paper uses individual cost method theory, combining Chinese pension system and its operation, builds up the implicit pension debt calculation model, then it measures the Chinese IPD quantity by statistical data. The paper finds out that the average IPD per-year is 39.404 billion Yuan in 2013–2050, the maximum is 185.053 in 2022, the minimum is 0.150 in 2050, and the accumulative IPD will sustain growth with annual growth rate of 7.06% in 2013–2050, from 119.787 billion Yuan to 1497.337 billion Yuan. Finally, this paper proposes the government to raise the legal retirement age, reduce the pension substitution rate, expand the coverage of endowment insurance, improve the investment yield of the pension fund, and so on, to compensate the IPD in China.

1. Introduction

To accelerate the pace of economic reform and political reform of China, we must establish the social security system, which is the vital condition of social stability. In the past decade, the Chinese government has put great effort on it and achieved great success. And an important point is the reform of the endowment assurance system, which is the vital part of the social security system. The reform of the endowment assurance system began in 1984. And in 1997, as the State Department of China issued an important document, China's endowment assurance system was finally established, which is called "the combining of overall social planning and individual account" [1]. After several years' operation, the new system has achieved some success. However, some deep-seated problems are left unsolved, especially the problem of implicit pension debts (IPD) [2–4]. If the old pay-as-you-go system continues, as the aging problem getting more and more serious, the endowment assurance system would crash, that's why we reform the old system. But, as the IPD problem was left unsolved, and as the elapsing of time, the implicit debts will be emerging. Then the reform will definitely fail and the old system will come back. So, we must make clear the size of the IPD and then find a way to solve it.

What is IPD? Bovenberg describes IPD as pension promises of a certain pension plan to employees and retirees [5]. And Robert Holman thinks of IPD as government responsibility which lacks the most powerful financing support [3]. Most of scholars agree that IPD is responsibility, the IPD of the basic endowment insurance system for enterprise employees in China is the promise that the traditional pension system makes to pension the retired people and the employees in active service who have taken part in the pension system before the new one is brought into effect, when the pay-as-you-go pattern public pension system is transferred to funded pattern [6–8]. IPD is not only the transfer cost when Chinese public pension system is transferred from pay-as-you-go pattern to partially funded pattern, but also the serious problem that must be solved in order to get through the aging peak smoothly and to reform the pension system. The year of 1997

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is an important time node, retirees who retired before 1997 are defined as “old-people”, and workers who engaged the work before 1997 and retired after 1997 are defined as “mid-people” [9]. Under the current system, IPD is sum of old-people’s pensions and mid-people’s non-contributing pensions. Such a debt would require financial support from the central government, putting additional strain on China’s public finances.

The current research of IPD mainly concentrates on measuring its size and compensating its loss. In 1997, A team of World Bank experts found that the quantity of Chinese IPD would be the equivalent of half of Chinese GDP in 1994, and the net present value of Chinese IPD was 1917.6 billion Yuan [3]. Chen pointed out that the IPD of the basic endowment insurance system for enterprise employees in China was 3609 billion Yuan in 1997 [10]. Experts of Chinese Labor and Social Security concluded the IPD was 5720.42 billion Yuan. There is a huge difference among these results, and the reasons are the different measuring methods, different measuring periods of time, different assumptions, different measuring standard, different definition of IPD, and so on.

The solution has two options for how to make up the IPD [11,12]. One relies on the financing. Some academics have suggested raising the share of pension subsidies expenditures in fiscal expenditure, transferring state-owned assets, collecting the land-use fees, selling state-owned apartment, adjusting the pension tax and pension fund gains, supporting by the working generation, and so on. The other depends on system design. According to specific conditions in China, only by redesigning the basic endowment insurance system for enterprise employees system in China can compensate IPD radically. Government should disclose the quantity of IPD, and solicit advice from the whole member of society, but till now, researches on IPD in China are not enough, how much and how to compensate the IPD are not solved.

This paper constructs the IPD calculation model based on the individual cost method and the public policies of the basic endowment insurance system for enterprise employees in China. And then, it measures the Chinese IPD quantity and gives some compensation countermeasures.

