

A Financial Assessment of the Chinese Pay-As-You-Go Pension System

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Abstract

This paper analyses the Chinese pay-as-you-go (PAYG) pension system for urban areas over the 75-year period 2014-2088 using the actuarial approach used by the Social Security actuaries in the United States, and by a number of other countries, that takes into account projected values for relevant demographic and economic variables using current program parameters. The paper finds that very high contribution rates would be needed, if no other changes are made, in order to maintain the sustainability of the Chinese pension system. To provide perspective on the results, the paper compares these results to similar results for the Social Security program in the United States. A key factor in the high cost of the PAYG system for urban workers, compared to the cost in the United States, is the longer period in China that workers can expect to receive benefits, which is roughly 25 percent (5 years) longer in China than in the United States. The paper also analyzes parametric reforms that need to be immediately taken to restore the financial health of the Chinese pension system. We find that the Chinese social security pension system faces serious financing problems in the future that cannot be fixed solely by raising the contribution rate, and will require other changes, such as raising the benefit eligibility

age.

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1 Introduction

Pay-As-You-Go (PAYG) pension systems operate in the way that pensions for current retirees are paid by current active workers. Therefore, they require a balance between the benefits paid to pensioners and the contributions made by active workers. In this sense, PAYG pension systems are facing financial problems worldwide mainly because of the global demographic change.

Many European countries have already carried out parametric reforms¹, such as an increase in the retirement age or a decrease in the indexation on pensions, to reduce the expenditure on social security pensions. In Asia², the demographic situation presents a greater challenge than in other parts of the world. The speed of ageing in Asia is much faster than in Europe. According to United Nations (2015), the old-age dependency ratio³ for Europe is forecast to roughly double from 24% in the early 2010s to 50% in the 2080s, while for Asia⁴ it will increase fourfold from 10% to 42%.

In China, the problem of financing social security pensions is even more difficult than in Europe, North America and other parts of Asia. China has the most rapidly aging population in the history of the world. The ‘one child’ policy was pursued to reduce population growth starting in the 1980s, and has only recently been relaxed.⁵ This policy

¹ Detailed pension reforms for European countries can be found in OECD (2015) and Whiteford and Whitehouse (2006).

² Detailed pension reforms regarding Asian countries can be found in Chomik And Piggott (2015) and Hujo and Cook (2012).

³ According to the definition given by the United Nations, the old-age dependency ratio is the number of older people aged above 65 years (currently defined as old age) divided by the number of the working-age population.

⁴ For detailed pension reforms of Asian countries, see Sakamoto(2005) for Japan, Moon (2009) for South Korea, Giang (2013) for Vietnam, Brustad (2012) for Thailand and Bali (2014) for India, amongst others.

⁵ ‘One child’ policy, which was started in the 1980s, is a compulsory policy that does not allow more than one child for

led to a sharp decline in the fertility rate from 6.11 in the 1950s to 1.55 in the 2010s, and as a result, a decrease in the number of contributors financing each pensioner from 13.2 in the 1980s to a projected 1.6 in the 2080s, according to United Nations (2015). At the same time, China's life expectancy at birth doubled from 35 years to 70 years from 1949 to the end of the 20th century. Wang and Deborah (2009) describe China as a demographic over-achiever, since the fertility and mortality transitions that happen typically on a century in other countries have happened within a decade in China.

As a result of the demographic change, China has taken some actions by decreasing the replacement rates in its social security old-age benefits program for urban areas from 77% to 45% in the last decade, and is currently considering increasing the pension age from 60 to 65. At the same time, China has introduced longevity insurance annuities in some parts of the country to maintain the living standard of people at advanced older ages.⁶

Feldstein (1999) proposes that China should change its current pension schemes from PAYG to funded type, since the increasing longevity of populations will require higher contribution rates in the future in order to maintain the current relation between retiree benefits and preretirement wages. He also suggests on the transition from defined-benefit (DB) to defined-contribution (DC) schemes.⁷ After that, Diamond and Barr (2006), Dorfman et al., (2013), and Zheng (2014) propose current Chinese pension system to be changed into a notional-DC (NDC) system⁸.

However, Cheng (2005) and Feng (2004) state that the problems of the Chinese pension system are not caused by the use of PAYG but by the use of inappropriate values for the contribution rate, level of pension benefits and the retirement age. Cai and Du (2015) also argue that the actions taken so far by the government are insufficient to deal with the labour shortage and ageing problem faced by the Chinese population.

any Chinese family. Since December 2013, the 'one child' policy has been relaxed; and, as a result, a family can have a maximum of two children if one of the couple is the only child in his/her family. Detailed information for China can be found in Lu et al. (2014) and McCarthy and Zheng (1996).

