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Social Security Individual Accounts in China: Toward Sustainability in Individual Account Financing

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Received: 12 June 2014; in revised form: 20 July 2014 / Accepted: 1 August 2014 /

Published: 7 August 2014

Abstract: China has both mandatory and voluntary individual account pensions that are provided through the government. The experience of China makes a particularly interesting case study concerning the functioning of individual accounts in that its mandatory individual accounts have been defunded to pay for benefits in the associated pay-as-you-go system, while its voluntary individual accounts are fully funded. This paper examines three questions. First, it analyses why the mandatory individual accounts have become defunded and converted largely to notional accounts generally holding little in financial assets, while the voluntary accounts have been fully funded. Second, it examines the merits of funding *versus* pay-as-you-go financing of pensions in the context of China's economic and demographic situation. Third, it discusses a policy change to insure the sustainability of financing for the defunded individual accounts. The experience of China, with its two types of individual accounts, and with different outcomes for those accounts, may provide lessons for other countries.

Keywords: social security; individual account; implicit pension debt; China

1. Introduction

Countries generally have provided social security benefits through social insurance programs that base benefits on a formula, and often are redistributive, usually taking into account years of work and earnings in calculating benefits. They are financed on a pay-as-you-go basis. Some countries, however,

have moved toward funding and the use of individual accounts, where the benefit provided is based on the amount the individual has in his account or that is credited to the account.

Individual accounts can be fully funded, partially funded, or financed on a pay-as-you-go basis and thus unfunded. Unfunded individual accounts are called notional individual accounts. The Notional Defined Contribution System, which provides the majority of social security benefits in Sweden, is an individual account system that is largely unfunded. A rate of return is specified on an account balance that is recorded as an accounting entry. Sweden also has mandatory funded individual accounts that provide a relatively small part of total retirement benefits.

China has both mandatory and voluntary individual accounts, covering different groups of workers. The experience of China makes a particularly interesting case study concerning the functioning of individual accounts in that its mandatory individual accounts have been defunded, while its voluntary individual accounts are fully funded.

Oposing viewpoints can be found in the policy literature as to the merits of funded *versus* unfunded individual accounts in China. Feldstein (1999) argues that the benefits funded accounts can provide will be considerably larger than those provided by a pay-as-you-go system [1]. Williamson and Deitelbaum (2005) present a critical analysis of China's decision to partially privatize its social security system, arguing that this change will hurt some vulnerable populations [2]. Pozen (2013) notes that with low rates of return earned on the individual accounts and relatively high rates of growth of wages the individual accounts will provide low replacement rates [3]. Earlier, Barr and Diamond (2010) recommend that the existing mandatory individual accounts be turned into notional accounts [4]. They also point out fully funded individual accounts are not appropriate in the short run. By comparison, Feldstein and Leibman (2006) argue that China should fund its individual accounts [5]. Dorfman *et al.* (2013) present the case for China not having mandatory funded individual accounts, but rather having mandatory notional (unfunded) individual accounts and voluntary funded accounts [6]. Leckie and Xiao (2014) comment that the development of the National Social Security Fund, explained later, is a major development in the management of investments for funded individual accounts [7].

This paper compares two types of social security individual accounts in China. First, it analyses why the mandatory individual accounts have become defunded and converted largely to notional accounts generally holding little in financial assets, while the voluntary accounts have been fully funded. This comparison has not been addressed previously in the studies of individual accounts in China, in part because of the relative newness of the voluntary individual accounts. Second, it examines the merits of funding *versus* pay-as-you-go financing of pensions in the context of China's economic and demographic situation. Previous studies have addressed this issue, but with differing results. Third, this paper assesses the possible effect of a policy change that would reduce the financing pressure on the pay-as-you-go program, thus reducing pressure to use the funded accounts to finance the pay-as-you-go system. This change would improve the sustainability of the individual account system.

