Article

Enhancing Singapore's Pension Scheme: A Blueprint for Further Flexibility

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Abstract: Building a social security system to ensure Singapore residents have peace of mind in funding for retirement has been at the top of Singapore Government's policy agenda over the last decade. Implementation of the Lifelong Income For the Elderly (LIFE) scheme in 2009 clearly shows that the government spares no effort in improving its pension scheme to boost its residents' income after retirement. Despite the recent modifications to the LIFE scheme, Singapore residents must still choose between two plans: the Standard and Basic plans. To enhance the flexibility of the LIFE scheme while maintaining its simplicity, we propose some plan modifications such that scheme members do not face a dichotomy of plan choices. Instead, they select two age parameters: the *Payout Age* and the *Life-annuity Age*. This paper provides an actuarial framework for determining members' payouts and bequests based on the proposed age parameters. We analyze the net cash receipts and internal rate of return (IRR) for various plan-parameter configurations. This information helps members make their plan choices. To address cost-of-living increases we propose to extend the plan to accommodate an annual step-up of monthly payouts. By deferring the Payout Age from 65 to 68, members can enjoy an annual increase of about 2% of the payouts for the same first-year monthly benefits.

Keywords: inflation risk; investment returns; life annuity; longevity risk; post-retirement benefits

1. Introduction

Building a social security system to ensure Singapore residents have peace of mind in funding for retirement has been at the top of the Singapore Government's policy agenda over the last decade. Implementations of the Minimum Sum Scheme in 1987, the Central Provident Fund (CPF) Lifelong Income For the Elderly (LIFE) scheme in 2009, the simplified LIFE scheme in 2013 and the recently proposed changes to the LIFE scheme in 2016 clearly show that the government spares no effort in improving its pension scheme to boost its residents' income after retirement.[1]

Although many developed countries have valuable experiences in establishing and implementing public pension schemes, it is evident that the Singapore government desires to build a system based on its own principles of governance and unique social structure, rather than simply adopting an existing system. Several characteristics of the current LIFE scheme distinguish it from other public pension systems. First, it is a defined-contribution scheme in which individuals get their benefits based on what they have contributed. Second, the scheme is compulsory and comprehensive, casting a wide safety net and mitigating the self-selection problem. Third, members in the scheme receive life-annuity payouts, which reduces longevity risk. Fourth, the scheme is managed by the

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[1] According to the Melbourne Mercer Global Pension Index 2016 [1], Singapore's retirement income system is ranked the highest among all of the Asian countries considered.

government with low operating costs and no credit risk. Fifth, there is a guarantee of return for the cash contributions in the form of bequests to the beneficiaries.

The many changes made since the first implementation of the LIFE scheme should be viewed as a commitment on the part of the government to make the system responsive to the needs and perceptions of Singapore residents. For instance, the revamp of the LIFE scheme in 2013 resulted in reducing the number of plan choices from four to two; namely, the Standard and Basic Plans. Although both plans provide life-annuity payouts, they differ in the amounts of monthly payouts and bequests to the beneficiaries when the CPF member passes away.

As more Singapore residents enter retirement, their experiences and needs become better known. This led the government to form the CPF Advisory Panel in 2014 to review the overall social security system. In Part I of their report issued in 2015, the Panel laid down three guiding considerations – adequacy, flexibility and simplicity – based on which of several recommendations were made. In adopting these recommendations, the government has made several changes to the LIFE scheme and implemented them beginning in 2016. First, the starting age of the annuity payouts can be selected by the CPF members, ranging from age 65 up to 70. Second, members are given the option to increase their contributions if desired, so that they receive higher payouts and bequests. Third, members can withdraw lump sums from their CPF accounts after reaching the Payout Eligibility Age. Fourth, members can top up their spouses' CPF accounts to enable them to enjoy the benefits of the LIFE scheme.

Despite the flexibility provided by the enhanced LIFE scheme, members must still choose between two plans: Standard and Basic. However, some members may still feel apprehensive about making this decision, as the only information they have regarding the two plans is the differences in their estimated payouts and bequests.[2] To address this concern and enhance further plan flexibility, we propose to modify the LIFE scheme while maintaining the key features of the two plans. We call our modified scheme the Unified Plan.

Under the Unified Plan, CPF members do not face a dichotomy of plan choices. Instead, they select two age parameters: the Payout Age and the Life-annuity Age. The Payout Age is the age at which the member starts to receive monthly payouts from the Retirement Account, and the Life-annuity Age is the age at which the member starts to receive monthly payouts from a life-annuity fund. Similar to a universal life insurance policy, the Unified Plan considers each installment payable from the Retirement Account as a contribution to a notional account rather than the premium for an insurance product. With this new feature, the adjustments of payouts and bequests under the Unified Plan are simpler and easier to understand. Our proposal also streamlines the recent changes introduced and opens up possible enhancements to the scheme in the future.

The remainder of this paper is organized as follows. Section 2 presents the major features of the proposed Unified Plan, and Section 3 illustrates its main outcomes. Section 4 discusses a possible extension of the plan, and Section 5 provides a case study under the Unified Plan with different options. Finally, Section 6 summarizes the findings and discusses possible extensions of the CPF LIFE scheme.

2. The Proposed Unified Plan

Under the proposed Unified Plan, CPF members select two age parameters: the Payout Age (PA) and the Life-annuity Age (LA). According to their choice of age parameters, members receive different amounts of payouts and bequests, thus enhancing the flexibility of the dichotomized LIFE

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[2] The CPF Board provides the CPF LIFE Payout Estimator on its official website. Members enter their personal information such as age, gender and Retirement Account balance to obtain estimates of their payouts and bequests under the two plans. However, the Estimator does not allow members to input the projected contributions at age 65. The trade-off between the two plans is that the Standard Plan makes higher annuity payouts and lower bequests, whereas the Basic Plan makes lower annuity payouts and higher bequests.

scheme. To fund the monthly payouts and possible bequests, two funding sources are established: the Retirement Account (RA) and the Lifelong Income Fund (LIF). Unlike the two annuity income funds of the current LIFE scheme, the LIF is considered as a separate notional account for each member, so that the plan administrator can determine the payouts and bequests. Our proposal simplifies the life-annuity funding arrangement without losing any flexibility. In this section, we outline the major features of the Unified Plan.