⁶ Longevity insurance annuities are deferred annuities that start at an advanced age where roughly 50 percent or more of the population entering the workforce has died. Detailed information for China can be seen in Chen and Turner (2014).

⁷ Although pension systems vary in design, they are usually classified into two broad types: defined-contribution (DC) and defined benefit (DB). Under a DC plan, each employee has an account into which they make regular contributions, and pension is dependent on the amount of money they contributed and the return of the accumulation in the account. In DB plan, the pension benefit is determined by a formula which takes into account the number of contribution years and the participant's wages (Bodie et al., 1988).

⁸ Under this system, a worker contributes a certain percentage of income to his/her personal account over time. The funds in the account accumulate according to an interest rate determined by the government, and the worker receives a pension according to the accumulated funds when retired. There are no actual funds in the account as the financing method is still PAYG.

Despite the importance of China as the world's most populous country, and the seriousness of the problems of its social security pension system, little previous research⁹ examines the magnitude of the changes needed to maintain the sustainability of its current social security pension system.

This paper estimates the magnitude of the changes needed to maintain the sustainability of the Chinese PAYG social security pension system for urban areas.¹⁰ The paper finds that the Chinese PAYG social security pension for urban areas faces serious financing problems in the future. China has a separate program for rural areas that we do not consider in this paper due to its nature of voluntary participation and the independent management of the pension funds between the two systems.¹¹ We assess the long-term financial status of the system using the same actuarial methodology used by the United States Social Security Administration and a number of other countries. The paper also discusses parametric reforms which could be made to the current Chinese PAYG pension system in order to maintain the sustainability of the system.

The remainder of the paper is organized as follows. Section 2 provides an overview of the Chinese social security pension system. Section 3 introduces the actuarial methodology we use to evaluate the Chinese pension system for urban areas, which is the largest compulsory pension system in China. Section 4 describes the data used together with the main assumptions and presents the result of the sustainability level of the Chinese PAYG pension system using the U.S. Social Security actuarial methodology as a benchmark. This section also compares the magnitude of the reforms needed in China to those needed in the United States. Section 5 calculates different combinations of parametric reforms involving key parameters of the pension system (contribution rate, retirement age, replacement rate and indexation of pensions) that restore sustainability to the system. Section 6 provides concluding comments. Two appendices describe the structure of current Chinese public pension system and the formulae to calculate the initial pension in China.

2 The Chinese pension system

Current Chinese public pension system can be divided into two parts based on the types

⁹ Sin (2005) analyses the financing of the Chinese social security pension system for the year 2001 using the Pension Reform Options Simulation Toolkit (PROST) of the World Bank.

¹⁰ It is called Urban Employees Pension System in Pozen (2013).

¹¹ Appendix 1 illustrates the structure of Chinese public pension system. Information on rural pension system in China can be found in Wang and Beland (2014) and Yang et al. (2010).

of participation: compulsory and voluntary. The compulsory plan is called Urban Employees Pension System (UEPS) for the urban workers, and it consists of two accounts, which are PAYG social account and funded individual account. Our analysis focus on the PAYG program for urban workers, which is the largest compulsory pension scheme in China. The voluntary plan covers the urban citizens who has not entitled with UEPS and all the rural residents. The illustration of the current public pension system in China is shown in Appendix 1.

Urban Employees' Pension Program

The Urban Employees' Pension Program is for employed workers working in urban areas. Workers in government agencies and public institutions are not covered by this program. At the end of 2014, 341.24 million employees participated in the Urban Employees' Pension Program, of which there were 255.31 million contributors and 85.93 million beneficiaries (National Bureau of Statistics of the People's Republic of China, 2014).

Since the beginning of Chinese economic reforms in the early 1980s, the Chinese urban pension system has undergone a series of reforms. The pre-reform system existed only in the state and urban collective sectors and was a pure PAYG system within each enterprise. After the 1997 pension reform, pooling of pension funds spread to provinces, and all urban workers were expected to participate regardless of ownership of the enterprise where they worked (Zhao and Xu, 2002).

With the encouragement of the World Bank, funded individual accounts were established in 1995 to increase the portability of the pensions for redundant workers who left state-owned enterprises (SOE) during the economic reforms in the mid-1980s, and to add an element of funding to a system that formerly was unfunded. However, the individual account system did not work in the way it was intended. Because of the large-scale SOE restructuring, many laid-off workers were given immediate pensions at quite young ages (even at age 40) which broadly emptied the individual accounts because the administration used the revenues designated for those accounts to pay the pensions of current retirees. As Chen and Turner (2014) state, the defunding of the individual accounts in is partly due to the large amount of implicit pension debt for PAYG pensions. In 2001, in order to solve the “empty accounts” problem, the PAYG social account was separated from the funded individual account by the “*State Council Document No. 42*”.¹² In the meantime, the contribution rate also changed many times since the establishment of the two accounts.

