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RESEARCH ARTICLE

The pension system in China: an empirical study of the money's worth ratio of annuities

Wan, Qingyao; Cheng, Deyi; Niu, Leilei

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Abstract

According to the World Bank, China has experienced the kind of fertility transition over the past 40 years that typically took more than 100 years in developed countries. With rising life expectancy and a sharp fall in the total fertility rate to around just 1.5, the country has "grown old before growing rich". The share of people aged 60 and over in the total population is set to rise dramatically in the coming decades, from around just 12 per cent in 2010 to almost one quarter by 2030 and over a third by 2050. By 2030, this would give China a population share over 60 only just under the OECD average. As a result, the old age dependency ratio in China will increase at an almost unprecedented rate over the coming decades, with the rural old age dependency ratio rising to over 34 per cent and the urban rate to around 21 per cent by 2030. The emerging "4-2-1" extended family pattern of four grandparents, two parents and one child will exacerbate the strains on family support networks. The ageing population will also present a challenge to social programmes, particularly pensions and health care. There is a three-pillar pension system in China, but the second and third pillar are in their incipient stages. A long list of improvements is required to reach the goal of a properly functioning three-pillar system set out by the government, with the development of an annuity market an especially necessary element. Annuities can hedge longevity risk but they are not popular in China. One of the key obstacles is the low level of annuity literacy; there is a real lack of consumer education materials in China, such as the Money's Worth Ratio of annuities. This study represents the first time that macro and micro data from the Chinese market are used to calculate the Money's Worth Ratio (MWR) of annuities. We found that: (1) according to the law that deems an annuity fairly priced if its MWR is no less than 0.9, annuities are fairly priced in China; (2) annuitants who reach the life expectancy estimated in some big cities can get the premium back; (3) there are some big differences in MWR among different annuity products and the highest MWR is for a life annuity without any guaranteed payment; and (4) there is an optimal age to buy the annuity which depends on the sex of the buyer and the type of product. An improved supply of annuities is highly recommended.

Keywords: Pension system, Annuity, Money's worth ratio (MWR), Longevity risk.

JEL classification: D14, G12, G22, G23.

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Wan, Q. ✉ School of Insurance, Shanghai Lixin University of Accounting and Finance. 995 Shangchuan Road, Shanghai 201209, People's Republic of China. Email: wanqingyao@sfu.edu.cn

Cheng, D. Government Administration School, Nanjing University. 163 Xianlin Dadao, Xixia District, Nanjing, Jiangsu Province 210023, People's Republic of China. Email: cdy.02@163.com

Niu, L. Guolian Life Insurance Company. Guolian Finance Tower, 8 Jinrong Yi Street, Wuxi, Jiangsu Province 214121, People's Republic of China. Email: niuleilei@guolian-life.com

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El sistema de pensiones en China. **Un estudio empírico de la razón valor/prima de las anualidades**

Wan, Qingyao; Cheng, Deyi; Niu, Leilei

Resumen

Según el Banco Mundial, en los últimos 40 años China ha experimentado el proceso de transición de la fertilidad que solía llevar más de 100 años en los países desarrollados. Con una esperanza de vida al alza y una drástica caída de la tasa de fertilidad total hasta1,5 hijos por mujer, China ha sido vieja antes que rica. La participación de la población de 60 o más años en la población total se incrementará cada vez más en las décadas venideras, pasando desde alrededor del 12% en 2010 a casi un cuarto en 2030 y un tercio en 2050, lo que llevaría a China a tener una cuota de población de 60 y más años ligeramente por debajo de la media de la de los países de la OCDE. Como consecuencia, la ratio de dependencia de la vejez se incrementará hasta casi llegar a alcanzar tasas nunca vistas: alrededor del 34% y 21% para la población rural y urbana, respectivamente, en 2030. El patrón familiar emergente "4-2-1" de 4 abuelos, dos padres y un hijo tensionará fuertemente las redes de apoyo familiares. El envejecimiento también desafiará los programas sociales, en particular las pensiones y la atención sanitaria. El sistema de pensiones chino tiene tres pilares, pero el segundo y el tercero se encuentran en sus primeros estadios. Se requiere un gran número de mejoras para alcanzar los objetivos de un sistema de tres pilares que funcione correctamente establecidos por el gobierno, especialmente el desarrollo de un mercado de anualidades. Las anualidades pueden cubrir el riesgo de longevidad, pero no son populares en China, debido, fundamentalmente, a la escasa cultura actuarial y a que no existe información sobre la razón valor/prima. En este artículo se utilizan, por primera vez, datos macro y micro de China para calcular la razón valor/prima de la anualidad. Los resultados obtenidos ponen de manifiesto que: (1) Las anualidades están justamente valoradas en China con la ley que establece que la valoración es justa si la razón valor/prima no es inferior a 0,9. (2) En algunas grandes ciudades, los asegurados con esperanza de vida promedio como la estimada en dichas ciudades pueden recuperar la prima. (3) Existen grandes diferencias en la razón valor/prima de distintos tipos de anualidad, correspondiendo la ratio más elevada a las rentas vitalicias sin garantía de pago. (4) Existe una edad óptima para comprar la anualidad que depende del sexo del comprador y el tipo de producto. Es altamente recomendable mejorar la oferta de anualidades.

Palabras clave:

Sistema de pensiones, anualidad, razón valor/prima, riesgo de longevidad.

1. Introduction

1.1. The ageing population in China

With rising life expectancy and a sharp fall in the total fertility rate to around just 1.5, China has "grown old before growing rich". The United Nations (2010) has estimated that the share of people aged 60 and over in the total population will rise dramatically in the coming decades, from around just 12 per cent in 2010 to almost one quarter by 2030 and 31 per cent by 2050 in China. As a result, the old age dependency ratio in China will increase at an almost unprecedented rate over the coming decades, with the rural old age dependency ratio rising to over 34 per cent and the urban rate to around 21 per cent by 2030. The emerging "4-2-1" extended family pattern of four grandparents, two parents and one child will exacerbate the strains on family support networks. The end of the demographic dividend and exhaustion of the rural labour surplus will shift labour market dynamics in China.

The combined impact of rapid ageing, the emerging core family pattern, a declining labour force and the exhaustion of the rural labour surplus means that reforming social programmes, in particular pensions and health care, will become critical as China simultaneously seeks to improve overall levels of pension income. Longevity risk management will no longer be a purely family obligation. According to Mitchell and Piggot (2010), in the international context there are only three major sources of longevity insurance. The first is large families, the second is state provision, and the third is the insurance industry.

1.2. Overview of the Chinese pension system

We next focus on the three main systems that currently provide pensions in China (a brief summary of the Chinese pension system, as well as the challenges it faces and solutions, can be seen in Appendices 1 and 2, respectively):

1) The urban pension system consisting of five elements: minimum guarantee, social pool, individual account, voluntary enterprise annuity and other voluntary supplementary benefits, and family care (details are in Table 1). In 2015, this system covered 262 million active urban enterprise workers and 91 million pensioners.[1]

