

LONGEVITY RISK MANAGEMENT IN SINGAPORE'S NATIONAL PENSION SYSTEM

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ABSTRACT

Although annuities are a theoretically appealing way to manage longevity risk, in the real world relatively few consumers purchase them at retirement. To counteract the possibility of retirees outliving their assets, Singapore's Central Provident Fund, a national defined contribution pension scheme, has recently mandated annuitization of workers' retirement assets. More significantly, the government has entered the insurance market as a public-sector provider for such annuities. This article evaluates the money's worth of life annuities and discusses the impact of the government mandate and its role as an annuity provider on the insurance market.

INTRODUCTION

While defined contribution (DC) pensions have enjoyed varying degrees of success during the accumulation phase, proponents of the DC model now confront the larger question of how participants will manage their capital throughout the payout phase so as not to run out of money in retirement. Not surprisingly, governments have become involved in this decision, as in the case of Switzerland where annuitization is the default payout modality; given a choice, most retirees elect to annuitize (Bütler and Teppa, 2007). The United Kingdom has a long history of annuitization for those holding private DC pension accounts, yet retirees have substantial leeway over how

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much to annuitize and when (Finkelstein and Poterba, 2002, 2004). And in Chile, workers have long been given a choice between phased withdrawal and annuitization when they claim their pensions (Mitchell and Ruiz, Forthcoming).

In contrast to such flexibility over annuitization, the Central Provident Fund (CPF) of Singapore has recently announced that retirement assets held by its citizens in the national DC plan must be mandatorily annuitized so as to better protect retirees against the possibility of outliving their wealth. At the same time, the government has decided to enter the insurance market as a provider for these annuities. This article evaluates the money's worth of privately offered annuities prior to the reform, discusses the impact of the government mandate, and assesses how the entry of the government as an annuity provider is shaping the nation's insurance markets. Our results are of interest for several reasons. First, the CPF is widely acknowledged as one of the world's largest—and arguably most successful—DC schemes. Accordingly, it is valuable to see how this system is handling the challenges of a rapidly aging population. Second, we seek to determine whether market failure—that is, low value-for-money annuities—prompted the government to enter the insurance market as an annuity provider and whether the new government-offered annuities will provide greater value to retirees.

We show that competitively priced life annuities were offered by private insurers in Singapore prior to the reform, with money's worth ratios (MWRs) in the 0.88–1.05 range for males—on par with those in many other countries. Moreover, adverse selection costs were reasonable, on the order of 3.3–5.6 percentage points. The new government-offered annuities are estimated to provide MWRs exceeding unity, benefiting annuitants on average but also implying that the annuity mandate will be expensive for the government if current pricing continues.

These findings are relevant to the current debate about how to best deploy annuities to manage longevity risk within the context of a DC scheme. On the positive side, mandating annuitization can reduce loads and adverse selection and can help retirees better manage the risk of outliving their income, as detailed by Emms and Haberman (2008) and Horneff, Maurer, Stamos (2008). Yet on the negative side, mandating can also pose challenges. For instance, making annuity purchase compulsory produces utility losses for less risk-averse retirees.¹ Also, if left to private annuity providers, market distortions can arise: for instance, in the United Kingdom. Murthi, Orszag, and Orszag (2000) describe falling annuity yields, high markups on annuities, and “mis-selling” incidents, which they attributed to a captive yet privately run insurance market. By contrast, the Singaporean approach shows that a national government can both mandate and provide a risk-pooling scheme. Yet, there are also risks in government provision, in that private insurers may be crowded out in the process. Indeed in Singapore, all but one of the eight private insurers stopped selling CPF-compliant annuities between 2007 and 2009. Whether this crowd-out effect is short term or permanent remains an open question and an important one to address in future research.

¹See, for example, Mitchell et al. (1999) and Blake, Cairns, and Dowd (2003).

BACKGROUND

Established in 1955, the CPF is the mainstay of Singapore's old-age system. It is one of the world's largest DC schemes with about 3.23 million members; the program also faces a rapidly aging population due to one of the world's lowest fertility rates (1.29 per female) and longest life expectancies (80.6 years at birth).² The government of Singapore has recently introduced the concept of a national longevity insurance scheme to address the challenges of increasing life expectancy given population aging (CPF 2009a). As of 2013, annuitization, rather than the current phased withdrawal approach, will become the mandatory vehicle for a portion of CPF retirement savings under the auspices of the regulatory public agency known as the CPF Board. Under the CPF LIFE scheme, new annuity products began to be offered in September 2009.

Prior to this reform, the government had established the concept of a minimum sum (MS) that required participants at age 55 to set aside for retirement a specific dollar value of assets from their total CPF accumulations;³ excess accumulations could be withdrawn as a lump sum.⁴ This MS had to be preserved to age 65 (previously 62) before any drawdowns were permitted, and the default decumulation option after that was a phased withdrawal scheme paying benefits over about 20 years (or until the balance was exhausted). This framework exposed participants to significant longevity risk, since about half of all age 65 members would be expected to outlive their assets (CPF, 2008). Those having the full MS amount in cash could voluntarily buy a life annuity from private insurers, but this group was a small fraction of the total. Among the active members who turned 55 in 2008, only about one-third had accumulated the required MS (CPF, 2009b). And only one in six eligible to do so actually elected to buy an annuity from private insurers under the MS Scheme,⁵ perhaps because the phased withdrawal payout of S\$790 was higher compared to an average monthly annuity payment of S\$520.⁶ Another reason might be costs; indeed, Prime Minister Lee suggested as much in stating that "frankly speaking, the returns have not been very attractive, (and) the costs have been high" (SPMO, 2007).

In 2007, the Singapore Government convened a National Longevity Insurance Committee (NLIC) to study the feasibility of the national longevity insurance scheme. After extensive hearings and review, it concluded:

²Figures for year-end 2007 from the Singapore Department of Statistics (SDOS, 2008a).

³The required MS is set by the CPF and increases each year. It was S\$80,000 in 2003, S\$99,600 in 2007, and it is expected to be about S\$134,000 in 2013 (CPF, 2008, 2009b).