The framework of the Unified Plan is presented in Figure 1. Following the LIFE scheme, an RA is created for each member at age 55, provided the member's CPF accounts have sufficient funds. The first installment is then transferred from the RA to the LIF. Upon reaching the Payout Eligibility Age of 65, the member has five years to decide when the monthly payouts will start. At the time the PA is selected, the member also selects the LA. In other words, the possible values of the PA range from 65 to 70, whereas the LA is higher than or equal to the PA.

If a member specifies that the LA should be the same as the PA, the balance in his RA is completely transferred to the LIF as the second installment. After the transfer, the RA is closed and the member receives monthly annuity payouts from the LIF for life. Upon the member's death, if the total amount of monthly payouts is less than the sum of the two installments to the LIF, the difference is payable to the member's beneficiaries as bequests. Otherwise, no bequest is payable. Under this parameter configuration (*i.e.*, PA = LA), the plan works as an ordinary life-annuity, with the premium refund feature as the bequest. This plan configuration is similar to the current Standard Plan, and is illustrated in the upper right-hand panel of Figure 1.

In contrast, if the member chooses an LA that is higher than the PA, the amount of the second installment is determined actuarially. This amount is then transferred from the RA to the LIF at the PA, and the remaining balance in the RA acts as the source of an annuity-certain to fund payouts for the period from the PA to the LA. If he dies before reaching the LA, any outstanding balance in his RA, together with the two installments to the LIF, are paid to his beneficiaries as bequests. If he survives and reaches the LA, the RA is closed and the monthly payouts are payable for life from the LIF. Upon the death of the member after the LA, if the total amount of the monthly payouts from the LIF is less than the sum of the two installments to the LIF, the difference is paid to the member's beneficiaries as a bequest. Otherwise, no bequest is payable.[3] This age-parameter configuration is illustrated in the lower right-hand panel of Figure 1. Note that this choice is similar to the current Basic Plan. Given that the current Basic Plan has fixed 90 as the starting age for the life-annuity payments, we propose to set the upper limit of the LA at 90, while allowing members to select lower values, such as 80 or 85, for higher payouts and lower bequests.

Given the same amount of contributions to the scheme, different configurations of PA and LA in the Unified Plan result in different monthly payout and bequest amounts, providing additional flexibility to meet the members' needs. Furthermore, under the Unified Plan, only one LIF operates for each member, unlike the current LIFE scheme, which has two annuity income funds. Thus, when interest rate and mortality experience deviate from the actuarial assumptions, or when there is any lump sum withdrawal from the scheme, it is straightforward to evaluate their effect on the LIF balance and the necessary adjustments to the monthly payouts. This results in much desired simplicity for fund management while also enhancing the flexibility of the plan options.

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[3] Instead of calculating the bequest as the refund of two premium contributions from two annuity funds, as in the current scheme, the Unified Plan simplifies the determination of the amount of bequest as the unused amount in the LIF.
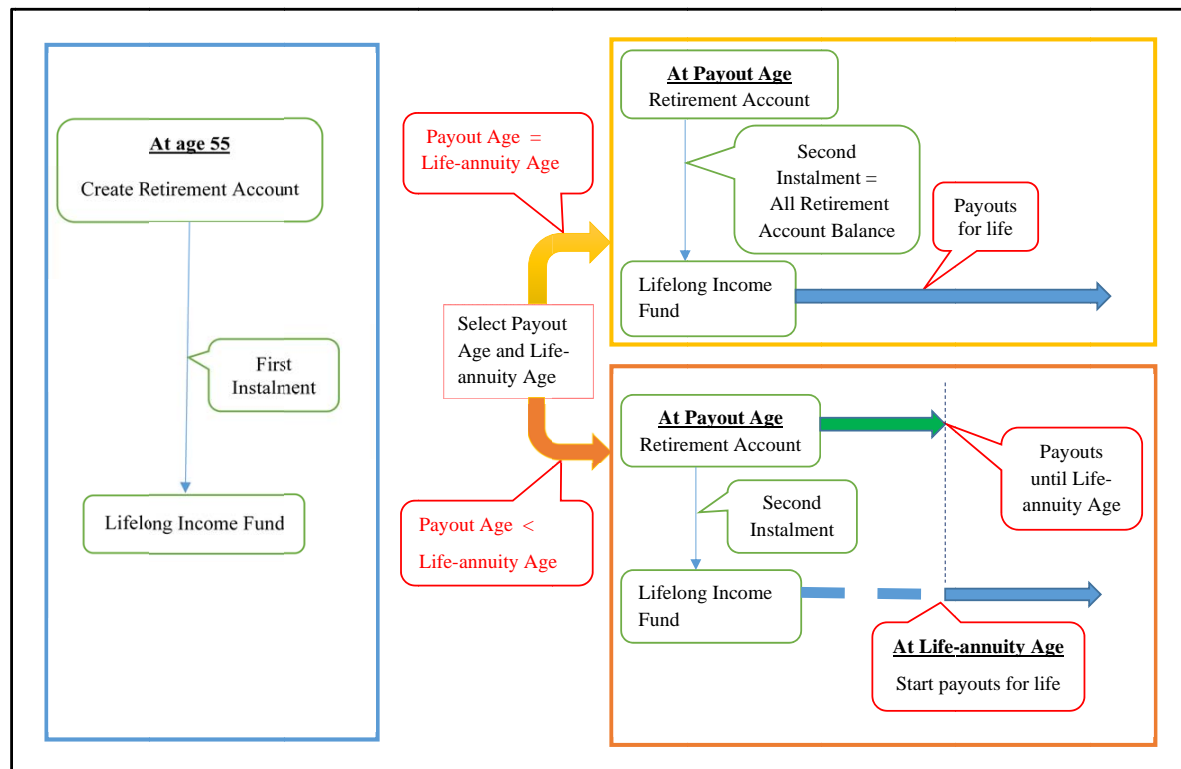
Figure 1. The proposed Unified Plan

When the PA is equal to the LA, the computation of the monthly payouts is straightforward for a given amount of total contributions to the LIF. In this case, the LIF acts as a universal life annuity with the premium refund feature. When the PA is less than the LA, however, the monthly payouts come from two funding sources in two different phases. To ensure that CPF members receive level payouts ('stable' payouts as required by the Advisory Panel) for life, the required amounts of the installments to the LIF must be computed according to sound actuarial principles. The installments and monthly payouts can be determined using the actuarial framework proposed by [2]. The details of the computation are described in Appendix A. This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation as well as the experimental conclusions that can be drawn.