[1] http://www.mohrss.gov.cn/

Table 1. **Urban enterprise pension system in China**

	First pillar	Second pillar	Third pillar
Schemes	•Urban Enterprise Basic Pension Scheme	• Enterprise Annuity	Saving plan and Commercial annuity insurance
Status	Mandatory: Social Pool/Individual Account (IA)	Voluntary	Voluntary
Retirement age	60 (men), 50 for blue collar women workers, 55 for white collar women. Early retirement age: 50 (men), 45 (women)		
Minimum vesting period	15 years	Set by the plan sponsor	NA
Types of plans	Social Pool: unfunded Individual Account: DC	DC	DC
Contribution rate	Social pool: 20% (on average) of salaries by employer IA: 8% of salary by employee	EET model (limit of tax-deferred contribution rate): Employer: 5%, Employee: 4% Contributions set by the plan sponsor	Contributions set by the individual
Investments	Implementing < Measures for the Administration of Investment with Basic Pension Funds> since Aug. 2015 The fourth country to reform the basic pension fund administration with marketization and diversification principle within the PAYG Model •One-year term bank deposit, government bond: >=5% •Long-term bank deposit and government bond: <40% •Stock, Equity, Fund: <30% •Large-scale project and large-scale enterprise share: <20%	•EA: ≤30% in equities/equity products; ≤50% in bonds; •≥20% in cash and cash deposits	
Benefits	•Social pool: monthly pension based on average local monthly wage, indexed individual wage and years of employment •IA: monthly pension of 1/139 of IA balance at the time of retirement assuming at least 15 years of contributions otherwise lump sum payable	Lump sum or annuity benefit	Lump sum or annuity benefit
Parameters	•Base Accrual rate: 1%; •Valorization: 50% is based on regional average wage and 50% is based on individual final year's wage	NA	NA
Indexation	Depending on real price movements and economic development	NA	NA
Replacement ratio	42% on average (2015)	NA	NA
Extension to survivors	Remaining balance of IA at the time of death		

SOURCE: OWN ELABORATION.

2) The civil and public service pension system, with about 40 million participants. Before 2014, civil servants and public institution (*shiye danwei*) employees enjoyed a traditional defined benefit pension, although some provinces and the central gov-

ernment had implemented local pilots experimenting with reform of these pensions for public institution employees. In 2014, the reform of the civil servants and public institution pension system was launched, covering both the basic pension scheme with two major components—social pool and individual account—and the occupational pension scheme with individual account. Both schemes are compulsory.

The civil servants and public institution basic pension scheme requires a total contribution of 28 per cent of an employee's salary; with employers providing 20 per cent to a social pooling account and employees contributing 8 per cent of their wage income to individual accounts. The occupation pension contribution scheme of civil servants and public institution employees requires a total contribution of 12 per cent of an employee's salary, with employers providing 8 per cent and employees contributing 4 per cent of their wage income to individual accounts.

● Table 2. **Civil servants and public institution pension schemes in China**

Item	First pillar	Second pillar	Third pillar
Schemes	• Civil Servants and Public Institution Basic Pension Scheme	• Occupation Pension	Saving plan and Commercial annuity insurance
Status	Mandatory: Social Pool/ Individual Account (IA)	Mandatory: Individual Account (IA)	Voluntary
Retirement age	60 (men), 55 (women), 60 for women cadres.	Early retirement age: 55 (men), 50 (women)	
Minimum vesting period	15 years	Set by the plan sponsor	NA
Types of plans	Social Pool: unfunded Individual Account: NDC	NDC	DC
Contribution rate	Social pool: 20% of salaries by employer IA: 8% of salary by employee	EET model: Employer: 8% Employee: 4%	Contributions set by the individual
Investment	Administered by the Ministry of Finance and local provincial government.	Administered by private investment institutions and supervised by the Ministry of Human Resources and Social Security (MOHRSS)	
Benefits	•Social pool: monthly pension based on average local monthly wage, indexed individual wage and years of employment •IA: monthly pension of 1/139 of IA balance at the time of retirement assuming at least 15 years of contributions otherwise lump sum payable	Lump sum or annuity benefit	Lump sum or annuity benefit
Parameters	•Base Accrual rate: 1%; •Valorization: 50% is based on regional average wage and 50% is based on individual final year's wage	NA	NA
Indexation	Depending on real price movements and economic development	NA	NA
Replacement ratio		NA	NA
Extension to survivors	Remaining balance of IA at the time of death		

SOURCE: AUTHORS' COMPILATION BASED ON RELEVANT POLICY DIRECTIVES AND DOCUMENTS.

3) The national pension schemes for rural and urban residents, with two major components—social pool and individual account—were launched in 2008 and in 2011, respectively, and further integrated in 2014. As part of the ongoing social protection reforms, in September 2009 the authorities established a national framework for rural pensions, the Rural Pension Pilot Scheme (RPPS), followed by the National Rural Pension Scheme (NRPS). In July 2011, the authorities then established an Urban Resident Pension Scheme (URPS). Both schemes fall under the broader umbrella of the 2010 Social Insurance Law. They were rapidly rolled out and by 2012 they had more than 483.7 million contributors, more than 130.7 million people receiving basic pensions, and a fund balance of CNY230 billion. [2] In April 2014, the NRPS and URPS were combined to form the national pension schemes for rural and urban residents (NRURSP).

The NRURSP framework is an individual account financed by individual contributions and matched local government subsidies, with defined basic pension benefits paid after retirement. The contribution rates, however, differ across regions, and unlike the employer-based programs, participation is voluntary.

All residents aged 16 and over (excluding school students) who are not engaged in employment, and hence do not qualify for enrolment under the basic pension scheme for urban employees, can join the urban and rural resident pension insurance programme on a voluntary basis.

Enrolled residents can chose one of the 12 scales ranging from CNY 100 to CNY 2,000 as an annual contribution to their individual account, and the government will provide a matching subsidy of no less than CNY 30 to each person every year. The scales may differ in different regions.

In Shanghai, for example, the 12 scales for both rural residents and the unemployed are CNY 500, 700, 900, 1100, 1300, 1500, 1700, 1900, 2100, 2300, 2800 and 3300; Shanghai residents can choose one of these amounts as an annual contribution to their individual account and the government will provide a matching subsidy of between CNY 200 and CNY575, accordingly, per person per year. Upon reaching the age of 60, an insured person will receive not only a monthly pension benefit based on his or her individual account accumulation divided by 139, but also a monthly basic (social) pension of no less than CNY 540, which is fully financed by the government and adjusted according to economic development and price changes. Those aged 60 and over who meet the prescribed conditions, however, are not required to pay any contribution and

[2] http://www.mohrss.gov.cn/

can claim the basic social pension each month. For this basic pension, the central government provides a 100 per cent subsidy to the less developed central and western provinces and 50 per cent to the more developed eastern provinces, just as it did for the earlier rural pension scheme.

In 2015, NRURSP had more than 504.7 million contributors, and more than 148 million people were receiving basic pensions, while the fund balance was CNY459 billion.[3]

1.3. Development of the annuity market in China

In China, the annuity market is only in its initial stages, with low levels of consumer literacy and incentives. As of the end of 2015, China had more than 60 life insurers offering hundreds of group and individual annuity products, including traditional fixed annuities, participating policies and universal policies with guaranteed minimum returns, as well as unit-linked policies without guaranteed minimum returns. In addition, the variable annuity has been offered on a trial basis since 2010. In recent years, annuity insurance has been growing rapidly but it is still limited in scale and coverage. By the end of 2014, premium income from annuity insurance had grown substantially to reach CNY282 billion, with an average annual growth rate of 17% between 2001 and 2014 and an accumulated fund balance of CNY1 trillion. By the end of 2015, premium income from annuity insurance had reached CNY540 billion with an annual growth rate of 92%. It is forecasted that the pension payment amount will be between CNY 2078.9 and 31515.8 billion, while the annuity demand for pension pay-out phase will be between CNY 900.5 and 4233.8 billion by 2030 (Zheng *et al*., 2011). In August of 2014, the State Council of the People's Republic of China issued a guide to promote the development of the modern insurance industry, which is part of a key policy that aims to make annuity insurance a main pillar of the old-age protection system. The individual tax-deferred pension insurance pilot programme was designed after many rounds of evaluation. This voluntary programme is based on a defined contribution individual account. The insured can purchase a certified annuity contract from a life insurance company. The contributions may be tax-deductible but there are limits and other rules that affect the amount that can be contributed. Any deductible contributions and earnings that the insured withdraws or that are distributed from this individual account are taxable. The launch of the individual tax-deferred pension insurance pilot programme depends on the process of individual taxation reform; the individual taxation system reform that aims to change from a system where the income tax is paid separately according to the income category to a consolidated income tax is set to take place early in the 13th Five-Year Plan (2016-2020).