⁴If a member's total balance is higher than the MS, any remaining balance can be withdrawn as a lump sum. If the total balance is less than the MS, the following withdrawal rules currently apply to members who reach age 55 between January 1, 2010 and June 30, 2010: if the balance \leq \$5,000 one may withdraw everything; if $\$5,000 < \text{total balance} \leq \$16,667$ one may withdraw \$5,000 and set aside the remainder in the retirement account (RA); and if $\$16,667 < \text{total balance} \leq \$167,143$ one may withdraw 30 percent of the balance and set aside the remainder in the RA (CPF, 2009c).

⁵See Fong, Mitchell, and Koh (Forthcoming).

⁶This applies to a member with the full MS of \$99,600 at age 55 (as of 2007) (CPF, 2007). Under phased withdrawal, he could draw down his balance plus interest via monthly payouts of \$790 and the flow would continue for 20 years at which point the balance is likely to be exhausted.

The operation of the scheme will involve significant mortality and investment risks over a very long time horizon The committee notes the difficulties that some annuity providers abroad . . . had run into when various risks were not properly managed. In some circumstances, provider risked insolvency as they were unable to meet liabilities. . . . Members of the public have therefore expressed a preference of the CPF Board to administer the scheme due to the favorable CPF interest rates . . . participants will need to have confidence in this national scheme to provide for their retirement, the operator must engender public trust and have strong administration capability. (CPF, 2008)

In other words, the Committee argued that the government should offer annuities due to greater public trust and perhaps greater efficiency, and indeed it is possible that a government-run pooling scheme could benefit from better annuity pricing through economies of scale and lower administrative loads. Furthermore, if it could become the primary provider, it could pool sufficient annuitants such that the average mortality risk of the pool would decrease. Mitigating these advantages includes concern about whether the public sector would have sufficient in-house expertise and might crowd out commercial insurers. In any event, in February 2008, the government mandated life annuities and also required the CPF Board to operate a national longevity insurance scheme that would “give Singaporeans confidence that the scheme will be properly administered” (CPF, 2008). Personnel from the Ministry of Manpower and the CPF Board devoted almost 2 years to designing the system, consulting industry professionals in the process. The launch of the pilot program in September 2009 was accompanied by intensive public education through the media, road-shows, and pamphlets, and it generated substantial interest: since launch, over 30,000 members committed about S\$1.5 billion to the CPF LIFE scheme (CPF, 2010).

In what follows, we assess whether unattractive annuity yields and high costs were, in fact, problematic in the Singaporean context and thus might rationalize government provision.

Methodology: Modeling MWRs

A large literature focuses on measuring the money’s worth of annuities in Western countries. Consistent with that opus, we define the MWR of a payout annuity as the ratio of the expected present discounted value (EPDV) of annuity payments to the initial premium (Mitchell et al., 1999). Whereas a fairly priced annuity with no loadings will have an MWR of unity, in the real world, privately sold annuities have MWRs of less than one due to administrative costs and adverse selection. Adverse selection occurs in a voluntary market since those who elect to purchase a payout annuity tend to live longer than those who do not; adverse selection raises prices for all those who do purchase. Adverse selection costs are computed as the difference between the MWRs using annuitant and population survival tables (Mitchell et al., 1999). Many prior studies have used the MWR notion to measure value for money in a range of annuity products including constant and rising payout products, joint-and-survivor annuities, and annuities with guarantee periods (cf. Mitchell et al., 1999; Brown et al., 2001; Finkelstein and Poterba, 2002, 2004; Thorburn, Rocha, and Morales, 2005).

The annuities offered under the Singaporean CPF scheme are somewhat different from products on offer elsewhere, as they include a guaranteed amount if the death of the insured occurs in a specified time frame. Specifically, when the insured dies, the beneficiary receives the guaranteed amount of the single premium plus accrued interest (if any) less total amount of annuity payouts already made (if positive).⁷ The refund, which is a lump-sum payment to the beneficiary, provides an element of capital protection.⁸ Accordingly, the EPDV of a nominal annuity with a guaranteed amount may be written as follows:

$$EPDV = \sum_{t=0}^{D-1} {}_t p_a \cdot q_{a+t} \cdot v^{t+1} G_{t+1} + \sum_{t=D}^{\infty} \left({}_t p_a \cdot q_{a+t} \cdot v^{t+1} G_{t+1} + {}_t p_a \cdot v^t A_a \right), \quad (1a)$$

where $G_{t+1} = \max \{0, \text{premium} + \text{accrued interest} - \text{total annuity payouts received prior to time } t + 1\}$

In Equation (1a), a is the age at which the annuity is purchased, t represents the number of months beyond the annuity start date, A_a refers to the fixed monthly nominal annuity payout for the individual purchasing the annuity at age a , v^t is the nominal discount rate at month t based on a riskless term structure, and ${}_t p_a$ is the probability that an individual of age a survives after t months. To account for the guarantee amount and the deferral period, we also define D to be the deferred period (expressed in months), G_{t+1} is the death benefit at time $t + 1$, and ${}_t p_a \cdot q_{a+t}$ is the probability of an annuitant age a surviving to t months and then dying between month t and month $t + 1$. The first term in Equation (1a) captures the guarantee amount to the beneficiary if the insured dies during the deferral period, while the second term reflects benefits paid to the insured if he lives to the point when payouts start. Alternatively, the formula can be more neatly presented per Equation (1b) where the first summation accounts for the death benefit arising from the money-back guarantee, and the second summation captures the annuity benefit over the lifetime of the individual:

$$EPDV = \sum_{t=0}^{\infty} {}_t p_a \cdot q_{a+t} \cdot v^{t+1} G_{t+1} + \sum_{t=D}^{\infty} {}_t p_a \cdot v^t A_a. \quad (1b)$$

To implement the EPDV valuation for Singapore, we use the newly released population mortality tables from Singapore Statistics (SDOS, 2008b) having a limiting age of 100; we then cohortize the population tables (as cohort mortality tables are

⁷Accrued interest is accumulated from age 55 when the premium is paid to the point where payouts start (at age 62 in 2007). Not all annuities incorporate the accrued interest component in the guaranteed amount on death. Accrued interest ranges from 0 percent to 2.5 percent per annum in 2007; see Table 1.

