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Balancing Act: Exploring Intergenerational Risk in Target Benefit Plans

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Abstract

Target benefit plans (TBPs) combine features of defined benefit (DB) and defined contribution (DC) plans, gaining international attention in countries like Canada, the Netherlands and the United Kingdom (UK). Canadian provinces have embraced TBPs, drawing inspiration from the Dutch Collective Defined Contribution (CDC) system. In parallel, the UK has made progress in the legislation for CDC schemes.

Central to TBPs is the concept of intergenerational risk-sharing, stemming from the collective nature of these plans. Contributions and investments are pooled, aiming to distribute risks and provide stable retirement incomes. However, this approach raises concerns about fairness, equity and cross-subsidies between generations. TBPs aim to address these complexities while fostering collective risk-sharing.

Building upon the Institute and Faculty of Actuaries' (IFoA) study of the Royal Mail CDC Scheme, this paper delves into three types of intergenerational cross-subsidies within TBPs: implicit cost transfers, shifts in investment risk and temporal cross-subsidies. Our objective is to deepen the understanding of intergenerational risk within these plans, informing legislative policy development and facilitating transparent, equitable plan designs.

TBPs present a promising solution in retirement planning, contingent on robust legislative policies. Careful management of intergenerational risk, thoughtful plan design and attention to the membership declining phase are vital for their success. This paper contributes to innovative retirement planning, with an aim to promoting financial security for present and future retirees.

Practical applications summary

This research offers practical applications for policymakers and retirement plan decision makers:

1. **Guidance for policymakers:** The findings and recommendations serve as a roadmap for policymakers shaping TBP-related legislative policies. Understanding TBPs' nuances and intergenerational risks helps craft regulations that ensure transparency, fairness and sustainability. This includes considerations during plan registration, operation and the declining phase, promoting equitable treatment of plan members.
2. **Plan design and operation:** Plan decision makers can make informed decisions about contribution rates, benefit level and adjustments, and overall plan design using the insights provided. Aligning these elements with TBPs' primary objective, delivering target retirement benefits with predefined contributions over members' working lives, mitigates undue risk.
3. **Ensuring fairness across generations:** Maintaining fairness and equity among plan members across generations is crucial. Addressing intergenerational risk-sharing enhances benefit stability and predictability, benefiting current and future members. The research provides a framework for adjusting contribution rates and/or benefits to ensure consistent fairness.
4. **Risk management in the declining phase:** As TBPs enter the declining phase, protecting benefits, especially for older members, becomes crucial. Administrators can explore risk transfer mechanisms, like annuity purchases, to safeguard benefits in challenging market conditions. Practical applications focus on effectively managing this phase.

In summary, this research informs policymaking, plan design and operation, promotes fairness across generations, and manages risks in TBPs. Stakeholders in retirement planning can leverage these insights to create more robust, equitable and sustainable pension solutions.

1. Introduction

Target benefit plans (TBPs) are unique financial arrangements that blend elements of both defined benefit (DB) and defined contribution (DC) pension plans. They offer a flexible approach to retirement planning by establishing predefined benefit levels and specified contribution rates. In essence, TBPs provide the stability of pooled pension plans while allowing for adjustments to contributions or benefits over time. Unlike traditional DB plans, TBP benefits are not fixed, and participants, including employees and retirees, share the associated risks.

Within a TBP framework, employer contributions and liabilities are limited to predetermined levels. While a minimum benefit level may be guaranteed, contributions and benefits are tailored to affordability and influenced by the plan's investment performance and other experience factors. Shortfalls in funding are addressed collectively by employees and retirees through increased contributions or reduced benefits, while surpluses are distributed to them. Notably, under a TBP, investment and longevity risks are collectively shared among all members, distinguishing it from DC plans where individual members assume their own risks.

1.1 Legislative landscape

Hybrid plans like TBPs have gained traction in various jurisdictions, including the Netherlands,[1] Canada and the United Kingdom (UK). In the Netherlands, the Collective Defined Contribution (CDC) model (another term for a TBP) bases pension benefits on average career earnings, which are not fully guaranteed and depend on the plan's investment performance. Employers contribute a fixed percentage of employees' salaries and bear no liability for investment fund underperformance (Dutch Association of Industry-wide Pension Funds, 2010). Employee contributions remain static for a specific period and are subsequently negotiated. In cases of underfunding, the plan's governing body may choose to reduce indexation, lower future benefit accrual rates or decrease accrued pension benefits.

In Canada, New Brunswick introduced a shared-risk pension plan model in 2012, inspired by the Dutch system (New Brunswick, 2012). Under this model, both employees and retirees collectively share the responsibility of addressing pension shortfalls, with the option to increase contributions or reduce benefits in such instances. Several Canadian provinces, including Quebec, Alberta and British Columbia, followed suit by enacting TBP legislation and regulations between 2012 and 2015. However, the two largest pension jurisdictions, Ontario and the federal government, have not fully implemented these measures.

In contrast, the UK has made significant progress in implementing CDC schemes. In 2018, Royal Mail and the Communication Union collaborated to advocate for legislative changes from the UK government to facilitate CDC schemes. With the enactment of the *Pensions Plans Act* 2021, CDC schemes are on the verge of becoming a reality, granting trustees the authority to seek authorization to operate them (Mirza-Davies, 2022).

1.2 Intergenerational risk

Intergenerational risk is a central consideration in the design of TBPs due to their collective nature. Unlike traditional DC plans, where each member has their own individual pension account, TBPs pool the contributions and investments of all members to provide a target retirement benefit. They are designed to smooth out fluctuations in retirement income as a result of uncertain investment returns and life expectancy. The pooled fund is invested, and retirement benefits are paid out based on the performance of the investments and the overall health of the fund. The goal is to provide a better and more predictable retirement benefit by spreading risk among plan members. While this pooling offers advantages, it also introduces complexities related to fairness and equity between different generations of plan members.

The pooling of resources across generations can lead to intergenerational dynamics that need careful consideration. Some generations of members might benefit more from favourable investment returns and longer lifespans, while others might experience less favourable outcomes. The main concern of

[1] After lengthy negotiations between social partners and the government, a new pension legislation is being implemented in the Netherlands. All occupational pension plans are required to transition to a defined contribution basis under the new legislation.

intergenerational risk-sharing is whether the distribution of benefits across generations is fair and equitable. Because TBPs aim to smooth out individual outcomes, members who experience better investment returns might cross-subsidize those who do not.

In summary, intergenerational risk in TBPs emerges from the desire to provide a more stable retirement income through collective risk-sharing. However, this approach also introduces complexities related to fairness and equity among different generations of plan members. Proper communication, transparency and thoughtful plan design are essential to address these complexities and strike a balance between the benefits of collective risk-sharing and ensuring fairness for all members.

1.3 Motivation for this paper

This paper draws inspiration from the IFoA’s comprehensive study on intergenerational cross-subsidies in TBPs, with a particular focus on the Royal Mail CDC Scheme (the “IFoA’s study”) (Donnelly, 2022). CDC schemes are designed to maintain fixed contribution rates while offering variable benefits, all with the overarching goal of distributing investment and longevity risks among members to enhance retirement outcomes. What sets the Royal Mail CDC Scheme apart is its use of a collective risk-sharing mechanism, notably annual pension increases, distinguishing it from other types of TBPs.

Our paper delves into the intricate concept of intergenerational cross-subsidies within TBPs, focusing on three distinct types of cross-subsidies and their ramifications. The first type centers on the fundamental principle of financial fairness, illuminating the transfer of costs from earlier to later generations, which results from the lack of compatibility between the plan’s design and the methodology used in plan valuations. The second type involves the intentional transfer of investment risk from older to younger members, a strategy aimed at achieving pension smoothing. The third type encompasses cross-subsidies over time, stemming from economic and demographic projections employed in plan valuations not borne out by plan experience.

Our goal is to provide an in-depth exploration of the intergenerational risk issues by demonstrating and explaining the mechanisms that drive cross-subsidies within the framework of a TBP. In doing so, we aim to contribute to a better understanding of the intricate design choices that underpin this type of plan and to offer insights that can inform the ongoing development of related legislation and regulations.

Our analysis of intergenerational risk involves a comparison of TBPs with individual defined contribution plans (IDCs), specifically concentrating on the accumulation phase before retirement. We focus on the impact of investment return risk, deliberately excluding other considerations such as salary adjustments, variations in retirement age and post-retirement longevity. While our approach is focused, we believe that it will offer valuable insights into understanding the dynamics of intergenerational risk-sharing within TBPs.

In the subsequent sections of this paper, we embark on an exploration of TBPs and their risk-sharing dynamics. Section 2 delves into the specifics of the UK CDC schemes, shedding light on their unique features and the legislative landscape that surrounds them. Section 3 presents our model of a target benefit plan, providing a conceptual framework to understand the underlying mechanics. Sections 4 through 9 examine various aspects of TBPs, from financial fairness and cost transfer to investment risk-sharing and the ramifications of incorrect assumptions. In Section 10, we bridge the gap between theory and practice by discussing the implications of our findings for legislative policies. Finally, in Section 11, we draw the threads together in our conclusion, summarizing our key insights and emphasizing the significance of TBPs in the evolving landscape of retirement planning.

2. United Kingdom collective defined contribution schemes

In this section, we will explore the unique features and principles of UK CDC schemes. Designing a TBP presents several challenges, chief among them being the need to establish clearly defined, sustainable, and equitable processes for valuations and benefit adjustments. Different TBPs employ distinct strategies for valuations and benefit adjustments. For example, the Dutch CDC plans rely on buffers (capital requirements) to ensure the security of benefits, whereas the Danish Labour Market Supplementary

Pension Plan (ATP) allocates 80% of the contribution to purchase new individual pension rights with the ATP, and the remaining 20% of the contribution is transferred to the ATP's free reserves serving as an investment buffer and financing source for longevity increases (OECD, 2021). On the other hand, Canadian plans focus on setting out pre-defined rules in response to changes in funding positions, thus mitigating the discretionary nature of benefits.

In contrast to the Dutch or Danish model, the UK approach to CDC schemes distinguishes itself by abstaining from the use of buffers. This approach, while potentially resulting in greater year-to-year volatility in benefits, aims to reduce intergenerational cross-subsidization. To minimize intergenerational unfairness within the UK CDC system, three core principles have been established: regular benefit adjustments, equitable treatment of all member cohorts during adjustments, and valuations that avoid excessive optimism or excessive prudence (Wilkinson, 2022).

A case in point: Royal Mail's Collective Defined Contribution Scheme

Consider Royal Mail's adoption of a CDC scheme in February 2018 following the closure of its defined benefit scheme. Under this arrangement, scheme members contribute 6% of their pensionable pay, while Royal Mail contributes 13.6%. The target pension is set as 1/80th of pensionable pay for each year of service plus annual revaluation.