[3] http://www.mohrss.gov.cn/

1.4. Purpose and structure of the paper

The payout phase is a critical part of a pension system but receives far too little attention. It is central to the ultimate outcome of income security. In addition to hedging longevity risk, life annuities may offer retirees attractive financial returns, but they are not popular in China.

Under China's 12th Five-Year Plan for the economy and social development, the government set out its determination to integrate the pension system as a whole and to improve overall levels of pension income. A vital element of this was to establish a properly functioning three-pillar system. Education and incentives were needed in order to encourage sustainable saving behaviour and early planning for retirement.

Since the lump-sum premium of annuities constitutes a large negative cash outflow, the net present value of an annuity investment generally starts out as negative before gradually increasing over the annuitant's lifetime. MWR visuals provide useful information that may help less financially literate retirees better understand their annuity contract by answering three critical questions:

1) How long do I need to live to in order for the discounted benefits to exceed my initial outlay? ("cross-over age").
2) What is the "worst time to die"?
3) On average, what is the chance that I will lose or win on the deal?

An understanding and analysis of the MWR of annuities in China is of great importance, especially if calculated with a dataset specifically for China, since it will help educate consumers on the value of annuities and the best age to buy an annuity, as well as providing information for the design of policies oriented at improving longevity risk management in China.

This is the first time that an empirical study on the MWR in the pension and annuity market in China has been implemented. The rest of the paper is structured as follows: After this introductory section, MWR is defined and different scenarios for calculating its value are designed according to population ageing, improvements in life expectancy, and market development and reform. Section 3 is devoted to the calculation and analysis of the MWR for different annuity products, in order to compare the results with international equivalents, judge whether the annuities are fairly priced, determine the best age to buy an annuity, and establish how long an individual needs to live to in order for the discounted benefits to exceed the initial outlay. The article ends with a summary of this research and presents some policy implications derived from the study.

2. Money's worth ratio of annuities

The money's worth ratio (MWR) is the expected return to the annuity purchaser per premium dollar invested. The money's worth ratio is defined as the ratio of the expected present discounted value of the (uncertain) future payment stream associated with an annuity product to the product's purchase price (or premium invested). See Brown (1999) for an overview of the money's worth valuation framework.

The formula of MWR is as below:

$$MWR = \left\{ \sum_{j=1}^{T} \frac{p_{t,t+j} \; A_j}{(1+R_j)^j \; (1+I_j)^j} \right\} / P_t$$

$$p_{t,t+j} = (1-q_{t,t+1}) \; (1-q_{t+1,t+2}) \ldots . \; (1-q_{t+j-1,t+j})$$

where:

A_j : the withdrawn benefit amount at age j for insured buying at age t
$p_{t,t+j}$: the probability of survival from t to $t+j$
$q_{t+j-1,t+j}$: the probability of death from $t+j-1$ to $t+j$
T : the maximum period from age t, $p_{t,t+T} \approx 0$
R_j : discount rate during age $t+j-1$ to $t+j$
I_j : inflation rate during age $t+j-1$ to $t+j$
C_t : administration charge in a lump sum at age t
P_t : premium paid in a lump sum at age t

Earlier studies estimate the MWR of an annuity to be about 0.93-0.99 for annuitants in US and UK voluntary markets (Mitchell *et al.,* 1999; Finkelstein and Poterba, 2002, 2004). Cannon and Tonks (2002, 2010) find that MWR estimates in the UK stayed within a band of between 0.90 and 1.10 over a 30-year period (1972-2002) despite fluctuations due to interest rate movements.

They conclude that the result is "surprising" as it suggests that not only are annuities fairly priced on average, they are at times *more* than fairly priced. Similarly, James and Vittas (1999) and James and Song (2002) report "surprisingly high" MWR values in various annuity markets, including Canada, Switzerland, Australia, Israel, Chile and Singapore – estimates exceed 0.95 in most countries and are sometimes greater than unity for an average annuitant. Bütler *et al*. (2004, 2010) report MWRs for Switzerland and find values to be very high in the second pillar, exceeding one for women and married men, even at a relatively high discount rate of 3.5%. Fong *et al*. (2015) report an MWR of about 0.95 in Singapore.

Table 3. Money's worth ratios for 65-year-old men in different countries

		General population		Annuitants	
		Treasury	Corporate	Treasury	Corporate
US men 65					
	1985	0.749	0.677	0.827	0.740
	1990	0.814	0.745	0.912	0.828
	1995	0.816	0.742	0.916	0.825
	1998	0.849	0.772	0.970	0.871
US JLS 65					
	1995	0.841	0.750	0.890	0.788
ILONA US 1998					
	Nominal	0.864	na	0.987	na
	Real	0.702	na	0.822	na
UK men 65,1998a					
	Nominal	0.908	na	0.908	na
	Real	0.854	na	0.854	na
UK men 65, 1998b					
	Compulsory, nominal	0.897	na	0.944	na
	Voluntary, nominal	0.865	na	0.953	na
	Compulsory, real	0.822	na	na	na
	Voluntary, real	0.791	na	na	na
	Compulsory, 5% escalating	0.858	na	0.922	na
	Voluntary, 5% escalating	0.804	na	0.930	na
Switzerland men 65, 2009					
	Single	na	na	1.117	1.007
	Married	na	na	1.324	1.161
Korea men 65, 2010					
	10-year guarantee	0.635	na	na	na

Note: ILONA: Irish Life of North America; JLS refers to Joint Life Survivor Annuity

3. Empirical study: data, methods and results

3.1. Products, assumptions and scenarios

We have selected the following three products as a sample (Table 4): the first is a life annuity with a 10-year period of guaranteed benefits payment (a combination of a life annuity and a 10-year certain annuity. You receive a guaranteed payout for life that includes a period certain phase. If you die during the period certain phase of the account, his/her beneficiary will continue to receive the payment for the remainder of the period); the second is a life annuity with guaranteed payment of a premium (if the annuitant die before having received the premium, his/her beneficiary will receive the remainder of the guaranteed payments. The third is a life annuity without any guarantee of payment and benefits that are terminated on the death of the insured.

The main assumptions for the key parameters are set out in Table 5. We consider four scenarios with different combinations of the main assumptions (Table 6).

Table 4. **Products**

Products	Benefits
Product 1	Lifelong benefit (Guaranteed payment for a 10-year period)
Product 2	Lifelong benefit (Guaranteed payment of a premium)
Product 3	Lifelong benefit (No guarantee of payment)

Table 5. **Assumptions**

Assumptions			**Remarks**
Mortality ($q_{t+j-1,t+j}$)	1	M (CL3) 0.45, W (CL4) 0.4	Based on China Life Table (2000-2003) Annuity table, considering the improvements in mortality.
	2	M (CL3) 0.6, W (CL4) 0.5	
Age	Maximum 105		
Discount rate (R_j)	1	5% (Fixed)	Based on the actuary assumptions of the annuity product.
	2	3% (Fixed)	Referring to the fixed-interest government bond (five-year term) yield 2006/12/31-2015/7/6.
Inflation rate (I_j)	2.3% (Fixed)		Forecast based on the average inflation rate during 2000-2014.
Administration charge (C_t)	1	2%	Referring to the group purchase charge, in a lump sum.
	2	5%	Referring to the individual purchase charge, in a lump sum.
Premium payment (P_t)	In a lump sum		Paid in a lump sum at the beginning of the year.
Benefit payment (A_j)	Annual payment		Benefit payment starts immediately after purchase, at the end of each year while the insured is still living.