¹² Detailed information on historical pension reforms in China is included in Oksanen (2010) and Salditt et al. (2008).

The contribution rate for the Urban Employees' Pension Program is 28 percent of wages—the employee contributes 8 percent to an individual account and the employer contributes 20 percent to the account for the PAYG pension, called the social account. The 8 percent contribution rate that workers make for the individual account does not vary across provinces because the account is linked to the individual participant and is not affected by the age structure in the province.

The contribution rate of 20 percent for the PAYG pension, however, is a standard suggested by the central government, but the exact contribution rates can be decided by local government, and can be higher or lower. For example, the contribution rate for Guangzhou city is 12 percent for the social account. The case of Guangzhou with its considerably lower contribution rate for the social account is because many younger migrants live in the city, so population aging is not so serious in this city. The contribution rate for Beijing is 20 percent. The contribution rate for Shanghai is 22 percent for the social account because Shanghai faces serious population aging.

The expense of providing social security old-age benefits depends on the replacement rate provided by the benefits, the age at which the benefits can be received, the number of expected years the benefits are received, and the coverage rate. Relatively low retirement ages are an important reason why social security benefits are expensive to provide in China. Workers must have 15 years of credits, based on years of contributions, to be eligible for monthly benefits when they retire. The statutory retirement age is 60 for men¹³ and for women working in certain professions, 55 for female managers, and 50 for other women.

Many workers, however, are able to collect benefits before the statutory retirement age do to special provisions of the system. Retirement age is reduced for those working in hazardous occupations or who are seriously ill or disabled because of work. For those who have worked in hazardous occupation for certain number of years and contributed to social security program for at least 15 years, social security receipt age for males and females are 55 and 45. For those being seriously ill or disabled, males can apply for social security benefits at age 50 and females can do this at age 45, on the condition that they have contributed for at least 15 years.

The government has provided no specified and clear standard of hazardous occupations and disability. Employers tend to help employees to apply for social security benefits earlier to reduce the cost to employers for older employees. Thus, early retirement is quite common for both women and men (Feng and Hu, 2008). One study found an average retirement age in urban areas of 53 (Ministry of Labour and Social Security of the People's Republic of China, 2006). Recently, due to the ageing problem and "empty accounts" in the individual account system, the Chinese government is considering

¹³ China is currently considering increasing the pension age from 60 to 65.

increasing the retirement age to 65.

An additional factor affecting the cost of providing benefits is relatively high life expectancy for a country with its level of GDP per capita. Life expectancy has improved dramatically. For the period 1950 to 1955, life expectancy at birth for males and females was 42.11 and 44.84 years, respectively. In the period from 2010 to 2015, life expectancy at birth for males and females is estimated to be 73.97 and 77.02, respectively (United Nations, 2015). Considering life at expectancy at older ages, the life expectancy in China at age 50 is 78.50 years, compared to 81.67 years in the United States (United Nations, 2015). These figures understate life expectancy for urban workers in China, who presumably have longer life expectancy than do people in rural areas.

Thus, a key factor in the high cost of the PAYG system for urban workers, compared to the cost in the United States, is the longer period in China that workers can expect to receive benefits. While workers in the United States can expect to receive benefits (starting at age 62) for roughly 20 years, workers in China can expect to receive benefits (starting at age 53) for roughly 25 years, a period that is 25 percent (5 years) longer. These figures are not precise measures, but they do provide an indication of a major difference between the Chinese and U.S. social security programmes.

The cost of the PAYG system for urban workers has risen sharply since the program was established in 1997 and cost 1.5 percent of GDP. In 2014, it cost nearly 4 percent of GDP (Chinese Statistical Yearbook, 1997, 2015).

Recently, due to the ageing problem and “empty accounts” in the individual account system, the Chinese government is considering increasing the statutory retirement age from 60 to 65.

This paper focuses on the urban PAYG system not only because the contributions to this part account for the largest proportion of the total income from contributions, but also because the pension system was rooted in the origin of the Chinese pension system.

3 Methodology used to calculate the financial health of the Chinese PAYG pension system

The main methodology used to measure the financial status of PAYG social security pension systems could be described as an aggregate accounting projection model that compares the spending on pensions with the income from contributions.¹⁴ It uses a

¹⁴ The most commonly used methodologies for making projections of spending on pensions or analysing the sustainability of pension systems are: aggregate or growth accounting models, micro-simulation models, general equilibrium models and indirect models. On this aspect, see the papers by Lefebvre (2007) and TEPC (2007).

forecast demographic scenario to determine the future evolution of the number of contributors and pensioners according to the rules of the pension system together with a macroeconomic scenario to determine the amounts of future contributions and pensions.

