

**THE INVESTMENT RISKS IN SINGAPORE'S
RETIREMENT FINANCING SYSTEM**

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FINANCING SYSTEM**

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THE INVESTMENT RISKS IN SINGAPORE'S RETIREMENT FINANCING SYSTEM

Abstract

The foundation of Singapore's retirement financing system is a fully-funded mandatory savings scheme administered by the Central Provident Fund Board. The Central Provident Fund (CPF) is a defined contribution retirement savings scheme with a guaranteed minimum level of interest granted on members' accounts. The CPF's assets are for the most part invested in Special Singapore Government Securities (SSGS). In turn, the proceeds from these SSGS are pooled with the government's surplus funds and invested by the government through various agencies, the investment risk of which is borne by the government.

This paper sets out the investment risks and opportunity costs faced by the individual member of/contributor to Singapore's Central Provident Fund as well as the investment risks faced by the government in the investment of the pooled funds. A framework is outlined for evaluating the investment risks in the system, explaining conceptually how once all the various risks are priced why there might be differences in the investment returns achieved both by the individual, as well as the state (and its various agents).

THE INVESTMENT RISKS IN SINGAPORE'S RETIREMENT FINANCING SYSTEM

SECTION 1: INTRODUCTION

1.1 Pension system design and reform have come under more intense scrutiny over the past two decades as developed countries experience more rapid ageing and traditional societal and familial support systems weaken as a result of urbanisation and globalisation. At the same time, fiscal consolidation in many developed economies in the aftermath of the global financial crisis of 2008/9 coupled with already high levels of taxation are limiting the ability of governments to keep pace with anticipated rises in public pension commitments (International Monetary Fund, 2011), and there are concerns about the sustainability of these pension systems.

1.2 Singapore's retirement financing system is primarily based around a single-pillar¹, fully-funded mandatory savings scheme called the Central Provident Fund (CPF). A fully-funded, defined contribution pension scheme, each cohort of CPF contributors supports itself through savings from their labour incomes.

1.3 The central tenets of the CPF scheme are those of self-reliance and sustainability. The Economic Review Committee (2002, p.2) noted:

¹ The World Bank policy research report, *Averting the Old Age Crisis* (The World Bank, 1994) recommended pension systems perform the function of savings, redistribution and insurance, and indicated that pension systems be developed with multiple mandatory and voluntary, and publicly and privately managed pillars. This paper does not address the need in Singapore to enhance supplemental retirement savings beyond the CPF.

The CPF system is fundamentally sound. It emphasises personal responsibility for retirement. Each member's retirement benefits are self-funded from the contributions he has made over his working life. This is a more sustainable system than the pay-as-you-go pension systems prevalent in many developed countries where retirees' benefits are funded by the current working population.

1.4 Whilst sustainable within the rather narrow context of continued solvency, the risk of retirement inadequacy falls mainly on the contributor should accumulated savings and the investment returns therefrom be insufficient to cover post-retirement expenditure, a matter that has been taken up by some commentators (Hui, 2012), (Asher & Bali, 2013).

1.5 In a defined contribution pension system, the accumulated account balance at retirement age is dependent on:

- i. the total contributions paid in, which depends on contribution rates and income levels, including the application of any income ceiling
- ii. the extent of any pre-retirement withdrawals such as for housing or healthcare
- iii. the investment returns earned

1.6 This paper focuses on the third of these factors: the investment returns achieved on CPF savings, and considers the returns in the context of the risks borne by the various stakeholders. The paper focuses on the accumulation phase only and

does not consider the decumulation phase. Section 2 of this paper comprises a summary of Singapore's CPF scheme and a description of the financial and investment risk flows within the system. Section 3 evaluates the investment risks experienced by individual contributors to the CPF, and the investment risk exposure of the state and its agents. Section 4 of the report then outlines a numerical framework for evaluating the investment risk and return from the point of view of CPF members. This framework explains why there might be differences in the investment returns achieved by the individual and the state (and its various agents). The framework includes a risk-return simulation to highlight the range of possible outcomes.

1.7 The paper does not focus on the return distribution of individual CPF contributors from their withdrawals to purchase public housing or private residential properties, nor from their withdrawals from the CPF Investment Schemes. Other authors have made reference directly or indirectly to the investment return distribution faced by CPF contributors in their housing and other investments made from various withdrawal schemes, namely Low and Aw (2004), Koh et al. (2008), and Chia and Tsui (2012). The paper also does not address the other non-investment risks faced by CPF contributors with regard to their retirement adequacy, such as longevity risk (i.e., the risk of outliving one's retirement savings) and employment risk (i.e., of having breaks in employment and therefore not contributing to accumulate sufficient retirement savings during one's working life).

SECTION 2: OVERVIEW OF THE CPF SYSTEM

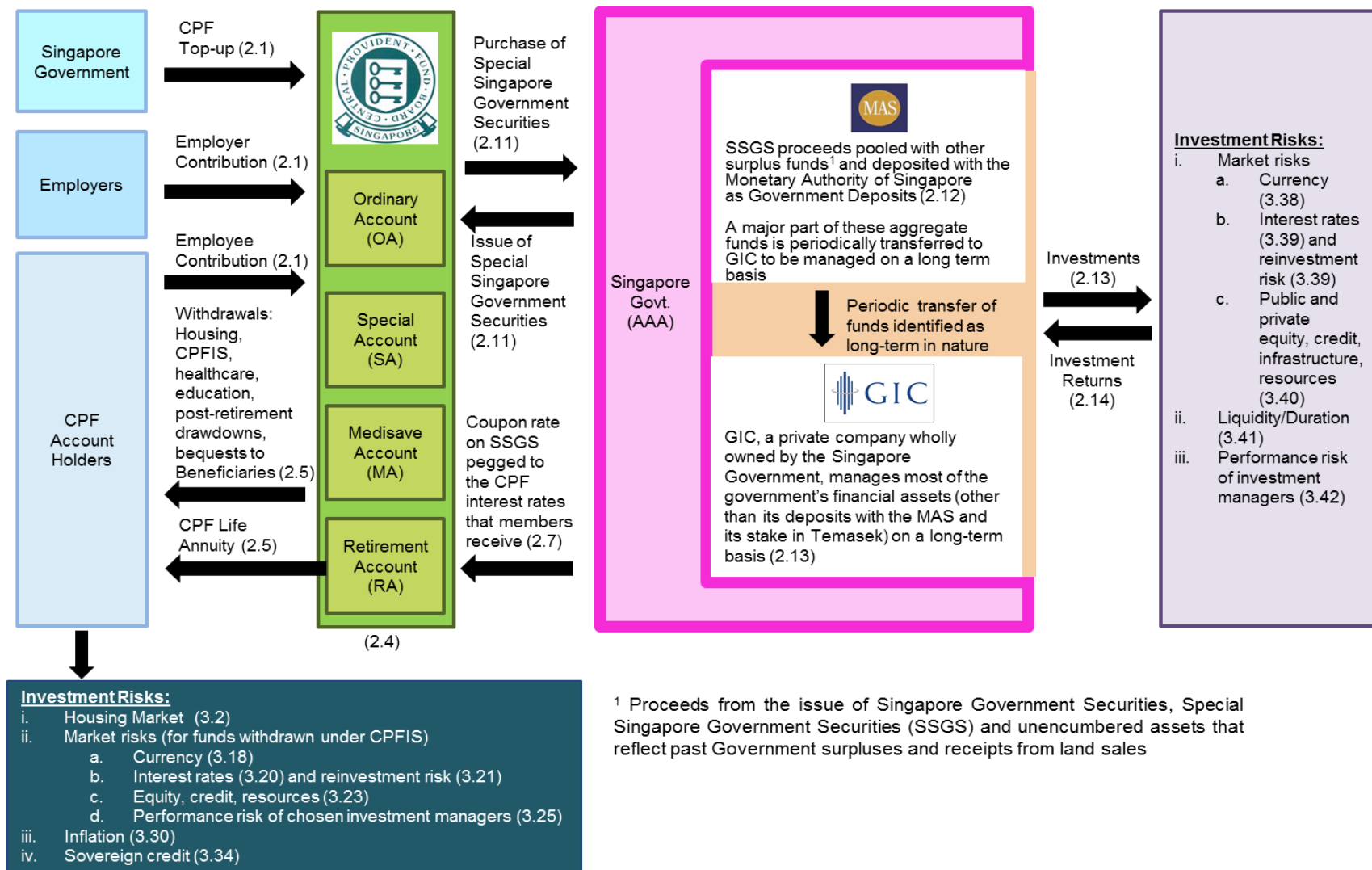
2.1 Singapore's CPF is a single-tier, fully-funded mandatory savings scheme administered by the Central Provident Fund Board, a statutory board supervised by the Ministry of Manpower. Members and their employers make contributions based on age-based percentages of gross wages up to a fixed ceiling into members' individual accounts with the CPF Board². The government (through top-up schemes) also makes periodic contributions to members' accounts. The CPF is open only to Singapore citizens and permanent residents.

2.2 There were 3.55 million CPF members as at end June 2014, with 1.9 million active members (who are those with at least one contribution paid into his or her account in the current or previous three months). Around 92% of the Singapore resident population are CPF members.

2.3 Figure 1 shows a schematic diagram of the financial and risk flows in Singapore's CPF system, outlining the main flows of funds from contributors into the system, and how the funds may be invested and withdrawn. Contributions into and withdrawals from members' accounts are shown on the left hand side of the diagram, whilst the funds flows between the CPF Board, the government and its agencies involved with investment management are set out on the right.

² Greater detail of the CPF system, including historical data on employee and employer contribution rates and the wage and additional wage ceilings may be found on the CPF Board website at www.cpf.gov.sg. In addition, Low and Aw (1997) present a comprehensive historical account of the establishment of the CPF system.

Figure 1. Financial and Risk Flows in the CPF System



Transaction Flows Between CPF Members and the CPF Board

2.4 An individual member's CPF balances are held in different accounts: the Ordinary Account (OA), the Special Account (SA), the Medisave Account (MA) and the Retirement Account (RA). The RA is automatically created when a CPF member reaches 55 years of age, when accumulated balances in the OA and the SA are transferred into the RA. As at end June 2014, CPF members' total balances amounted to \$264.8 billion, segregated in the various accounts as set out in Table 1 below.

Table 1. CPF Account Balances (\$ millions)

	2009	2010	2011	2012	2013	Jun-14
Total Members' Balance	166,804	185,888	207,546	230,158	252,969	264,768
Ordinary Account (OA)	70,594	77,940	85,085	91,862	98,336	102,052
Special Account (SA)	35,389	40,393	46,534	53,192	60,143	64,612
Medisave Account (MA)	46,238	50,671	55,329	60,024	65,576	67,504
Retirement Account and Others (RA)	14,583	16,885	20,598	25,079	28,914	30,600

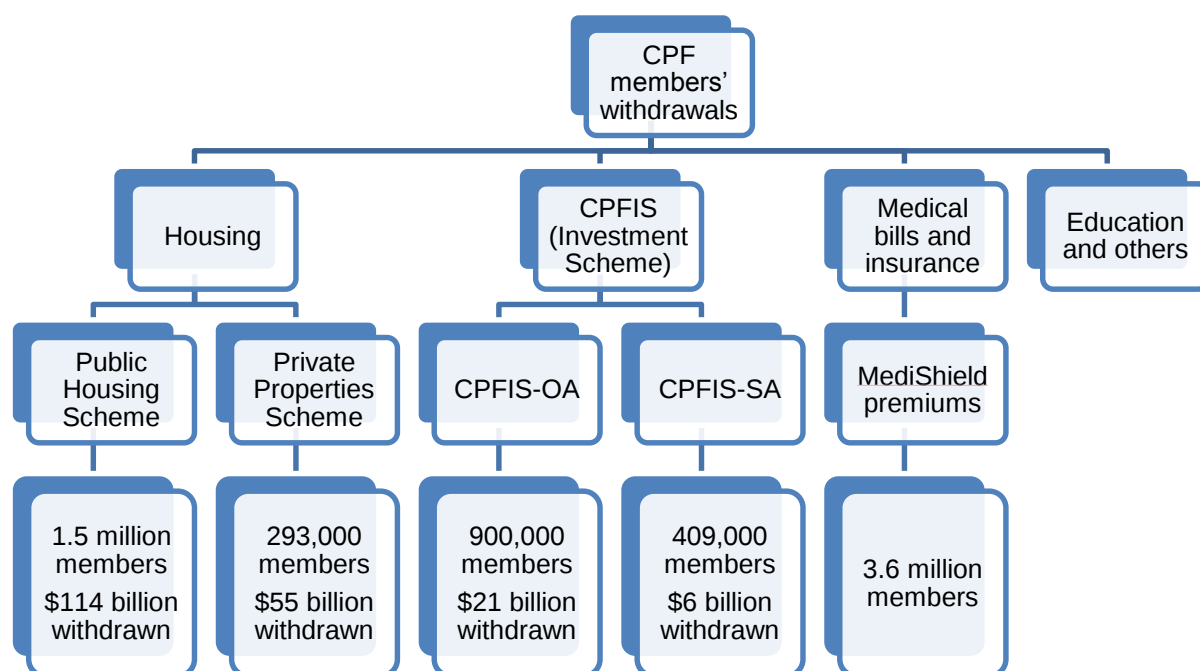
Source: CPF Statistics, from http://mycpf.cpf.gov.sg/CPF/About-Us/CPF-Stats/CPF_Stats.htm.

2.5 A member's CPF account balances may be used for various purposes. Balances in a member's OA may be withdrawn to purchase a home (or to pay a housing loan), insurance, make approved investments and to finance education. The SA is maintained for the purpose of retirement adequacy and investments in retirement-related financial products, whilst the MA is for hospitalisation expenses and the payment of approved medical insurance premiums. The RA may only be

used for retirement adequacy and the purchase of annuities under the Minimum Sum Scheme or CPF LIFE.

2.6 The various pre-retirement withdrawals schemes are set out in Figure 2. Pre-retirement withdrawals for the purchase of public or private residential properties amounted to \$169 billion as at end June 2014, whilst another \$27 billion had been withdrawn to make investments via the CPF Investment Scheme (CPFIS-OA or CPFIS-SA).

Figure 2. CPF Withdrawals: Various Schemes



Source: CPF Statistics, from http://mycpf.cpf.gov.sg/CPF/About-Us/CPF-Stats/CPF_Stats.htm.

2.7 Interest is provided on the OA, SA, MA and RA subject to a legislated minimum rate of 2.5% on all balances (Central Provident Fund Act, 1953 [revised

2013]). The CPF Act grants the Minister of Finance the authority to approve the payment of an interest rate in excess of 2.5%, with rates reviewed on a periodic basis and determined based on the formulae described in Table 2 below.

Table 2. CPF Interest Rates in the Various Accounts

	Basis	Interest rate based on the relevant formula for 1 July to 30 September 2014	Applicable interest rate for period 1 July to 30 September 2014
Ordinary Account (OA)	Average of 12-month fixed deposit rates (weighted at 80%) and the savings rates (weighted at 20%) of the major local banks, subject to a minimum of 2.5% p.a. The rate is adjusted quarterly.	0.21%	2.5%
Special Account (SA) and Medisave Account (MA)	12-month average yield of 10-year Singapore Government Securities plus 1%, or 4%, whichever is higher. The rate is adjusted quarterly.	3.42%	4.0%
Retirement Account (RA)	New savings in the RA receive the 12-month average yield of 10-year Singapore Government Securities plus 1%, or 4% (whichever is higher). The rate is adjusted annually.	3.93%	4.0% ^a

^a The RA interest rate is applicable to the period from 1 January to 31 December 2014.