2. IPD’s actuarial model

Individual cost method is a way to calculate the old-people’s and mid-people’s non-contributed pension respectively, then adding them up to get the amount of IPD. Comparing with pension actuarial cost method and payment actuarial cost method, the individual cost method can embody the influence of the pension system sufficiently and differentiate the gender, age, and so on of pensioners exactly.

Let $LO_{x,\,t}$ denotes the number of old-people aged x in t year, Q denotes the total number of old people’s pension, g denotes the growth rate of average wage in society, k denotes the pension adjustment factor, z denotes the reform time of the basic endowment insurance system for enterprise employees, r denotes the retirement age, ω denotes the maximum live age, v denotes the discount rate, $\overline{W}_0$ denotes the average wage in society in t_0 year, λ denotes the issue proportion of pension, ε denotes the empirical coefficient of transitional pensions, TI_x denotes the time of contribution payment and deemed time of contribution payment, β denotes the average payment index, γ denotes the adjustment pensions, $LM_{Z(x,\,t)}$ denotes the number of working mid-people in t year, $LM_{T(x,\,t)}$ denotes the number of retired mid-people in t year, and d_0 denotes the present pension value of old-people aged x. From the basic endowment insurance system for enterprise employees policies in China, we have

$$d_o = \sum_{i=0}^{\omega-x-1} Q(1+kg)^i v^i {}_i p_x \tag{1}$$

And let IPD_o denotes the quantity of old-people’s IPD, we obtain that

$$IPD_o = \sum_{x=r+t-z}^{\omega-1} LO_{x,t} \sum_{i=0}^{\omega-x-1} Q(1+kg)^i v^i {}_i p_x \tag{2}$$

Toward to mid-people’s IPD, we let d_{Z1}, d_{Z2}, d_{Z3} denotes the present value of basic pension, transitional pension, adjustment pension working mid-people aged x, respectively, we have

$$d_{Z1} = \frac{x-(a+t-z)}{L}\lambda\overline{W}_0(1+g)^{r-x}{}_{r-x}p_x v^{r-x} \times \sum_{i=0}^{\omega-r-1}\left[{}_i p_r (1+g)^i v^i\right] \tag{3}$$

$$d_{Z2} = \varepsilon TI_x \beta \overline{W}_0 (1+g)^{r-x}{}_{r-x}p_x v^{r-x}\ddot{a}_r \tag{4}$$

$$d_{Z3} = \sum_{i=r-x}^{\omega-x-1} \gamma TI_x v^i {}_i p_x \tag{5}$$

Then let IPD_{mz}, IPD_{mt}, IPD denote the quantity of working mid-people’s IPD, the quantity of retired mid-people’s IPD, the quantity of IPD respectively, we obtain that

$$IPD_{mz} = \sum_{x=a+t-z}^{r-1} LM_{Z(x,t)}\left\{\frac{x-(a+t-z)}{L} \times \lambda\overline{W}_0(1+g)^{r-x}{}_{r-x}p_x v^{r-x}\sum_{i=0}^{\omega-r-1}\left[{}_i p_r(1+g)^i v^i\right] + \varepsilon TI_x\beta\overline{W}_0(1+g)^{r-x}{}_{r-x}p_x v^{r-x}\ddot{a}_r + \sum_{i=r-x}^{\omega-x-1}\gamma TI_x v^i {}_i p_x\right\} \tag{6}$$

$$IPD_{mt} = \sum_{x=b}^{r+t-z-1} LM_{T(x,t)}\left\{\frac{x-(a+t-z)}{L}\lambda\overline{W}_0 \times \sum_{i=0}^{\omega-x-1}\left[(1+g)^i v^i {}_i p_x\right] + \varepsilon\beta TI_x\overline{W}_0\ddot{a}_x + \sum_{i=0}^{\omega-x-1}\gamma TI_x v^i {}_i p_x\right\} \tag{7}$$

Owing to

$$IPD = IPD_o + IPD_{mz} + IPD_{mt} \tag{8}$$