The United States follows this methodology and has annually calculated an actuarial balance since 1941 (Board of Trustees, 1941). This approach measures the system's financial sustainability by calculating the difference in discounted present value between spending on pensions and income from contributions. This value summarises the system's financial deficit or surplus for the 75-year horizon by taking into account the beginning and ending amount in the pension fund.

In the U.S., the actuarial projections are condensed into a single number. This number indicates how much the current contribution rate should increase for the system to be sustainable for the next 75 years. If the actuarial balance indicator is greater than zero the system is sustainable for the next 75 years.

The formula to calculate the U.S. Actuarial Balance indicator (AB) is as shown as follows:

$$AB = \left[\frac{\overbrace{TF_0 + y_0 \cdot \sum_{t=0}^{74} \theta_t \cdot N_t \cdot \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}^{\text{Present value of Contributions}}}{\underbrace{y_0 \cdot \sum_{t=0}^{74} N_t \cdot \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}_{\text{Present value of payrolls}}} \right] - \left[\frac{\overbrace{B_0 \cdot \sum_{t=0}^{74} R_t \cdot \prod_{h=1}^t \frac{(1+\lambda_h)}{(1+r_h)} + \prod_{h=1}^{74} \frac{(TF_{74})}{(1+r_h)}}^{\text{Present value of benefits}}}{\underbrace{y_0 \cdot \sum_{t=0}^{74} N_t \cdot \prod_{h=1}^t \frac{(1+g_h)}{(1+r_h)}}_{\text{Present value of payrolls}}} \right]$$

Summarised Income Rate
Summarised Cost Rate

(4.1)

Where TF_0 denotes the value of assets in the trust fund at the beginning of the period, TF_{74} denotes the value of assets required in the last year of the analysed period, θ_t is contribution rate at t , y_0 denotes the contribution base at the starting year, N_t denotes the number of contributors in year t , g_t is the annual real wage growth rate in year t , r_t is the projected yield rate on trust fund assets in year t , B_0 denotes the average pension at the starting year, R_t denotes the number of pensioners in year t , and λ_t is the annual real indexation of pensions in year t .

The U.S. model is highly dependent on the projections of demographic and economic

variables, such as annual wage growth rate, g , yield rate on trust fund assets, r , indexation of pensions, λ , and projected number of contributors and pensioners.

United States is the first country formally using aggregate accounting method to analyse its national pension system. After that, other countries such as Japan, Canada, and Finland also follow the main aggregate accounting methodology,¹⁵ but some particularities and the way in which the main results are presented differ from those in the U.S. actuarial

4 Analysis of the Chinese PAYG pension system and comparison with the U.S.

This section first presents the data and assumptions used during the calculation of Chinese actuarial balance. Then, the results of Chinese actuarial balance together with the comparison with U.S. are provided. A sensitivity analysis for the Chinese actuarial balance under different demographic structures is also presented.

5.1 Data and assumptions

This section provides the data used and the assumptions made to calculate the Chinese actuarial balance

- Because of provisions for early retirement, the average effective¹⁶ retirement age for urban workers in China is 53. The entry age of the contributors is assumed to be 16, which is equal to the earliest legal age to enter the labour market in China.
- It is assumed that once individuals enter the labour market they contribute throughout their working lives with 100% density.
- Data on the population projections of China is obtained from World Population Prospects: The 2015 revision.
- Total number of contributors and pensioners are obtained from Human Resources and Social Security Statistics Bulletin (2014). The coverage rate (expressed as the participants in UEPS programme to the total population) for the current pension system is 25%. In our analysis, it is assumed that there is no coverage expansion in the future. Currently, there are 255 million contributors and 86 million pensioners participating in the system in 2014, i.e. the dependency ratio for the

¹⁵ For a general overview see Boado-Penas and Vidal-Meliá (2012). For particularities see Japan (AAD, 2014), Canada (Office of the Chief Actuary, 2015) and Finland (Finnish Centre for Pensions, 2016).

¹⁶ In China, the effective retirement age does not coincide with the statutory normal retirement age which is 60 for men and 50 for women. For detailed information about the effective age, see the Enterprise Retiree Basic Situation Investigation, published by the Ministry of Labour and Social Security of the People's Republic of China (2006).

current pension system is 34% (86/255). So, I cannot understand the 25% versus 34%...