In Royal Mail's design, the impact of asset market fluctuations is smoothed over the long term through adjustments to the future rate of pension increases. The adjustments are designed to ensure the stability of benefits for members over the long term.

In general, CDC schemes operate with fixed contributions, with long-term pension levels contingent upon the scheme's ability to generate asset returns and the actual lifespans of its members. At the outset of a CDC scheme, an estimate is made regarding the pension levels that can be provided by the fixed contributions, assuming that targeted asset returns and life expectancies remain constant.

Figure 2.1 illustrates the "headroom" funding for future pension increases, reflecting the balance between the asset and pension liability values. Initially, this headroom funding is adequate to provide for increases of Consumer Price Index (CPI) +1% per annum under Royal Mail's CDC Scheme, designed to absorb deviations between asset and liability values (Willis Towers Watson, 2020). "Accrued liability" in the figure stands for the amount of funding required to sustain existing level of pension benefits with no further increases.

Figure 2.1: The Royal Mail CDC Scheme

While we lack access to the specific details of how the accrued pension is adjusted in the Royal Mail CDC Scheme, we can draw from the IFoA's study for insight (Donnelly, 2022). An annual valuation of the scheme's assets and liabilities is conducted, with liabilities calculated as the present value of accrued benefits for all members. This value is then compared to the market value of assets at the valuation date.

To maintain financial balance, an annual pension increase rate (h) is applied to each member's accrued pension. The rate (h) is determined by equating the asset value to the present value of projected benefits payable at retirement for all members, with future pension increases from the valuation date to the retirement date at the rate of h. This process ensures that the scheme's assets can cover the benefits accrued by members up to that point in time, including a rate of future pension increases.

In short, the intent of this approach is to ensure that pension increases are applied uniformly to all generations of members in the plan in a way that keeps the scheme financially in balance (based on its measurement of assets and liabilities).

3. Model of a target benefit plan

Intergenerational risk-sharing plays a crucial role in the context of TBPs but remains a subject of contention. These plans operate by redistributing risk from older to younger members, thereby enabling the plan to pursue more aggressive investment strategies while shielding older members from the ensuing volatility. To illustrate and better understand the risk-sharing within a TBP, we conduct our analysis based on a model plan that mimics the main features of the Royal Mail CDC Scheme.

The Royal Mail CDC scheme serves as a focal point in our exploration of intergenerational cross-subsidies within TBPs for specific reasons. While TBPs are globally relevant, the Royal Mail scheme's distinctive benefit adjustment mechanism offers a unique lens through which to examine intergenerational risk-sharing. Its approach to benefit adjustments sheds light on potential cross-subsidies among different generations of participants that could exist in other TBPs. By closely examining this scheme, we aim to reveal broader implications inherent in various benefit adjustment mechanisms within TBPs. The scheme's prominence within the UK pension landscape and its characteristic collective risk-sharing model render it a suitable case study to understand how a benefit adjustment mechanism may influence intergenerational fairness and the distribution of benefits among plan participants in TBPs in diverse international contexts.

3.1 Plan provisions

The key features of our model plan are outlined below:

- **Pensionable pay**: Comprises the basic salary only.
- **Employee contributions:** None required.
- **Employer contributions:** Set at 10.8% of pensionable pay; see subsection 3.3 for how this rate is determined.
- **Target retirement benefit:** Calculated as 1/60th of pensionable pay for each year of service, subject to indexing up to the retirement age.
- **Pre-retirement indexing:** Targeted to CPI but subject to revaluation.
- **Other ancillary benefits:** None included.
- **Normal retirement age:** Set at 65.
- **Normal form of pension:** A lifetime pension with a fixed-rate indexing.

The retirement benefit is assumed to be distributed at the normal retirement age as a lump sum, equivalent to the lifetime pension amount inclusive of future indexing, payable at that specific age. This deliberate decision of benefit settlement aimed at streamlining the analysis to shed light on intergenerational cross-subsidies within TBPs, effectively bypassing considerations of post-retirement longevity/investment risk.

3.2 Membership characteristics

We assume the presence of 120 generations of members throughout the plan's existence. The first generation joined the plan 40 years ago (denoted as time 0), with each subsequent generation joining in consecutive years. The current generation, the 40th generation, enters the plan at time 39, and the final generation joins the plan at time 119. Each generation comprises 100 members with identical pensionable pay. All members enter the plan at age 25, survive until age 65 and then retire. The current level of annual pensionable pay for all members in the plan is $50,000. The pay level of each generation surpasses that of the preceding generation by 3%.

The life of the plan unfolds in three distinct phases:

- **Growing phase:** Occurs from time 0 to time 39, during which the membership grows.
- **Stationary phase:** Extends from time 40 to time 119, with a stable membership of 4,000 members distributed evenly between ages 25 and 64.
- **Declining phase:** Begins at time 120 and continues until the last member retires at time 159, characterized by a shrinking membership.

Our analysis employed an idealized representation of pension plan membership to delineate the distinct phases of pension plans. However, actual plan memberships are more intricate. At the outset of a plan, members join at various career stages and income levels, resulting in a diverse demographic composition. Moreover, the transition into the declining phase might not be sudden; it could involve gradual reductions or even fluctuations in the influx of new members.

While our membership model may not capture the complexities of real-world scenarios, its intentional simplicity served a purpose. It allowed for a more focused examination of intergenerational cross-subsidies, providing valuable insights into their impact on a plan's financial sustainability and the equitable distribution of benefits among different generations. Although a more realistic membership structure exists, incorporating such complexity might have obscured rather than illuminated the complex dynamics of intergenerational risks.

3.3 Static economic and mortality assumptions

Our analysis is based on straightforward, constant economic and mortality assumptions:

- The expected long-term investment return of the pension fund is 6% per annum (net of expenses), derived from an investment portfolio with significant exposure to risky assets such as equities.
- Salary growth is assumed to be 3% per annum.
- The target inflation rate is set at 2% per annum.
- Post-retirement mortality rates are based on a standard mortality table, yielding a life annuity factor at age 65 of 15. This annuity factor is determined based on a 6% discount rate and an annual indexing rate of 2%.

Given a discount rate of 6%, a salary growth rate of 3%, and a pre-retirement indexing rate of 2%, an employer contribution rate of 10.8% is projected to accumulate a sufficient amount of fund to provide for the target retirement benefit, inclusive of indexing at 2% following retirement, in respect of a member who joined the plan at age 25. The target income replacement ratio for a retired member at age 65 is estimated to be 56.6% of their final-year pay. The mathematical formula for calculating the specified contribution rate is provided in Appendix A.

3.4 Benefit adjustment mechanism

In Royal Mail's pension model, members' pension benefits are systematically accrued each year, calculated as a predefined percentage of their pensionable pay. These accrued pension benefits undergo annual adjustments over the course of members' remaining working years, with the specific rate of increase or decrease contingent upon the plan's funding position. The increase (or decrease) rate will be referred to as the "indexing rate" throughout this paper.

As noted above, a contribution rate is established as a fixed percentage of members' pensionable pay when the plan is established. On each anniversary date following the plan's inception, the Royal Mail CDC Scheme calculates the applicable indexing rate by comparing (1) the value of fund assets with (2) a funding target determined as the present value of members' accrued benefits at the calculation date, with targeted indexing up to members' retirement. The indexing rate is then adjusted to ensure that the values of these two components are identical.

The aforementioned model forms the basis of our subsequent analysis. Particularly, our analysis will focus on the period spanning from members' enrollment in the plan to their retirement date, encompassing the accumulation phase of their retirement planning horizon.

4. Financial fairness in target benefit plans

The IFoA's study (Donnelly, 2022) delves into the concept of intergenerational cross-subsidies within Royal Mail-like CDC schemes. It identifies a particular type of cross-subsidy pertaining to the concept of financial fairness. This cross-subsidy revolves around the transfer of costs from earlier to later generations, due to a predefined benefit accrual rate and contribution rate structure.

Within the existing literature on TBPs, the notion of financial fairness commonly entails ensuring that the discounted value of benefits accrued aligns with each contribution made (Cui, De Jong, & Ponds, 2011). In simpler terms, the present value of benefits associated with each contribution should equate to the contribution amount itself.

An anomaly comes to light in the context of the Royal Mail CDC Scheme, stemming from a lack of financial fairness in the way benefits being accrued over time. Specifically, the annual pension increase calculation compares the accumulated value of contributions with a funding target set as the present value of benefits accrued in relation to those contributions. When the early generations of members join the scheme, their contributions are well in excess of the value of benefits they have accrued, primarily due to being in the early stages of their careers. To rectify this disparity and ensure that the value of accrued benefits aligns with the value of contributions made, the annual pension increases for these early generations tend to be relatively high. This anomaly persists, potentially leading subsequent generations to bear the cost burden of the initial imbalance.

To address this financial inequity, the IFoA's study recommends the adoption of an age-related benefit accrual approach. Under such a plan design, when two members contribute the same amount to the plan, the younger member accrues a higher pension amount compared to their older counterpart. This strategy has the potential to mitigate certain financial imbalances and reduce the magnitude of pension increases granted to the earliest generations of members.

In the ensuing section, we will illustrate how the benefit costs are transferred across generations as a result of the benefit adjustment mechanism within the modelled TBP. Furthermore, we will introduce an alternative strategy to address this challenge of financial inequity.

5. Cost transfer in the model plan

To explore the cost transfer issue within the model plan, we begin our analysis with an examination of the relationship between contributions and accrued benefits throughout a member's career, while considering the targeted annual pension increase. Notably, the contribution rate stands at 10.8% of the member's pensionable pay, while the annual benefit accrual is set as 1/60th of pensionable pay, accompanied by a target indexing rate of 2% per year leading up to retirement. The annual pensionable pay is assumed to be $50,000 in year 40, adjusted for a wage growth rate of 3% over 39 years, resulting in a pay level of $15,788 in the first year of plan operation.

5.1 Benefit accruals within a single generation

Figure 5.1 provides a year-by-year comparison between contributions made and the corresponding values of accrued benefits for a member of the initial generation, taking into account the target indexing rate. It's evident that during the early years of the member's career, the annual contribution exceeds the value of the accrued benefit attributable to that contribution. This relationship undergoes a reversal from age 44 onward.