⁸This is somewhat similar to the money-back annuities available in other countries. For example, value-protected annuities that were introduced in the United Kingdom in 2006 feature partial money-back option where the lump-sum death benefits are permitted up to age 75 and are taxed (Boardman, 2006).

unavailable) using period life tables. Thus, having a year 2007 period life table, we compute:

$$\hat{q}_x(2007 + t) = q_x(2007) \times (\beta_x)^t, \quad (2)$$

where $q_x(2007)$ is the annual mortality rate for age x in year 2007, $\hat{q}_x(2007 + t)$ is the estimated annual mortality rate for age x in year $(2007 + t)$, and β_x represents the estimated annual mortality improvements for an individual aged x extrapolated from mortality changes between 1990 and 2005. As in previous studies, mortality improvement rates are projected from the abridged period population tables for Singapore published by the World Health Organization (various years).

Little is publicly known on actual annuitant mortality experience in Singapore. Insurance industry practice and previous research including Fong (2002) has adopted the U.K. annuitant mortality experience with adjustments for local conditions, similar to what is done in Australia. The Monetary Authority of Singapore (MAS) in its capacity as insurance regulator requires firms to employ the U.K. a(1990) ultimate tables rated down 5 years for reserves and liability valuations pertaining to annuities sold (MAS, 2008a).⁹ Accordingly, we use the a(1990) tables with a 5-year setback to estimate the annuitant experience for our valuation year, and then we cohortize the resulting annuitant tables.¹⁰ We compute cumulative survival probabilities from the cohort tables as follows:

$${}_t p_a = \prod_{j=0}^{t-1} (1 - q_{a+j}), \quad (3)$$

where ${}_t p_a$ is the cumulative probability of a person aged a surviving for t years, and q_{a+j} is the probability of a person age $(a + j)$ dying within the year. These cumulative survival probabilities are sex specific and calculated on a monthly basis to match the frequency of the annuity payouts. In addition, we apply a uniform distribution of deaths (UDDs) assumption to reflect mortality patterns in Singapore. We justify using UDD for fractional ages within a year due to the lack of variation in Singapore's weather (so death rates are unlikely to vary seasonally).¹¹ We match the limiting age of the population group with that of the annuitant group by extrapolating population

⁹The Sixth Schedule of the Insurance Regulations 2004 stipulates that insurers may employ the rates in the U.K. a(1990) tables with a 5-year setback to value their annuity liabilities. Previously, Insurance Regulations 1992 required insurers to employ the a(1990) tables with a 2-year setback. The a(1990) tables are constructed based on U.K. annuitants' mortality experience from 1967 to 1970 with mortality improvements projected to 1990. By applying the 5-year setback, we effectively age the tables to year 2007 and then cohortize for the MWRs.

¹⁰As a robustness check, we verify that our calculations yield a lower mortality for annuitant cohort than the population cohort; for instance, a 65-year-old male in the general population has a mortality of 0.01028 compared to 0.00933 for an annuitant.

¹¹Various actuarial assumptions could be used for fractional ages within a year, including a uniform distribution of deaths, a constant force of mortality, or a hyperbolic pattern (Bowers et al., 1997). Prior studies on MWR have not explicitly specified assumptions for fractional

mortality estimates to the common maximum age of 117 to properly capture the longevity tail risk in the population group.¹² This improves comparability between the two groups by ensuring that a person drawn randomly from the population also has some probability of survival leading to annuity payouts even at the tail end, rather than being curtailed at 100 years of age.

Figure 1 compares the cumulative survival probabilities we derive for the general Singaporean population and for annuitants. The figure shows the probability that a 55-year-old man (or woman) will survive to various ages given mortality rates for the population at large, as well as those for annuitants. Not surprisingly, the average 55-year-old annuitant has a higher survival probability at all ages, implying some adverse selection costs to be discussed below.¹³

The EPDV calculation requires a term structure of interest rates; we judge the Singaporean Treasury bond rates as most appropriate, since the MSS annuities are viewed as capital protected. Prices and yields of the Singapore Government Securities Treasury bonds obtained from MAS (2008b) are used to compute the riskless spot rates to proxy the yields on hypothetical zero coupon bonds.¹⁴ To obtain the full term structure, we then linearly interpolate between intervals where spot rates are unavailable, for instance, between the 7- and 10-year spot rates.¹⁵

Results: MWRs for Voluntary Private Annuities

Prior to the mandatory annuity reform, plan participants with sufficient cash could voluntarily purchase a life annuity from 7 to 9 insurers participating in the market; the firms included some international players with Singaporean offices (e.g. AIA, Prudential, and HSBC Insurance), as well as several local insurers.¹⁶ This program promoted annuity purchase among CPF participants; Fong (2002) estimated that as

ages within a year (e.g. Doyle, Mitchell, and Piggott, 2004). For a plot of our values of derived from the UDD assumption, see Appendix A.

¹²We use population period tables from Singapore Statistics. These tables had applied the Coale-Kisker method to project mortality at higher ages, using a separation factor of 0.5 (SDOS, 2008b). Given q_x for ages 85–99, we back out the death rates (m_x) and observe that the change in m_x between each age interval is constant at about 9.3 percent. Extrapolating this constant graduation rate, we then derive the q_x for ages 100–117.

¹³Finkelstein and Poterba (2002) attribute these mortality differences largely to socioeconomic, or passive, selection effects.

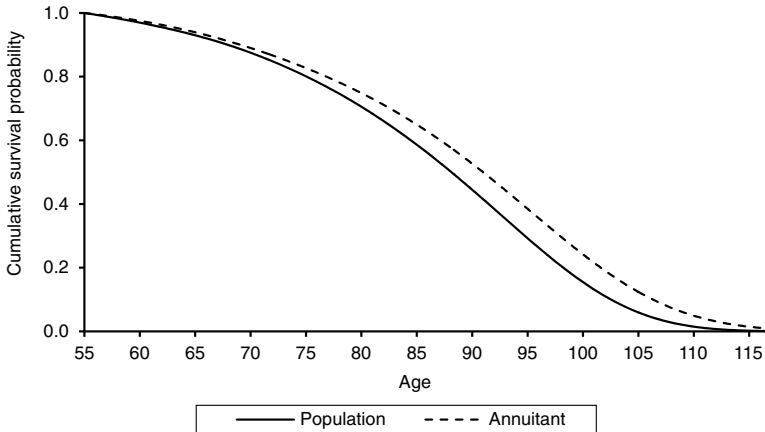
¹⁴The first-year rate is derived from the 1-year Treasury bill; thereafter, the 2-, 5-, 7-, 10-, 15-, and 20-year Treasury bond rates as of 2007 are used to estimate the riskless spot rates. Our annual spot rate ranges from 1.4 percent to 3.44 percent. Since maximum duration available is only 20 years, we then extrapolate the last spot rate into the future, yielding a nominal riskless term structure of interest rates on Singapore's Treasury bonds.