3. Illustrative Plan Outcomes

In this section we present some results from comparing different plan parameter choices. We first summarize the monthly payouts and bequests under different plan age parameter and retirement savings combinations. We then segregate the contributions to the LIF as the implicit costs of a life-annuity and the life insurances provided by the plan. This analysis provides useful insights into the relative importance of the payouts versus the bequests as different plan choice outcomes.

3.1. Plan Assumptions

We now consider the assumptions of the investment return and mortality in the actuarial models. As the CPF Board is currently crediting 4% interest for the RA savings, we assume the investment return rate to be fixed at 4% per annum. For the mortality assumption, we first note that life tables for the CPF members are not available. If the Singapore Complete Life Tables are used for the CPF members, the mortality rate is likely to be overstated, as the survival rates of the CPF members are expected to be higher than those of the general population. To construct the survival distributions

of the CPF members, we propose using the U.S. RP2014 annuitant mortality tables as a proxy.[4] With possible mortality improvement, we also modify the RP2014 mortality tables by incorporating the MP2014 mortality improvement factors.[5] As a result, the life table for the cohort age 55 in 2014 is derived for our model. Furthermore, we adopt the constant force-of-mortality assumption within each year of age. These assumptions were also used in [2].

3.2. Monthly Payouts

To evaluate the financial effects on the annuity payouts under different configurations of the Unified Plan and varied contribution amounts, we construct a Unified Plan Estimator to calculate the cash flows. To illustrate the plan outcomes based on the Estimator, we consider some retirement savings cases. Following the recent CPF LIFE scheme descriptions, we consider the following Retirement Account savings at age 55: Basic Retirement Sum (BRS) of 80,5000, Full Retirement Sum (FRS) of 161,000 and Enhanced Retirement Sum (ERS) of 241,500.[6] We also consider cases in which the member makes new money contributions to the RA at age 65, such that the FRS and ERS can be reached. Table 1 provides the monthly payouts for a male CPF member under different savings contribution amounts and age-parameter configurations, with the PA equaling 65 to 70 and the LA equaling the PA, 80 and 90.

Table 1 shows the following results. First, for every one-year deferment in the PA, the monthly payouts increase by about 6 – 7% for any LA choices.[7] If a member defers his PA to 70, he gets about 35% more in his monthly payouts than what he receives if he opts to start the payout at age 65. Second, for a selected PA, if a member chooses an LA of 80, he receives about 3 – 4% less each month than if he chooses an LA that is the same as the PA. The drop in the monthly payouts increases to about 10% if he chooses an LA of 90. In return, he is covered by a longer term insurance and leaves more bequests to his beneficiaries. Third, while the total contributions to the RA for Cases C, E and F are the same, the monthly payouts for Case C (F) are about 14% (28%) more than those for Case E. Due to the higher contributions at an earlier age for Cases C and F, compared to Case E, the former earn more interest over a longer period, resulting in higher monthly payouts. Likewise, payouts for Case B are about 20% more than those for Case D, although the total contributions to the RA for the two cases are the same.

As Table 1 shows, regardless of the contributions to the RA, the maximum monthly payout is about 50% more than the minimum over the possible PA and LA choices. In summary, the Unified Plan provides a variety of payout possibilities to suit CPF members' preferences.

3.3. Net Cash Receipts Analysis

To assess the Unified Plan's cash flows, we define the members' net cash receipts as the sum of the aggregate monthly payouts and bequests minus the total contributions to the RA. As the Unified Plan provides returns of the unused contributions, the net cash receipts are always positive. To evaluate the effect that the age-parameter configuration choice has on the net cash receipts, we plot the latter at different age-at-death values under a variety of parameter configurations and contributions in Figure 2. To facilitate exposition, we denote a plan choice by the duplet (PA, LA). Figure 2 reveal the following results. First, the net cash receipts in configuration (70, 70) dominate those in configuration (65, 65). Likewise, (70, 90) dominates (65, 90). These results are perhaps not surprising, as deferring monthly payouts enables the funds to earn more interest, giving rise to higher aggregate payments over time. Second, (70, 70) dominates (70, 90) and (65, 65) dominates (65, 90) in terms of the net cash

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[4]   See *RP-2014 Mortality Tables Report* [3] for a description of the mortality table construction methodology.
[5]   See *Mortality Improvement Scale MP-2014 Report* [4] for a description of the mortality improvement estimation methodology.
[6]   All monetary amounts in this paper are in Singapore dollars. For simplicity, however, the dollar signs are suppressed.
[7]   Note that this result is in line with the CPF LIFE scheme description.

receipts if the member lives to an age of approximately 90 or beyond. As configurations with PA equaling LA provide higher payouts and lower bequests than those with a PA of less than the LA, the net cash receipts for plans of the former configuration are lower (higher) than those of the latter if the member dies earlier (later).

Table 1. Payouts of the Unified Plan for a male CPF member.

	Retirement savings			Payout Age (PA)					
Case	RA savings at age 55	New money at age 65	Life-annuity Age (LA)	65	66	67	68	69	70
A	80,500	0	PA	649	688	729	774	823	875
			80	622	661	703	748	797	849
			90	582	617	655	696	740	788
B	161,000	0	PA	1,298	1,375	1,459	1,549	1,645	1,749
			80	1,245	1,322	1,405	1,496	1,593	1,699
			90	1,164	1,234	1,310	1,392	1,480	1,576
C	241,500	0	PA	1,947	2,063	2,188	2,323	2,468	2,624
			80	1,867	1,983	2,108	2,243	2,390	2,548
			90	1,746	1,852	1,965	2,088	2,220	2,364
D	80,500	80,500	PA	1,085	1,149	1,219	1,293	1,373	1459
			80	1,040	1,104	1,173	1,248	1,328	1,416
			90	971	1,029	1,091	1,158	1,231	1,310
E	80,500	161,000	PA	1,521	1,611	1,708	1,812	1,923	2,044
			80	1,457	1,547	1,643	1,748	1,860	1,982
			90	1,360	1,440	1,527	1,621	1,722	1,832
F	161,000	80,500	PA	1,734	1,837	1,948	2,067	2,196	2,334
			80	1,662	1,765	1,876	1,995	2,125	2,265
			90	1,553	1,646	1,746	1,854	1,971	2,098

Note: The mortality table used is MP-2014, and the interest rate assumed is 4%.