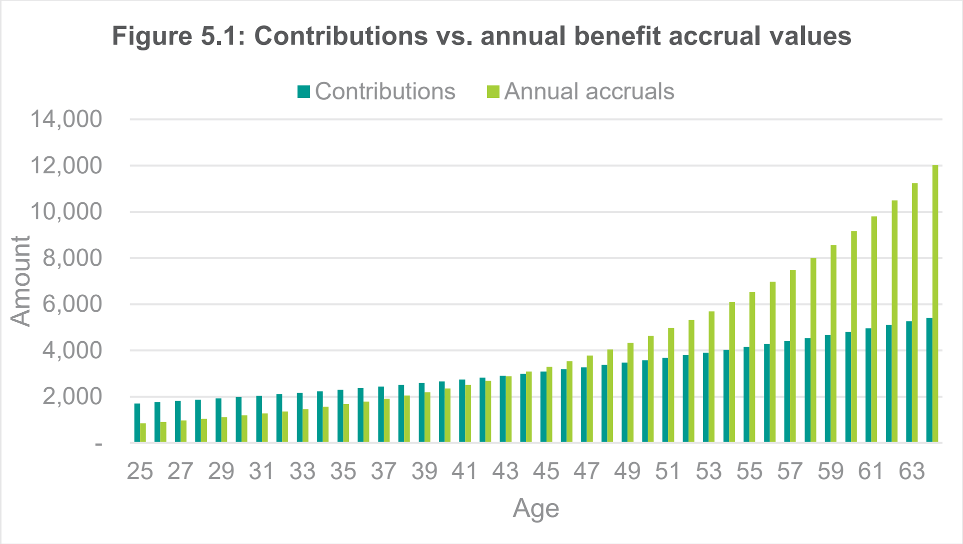
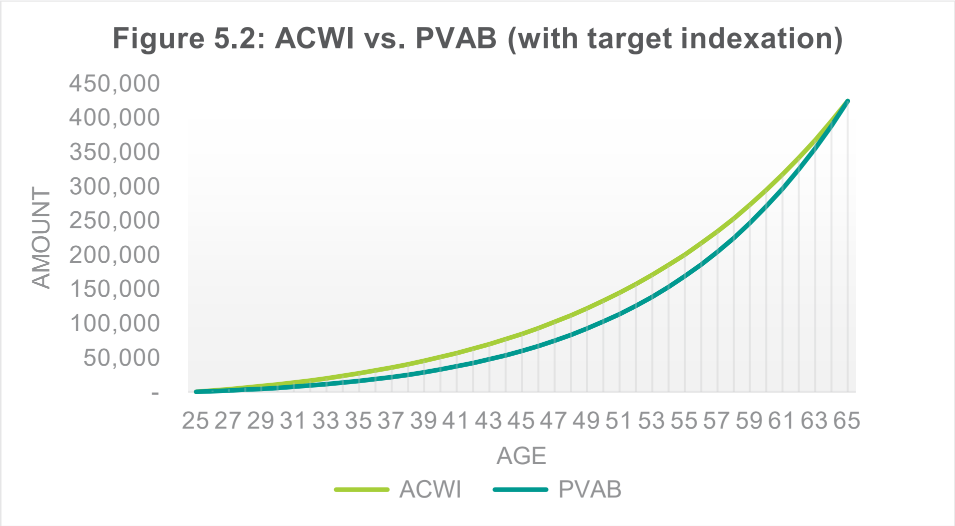
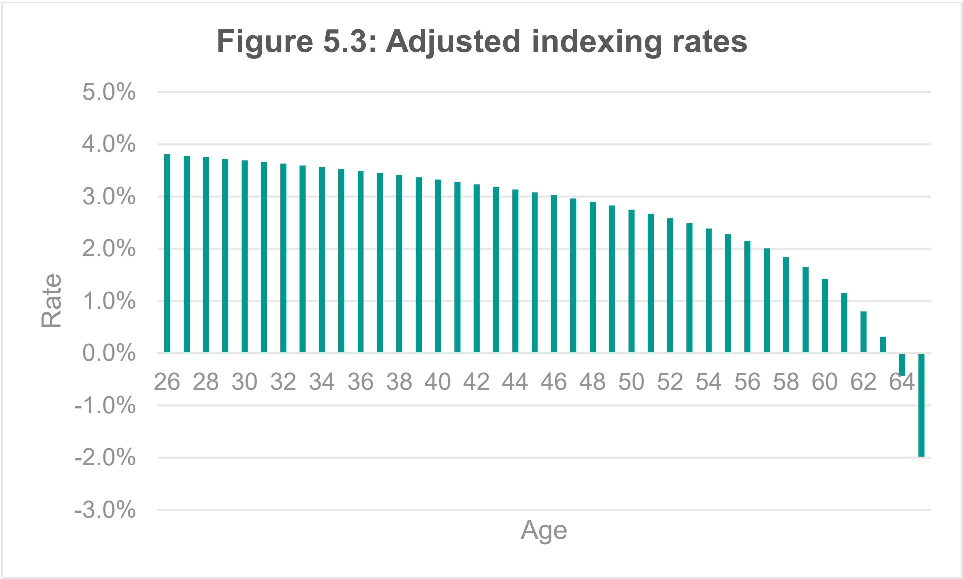


Figure 5.2 below reveals that the accumulated value of contributions with interest $(ACWI)$ consistently exceeds the present value of accrued benefits $(PVAB)$ related to those contributions, with targeted indexation up to retirement. These values ultimately converge at age 65, aligning with the plan's objective of accumulating the required amount of fund to meet the target retirement benefit, provided that all assumptions employed in the valuation are fully realized.



Collectively, these graphical representations highlight that financial fairness is achieved for members on a full career basis but does not apply to the benefit accrued for each individual contribution.

An anomaly arises within the benefit adjustment mechanism of the model plan as it determines the indexing rate by comparing the accumulated value of contributions made with the present value of the benefits accrued by members during each plan valuation. Figure 5.3 below depicts the resulting indexing rates.



The indexing rate decreases from 3.8% at age 26 to approximately 2% at age 57, eventually declining to below 0% towards the end of one's career. This is evidently incongruent with the primary objective of the model plan design, which is to provide a target indexing rate of 2% per year.

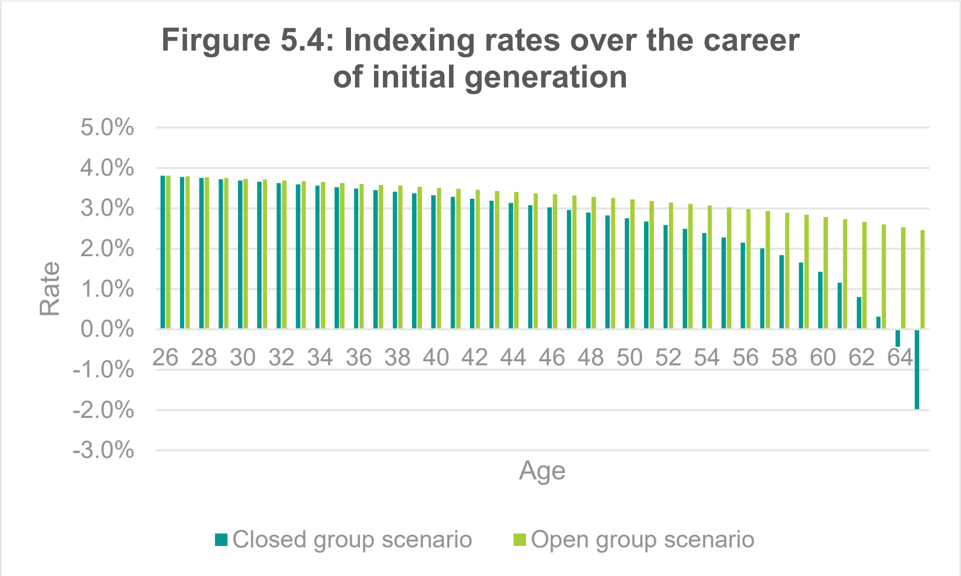
5.2 Cost transfers across generations

The plan's benefit adjustment mechanism effectively maintains equilibrium over the course of members' careers within a single generation by continuously adjusting indexing rates to ensure that the value of benefits accrued aligns with total contributions made, inclusive of interest. However, this balance is disrupted when new members are allowed to join the plan. In the subsequent discussion, we will provide a detailed exploration of this phenomenon.

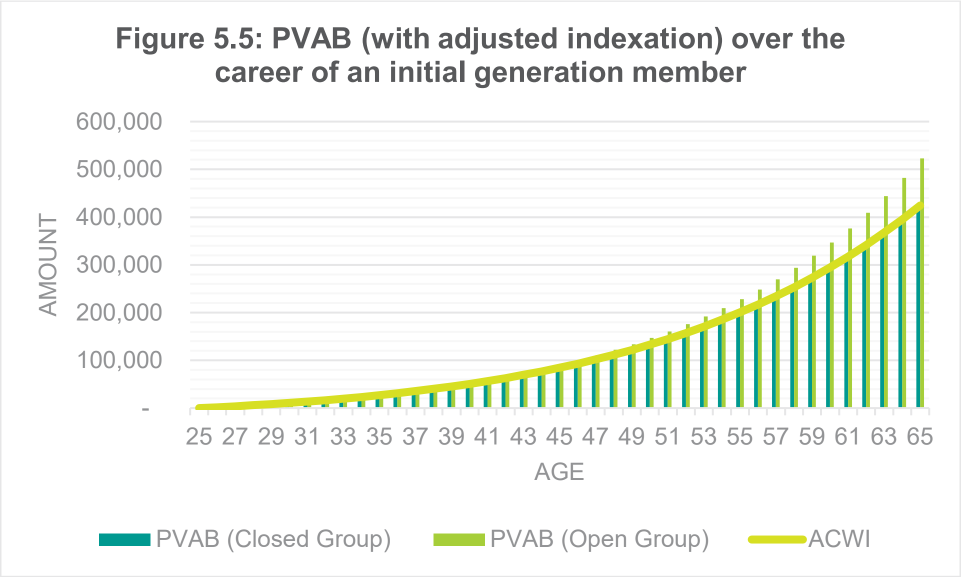
The mathematical foundation for the analysis presented in this section is provided in Appendix B.

Impact of the benefit adjustment mechanism on the initial generation

Figure 5.4 below presents a comparative analysis of annual indexing rates throughout the career of the initial generation, considering two scenarios: the "closed group" and the "open group." In the closed group scenario, the initial generation exclusively participates in the plan, while the open group scenario allows new members to join during the career of the initial generation.



In the open group scenario, indexing rates continue to decrease over members' careers but maintain levels higher than those observed in the closed group scenario. They gradually diminish from 3.8% at age 26 to 2.5% at age 65, in contrast to the decline from 3.8% to -2% observed in the closed group scenario. Consequently, the fund accumulated through contributions from the initial generation members falls short of the amount necessary to cover their accrued retirement benefits, as shown in Figure 5.5. This funding shortfall is subsequently passed onto future generations of members.