Table 6. **Calculation scenarios**

Scenarios	**Assumptions**
1	Mortality 1, Discount rate 1, Administration charge 1, other assumptions
2	Mortality 2, Discount rate 1, Administration charge 1, other assumptions
3	Mortality 1, Discount rate 2, Administration charge 2, other assumptions
4	Mortality 2, Discount rate 2, Administration charge 2, other assumptions

3.2. Data sources

The data are sourced from the China Statistical Yearbooks (2000-2014), the Fifth and Sixth National Population Survey, China Life Table (2000-2003) Annuity table, the Listed Insurance Companies' Yearbooks (2004-2014), and the information from the China Insurance Regulatory Committee, the website for Chinese insurance companies etc. The "Ping An Pension Annuity" is selected as the product sample. The key parameters for calculation are determined using information collected from specific surveys and interviews with experts (see Appendix 3). The calculation is carried out using *R* software.

Taking into account the abovementioned products, assumptions and scenarios, we calculate:

1) The MWRs of different annuity products.
2) The MWR results for insured men purchasing an annuity aged 65-75, and equivalent values for insured women aged 55-75.
3) For an insured man purchasing an annuity at the age of 65 and an insured woman at the age of 60, the age at which the highest MWR is registered, as well as the length of time the individual needs to live to in order for the discounted benefits to exceed the initial outlay (the cross-over age).

3.3. Results

Different annuity products have different MWRs. The highest MWR corresponds to the life annuity without any payment guarantee.

For insured men (Table 7), regardless of both the age at which they buy the annuity and the scenario, the products ranked from high to low according to their MWRs are products 3, 1 and 2, for the same age at time of purchase. For an insured man who makes the purchase at the age of 65, the corresponding MWRs of products 3, 1 and 2 are 0.966, 0.809 and 0.727, respectively, for scenario 1; 0.924, 0.780 and 0.700, respectively, for scenario 2; 1.235, 0.977 and 0.913, respectively, for scenario 3 and 1.173, 0.937 and 0.872, respectively, for scenario 4. For an insured man who makes the purchase at the age of 70, the corresponding MWRs of products 3, 1 and 2 are 1.012, 0.758 and 0.6990, respectively, for scenario 1; 0.942, 0.712 and 0.654, respectively, for scenario 2; 1.216, 0.866 and 0.830, respectively, for scenario 3 and 1.125, 0.809 and 0.773, respectively, for scenario 4.

Table 7. **MWR of three annuity products for men**

Age at time of purchase	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	Product			Product			Product			Product		
	1	2	3	1	2	3	1	2	3	1	2	3
55	0.791	0.711	0.905	0.771	0.692	0.876	0.983	0.917	1.194	0.952	0.886	1.146
60	0.809	0.727	0.966	0.780	0.700	0.924	0.977	0.913	1.235	0.937	0.872	1.173
65	0.798	0.723	1.007	0.759	0.686	0.950	0.934	0.881	1.244	0.884	0.831	1.167
70	0.758	0.699	1.012	0.712	0.654	0.942	0.866	0.830	1.216	0.809	0.773	1.125
75	0.660	0.631	0.963	0.605	0.576	0.876	0.729	0.724	1.113	0.666	0.659	1.009

SOURCE: AUTHORS' CALCULATION

For insured women (Table 8), regardless of both the age at which they buy the annuity and the scenario, the products ranked from high to low according to their MWRs are products 3, 1 and 2, for the same age at time of purchase. For an insured woman who

makes the purchase at the age of 55, the corresponding MWRs of products 3, 1 and 2 are 0.848, 0.764 and 0.691, respectively, for scenario 1; 0.835, 0.754 and 0.682, respectively, for scenario 2; 1.127, 0.96 and 0.898, respectively, for scenario 3; and 1.104, 0.944 and 0.883, respectively, for scenario 4. For an insured woman who makes the purchase at the age of 70, the corresponding MWRs of products 3, 1 and 2 are 0.979, 0.778 and 0.707, respectively, for scenario 1; 0.945, 0.755 and 0.685, respectively, for scenario 2; 1.182, 0.895 and 0.845, respectively, for scenario 3; and 1.139, 0.866 and 0.816, respectively, for scenario 4.

Table 8. **MWR of three annuity products for women**

Age to buy	Scenario 1			Scenario 2			Scenario 3			Scenario 4		
	Product			Product			Product			Product		
	1	2	3	1	2	3	1	2	3	1	2	3
55	0.764	0.691	0.848	0.754	0.682	0.835	0.960	0.898	1.127	0.944	0.883	1.104
60	0.794	0.714	0.911	0.780	0.701	0.892	0.968	0.903	1.174	0.948	0.883	1.145
65	0.800	0.721	0.961	0.781	0.703	0.934	0.800	0.721	0.961	0.920	0.859	1.159
70	0.778	0.707	0.979	0.755	0.685	0.945	0.895	0.845	1.182	0.866	0.816	1.139
75	0.702	0.654	0.951	0.674	0.626	0.909	0.781	0.754	1.104	0.747	0.721	1.053

SOURCE: AUTHORS' CALCULATION

For the same product, there are different MWRs according to the age of the buyer, and so it is possible to determine the best age at which to buy.

For an insured man buying an annuity aged between 55-75, the MWR ranges from 0.500 to 1.246 (Figure 1-Figure 4).

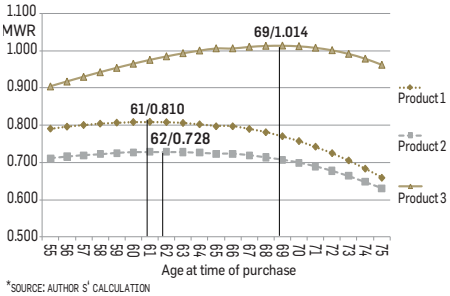
For example, for product 1, the best age at which to buy is 62 in scenario 1 (MWR 1.014), 67 in scenario 2 (MWR 0.951), 63 in scenario 3 (MWR 1.246), and 62 in scenario 4 (MWR 1.176). For product 2, the best age at which to buy is 62 in scenario 1 (MWR 0.728), 60 in scenario 2 (MWR 0.700), 57 in scenario 3 (MWR 0.918), and 55 in scenario 4 (MWR 0.886). For product 3, the best age at which to buy is 69 in scenario 1 (MWR 1.014), 67 in scenario 2 (MWR 0.951), 63 in scenario 3 (MWR 1.246), and 62 in scenario 4 (MWR 1.176).

For an insured woman buying an annuity aged between 55-75, the MWR ranges from 0.56 to 1.195 (Figure 5-Figure 8).

For example, for product 1, the best age at which to buy is 64 in scenario 1 (MWR 0.721), 63 in scenario 2 (MWR 0.705), 59 in scenario 3 (MWR 0.968), and 58 in scenario 4 (MWR 0.949). For product 2, the best age at which to buy is 64 in scenario 1 (MWR 0.801), 63 in scenario 2 (MWR 0.784), 59 in scenario 3 (MWR 0.903), and

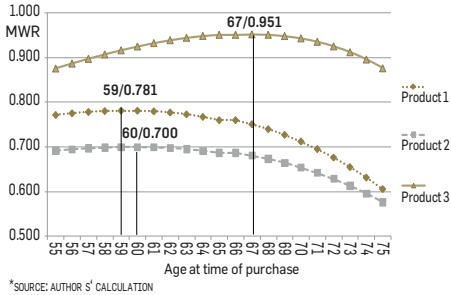
58 in scenario 4 (MWR 0.885). For product 3, the best age at which to buy is 70 in scenario 1 (MWR 0.979), 70 in scenario 2 (MWR 0.945), 65 and 66 in scenario 3 (MWR 1.195), and 64 in scenario 4 (MWR 1.159).