¹⁵See Appendix B for a list of key inputs compared to those used in two earlier money's worth studies for annuities in Singapore.

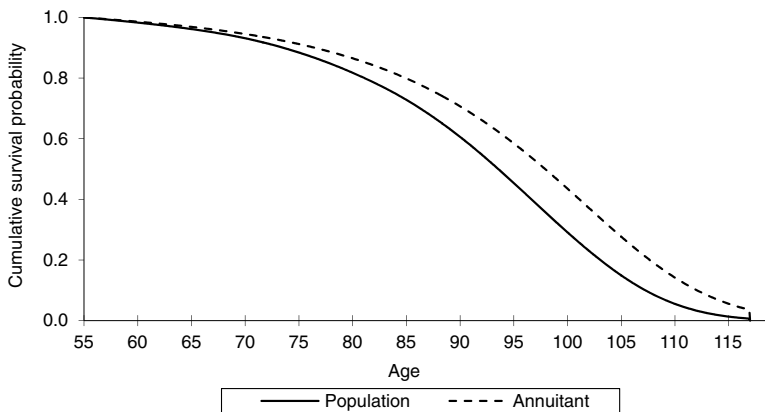
¹⁶As of December 2007, three insurers accounted for almost 80 percent of the total market share for individual annuity policies, inclusive of annuity purchases using non-CPF pension saving (MAS, 2007). In particular, a homegrown cooperative, NTUC Income, has long been the market leader with 58 percent market share and about 38,000 annuity policies in force as at end 2007. Great Eastern Life and UOB Life have approximately 11 percent market share each, higher than that of AIA (8.5 percent) and Prudential (1.6 percent).

FIGURE 1
 Cumulative Cohort Survival Probability: General Population and Annuitant Groups
 (Conditional on Attaining Age 55 and Limiting Age of 117; 2007)

A. Singaporean Males



B. Singaporean Females



Source: Authors' computations; see text.

of 2000, about 87 percent of all Singapore annuitants had purchased their policies through this scheme. The annuity premium equaled the prevailing MS for the year, and insurers were free to determine participant payouts and guarantee amounts. In 2007, for instance, in exchange for a lump-sum premium at age 55 of S\$99,600, monthly annuity payouts beginning at age 62 varied as outlined in Table 1. The nine annuities on offer by eight commercial insurers were similar in that the standard deviation in payments was only about 5 percent. All annuities had fixed nominal payouts; two also promised a nonguaranteed annual bonus payment depending on

TABLE 1

Monthly Nominal Payouts for Life Annuities Purchased at the Minimum Sum of S\$99,600 (2007; S\$ per Month)

Company and Product	Monthly Annuity Payout for Entry Age of 55		Guaranteed Amount Upon Death (Less Total Annuity Payments)
	Male (S\$)	Female (S\$)	
Nonparticipating annuities			
Asia Life Assurance	505.47	454.47	Premium
American International Assurance (AIA)	530.87	513.94	Premium
Aviva	559.00	507.00	Premium + accrued interest compounded at 1% p.a. to commencement date of annuity
Great Eastern Life (GE Life I)	535.35	484.30	Premium + interest accumulated at 0.75% p.a. to age 62
Great Eastern Life (GE Life II) <i>(Note: This product includes long-term care benefit.)</i>	494.26	440.73	Premium + interest accumulated at 0.5% p.a. to age 62
Overseas Assurance Corporation (OAC)	535.35	494.26	Premium + interest accumulated at 0.75% p.a. to age 62
Prudential Assurance	518.44	449.87	Premium
<i>Subaverage</i>	525.53	477.80	
Participating annuities			
HSBC Insurance	474.00 (541.58)	458.00 (525.58)	Premium + interest accumulated at 2% p.a. to age 62
NTUC Income Co-op	523.50 (591.08)	490.25 (557.83)	Premium + interest accumulated at 2.5% p.a. and bonuses to age 62
<i>Subaverage</i>	498.75	474.13	
Overall average	519.58	476.98	

Notes: p.a. denotes per annum. Monthly payouts for a nominal deferred annuity purchased at age 55 with payments starting at age 62. The single premium is the Minimum Sum of S\$99,600 for members age 55 (7/07-6/08). The MS Scheme currently guarantees named beneficiaries a given amount in the event of annuitant's death equal to the (positive) difference between the guaranteed amount and annuity payments made. Previously (in 2000) most MS annuities were guaranteed for a certain period so if death occurred during the guaranteed period, remaining annuity payments would be converted into a lump sum paid to beneficiaries. Bonus rates depend on company performance; NTUC Income's annual bonus rates were 1–3.5% historically (NTUC, 2009) and a 2% bonus is used in NTUC Income benefit illustrations. Original payouts without bonus expressed without parentheses; figures in parentheses incorporate bonus component assuming an annual projected bonus rate of 2%.

Source: Authors' computations from CPF (2007).

TABLE 2

Money's Worth Ratios and Adverse Selection Costs for Nominal Life Annuities Offered by Private Insurers Under the CPF Plan (2007)

Company and Product	Male			Female		
	Population MWR	Annuitant MWR	Adverse Selection	Population MWR	Annuitant MWR	Adverse Selection
Nonparticipating annuity						
Asia Life Assurance	0.861	0.896	3.47	0.840	0.885	4.44
AIA	0.907	0.943	3.62	0.943	0.995	5.20
Aviva	0.943	0.982	3.98	0.930	0.981	5.14
GE Life I	0.910	0.947	3.71	0.893	0.941	4.78
GE Life II	0.846	0.879	3.34	0.818	0.860	4.22
OAC	0.907	0.945	3.74	0.908	0.957	4.98
Prudential Assurance	0.879	0.915	3.62	0.833	0.876	4.37
Participating annuity						
HSBC Insurance	0.933	0.969	3.59	0.969	1.021	5.20
NTUC Income Co-op	1.006	1.047	4.09	1.024	1.081	5.61
Mean	0.910	0.947	3.69	0.906	0.955	4.88

Notes: Money's worth ratios are in decimals and adverse selection costs are in percentage points. Computations pertain to a CPF participant who purchases the MS Scheme annuity at entry age 55 for a premium of S\$99,600 and starts receiving payouts at age 62. The term structure of interest rate uses derived spot rates for 1-, 2-, 5-, 7-, 10-, and 20-year bonds with linear interpolation between years.