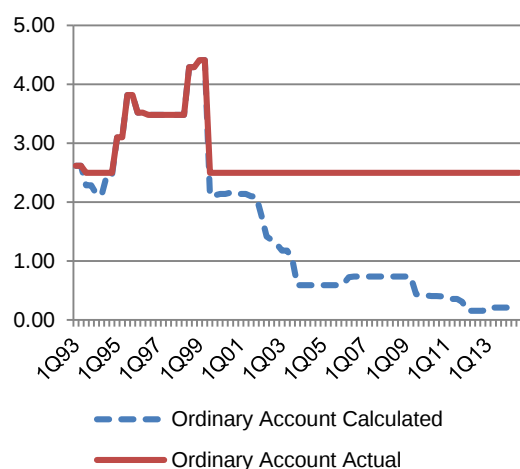
Source: CPF website at <http://mycpf.cpf.gov.sg/Members/Gen-Info/Int-Rates/Int-Rates.htm>

2.8 From 1 January 2008, an additional 1% of interest is paid on the first \$60,000 of a member's combined balances (up to \$20,000 on the OA). The additional 1% interest paid on the OA balance is credited into the member's SA or RA in order to improve retirement savings accumulation.

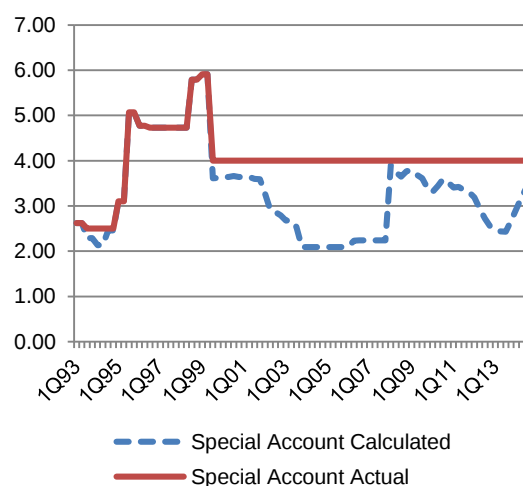
2.9 The difference between the calculated interest rates as determined on the formulae in Table 2 above and the actual rates paid into the OA and SA is shown in Figures 3 and 4 below. Since 1 July 1999, the calculated interest rate on the OA has

been below the 2.5% floor rate, with the differential between market rates and the floor rate as wide as 2.34% in 2012. With long-term Singapore government bond yields remaining at low levels for the past 15 years, the calculated interest rate on the SA has also been below the actual 4% rate declared. As an illustration, \$100 in the OA as at 1 January 1993 would have earned compound interest amounting to \$80 up to 30 June 2014 at the actual rates declared, as compared with only \$41 under the calculated interest rate (if the interest rate floor did not apply). Correspondingly, \$100 in the SA as at 1 January 1993 would have earned \$137 of compound interest up to 30 June 2014 at the actual rates declared, as compared to \$102 if the calculated interest rate had applied instead.

**Figure 3. CPF Ordinary Account
Calculated and Actual Interest Rates
(%)**



**Figure 4. CPF Special Account
Calculated and Actual Interest Rates
(%)**



Source: CPF Statistics available at <http://mycpf.cpf.gov.sg/NR/rdonlyres/5C7AAE66-A2F1-4DCD-9898-D6D1F37A8FB0/0/InterestRate.pdf>, accessed 10 October 2014

Flows Between the CPF Board, the Government and the State's Investment Management Agencies

2.10 A summary of the total contributions and net withdrawals into the CPF is set out in Table 3. Pre-retirement withdrawals under Section 15 and Section 25 of the CPF Act (upon reaching the age of 55 and for other reasons such as permanently leaving the country) in 2013 amounted to \$4.0 billion, or 27% of net withdrawals in the year. Between 2009 and June 2014, contributions in excess of withdrawals into the CPF system amounted to \$70.8 billion.

Table 3. Members' Contributions and Withdrawals (within period, \$ millions)

	2009	2010	2011	2012	2013	Jan–Jun 2014
Total Contributions	20,125	21,993	24,628	26,048	28,530	15,352
Net Withdrawals	10,719	9,617	10,437	11,727	14,863	8,483

Source: CPF Statistics, from http://mycpf.cpf.gov.sg/CPF/About-Us/CPF-Stats/CPF_Stats.htm.

2.11 Contributions into CPF members' accounts in excess of withdrawals (from Table 3 above) are placed by the CPF Board with the government through the auspices of the Monetary Authority of Singapore (MAS, Singapore's central bank) in exchange for Special Singapore Government Securities (SSGS). SSGS are non-tradable bonds issued primarily to fulfil the investment needs of the CPF (Accountant-General's Department, 2013).

2.12 In accordance with the Government Securities Act, all proceeds from the issue of the SSGS (as well as from the issue of regular Singapore Government Securities and Treasury Bills) are paid into the Government Securities Fund. These funds are pooled with the government's funds from past fiscal surpluses and the

receipts from government land sales (from the Consolidated Fund) and deposited with the MAS (Singapore Parliament, 2014).

2.13 Periodic transfers of these government deposits are made to GIC Pte Ltd (GIC), a private company wholly-owned by the Singapore Government. GIC acts as the investment manager of most of the Singapore Government's financial assets, and it is charged with the management of these funds on a long-term basis. GIC describes itself as taking "calculated risks in order to achieve long-term returns, over an investment horizon of 20 years" (GIC, 2014, p.9).

2.14 Investment returns generated on the government's funds placed with GIC and the MAS feed into the Net Investment Returns Contributions (NIRC) in the government's annual budget. NIRC comprises up to 50% of Net Investment Returns on net assets managed by GIC and MAS, and up to 50% of investment income from the remaining assets (which includes Temasek). The NIRC in FY2013 amounted to \$7.94 billion (Ministry of Finance, 2014a), or around 15% of government's budgeted total expenditure in that year.

2.15 In the next section the risks faced by CPF members relating to their retirement adequacy are summarised, as are the investment risks borne directly and indirectly by the government in the investment of its financial assets (including the pooled funds sourced through the issue of SSGS). The non-investment related risk factors of CPF members' retirement adequacy are beyond the scope of this working paper, and are not considered here.

SECTION 3(A): INVESTMENT RISKS FACED BY CPF MEMBERS IN SINGAPORE'S RETIREMENT FINANCING SYSTEM

3.1 The chief investment risks CPF members face can be broken down into two different groups: (i) risks taken by CPF members in withdrawing their CPF funds (either from the OA or SA) to make approved investments in housing or through the CPFIS, which can be likened to the opportunity cost of not keeping the funds in the OA or SA, and (ii) residual risks in the CPF system, namely, those of inflation and sovereign credit risk. We discuss each of these risk factors in turn.

Housing Market Risks

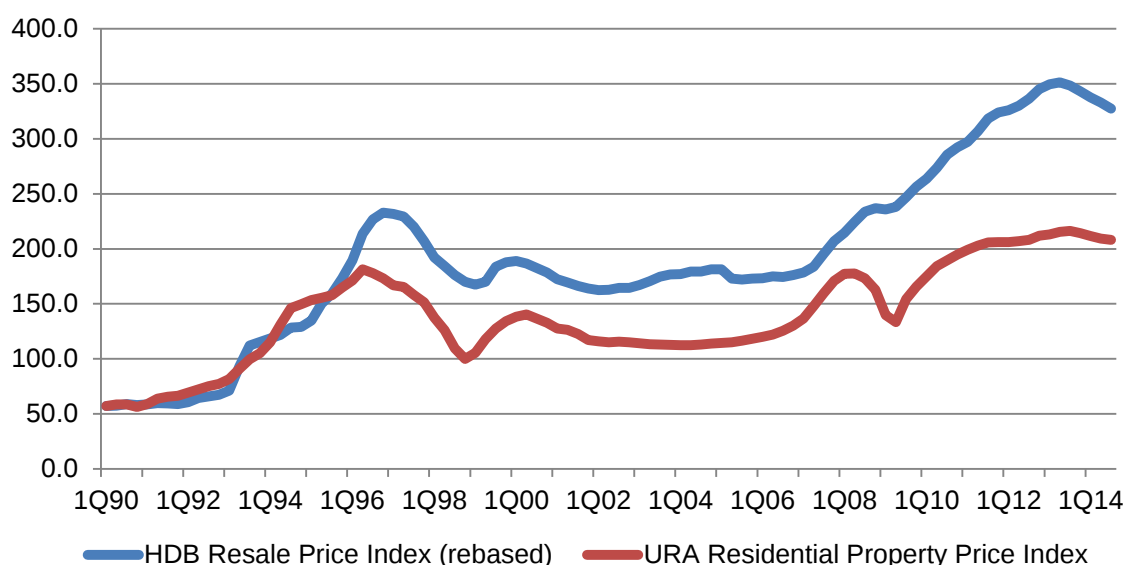
3.2 Almost 1.8 million CPF members (or around 50% of members) have made withdrawals totalling \$169 billion under the CPF's various housing schemes (Public Housing Scheme or Private Properties Scheme) to purchase either public housing apartments from the Housing Development Board, or private properties. Koh et al. (2008) calculated that 44% of CPF savings had gone towards the purchase of residential and investment properties.

3.3 To the extent that these CPF members have utilised some of their retirement savings to purchase a residential property, such funds are subject to the risk of the housing market. These risks can in turn be decomposed into the risks inherent in the residential property cycle, leverage, liquidity and concentration risks.

Property Cycle Risk

3.4 The public and private housing market cycles from 1Q 1990 can be seen in Figure 5 below. Both the HDB Resale Price Index and the URA Residential Property Price Index have been volatile (with the former series slightly more volatile than the latter) over this period, with a number of periods of negative returns as well as periods of substantial positive returns.

Figure 5. HDB Resale Price Index and URA Residential Property Price Index (1Q1990–3Q2014, HDB Resale Price Index rebased to 57.2=1Q1990)



Source: HDB and URA

3.5 The point of entry and exit into housing markets at different parts of the property cycle can have a substantial impact on returns. For example, an owner of a typical HDB apartment acquired in March 1990 in the resale market has an unrealised gain of 473% (compound annual return of 7.6%), whereas a purchaser of a similar flat in the resale market in 4Q 1999 who still owns the property as at

September 2014 would have an unrealised gain of 41% (a compound annual return of 1.9%). Although the purchaser in 4Q 1999 is in-the-money on the housing investment (i.e., the market value of the asset being higher than the purchase price), he or she would have underperformed the interest rate returns to the CPF OA over that period (2.5% p.a. over that period).³

Leverage Risk

3.6 Housing purchases are typically financed with a substantial amount of debt in addition to minimum stipulated amounts of equity, which may be sourced from a CPF member's OA. Housing loan to value ratios have been as high as 90% for first-time buyers, but range from 50% to 80% for typical new property loans.

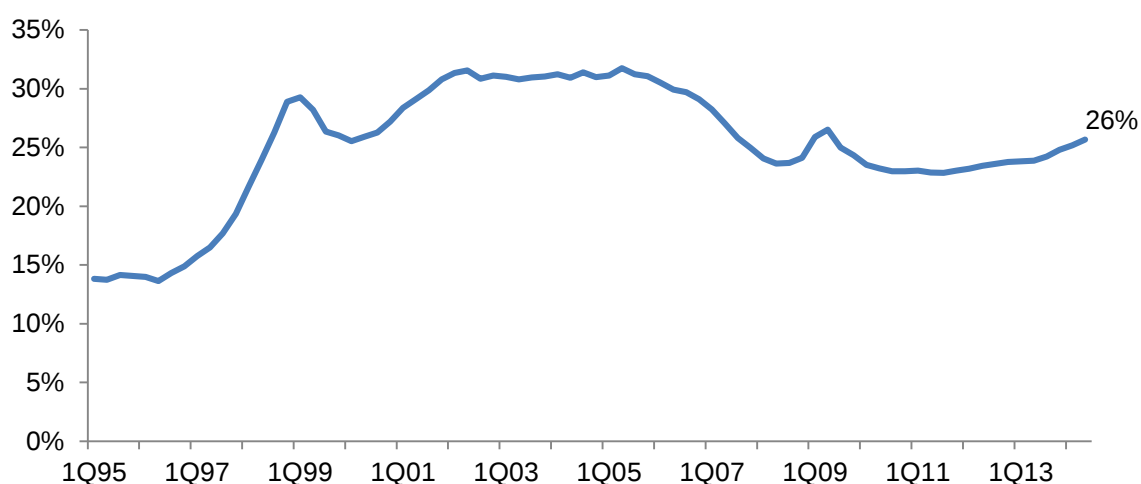
3.7 Leverage can magnify the investment returns from housing investments, but also amplify the risk. The fixed claims on the CPF member's monthly income rises correspondingly with the amount of leverage taken up on the housing purchase, with the first charge on the amounts withdrawn from the member's OA granted to the CPF Board; subsequent charges are also placed on the property by the providers of the housing loans (either bank, finance companies or the HDB).

3.8 According to statistics from the Singapore Department of Statistics, the average housing loan to valuation for Singaporean households' property is just 26% as at end 2Q 2014 (Department of Statistics, 2014). Nevertheless, as the MAS

³ In addition, if the CPF member had withdrawn amounts from the OA to part-finance the housing purchase, the amounts withdrawn plus accumulated interest would have to be returned to the member's account on the sale of the house.

Financial Stability Review 2013 notes, the low average loan-to-value on housing assets may mask specific households who may have over-extended themselves. The MAS estimates that the share of over-leveraged households in Singapore could rise to 10%–15% if mortgage rates rise by three percentage points (Monetary Authority of Singapore, 2013). The average tenure of new housing loans also reached a record 30 years in 3Q 2013.

Figure 6. Residential Property Loans as % of Housing Asset Value (1Q 1995 to 2Q 2014)



Source: Department of Statistics, 2014

Liquidity Risk

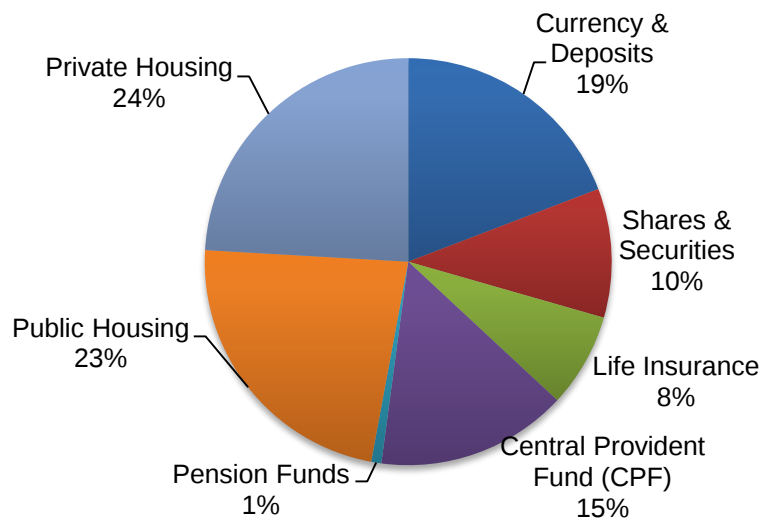
3.9 Housing investments are, like other real estate assets, typically illiquid, in that it does take time to convert the asset to cash even in normal market conditions. Such illiquidity can increase during times of market stress. The liquidity risk of such assets is the risk that the housing asset may not be sold within a desired timeframe without incurring unacceptable costs or losses. To the extent that housing assets

are generally held for the long-term, such liquidity risks may not be so relevant, particularly if the asset is being utilised (i.e., occupied). Housing monetisation options to unlock home equity for the elderly such as the HDB's Enhanced Lease Buyback Scheme can also reduce this liquidity risk.

Concentration Risk

3.10 The investment in property is generally the single largest investment the typical Singaporean household will ever make. As at 2Q 2014, Singaporean households had 47% of their total assets in public and private housing, more than three times the proportion represented by CPF balances (Figure 7).

Figure 7. Singaporean Households' Assets (2Q 2014)



Source: Department of Statistics, 2014

3.11 This average picture likely masks the concentration of housing assets of the median household, as financial assets are more likely to be held by households towards the upper end of the wealth distribution. Households at or below the median by wealth are likely to have almost 75% of their net assets represented by the home they occupy, particularly those towards the age of retirement (McCarthy, Mitchell, & Piggott, 2002).