Figure 1. **MWR scenario 1 for men**



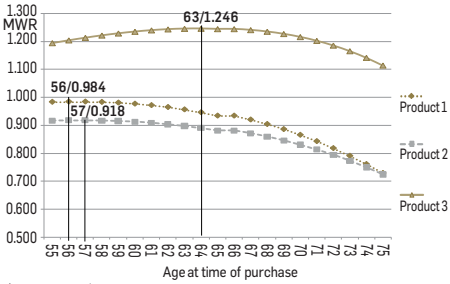
*SOURCE: AUTHOR S' CALCULATION

Figure 2. **MWR scenario 2 for men**



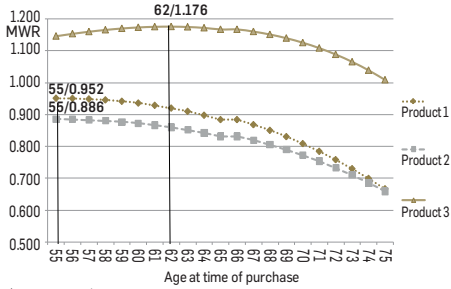
*SOURCE: AUTHOR S' CALCULATION

Figure 3. **MWR scenario 3 for men**



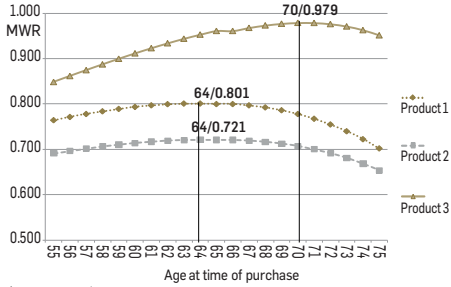
*SOURCE: AUTHOR S' CALCULATION

Figure 4. **MWR scenario 4 for men**



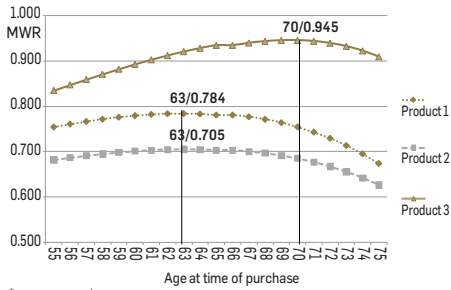
*SOURCE: AUTHOR S' CALCULATION

Figure 5. **MWR scenario 1 for women**



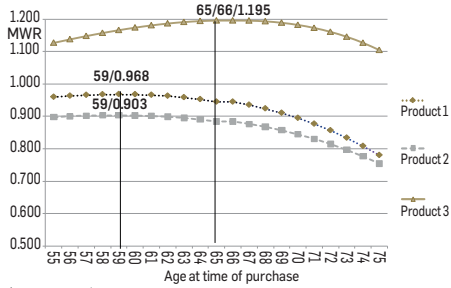
*SOURCE: AUTHOR S' CALCULATION

Figure 6. **MWR scenario 2 for women**



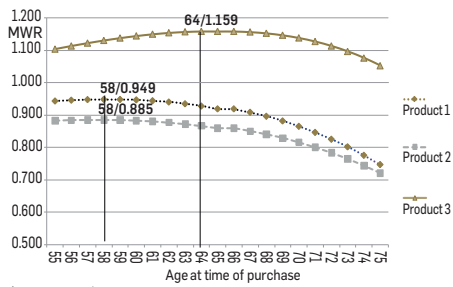
*SOURCE: AUTHOR S' CALCULATION

Figure 7. **MWR scenario 3 for women**



*SOURCE: AUTHOR S' CALCULATION

Figure 8. **MWR scenario 4 for women**



*SOURCE: AUTHOR S' CALCULATION

A common concern for annuitants is how long an individual needs to live to in order for the discounted benefits to exceed the initial outlay. This is the crossover age, the point with the highest MWR; in other words, the age they must live to in order to get the premium back.

With the acceleration of population ageing forecasted by the United Nations (2010), the average life expectancy in China in the period 2015-2020 is 72.98 for men and 76.66 for women, and in 2030-2035 it rises to 75.31 for men and 79.21 for women. According to statistics from the World Health Organization, life expectancy in China in 2015 is 74 for men and 77 for women. However, the forecasts from the UN and the WHO are not broken down into urban and rural populations or by cities, when in fact there are big differences among provinces and cities. For example, in 2014, the life expectancy in Beijing is 79.33 for men and 83.96 for women, and in Shanghai it is 80.4 for men and 84.59 for women, both of which are much higher than the national average.[4]

- An insured man buying an annuity at the age of 65 has a greater probability of getting the premium cost back, as the MWRs are over 1 in most scenarios.

  For example, if a man purchases a life annuity at the age of 65 (Product 3), the highest MWR will occur at the age of 89; for the four scenarios, the MWR is 1.007, 0.95, 1.244 and 1.167, respectively (Figure 9). In other words, if an insured man died before the age of 89, the present value of the accumulated benefits would not have reached the maximum; if he died after 89, the present value of the accumulated benefits would be close to or greater than 1, which means that he gets his premium back.

  For men younger than 89, the results of the present values of the accumulated benefits (Product 3) are shown in Figure 9. The MWRs will reach 1 in three of the four scenarios: at the age of 89 in scenario 1 (MWR 1.007), 83 in scenario 3 (MWR 1.031), and 84 in scenario 4 (MWR 1.022).

  Calculating according to the current life expectancy for men in China — 74 nationwide, 79 in Beijing and 80 in Shanghai — the results of the present values of accumulated benefits show that those reaching the current average life expectancy will not obtain the maximum MWRs (Figure 9). Of course, the future life expectancy improvements forecasted in urban cities notably increase the probability of insured men getting their premium back.

[4] http://www.phic.org.cn/tonjixinxi/weishengshujutiyao/jiankangzhibiao/201304/t20130425_60133.htm

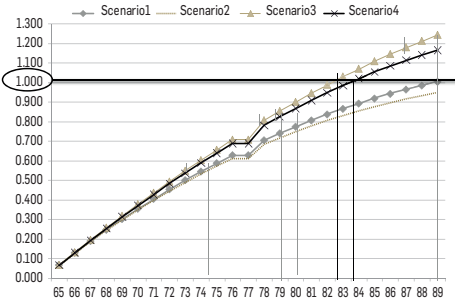
An insured woman buying an annuity at the age of 60 has a big probability of getting her premium back, as the MWRs are greater than 1 in most of the scenarios.

For example, if an insured woman purchases a life annuity at the age of 65 (Product 3), the highest MWR will occur at the age of 89; for the four scenarios, the MWR is 0.911, 0.892, 1.174 and 1.145, respectively (Figure 10). In other words, if an insured woman died before the age of 89, the present value of the benefits would not have reached the maximum; if she died after the age of 89, the present value of the accumulated benefits would be close to 0.9 (scenarios 1 and 2) or greater than 1(scenarios 3 and 4), meaning that she gets her premium back.

For women younger than 89, the results of the present values of the accumulated benefits (Product 3) are shown in Figure 10. The MWRs will reach 1 in two of the four scenarios: at the age of 83 in scenario 3 (MWR 1.0) and 84 in scenario 4 (MWR 1.014).