China's experience may provide lessons for other countries considering introducing individual accounts. In particular, the comparison between the financing of the mandatory individual accounts for urban workers and the voluntary individual accounts for rural workers provides possible lessons concerning the funding of individual account programs. While the contributions to the mandatory individual accounts for urban workers have been largely used to finance the pay-as-you-go benefits for retirees in that system, the contributions to the voluntary individual account plans for rural workers

have been deposited in bank accounts and are accruing interest. We argue that the difference is not due to a greater ability to manage individual account plans in rural areas than urban areas, but primarily is due to differences in the amount of implicit pension debt for pay-as-you-go pensions in the two areas. Another factor is the overly generous benefits provided by the individual accounts, particularly those associated with the mandatory pensions.

The paper is structured as follows. First, to provide institutional background information it describes the social security old-age benefits programs in China and compares the structure of the two main social security programs. Then it describes the development process of the mandatory individual accounts for urban workers, which are largely unfunded. This discussion clarifies why there is a large amount of implicit pension debt associated with the mandatory pension system. This discussion is followed by an analysis of investment of the funded part of the mandatory and voluntary individual accounts. A policy section analyses the lessons to be learned from the functioning of these two systems. Lastly, the paper provides concluding comments.

2. Fragmented Social Security Systems in China: A Comparison of the Two Main Programs

The worker registration system in China plays a key role in the provision of social security benefits. In China, all persons have either urban or rural registration. By the end of 2013, 731.1 million people (53.73%) had urban registration and 629.6 million (46.27%) had rural registration [8]. This division in worker registration is important in the provision of social security old-age benefits because old-age security systems differ for the two groups of workers.

China has two main social security old-age benefits programs: the Urban Employees' Pension Program and the National Rural Pension Program. The Urban Employees' Pension Program covers employed workers with rural or urban registration in urban areas. By the end of 2013, 322.18 million employees participated in this program, of which 241.44 million (74.9%) are in labor force age and 80.41 million (25.1%) are beneficiaries [9]. The Urban Employees' Pension Program is mandatory.

The National Rural Pension Program, started in late 2009, provides a voluntary individual account benefit. All people with rural registration aged 16 or older, who are not students and who do not participate in another pension plan, can voluntarily participate in the new program. They can participate whether they work in a rural or urban area, whether they are employed or self-employed, and whether they work for pay or are not working for pay. By the end of 2013, about 474.01 million rural people participated in the National Rural Pension Scheme, of which 346.1 million (73%) are labor force age and 128 million (27%) are retirement age [10]. Several factors contribute to the fast expansion of social security coverage in the rural areas in China. Those over age 60 can receive the basic pension benefit without contributing by themselves, provided their children are contributing to the scheme. Thus those aged 60 and older have strong incentives to apply for noncontributory benefits. Besides, governments provide matching contribution as an incentive for rural workers to participate in the rural program.

A total of 587.5 workers were participating in these two programs at the end of 2013, which compares to a total labor force of 797.6 million [11]. However, government workers, the military and other groups are not included in these two programs but are covered by other pension programs.

Both social security programs are composed of a social account benefit and an individual account. The financing of the individual accounts has been linked with that for the social account pensions in the Urban Employees' Pension Program, with the funded individual accounts being used to pay for the unfunded social account pensions. Thus, to understand the financing of the individual accounts, it is necessary to also understand the financing of the social account pensions. In this part, the structure of these two programs is compared from the perspectives of contributions, benefit age and benefit level. It is seen later in the paper that these three aspects of the pensions all affect the financing of the individual accounts.

2.1. Contributions

In the Urban Employees' Pension Program, the current contribution rates are 8% of wages for the mandatory individual account and 20% for the social account. These rates are set by the central government as guidelines, but the exact contribution rate for the social account pension can be decided by local government, and can be higher or lower, depending on the social security financing needs of the local government. The 8% contribution rate that workers pay 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 [12]. An important aspect of the financing of the mandatory individual account is that the government entity that is responsible for financing the social account pension also has responsibility for the mandatory individual account. Thus, governments face pressure to use the funds in the mandatory individual accounts to help pay for the social account pension.