- The initial value of the buffer fund is obtained from National Social Security Fund Report (2014), which is equal to 2,680 billion RMB in 2014.¹⁷
- Data on the average wages for current workers is from National Bureau of Statistics of the People’s Republic of China.
- Pension benefit is calculated based on the formula stipulated by the Chinese central government, see Appendix 2.
- Annual real wage growth rate g , the annual real indexation of pensions λ , and projected yield rate r for the Chinese pension fund are assumed to keep constant at the last 20 years’ average rates, i.e. 7.61%, 9.4% and 3.68% respectively in 2014.
- The discount rate for future pensions and contributions should be consistent with the rate of return on trust fund assets, and this rate is assumed to be 3.68%.
- The projections under the “normal scenario” follow the structure of “Medium Variant” (Medium fertility, normal mortality, normal international migration) from the World Population Prospects: The 2015 revision. Under this projection, the dependency ratio increases from 34% in 2014 to 127% at the end of the analysed period. The high dependency ratio is the result of the assumption of no reform of the early age at which people receive benefits.

5.2 Results of actuarial balance for the Chinese PAYG pension system and its comparison with the U.S.

This section presents the result for the Chinese actuarial balance together with a comparison with the U.S.. The U.S. data are taken from the annual report prepared by the Office of the Actuary of the U.S. Social Security Administration (Board of Trustees, 2014). A sensitivity analysis of the Chinese actuarial balance under three different demographic scenarios (pessimistic, normal and optimistic) is also provided.

Table 1: Elements of the 75-year actuarial balance 2014-2088. Present value as of January 2014. (US \$1= 6.73 RMB)

| | Items | China (RMB in billions) | US (Dollar in billions) |
|--|-------|----------------------------|----------------------------|
| | | | |

¹⁷ The total amount of pension fund in 2014 is 3,180 billion. The funded amount in individual accounts has been eliminated to achieve the final value in PAYG social account, i.e. 2680=3180-500 (unit: billion).

| | | | |
|------------|--------------------------------|------------|---------|
| 1 | Income from contributions | 792,358 | 50,969 |
| 2 | Spending on pensions | 2,198,122 | 64,299 |
| 3=1-2 | Initial deficit | -1,405,764 | -13,330 |
| 4 | Trust fund at start of period | 2,680 | 2,764 |
| 5=3+4 | Open group unfunded obligation | -1,403,084 | -10,565 |
| 6 | Ending target trust fund | 104,101 | 582 |
| 7=5-6 | Results for the period | -1,507,158 | -11,148 |
| 8 | Aggregate contribution bases | 3,961,789 | 386,884 |
| 9=(1+4)/8 | Summarised income rate | 20.07% | 13.89% |
| 10=(2+6)/8 | Summarised cost rate | 58.11% | 16.77% |
| 11=9-10 | Actuarial Balance (AB) | -38.04% | -2.88% |
| 12 | Year of first deficit | 2030 | 2014 |
| 13 | Reserve fund exhausted (year) | 2037 | 2033 |

Source: Authors' calculations for China. The U.S. results are based on the Board of Trustees (2014).

Table 1 shows the calculation of actuarial balance for the Normal Scenario for China and compares it with the U.S. for the period 2014-88. The calculation process for actuarial balance is stated in the left column in Table 1. The actuarial balance is calculated as the difference between the summarised income rate and summarised cost rate. The summarised income rate is equal to the total income from contributions in the next 75 years plus the amount in the trust fund at the start of period, divided by aggregate contribution bases. The summarised cost rate is equal to the total spending on pensions in the next 75 years plus the amount required for the last year in the trust fund, divided by aggregate contribution bases. Table 1 shows that China will have 1,405 trillion RMB deficit in its PAYG pension fund, if no reform will be taken in the next 75 years. The amount of pension fund in the beginning, which is equal to 2,680 billion is far from sufficient to cover the shortage in the next 75 years. If no action will be made, 1507 trillion RMB will be needed at the end of year 2088 to meet the pension payment requirement. Despite of the serious ageing in China, the large deficit in the Chinese pension fund also result from lack of effective reforms for a long period.

The actuarial balance for China for year 2014 is -38.04%, which means that the current contribution rate in China would need to be increased by 38.04 percentage points to make the Chinese PAYG pension system sustainable. That change would raise the contribution rate in China from 20% to 58% for the PAYG system, and 66% for the social security system, including the 8 percent contribution to the individual account plan. These contribution rates clearly are not feasible.

By comparison, the actuarial balance for the United States in 2014 was -2.88%. Thus, the US needs to increase the contribution rate to 13.5% in order to make its pension system

sustainable over the next 75 years.