3.12 This concentration of household wealth in a single asset may amplify the risk exposure of most Singaporean households to the other housing investment risks discussed above.

Sources of Non-Monetary Returns from Housing Investments

3.13 It might be argued that given housing investments are a more tangible asset class than financial assets, endowment effects (Kahneman, Knetsch, & Thaler, 1990) are also likely to be stronger for housing, particularly if it is occupied by its owners. It might be true that CPF members may accept a lower financial return from their housing investments financed (in part) by withdrawals from the CPF OA under the various housing schemes due to this endowment effect.

Investment Risks on Funds not Invested with the CPF or Amounts Withdrawn under the CPFIS

3.14 This section summarises the specific investment risks that may be faced by the individual CPF member on surplus funds not invested with the CPF or on those amounts withdrawn under the CPFIS. As at June 2014, CPF members had withdrawn \$27 billion from their OA and SA to make investments in approved products, ranging from investment-linked products offered by insurance companies, unit trusts and exchange traded funds, fixed deposits, bonds and T-bills, listed equities and real estate investment trusts, to gold exchange traded funds.

3.15 The opportunity cost of withdrawing funds from members' OA and SA under the CPFIS is the government-guaranteed interest rate of 2.5% and 4% respectively. Koh et al. (2008) found that the majority of CPF members choosing to make their own investment decisions on the amounts withdrawn under the CPFIS struggled to beat the CPF interest rates, with some having lost money. The same authors in a later paper (Koh, Mitchell, & Fong, 2010) also found that whilst CPFIS-approved unit

trusts did provide substantial diversification benefits (especially to smaller investors) and also provided returns that were on average higher than risk-free rates and the CPF interest rates, only a minority of these funds outperformed their style-specific benchmarks (a function of investment decision-making and investment management costs and fees).

3.16 The investment risks (such as market and reinvestment risks) that are faced by the individual on their surplus funds are except as discussed here little different to those faced by the government (and its investment management agencies) and are explored in more detail in this section of this report.

Market Risks

3.17 Market risk is the risk that returns and the value of investments vary. This is composed of different kinds of specific market risks, which we discuss below.

Currency risk

3.18 Assuming the typical retiree does not emigrate from Singapore post-retirement, a CPF member's post-retirement expenditure will be most likely be denominated in Singapore dollars. Investing in non-Singaporean assets and receiving investment returns and principal in foreign currencies will expose CPF members to currency risk — the risk that foreign currency denominated investment returns and principal repayments are lower than anticipated once converted into Singapore dollars.

3.19 This is especially relevant in the context of Singapore's monetary policy (conducted by the MAS) that has seen the Singapore dollar nominal effective exchange rate (S\$NEER) rise over 20% from 1Q 2004 to 2013 (Ong, 2013).

Interest rate risk

3.20 Interest rate risk is the risk that arises when interest rates (i.e., the price of money) fluctuate. The value of fixed interest rate securities (government and most corporate bonds, and T-bills) will depend on the prevailing interest rate, with the sensitivity of the fixed interest security to interest rate movements dependent on the security's time to maturity (duration) and its coupon rate.

3.21 Related to interest rate risk is the reinvestment risk that comes about during periods of interest rate declines, where interest and principal repayments are not capable of being reinvested at the same interest rate as the maturing security, thereby lowering the future return.

3.22 CPF members take on interest rate risk when they invest in government, statutory board and corporate bonds, and T-bills, that pay a fixed coupon, or purchase investment-linked products or unit trusts that in turn invest in such fixed income securities.

Other market risks

3.23 Other market risks are specific to the particular investment or security. For example the credit standing of a corporate bond issuer may change dependent on its financial health, whilst the market value of equities may rise or fall depending on the expected future trajectory of profitability and dividends.

3.24 CPF members are exposed to these other market risks if they invest directly into assets whose returns and market value may vary. Under the CPFIS, CPF members can invest in a range of assets that are exposed to these specific market risks, including credit, equities, real estate, infrastructure and commodities (including gold).

Performance Risk of the Chosen Investment Managers

3.25 There are currently 10 insurance companies, three investment administrators and 30 fund management companies that are approved under the CPFIS to provide investment management products and services. As Koh, Mitchell and Fong (2010) showed, only a minority of CPFIS-approved unit trusts were able to outperform their style-specific benchmarks over time, and it can be difficult for many investors to choose the best investment manager or administrator by themselves.

Costs, Fees and Commissions

3.26 Whilst investment management and marketing costs are subject to a ceiling for CPFIS-approved investments, this is not necessarily the case for funds that are not CPFIS-approved. Sales charges for typical retail funds are as high as 5%.

3.27 In contrast, the returns to a CPF member's OA, and SA, MA and RA (collectively referred to as SMRA) are net of investment management fees and costs. The CPF Board's administration expenses are charged to the CPF when incurred.

Liquidity Risk

3.28 As noted earlier, liquidity risk is the risk that an investment may not be sold within an acceptable time frame without incurring unacceptable costs and losses. CPF members are exposed to this risk for investments that are not immediately convertible into cash. For example, early redemption of certain CPFIS-approved investment linked products may result in surrender charges being levied, and the cash value realised may be lower than the premiums paid.

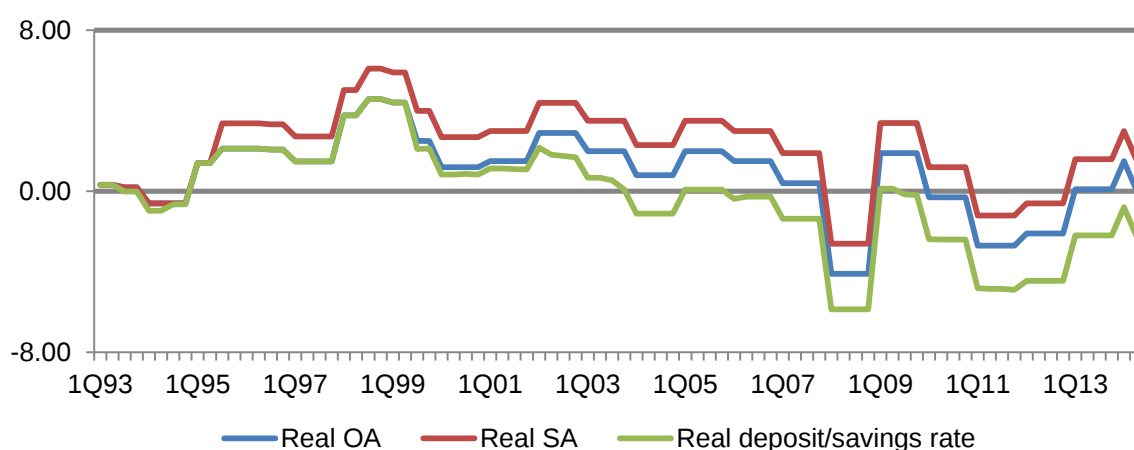
3.29 An individual's liquidity needs can be affected by unexpected events such as temporary or permanent disability or the decease of a spouse or family member. Given this uncertainty, the liquidity risk tolerance of individual portfolios will tend to be lower than if this risk were to be pooled (see paragraphs 4.48 and 4.49 for a discussion of this issue within our framework).

Residual Risk of Inflation

3.30 The benefits that CPF members may receive are not inflation protected, and members therefore bear the risk of higher than anticipated rises in the cost of living. In order to keep pace with pre- and post-retirement inflation, savings accumulation would need to be greater than if inflation were to be very low or zero. One of the ways in which savings accumulation could account for inflation is if investment returns on CPF retirement savings are defined in real terms, i.e., excluding the wealth-eroding effects of inflation. The investment return in the CPF OA and SMRA is currently a nominal return, the real value of which is lowered by the rate of inflation.

3.31 Since 1993, CPF OA and SMRA interest rates have been in excess of the rate of inflation with the exception of three periods (in 1994, 2008, and 2011–12) that coincided with significant increases in the inflation rate.

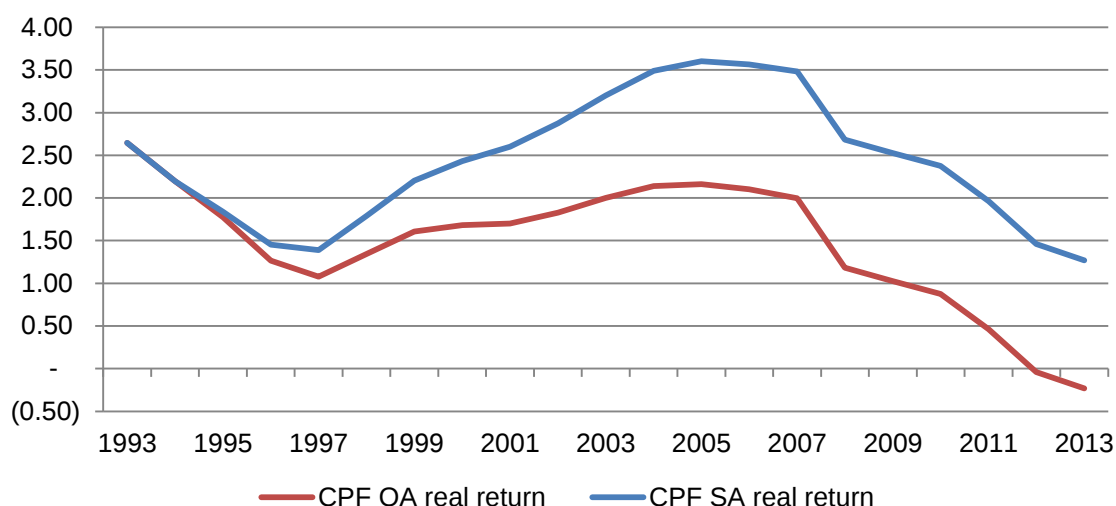
Figure 8. OA, SA and Bank Deposit/Savings: Annual Real Rates of Return (%)



Source: Authors' calculations based on CPF interest rate data as per Figures 2 and 3 and CPI from Department of Statistics.

3.32 It is perhaps inappropriate to compare CPF OA and SA returns with shorter-term measures of inflation, given the long-term investment orientation of the CPF system and of retirement savings in general. Figure 9 below shows rolling 10-year real returns from the CPF OA and SA, adjusting for inflation over the preceding 10-year period. This shows that CPF OA and SA real returns have been positive from 1989, although the 10-year OA real interest rate declined into negative territory in 2013.

Figure 9. CPF OA and SA 10-Year Real Returns 1993–2Q2014 (%)



Source: Authors' calculations based on CPF interest rate data as per Figures 2 and 3 and CPI from Department of Statistics.

3.33 The impact of pre-retirement inflation on a member's savings accumulation can be significant. As an illustration using the CPF Board's Retirement Estimator⁴, a 55 year-old who earns \$42,900 p.a. expecting to retire at 62 and live until 82 years of age would need a retirement fund 17% greater at a 3% p.a. inflation rate as

⁴ Accessible at CPF website at <http://mycpf.cpf.gov.sg/Members/Calculators/mbr-Calculators.htm>

compared to 2% p.a. (assuming a nominal investment return of 4%, see Appendix 1).

Residual Sovereign Credit Risk

3.34 Sovereign credit risk is traditionally defined as the risk that a sovereign state defaults on its liabilities by failing to meet its financial commitments such as interest payments and repayment of principal on a timely basis (International Monetary Fund, 2010). As stated in Section 2, the SSGS issued to the CPF Board are liabilities of the Singapore Government, and the interest and principal payments on the SSGS represent its financial commitments to the CPF Board.

3.35 Singapore is one of only nine sovereign nations with the highest credit rating from all three major credit rating agencies (Standard & Poor's, Moody's and Fitch). In June 2014, Moody's re-affirmed its Aaa credit rating for Singapore, assessing the country's fiscal strength as "very high (+)" and noting that whilst credit pressures exist and old-age and healthcare-related expenditures are on the rise, "Singapore's fully funded compulsory pension system and the absence of a comprehensive government-funded social welfare system mitigate future liabilities" (Moody's Investors Service, 2014).

3.36 In giving Singapore the highest possible credit rating, the rating agencies are likely to have taken into consideration the Singapore government's total economic

capital, including the government's unencumbered financial assets⁵ that are pooled with the funds contributed by CPF members (see earlier paragraph 2.12). These unencumbered assets represent a buffer that acts in a similar way to the core capital base of a private financial institution such as an insurance company or a bank. In addition, the government's other non-financial assets (in particular, its ability to levy taxes) would also be taken into consideration in the assessment of the government's credit standing.

SECTION 3(B): INVESTMENT RISKS BORNE BY THE GOVERNMENT AND ITS INVESTMENT MANAGEMENT AGENCIES

3.37 The investment risks faced by the government (and its investment management agencies) are not significantly different to that of an individual investing surplus funds. Nevertheless, in some aspects there are subtle but important differences that are highlighted in this section.

Currency Risk

3.38 The government is exposed to a currency mismatch insofar as its liabilities to the CPF Board in the form of SSGS are denominated in Singapore dollars, whilst the government's funds that are transferred to GIC and MAS are invested primarily abroad and are thus denominated in foreign currencies.

⁵ As at end FY2012, the Government's Consolidated Fund amounted to \$226.8 billion (Ministry of Finance, 2014b).

Global Interest Rate Risk

3.39 The government's funds deployed in overseas asset markets are exposed to global interest rate fluctuations. Whilst individual Singaporean households' and CPF members' interest rate exposure would be more related to domestic interest rates (over which the MAS' monetary policy has some influence [Ong, 2013]), the government's primary interest rate risk would be affected by the price of money set by global economic conditions and the monetary policies of the largest economies in the world.

Other Market Risks

3.40 GIC's Investment Framework (implemented with effect from 1 April 2013) identifies six core asset classes that represent specific market risks: developed market equities, emerging market equities, nominal bonds and cash, inflation-linked bonds, real estate and private equity. Whilst all of these asset classes and market risks are available to investors with sufficiently sized surplus funds, inflation-linked bonds and private equity are not available to available for direct investment through the CPFIS.

Liquidity Risk

3.41 The long-term mandate of the government's investment funds allows it to tolerate high levels of liquidity risk (or to put it another way, to participate in any

illiquidity risk premium) by investing in illiquid asset classes such as real estate or private equity.

Performance Risk of the State's Investment Management Agencies

3.42 The government has appointed GIC as the investment manager of its funds, and is subject to the risk of this agent not performing its investment management functions according to the mandates.

3.43 All of these risks combine to represent the risk that the government is unable to generate returns sufficient to meet the cost of its own liabilities (including on the SSGS owed to the CPF Board). Whilst government risk is not quantified explicitly in Section 4 of this paper, the risks of ultimately utilising a market portfolio of assets to meet a fixed return is similar to the issues faced by a CPF member when considering opting out of the fixed CPF return to take more market risk on his portfolio (see paragraphs 4.44 and 4.45). Section 4 focuses on quantifying the risk from a member's perspective.

SECTION 4: QUANTITATIVE FRAMEWORK FOR EVALUATING THE INVESTMENT RISKS TO CPF MEMBERS

4.1 In this section we look to address any concerns CPF members may have in terms of the attractiveness of returns on their CPF accounts. We understand that in an environment where returns from equity markets have been strong, CPF members may view their existing arrangements differently as compared to the extended period

when interest rates were very low (as they still are) and equity returns were also low or negative. We set out to produce analysis to assist CPF members and others understand the balance between risk and return that is involved in the current CPF arrangements. For the CPF member to have exposure to the potential upside from equities means there needs to be a compromise in terms of risk or cost. Consistent with the points raised before, this analysis only considers pre-retirement asset accumulation.

4.2 To provide this perspective we have carried out analyses to answer the following questions:

1. What is the *value* of the benefits that are provided to CPF members by the Government?
2. How do the risk and return characteristics offered by the Government compare to the characteristics of other investment portfolios available to CPF members via the CPFIS?
3. What alternative perspectives can financial theory provide that might help members target the risk and returns they want to be exposed to, or at least provide further perspective on the trade-offs?