The revenue and benefit payments for the Urban Employees' Pension Program are not divided in the national statistics between the social account pensions and the mandatory individual accounts. In 2012, the revenue for the Urban Employees' Pension Program was 2 trillion yuan (US\$333.3 billion), the benefit expenditure for that year was 1.56 trillion yuan (US\$260 billion), and the accumulated balance at the end of 2012 was 2.39 trillion yuan (US\$400 billion) [13]. Thus, the amount received was about 28% more than the amount spent. Assuming that about 30% of the amount received was for the mandatory individual accounts would imply that about 600 billion yuan (US\$100 billion) was received in contributions for the individual accounts. That would mean that the total amount accumulated in the individual accounts equaled about 4 years of contributions. Since the program started in 1997, this calculation is consistent with the accounts being substantially underfunded. To put the 4 year amount into perspective, it can be compared to statistics for the Thrift Savings Plan, which is an individual account plan for U.S. government employees. For the Thrift Savings Plan, accumulated assets equal about 13 years of contributions [14].

In the National Rural Pension Program, participants do not need to have a formal job. Anyone meeting the age requirements can contribute to these programs regardless of earnings, and the amount of the individual's contributions is not a fixed amount related to earnings. In the National Rural Pension Program, the contribution level regulated by central government is 100 to 500 yuan per year (US\$16 to US\$81), divided into 100 yuan increments [15]. Participants can choose their contribution level within this range. But as the program is managed by the county (district) or municipal government, the range of choice of contribution levels differs between different areas.

2.2. Benefit Eligibility Age

The age at which benefits can be received is a factor placing stress on the financing of the Urban Employees' Pension Program, and thus may be a key factor in the underfunding of the mandatory individual accounts. In the Urban Employees' Pension Program, the retirement age is 60 for men. It is 60 for women working in certain professions, 55 for female managers, and 50 for other women, with most women having a retirement age of 50. In the National Rural Pension Program, to receive benefits, the person must have contributed 15 years and be at least 60 years old. Thus, most female workers in urban areas can retire and receive benefits 10 years earlier than female workers in rural areas.

In 2012, the ratio of persons age 65 and older to those ages 15 to 64 in China was 12% [16]. A simple calculation using the pay-as-you-go budget constraint indicates what the social security replacement rate would be with a tax rate of 20% and with that old-age dependency ratio, in other words assuming that people collected benefits at age 65. The pay-as-you-go budget constraint is

$$BN = twL \quad (1)$$

where B is average benefits per beneficiary, N is number of beneficiaries, t is the social security tax rate, w is the average wage rate, and L is the number of workers. Rewriting the equation in terms of the replacement rate B/w yields

$$B/w = tL/N \quad (2)$$

With a tax rate of 20% and an old-age dependency ratio of 12% (assuming retirement at age 65), the replacement ratio would be 160%, meaning that social security benefits would exceed average wages. Thus, if China were to change its retirement age to 65, it could cut in half its tax rate, to 10%, and still have a generous replacement rate of 80%. While it is unreasonable to expect that China would raise its retirement age that high, this calculation puts into perspective the current situation where a tax rate of 20% is insufficient to finance benefits and money needs to be taken from the funded individual accounts. The low retirement age for women causes there to be fewer workers and more beneficiaries than if there were a higher retirement age, and thus has a double effect on the ability to finance the benefits.

By 2030, the old-age dependency ratio is predicted to be 24%, which is twice that of 2012 [17]. When the tax rate is fixed to 20% and retirement age is set at 65, the replacement ratio will be about 80%. This demonstrates that when the old-age ratio is twice as high in the future compared to the present, the replacement ratio will be halved. It also indicates that the financial problems China has currently in financing the Urban Employees' Pension Program benefits, and the pressure that places on the individual account pensions, will get substantially worse over the next 16 years if it does not do something about the retirement age for female workers.

2.3. Benefits

In the Urban Employees' Pension Program, a basic benefit from the social account and an individual account benefit are provided. The basic benefit from the social account pension is calculated by considering total contribution years and the indexed monthly wage of the employee. The benefit

from the individual account is provided based on the amount credited to the participant's individual account from the participant's contributions and accrued investment returns.

Benefits from the National Rural Pension Program are also composed of two parts. One part is the non-contributory social account benefit—55 yuan (US\$9) per person per month. The local governments pay the cost of the small non-contributory benefit and local government can raise the non-contributory benefit level according to its financial ability. People aged 60 or older before the start of the system can receive this benefit from government without having contributed. The other part comes from the person's individual account, which depends on the contribution level of the participant and the matching contribution.