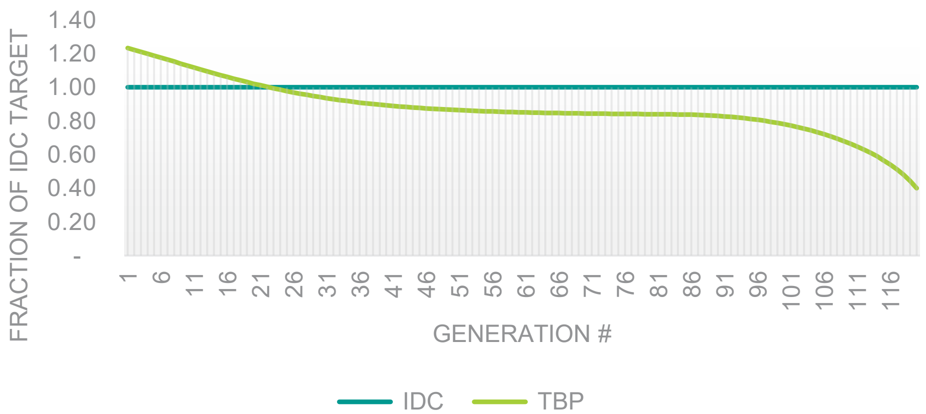
Comparing retirement benefit outcomes between individual defined contribution plans and target benefit plans

On the one hand, in the context of an IDC with a contribution rate of 10.8%, a member's retirement benefit essentially equals the accumulated value of their contributions with interest at the retirement date. On the other hand, the TBP, as modelled, is designed to provide an equivalent retirement benefit, assuming that all underlying assumptions in the plan's valuation materialize, regardless of the time at which members join the plan. However, the mechanism for adjusting benefits under the model plan results in early generations of members receiving significantly higher benefits than later generations.

To demonstrate this outcome, we introduce a metric called the "benefit payout ratio (BPR)" for both of the IDC and the model TBP. The BPR is defined as the ratio of (1) the retirement benefit paid under the plan to (2) the target retirement benefit under the IDC, linked to the contribution rate stipulated in the plan. The IDC target retirement benefit is determined as the accumulated value of contributions with the expected investment return at retirement. (Refer to subsection B.3 of Appendix B.) A plan offers a more favourable retirement benefit for its members if the BPR is greater than 1.0, and vice versa.

Figure 5.6 presents the BPRs under both the IDC and the model TBP over the course of the plan's existence. As expected, the BPR remains at 1.0 for all generations of members under the IDC if the plan fund earns the expected rate of return. In the case of the model TBP, however, the BPR for the initial generation (those who join the plan at time 0) stands at 1.23. For subsequent generations, the BPR progressively decreases, eventually becoming less than 1.0 for the 23rd generation (those who join the plan at time 22) and beyond. As the plan membership enters its declining phase at time 120, the BPRs for plan members experience a sharp decline, starting at 0.80 for the 97th generation and decreasing further to 0.40 for the final generation. It is evident that the early generations of members benefit significantly from the design of the model TBP, while the later generations, especially those in the declining phase of the plan, bear the brunt of the costs associated with the higher benefits provided to earlier generations.

Figure 5.6: Benefit Payout Ratios

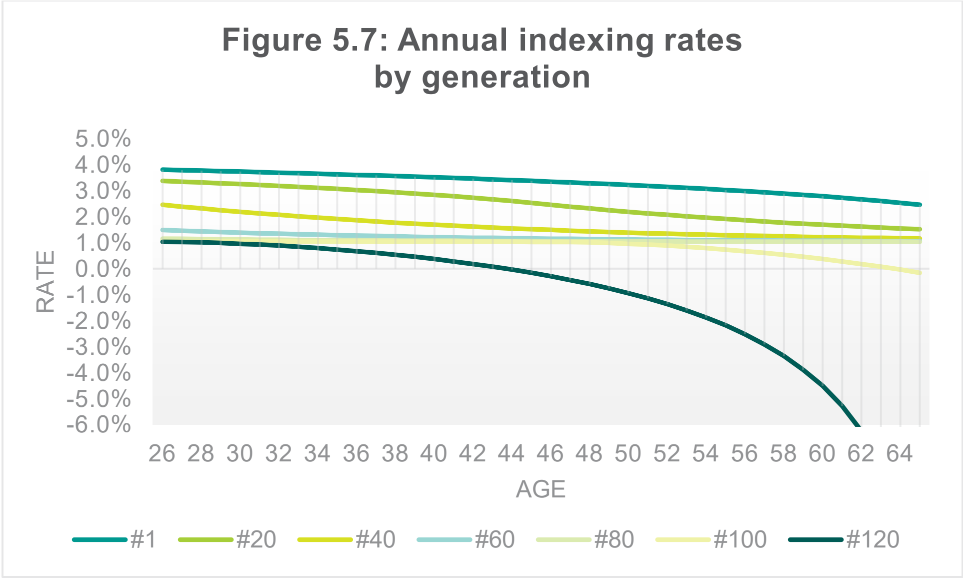


Annual indexing rates across generations

We now delve into the annual indexing rates to illuminate the disparities in benefit payouts among the diverse generations of members participating in the model TBP.

Figure 5.7 illustrates the annual indexing rates in effect for select generations throughout the entire lifespan of the plan. Notably, these rates exhibit a progressively declining trend. The earlier the generation in question, the higher the applied indexing rates tend to be. This phenomenon is especially pronounced during the membership growth phase, exemplified by Generation #1, where the rates materially surpass the 2% targeted indexing rate.

As membership stabilizes into the stationary phase, the rates continue to decline but within a narrower range, as observed with Generations #40, #60 and #80. In the declining phase, these rates exhibit a significant decrease over time, with a particularly pronounced drop for the last generation (Generation #120), where annual indexing rates plummet from 1% at age 26 to -12% at age 65.



Based on the above analysis, it becomes evident that the decreasing trend in BPRs across successive generations can be attributed to the benefit adjustment mechanism at the core of the model plan's operation.

In the next section, we will explore how these disparities in benefit payouts could be remedied and provide recommendations for improving financial fairness across different generations of members.

6. Addressing disparities in benefit payout ratios

The model TBP's benefit adjustment mechanism relies on a comparison of the plan's asset value with a funding target, which is determined using the unit credit cost method (UC method) and is equal to the present value of accrued benefits for plan members (Anderson, 1992).

6.1 Valuation methodology

In a paper titled "An Actuarial Balance Sheet Approach to Assessing the Sustainability of Target Benefit Plans" (Ma, 2017), the author contends that a funding target based on the UC method may inadvertently shift costs from current plan members to future generations. Our analysis in Section 5 supports this perspective, emphasizing the need to address such an unintended transfer of costs.

When a TBP is initially established, the contribution rate is determined as a fixed percentage of members' pensionable pay, ensuring that the present value of contributions made throughout members' career equals the present value of projected benefits members expect to receive upon retirement. This calculation accounts for the benefit accrual rate and the target indexing rate stipulated in the plan.

At a subsequent valuation date, these two present values, denoted as $PVTC$ (present value of total contributions) and $PVTB$ (present value of target benefits), must remain identical for each member in the plan if the initial assumptions hold true. Each of these values can be divided into two components: one for past service and one for future service:

$$PVTC = PVPSC + PVFSC$$

$$PVTB = PVPSB + PVFSB$$

Here:

- $PVPSC$ represents the accumulated value of contributions made prior to the valuation date, which was denoted as $ACWI$ in subsection 5.1.

- $PVFSC$ is the present value of contributions expected to be made for future years of service.
- $PVPSB$ represents the present value of benefits accrued for past years of service with the target indexing rate up to retirement, which was denoted as $PVAB$ in subsection 5.1.
- $PVFSB$ is the present value of benefits accrued for future years of service with the target indexing rate up to retirement.

Thus, we have:

$$ACWI + PVFSC = PVAB + PVFSB$$

Rearranging this equation:

$$ACWI - PVAB = PVFSB - PVFSC$$

To the extent that $ACWI$ exceeds $PVAB$, which is the case throughout the career of a member (see Figure 5.2), the excess should be held as a reserve to cover the expected contribution shortfalls related to future service benefit accruals (i.e., the difference between $PVFSB$ and $PVFSC$). This reserve is necessary to maintain financial balance within the plan. However, this is not the case for the model plan, where the excess is applied to increase members' accrued benefits through its benefit adjustment mechanism.

To rectify this anomaly, we recommend setting the funding target for each plan member as: $PVAB + PVFSB - PVFSC$, instead of considering $PVAB$ in isolation. The funding target for the plan as a whole is equal to $PSL + FSL - PVFC$, where:

- PSL is the sum of $PVAB$ for all members in the plan, representing the plan's past service liability.
- FSL is the sum of $PVFSB$ for all members in the plan, representing the plan's future service liability.
- $PVFC$ is the sum of $PVFSC$ for all members in the plan, representing the present value of contributions made in respect of members' future service.

Mathematical formulas for calculating PSL, FSL and $PVFC$ for the model plan are given in Appendix C.

To facilitate the determination of the applicable indexing rate at a valuation date based on this revised funding target, we can establish a valuation balance sheet for the plan at the valuation date, as outlined in Table 6.1 below.

Table 6.1: Main entries on the valuation balance sheet of the model plan

Assets	Liabilities
Value of fund assets (F)	Past service liability for members (PSL)
Present value of future contributions $(PVFC)$	Future service liability for members (FSL)
Total assets $(1) = F + PVFC$	Total liabilities $(2) = PSL + FSL$
Funding Deficit (Excess) Equals (2) – (1)	

Where there is a non-zero funding deficit or excess, the indexing rate applied in the calculation of PSL can be adjusted to eliminate such deficit or excess.

By adopting this approach, the annual indexing rate can be maintained at the target rate of 2% for all generations of plan members, ensuring that their BPR consistently remains at 1.0, provided that the assumptions underlying the contribution rate specified in the model plan materialize.

For the analyses presented hereafter, we will assume that the model plan adopts a funding target for its benefit adjustment mechanism as that described above.