Source: Author's computations, see text.

the insurer's performance. Level monthly payouts ranged from S\$495 to S\$559 for males and S\$441 to S\$514 for females; the guaranteed amount upon death was at least the premium S\$99,600 and several annuities paid interest of 0.5–2.5 percent.

Using these annuity quotes in Equation (1) generates the desired MWRs reported in Table 2. Here, we see that, per premium dollar, the typical male annuitant would have anticipated receiving an average of \$0.947 and the female \$0.955 in 2007. It is also of interest that the NTUC Income cooperative offered the highest MWRs of 1.047 (males) and 1.081 (females); these exceeded the private insurer average by 10.5 and 13.1 percent, respectively.¹⁷ We measure the cost of adverse selection as the difference in the MWR using population versus annuitant tables. Our values of 3.3–4.1 percentage points (or cents per one dollar premium) for males and 4.2–5.6 for females are comparable to the U.K. figure of 4.6 reported by Finkelstein and Poterba (2002) but below the 6 and 10 percentage points found for Australia and United States, respectively (Doyle, Mitchell, and Piggott, 2004; Mitchell et al., 1999). In terms of proportion, we see from the table that adverse selection costs accounted for about 47 percent of the total loadings, which is quite reasonable compared to other countries.

¹⁷NTUC Income is a nonprofit oriented cooperative for the Workers' Union. This result is consistent with NTUC Income's mission to return the majority of profits to policyholders (NTUC Income, 2009).

TABLE 3

Robustness Analysis for Nominal Life Annuities Offered by Private Insurers Under the CPF Plan (2007)

Mortality Rates	Male			Female		
	Annuitant	Population	AS	Annuitant	Population	AS
Panel A: Sensitivity to Alternative Mortality Assumptions						
2 years lighter	0.962		6.05	0.972		7.11
Base case	0.939	0.901	3.80	0.951	0.901	5.03
2 years heavier	0.917		1.57	0.929		2.86
Panel B: Sensitivity to Alternative Long-Term Interest Rate Assumptions ($\pm 0.5\%$ and $\pm 1\%$) Long-Term Interest Rate						
2.44%	1.067	1.010	5.70	1.110	1.033	7.69
2.94%	0.998	0.951	4.66	1.024	0.961	6.22
3.44% (base)	0.939	0.901	3.80	0.951	0.901	5.03
3.94%	0.889	0.858	3.10	0.889	0.849	4.07
4.44%	0.846	0.821	2.51	0.837	0.804	3.28

Notes: This analysis uses the average annuity payouts (with bonus) of the private annuities given in Table 1. For the base case of 3.44%, the MWR values of this pseudo average-payout annuity are slightly lower than the mean of the individual MWR values reported in Table 2 because the individual computations incorporate interest accrued during the deferral period where applicable.

Source: Authors' computations.

For example, in the United States, Brown et al. (2001) found that roughly half of the cost of purchasing a voluntary annuity could be attributed to adverse selection.

The reasonable adverse selection costs observed in the private annuity market in Singapore may be partly attributed to the unique characteristics of the MS Scheme annuities. For one thing, the premium guarantees contribute significantly to reducing adverse selection; indeed, in results not reported here in detail, removing the embedded guarantee would increase adverse selection by 20–26 percent. Also important is the deferral period on these annuities (between ages 55 and the benefit-claiming age). Without this, adverse selection would have been higher by 9–13 percent. In any case, the annuity marketplace prior to the most recent reform offered relatively competitively priced products, by world standards, with reasonable adverse selection costs.

Sensitivity Analysis

As noted earlier, annuitant mortality rates for Singapore are derived from U.K. annuitant tables, due to lack of annuitant experience in Singapore. To evaluate how sensitive our results are to variations in mortality, we modify the tables to allow life expectancy to vary by 2 years on either side of our base-case estimates, dated from the year of purchase. The mortality of a 57-year-old then represents a +2-year adjustment and the mortality of a 53-year-old represents a –2-year adjustment. Results in Table 3 (Panel A) show that lightening mortality by 2 years exacerbates adverse

selection, while the opposite holds when mortality is made heavier. In addition, the adjustments make slightly more difference to the adverse selection results for males than females. We also explore sensitivity to interest rate variations. The Singapore government bonds were used to derive the riskless term structure. The spot rate on the 20-year bond (3.44 percent) was used as a proxy for the long-term interest rate for periods beyond 20 years. Sensitivity testing using 50 and 100 basis points around the central case shows that money's worth values are sensitive to these changes, as Table 3 (Panel B) indicates. In any event, our estimates of adverse selection remain robust.

Results: MWRs for Mandatory Annuities

Under the new CPF LIFE scheme introduced in 2009, participants may either purchase a private annuity or select from a menu of government-offered annuity products called the CPF LIFE plans. Initially the intention was to provide a dozen different payout options outlined in 2008, but the menu was later pared back to four plans in 2009 after public feedback suggested that too much choice was confusing. The final four are known as CPF LIFE Basic, LIFE Balanced, LIFE Plus, and LIFE Income. Table 4 presents illustrative payouts for the various LIFE plans as the government's proposals evolved, for an annuity premium of half the estimated MS or S\$67,000 in 2013.¹⁸ For that premium, benefit payouts were initially set to be quite generous: in 6 of the 12 original plans proposed in early 2008, monthly payouts would have ranged from S\$560 to S\$650 for males and S\$540 to S\$590 for females. By September of 2009, when the final LIFE plans were launched, promised monthly payouts had been adjusted downward to about S\$524–S\$636 for men and S\$500–S\$553 for women.