The monthly benefit based on the individual account in both programs is the credited balance in the worker's individual account balance at the time of retirement, divided by 139 for those retiring at age 60. The divisor depends on the age at which the person collects benefits, with it being higher at lower ages. It is 195 for a woman retiring at age 50 and 170 for a woman retiring at age 55 in the Urban Employees' Pension Program. Generally, men cannot collect retirement benefits at those ages.

The divisor of 139 for benefits received at age 60 is the key parameter in determining the generosity of the individual account benefit. Thus, in assessing the financing of those benefits, it is important to determine whether that divisor provides benefits that are adequately financed, or alternatively, whether the benefits are overly generous. Those benefits being overly generous would be another factor placing pressure on the financing of the individual account pensions. When financial planners in the United States advise individual account holders as to the sustainable amount that a retiree can withdraw from an account without overly risking that they will run out of money, they often advise that a retiree can withdraw 4% of the initial account balance, adjusted for inflation, each year [18]. The 4% figure is designed to provide an inflation-indexed withdrawal. That advice depends on the life expectancy of the individual and the expected rate of return received on the account. It would be a higher percentage for a shorter life expectancy and a higher expected rate of return. If the amount, instead, was used to purchase an annuity, which is a better comparison for the individual accounts in China, the amount would be equivalent to a withdrawal of 5.7%, based on U.S. male annuity rates, no inflation adjustment of benefits, and the low interest rates available in 2013. The withdrawal rate would be lower than 5.7% for a benefit that was adjusted for inflation, as is done in China on an ad hoc basis.

The divisor of 139 for monthly benefits is equivalent to withdrawing 8.6% of the initial account balance each year. Thus, it appears that the benefit divisor of 139 should be increased if the goal is to have an individual accounts system that is financed by the contributions of participants. That change would result in lower benefits, but would be more consistent with a sustainable, self-funding pension system. Conversely, the overly generous provision of individual account benefits is an additional factor, for the defunding of these benefits. By one analysis, because of the generosity of benefits, county governments will be liable for 40% of the payments from the individual account pensions [19]. The government thus subsidizes a substantial portion of the individual account benefit. This cost is borne by local governments.

The benefit payment is not limited to the amount in the individual account, but is guaranteed by the government for life, and thus is paid as an annuity [12]. If the person dies before receiving the full amount in their individual account, the spouse receives the remaining amount, then the children, if the spouse is not surviving. The provision of survivor benefits in this form provides some income protection

for survivors, but also raises the cost of the individual account pensions. The system does not provide a benefit to a surviving spouse if the amount credited to the account has been paid in benefits.

For a couple of reasons, the individual account pensions are less generous in rural areas than in urban areas. First, women cannot receive them until age 60 in rural areas, compared to age 50 in urban areas. Second, average life expectancy in urban areas likely exceeds that in rural areas because life expectancy tends to be higher for persons with higher income.

The government is thus incurring what appear to be substantial unfunded liabilities for the individual account systems, both through providing overly generous benefits relative to the contributions, and to using the money in the individual accounts to pay for the benefits provided by the social account pension for the Urban Employees' Pension Program [20]. Most countries, however, have pay-as-you-go social security systems with unfunded liabilities, thus unfunded liabilities are a common feature of social security systems.

3. Development Process of Individual Accounts in the Urban Employees' Pension Program

Like all countries with pay-as-you-go social security systems, China has legacy social security liabilities. Some of these unfunded liabilities are from earlier social security arrangements, but they affect the financing of its current social security system because they provide benefits that must be paid out of current contributions. With the economic reforms in 1978, the Chinese government increased social security benefits in its social insurance program for urban workers—with high replacement rates of 60% for 10 years of work, 70% for 15 years, and 75% for 20 or more years [21]. The generous benefit level of the former program brought stress on the new program when the liabilities of the system based on state owned enterprises that preceded the current system have been taken over by the current system [22].

The implicit pension debt of pay-as-you-go social insurance programs is the amount of unfunded liabilities of these programs. The implicit pension debt has been an issue in the introduction of mandatory funded individual accounts in Chile, Argentina, Poland and a number of countries [23]. When mandatory funded individual accounts are introduced, current workers are required both to contribute toward the funding of their own retirement and to pay for the unfunded pension debt to provide benefits to current workers.