4.3 Answering these questions will help CPF members understand the existing arrangements and therefore make more informed assessments as to whether the benefits offered are attractive, or not, and whether there is an appropriate alternative strategy to satisfy their desire for higher returns than is currently offered and the potential compromises of these alternative strategies.

4.4 For the purposes of this paper, we have defined “value to CPF members” as the additional return, both in percentage and monetary terms, that CPF members are provided by the Government in excess of a market risk-free rate over the long term, i.e., if the market offers a risk-free rate of 3% p.a. and the Government offers a return on accounts of 4% p.a., then the “value” becomes 1% p.a. In monetary terms, for \$100 of benefits held today, the “value” is equivalent to an additional \$22 in 20 years’ time. We have used this definition as it provides a way of considering the benefit being added to CPF members without any compromise, in terms of additional cost or additional risk being taken.

4.5 Readers should note that the concept of value is a complex one, with comparisons between one fixed rate and another (the market risk-free rate and the rate the Government pays CPF members) in stark contrast with the “average” differences we derive later from distributions of investment market outcomes.

4.6 In order to assess the value of the benefits, and the risk return characteristics of different portfolios, we have had to make some assumptions. These assumptions are based on Towers Watson’s (TW) central assumptions regarding key economic and market parameters such as inflation, GDP, interest rates and equity markets. Some key features of these assumptions include:

- Singapore cash rates to increase from current levels to 4% p.a. over 10 years.

The view that cash rates will increase is consistent with the implied view of the

market via the expected yield on long dated bonds. Over the long term, investors will seek a positive return in excess of inflation from holding cash as an incentive to save. TW's view is that this premium is in the order of 1.5% p.a.

- In TW's central economic and market scenario, Singapore government bond yields are expected to increase to 5.3% p.a., from current levels, over 10 years, i.e., a premium in the order of 1.3% p.a. over cash rates which is consistent with historical relationships, finance theory and Towers Watson's forward-looking expectations. This leads to low or negative expected returns from investing in bond markets in the next few years, but higher subsequent returns as interest rates are higher.
- Global equities are expected to achieve returns in excess of Singapore inflation of 5.0% p.a. over the long term, reflecting the higher risk and return characteristics of equity investments.
- Singapore and global inflation is expected to remain modest (around 2.5% p.a.), resulting in positive real (after inflation) returns for investors.

4.7 Clearly, there are any number of plausible forward-looking scenarios for the key market and economic variables that affect both the return to CPF members and the balance of risk and return, so we do not mean to imply that a single scenario can fully describe these outcomes. To that end, we provide commentary on the sensitivity of the outcomes to these assumptions in Appendix 2 of this paper.

What is the value of the benefits that are provided to CPF members by the Government?

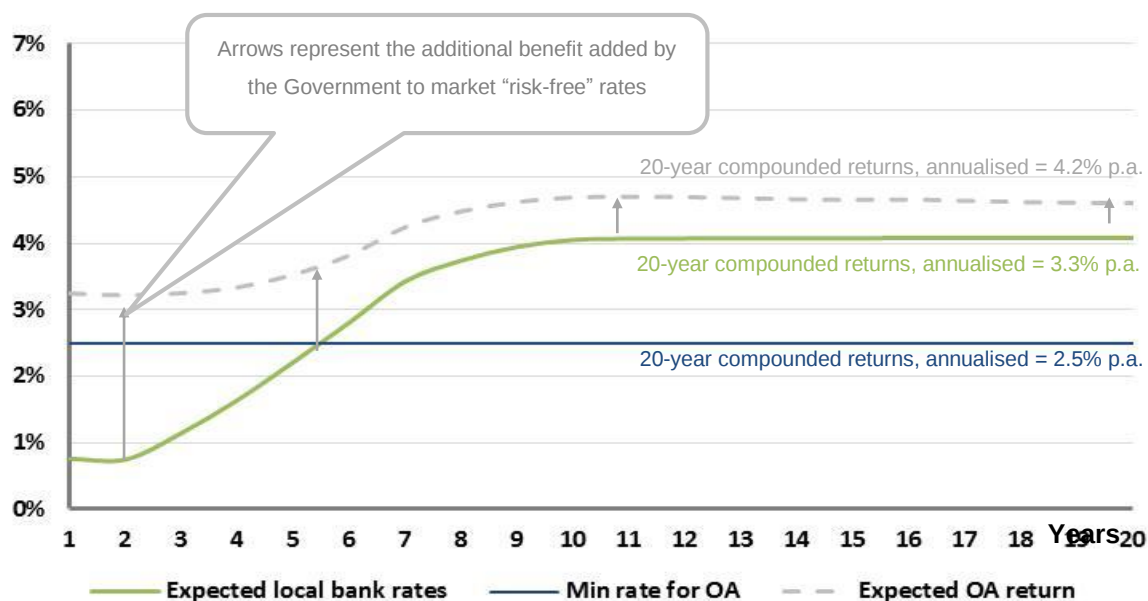
4.8 To assess the value to CPF members over time from the current arrangements, we first consider the OA and SMRA separately as the benefits are different.

4.9 For both accounts we consider (a) the expected return from market rates alone (which is local bank savings rates for OA and 10-year government bond yields for SMRA) and then (b) the expected return with additional benefits provided by the Government (i.e., minimum rate increases, with an additional 1% on the first layer of account balances and 1% additional uplift to the government yield for SMRA). We can then assess the value by comparing the difference between the two expected returns (i.e., $[b] - [a]$).

What is the expected value added to OA funds from the Government?

4.10 As detailed in paragraph 2.7, OA receive returns based on local bank savings rates, subject to a minimum of 2.5% p.a. (with an additional 1% p.a. on the first \$20,000). Figure 10 below shows the expected change in local bank rates (i.e., the market rate applied to OA) over time (green line), based on TW's central assumptions, compared to the minimum rate of 2.5% p.a.

Figure 10. Return Profile of Local Bank Rates and CPF OA Minimum Interest Rates



4.11 The average expected market rate (green line) over the 20-year projection period is 3.3% p.a., which is above the floor, implying that CPF account holders will receive a market rate. However, we can see that the market rate is expected to be below the minimum rates for the next five years, i.e., the expected return on OA will be higher than market rates over that period, implying that the government is paying a rate in excess of that available in the market. In addition, the government awards an additional 1% p.a. to the first \$20,000 in the account.

4.12 To quantify the impact of the benefits provided by the government (minimum rates being applied and the additional 1% p.a.), we estimate that the expected return on the OA (grey dashed line) is 4.2% p.a. over the next 20 years, compared to the expected return on local bank savings rates (3.3% p.a.), i.e., *the expected value added to OA is 0.9% p.a., due to the awards from the government.*

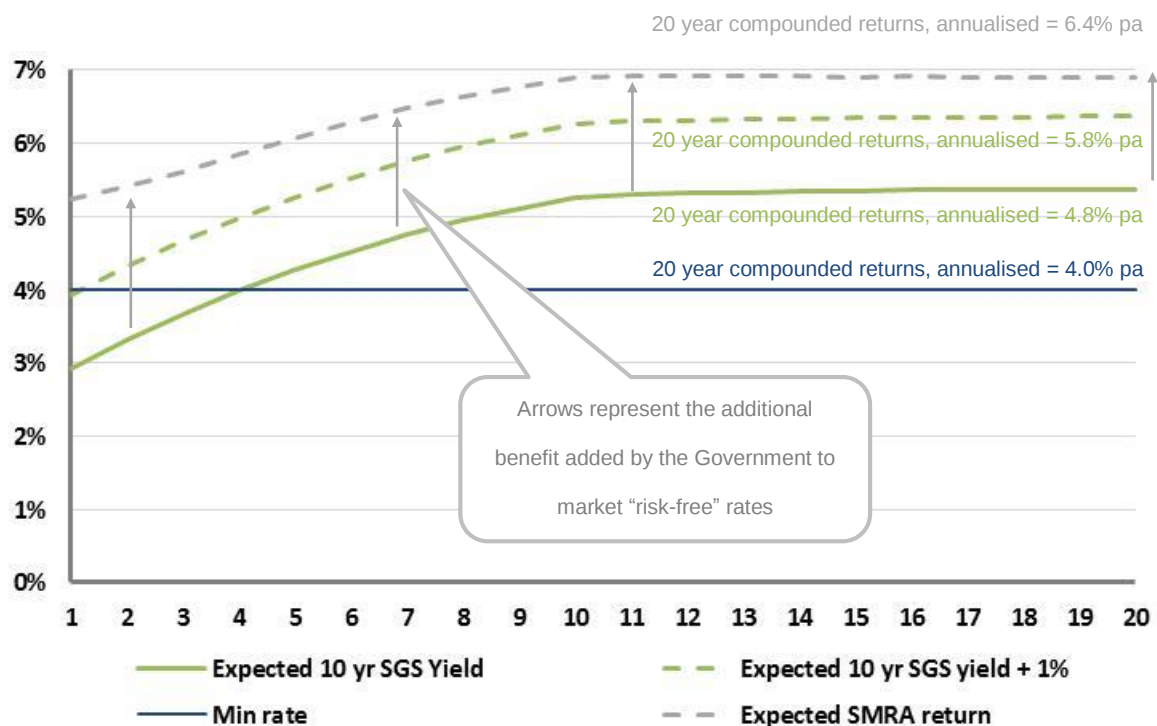
4.13 In monetary terms, if \$100 was invested in local bank savings accounts today, the value in 20 years' time is expected to be \$191. This compares to an expected value of \$228 in the OA (a 19% difference).

What is the expected value added to SMRA funds from the Government?

4.14 Similar to the analysis above, we can consider the expected benefit to SMRA from the government providing above market interest rates. As detailed in paragraph 2.7, SMRA receive returns based on the yield on a 10-year Singapore Government bond with an additional 1% p.a., subject to a minimum of 4% p.a. (with an additional 1% p.a. on the first \$40,000).

4.15 Figure 11 below shows the expected change in 10-year Singapore Government bond yields (with and without the additional 1% p.a. applied) over time (the green lines) compared to the minimum rates applied to the SMRA, again based on TW's central assumptions.

Figure 11. Return Profile of Government Bond Yields and CPF SMRA Interest Rates



4.16 The expected government yield (average of the green solid line) over the 20-year projection period is 4.8% p.a., based on TW's assumptions. With the Singapore Government providing an additional 1% to this yield each year, the expected return before minimum rates are applied is 5.8% p.a. (average of the green dashed line).

4.17 The chart shows that the yields plus 1% are above the 4% minimum rate. Therefore the minimum rates have minimal impact on the expected return for SMRA under these assumptions.

4.18 The SMRA do, however, benefit from the additional 1% p.a. return awarded on the first \$40,000 held in the account. This benefit increases the expected SMRA

returns (average of the grey dashed line) by 0.6% p.a. to 6.4% p.a. based on aggregate funds held in SMRA in 2013. Therefore, the *expected value to SMRA, due to benefits provided by the Government, is 1.6% p.a.* relative to just the expected government bond yield (4.8% pa).

4.19 In monetary terms, if \$100 was invested today in 10-year Singapore Government bonds alone, the value in 20 years' time is expected to be equivalent to \$255. This compares to an expected value of \$346 in the SMRA (a 37% difference).

What is the combined value added to CPF accounts from the Government?

4.20 We have seen that the expected value added to OA and SMRA is 0.9% p.a. (paragraph 4.12) and 1.6% p.a. (paragraph 4.18), respectively. Based on the account sizes in 2013, the combined expected value added by the Government to CPF members is 1.4% p.a. The expected return from the fixed rate benefit offered by the Government is 5.7% p.a. over 20 years. This compares to the average expected return of 4.3% p.a. if only expected market risk-free rates were applied to the different accounts.

4.21 In monetary terms, the expected value of \$100 in 20 years' time under the fixed rate arrangements would be \$303. This compares to \$232 if the Government did not award any benefits in excess of market "risk-free" rates, i.e., *an additional \$71 in 20 years' time for every \$100 held by CPF members today.*

How is the value attributed to the different benefits offered by the Government?

4.22 In Table 4 we attribute the 1.4% p.a. (and the \$71 per \$100 held today) of value added from the three different benefits added by the Government:

Table 4. Value Added from the Three Benefits offered by the Government to CPF Members in 20 Years' Time

Benefit	Value added (% pa)	Value added (\$ per \$100 held today)
1% added to first \$60,000 held in the combined accounts	0.6%	31
Minimum rates applied	0.3%	15
1% added to market rate for SMRA	0.5%	25
Total	1.4%	\$71

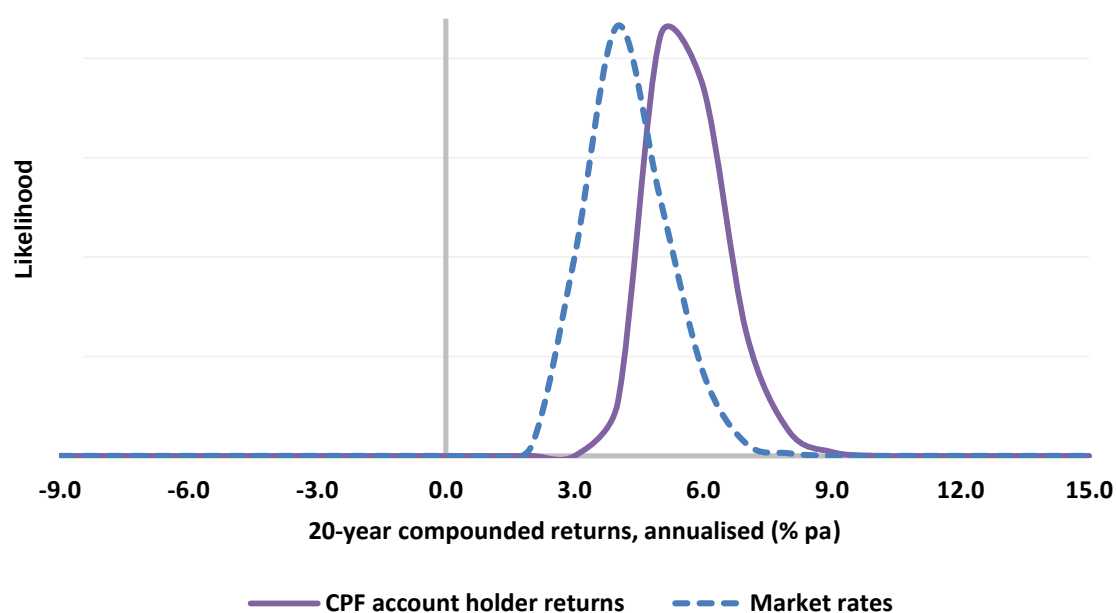
4.23 We can see that almost half of the value added to CPF members is in respect of the 1% added to the first \$60,000 held in the accounts.

4.24 We note that the value of the minimum rates is dependent on where rates are at the start and where they are expected to be over time. At present rates are below the minimum rate for OA and above for SMRA. For both OA and SMRA, rates are expected to be above the minimum level in the next few years, therefore the value of this benefit is not very material under these assumptions. In Appendix 2 we provide sensitivity of the value to CPF members if cash rates and bond yields increase by more or less than those assumed in the central scenario.

What are the risks under the current fixed rate arrangements?

4.25 The analysis considered so far has focused on the expected return on the CPF funds under the current arrangements. The expected return is not certain as market rates (local saving rates or government yields) will vary over time. Using TW's assumptions for the potential variability of these market rates, we can consider the potential range of different returns to CPF members. To illustrate this variability of the combined returns to CPF members, Figure 12 shows the full distribution of 20-year annualised returns (purple line), based on 5,000 different economic scenarios. This considers the variability (or risk) relative to the central CPF returns considered earlier. At the extreme, the average government bond yield over a 20-year period could range from 2.4% p.a. to 9.6% p.a. The distributions below allow for the impact this variability has on the returns and the likelihood of different outcomes occurring.