The difference in the summarised income rate between China and U.S. is 6.18% (20.07%-13.89%), while in the summarised cost rate is 41.34% (58.11%-16.77%). Thus, the gap between the actuarial balances is mainly due to the expected expenditures on the pension payment is too large compared to its contribution base in China.

The year of first deficit shows the first year when the cash shortage, i.e. each year's pension expenditure minus each year's income from contribution, will happen in the pension system. The time of the shortage for China is 16 years later than U.S. (2030-2014). The same situation exists when the year in which the pension fund reserves will be exhausted is taken into account. It will be four years later in China for the financial reserves in pension fund to be exhausted compared to U.S.. It is because, although the situation of ageing in China will be more serious than U.S. at the end of the period, the emergence of the ageing problem starts later in China. According to United Nations (2015), the old-age dependency ratio in 2014 for China is 11.1%, and for U.S. is 19.4%. Nevertheless, this ratio in 2090 is projected to be 64.2% for China, and 45.6% for U.S.

Sensitivity analysis for the Chinese actuarial balance indicator

Table 2 shows the Chinese actuarial balance under “optimistic” and “pessimistic” scenarios. The terms “optimistic” and “pessimistic” refer to the effect of the assumptions on the actuarial balance. Thus, the “optimistic” assumptions include a lower dependency ratio than the “pessimistic assumptions”. The projections under the “optimistic scenario” assume a dependency ratio constant and equal to 34% as in the current year 2014 (beginning of the analysis). While the projections under the “pessimistic scenario” follows a “low fertility” (the total fertility rates is 0.5 children per women lower than in the normal scenario) structure of World Population Prospects: The 2015 revision. It leads to a higher dependency ratio equal to 198% at the end of the analysed period.

Table 2: *Elements of the 75-year actuarial balance 2014-2088 for China under different scenarios. Present value as of January 2014. Unit: RMB in billions (US\$1= 6.73 RMB)*

| | Items | Optimistic | Normal | Pessimistic |
|-------|--------------------------------------|------------|------------|-------------|
| 1 | Income from contributions | 1,187,007 | 792,358 | 629,429 |
| 2 | Spending on pensions | 1,668,693 | 2,198,122 | 2,103,738 |
| 3=1-2 | Initial deficit | -481,686 | -1,405,764 | -1,474,309 |
| 4 | Trust fund assets at start of period | 2,680 | 2,680 | 2,680 |
| 5=3+4 | Open group unfunded obligation | -479,006 | -1,403,084 | -1,471,629 |
| 6 | Ending target trust fund | 88,759 | 104,101 | 87,334 |
| 7=5-6 | Results for the period | -567,766 | -1,507,158 | -1,558,963 |

| | | | | |
|------------|-------------------------------|-----------|-----------|-----------|
| 8 | Aggregate contribution bases | 5,935,035 | 3,961,789 | 3,147,145 |
| 9=(1+4)/8 | Summarised income rate | 20.05% | 20.07% | 20.09% |
| 10=(2+6)/8 | Summarised cost rate | 29.61% | 58.11% | 69.62% |
| 11=9-10 | Actuarial Balance (AB) | -9.57% | -38.04% | -49.54% |
| 12 | Dependency Ratio at year 2088 | 34% | 127% | 198% |

Source: Author's calculations

In the “optimistic scenario”, when the assumed demographic structure is kept constant for the next 75 years as in 2014, the actuarial balance for China is -9.57%, compared with -38.04% for the normal scenario, that is, the Chinese pension system is not sustainable without a contribution rate increase even in the case of the “optimistic scenario”. In the “pessimistic scenario”, the actuarial balance for China is equal to -49.54%, which is worse than the other two scenarios. The differences in the scenarios come from differences in the benefits projected to be paid under the different assumptions, because the gap is much larger in the summarised cost rate compared to the summarised income rate.

The results of the sensitivity analysis show that, even in the extreme cases, the Chinese PAYG pension system is still not sustainable.

Since the population ageing problem is one of the most important problems for the future of the Chinese PAYG pension system, this sensitivity analysis only considers the different scenarios for demographic structure changes. Further research is required for macroeconomic variable changes, which is beyond the scope of this paper¹⁸.