In 1997, when the Urban Employees' Pension Program was first established in China, the contributions to the mandatory individual account were set at 11%, of which 7% of pay was contributed by employers and an amount starting at 4% of pay was contributed by employees. The contribution level of employees to individual accounts was set to increase to 8% of pay, with the contribution of employers to individual account decreasing to 3%. Employers also contributed 13% of pay to the social account pension [21].

In 2000, the 1997 reform was revised to separate the financing of the social account and individual account. Problems had arisen because the financing and the administration of the social account pension and the mandatory individual accounts had not been separated. Sin (2000) reported that many localities were using the funds from the individual accounts to pay current beneficiaries in the social account pension, and that in many provinces the individual accounts were notional, meaning that they had little or no funds in them [21]. While in a few areas, the contributions for the individual accounts

were being used to fund those accounts, in most provinces and municipalities, that contribution was being used to pay for the benefits of current beneficiaries [24].

Because of the insufficient funding of the social account pension, in part because of the relatively young ages at which benefits could be received, the 2000 reform specified that the 20% employer contribution is to go to the social account pension. Employees contribute 8% to the mandatory individual accounts, while the employer contribution to the individual accounts was eliminated [2,21]. The implicit pension debt in the pay-as-you-go system is still an issue in that the 20% contribution rate by employers, while high by international standards, is not adequate to pay for the already promised benefits that are currently being paid. While the money contributed to the individual accounts was not a subtraction of money that had been contributed to the social account system, it was money that could have been used to raise the contribution rate to the social account system to assure that it was adequately financed. One estimate suggests that the contribution rate necessary to fund the Urban Employees' Pension Program on a pay-as-you-go basis would be 35% [25], with a more recent estimate suggesting it might be 30% [6].

In spite of the 2000 reform, the practice of using the money from the individual accounts to pay for the social account benefit has persisted. In 2001, three provinces—Heilongjiang, Jilin, Liaoning—started to fund the individual account. Funding was made possible by large subsidies from the central government to help pay for the social account pension [26]. Before this time, the individual account was a notional account, without any funding in it. Government policy of the Ministry of Labor and Social Security at the end of 2005 mandated that all provinces fund individual account programs. Many of the provinces when they first started to fund individual accounts did not put the full 8% contribution into them, but put 2% in. By 2006, individual accounts programs were partially funded in 10 of the 33 provinces. The extension of partial funding to other provinces stagnated, but has now occurred [27]. Thus, the government has not until recently segregated the money in the individual accounts from other social security funds, and has spent much of that money, in essence converting those accounts to notional accounts to which interest is credited to notional account balances [28].

4. Investment of Individual Accounts Funds

Funded individual accounts can be structured in different ways. In Sweden, the government manages the mandatory funded individual account system, but the investments in different mutual funds are chosen by workers. In Chile, workers choose between different pension fund management companies. The system in China differs from both of these approaches. The system is government run with workers having no choice as to pension fund provider or the investment of the assets. In this respect, it is more similar to the mandatory provident funds in some countries in Asia, such as Indonesia or Malaysia.

Unlike in most other countries, where social security is solely a responsibility of the national government, the responsibility for social security programs is divided among central, provincial, municipal, and county or district governments in China. Because of this division of responsibility, the management of social security funds is fragmented, even within provinces. Only four provinces, two of them being the cities of Beijing and Shanghai, have pooled the social security funds. Different government entities manage more than 2000 social security funds [27].

According to regulation, the balance in the Urban Employees' Pension Program can be deposited in a bank account or used to buy government bonds. In most provinces, this fund is deposited in the bank. The rate of return on provincial urban pension funds has averaged 2% over the last 10 years, which is less than the rate of inflation over that period [29]. Because interest rates set by the government have been below inflation rates, money in these accounts has lost value over time. These strict regulations have led to evasion in contributions and some areas engaging in alternate investments in potentially higher return, but also higher risk, local projects [30]. The low rate of return means that the pension participants are in effect subsidizing the banks.