3.4. Internal Rate of Return Analysis

Although net-cash-receipts analysis is easy to understand, it does not consider the time value of money. An alternative measure of the plan outcome is the internal rate of return (IRR), evaluated over different age-at-death. Figure 3 presents the IRR of four selected plan configurations under different fund contributions, and shows the following results. First, the IRR of configuration (70, 70) is significantly higher than that of (65, 65) if the member dies earlier (approximately age 82 or before). Otherwise, the IRR values of the two plans are very close. This result is in line with the results from Figure 2, and shows the advantage of deferring the monthly payouts. Second, the IRR of configuration (65, 80) is higher than that of (65, 65) if the member dies earlier (approximately age 83 or before). Otherwise, the IRR of configuration (65, 65) is slightly higher. When the member dies earlier, the higher bequest for the plan (65, 80) compensates for its lower monthly payouts and leads to a higher IRR when compared to configuration (65, 65). Third, the configuration (70, 90) has a stable IRR of slightly less than 4% until age-at-death of around 90. Beyond this point, the IRR rises, although it is lower than the IRR values of the other three plans. Overall, this plan configuration is the best choice under a maximin IRR criterion of selecting the plan parameters.

3.5. Analysis of the Lifelong Income Fund

As the plan administrator, the CPF Board shares the profit and loss of the LIFE scheme, due to the uncertainty in mortality and investment returns, with its members through the credited rate of interest rate declared periodically. The LIF, which is made up of the contributions from the RA and

credited interest, is subject to monthly payout deductions and life insurance coverage costs. Thus, from an actuarial perspective, the LIF is like the notional account of a universal life product, as the underlying assets are not segregated from the CPF's general account. In this section, we analyze the balance of the LIF as the premiums of life-annuity and life insurance coverage at members' different life stages. We consider the actuarial evaluation of each component over these stages. The mathematical details are summarized in Appendix B. This analysis clarifies the relative importance of the insurance components in different plan parameter choices.[8]
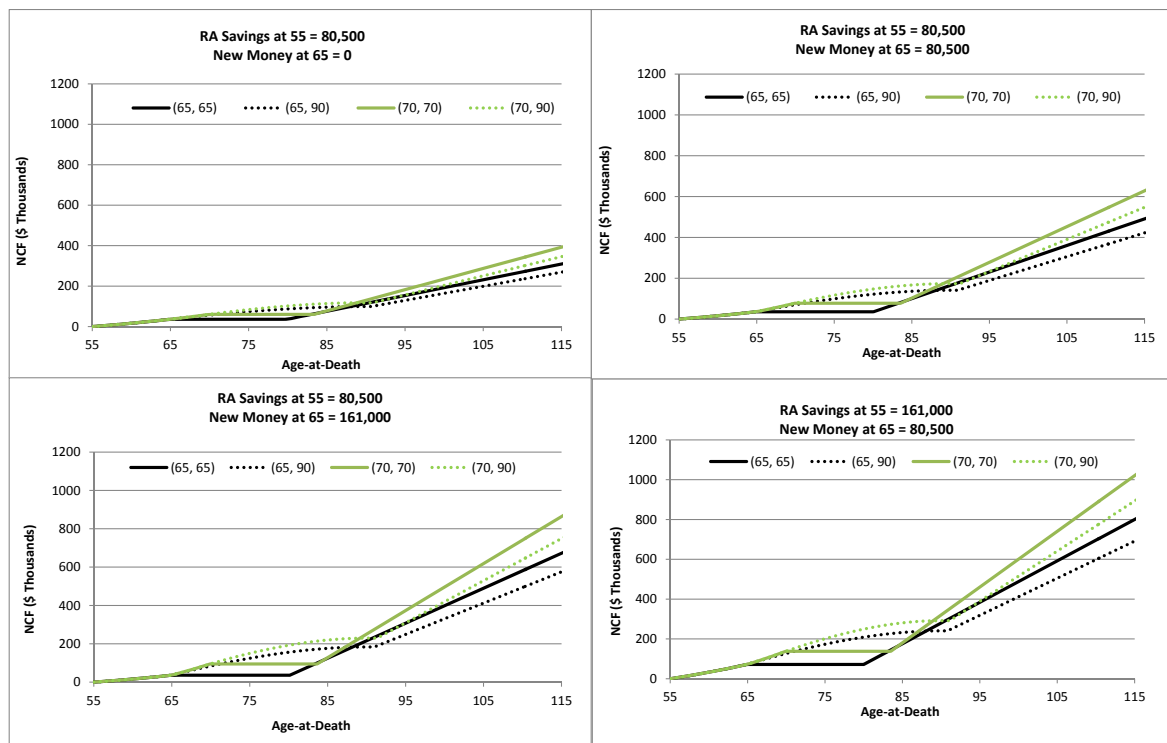

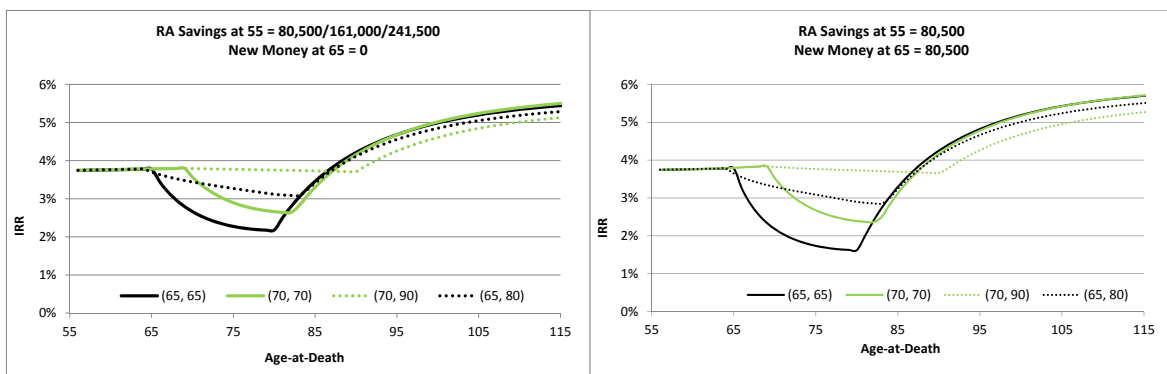**Figure 2.** Net Cash Receipts (NCR) under various parameter configurations and plan choice (PA, LA)