Figure 12. Distribution of 20-Year Annualised Returns (% p.a.) to CPF Members

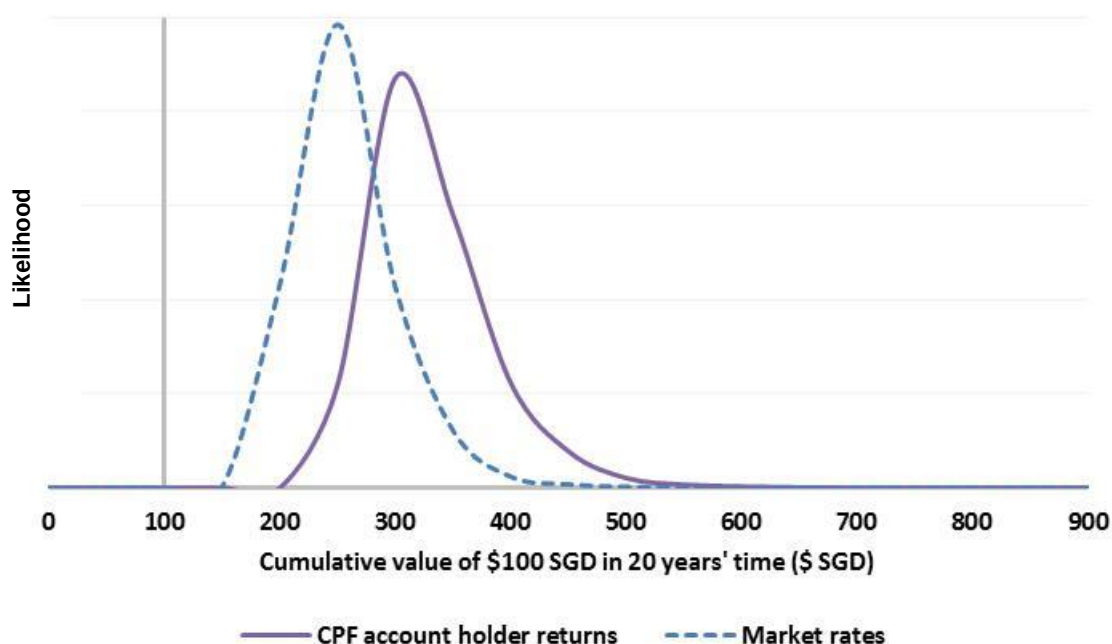


4.26 For comparison, we also show the distribution assuming that only expected market rates (blue dashed line) were applied to CPF accounts (i.e., local savings rates for OA and 10-year government yields for SMRA), to highlight the value of the additional benefits provided by the government to CPF members.

4.27 The peaks of the distributions show the most likely outcomes. These are close to the respective expected returns; 4.3% p.a. for market rates and 5.7% p.a. for CPF members. Figure 10 also highlights that the distributions are narrow, i.e., there is not much volatility in the returns. The distributions are very similar in shape as the value added by the Government is guaranteed so there is not additional investment risk taken on by CPF members. The risk to CPF members under the current arrangements is that the Government does not pay the benefits promised, i.e., sovereign risk. We have not made any allowance for this risk in our analysis, but suffice to say it is minimal in view of the Government's credit rating (see paragraph 3.35).

4.28 Figure 13 below highlights the distribution of outcomes in monetary terms after 20 years based on \$100 invested today. This shows that whilst the spread of annual returns is quite narrow, the impact of these returns can be very material when compounded over 20 years.

Figure 13. Distribution of Cumulative Returns in 20 Years' Time for Every \$100 Held by CPF Members



4.29 Summing up the above, we have provided a perspective on the value that is expected to be added to CPF accounts (1.4% p.a. or \$71 per \$100 held today), where the value is expected to come from and the expected distribution of CPF returns under the current fixed rate arrangements. With this information we can now look to address any potential concerns of CPF members that their benefits are unfavourable. One possible cause of concern could be that CPF members do not benefit from strong rises in equity markets, given that there is no link to equity markets in the formulae used to calculate CPF returns to members. Having said that, the Government is adding extra returns to market rates, so that by itself does compensate to some extent. To develop a sense of magnitude for the differences we develop comparisons to a range of alternative portfolios available to CPF members via CPFIS.

How do the risk and return characteristics offered by the fixed rate benefit compare to the characteristics of other investment portfolios available to CPF members via the CPFIS?

4.30 To help compare the risk and return characteristics of the existing arrangements, we consider a series of alternative investment portfolios with varying levels of investment risk. CPF members have the flexibility to do this via the CPFIS. We therefore consider the following example portfolios:

- 100% Singapore government bonds
- 100% Global government bonds
- Balanced portfolio (60% global equity / 40% global bonds)
- 100% Global equities

4.31 Table 5 provides the key statistics of the different portfolios.

Table 5. 20-Year Expected Returns and Standard Deviation of CPF and Possible CPFIS Portfolios
(Arrows and colours are changes relative to CPF members' aggregate balances)

% terms	CPF account holder	Singapore government bonds	Global bonds ^d	Balanced portfolio ^d	Global equities ^d
Expected return	5.7%	3.7% ↓	3.4% ↓	5.9% ↑	6.8% ↑
Standard deviation (annual / annualised) ^a	1.4% / 0.7%	5.3% / 0.8% ↑	4.2% / 0.8% ↑	12.3% / 2.5% ↑	20.0% / 4.1% ↑
5 th percentile return ^b	4.5%	2.6% ↓	2.2% ↓	1.7% ↓	0.1% ↓
95 th percentile return ^c	7.2%	5.0% ↓	4.7% ↓	10.1% ↑	13.7% ↑

Value of \$100 held today in 20 years' time	CPF account holder	Singapore government bonds	Global bonds ^d	Balanced portfolio ^d	Global equities ^d
Expected value	\$303	\$207 ↓	\$195 ↓	\$315 ↑	\$373 ↑
5 th percentile value ^b	\$241	\$167 ↓	\$154 ↓	\$140 ↓	\$102 ↓
95 th percentile return ^c	\$402	\$265 ↓	\$251 ↓	\$685 ↑	\$1,300 ↑

^a Standard deviation of returns in one year (annual) and 20 years compounded returns (annualised)

^b 5% of outcomes will be this level or below after 20 years.

^c 5% of outcomes will be this level or above after 20 years.

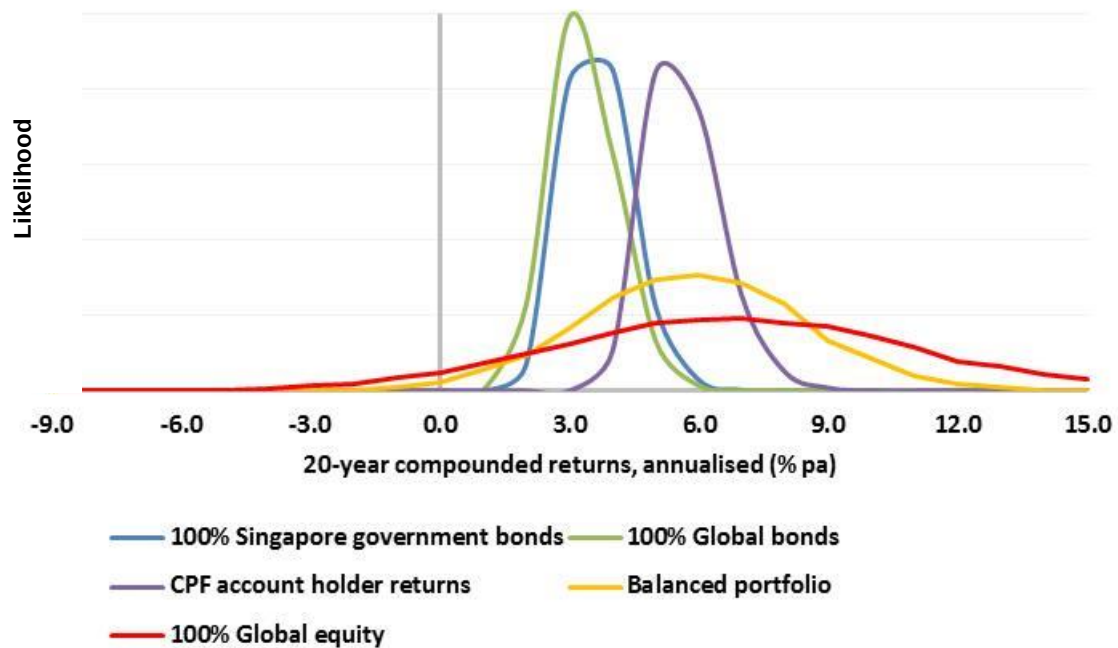
^d Global bonds and equities returns are in SGD terms and we have assumed bonds are hedged against currency changes, whereas equities are not.

4.32 Based on TW's assumptions, *there is very limited benefit to the CPF member from investing the funds in a portfolio of Singapore Government or Global bonds as the expected return is lower and the risk (standard deviation) is significantly higher than is currently offered to CPF members via the current fixed rate arrangements.* In Figure 12, we can see that the bond distributions (green and blue lines) are both to

the left of the CPF return distribution, which indicates that returns are likely to be lower (peak of distributions) and there is potential for much lower returns (left-side tail of the distribution). These portfolios do not benefit from the minimum rate increases, which are applied to OA and SMRA.

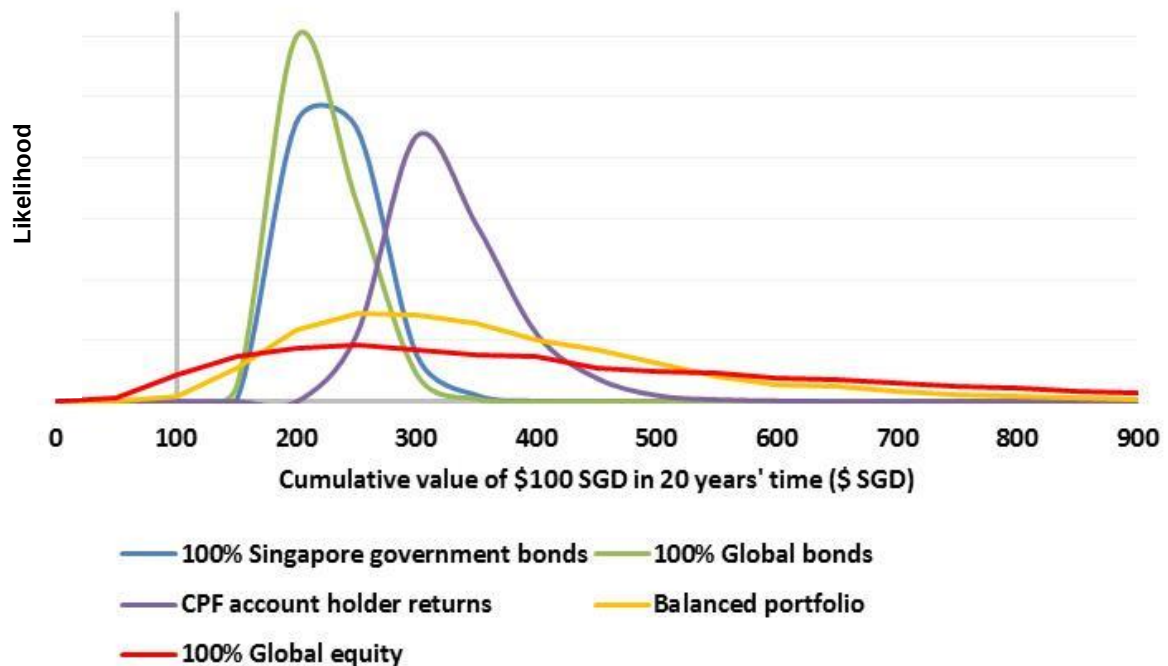
4.33 To achieve a similar level of expected return as the current CPF arrangements, the CPF member would need to hold around 60% in global equities. Increasing the allocation to global equities beyond 60% would further increase the potential return benefit, with a portfolio of 100% global equities being expected to outperform the current arrangements by 1.1% p.a. In addition, holding a portfolio with equities also provides the CPF member with the opportunity to generate very large returns compared to the current arrangements if equities perform better than expected. This is shown by the right-hand side of the distributions in Figure 14 (yellow and red lines). These potential upside outcomes need to be considered relative to the increased exposure to the potential downside outcomes from holding equities (the left-hand side of the distributions in Figure 14). The current arrangements have minimal downside risk with only 5% of scenarios expected to return less than 4.5% p.a., whereas there is a 5% chance that returns could be lower than 1.7% p.a. or 0.1% p.a. over 20 years, based on the balanced portfolio and 100% global equity portfolio, respectively.

Figure 14. 20-Year Compounded Returns, Annualised (% p.a.)



4.34 Whilst the current arrangements do not provide returns linked to equity performance, the expected return of the current arrangements is broadly equivalent to a 60% global equity portfolio but without the downside risk associated with that portfolio.

Figure 15. Distribution of Cumulative Returns in 20 Years' Time for Every \$100 Held by CPF Members



4.35 Figure 15 illustrates the potential upside in monetary terms from holding global equities due to the compounding of returns over a long time horizon which creates a skew in the outcomes. This is best considered in an example: if you start with \$100 and have two years of -50% returns your money has reduced from \$100 to \$25 (a \$75 loss), whereas if you have two years of +50% your money has increased from \$100 to \$225 (a \$125 gain), i.e., the monetary gain is larger than the monetary loss which creates the skew in the outcomes. Whilst this is attractive if there is a period of continued positive returns, if you experience a -50% return in the first year, you need a 100% return the following year to get back to where you started.

4.36 Summing up the above, we have illustrated that there is no clear benefit from moving from the current fixed rate arrangements to a portfolio of domestic or global

bonds. We have also illustrated that holding a portfolio which has a large allocation to equities provides CPF members with the opportunity to generate higher returns than offered under the current arrangements if equities perform better than expected. There is also increased scope for returns to be materially lower. In the next section we illustrate an alternate way of thinking about the relative risks, to assist members and stakeholders to further consider the trade-offs. .

What are the options available to members to help them target the risks and returns they want to be exposed to?

4.37 As shown in Table 5, the current fixed rate arrangement offered to CPF members has a similar expected return as a 60% global equity portfolio but without the downside risk. We therefore use a 60% global equity portfolio as a comparison in this section to help illustrate the different options that a CPF member could consider in order to target the risks and returns to which they wish to be exposed. We provide summary statistics based on portfolios with different allocations to equities in Appendix 2.

4.38 Figure 16 below illustrates the relative risk and return for CPF members when moving from the fixed rate benefit to the example 60% global equity portfolio.

Figure 16. Distribution of the Relative Returns (60% Global Portfolio Return Less CPF Fixed Rate Portfolio Return) (% p.a.)