Since 2007, provincial governments have been allowed to entrust the National Council for Social Security Fund to invest the funded part of the mandatory individual accounts. The National Council for Social Security Fund was established in 2000. It manages National Social Security Fund (NSSF) to support China's future social security expenditures, including the ongoing need to provide subsidies to some of the municipal funds. The NSSF receives money from government allocations, from a government lottery, and from the sale of state-owned enterprises. It is a strategic reserve fund designed to help pay for future social security expenditures during periods of rapid aging [29]. In 2012, the NSSF spent 2.73 trillion yuan (US\$455 billion) in paying for social security benefits [31].

Since 2006, the NSSF has managed the investments of the individual account funds of nine provinces, municipalities and autonomous regions. As of 31 December 2012, the NSSF managed fund assets of 893.3 billion yuan (US\$149 billion). Included in that, the value of the individual account funds managed by the NSSF is 78.7 billion yuan (US\$13.1 billion) [32].

In 2012, the national government announced a pilot program that would permit the 13 provinces that manage pension funds for individual accounts to invest in domestic equities. The National Social Security Fund Council acts as the trustee and principal investor of each of these funds. The amount invested this way could be as much as 360 billion yuan (US\$60 billion), roughly 20% of the funds' combined total assets under management [33].

When the National Rural Pension Program was established, individual account funds were separated from the social account fund and were fully funded. According to the regulations of the central government, the individual account funds of this program are deposited in a bank. Most banks are owned or partially owned by the government, and thus substantially under the control of the government [34]. The fund rate of return is calculated using one-year bank deposit rates. The one-year bank deposit interest rate was about 3% in 2012 [35]. The estimated inflation rate for 2012 was 2.6% [34].

5. Policy Analysis

5.1. Background

In 2010, pension fund assets in China as a percent of GDP were 2.9%, up from 1.5% in 2005 [36]. Pension fund assets as a percent of GDP will continue to grow in China due to the funding of voluntary individual accounts and perhaps due to increased funding of mandatory individual accounts. China's capital markets currently may not be sufficiently developed to support a large amount of savings, but the start of this type of investment will encourage the development of capital markets, which would be

expected to provide higher rates of return on the funded accounts. For the funded systems to be successful, they need to have access to investments with rates of return exceeding the inflation rate. Current developments in the financial system in China include a move from a centrally directed system to one that is commercially based [36].

By comparison, one study of the implicit debt has placed the implicit debt for future pensions for urban employees and government workers at between 44 and 56% of GDP if the contribution rate were to be raised to 25% [6]. That study did not estimate the implicit debt associated with the pensions for rural workers, but that amount would be very small in comparison because there are no legacy costs, only the implicit debt that has been incurred since the start of that system.

Major differences exist between the mandatory individual accounts for urban workers and the voluntary individual accounts for rural workers. One of those differences is that the contributions to the voluntary individual accounts have been deposited in banks. This compares to the contributions to the mandatory individual accounts, which have been largely used to pay for the pay-as-you-go social account program for urban workers. The size of the implicit debt in the voluntary systems compared to the mandatory system may explain the difference. The implicit debt is the unfunded liability for future benefits that have already been earned by workers. The voluntary systems have a relatively small implicit debt due to the relatively low level of unfunded benefits they provide and the older eligibility age to receive benefits, particularly for women.

The voluntary individual accounts would have no implicit debt if they were funded entirely by the contributions made to them. However, because of the generosity of the conversion factor used to convert the account balance to an annual payment, the government is required to subsidize future benefit payments, which is the source of an implicit debt. Implicit debt also arises for the basic benefit, which is an unfunded benefit. By comparison, the implicit debt associated with the mandatory individual accounts is relatively large due to the generosity of benefits provided by the social accounts program in the urban area, including the relatively young ages at which many workers take these benefits. Raising the eligibility age for benefits in the Urban Employees' Program would reduce the implicit debt in that program and reduce the pressure to use the mandatory individual accounts to fund the social account pension.

Given the state of development of China's capital markets, and given its very high savings rate, the underfunding of the individual accounts in the Urban Employees' Pension Program may be the best outcome at the present time. An international study group has recommended that the mandatory individual accounts be turned into notional (unfunded) accounts [37].