Figure 3. Internal Rate of Returns (IRR) under various parameter configurations and plan choice (PA, LA)

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[8]   The balance of the LIF represents the cash value for a surrendering policyholder. As a result, this analysis is important in assessing the financial outcomes of the Unified Plan, should the option of plan switch or early termination be granted to the member.

We first consider the case when the LA is set to be equal to the PA. In this case, the LIFE scheme can be divided into two stages. Stage 1 is from age 55 to the PA, and Stage 2 is from the PA onward. The first installment made at age 55 (the beginning of Stage 1) can be considered as the sum of two premiums: one for purchasing a pure endowment policy that matures at the PA and the other for purchasing a term insurance policy (for the bequest). When the member survives to the PA, the balance of the LIF is equal to the survival benefit of the pure endowment insurance. Any new contribution from the RA to the LIF plus the survival benefit is then used to purchase a life annuity and a decreasing term insurance policy in Stage 2.

To illustrate the breakdown of these components, we consider a case of a male member with 80,500 savings in his RA at age 55 and a new contribution of 161,000 to the RA at age 65. Among the parameter configurations of PA equal to LA, we consider three different configurations (PA = LA = 65, 67 and 70) and analyze the LIF in these two stages. The results are summarized in Panel A of Table 2. At age 55, the amount in the RA to be transferred to the LIF is 5,190.[9] If PA = LA = 65, the balance of the LIF at age 55 is 4,891 for the premium of the pure endowment insurance and 299 for the premium of the term insurance, which represent 94% and 6%, respectively, of the first installment. If the member survives to the PA, the survival benefit of the pure endowment insurance is 7,792 and the second installment from the RA to the LIF is 272,477. The sum of the survival benefit and the second installment is divided into the premium of a life-annuity of 257,910 and the premium of a decreasing term insurance of 22,359. Thus, the relative weights of the premiums of the life-annuity and term insurance are, respectively, 92% and 8%. The results for the other two configurations are similar, and it can be seen that the term insurance components increase with the PA, but are at most 10% in all three cases.

For the case where the PA is less than the LA, three stages of policy separation can be considered. Stage 1, from age 55 to the PA, is the same as Stage 1 of the case with PA = LA. Stage 2 now refers to the period from PA to LA, in which the member receives an annuity-certain from the RA. Stage 3, which is from the LA onward, consists of a life-annuity and a decreasing term insurance.

Again, we consider the case of a male member with 80,500 savings in his RA at age 55 and a new contribution of 161,000 to the RA at age 65. The results of three different configurations in which the PA is less than the LA are summarized in Panel B of Table 2. It can be seen that in Stage 1 (age 55 to PA) the results are the same as those in Panel A (with PA = LA). Similar to Stage 1, Stage 2 also consists of a pure endowment and a term insurance. However, the premium component of the term insurance policy in Stage 2 is much higher than that in Stage 1, reaching 30% for the case of PA = 70 and LA = 90, as the cost of the term insurance is higher due to higher mortality rates in this stage. Finally, in Stage 3, the weight of the decreasing term insurance component drops to below 5% as the death benefit reduces rapidly.

4. Plan Extension with Step-up Payouts

Currently, the LIFE scheme makes level monthly payouts throughout the life of a CPF member. As inflation risk is a major risk for retirement funding, it may be useful to consider extending the Unified Plan to allow for a step-up of monthly payouts. Assuming a constant step-up rate for monthly payouts, it is straightforward to modify the method in Appendix A to evaluate the payouts based on the principle of actuarial equivalence. To illustrate this extension, we consider Cases C and E in Table 1, with level payouts and a payout step-up of 2% per annum. In Table 3, we summarize the results of the payouts in the first year, with different PA and LA parameters. It can be seen that with a step-up, there is a drop in the first year payout of about 20% if PA = 65, with the same LA. This drop is reduced to about 18% if PA = 70, with the same LA. Regardless of the contribution amounts, with a step-up of 2% in the monthly payouts, the maximum starting payout is about 57% more than the minimum

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[9]   See Appendix A for how to compute the cash flows.

starting payout over the possible PA and LA choices. As this figure is higher than the corresponding value of about 50% when there is no step-up, the plan extension provides an even wider range of payout amounts for the members to choose.

Table 2. An illustrative example of the premium components of the LIF.

Panel A: Cases of Payout Age (PA) equaling Life-annuity Age (LA)

	PA = LA = 65		PA = LA = 67		PA = LA = 70	
	Monetary amount	Premium as percent of LIF	Monetary amount	Premium as percent of LIF	Monetary amount	Premium as percent of L
Stage 1: Age 55 to PA						
First installment to LIF	5,190		5,190		5,190	
Pure endowment premium	4,891	94%	4,828	93%	4,728	91
Term insurance premium	299	6%	362	7%	462	9
Stage 2: PA onward						
Endowment benefit brought forward	7,792		8,491		9,702	
Second installment to LIF	272,477		294,711		331,510	
Life annuity premium	257,910	92%	276,539	91%	306,355	90
t_2-year decreasing term premium	22,359	8%	26,663	9%	34,857	10
t_2	$15\frac{2}{12}$ years		$15\frac{6}{12}$ years		$14\frac{7}{12}$ years	

Panel B: Cases of Payout Age (PA) less than Life-annuity Age (LA)