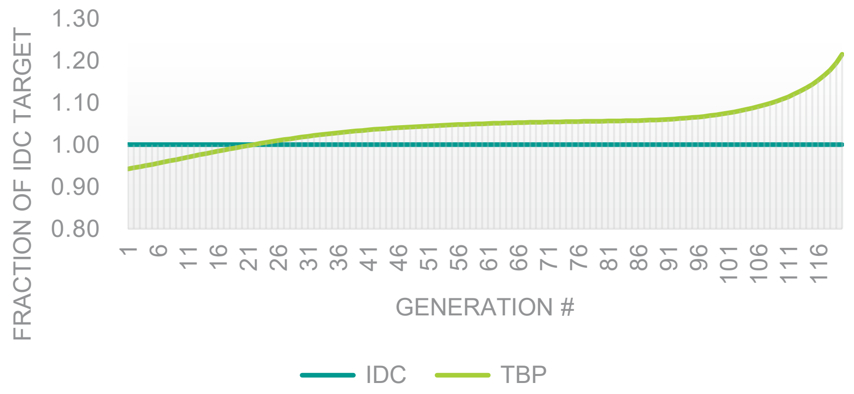
6.2 Valuation assumptions

Here, we examine how the choice of assumptions for valuing a TBP impacts the benefit outcomes for various generations of plan members, particularly when compared to benefits provided under an IDC with the same level of contributions.

The contribution rate stipulated in our model TBP plan stands at 10.8%, which is derived based on an assumed discount rate of 6% per annum. This 6% discount rate reflects the expected rate of return on a balanced investment portfolio. Now, let's consider a scenario where the plan trustees decide to embrace a more aggressive investment strategy, aiming for a higher expected rate of return at 6.5%. To ensure that the plan continues to meet its target benefit commitments, the trustees opt to keep a conservative margin of 0.5% and maintain the 6% discount rate assumption, for establishing the target benefit level and assessing the funded status of the plan.

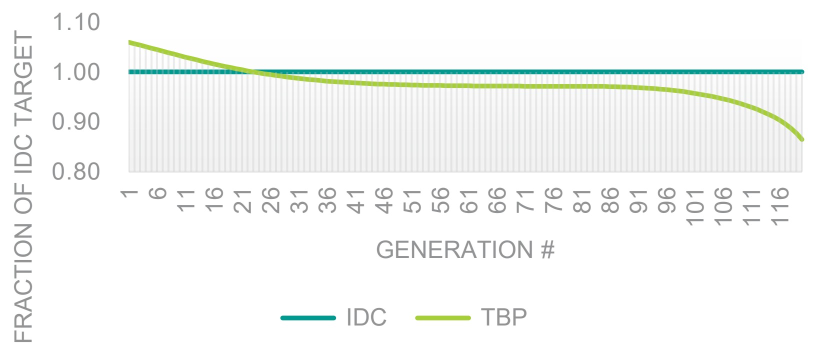
Figure 6.1 illustrates the BPRs across generations, assuming that the pension fund successfully achieves the expected return of 6.5% per annum. Notably, early generations of plan members receive a relatively lower level of benefits compared to their later counterparts. For example, the BPR for the first generation is 0.94, for the 20th generation, it's 1.0, and for the last generation (120th generation) it reaches 1.21. This suggests that later generations of members benefit from the more conservative assumption employed in the plan's valuation, to the disadvantage of the earliest generations.

Figure 6.1: Benefit payout ratios with a 6.5% expected return



Conversely, if the plan trustees overestimate the expected rate of return of the pension fund, projecting a 6% annual return (and using it as a discount rate for the plan's valuation) while the actual return is only 5.5%, the outcome would shift in favour of the early generations. Figure 6.2 illustrates this scenario.

Figure 6.2: Benefit payout ratios with a 5.5% expected return



To uphold the principle of intergenerational fairness, the actuarial assumptions used to assess the funded status of a TBP should not result in more favourable benefit outcomes for certain generations of members at the expense of others. Consequently, a TBP's valuation should employ a central estimate methodology, in setting its assumptions, that avoids unwarranted optimism or excessive prudence.

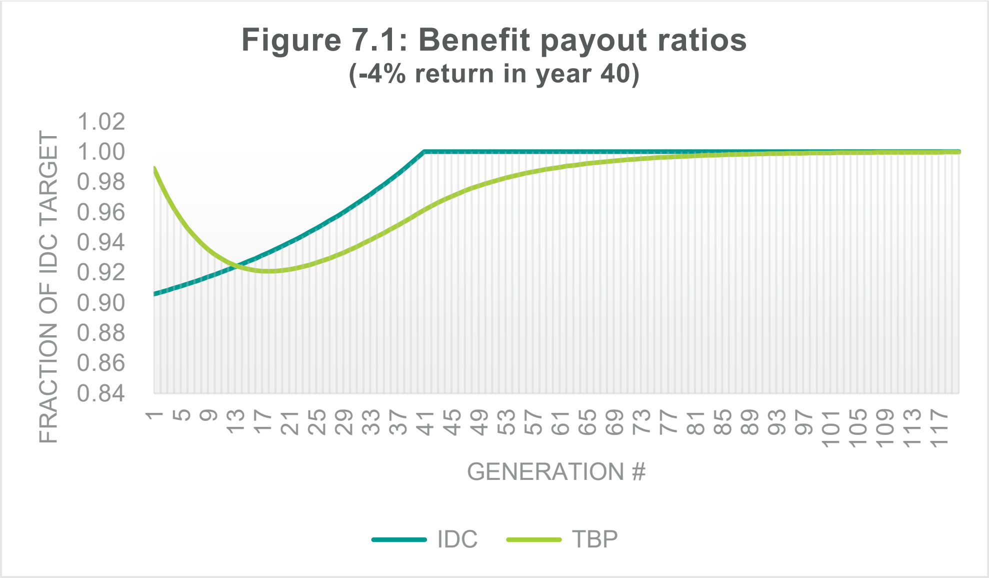
7. Risk transfer in the model plan

On the one hand, in an IDC, older members face elevated investment risk as their retirement accounts have accumulated substantial assets. On the other hand, a TBP allocates investment loss risk across all generations of members, including potential future participants. We illustrate this risk transfer below.

7.1 Impact of investment loss with no recovery during stationary phase

In our model TBP, the plan's contribution rate is determined based on an expected annual fund return of 6%. Now, let's suppose that in the 40th year after the plan's establishment, at the start of the stationary phase, the fund experiences an investment shock, resulting in a -4% return (in other words, a 10% loss relative to the expected 6% return.) Figure 7.1 illustrates how this single-year loss (assuming no further gains or losses) would affect plan members' benefits when compared to the IDC.

While our analysis assumes the IDC being entirely invested in a balanced portfolio, in practice, individuals often reduce their risk exposure as retirement approaches. This adjustment might align IDC payouts more closely with TBPs than suggested in the figure. However, to ensure a more relevant comparison regarding the impact of investment risk between the two plan types, our analysis assumes that the IDC adopts the same investment strategy as the TBP.

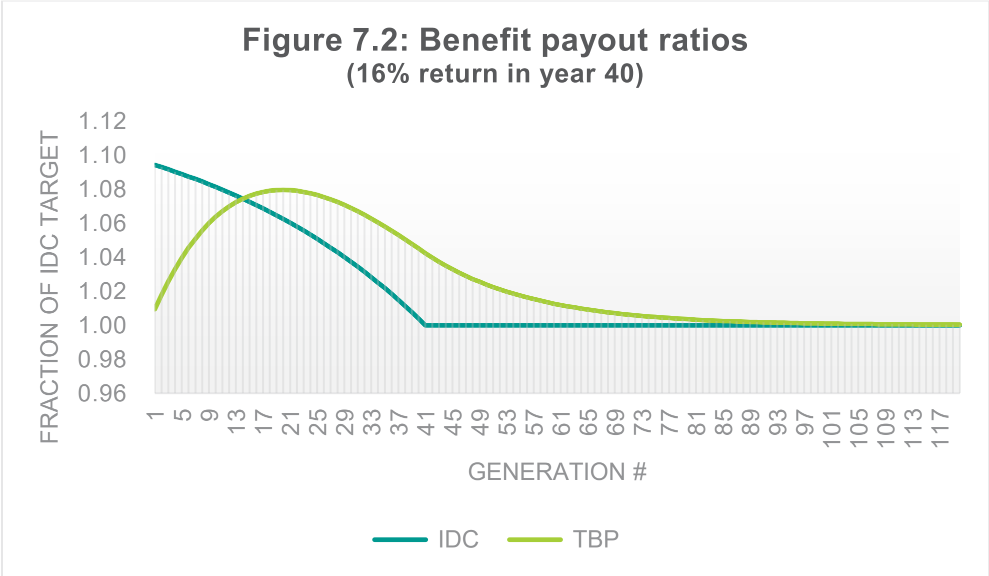


Under the IDC, Generation #1 (the oldest members) faces a 9.4% reduction in benefits compared to their target retirement benefit. Subsequent generations (Generation #2 to Generation #40) experience progressively smaller reductions, with members joining the plan after the investment loss being unaffected.

In the TBP, older generations of members experience comparatively smaller reductions in their benefit payouts. For example, Generation #1 members would only see a 1.1% reduction in their benefits compared to the 9.4% reduction in the IDC. However, mid-career members who joined the plan roughly 20 years ago bear a larger share of the investment loss, resulting in a more substantial reduction in their benefits. For instance, Generation #18 members would experience a 7.9% reduction, although it is less than the 9.4% experienced by the oldest generation in the IDC. The investment loss impacts mid-career members more because they have accrued substantial benefits by the time of the loss, and there are still quite a few years until retirement for the decrease in the indexing rate (as a result of the investment loss) to take effect.

It is essential to note that future plan members can also anticipate a reduction in their benefits, although this reduction becomes negligible for those who join the plan at time 80 or later.

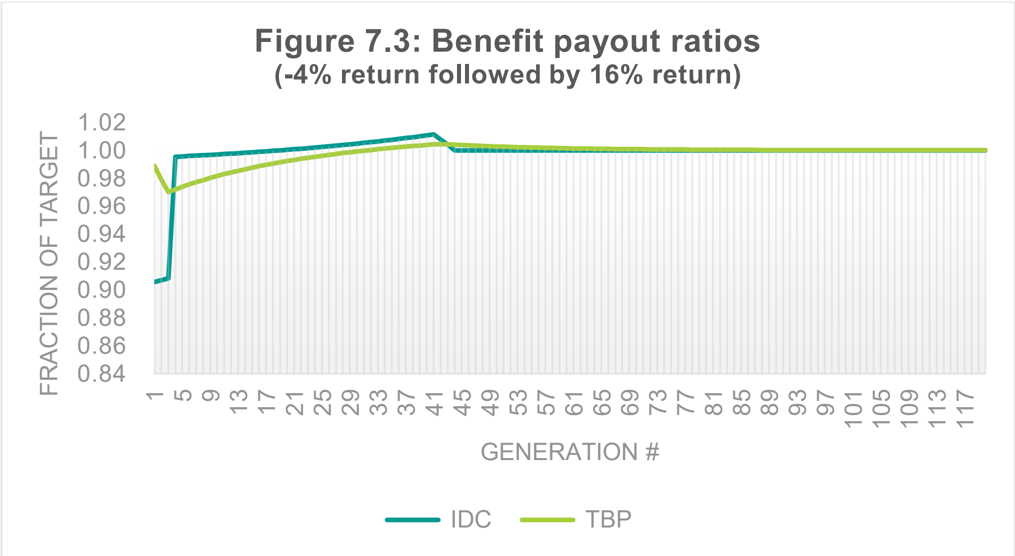
The benefit adjustment mechanism in the model plan helps reduce income volatility for older members, while having a relatively more material impact on the benefits for younger members. As noted above, investment losses would have the most adverse impact on mid-career members. However, they would stand to gain more with larger benefit increases if there is an investment gain. Figure 7.2 displays the BPRs for the IDC and TBP in the scenario where the fund earns a return of 16% (a 10% gain relative to the expected 6% return) in year 40. From an ex-ante perspective, it can be concluded that the risk-sharing process is equitable and fair across different generations of members when the discount rate used for plan valuations represents a central estimate of future investment returns on the pension fund.