China differs from many countries in that it has a very high saving rate, with gross savings as a percent of GDP at 49%, compared to 12% for the United States [38]. Thus, there may be more justification in China for unfunded liabilities than in other countries because it already has adequate savings. In addition, the central government has large non-pension reserves that could be used in the future to help pay for these liabilities [28]. China had reserves of foreign exchange and gold in 2012 of US\$3.3 trillion, which is the largest in the world [13].

China also is experiencing rapid wage growth. The average real wage growth rates for private institution workers and non-private institution workers were 14% and 9% respectively in 2012 [13]. When wage growth is rapid and rates of return in financial markets are relatively low, pay-as-you-go social security may be more efficient in providing future benefits than a funded program [39].

5.2. Analysis

This section first analyzes the largely unfunded individual accounts, then analyzes the funded individual accounts. Then the two types of accounts are compared.

5.2.1. Pay-As-You-Go Pensions

With a pay-as-you-go pension system, the total benefits paid out in a year equal the total contributions received. That relationship can be expressed as a budget constraint (Equation (3)), repeated from earlier in the paper, where, B is average annual benefits, N is the total number of beneficiaries, t is the contribution rate, w is the average annual wage earnings of workers covered by social security, and L is the number of workers covered by social security.

$$BN = twL \quad (3)$$

The budget constraint of Equation (3) is a single-period constraint. That budget constraint can be rewritten in terms of percentage changes over time, where E is the percentage change operator (technically, the derivative of the natural logarithm).

$$E(BN) = E(twL) \quad (4)$$

Equation (4) is a dynamic budget constraint, which can be used to analyze changes over time in social security finances. If the conditions derived from Equation (4) are met over time, a system in balance will continue to be in balance. The implicit debt is represented in this equation through its effect on the growth of benefits over time. Equation (4) indicates that for social security to maintain financial balance over time, the growth rate in total real benefit payments must equal the growth rate in total real contributions.

An alternative framework for this analysis is the Generational Accounting approach. An advantage of the approach used here for this analysis is that this approach is tied to pay-as-you-go financing and the sustainability of social security within that framework. Generational Accounting, by comparison, would be better suited for an analysis of the costs borne by different generations. While we do not model the optimal bearing of costs by different generations, we do note that with rapid wage growth, it may make sense in terms of intergenerational differences in utility to shift costs to future generations who will be substantially wealthier than the current generation of retirees.

Splitting the dynamic budget constraint into its component parts, Equation (4) becomes

$$E(B) + E(N) = E(t) + E(w) + E(L) \quad (5)$$

The growth rate in total social security contributions equals the sum of the growth rates of the contribution rate, average real wages, and the labor force. The growth rate of total benefits equals the sum of the growth rate of benefits per beneficiary and the growth rate of beneficiaries (Equation (5)).

Two different scenarios are now considered. First, financing is examined under the assumption that the contribution rate, including both contributions by workers and subsidies by the government, as a percentage of wages, is fixed. Second, financing is examined under the assumption that the replacement rate is fixed. These two scenarios indicate the range of possible future approaches for Chinese policy.

5.2.2. Fixed Payroll Tax Rate

When the contribution rate t is fixed ($E(t) = 0$), having reached the maximum level considered politically acceptable, the dynamic constraint for a sustainable benefit formula becomes

$$E(B) = E(w) + E(L) - E(N) \quad (6)$$

Equation (6) indicates that to maintain solvency, the growth rate in average real benefits per beneficiary must equal (or not exceed) the growth rate in real wages plus the difference between the growth rate in the labor force and the growth rate in beneficiaries. This equation highlights that with a pay-as-you-go system, when wages are growing rapidly, benefits will also grow rapidly. In China, because of population aging, the growth rate in beneficiaries exceeds the growth rate of the labor force, which currently is negative (the labor force is shrinking).