	PA = 65, LA = 80		PA = 65, LA = 90		PA = 70, LA = 90	
	Monetary amount	Premium as percent of LIF	Monetary amount	Premium as percent of LIF	Monetary amount	Premium as percent of L
Stage 1: Age 55 to PA						
First installment to LIF	5,190		5,190		5,190	
Pure endowment premium	4,891	94%	4,891	94%	4,728	91
Term insurance premium	299	6%	299	6%	462	9
Stage 2: PA to LA						
Endowment benefit brought forward	7,792		7,792		9,702	
Second installment to LIF	73,876		12,112		26,351	
Pure endowment premium	68,311	84%	14,431	73%	25,239	70
Term insurance premium	13,357	16%	5,473	27%	10,815	30
Stage 3: LA onward						
Endowment benefit brought forward	160,644		87,616		118,945	
Life annuity premium	154,865	96%	86,833	99%	116,987	98
t_2-year decreasing term premium	5,779	4%	783	1%	1,958	2
t_2	$5\frac{5}{12}$ years		1 year		$1\frac{5}{12}$ years	

Note: This example assumes a male member with 80,500 savings in his RA at age 55 and new money of 161,000 deposited into his RA at age 65. The mortality table used is MP-2014, and the interest rate assumed is 4%.

5. An Illustrative Case Study

We now consider an illustrative case discussed in the CPF booklet for a CPF male member whose Ordinary Account, Special Account and Medisave Account balances are 100,000, 200,000 and 43,500, respectively.[10] The member is currently aged 55 and is considering several options in planning for his retirement. He has to decide whether he should withdraw savings from his CPF accounts, the amount to withdraw, the amount to transfer to the RA and whether he should pledge his property to make additional transfers to the RA. Furthermore, he needs to decide whether he should work beyond age 65 and defer receiving his retirement income.

Table 3. Payouts of the Unified Plan with step-up feature for a male CPF member.

	Retirement savings				Payout Age (PA)					
Case	RA savings at age 55	New money at age 65	Step-up rate	Life-annuity Age (LA)	65	66	67	68	69	70
C	241,500	0	0	PA	1,947	2,063	2,188	2,323	2,468	2,624
				80	1,867	1,983	2,108	2,243	2,390	2,549
				90	1,746	1,852	1,965	2,088	2,220	2,364
			2%	PA	1,557	1,659	1,770	1,889	2,018	2,157
				80	1,490	1,593	1,703	1,823	1,953	2,094
				90	1,373	1,466	1,565	1,674	1,792	1,920
E	80,500	161,000	0	PA	1,521	1,611	1,708	1,812	1,923	2,044
				80	1,457	1,547	1,643	1,748	1,860	1,982
				90	1,360	1,440	1,527	1,621	1,722	1,832
			2%	PA	1,216	1,295	1,381	1,473	1,572	1,679
				80	1,163	1,242	1,327	1,419	1,520	1,629
				90	1,069	1,140	1,216	1,299	1,389	1,487

Note: The mortality table used is MP-2014, and the interest rate assumed is 4%.

Suppose the member considers the following options: (a) transfer 80,500 to the RA now and then 161,000 at age 65 or (b) transfer 241,500 to the RA now.[11] If he also has a plan to work until age 67, he can decide to start receiving payouts at that age. Our calculations show that his monthly payouts will range from 1,527 to 1,708 for option (a) (see Case E in Table 3) and 1,965 to 2,188 for option (b) (see Case C in Table 3), depending on his choice of LA. If he chooses a payout step-up plan with a 2% increase per year, he will receive initial monthly payouts of 1,216 to 1,380 for option (a) (see Case E in Table 3) and 1,565 to 1,770 for option (b) (see Case C in Table 3).

Let us suppose the member finally chooses option (a) and picks a PA and LA of 67 and 90, respectively, with no payout step-up. Table 4 presents the summary of the projected cash flows and premium components funded by the LIF, with some hypothetical death age scenarios. We note that the member will receive a projected level monthly payout of 1,527. His first and second projected installment to the LIF are 5,190 and 21,772, respectively, whereas his projected RA balance at age 67 is 277,508. Table 4 provides his projected aggregate payouts and bequests at different death ages. The breakdown of his premium components shows that the term insurance constitutes 7% of the total amount of the LIF in Stage 1, and this component increases to 28% of the LIF in Stage 2 and then drops to 1% for the decreasing term insurance in Stage 3.

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[10]   Refer to *CPF: Your Assurance in Retirement* (Singapore CPF board [5]).
[11]   He is allowed to transfer the maximum amount of 241,500; namely, the Enhanced Retirement Sum, to the RA at age 55.

Table 4. Illustrative outcomes of a plan choice.

Panel A: Plan choice and monthly payout

Step-up rate	0
Payout Age	67
Life-annuity Age	90
Monthly payout	1,527

Panel B: Saving contributions

RA savings at age 55	80,500
New money at age 65	161,000
Total	241,500

Panel C: installments to LIF

First installment to LIF at age 55	5,190
Second installment to LIF at age 67	16,582
Total	21,772

Death age	RA balance	Total payouts	Bequest	Net cash receipts
67	277,508	1,527	299,280	59,307
70	253,720	56,505	275,492	90,497
75	207,292	148,135	229,064	135,699
80	150,806	239,764	172,578	170,842
85	82,082	331,394	103,854	193,747
90	0	423,024	20,245	201,768

Panel D: Premium components of the LIF

	Monetary amount	Premium as percent of the LIF
Stage 1: Age 55 to 67		
Pure endowment premium	4,828	93%
Term insurance premium	362	7%
Stage 2: Age 67 to 90		
Pure endowment premium	17,937	72%
Term insurance premium	7,135	28%
Stage 3: Age 90 onward		
Life-annuity premium	97,535	99%
t_2-year decreasing term premium	1,110	1%
t_2	$1\frac{2}{12}$ years	

Note: The mortality table used is MP-2014, and the interest rate assumed is 4%.
Net cash receipts = Total payouts + Bequest − Saving contributions.

6. Summary

We propose a modified version of the Singapore CPF LIFE Scheme, called the Unified Plan, which requires CPF members to select two age parameters: the Payout Age and the Life-annuity Age. Depending on the plan-parameter choice, retirees receive different amounts of monthly payouts

and bequests to suit their preferences. Our proposal streamlines the funding sources for the payouts to the member's own RA and a pooled LIF. It is not only flexible in incorporating the recent changes in the LIFE scheme, but also simplifies the financial arrangements of the member's future benefits. The latter is important in modifying the payouts in response to changes in the actual mortality experience and investment returns. We outline an actuarial framework to determine the payouts under different plan-parameter choices. A Unified Plan Estimator is constructed to project the cash flows under a given set of input parameters. Our models can be used to study possible future enhancements of the scheme, such as allowing members to take on certain investment risks or granting additional interest benefits for accounts with low balances.