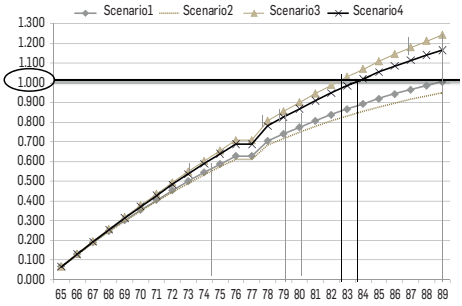
Calculating according to the current life expectancy for women in China — 77 nation-wide, 83 in Beijing and 84 in Shanghai — the results of the present values of accumulated benefits show that those reaching the current average life expectancy cannot will not obtain the maximum of MWRs (Figure 10), but insured women in Beijing (scenario 3) and Shanghai (scenario 4) can achieve MWRs greater than 1. Of course, the future life expectancy improvements forecasted in urban cities notably increase the probability of insured women getting their premium back.

Figure 9. **Present value of accumulated benefits for men insured of 65 (Product 3)**



Scenario \APV \Age	74	79	80	89
Scenario 1	0.546	0.742	0.776	1.007
Scenario 2	0.533	0.718	0.750	0.950
Scenario 3	0.603	0.855	0.901	1.244
Scenario 4	0.589	0.827	0.869	1.167

Figure 10. **Present value of accumulated benefits for women insured of 60 (Product 3)**



Scenario \APV \Age	74	79	80	89
Scenario 1	0.546	0.742	0.776	1.007
Scenario 2	0.533	0.718	0.750	0.950
Scenario 3	0.603	0.855	0.901	1.244
Scenario 4	0.589	0.827	0.869	1.167

4. Conclusion and discussion

As the annuity market is entirely voluntary and insurance literacy is very low, annuities are not popular in China. It is of key importance to determine the money's worth ratio of annuities in China; however, there is no research to date on this topic. This article addresses this gap and uses exclusive macro and micro data from the Chinese market to calculate this ratio. We found that, according to the law that an annuity's MWR must be greater than 0.9, annuities in China are fairly priced and worth buying. This finding is new evidence in regard to other annuity contexts, and will help educate consumers about the value of an annuity and the best age to buy an annuity, as well as contributing to the improvement of longevity risk management in China.

More specifically the main conclusions drawn are the following:

1) According to the law that an annuity is fairly priced if its MWR is no less than 0.9, annuities are fairly priced in China. For insured 65-year-old men, the MWR of the life annuity without any payment guarantee lies in the range 1.007-1.174; the equivalent value for 60-year-old women is in the range 0.911 -1.145.

2) It is worthwhile buying an annuity. According to the average life expectancy in most Chinese cities, there is a big probability of getting the premium back, while simultaneously hedging longevity risk. For 65-year-old insured man, MWR will reach 1 at the age of 83 or 84 in some of the scenarios; for 60-year-old insured women, MWR will reach 1 at the age of 83 or 84 in some of the scenarios.

3) There are some big differences in MWR among different annuity products and the highest MWR is for a life annuity without any guaranteed payment. For each annuity product, the MWR depends on the age of the annuitant when the annuity is bought. Annuitants who reach the life expectancy estimated for some big cities can get the premium back. There is an optimal age to buy the annuity which depends on the sex of the buyer and the type of product.

4) MWR is very sensitive to the assumptions of mortality, interest rates and administration costs, and is also influenced by key factors such as product type, the age of the insured at time of purchase and the number of years the insured lives. Of course, a limitation of the study is that the conclusions are constrained by the assumptions made. When calculating MWR, an important prerequisite is that the customer has a neutral attitude to risk, which can be achieved through consumer education and advertisements. As annuities can hedge longevity risk, MWR is an important indicator that can be used to evaluate and compare the annuity with other pension saving instruments, but it is not the only such indicator.

In order to establish a properly functioning three-pillar pension system to provide old-age income security in China, it is vital to develop the annuity market. There is presently a long list of improvements required to reach the goals set out by the government. Recommendations for the development of the annuity market include (i) strengthening the guidance and support from the government; (ii) introducing compulsory annuities, (iii) implementing individual tax-deferred annuity insurance as soon as possible; (iv) improving the capital market; (v) improving insurance company and product information disclosure; (vi) improving consumer financial literacy and insurance literacy, and their ability to understand and choose suitable finance and annuity products; (vii) improving public identification and recognition of the insurance industry; and (viii) optimizing the administration cost of the insurer to maximize the MWR of annuity products. Education and incentives should be put in place to encourage well-informed, sustainable saving behaviour and early planning for retirement.

Acknowledgement

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Appendix 1. China pension system: history

Pension, health care and tax-financed minimum subsistence guarantee are the centres of the current Chinese social security system which is based on social insurance (pension, health, unemployment, work-injury, and maternity) and supplemented by charitable undertakings and private insurance. China has followed a developmental welfare approach, or "developmentalism", which attaches great importance to economic development and strives to integrate welfare policies within a planned national development process.

The development of the Chinese pension system, which was initiated in 1951 with the promulgation of the Labour Insurance Regulations (amended in 1953, 1958 and 1978), can be briefly divided into four stages.

1. The first stage is the labour insurance period (1951-1984), during which all social insurance benefits except unemployment were introduced, although the scope of coverage was confined to the urban state-owned enterprises (SOEs), with universal contribution rate, benefits and withdraw rules. While individual enterprises had to finance their own welfare programmes as a result of the disruption of the ten-year (1966-1976) period of domestic turmoil known as the Great Cultural Revolution. In 1978, State Council issued Measures of retirement and resignation which redefined the retirement and benefits rules.

2. The second stage is the reconstruction period (1985-2000) during which the Government initiated employment-based and contribution-financed social insurance programmes, mainly in urban areas. Major decisions were made in 1991, 1993, 1997 and 1998 in terms of nationwide implementation of the basic pension insurance for urban employees.

In 1991, the State Council issued the Determination on reforming enterprise employee pension systems, which proposed the establishment of a nationwide unified pension system with social pool. In 1993, the Determination on the establishment of Socialism Market Economy was issued by the Central Committee of the Communist Party of China, which put forward the proposal of a multi-layer social insurance system. In 1997, the State Council issued the Determination on Perfecting the Basic Pension System for Enterprise Employees that finalized the uniform pension insurance scheme. In 1998, the Ministry of Labour and Social Security (MOLSS) was set up to be responsible for the supervision of social insurance. Meanwhile, the government integrated the previously self-administered industry pension funds (for coal mining, civil aviation, etc.) into provincial or local pooled or solidarity funds. At the same time, efforts had also been made to pilot social insurance in rural areas and the expansion from employment-based to residence-based schemes, through the establishment of a budget-financed minimum livelihood guarantee system and a government contribution subsidy to vulnerable social groups.

3. The third stage is the reform and the rapid expansion period (2000-2015), characterized by unified planning for both urban and rural areas and enhanced efforts for the extension of coverage, the development of enterprise annuity and private annuity insurance.

Following the principle of "wide coverage, modest benefit, multi-tiered programmes and a sustainable system", the Chinese Government committed itself in 2006 to build-

ing up a comprehensive social security system covering the whole population by 2020, with a focus on basic pension and health insurance as well as the minimum subsistence guarantee system. China's 12th Five Year National Economic and Social Development Plan (2011–2015) lays great emphasis on the concept of inclusive growth, and the improvement of social security programmes was a central part of this development.

The period since 2003 has indeed witnessed an extremely rapid extension of social security coverage in China. In 2005, the State Council issued the Determination on Improving the Basic Pension System for Enterprise Employees, in which the focus of the future extension of coverage was on urban non-public enterprises and the self-employed, as well as people engaged in flexible types of employment.