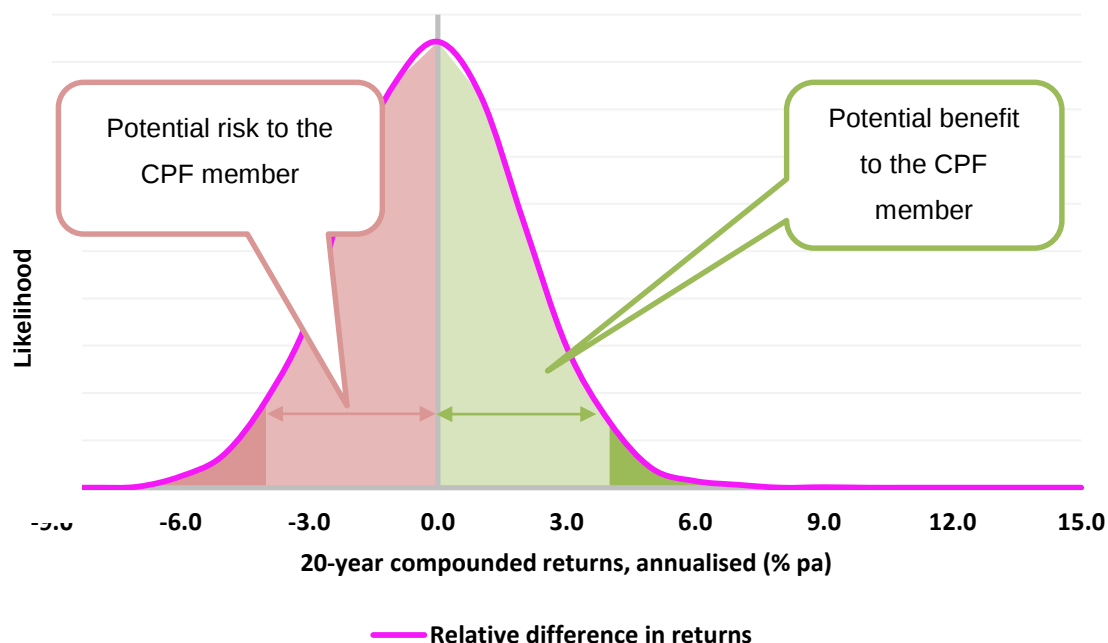
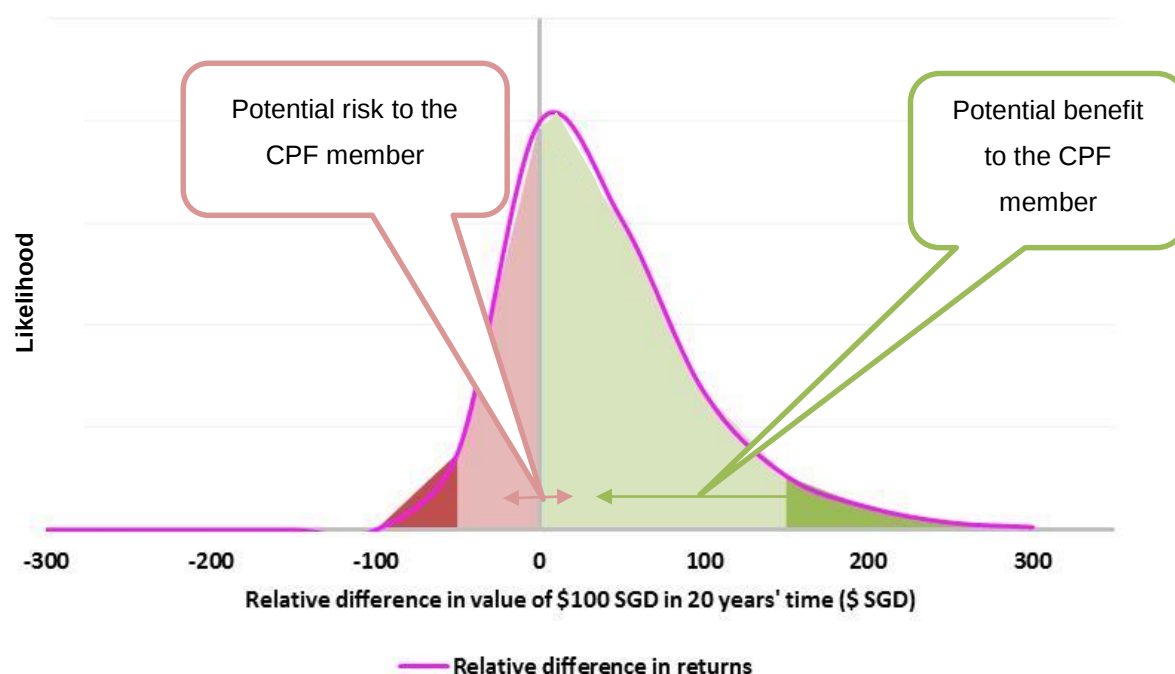


Figure 17. Distribution of Relative Returns in 20 Years' Time for Every \$100 Held by CPF Members (60% Global Portfolio Return Less CPF Fixed Rate Portfolio Return)



4.39 This distribution highlights the risk and return to the CPF member from moving away from the default fixed rate arrangement to a 60% equity portfolio. To assess the attractiveness of the current arrangements, the CPF member needs to consider their preference for high potential returns and tolerance for the potential downside risk from holding equities.

4.40 For the members to gain exposure to the potential upside from investing in equities there is an associated compromise in the form of risk or cost, which needs to be understood by the member.

4.41 We therefore consider the following options to CPF members in terms of the risk exposures and compromises:

- A. Retain the existing fixed rate arrangements
- B. Move to a market portfolio and seek higher returns and accept the downside risk
- C. Move to a market portfolio and hedge the downside risk via option strategies

4.42 We consider each of these options in more detail below.

A. Retain fixed rate benefit

- Expected return is similar to that of a 60% global equity portfolio
- Minimal downside risk

- **Compromise:** No direct exposure to equity returns, i.e., does not benefit if equities perform better than expected, less feeling of ownership of the outcomes.

4.43 When compared to a 60% global equity portfolio, there is minimal downside risk for CPF members and the CPF member forgoes the upside of the equity exposure, in scenarios where equities perform better than expected.

Figure 18. 20-Year Compounded Returns, Annualised (% p.a.)

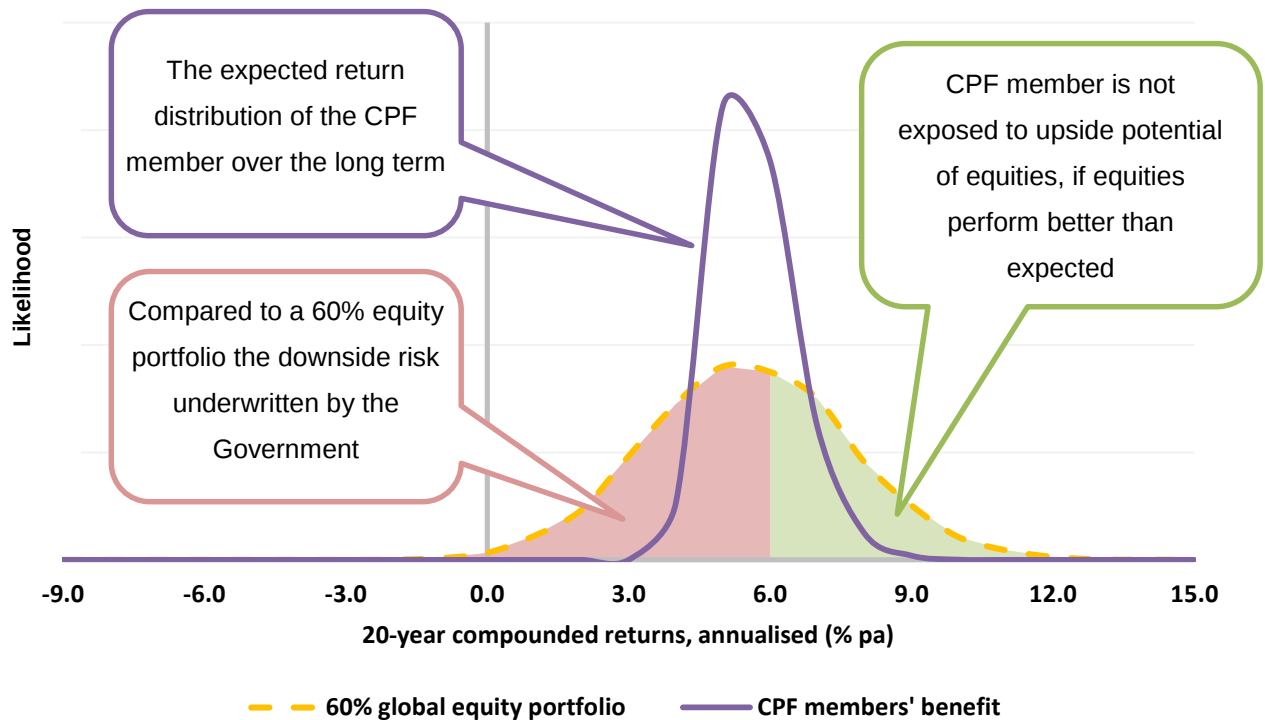
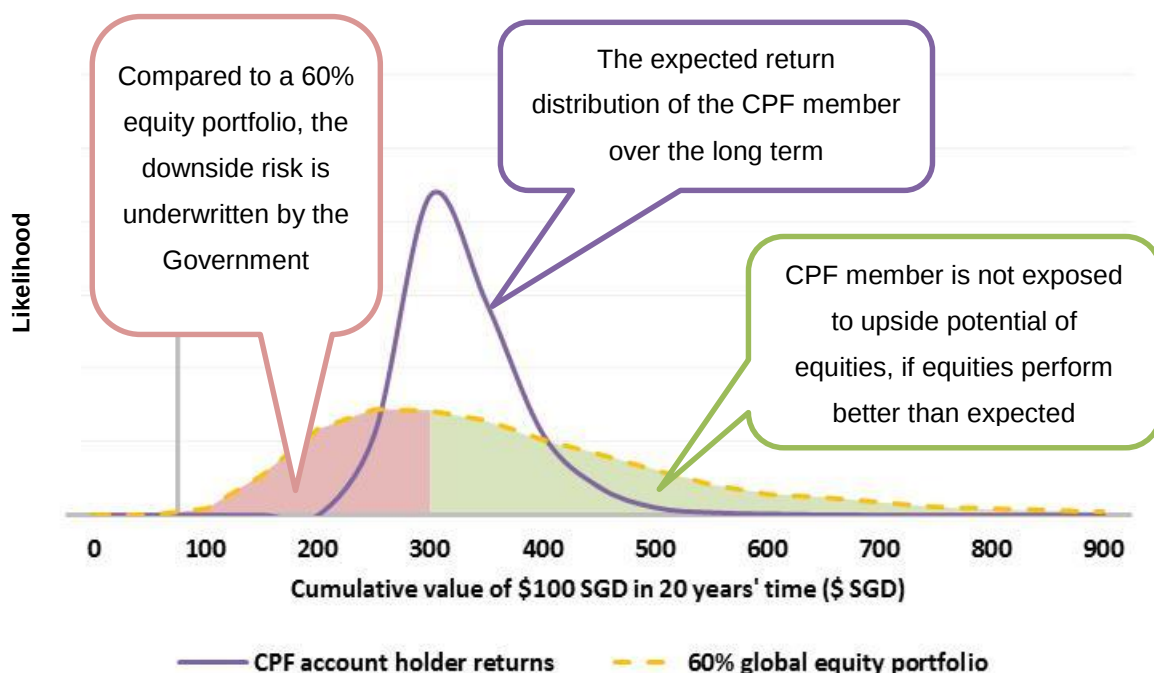


Figure 19. Distribution of Relative Returns in 20 Years' Time for Every \$100 Held by CPF Members



4.44 The above is just an illustration of the risk/return trade-off. The actual risk taken by the Government varies based on the portfolio the Government holds for its investments. Over recent years the portfolio held by the Government, via the GIC, is closer to an 80% global equity portfolio (without any currency hedging), i.e., the potential upside and downside would be larger than the example above.

4.45 The current arrangements are the “default option” as the Government is better placed to withstand the downside risk compared to an individual CPF member due to its resources and long time horizon (we consider the time horizon further below). The Government will primarily use any unexpected upside from a portfolio of equities to protect against future falls in equity values, such that over the very long term it can offer the current level of benefits offered to CPF members.

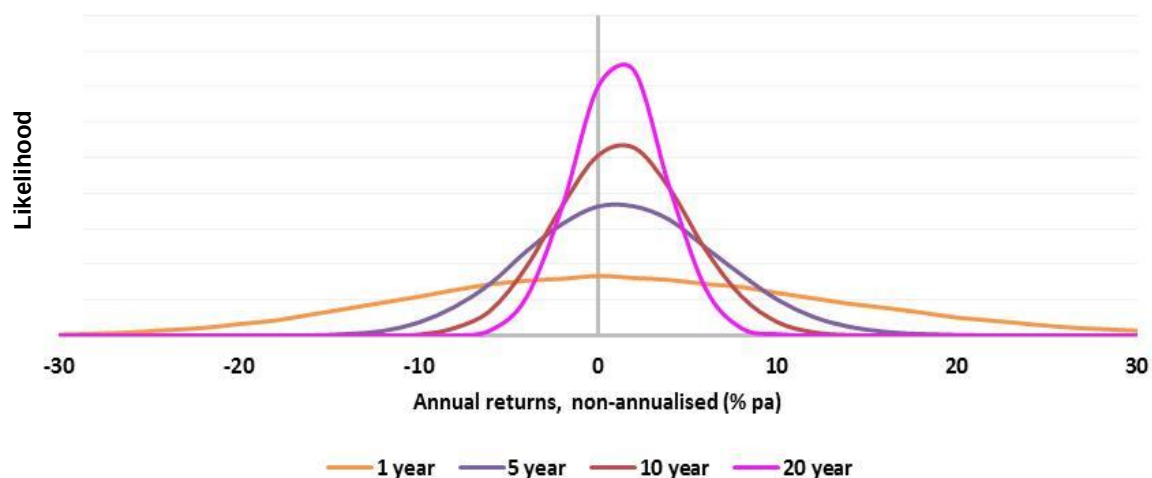
B. Move to a market portfolio and accept the downside risk

- Expected return is similar to that of the fixed rate arrangements
- Potential for higher returns than available via the fixed rate arrangements if equities perform better than expected
- **Compromise:** Exposed to downside risk if equities underperform

4.46 CPF members could choose to move to a 60% global equity portfolio and accept the potential downside risk. This choice would depend on the risk appetite and tolerance of the different CPF members. A key element when considering their individual risk appetites and tolerances is the time horizon. Our analysis has so far considered the return distributions over 20 years. The distributions over different time horizons can be materially different.

4.47 Figure 20 below shows the potential risk and return from a 60% global equity portfolio, relative to retaining the CPF fixed rate benefit, over different time horizons.

Figure 20: Distribution of the Relative Returns Based on Different Time Horizons (60% Global Portfolio Return Less CPF Fixed Rate Portfolio Return, in % p.a.)



4.48 It can be seen that over shorter time horizons the potential downside outcomes can be materially worse. CPF members need to understand their time horizon, which should be based on their circumstances. For example, if they are near retirement age or looking to purchase a property in the near term the member needs to understand the potential shorter term risks they are taking and the implications of those risks on their ability to retire or purchase a property should a downside event occur.

4.49 Unlike the Government, the CPF member does not have the resources to keep extending the time horizon following a downside event. Therefore the ability for the member to withstand a downside event is less. If the member is not able to tolerate the level of risk implied in these different strategies, then they need to consider how they manage this risk, or at the very least consider the implications and

risk sharing of different approaches that modify the risk profile of a long only portfolio.

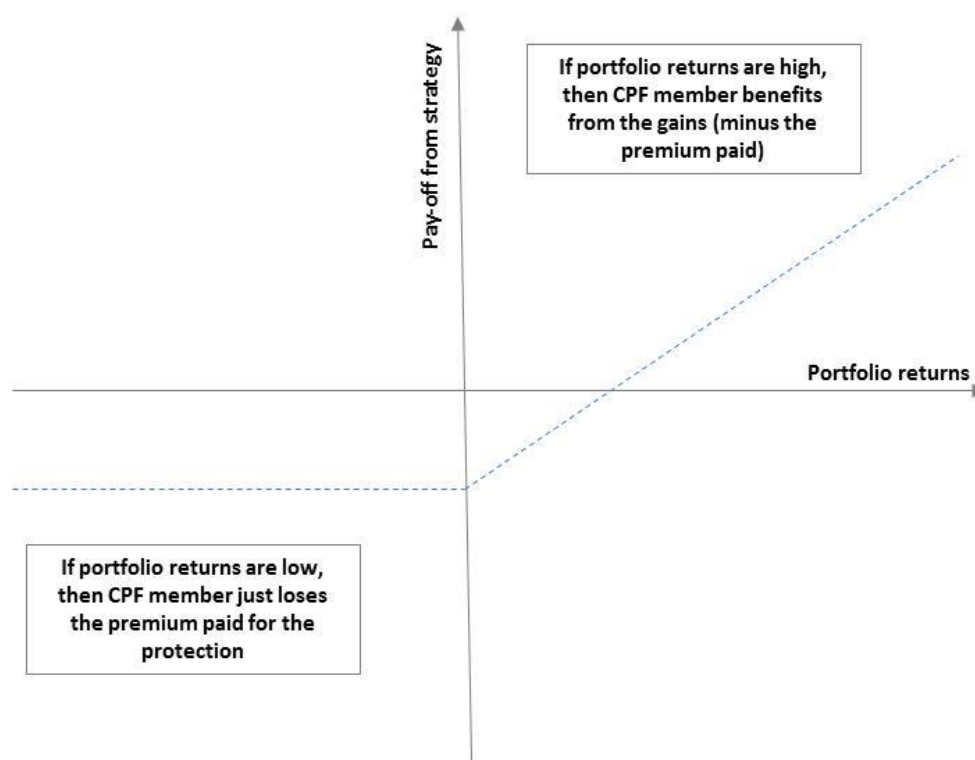
4.50 We consider potential ways to manage this risk below, assuming the CPF member wants to retain exposure to equity market returns (otherwise they should remain in the existing fixed rate arrangements).