Author Contributions: The three authors have equally contributed to the paper.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

BRS   Basic Retirement Sum
CPF   Central Provident Fund
FRS   Full Retirement Sum
IRR   Internal Rate of Return
LA   Life-annuity Age
LIF   Lifelong Income Fund
LIFE   Lifelong Income for the Elderly
PA   Payout Age
RA   Retirement Account

Appendix A   Determination of Annuity Payouts and Bequests

We first define the following notations:[12]

c = Payout Age

d = Life-annuity Age

e = Number of years payouts funded by RA, i.e. $e = d - c$

i = Annual effective interest rate

v = Discount factor = $1/(1+i)$

B_g = Bequest payable at age g

C_1 = First installment from RA to LIF at age 55

C_2 = Second installment from RA to LIF at Payout Age

$K_g^{(12)}$ = Monthly curtate future lifetime random variable at age g

P^* = Monthly payout estimate at age 55

P = Monthly payout

R_g = Balance of RA at age g

T_g = Aggregate amount of payouts from LIF up to age g

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[12]   Commonly used actuarial notations are not defined in this paper. Readers may refer to [6] for the details.

Under the Unified Plan, the cash outflows consist of the monthly payouts P starting at the Payout Age c until death at age g, with possible bequest B_g payable upon death. If c is less than the Life-annuity Age d, the payouts are funded by the RA from age c to age d and then by the LIF from age d until death. The minimum value of c is the Payout Eligibility Age (currently set to be 65), and it cannot exceed 70. In contrast, the value of d may be from c to 90. If $c = d$, the annuity payouts are entirely funded by the LIF for life and the configuration is similar to the Standard Plan.

As per the plan design, if a member dies at age g before reaching age c, the bequest B_g consists of the balance of his RA R_g and his first installment C_1 to the LIF, i.e. $B_g = C_1 + R_g$, for $55 \leq g < c$. If a member lives to start receiving monthly payouts and chooses $c = d$, a second installment C_2, which is the balance in his RA, is transferred to the LIF. Thus, his RA is depleted and the monthly payouts are funded by the LIF. If he dies after age c, the bequest is the difference between the sum of two installments and the aggregate amount of payouts from the LIF T_g, i.e. $B_g = \max[C_1 + C_2 - T_g, 0]$ for $g \geq c$.

If his choice is $d > c$, C_2 to the LIF is only part of the RA balance, as the rest is used to fund the annuity-certain up to age d. If he dies between ages c and d, the bequest to his beneficiaries is the sum of two installments plus the balance of RA, i.e. $B_g = C_1 + C_2 + R_g$ for $c \leq g < d$; otherwise, the bequest is the difference between the summary of two installments and the aggregate amount of payouts from the LIF. In summary, we can write the bequest B_g as

$$
B_g = \begin{cases} C_1 + R_g, & \text{if } 55 \leq g < c, \\[2em] \max\left[C_1 + C_2 - T_g, 0\right], & \text{if } g \geq c, \end{cases}
$$

for $c = d$ and

$$
B_g = \begin{cases} C_1 + R_g, & \text{if } 55 \leq g < c, \\[1.5em] C_1 + C_2 + R_g, & \text{if } c \leq g < d, \\[1.5em] \max\left[C_1 + C_2 - T_g, 0\right], & \text{if } g \geq d, \end{cases}
$$

for $c < d$.

We now determine the amount C_1 to be transferred from the RA to the LIF at age 55, and the initial estimate of the monthly payout P^*. As the age-parameter configuration is determined at age $c > 55$, our strategy is to determine the value of C_1 so that no transfer from the LIF to the RA is required should other age parameters be chosen later. To this effect, we adopt the minimum value of c and the maximum value of d for the determination of C_1, i.e. $c = 65$ and $d = 90$.[13] Under this configuration, the present value of the future loss of the LIF at age 55, denoted by L_1, is given by

---

[13] With this conservative age-parameter assumption, C_1 is the minimum amount of installment transferred from the RA to the LIF under any possible age-parameter configurations chosen at age c. As a result, no matter what age-parameter configuration is finally chosen, there is no need to transfer funds back from the LIF to the RA.

$$
L_1 = \begin{cases}
-C_1 + C_1 \times v^{K_{55}^{(12)} + \frac{1}{12}}, & \text{if } K_{55}^{(12)} = 0, \frac{1}{12}, \cdots, 34\frac{11}{12}, \\[2em]
-C_1 + v^{35} \times 12P^* \times \ddot{a}^{(12)}_{K_{55}^{(12)} - 34\frac{11}{12}} \\
\quad + \max[C_1 - T_{K_{55}^{(12)}}, \, 0] \times v^{K_{55}^{(12)} + \frac{1}{12}}, & \text{if } K_{55}^{(12)} = 35, 35\frac{1}{12}, \cdots,
\end{cases}
$$

where $T_{K_{55}^{(12)}} = P^* \times (12K_{55}^{(12)} - 419)$ for $K_{55}^{(12)} \geq 35$.

Let t_1 be the term (in years) of the monthly decreasing term insurance benefit covered by C_1 after age 90. Invoking the equivalence principle that the actuarial present value of cash inflows equals the actuarial present value of cash outflows, P^*, C_1 and t_1 can be obtained simultaneously by solving a system of equations and inequalities, so that

$$
P^* = \frac{C_1 \times \left(1 - A^{\quad(12)}_{55:\overline{35+t_1}|}\right)}{12 \times {}_{35}E_{55} \times \left[\ddot{a}^{(12)}_{90} - (I^{(12)}A)^{\quad(12)}_{90:\overline{t_1}|}\right]}
$$

subject to $12t_1 P^* < C_1 < (12t_1 + 1)P^*$ and the annuity-certain constraint $(1+i)^{10}(R_{55} - C_1) = 12P^* \times \ddot{a}^{(12)}_{\overline{25}|}$.[14]

At age 65, if the member really chooses the age-parameter configuration of $c = 65$ and $d = 90$, and no new money is contributed to the RA, the monthly payout is $P = P^*$. In other cases, we have to re-calculate the monthly payouts.