Table 4 also shows the "annuity component" expressed as a percentage of the annuity premium. That is, the CPF LIFE products split the premium paid into a term and an annuity component. The first covers payouts from age 65 to the vesting age that differs across the plans; any unused balance from the term component and interest from it is fully refundable to one's heirs. The annuity component finances payouts from the vesting age to death with no funds passed on to the beneficiary. Thus, the four finalized LIFE plans provide a range of trade-offs, balancing providing for oneself and leaving a bequest for one's beneficiaries. In practice, the transition from the term to the annuity component is purely procedural and does not affect monthly benefits to any CPF member in receipt, with the interest from the annuity component being nonrefundable to individual participants as it funds the CPF LIFE scheme. In other words, interest forfeited represents participants' opportunity cost of joining the LIFE plan. This cost is factored into the money's worth computations by means of a guaranteed amount G_t that falls as the retiree ages. While the LIFE Plus and LIFE Income plans both feature only an annuity component, the LIFE Plus product permits some bequest whereas LIFE Income allows none.¹⁹ A retiree who opts for the LIFE

¹⁸By 2013, the prevailing MS is expected to be about S\$134,000 (S\$99,600 in 2007). The CPF estimated that of the approximately 35,000 active members in the 2103 cohort of members turning age 55, about 60 percent will have at least S\$67,000 in cash in their RAs (CPF, 2008).

¹⁹The bequest on the LIFE Plus plan is the unused portions of the annuity component (which in this case is equal to the premium paid). In other words, the refund is the premium paid less annuity payouts already made. Members who join CPF LIFE may not withdraw unless they have medical grounds of shortened life expectancy or if they are leaving Singapore and

TABLE 4

Illustrative Payouts and Money's Worth Ratios of CPF LIFE Plans (for a Premium of S\$67,000; Various Dates)

LIFE Plans	Male			Female		
	Monthly Payout (S\$)	Annuity Component	MWR	Monthly Payout (S\$)	Annuity Component	MWR
Proposed LIFE plans (as of February 2008)						
Refund 90	560	6%	1.306	540	8%	1.350
Refund 85	590	13%	1.315	560	16%	1.361
Refund 80	610	24%	1.331	570	28%	1.371
Refund 75	630	41%	1.341	580	45%	1.374
Refund 70	640	66%	1.323	590	68%	1.370
Refund 65	650	100%	1.284	590	100%	1.311
LIFE plans (as of June 2009)						
LIFE Basic	519	6%*	1.264	496	8%*	1.308
LIFE Balanced	556	24%*	1.313	515	28%*	1.355
LIFE Plus	590	100%	1.308	531	100%	1.332
LIFE Income	632	100%	1.287	549	100%	1.313
LIFE plans (as of September 2009)						
LIFE Basic	524	8.6%	1.240 [1.099]	500	13%	1.255 [1.088]
LIFE Balanced	561	30%	1.252 [1.110]	520	35.5%	1.270 [1.098]
LIFE Plus	594	100%	1.315 [1.149]	535	100%	1.340 [1.142]
LIFE Income	636	100%	1.294 [1.119]	553	100%	1.322 [1.118]

Notes: The default plan offered at each point in time is bolded. Computations pertain to a CPF participant who joins the LIFE plan at age 55 for a premium of S\$67,000, and starts receiving payouts at age 65. In particular, the parameter inputs generating this set of illustrative payouts in the CPF web calculator assume the Singaporean worker was born June 1958 (so he is age 55 in 2013); AV = more than S\$11,000; AI = more than S\$54,000. The premium paid is split into a term component and an annuity component. The term component funds payouts from age 65 to the vesting age; vesting age differs across plans. The annuity component, expressed as a percentage of the annuity premium, funds payouts from the vesting age to death. The reported payouts are indicative only; actual payout will depend on actual CPF interest rates and mortality experience. CPF interest is computed monthly, reviewed quarterly, and compounded and credited annually. Figures marked with (*) are estimated. Money's worth ratios are computed using the riskless term structure of interest rate with long-term interest rate assumption of 3.44% and assume constant payouts over the participant's lifetime. The assumed CPF interest rate is 4% with the statutory additional 1% paid on the first S\$60,000. The guaranteed amount refunded to the beneficiary upon the annuitant's death is the unused amounts left in the annuitant's CPF retirement account (term component plus any interest earned) and the unused amount of the annuity component (if refundable). MWR in brackets are based on an alternative long-term interest rate assumption of 4.44%.

Source: Authors' computations; see text. Payout data obtained from CPF website (CPF, 2008, 2009e).

Income product received a higher monthly payout while alive, making the product most appealing to unmarried or childless individuals. By comparison, the LIFE Basic plan provides for the highest bequest amount in exchange for the lowest monthly payouts by allocating most to the term component. The LIFE Balanced plan provides an intermediate mix.

Since these annuities are being mandated, we generate money's worth values using Singapore population mortality tables. Results in Table 4 show that the government LIFE plans offer excellent value-for-money to annuitants.²⁰ For instance, using the riskless term structure with a long-term rate assumption of 3.44 percent, MWRs range from 1.24 to 1.31 for males and 1.26 to 1.34 for females. These values are far above those provided by the privately provided life annuities where it will be recalled that mean MWRs were 0.947 for men and 0.955 for women (using annuitant mortality). It might be thought that the interest rate environment in Singapore is unusually low, so we recomputed the MWRs using a higher long-term rate of 4.44 percent (close to the yield of the longest term 10-year bond in 1998); under these circumstances, the MWRs appear in brackets in the last four rows of Table 4. The higher interest rate assumption still yields MWRs of 1.10–1.15 for males and 1.09–1.14 for females.

Looking at the patterns of benefit values, it is interesting to note that the LIFE Income (sans bequest) and LIFE Plus (low bequest) plans provide higher MWRs than do the other two plans, implying a small penalty if participants elect a plan that includes bequests. Also, it is apparent that as the design was fine-tuned over time, MWRs were dialed down; perhaps policymakers realized that the early pricing was overly generous. Yet even so, MWRs of the CPF LIFE payouts remain at or slightly above unity, compared to the lower values of private insurer annuities that had been available. The government's higher payout results in part from lower administrative loads compared to those levied by private insurers, and in part from less adverse selection due to the compulsory annuitization (though above we had indicated this was relatively small in Singapore).²¹ A long-term rate assumption set closer to historical norms also generates MWR values closer to one.