In the 2006–2010 Five Year National Economic and Social Development Plan, the Government included for the first time a compulsory quota for the extension of urban pension insurance coverage and that of the New Rural Cooperative Medical Scheme (NRCMS). Based on the national targets, the relevant ministries also worked out annual and five-year quotas (split among different regions) and supervised their implementation nationwide (Zhu, 2009). The pilot on urban residents' medical insurance and nationwide implementation of the budget-funded and means-tested minimum subsistence income guarantee scheme was introduced in 2007; the launch of a new type of rural social pension scheme(NRSP) in 2009; and the launch of a new pilot on the urban resident social pension insurance programme (NURSP) in July 2011. In 2014, the government announced the NRSP and NURSP were to be integrated into the Urban and rural resident social pension insurance programme.

The Social Insurance Law, a milestone piece of legislation for the Chinese social security system, came into force as of July 2011 and set the tone for its future development. Major provisions include the portability of basic pension and health care benefits across different regions in the country; the establishment of a nationwide unified personal social security ID system based on an identity number for each citizen; the gradual realization of a national pooled fund for the basic pension scheme and a provincial pooled fund for each of the other social insurance schemes; the coverage of foreigners working in China; enhanced compliance and enforcement measures with regard to a unified collection of social insurance contributions; privacy protection as regards social security information; prevention of the misappropriation of social insurance funds; and the investment and management of the non-contributory national social security fund as a strategic reserve for the social insurance schemes.

Civil servants and public institution *(shiye danwei*) employees total about 40 million people and they enjoy a traditional defined benefit pension, although some provinces and the central government have recently implemented local pilots experimenting with reform of these pensions for public institution employees. In 2014, the reform of civil servants and public institution pension system was launched, which covers both the basic pension system with two major components—social pool and individual account—and the occupational pension system.

The past decade has witnessed the initial establishment of a social security system framework covering both urban and rural areas and a major breakthrough in the extension of social security coverage. Among the five social insurance programs (pension, health, unemployment, disability, and maternity), pension programmes have had the largest number of urban participants. In general, big improvements have been made to the Chinese pension system.

Coverage has expanded rapidly. By 2015, in the first pillar, basic pension participants had risen to 858.33 million with a participation rate of 82 percent and an annual growth rate of 33 per cent since 2009. In the second pillar, enterprise annuity participants had risen to 23.16 million with an annual growth rate of 17 per cent, and the number of employers to 75.5 thousand with an annual growth rate of 26 per cent since 2006.In the third pillar, private pension annuities covered 100 million people with 69 million policies in 2014.

In this time, the pension fund reserve has also increased. By 2015, in the first pillar, the basic social pension fund balance was CNY 3,993.7 billion with an annual growth rate of 34 per cent since 2009. In the second pillar, the EA pension fund balance was CNY 952.5 billion with an annual growth rate of 93 per cent since 2006. In the third pillar, the pension fund balance was CNY 282 billion with an annual growth rate of 17 per cent since 2001.

Pension fund management is relatively safe. In the first pillar, basic pension investment is restricted to bank deposits and government bonds, with annual yields of about 3 per cent on average; in the second pillar, investment options include bank deposits, government bonds, and stock, with average annual yields of about 7.87 per cent since 2007; in the third pillar, the average yield has been about 5.6 per cent since 2004.

4. The fourth stage is the perfect period (2016-). Currently, social insurance programmes and enterprise annuity are supervised by the MOHRSS, while private annuity and life insurance are supervised by China Insurance Regulatory Committee (CIRC). The following are the three main systems for providing pensions in China.

- The urban enterprise employee pension system.
- The civil servants and public institution pension system.
- The national pension schemes for rural and urban residents with two major components—social pool and individual account.

China's 13th Five-Year National Economic and Social Development Plan (2016–2020) lays great emphasis on the concept of inclusive growth, and seeks to tackle rising inequality and create an environment for more sustainable growth by prioritizing more equitable wealth distribution, increased domestic consumption, and improved the equality and the sustainability of social insurance system.

MOHRSS expects to realize basic universal social insurance coverage within the next five years, and sets the major new five-year (2016–2020) targets. The target for basic pension insurance is 945 million participants with a participation rate of 90 per cent in 2020. It proposed to improve the finance system of social insurance, set up the adjustment system of benefits, raise the legal retirement age gradually and improve the pooling level of pension funds and ensure sound investment returns. It also sought to implement an occupational pension system, expand enterprise annuity coverage, push the development of private pension insurance and implement the tax-deferred individual pension insurance.

Appendix 2. China pension system: challenges and solutions

1. High contribution rates discourage employer compliance and worker participation. Financed by combined employer and employee contributions of 40 to 42 per cent of payroll for the five basic insurance programs and a further 10 per cent or more for housing funds, China's urban social insurance system carries heavy burdens for both employers and workers, and may carry significant implications for China's long–run competitiveness. The 20 per cent (or more) monthly contribution of basic pension may be less of an issue for state-owned enterprises or for large corporations; however, small or medium-sized companies often find it challenging to fulfil this obligation. The wage disparity among provinces and regions can be extremely wide even within the same pension system. It varies significantly by sector, type of organization, local minimum wage level, and local cost of living. Also, there are cap and floor contribution rates that limit contributions payable by high wage earners and benefits received by low wage earners. Moreover, this high implied labour tax wedge likely encourages informalization of the labour market: employers under-report wages and game the system in numerous ways, while workers have incentives to opt out of participation in social insurance schemes. In April of 2016, the State Council issued the notice to decrease the social insurance contribution rate from May 1, 2016 to April 30, 2018.

During this period, the employer contribution rate of the basic pension can be decreased from 21 per cent to 20 per cent in some regions, or from 20 per cent to 19 per cent; and the total unemployment insurance contribution rate decreased from 2 per cent to 1-1.5 per cent (individual contribution rate no higher than 0.5 per cent); the implementation schemes may vary by provinces and regions.

2. Management of contributory social insurance funds remains a hard nut to crack. The management of contributory social insurance funds remains a hard nut to crack for Chinese social insurance agencies. On one hand, there are a few thousand fragmented schemes administered at provincial, municipal and county levels. Some coastal provinces such as Guangdong have accumulated enormous savings, while less developed areas have to rely on central government subsidies just to ensure the timely payment of pension benefits. On the other hand, social insurance funds have been growing continuously over the past few years. By 2015 the basic pension insurance funds had accumulated total assets of CNY 3,993.7 billion.

Unlike the diversified investment profiles of the annuity funds and the non-contributory social security reserve fund, social insurance funds can be deposited only in state-owned banks or used to purchase domestic state bonds before, and thus come under pressure to ensure that there is no reduction in fund values in real terms. Reportedly, the State Council approved in March 2012 the proposal of the Guangdong provincial government to entrust investment operations of its CNY 100 billion pension fund surplus to the National Council of Social Security Fund (NCSSF), which is allowed to diversify its investment portfolios and has recorded a much higher investment return over the past ten years. In 2015, for example, the NCSSF managed a total of CNY 1,913.82 billion of entrusted provincial pension funds (mainly as central government subsidy for recapitalizing the individual accounts), and achieved an investment return of 15.19 per cent, 13.75 per cent higher than the annual inflation rate. More provinces are expected to follow suit. To solve the problem, the Government has anticipated a national pooling of pension funds and plan to gradually put this in place during 2016-2020. In August 2015, new regulations on the investment of contributory social insurance funds were issued to allow for diversified investment, with reference to the experience of annuity and non-contributory funds. For example, the share of pension funds that can be invested in one-year term bank deposits and government bonds is no less than 5 per cent, in long-term bank deposits and government bonds no higher than 40 per cent, in stock, equity and funds no higher than 30 per cent, and in large-scale projects and large-scale enterprises no higher than 20 per cent. The implementation will make China the fourth country to reform the basic pension fund administration according to a marketization and diversification principle within the PAYG Model. Meanwhile, effective measures are needed to guarantee the maintenance and increase of the value of the contributory social insurance funds.