5 Parametric reforms based on the actuarial balance indicator for China

Since the actuarial balance for China indicates that the current Chinese PAYG pension system is not sustainable without reform under all the scenarios analysed, reforms need to be implemented to make the system sustainable in the future. If only one parametric reform was undertaken, then the contribution rate should be increased by 38.04 percentage points to restore the sustainability into the system, as shown in Table 1. Another equivalent reform that would restore sustainability would be an increase in the retirement age to 65.79. The required retirement age based on our calculation is consistent with the one proposed in the 2015 annual sessions of NPC & CPPCC (The

¹⁸ To give a few examples: if the growth of salary and indexation on pensions were 1 percentage point lower, the value of actuarial balance would be -34.18%; if the rates were 1 percentage point higher, the value would be -41.40%. Compared to the value of -38.40% in the normal scenario, the magnitude of change is around 3%, which is not significant enough.

National People’s Congress of the People’s Republic of China & The National Committee of The Chinese People’s Political Consultative Conference).¹⁹ It means for current female workers, they need to work 15 years more to get eligible for the pension benefit, as their current retirement age is 50.

Apparently, when only one parametric measure is taken into account, the result is too harsh to be applied. Thus, Table 3 presents the combinations for two parametric measures are undertaken simultaneously. If indexation on pension decreases at an annual rate of 2 percentage points, the required retirement age only needs to be increased to 62. Alternatively, the system would be sustainable, if contribution rate increased by 20% and the replacement rate for the PAYG social account reduced to 20% at the same time.

The measures taken can also be defined as automatic balance mechanism (ABM) for China. ABM is defined as a set of predetermined measures established by law to be applied immediately as required according to an indicator that reflects the financial health of the system (Vidal-Meliá et al., 2009).

Table 3: Effect on the Chinese actuarial balance of two parametric reforms taken simultaneously

| Item | | RR | | | λ | | | Retirement Age | | |
|-----------|-----|--------|--------|--------|-----------|--------|-------|----------------|-------|-------|
| | | 31% | 25% | 20% | 0% | -1% | -2% | 62 | 64 | 66 |
| CR | = | -38.0% | -27.4% | -17.9% | -38.0% | -14.8% | -1.3% | -22.6% | -9.5% | -0.5% |
| | 10% | -28.0% | -17.4% | -7.9% | -28.0% | -4.8% | 8.7% | -12.6% | 0.5% | 9.5% |
| | 15% | -23.0% | -12.4% | -2.9% | -23.0% | 0.2% | 13.7% | -7.6% | 5.5% | 14.5% |
| | 20% | -18.0% | -7.4% | 2.1% | -18.0% | 5.2% | 18.7% | -2.6% | 10.5% | 19.5% |
| RR | 31% | | | | -38.0% | -14.8% | -1.3% | -22.6% | -9.5% | -0.5% |
| | 25% | | | | -27.4% | -8.4% | 2.6% | -14.8% | -4.1% | 3.3% |
| | 20% | | | | -17.9% | -2.7% | 6.1% | -7.8% | 0.7% | 6.6% |
| λ | 0% | | | | | | | -22.6% | -9.5% | -0.5% |
| | -1% | | | | | | | -5.5% | 2.4% | 7.8% |
| | -2% | | | | | | | 4.4% | 9.3% | 12.6% |

Note: Highlighted boxes are the results for the positive actuarial balance, i.e. measures that restore the sustainability of the Chinese pension system.

¹⁹ The proposal is raised by reviewing the pension reforms around the world, and claimed the retirement age in China is much lower than the majority of the countries. It proposes that the retirement age in China should be increased to 65 years old for both sexes.

CR is the percentage point increase in the contribution rate, RR is the replacement rate, λ is the reduction in the index rate for benefits in payment

6 Conclusions

PAYG pension system requires the balance between the expenditures paid to the pensioners and the contributions made by the active workers. The ageing problem has led to the global demographic changes between the number of contributors and pensioners. Thus, restoring the sustainability of a PAYG pension system is on the agenda for many governments and China is no exception. This paper uses an actuarial methodology to evaluate the financial health of the Chinese PAYG pension system for urban areas.

The U.S. actuarial approach, that takes into account financial projections, shows that the current contribution rate in China should be immediately increased by 38 percentage points, for a total contribution rate for the PAYG system of 58 percent and a total rate for the social security pension system, including the individual accounts, of 66 percent to make the Chinese pension system sustainable for the next 75 years. Equivalently, in the case of retirement age, it would need to be increased to 65.79. Obviously, these reforms with only one parametric measure are quite harsh and not reasonable to be implemented, and reforms should involve other changes at the same time. This paper presents the possible combinations for the pension reforms when two parametric measures are taken simultaneously. It shows that if the pension in payment would decrease at annual rate of 2 percentage points, the retirement age only needs to be increased to 62 years old in order to restore the sustainability in the long run.