7.2 Impact of investment loss with recovery during stationary phase

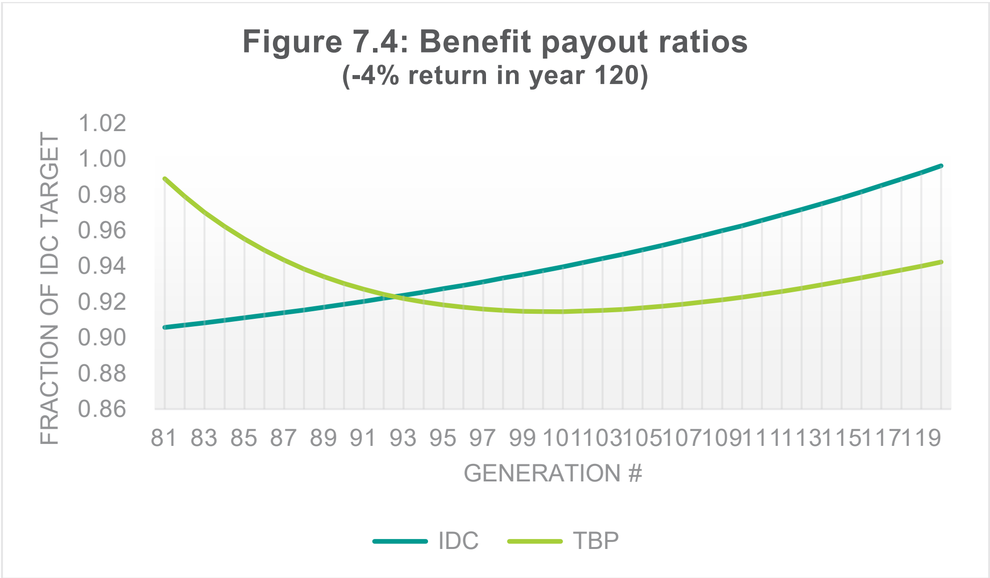
Now, let's consider a scenario where an investment loss is followed by an investment gain within a relatively short period, say, three years. Figure 7.3 presents the BPRs in the situation where the pension fund experiences a -4% return in year 40 and a 16% return in year 43.

Under the IDC, Generations #1, #2 and #3 see their benefits reduced by more than 9%, but subsequent generations experience little to no benefit reduction, as the loss in year 40 is nearly offset by the gain in year 43. In the TBP, Generation #3 experiences the largest reduction in benefits at 3%, which is significantly less than those experienced by the oldest IDC members, while subsequent generations face progressively smaller reductions. This illustrates the effectiveness of the plan's benefit adjustment mechanism in shielding older members' benefits from the volatile investment returns of the pension fund.



7.3 Impact of investment loss during declining phase

Here, we analyze the consequences of investment losses on members' benefit payouts when the plan enters its declining phase. For our model plan, this phase commences at time 120, with no additional members joining the plan thereafter. Figure 7.4 illustrates the BPRs in a scenario where the pension fund experiences a -4% return in year 120 with no subsequent recovery of losses.



Under the IDC, members' retirement benefits are proportionally reduced according to the size of their retirement accounts. Members of the oldest generation (Generation #81) would witness a 9.4% reduction in their benefits. Subsequent generations would experience progressively smaller reductions in benefits, with the youngest generation (Generation #120) facing minimal reductions.

In contrast, within the TBP plan, members of older generations ranging from Generations #81 to #92 would receive more favourable benefits than their IDC counterparts. Generation #81 members, for instance, would receive nearly 99% of their target benefits. However, subsequent generations would receive a reduced benefit compared to their IDC counterparts, with Generation #100 members receiving only 91% of their target benefits. Even the youngest generation, Generation #120, would encounter a significant reduction in their benefits, amounting to 5.8%.

In the absence of new members joining the plan during the declining phase, younger members in the TBP would bear a disproportionately large share of the investment loss burden. Moreover, with a shorter investment time horizon, the plan has fewer opportunities to recover from those losses. This raises questions about the suitability of using a pension smoothing mechanism under the TBP when there is an insufficient number of new members joining the plan to absorb the investment risk.

These findings underscore the need for careful consideration of the plan's structure and benefit adjustment mechanisms during its declining phase, especially when it faces challenges related to membership stability and investment performance.

8. Stochastic demonstration of benefit smoothing

In the preceding section, we illustrated how the benefit adjustment mechanism within the model plan mitigates benefit volatility for older members when a single investment shock affects the pension fund. This section expands on this concept by demonstrating the benefit smoothing effect across a spectrum of more realistic investment scenarios.

8.1 Generation of economic scenarios

Using the economic scenario generator outlined in (Ma, 2023), we constructed 1,000 economic scenarios, each encompassing annual time series data for long-term bond yields and equity returns over a 40-year period. Our parameters for the bond yield model, including the long-run mean, rate of reversion, and standard deviation, as well as other factors such as equity risk premium, standard deviation in the equity price model, diversification return, and expense loading, were aligned with the specifications provided in the cited paper.[2] Employing a balanced investment strategy, we evenly allocated the fund between equities and bonds, projecting an expected 6% annual return based on these models.

For analysis, we specifically chose three sample investment scenarios[3]

- **Consistent markets:** reflecting the median value (6.1%)
- **Unfavourable markets:** representing the 25th percentile (4.6%)
- **Favourable markets:** representing the 75th percentile (7.5%)

At time 39, the plan comprises members of Generation #1 to Generation #40 uniformly distributed between ages 25 and 64 (which will be referred to as "existing members" hereafter in this section). For modelling purposes, the TBP is assumed to be fully funded at this juncture, aligning with the funding target outlined in subsection 6.1 based on a 6% annual discount rate. Our investigation delves into the implications on benefits disbursed to both IDC and TBP members across these investment scenarios over a 40-year period, commencing at time 39. Subsequent sections present the simulation outcomes derived from these scenarios.

The indexing rates applied to the model TBP under the three investment scenarios are visually depicted in Appendix D for reference.

8.2 Stability amid market consistency

Figure 8.1 illustrates that under the consistent markets scenario, both the IDC and TBP maintain mean BPRs close to 1. The IDC averages at 0.98 and the TBP at 0.96, indicating minimal deviation in investment gain or loss relative to the expected 6% return. However, the IDC exhibits a wider spectrum of benefit payments compared to the TBP, with a larger span between the lowest and highest amounts paid (Table 8.1).

To assess benefit stability across generations, we calculated log changes in BPRs[4] for both plans. The statistical results suggest higher volatility and wider fluctuations in the IDC compared to the TBP over the observed period (Table 8.1).

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[2] The long-run mean, rate of reversion, and the standard deviation for the bond yield model are set as 0.04, 0.0194 and 0.0076 respectively. The equity risk premium and the standard deviation for the equity price model are specified as 0.04 and 0.15, respectively. Furthermore, we assume a diversification return of 0.35% and an expense loading of 0.52%.

[3] The investment scenarios are ranked according to their geometric average returns over the 40-year period.

[4] The log change in the BPR is the logarithm of the ratio between two consecutive BPR values. Let BPR_k denote the BPR for generation $\#k$, the log change between two consecutive values, BPR_k and BPR_{k-1} $(k > 1)$, is calculated as:

$$Log\ Change\ =\ ln(\frac{BPR_k}{BPR_{k-1}})$$

The log change represents the relative change between two consecutive observations. A positive log difference indicates an increase, while a negative log difference indicates a decrease. A log difference of 0 indicates no change.

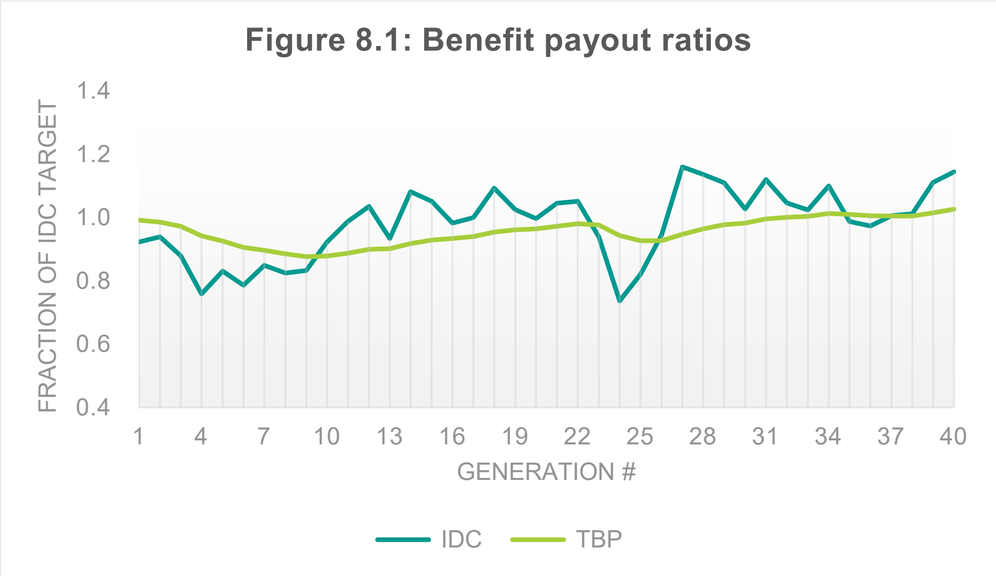


Table 8.1: Summary statistics of benefit payout ratios

	BPR		Log change in BPR	
	IDC	TBP	IDC	TBP
Mean	0.98	0.96	0.6%	0.1%
Standard deviation	0.11	0.04	9.0%	1.3%
Minimum	0.74	0.88	-24.3%	-3.5%
Maximum	1.16	1.03	20.5%	2.1%

8.3 Navigating unfavourable markets

Figure 8.2 illustrates BPRs under the downturn scenario. Both plans exhibit significantly lower mean BPRs than 1. The IDC averages at 0.80 compared to the TBP at 0.83. This suggests that, on average, the TBP disburses somewhat higher benefits than the IDC, indicating a transfer of a portion of investment loss relative to the expected 6% return from existing members to future generations.[5] The IDC displays a wider spread of benefit payments, encompassing lower minimums and higher maximums, while the TBP maintains a narrower range (Table 8.2).