As the administrator, the CPF Board determines the premium and payouts with advice from independent actuarial consultants, so the new design may intentionally

West Malaysia permanently with no intention of returning to either country. Members are also not allowed to change their LIFE plans after joining the scheme (CPF, 2009d).

²⁰Based on communications with the CPF Board, we also assume interest rates are compounded and credited annually to the RA, but if the member dies in any month, any interest earned up to that point in time is immediately credited and so refunded. Even when a member reached vesting age, any unused balance in the RA continues to earn interest. If the member adds top-ups to the RA, this also forms part of the principal and earns interest. On death, any unused balance in the RA is refunded. For the original 12 plans, the extra 1 percent earned on the total MS is allocated pro rata to the RA and pooled interest based on the component balances for each month. However, for the final four plans, the extra 1 percent earned on the total MS is allocated entirely to the RA. Finally, if the member dies after vesting age, any unused balance of the annuity component (except for the LIFE Income plan), will be refunded to his beneficiaries.

²¹Similarly, in the U.S. context, Abel (1986) shows that because the U.S. Social Security system is compulsory, it is immune to adverse selection, and a fully funded system can offer a rate of return equal to the actuarially fair rate based on population average mortality.

include a small subsidy to CPF members so as to jump-start the new scheme. Indeed the government has offered a sign-on bonus (called the L-bonus) for the first five cohorts of members joining CPF LIFE for whom the scheme is voluntary.²² Also, our computations assume constant nominal payouts, though in fact, payouts may vary in the future, depending on the future evolution of interest rates and mortality. Though the CPF Board can adjust payouts periodically to reflect actual mortality experience and investment return, it is noteworthy that it has assured members that adjustments will usually be small so that nominal payouts are anticipated to remain relatively stable over time (CPF, 2009d).²³

DISCUSSION AND CONCLUSION

A topic of substantial interest to international policymakers is whether a national annuitization scheme should be administered by the private or the public sector.²⁴ Having a single provider can reduce costs through economies of scale, and a government-run scheme may be perceived to be safer by retirees than private insurers that may face bankruptcy (Babbal and Merrill, 2007). In the Singaporean case, the Civil Service is regarded as one of the most efficient bureaucracies in the world with a high standard of discipline and accountability (Heritage.org, 2010) and the fact that the CPF has traditionally paid interest on annuities at a rate pegged to the 10-year Singapore Treasury bond plus 1 percent with a 2.5 percent floor implies that citizens tend to view such returns as risk free (given the AAA rating of government bonds). It is therefore interesting that the annuities offered by Singapore's CPF LIFE scheme appear to be priced very favorably to the consumer compared to other developed countries (see Table 5). Our preliminary evidence therefore could indicate that Singapore has been able to pass cost savings from scale economies and onto annuitants.

It is also worth noting that while CPF members may still buy life annuities from a private insurer, few firms appear to be able to compete. That is, there were nine private insurance companies offering annuities in 2007, but only one remained by late 2009.

²²The L-Bonus is targeted at lower- and middle-income CPF members ages 46–50 in 2008. It is given to these members when they enroll in the CPF LIFE scheme at age 55. In fact, the LIFE Plus plan, which provides a higher monthly payout and leaves less bequest for beneficiaries, has proven most popular in the pilot launch (CPF, 2010); over half of the members selected it. In addition, more than S\$60 million of LIFE Bonus (L-Bonus) has been given to about 70 percent of the members for joining the scheme.

²³Responding to members seeking to join CPF LIFE ahead of the official launch date of 2013, the CPF Board began offering LIFE plans in September 2009 to members born in 1954 or before. Inasmuch as annuitization is not yet mandatory, this first phase of CPF LIFE operates on a voluntary opt-in basis (from 2013, annuitization will be mandatory). Younger members will be auto-included in the LIFE Balanced plan, if they have at least \$40,000 cash savings in their RA as of age 55. Members with less than S\$40,000 can opt-in if they wish (CPF, 2009d). The cutoff for auto-inclusion into CPF LIFE was selected to balance the level of monthly income and the percentage of active CPF members automatically included. At S\$40,000, it is estimated that some 70 percent of active members will be automatically included from the first cohort (i.e., those who turn age 55 in 2013; CPF, 2009f).

²⁴Here, we do not take up the question of whether mandatory annuitization is welfare enhancing, a topic explored in some detail by Brown (2003).

TABLE 5
International Comparison of Money's Worth Ratios

Country	Study	Valuation Date	MWR (65-Year-Old Male; Annuitant Mortality)	Cost of Adverse Selection as % of Total Loading
United States	Friedman and Warshawsky (1988)	1983	0.868	35.0%
United States	Mitchell et al. (1999)	1995	0.916	54.3%
United Kingdom ^a	Finkelstein and Poterba (2002)	1998	0.988	91.1%
		1998	0.962	62.0%
Singapore	Fong (2002)	2000	0.933	13.0%
Singapore	Doyle, Mitchell, and Piggott (2004)	2000	0.947	4.7%
Australia	Doyle, Mitchell, and Piggott (2004)	2000	0.939	49.7%
Singapore ^b	This study	2007	0.947	41.1%
		2008–2009	1.10–1.15	—

Notes: All the MWR values reported for Singapore are based on a 55-year-old male instead of a 65-year-old male. Total loading is defined as one minus money's worth of annuity for an individual from the general population.

^aResults are reported in separate rows for the U.K. voluntary and compulsory annuity markets, respectively. Data in both markets are drawn from annuities offered by commercial insurers.

^bResults are reported in separate rows for annuities offered by commercial insurers, and new annuities offered by the CPF Board, respectively. MWR values for the latter are based on September 2009 LIFE plan payouts and a long-term interest rate assumption of 4.44%.

Source: Authors.

The withdrawal of insurers from the annuity market may be of concern to policymakers if product innovation and pricing pressure requires competition among product providers in the industry. In addition, by marketing both life insurance and life annuities, insurers would be expected to benefit from some natural hedging across the two products. It is possible that private annuity providers could refocus their business outside the CPF scheme for retirees seeking to annuitize nonpension wealth. Also, since the amount that CPF members can annuitize via the CPF LIFE product is capped at the stipulated MS amount, wealthy individuals could still turn to commercial annuities. Moreover, the life annuities currently offered by the government are nominal and not inflation adjusted, and hence retirees may find some benefit from inflation-linked payouts not currently available under the CPF LIFE system.