Changes in the ratio of beneficiaries to covered workers (the old-age dependency ratio) play a key role in social security financing in pay-as-you-go systems, as shown in Equation (7).

$$E(B) = E(w) - E(N/L) \quad (7)$$

Equation (7) indicates that a sustainable pension with pay-as-you-go financing would have benefits growing at less than the real wage growth rate when there is population aging. They would grow at the rate of real wage growth less an adjustment for the rate of growth in the old-age dependency ratio. The replacement rate is the ratio of benefits to some measure of wages. Replacement rates can be defined in a number of different ways with respect to the measurement of wages. In this paper, the replacement rate is represented by the ratio of social security benefits to the wages of current workers (B/w). Equation (7) can be rewritten to show the relationship between the old-age dependency ratio and the replacement rate.

$$E(B/w) = - E(N/L) \quad (8)$$

With the labor force growing slower than the number of beneficiaries and the contribution rate fixed, the generosity of benefits, as measured by the replacement rate, must fall over time at the rate of growth of the old age dependency ratio. Thus, the data presented earlier indicating that the old-age dependency ratio will double in roughly in twenty years indicates that the replacement rate must fall over time at roughly 3.6% per year if there are no other changes in the social security program.

5.2.3. Fixed Replacement Rate

Now, instead of assuming that the contribution rate is fixed, we assume that the replacement rate is fixed. The actual reality presumably lies between these two assumptions. In that case, Equation (5), with rearrangement of terms, becomes

$$E(t) = E(N/L) \quad (9)$$

Thus, if the replacement rate is fixed so as to maintain the generosity of the social security program, the contribution rate must increase at the same rate as the old-age dependency ratio. This scenario we view as unlikely because the payroll tax rate already is relatively high, but there may be some increase in government subsidies in the future.

5.2.4. Comparison to Funded Pensions

Aaron (1966) showed that when the sum of the rate of population growth plus the rate of growth of the real wage rate exceeds the rate of return on financial investments, an unfunded pension program will provide greater benefits than a funded program [39]. In China, that is the case for workers because of a very high rate of real wage growth currently, which offsets negative population growth, and low rates of return on investments available to individuals in pension plans. The high savings rate of Chinese workers may in part be a result of the low rate of return received on those savings. It may also be a result of the high rate of growth of wages, which necessitates a high savings rate to achieve a reasonable replacement of wages near retirement. This situation will not persist indefinitely because the rate of growth of real wages will likely decline in the future, and it is possible that such a decline is occurring currently.

Thus, to summarize the analyses in the two parts of this section, at the current time workers may be better off with unfunded pensions because of rapid wage growth and low rates of return on pension investments, but these pensions will provide declining replacement rates due to the demographic changes occurring in China, with an increasing old-age dependency rate.

6. Conclusions

The experience of China makes a particularly interesting case study concerning the functioning of individual accounts in that its mandatory individual accounts have been defunded to pay for benefits in the associated pay-as-you-go system, while its voluntary individual accounts are fully funded. We consider the two main social security benefit programs in China. China has two different types of individual account plans that are part of its social security system. One type is mandatory for employed workers in urban areas. The other type is for workers with rural registration. The two types of individual accounts also differ in another major way in that the mandatory individual accounts are for workers for whom the government has a large implicit pension debt. The money contributed for those accounts has largely been used to pay the pay-as-you-go benefits for current retirees. The voluntary program is not facing serious issue of implicit pension debt. Thus, the money that has been contributed to those programs has been saved.

We argue that the difference in funding between the mandatory and voluntary individual account programs is not due to a greater ability to manage individual account plans in rural areas than urban areas but is partly due to the differences in the amount of implicit pension debt for pay-as-you-go pensions in the two areas and may be partly due to the individual account benefits being overly generous, particularly for the Urban Employees' Pension system. The low retirement ages, particularly for women, are one factor in the large implicit debt, and the financial pressure to defund the mandatory individual accounts. The defunding of the mandatory accounts also may be affected by the allocation across government entities for the responsibility for the implicit pension debt. Thus, the experience of China, with its two types of individual accounts, and with different outcomes for those accounts, may provide lessons for other countries. At the current time, workers may be better off in unfunded pensions that are tied to wage growth because of the high real wage growth rate compared to the low rates of return

on investments available to them for their pension funds. In the future, this situation likely will change as real wage growth rates decline and as better investment opportunities are made available.

Acknowledgments

We thank the support of the Fundamental Research Funds for the Central Universities (2013115010201) and the research project Social Security Actuarial Research (11JJD840017) in China. We have received helpful comments from two referees.

Author Contributions

John Turner designed the research project. Tianhong Chen and John Turner discussed the structure and finished writing this article. Both authors read and approved the final draft of the article.

Conflicts of Interest

The authors declare no conflict of interest.

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