The log changes in BPRs further highlight the IDC's broader fluctuations and higher volatility relative to the TBP (Table 8.2).

[5] The fund balance at time 80 falls short of the total amount of contributions and investment returns that are attributable to members who joined the plan subsequent to time 40 (i.e., members of Generation #41 to Generation #80). The shortfall amount, estimated to be $321 million, represents the portion of investment loss transferred from existing members.

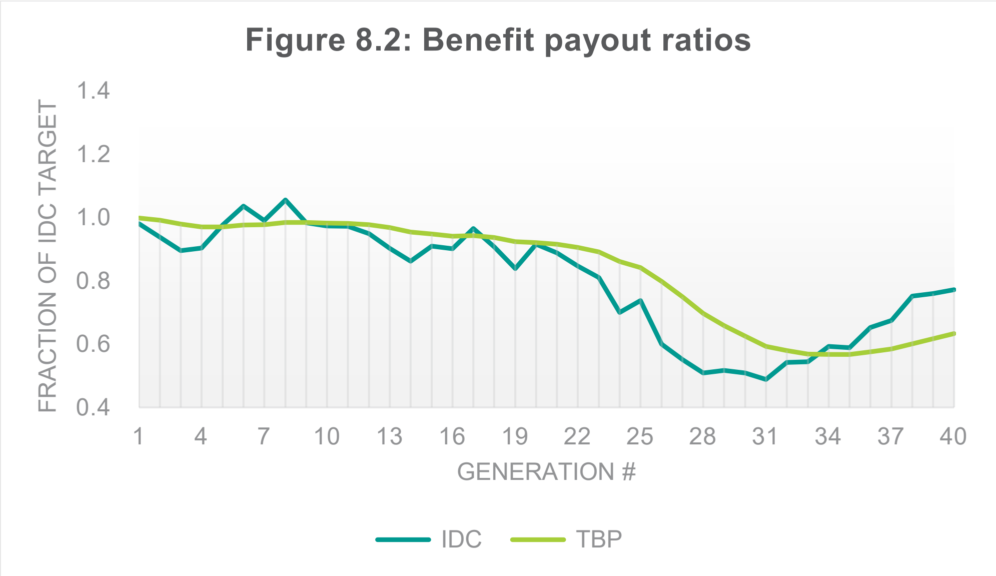


Table 8.2: Summary statistics of benefit payout ratios

	BPR		Log change in BPR	
	IDC	TBP	IDC	TBP
Mean	0.80	0.83	-0.6%	-1.2%
Standard deviation	0.18	0.17	7.0%	2.4%
Minimum	0.49	0.57	-20.7%	-7.2%
Maximum	1.05	1.00	10.7%	2.8%

8.4 Navigating favourable markets

Under the favourable scenario (Figure 8.3), the IDC shows a higher mean benefit payout ratio at 1.28 compared to TBP at 1.19. This indicates that under the TBP, a portion of the investment gain attributable to existing members is transferred to future generations.[6] The range between the minimum and maximum benefit payouts is wider in the IDC compared to the TBP (Table 8.3).

The log changes in BPRs indicate the IDC's greater variability and wider fluctuations, signifying higher volatility compared to the TBP (Table 8.3).

[6] The fund balance at time 80 exceeds the total amount of contributions and investment returns attributable to members who joined the plan subsequent to time 40. The excess amount, estimated to be $921 million, represents the portion of investment gain transferred from existing members.

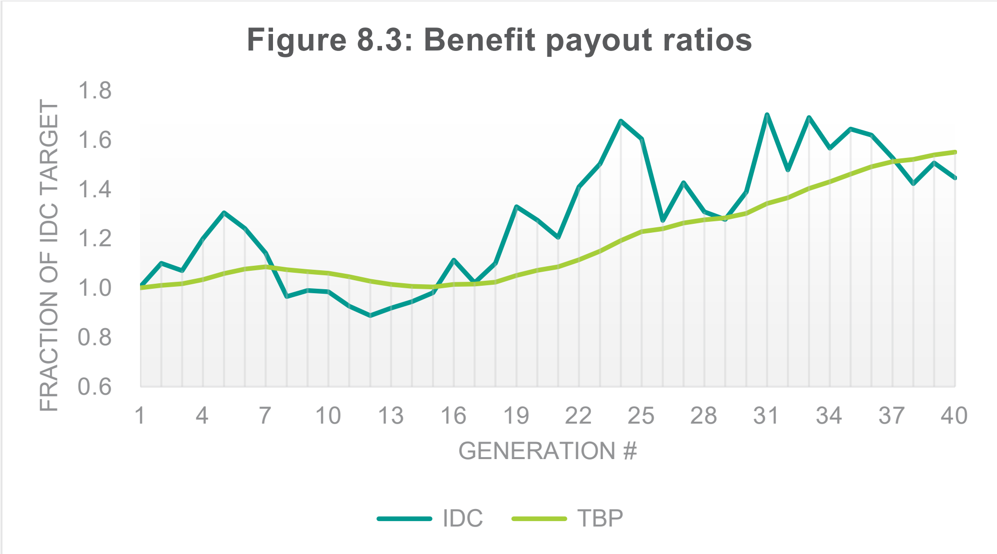


Table 8.3: Summary statistics of benefit payout ratios

	BPR		Log change in BPR	
	IDC	**TBP**	**IDC**	**TBP**
Mean	1.28	1.19	0.9%	1.1%
Standard deviation	0.25	0.18	9.8%	1.4%
Minimum	0.89	1.00	-23.0%	-1.8%
Maximum	1.70	1.55	20.3%	3.7%

Overall, our study highlights the profound impact of investment returns on benefit stability among different generations of members within the two types of plans. Despite equal contribution requirements, the IDC and the TBP exhibit distinct benefits across generations in diverse economic conditions. The IDC's wider range and higher volatility present challenges in maintaining stable benefit payouts, particularly during adverse investment scenarios. In contrast, the TBP's narrower range and lower volatility offer more predictability and stability in benefit payments. These implications underscore the necessity for robust risk-sharing mechanisms and adaptable investment strategies in pension plan design and management. Achieving a balance between maximizing returns and ensuring stability in benefit distributions across diverse generations is pivotal for the long-term sustainability and satisfaction of plan members.

9. The ramifications of incorrect assumptions in valuation

Robust pension plan governance requires periodic assessments of the plan's funded status, along with a thorough review of the assumptions and valuation methods employed. As demonstrated in subsection 6.2, the use of inappropriate assumptions in valuation can lead to unintended cross-subsidization among various generations of plan members. In this section, we delve deeper into strategies for mitigating the adverse consequences stemming from assumptions that do not accord with the plan's actual experience.

9.1 Correcting inappropriate valuation assumptions

Consider a scenario where, at the inception of the model plan, a discount rate assumption of 6% was employed for determining the plan's contribution rate and ongoing funding evaluations. Over the first 40 years of plan operation, the pension fund only realized an annual return of 5.5%. At the 40-year mark, in view of the plan's past investment performance, the plan trustees decide to revise the discount rate assumption to 5.5%, while keeping other assumptions intact.

Given this assumption change, the first step is to ascertain whether the contribution rate (10.8% of members' pensionable pay) stipulated in the plan would still be sufficient to provide the target retirement benefit as originally intended. For our model plan, let's assume that the annuity factor applied at age 65 for converting an indexed lifetime pension into a lump sum would increase from 15 to 16 as a result of the discount rate change. In this case, the contribution rate would only support a benefit accrual rate of 1.4% instead of the initial 1.67% (equivalent to 1/60). Consequently, the plan requires an amendment to reduce the target retirement benefit to 1.4% of members' pensionable pay, on a go-forward basis, in conjunction with the new discount rate assumption.

Table 9.1 presents the valuation results of the plan at the 40-year mark, both before and after the assumption change.

Table 9.1: Valuation results before and after assumption change

	Before change (6% discount rate)	**After change (5.5% discount rate)**
Assets ($million)		
Value of fund assets (F)	657.5	657.5
Present value of future contributions (PVFC)	326.3	343.3
Total assets (1)	983.8	1,000.8
Liabilities ($million)		
Past service liability (PSL)	564.1	632.3
Future service liability (FSL)[7]	449.0	449.0
Total liabilities (2)	1,013.1	1,081.3
Funding deficit (excess) ($million) (2) – (1)	29.3	80.5

Before the change in assumptions, there exists a deficit of $29.3 million. To eliminate this deficit, the indexing rate applied to members' accrued benefits would need to decrease from 2% to 1.51%. Following the assumption change, the indexing rate would further reduce to 0.77% in order to eliminate the $80.5 million deficit.

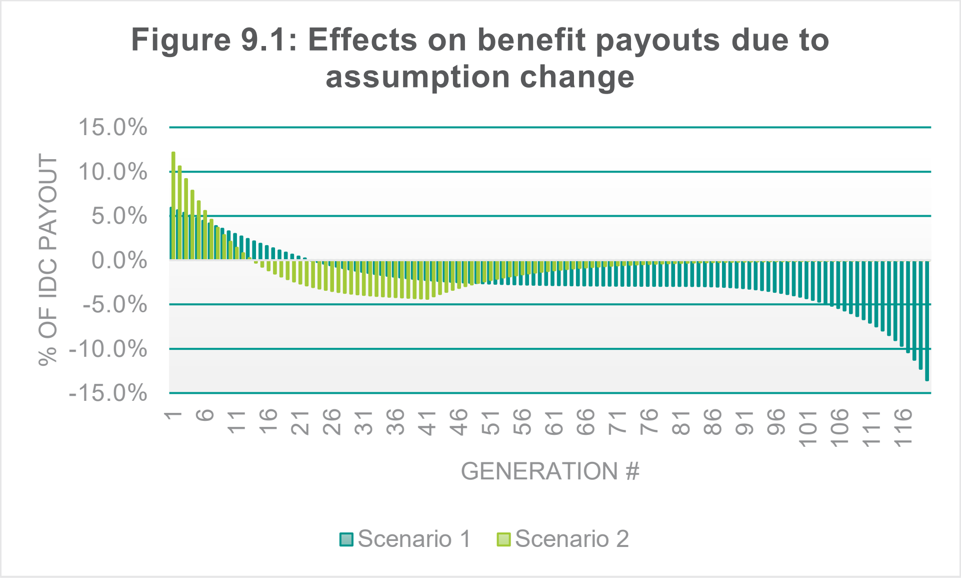
Now, let's assume that the pension fund continues to yield an annual return of 5.5% beyond the 40-year mark. Figure 9.1 provides a comparative analysis of the benefit payouts under two distinct scenarios:

- **Scenario 1:** The plan continues to use a 6% discount rate assumption for its valuations and there is no change in its benefit accrual rate.