C. Move to a market portfolio and hedge the downside risk via option strategies

- No direct downside from equity exposure
- Exposure to potential high returns if equities perform very well
- Compromise: Expected average return 2.9% p.a. lower than fixed rate arrangement due to premium required

4.51 The CPF member could look to protect against material falls in the value of the assets held using option strategies. Under this approach the CPF member would be required to pay a premium for the protection. The member would still be able to benefit from equity upside should equities outperform the return from the fixed rate benefit and the amount paid as a premium.

Figure 21. The Payoff from the Strategy Based on Different Portfolio Returns

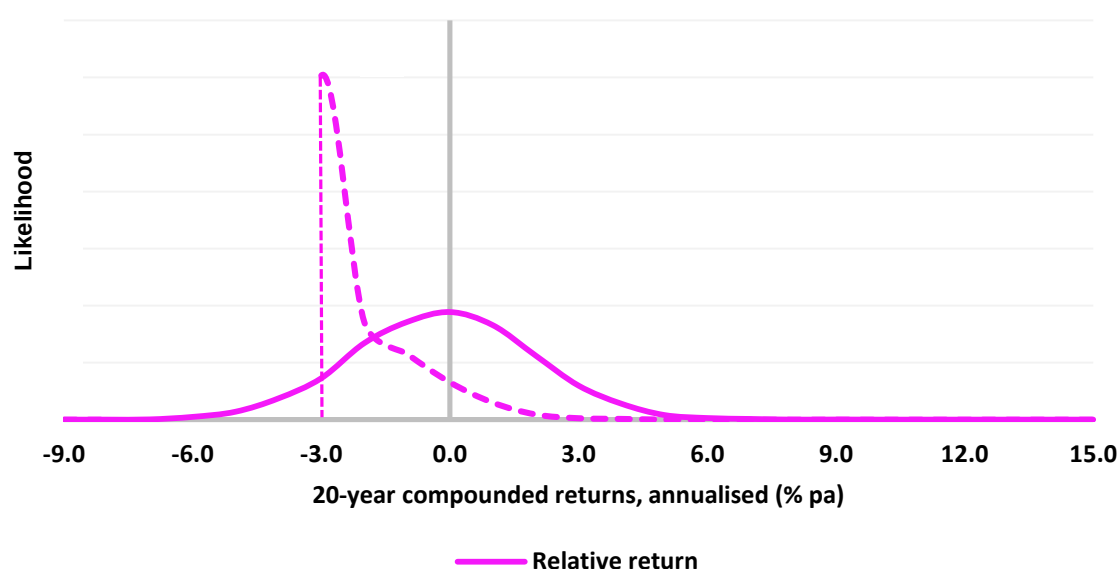


4.52 We can price this strategy using the Black-Scholes formula, which is an option-based approach that considers the arbitrage free price of protecting against certain falls in asset prices. The pricing is based on the volatility of the asset held. The outcome provides an indication of what a “fair price” would be for this type of protection. The actual cost is likely to be higher given the bespoke nature of the benefit, the lack of long-term options available in the market, and the relatively large size of the funds being protected (if many members sought protection)

4.53 A key input is the relative volatility or uncertainty of the investment returns, so in this case the key is the difference between the volatility of the 60% global equity portfolio and the volatility of the return from the fixed rate benefit. Based on TW’s assumptions we calculate this to be 12.3% p.a.

4.54 Using this approach, the “price” of this 20-year option to protect the downside is 2.9% p.a., (equivalent to \$64 today to protect \$100 of the portfolio). Adding this option to the portfolio of 60% equities decreases the expected return, but removes the extreme downside outcomes, as shown in Figure 22.

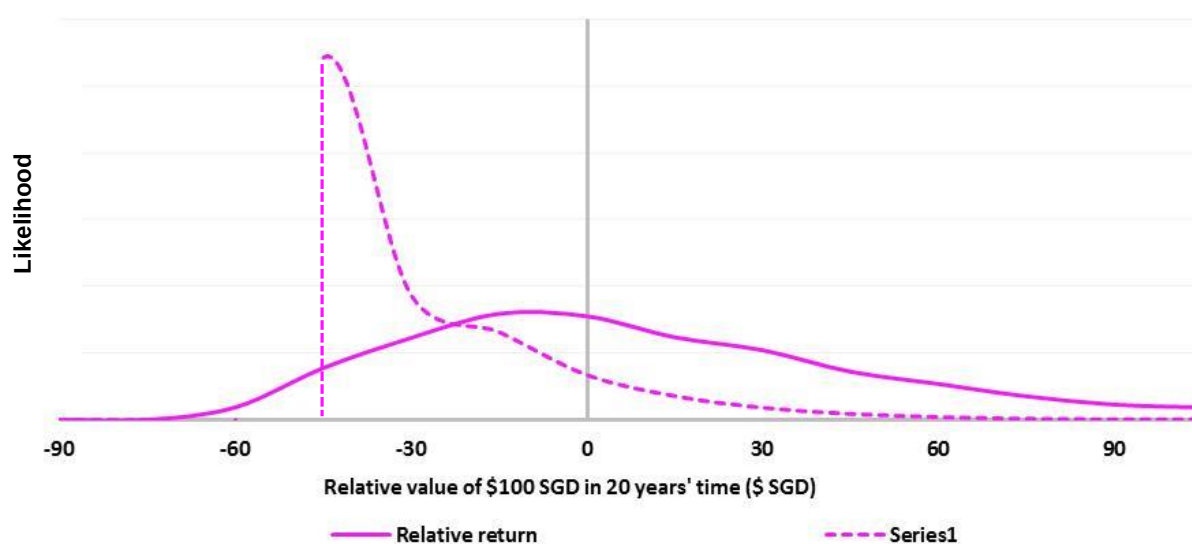
Figure 22. 20-Year Compounded Annualised Returns to the 60% Global Equity Portfolio (With and Without Protection, in % p.a.)



4.55 Considering Figure 22, in 87% of scenarios the CPF member would be expected to be worse off relative to the fixed rate benefit but the potential size of the underperformance would be limited to 2.9% p.a. This compares to underperformance of 2.9% p.a. or below in 12% of scenarios without the protection. In 5% of scenarios the CPF member could outperform the fixed rate benefit by 1.4% p.a. due to the upside retained (or \$32 in 20 years' time for every \$100 held today).

4.56 This analysis is based on paying a direct premium to limit the potential downside risk to the CPF member, i.e., it provides an alternative way of considering the downside risk compared to just showing the distribution of returns. It also provides the CPF member with a way to value the benefit offered by the Government under the fixed rate arrangements. This is not intended to provide a specific hedging solution for the CPF member. There is a vast array of different ways in which these types of strategies can be structured, each with a specific cost. These strategies may vary by the amount of upside potential that is retained (i.e., it is possible for the CPF member to forego a proportion of the right hand side of the distribution to reduce the costs) or consider different time horizons. The market for 20-year protection is not very liquid and therefore the actual cost could be much higher than that used in this illustration.

Figure 23. Cumulative Difference Based on \$100 Held Today (With and Without Protection)



4.57 The example used in Figures 22 and 23 is based on protecting aggregate falls over 20 years. The time horizon used makes a material difference to the potential risk and the “cost” of this risk. For example, if we considered the cost of protecting against falls over a year, the cost would be 6.2% p.a. (compared to 2.9% p.a. if managing the risk over 20 years). Over longer time horizons, there is more opportunity for any short term falls to be recovered, so average costs are lower.

4.58 Our general conclusion would be that hedging or removing the downside risk from equities looks to be very expensive for members.

SECTION 5: CONCLUSION

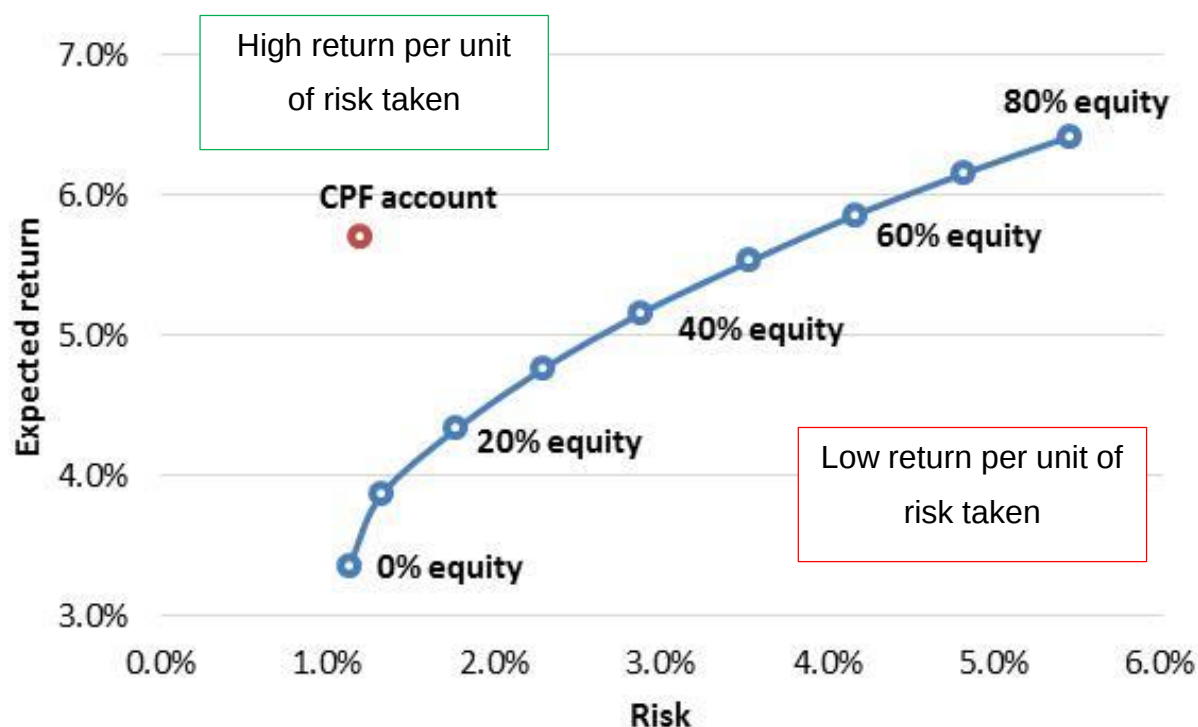
5.1 This paper has set out the main pre-retirement investment risks faced by CPF members and the government in the management of its funds. We show how the investment risks of CPF members on their OA and SMRA have been passed on to the government in exchange for a low-risk, government-guaranteed return, with the government in turn pooling CPF members’ net contributions with its own surplus funds which are then managed by its investment management agencies. CPF members may withdraw some of their CPF OA and SA balances for various purposes, including for housing purchases and to invest in approved CPFIS products, and thereby take on the investment risks associated with such investments.

5.2 In Section 4 we addressed the CPF members concerns regarding the value of the benefits being provided by the Government, given that they have not directly benefited from the positive returns from equities over recent years.

5.3 We first highlighted that the value of the benefits provided to CPF members is equivalent to an additional 1.4% p.a. over the market risk-free rate, without any compromises in terms of costs or additional risk. In monetary terms, this is equivalent to \$71 in 20 years' time for every \$100 held today. Most of this benefit is a result of the 1% added to the first \$60,000 in the members' accounts.

5.4 Whilst the current arrangements do not provide returns linked to equity performance, the expected return of the current arrangements are broadly equivalent to a 60% global equity portfolio but without the downside risk associated with that portfolio, i.e. more financially efficient (higher expected return per unit of risk). This is illustrated in Figure 24 by the CPF return being materially above the efficient frontier (risk and return available from a range of different equity allocations).

Figure 24. Risk and Return for a Range of Different Equity Allocations and the CPF Return (20-Year Compounded Annualised Returns)



Note: Risk is defined as the difference between the expected return and the 95th percentile outcome.

5.5 One advantage of the 60% global equity portfolio is that it provides CPF members with the potential for much higher returns if equity market perform better than expected over the long term, with 5% of scenarios offering an additional 4.3% p.a. in return over the expected benefits offered by the current arrangements.

5.6 CPF members need to understand what level of risk they can tolerate and whether they believe the potential upside warrants exposing themselves to the material risks that are inherent within market portfolios. We note that the potential downside risk is greater if the CPF member does not have a long time horizon. We

have shown that shorter time horizons result in potential losses being much greater and therefore the consequences are more material.

5.7 There is a range of different options to CPF members, each with their own compromises:

- Retain current arrangements — with an expected return equivalent to a 60% global equity portfolio with the downside risk underwritten (passed onto) the Government. In exchange the member does not benefit from better than expected equity performance.
- The member accepts the potential risks from holding a portfolio of equities, especially over the short term, in order to capture better-than-expected equity performance.
- Hold a market portfolio and pay premium to protect against downside events using option strategies. The high level of protection means that the premium is large and the CPF member is likely to be materially worse off than the existing arrangements in most scenarios.

5.8 With the analysis presented we believe that the Government offers the CPF members an attractive benefit, given the member is not exposed to downside risk, over the long term compared to other investment opportunities available.

5.9 We note that the analysis in this paper has focussed on the “average” CPF member based on the aggregate membership data from 2013. The specific risk, return and compromise will vary by the individual members’ circumstances. For

example, if the member only had monies held in SMRA, the expected return is 6.4% p.a., which is equivalent to the expected long-term return on a portfolio holding 80% global equities but without the downside risk.

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APPENDIX 1

This illustration of the wealth-eroding effects of inflation uses the following assumptions:

CPF member's birth date: October 1959

CPF member's desired retirement age: 62 years

CPF member's desired monthly retirement income: \$2,000 (in today's dollars)

CPF member's annual income: \$42,900 (13 months of \$3,300)

Number of years CPF member's retirement nest egg should last: 20 years

Return on investment (during retirement): 4%

Average inflation rate: 2% or 3%

The CPF Retirement Estimator⁶ indicates that at an inflation rate of 2% p.a., a CPF member with the expectations and retirement goals as stated above would require \$461,367 in future dollars to retire at age 62 and generate the retirement income as indicated. This is equivalent to 10.8 times the member's current annual income.

At an inflation rate of 3% however, this CPF member would require \$539,402 in future dollars to retire at age 62 and generate the equivalent amount of retirement income. This is equivalent to 12.6 times the member's current annual income.

⁶ Accessible at <http://mycpf.cpf.gov.sg/Members/Calculators/mbr-Calculators.htm>.

APPENDIX 2

Observation on Returns from CPF Interest Rates

The CPF account returns have no direct downside risk (due to the minimum rate floor), but have the potential to capture higher returns should government bond yields increase materially over time.

This compares to other investment opportunities, which may provide higher returns but are also likely to experience periods where the value is eroded by low or negative returns.

Figure 25 below shows a single scenario where the average year-on-year equity returns are 3% p.a., which is higher than the CPF returns. However, once the effects of compounding are taken into account, the difference in annualised returns after 20 years is only 1% p.a. This is due to the material gains in equity markets required following a fall, e.g., following a 50% fall you need a 100% return to be back to where you started. The CPF accounts do not experience this drawdown, therefore average year-on-year returns are broadly equivalent to annualised returns over time.