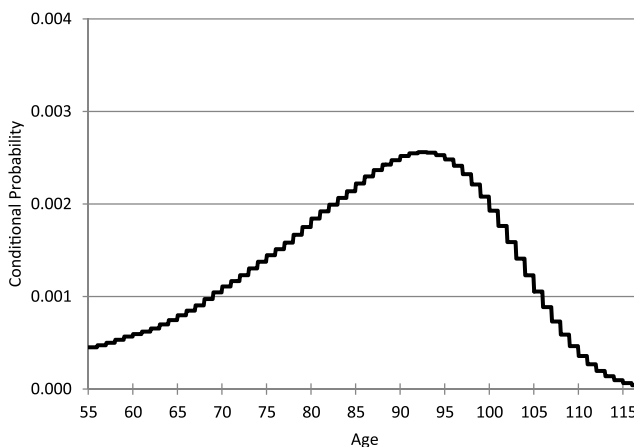
These findings are also of interest in nations where governments are increasingly concerned about annuitization in DC plans. For instance, in the U.S. 401(k) pension marketplace, few retirees convert their assets into insured payout products and instead take their money as a lump sum (Brown et al., 2001). In response, to protect against longevity risk, some have proposed making annuitization the default payout mechanism from a DC pension. For instance, Gale et al. (2008) recommend that 401(k) assets be automatically directed into a "trial" payout product unless the retiree affirmatively elects not to participate. After 24 monthly payments from the automatic payout plan, the retiree could either do nothing and be defaulted into a permanent income distribution plan or elect an alternative distribution option. By making

it easier for retirees to purchase lifetime income plans, it is anticipated that these would become a better value for the average consumer.

We conclude that Singapore's recent move to mandate annuities under the national DC pension system represents a logical step toward national longevity risk management. By establishing the government as an annuity provider, the CPF Board may have taken advantage of scale economies and reduced the pricing impact of adverse selection, given that the latter was found to be quite a substantial proportion of total loadings. Furthermore, the aggressive annuity pricing is creating public buy-in for the new mandate, while indirectly working to compensate less risk-averse individuals in terms of foregone equity premium. One offset may be that private insurers have been crowded out, in part because the CPF-designed product pays participants more than what commercial insurance companies had offered. Without competition, it is unclear whether annuity pricing will continue to be attractive and whether product innovation will continue in Singapore. Related questions, as yet unsettled, have to do with whether favoring annuity payments over payments to survivors is politically sustainable, and how long the government will be able to continue subsidizing payouts.

APPENDIX A: PLOT OF ${}_t p_{55} \cdot q_{55+t}$ (PROBABILITY OF DYING BETWEEN MONTH t AND MONTH $t + 1$ CONDITIONAL ON HAVING SURVIVED TO MONTH t)

The figure plots ${}_t p_{55} \cdot q_{55+t}$ for a random male drawn from the population who purchases an annuity at age 55 in 2007. It shows the probability of dying between month t and month $t + 1$ (conditional on living to month t) increasing from age 55 to about age 95 where the rise in q_{55+t} outweighs the decline in ${}_t p_{55}$. In the advanced ages, the opposite occurs and the probabilities fall. The jags in the plot indicate that within each year, the probabilities are level consistent with the UDD assumption. Because the limiting age is set at 117, any remaining probability mass is assigned to the tail resulting in heaping at that outside age.



APPENDIX B: ASSUMPTIONS USED IN MONEY'S WORTH COMPUTATIONS FOR LIFE ANNUITIES UNDER THE CPF MS SCHEME

This table summarizes the data and results for various studies that assessed the money's worth of life annuities offered by private insurers under the CPF Minimum Sum scheme. The three main inputs used in the money's worth computation are annuity quotes, annuitant and population mortality rates, and interest rates.

	Fong (2002)	Doyle, Mitchell, and Piggott (2004)	This study
Valuation Date	2000	2000	2007
Sample Chosen	Subset of 8 non-participating annuities & 1 participating annuity	Subset of 5 non-participating annuities with a 15-yr guarantee period or similar	All MSS annuities: 7 non-participating & 2 participating annuities
Model	MWR model with 15-year certain	MWR model with 15-year certain	MWR model for annuities with guaranteed amount. See Equation (1) in text
Mortality Assumptions			
<i>Annuitant</i>	a(90) with 2-year setback; limiting age used is 109	a(90) with 2-year setback; limiting age used is 109	a(90) with 5-year setback; limiting age used is 117
<i>Population</i>	Derived from 1960 and 1990 Ordinary Male and Female Lives Tables (Singstat). Limiting age of 99	Abridged life tables for Singapore (World Health Organization). Limiting age of 100	2007 complete life tables for Singapore resident population (Singstat), plus extrapolate from age 100 to limiting age of 117
Interest Rate Assumption	Flat interest rate (proxy by the 10-year Government bond yield of 4.6%)	Term structure (yield curve with long-term rate assumption of 4.76%)	Term structure (yield curve with long-term rate assumption of 3.44%)
MWR Results for a 55-Year-Old Male			
<i>Annuitant</i>	0.997	0.947	0.947
<i>Population</i>	0.986	0.945	0.910
<i>Adverse Selection (in pp)</i>	1.1	0.26	3.69

Notes: This table summarizes the data and results for various studies that assessed the money's worth of life annuities offered by private insurers under the CPF Minimum Sum scheme. The three main inputs used in the money's worth computation are annuity quotes, annuitant and population mortality rates, and interest rates. A total of 13 MSS life annuities were offered in July 2000, of which 9 were flat-rate annuities, 2 were participating annuities, and 2 were increasing annuities. The increasing annuities offered by AIA were dropped after that year (*Source:* Personal communication from CPF Board). The a(90) table refers to the UK a(1990) period life table for annuitants. It is based on UK annuitants' experience from 1967–70, with mortality improvements projected to 1990. Because of lack of annuitant experience in Singapore, previous studies used the a(90) and with a two-year setback to account for lower mortality among annuitants. A two-year setback means that a 65-year-old is treated as having the same mortality rate as a 63-year-old has in the initial table. Money's worth ratios are in decimals and adverse selection costs are in percentage points.

Source: Authors' computations; see text.

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