3. Low retirement ages affect incentives and benefits and undermine fiscal sustainability.

For both the urban enterprise system and the civil servants and public service systems, the retirement ages of 60 for men, 55 for white collar women, and 50 for blue collar women were set a long time ago when life expectancy was much lower. Today, the average life expectancy is 76.34 years for women nationally and is longer for urban residents. More importantly, this is life expectancy at birth, but the more relevant indicator for pension purposes is life expectancy at retirement age, which is expected to be even longer (Figure 1). For sustainability, the retirement ages for both men and women should be gradually raised. Not only would this reduce pension expenses, it would also increase contribution income and investment returns. The rural pension system is ahead of the urban and the civil and public service systems with respect to this important element as the pension age has been set at 60 for all rural residents irrespective of gender. Men and women should in fact have the same retirement age in the urban system, and there should be reductions in pensions for early retirement and enhanced pensions for deferred retirement. It is projected that the female retirement age should be gradually raised to 60 after which the normal retirement age for men and women should be extended to 65.

4. The Chinese social insurance system is facing a multitude of sustainability challenges.

First is the huge amount of unfunded basic pension liability, estimated by the former Ministry of Labour and Social Security (2005) to be as much as CNY 6 trillion over the next 30 years; the estimation of gap by Li (2012) to be as much as CNY 8.02 trillion and accounting for 91 per cent of GDP in 2050; the potential unfunded basic pension liability estimated by Cao(2012) to be CNY 18.3 trillion in 2013; the accumulated unfunded basic pension liability gap estimated by Ma(2012) will be CNY 37 trillion during 2013-2050, accounting for 83 per cent of GDP in 2011. This has been mainly caused by the rapid ageing of population, the disruption of the system and the subsequent transition towards a partly funded system without government funding for the middle aged and those already in retirement. Consequently, the current generation has to pay an extremely high contribution rate to support the retired generation while at the same time saving for their own pensions. In some places the individual pension accounts, although designed as a funded defined contribution scheme, remain largely empty because nearly all revenues have been spent to fulfil current pension obligations. According to a newspaper report (Guangzhou Daily, 2012), among the CNY 1.9 trillion total individual account value nationwide, only 203.9 billion had been recapitalized by the end of 2010, representing a funding gap of CNY 1.7 trillion; a World Bank report estimated the Chinese pension fund gap between 2001 and 2075 to be as high as CNY 9.15 trillion; the first 10-year pilot to recapitalize individual accounts in Liaoning Province proved a failure; and the Chinese pension system calls for a second round of reforms.

A second challenge for sustainability is the fragmentation of social insurance schemes according to urban and rural household registers, the public and non-public nature of establishments and areas of administrative jurisdiction, which tends to result in little pooling of risk, limited redistributive impact and high administrative costs, as well as barriers which prevent people from moving from one place to another and between different schemes. This fragmentation is one consequence of China's decentralized approach to reforming social insurance provisions, which gave authority and responsibility to local governments to devise reforms suitable to local fiscal capacity. At the outset of social insurance reform, funds were pooled at county, city or industry level. Since the mid-1990s, China's government has made concerted efforts to promote pooling across larger geographic areas and populations, especially for pensions and medical insurance. Pension insurance funds are now consolidated at the prefectural city level, and partially pooled at the provincial level through an adjustment fund for social pooling accounts. As China has 333 prefecture cities and 31 provinces, social insurance funds are still pooled at a low level. A rising problem is the increasingly heavy financial burden on local governments in the course of welfare competition among different localities to expand coverage and improve benefit adequacy via excessively high government subsidies. The recent social insurance law sets a target of pooling pensions at the national level, and at provincial level for other social insurance schemes. Raising the level of pooling, however, entails some tricky political economy issues. Pooling at higher levels would facilitate more efficient operation of the labour market, but more affluent provinces and localities are concerned about being required to subsidize the pension and social insurance funds of poorer provinces.

A third challenge is the issues of moral hazard and adverse selection in the voluntary insurance schemes, including the new urban and rural residents' pension and health insurance schemes.

The major challenges confronted by the Chinese pension system include – but are not confined to – ageing of the population, urbanization and diversification of work patterns. Aside from limited coverage, low benefit and rising inequalities, institutional segmentation is also a feature of the system, under which most of the schemes are administered at county or city level by different authorities. 2016-2020 will be a golden era for the Chinese pension system, with serious reforms planned, for example, a national pooling of basic pension funds and diversified investment, the introduction of Automatic Enrolment and Individual Option of Investment (QDIA) to the Enterprise Annuity system, and implementation of Individual Tax-deferred Annuity Insurance, all of which represent major steps toward the ambitious objective of a properly functioning multi-pillar pension system.

Appendix 3. Questionnaire used to calculate the MWR parameters for annuity

Please answer as accurately as possible and provide any additional information (tables, forms, etc.) that you think will be helpful to us. The accuracy of these data is very important.

DIRECTIONS
Please answer all questions if possible. If you have ANY questions about how to complete the survey, please contact **Qingyao WAN(T: 13916359309, Email: wanqingyao@aliyun.com)**. If you do not know the exact numbers or percentages, please do your best to provide an **approximate** figure based on your knowledge of the annuity parameters. Note that directions for responding are indicated with **. Thank you!

1. Name and location of your Institution

2. Person completing survey

   Name:
   Title:
   Position:
   Telephone number:
   Email:

Products	
1. What is/are the typical annuity products?	**PLEASE CIRCLE ALL THAT APPLY** a. Life annuity (Guaranteed payment for a 10-year period) b. Life annuity (Guaranteed payment with premium) c. Life annuity (No guarantee of payment) d. OTHER, please specify:
2. Which insurance company typically provides the annuity?	**PLEASE CIRCLE ALL THAT APPLY** a. China Life b. Ping An c. Pacific d. Xinhua e. AIA f. OTHER, please specify:
Mortality assumptions	
1. China Life Table (2000-2003) Annuity table	**PLEASE CIRCLE YES OR NO** a. Yes b. No
2. Mortality improvements	**PLEASE WRITE NUMBER ON LINE BELOW** Male ratio: Female ratio:
3. Maximum age	**PLEASE WRITE NUMBER ON LINE BELOW**

Discount rate assumptions	
Discount rate	**PLEASE CIRCLE ALL THAT APPLY** a. Based on the actuary assumptions of the annuity product b. Referring to the fixed-interest government bond (five-year term) yield c. Referring to the three-year term bank deposit interest rate d. OTHER, please specify:
Inflation rate assumptions	
Inflation rate forecast	**PLEASE CIRCLE ONE THAT APPLIES** a. Based on the average inflation rate during 2000-2014 b. Based on the average inflation rate during 2005-2014 c. OTHER, please specify:
Administration charge	
1. Administration charge payment	**PLEASE CIRCLE ONE THAT APPLIES** a. In a lump sum b. Paid annually
2. Administration charge	**PLEASE CIRCLE ALL THAT APPLY** a. Referring to the group purchase charge b. Referring to the individual purchase charge c. OTHER, please specify:
Premium payment	
Premium payment	**PLEASE CIRCLE ONE THAT APPLIES** a. In a lump sum b. Annually c. Occasionally
Benefit payment	
Benefit payment	**PLEASE CIRCLE ONE THAT APPLIES** a. In a lump sum b. Annually c. Variable