By comparison, sustainability in the U.S. system can be restored with an increase in the contribution rate of 2.9 percentage points, to a total contribution rate for the Social Security Old-Age and Survivors Insurance (OASI) program of 13.5 percent. A key factor in the high cost of the PAYG system for urban workers, compared to the cost in the United States, is the longer period in China that workers can expect to receive benefits, which is roughly 25 percent (5 years) longer in China than in the United States.

The absence of a publicly available actuarial report for the social security program in China produces a “mirage effect” because currently the income from contributions exceeds the expenditure on pensions. Instead of seeing a future problem, it is easy to see the situation of the current surplus, which was 355.5 billion RMB in the year 2014. The current surplus and the lack of information about the future may delay effective measures being taken to restore the sustainability of the Chinese system.

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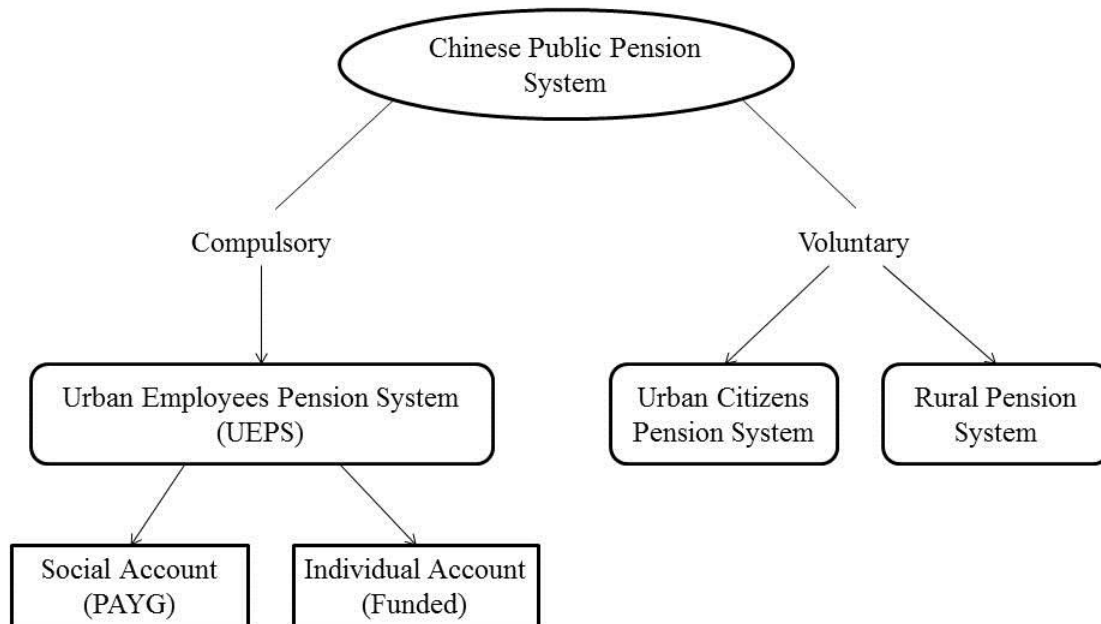
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Appendix 1: Illustration for the structure of Chinese public pension system

Figure A1: Structure of Chinese public pension system.



Source: Authors.

Chinese public pension system can be divided into two parts based on its different participation types as shown in Figure A1. The Urban Employees Pension System (UEPS) is a compulsory plan for urban workers, whereas the urban citizens who has not entitled with UEPS are voluntary to join the Urban Citizens Pension System. All the rural residents could participate in the Rural Pension System voluntarily as well. UEPS consists of two accounts, which are PAYG social account and funded individual account. The contribution to PAYG social account is from employers, and the amount is equal to 20% of the employees' salary. The contribution rate for funded individual account is 8%, and it is solely from employees. Our analysis focus on the compulsory PAYG social account.

According to the State Council Document No.8 (State Council, 2014), the voluntary parts have been unified into one system after 2015.

Appendix 2: Calculation of the initial retirement pension benefit

Assuming an individual retires at year t , the formula to calculate the initial retirement pension benefit of the PAYG-DB social account, P_t , is expressed as follows:

$$P_t = \frac{1 + WI}{2} \cdot Y_{t-1} \cdot A \cdot 1\% \quad (\text{A2.1})$$

Where Y_{t-1} is the average salary for all the contributors in the system at time $t - 1$ (i.e. one year before the retirement), A is the number of contribution years, and WI is the wage index. The WI is an indicator used to measure the relative weight of each individual's contribution base with respect to the average contribution base of the total working population. The formula to calculate the WI is as follows:

$$WI = \sum_{k=1}^A \frac{y_{t-k}}{Y_{t-k} \cdot A} \quad (\text{A2.2})$$

Where y_{t-k} is the salary at time $t - k$ for the individual who retires at year t .