Figure 25. Year-on-year returns (%) from aggregate CPF balances and global equity portfolio

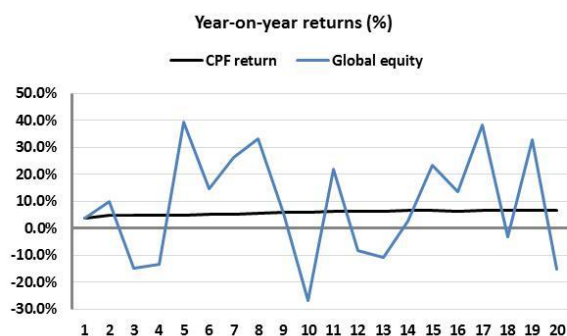
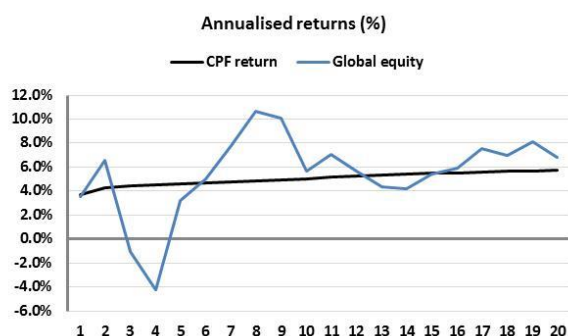


Figure 26. Annualised returns (%) from aggregate CPF balances and global equity portfolio



Towers Watson Assumptions

The analysis conducted in Section 4 is based on Towers Watson's central assumptions for economies and markets. These assumptions are set by TW's Global Investment Committee and based on a cascading approach, which first develops expectations for global and domestic inflation rates followed by cash rates, bond yields and then equity returns. This provides a globally consistent set of assumptions, which are used across TW's global client base. The assumptions are developed through a process that combines internal and academic research, references as a sense check historical data-sets, and takes into account other external practitioners views and opinions. These combine to help form a subjective view of future expected outcomes and potential ranges around these central expectations for over 400 economic factors and asset classes globally. For the purposes of this paper we extracted the relevant data series for Singapore.

To expand on the main assumptions used in the analysis:

Singapore inflation: Specific short-term forecasts for single country inflation are beyond the scope and intent of the model and this paper. For the purposes of this paper we reference a general long-term expectation that “global” inflation will average around 2.5%, which is meaningfully higher than current levels, following an extended period of muted recover after the Global Financial Crisis. We reference a modest long-term level of positive inflation of some 2.5% as a basis for the modelling framework.

Singapore cash rates: Cash rates refer to short-term deposit rates, and the central assumptions in our model is for those to steadily increasing to around 4% p.a. over 10 years, with an initial period of some years before this process begins. From a macro point of view, cash rates over the medium term need to offer savers some incentives to defer consumption, and this is manifested over time by savers receiving positive return after inflation, i.e., positive real returns, for this to be the case cash rates need to average something above inflation. For developed economies, historically cash rates have had a premium above inflation of around 1.5% p.a. Combining this real return premium with our medium-term inflation expectations generates a medium-term outcome of 4.0% for Singapore short-term rates, meaningfully above current levels.

Singapore Government bond yields: Generally, we represent bond yields as a premium over cash rates, reflecting the term and liquidity premia that investors earn by committing savings to longer terms. Over the long term this premium has ranged

between 1% and 1.5% for developed markets, so using this framework we expect bond yields to gradually increase to some 5.3% p.a. over 10 years

Global equity returns: In our model we represent equities as a risk premium over inflation, which is the level of additional real return investors need to compensate them for the additional risk of investing in equities. Over long periods of history this premium has ranged between 3% and 5%. With muted inflation rates, foundations of recovery we currently position our expectations more towards the upper end of a reasonable range.

Sensitivity of CPF Returns to the Assumptions Used

Altering the key assumptions used in the analysis in this paper or considering alternate scenarios could lead to different views on the relative attractiveness of the different options available to CPF account holders, as set out in this paper. The main assumption driving the relative attractiveness of the CPF return versus other investment opportunities is the return and volatility of global equities, and the path for interest rates. In scenarios where there are prolonged periods of high equity returns and low volatility (as has been witnessed in developed markets since the global financial crisis in 2008), the returns from holding a portfolio of equities could be expected to exceed the returns from the CPF account. If the CPF account holder believes this scenario is likely to continue over the long term then they may believe that investing via CPFIS is appropriate (i.e., not taking into account the potential downside risk from investing in equities).

In terms of bond returns/yields, holding a portfolio of bonds is only likely to generate a higher expected return than CPF accounts if there is a steady fall in yields over time (leading to increased bond returns from capital gains). Given current bond yields this scenario seems less likely to occur (although there is scope for falls in the short term).

Other assumptions in our analysis:

- We have not made any allowance for cash flow movements in and out of the accounts over time, nor have we assumed flows of money between the different accounts. Therefore the analysis does not capture liquidity risk or timing differences
- We have not made allowance for any inflation impact on the levels used for the minimum rates to be applied (fixed at \$20,000 and \$40,000 for OA and SMRA, respectively). Over time, should these thresholds increase, the benefit to the CPF holder would also increase.
- No allowance is made for sovereign credit risk (see paragraph 3.34), i.e., the risk that the returns offered to CPF account holders is now provided by the Singapore Government.

What are the implications for the value added by the Government to CPF members in 20 years' time if assumptions are different?

In Table 4 in the main body of the paper we set out the attribution of the expected 1.4% p.a. of value added to CPF members by the Government over 20 years. This was based on TW's central assumptions (cash rates increasing to 4% p.a. and

government bond yields increasing to 5.3% p.a. over 10 years). Below we set out the implication for the value added to CPF members by the Government if we stress test the central assumptions.

To do this we consider scenarios where cash rates and bond yields increase and decrease relative to the central assumptions. For the sensitivities we have looked at cases which are 1 and 2 standard deviations above and below the central scenarios, i.e., broadly a 1-in-6 chance of occurring and 1-in-20 chance of occurring respectively. Table 6 sets out the assumptions we have used in this sensitivity analysis.

Table 6. Assumptions Used in Sensitivity Analysis

Scenario	Cash rates after 10 years	10-year Government bond yields after 10 years
Minus 2 standard deviations	1.5%	2.4%
Minus 1 standard deviation	2.5%	3.5%
Central scenario	4.0%	5.3%
Plus 1 standard deviation	5.7%	7.2%
Plus 2 standard deviations	6.7%	8.4%

Figures 27 and 28 show the assumed progression of the market rates over time relative to the minimum rates for OA and SMRA, respectively.

Figure 27. Distribution of Annual Market Rates for OA

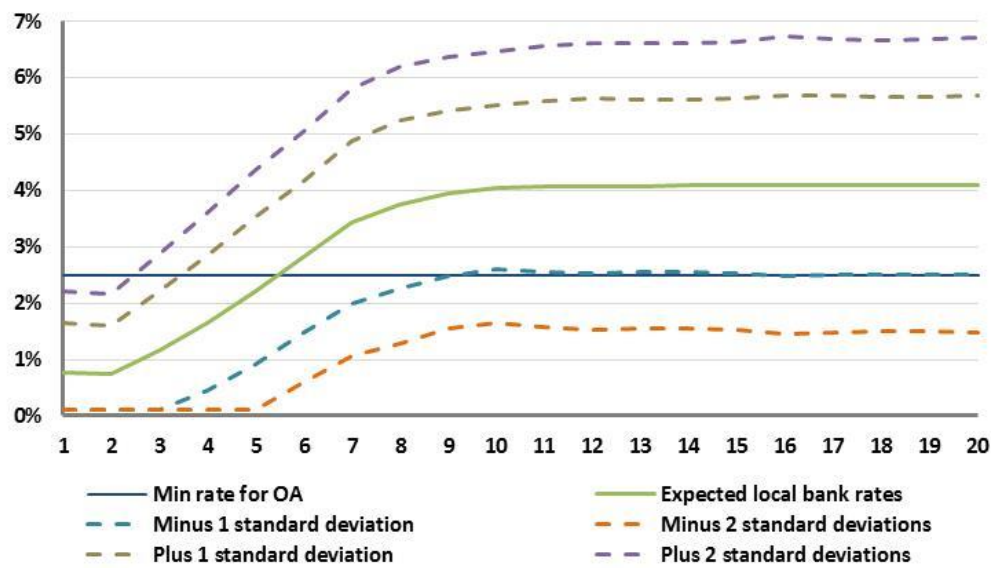
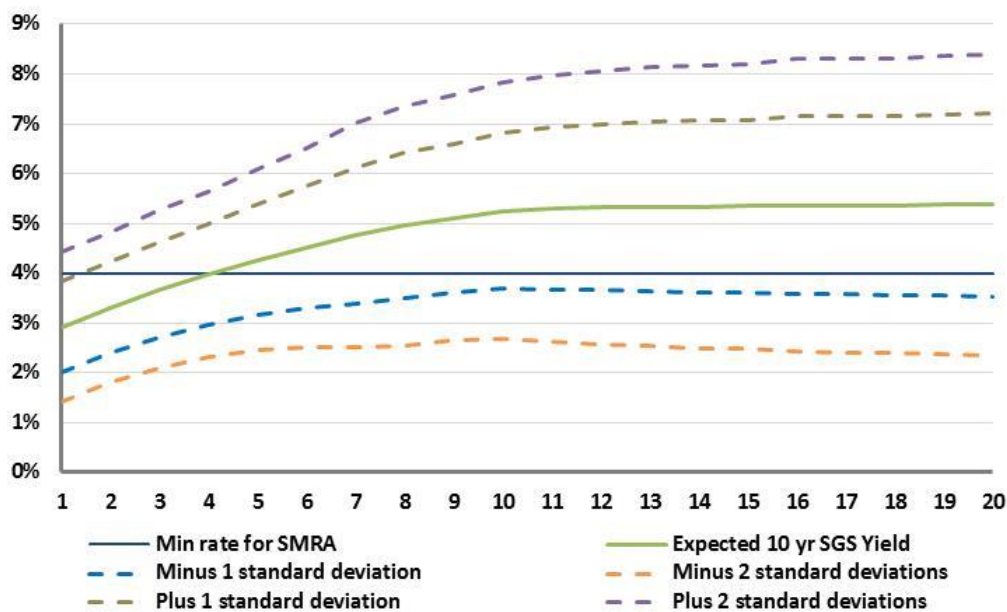


Figure 28. Distribution of Year-on-Year Government Bond Yields for SMRA



The table below shows the expected value and the attribution of the value added by the Government to CPF members between three different types of benefits offered based on the different sensitivities above.

Table 7. Attribution of Value Added to CPF Members in % p.a.

Benefit	Minus 2 SD	Minus 1 SD	Central	Plus 1 SD	Plus 2 SD
Market rates	2.0%	2.8%	4.3%	5.7%	6.4%
1% added to first \$60,000 held in the combined accounts	0.7%	0.6%	0.6%	0.5%	0.5%
Minimum rates applied	1.1%	0.6%	0.3%	0.0%	0.0%
1% added to market rate for SMRA	0.5%	0.5%	0.5%	0.5%	0.5%
Total 'value'	2.3%	1.7%	1.4%	1.0%	1.0%
CPF return	4.3%	4.5%	5.7%	6.7%	7.4%

SD = Standard deviation

Value From 1% Added to First \$60,000 Held in Combined Accounts

From this table we can see that the value from the 1% added to the first \$60,000 held in the combined accounts is material but does not vary materially under the different scenarios (0.5% p.a. to 0.7% p.a.). This benefit applied is not dependent on certain market conditions; however, there is a second order impact. As market rates increase, the size of the accounts increases, this means that a greater proportion of funds over the initial \$60,000 hurdle (which is entitled to a 1% uplift), this decreases the value of that benefit. This is best considered in an extreme example; if all accounts were \$60,000 then the value of the uplift would be 1%. If however, all accounts were 10 times bigger, i.e., \$600,000, the 1% uplift would only be applied to 10% of the funds (the first \$60,000), so the benefit would only be 0.1% of total funds.

This explains why there is a small difference in the value under the different stress tests.

Value from Minimum Rate Benefit

The “minimum” rate benefit is dependent on market conditions. The benefit becomes increasingly valuable to members in a low yield environment, like we are currently experiencing. If this low yield environment persists for an extended period of time then the value of this benefit would be greater than assumed under our central scenario. For example, if cash rates only increased to 2.5% and yields only increased to 3.5% from current levels over the next 10 years (one standard deviation below the central scenario), the value added from this benefit would be 0.6% p.a. This compares to 0.3% p.a. under the central assumptions. If market rates increase faster than expected then the “minimum rate” benefit has less value.

Value From 1% Added to Yields for SMRA

This is a fixed benefit, which does not vary by market conditions; therefore the value (0.5% pa) does not change when the assumptions are changed. The benefit would only change in percentage terms if the split between OA and SMRA changed materially over time.

Total Value

The total value of the benefits added to CPF members from the Government is sensitive to changes in assumptions, ranging from 1.0% p.a. to 2.3% p.a. in the

stress tests we have carried out. Unless there is a material change in value of CPF accounts or a material shift in the split between OA and SMRA, the minimum value is around 1% p.a. (when market rates are expected to be above the minimum rates in most years). In low yield environments, the total value can exceed 2.3% p.a. due to the minimum rates being applied.

The CPF Returns

The CPF returns range 4.3% to 7.4% under the different stress tests. In the low yield scenarios (first two columns), a large proportion is due to the benefits being added to CPF members from the Government. Table 8 is a repeat of the above table in monetary terms, i.e., the value added based on \$100 held in accounts today.

Table 8. Attribution of Value Added to CPF Members in Monetary Terms

Benefit	Minus 2 SD	Minus 1 SD	Central	Plus 1 SD	Plus 2 SD
Market rates	\$149	\$174	\$232	\$303	346
1% added to first \$60,000 held in the combined accounts	\$25	\$25	\$30	\$30	\$35
Minimum rates applied	\$40	\$22	\$15	\$2	\$1
1% added to market rate for SMRA	\$18	\$20	\$25	\$30	\$35
Total value	\$84	\$67	\$71	\$63	\$71
CPF return	\$232	\$241	\$303	\$366	\$417

The value in monetary terms varies based on the expected size of the accounts due to the underlying market rates and the value of the different benefits. We can see that value under the lower market rate scenario (second column, \$67) is lower in monetary terms than the central scenario (\$71), despite the benefit being higher in percentage terms (1.7% vs 1.4%). This is due to the expected account sizes being smaller as market rates are lower.

What are the risk and return implications from different allocations to global equities?

In Section 4 we considered the risk modifications available to a CPF member considering switching to a 60% global equity portfolio. In Table 9 below, we illustrate the impact of different allocations to global equities, relative to the current fixed rate returns.

Table 9. Risk Modifications Based on Different Allocations to Global Equities

Relative performance	Allocation to global equities							
	50%		60%		70%		80%	
	% p.a.	\$	% p.a.	\$	% p.a.	\$	% p.a.	\$
No protection								
Outperformance	-0.2%	5	0.2%	16	0.4%	28	0.7%	41
5th percentile	-3.6%	-52	-4.0%	-55	-4.3%	-59	-4.7%	-62
95th percentile	3.3%	92	4.3%	132	5.2%	178	6.1%	228
With protection								
Premium	2.9%	71	2.9%	64	2.9%	67	2.9%	71
Outperformance	-2.1%	-33	-1.8%	-27	-1.5%	-20	-1.2%	-13
5th percentile	-2.9%	-44	-2.9%	-44	-2.9%	-44	-2.9%	-44
95th percentile	0.4%	9	1.4%	32	2.3%	59	3.2%	89

Notes:

Analysis based on 20-year returns

The \$ amounts refer to the cumulative impact in 20 years' time based on \$100 held today.

The cost of protection does not vary much as the target return of the CPF benefit is high based on the assumptions used.

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