If the member chooses the configurations of $d = c$, the RA is closed after $C_2 = R_c$ is transferred from the RA to the LIF. The payouts are then funded by the LIF for life. Under the configuration of $d > c$, the monthly payouts are funded from two sources. From ages c to d, the payouts are paid from the RA as an annuity-certain and from age d onward they are paid from the LIF as a life-annuity. However, the payouts have to be level throughout the two periods so that members receive a stable monthly income. To meet this condition, C_2 and P have to be determined jointly according to actuarial principles.

Note that C_1 can be regarded as the cost of purchasing two insurance products at age 55: a $(c - 55)$-year term insurance with death benefit C_1 and a $(c - 55)$-year pure endowment insurance policy with survival benefit V_1, where V_1 can be determined by solving the following equation

$$
C_1 = C_1 \times A^{\quad(12)}_{55:\overline{c-55}|} + V_1 \times A_{55:\overline{c-55}|}^{\quad 1}.
$$

Thus, if the CPF member survives to age c, the balance in the LIF is actuarially equivalent to the survival benefit V_1 of a pure endowment insurance policy.

Let L_2 be the present value of the future loss of the LIF at age c and t_2 be the term of the monthly decreasing term insurance covered by LIF at age d. The variable L_2 is then given by:

---

[14] Note that $(1+i)^{10}(R_{55} - C_1)$ is the projected balance in the RA at age 65 based on the balance of the RA after the first installment transferred to the LIF at age 55.

$$
L_2 = \begin{cases} -V_1 - C_2 + (C_1 + C_2) \times v^{K_c^{(12)} + \frac{1}{12}}, & \text{if } K_c^{(12)} = 0, \frac{1}{12}, \cdots, e - \frac{1}{12}, \\[4em] -V_1 - C_2 + v^{t_2} \times 12P \times \ddot{a}^{(12)}_{\overline{K_c^{(12)} - e + \frac{1}{12}}\rceil} \\ + \max[C_1 + C_2 - T_{K_c^{(12)}}, 0] \times v^{K_c^{(12)} + \frac{1}{12}}, & \text{if } K_c^{(12)} = e, e + \frac{1}{12}, \cdots, \end{cases}
$$

where $e = d - c$ and $T_{K_c^{(12)}} = P \times [12K_c^{(12)} - 12e + 1]$ for $K_c^{(12)} \geq e$. Based on the equivalence principle, P, C_2, and t_2 can be evaluated by solving

$$
P = \frac{V_1 + C_2 - (C_1 + C_2) \times \left(1 - A^{1}_{c:\overline{e+t_2}\rceil}^{(12)}\right)}{12 \times {}_eE_c \times \left[\ddot{a}^{(12)}_d - (I^{(12)}A)^{1}_{d:\overline{t_2}\rceil}^{(12)}\right]}
$$

subject to $12t_2 P < C_1 + C_2 < (12t_2 + 1)P$ and

$$
C_2 = \begin{cases} R_c, & \text{if } c = d, \\[1em] R_c - 12P \times \ddot{a}^{(12)}_{\overline{e}\rceil}, & \text{if } c < d, \end{cases}
$$

where R_c is the balance in the RA at age c, inclusive of any new money amount.

Finally, we note that if $c = d$, C_2 is the RA balance R_c and P can be calculated directly after solving for V_1. If $c < d$, however, C_2 and P have to be determined jointly by iteration.

Appendix B   Determination of LIF Components

In the current LIFE scheme, the two installments transferred from the RA to the LIF are considered as separate premiums to two different funds. As a result, each of these two funds is used to fund part of the monthly payouts and part of the bequest. However, under the Unified Plan, the only annuity fund LIF is considered as a notional account directly funding the life-annuity payouts and possible bequests. It is hence simpler to analyze the benefits and costs provided by the LIF at different stages of the plan under different plan choices.

The Unified Plan can be divided into three stages. Stage 1 is from ages 55 to c, Stage 2 is from ages c to d and Stage 3 is from age d to death. If $c = d$, Stages 2 and 3 are collapsed into a single stage. As discussed in Appendix A, C_1 transferred from the RA to the LIF at age 55 is the cost to cover a term insurance and a pure endowment insurance with maturity at age c. If the member lives to age c, the LIF balance is equivalent to the survival benefit V_1 of a pure endowment insurance. Otherwise, the bequest payable is the sum of the death benefit C_1 from the LIF and the balance in the RA at the time of death.

If $c < d$ in Stage 2, the amount $V_1 + C_2$ at age c is used to cover the costs of two insurance products: an e-year term insurance with death benefit $C_1 + C_2$ and an e-year pure endowment insurance with survival benefit V_2. Hence,

$$
V_1 + C_2 = (C_1 + C_2) \times A^{1}_{c:\overline{e}\rceil}^{(12)} + V_2 \times A_{c:\overline{e}\rceil}^{1},
$$

from which we can solve for V_2. If the member lives to age d, the LIF balance is equivalent to the survival benefit V_2 of the pure endowment insurance. Otherwise, the amount of bequest payable is the sum of $C_1 + C_2$ from the LIF and the balance in the RA at the time of death. From age d onward (Stage 3), the reserve V_2 at age d is used to fund two insurance products: a life-annuity with monthly

payments P and a decreasing t_2-year term insurance with bequest $B_g = C_1 + C_2 - T_g$ for $g < t_2$ and zero for $g \geq t_2$.

However, if $c = d$ the amount $V_1 + C_2$ is used to fund the life-annuity and decreasing term insurance. In summary, we have the following result:

$$12P \times \ddot{a}_d^{(12)} + (C_1 + C_2) \times A^{\,1}_{d:\,\overline{t_2|}}{}^{(12)} - 12P \times (I^{(12)}A)^{\,1}_{d:\,\overline{t_2|}} = \begin{cases} V_1 + C_2, & \text{if } d = c, \\ V_2, & \text{if } d > c. \end{cases}$$

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