[7] The FSL values in the two last columns of Table 9.1 may appear to be identical, but they are not exactly the same. Note that the last column incorporates both the modification in the discount rate and the change in the benefit accrual rate.

- **Scenario 2:** The plan reduces its discount rate assumption to 5.5% and amends the benefit accrual rate to 1.4% of members' pensionable pay.

In Figure 9.1, each year's payout is presented as the difference between the payout under the model TBP and the payout under an IDC with an equivalent contribution rate. These differences are expressed as a percentage of the IDC payout.



In Scenario 1, as previously demonstrated in subsection 6.2, older generations accrue pension benefits at a level beyond what the pension fund's returns can sustain, impacting subsequent generations negatively. Scenario 2 attempts to correct this by adjusting the discount rate assumption to better align with the pension fund's actual performance. The companion change in the benefit accrual rate primarily affects future service benefits, leaving already accrued pension benefits unchanged. The corrective action affects various generations differently. Notably, older members (Generation #1 to Generation #13) still see increased benefit payouts (relative to the IDC payouts) due to the adjusted lower discount rate that reveal the true value of their accrued pension benefits. However, imbalances for future generations (e.g., Generation #70 and beyond) are rectified, while intervening generations experience reduced benefit payouts. This highlights that the trustees' action, along with the plan's existing benefit adjustment mechanism, does not fully address the intergenerational disparities. Consequently, additional corrective measures are necessary, a topic we will explore in the following section.

9.2 Enhancing measures to address intergenerational disparities

The plan's benefit adjustment mechanism primarily relies on modifying the indexing rate applied in the calculation of the plan's past service liability. When changes are made to key valuation assumptions, in particular the discount rate assumption, our analysis has revealed that this measure alone may not be sufficient to rectify the disparities in benefit payouts across various generations of plan members. In this section, we introduce an additional measure to adjust the benefits accrued by members.

Rather than simply reducing the indexing rate all the way to 0.77% to fully eliminate the funding deficit, we will explore the impact of alternative indexing rates on the plan's overall financial position. Table 3 provides a snapshot of the plan's valuation results at the 40-year mark, building upon the Scenario 2 framework outlined in subsection 9.1. We examine four distinct indexing rates: 2%, 1.5%, 1.2%, and 0.77%, designated as Options A, B, C, and D, respectively.

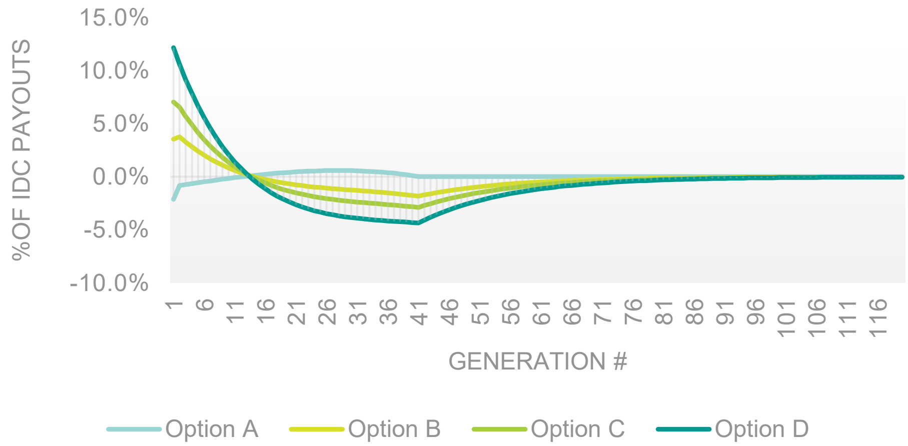
Table 9.2: Benefit adjustment options

	Option A	Option B	Option C	Option D
Applicable Indexing rate	2.00%	1.50%	1.20%	0.77%
Assets ($million)				
Value of fund assets (F)	657.5	657.5	657.5	657.5
Present value of future contributions (PVFC)	343.3	343.3	343.3	343.3
Total assets (1)	1,000.8	1,000.8	1,000.8	1,000.8
Liabilities ($million)				
Past service liability (PSL)	632.3	597.6	578.2	551.8
Future service liability (FSL)	449.0	449.0	449.0	449.0
Total liabilities (2)	1,081.30	1046.7	1027.2	1000.8
***Funding deficit (excess) ($million)* (2) – (1)**	80.5	45.9	26.4	0.0
F+PVFC-FSL	551.8	551.8	551.8	551.8
% Reduction in accrued benefits to eliminate funding deficit	12.7%	7.7%	4.6%	0.0%

The reductions in accrued benefits in the last row of the table are calculated as follows: $1 - (F + PVFC - FSL)\ /PSL$, expressed as a percentage. The combined effect of the indexing rate and the corresponding benefit reduction would fully eliminate the plan's existing funding deficit. For instance, with an indexing rate of 1.5%, a 7.7% reduction in accrued benefits would eliminate the $45.9 million deficit shown in the Option B column of the table.

Figure 9.2 below provides an illustrative overview of the expected benefit payouts across generations under the four benefit adjustment options.

Figure 9.2: Effects on benefit payouts under different benefit adjustment options



Option A entails moderately reduced benefits for older members and concurrently achieves a more equitable intergenerational balance. For instance, members of Generation #1 would receive benefits amounting to slightly less than 98% of the IDC payout, while the payouts for other generations closely align with the IDC payouts. However, it is noteworthy that members would see a substantial reduction in their accrued benefits under this option. In contrast, Option D predominantly favours older members at the expense of younger members, as it avoids a reduction in accrued benefits. Options B and C position themselves as middle-ground approaches between the two extremes.

As plan trustees deliberate over benefit adjustment mechanisms to navigate the impacts stemming from changes in valuation assumptions, they face the challenge of striking a delicate balance between two core objectives: (1) safeguarding the accrued benefits for older members and (2) fostering a greater sense of intergenerational fairness.

10. Implications for legislative policies

The findings presented in Sections 4 to 9 of this paper shed light on various aspects of TBPs and their intergenerational risk dynamics. These findings have important implications for the development of legislative policies governing TBPs. In this section, we will discuss these implications in three key areas: registration of the plan, ongoing operation of the plan and management of the declining phase.

10.1 Registration of the plan

Plan administrators should provide comprehensive support for the plan design during the registration process. Key elements of plan design that should be considered include the following:

- **Determination of contribution rate or target retirement benefit:** It is important for plans to establish clear guidelines on how the target retirement benefit is determined when a fixed contribution rate is in effect, or conversely, how the contribution rate is determined when a specific target retirement benefit is set. This process involves consideration of various factors, including expected investment returns, wage growth, inflation, mortality, and membership characteristics, as well as the aspects of cost affordability and target income replacement level. These considerations are critical in ensuring the plan remains viable and financially sustainable.
- **Benefit adjustment mechanism:** Mechanisms for adjusting benefits over time should be outlined. Our paper highlights the importance of aligning these adjustments with the primary

objective of the TBP design, which is to deliver the target retirement benefit with predefined contributions over the working lifespan of members.

- **Flexible designs:** Legislative policies should allow flexibility for plan decision makers to adopt different benefit designs depending on the objectives of their plans, such as the use of age-related benefit accrual approaches to mitigate financial imbalances between generations at each point in time.

10.2 Ongoing operation of the plan

To ensure the long-term sustainability and fairness of TBPs, legislative policies should address the operational aspects of these plans, which include the following:

- **Frequency of valuations:** Policies should specify the frequency of plan valuations to ensure that the plan's financial health is regularly assessed. This is essential for making timely adjustments to contributions and benefits as needed.
- **Funding target:** Legislative policies should require that the funding target be established based on an appropriate valuation method that takes into account expected future benefit accruals as well as expected future contributions (see Section 6). This approach can help prevent intergenerational cost shifts and maintain fairness among different generations of members.
- **Actuarial assumptions for plan valuations:** Policymakers should encourage the use of best estimates of future plan experience, including pension fund returns, wage growth, inflation and life expectancy, in setting actuarial assumptions (see Section 6). This promotes transparency and financial fairness in plan operations.
- **Benefit and contribution adjustments:** Policies should require plans to specify how benefits and/or contributions are adjusted in the event of a funding shortfall or excess. Clear guidelines should be provided to ensure equitable treatment of plan members in such situations.

10.3 Management of the declining phase

When a TBP enters the declining phase, legislative policies should shift the focus towards protecting the benefits accrued by members. This phase typically occurs when there are not enough new members to replenish the retired, terminated or deceased members. As the plan has lower capacity for risk-taking and risk-sharing, policies should emphasize the importance of safeguarding the accrued benefits for members, especially those in the older generations. These may include other considerations such as options for transferring risk to third-party entities (e.g., the purchase of annuities from insurance companies) to ensure that members receive their accrued benefits even in challenging market conditions.

In summary, the findings presented in this paper can serve as a guide for the development of legislative policies for target benefit plans. These policies should promote transparency, fairness and sustainability throughout the life cycle of the plan, from its registration and ongoing operation to its management in the declining phase. By addressing these key aspects, policymakers can create a regulatory framework that ensures the long-term viability and equitable treatment of plan members in target benefit plans.

11. Conclusion

TBPs have emerged as a promising solution in retirement provision. As our analysis in this paper has demonstrated, TBPs offer a dynamic approach to pension design, blending elements of DC and DB plans. By sharing investment and longevity risks among plan members, TBPs aim to provide sustainable and stable retirement benefits.

In this paper, we conducted a comprehensive exploration of TBPs, delving into their risk-sharing mechanisms, dynamics of benefit outcomes and the implications of our findings for legislative policies. We uncovered several key insights that underscore the significance of TBPs in the evolving retirement landscape.

Firstly, TBPs require careful management of intergenerational risk. By aligning contribution rates with the target retirement benefit and distributing risks across generations, these plans offer a balanced solution that adapts to changing economic conditions and demographic shifts. This adaptability ensures that future generations of retirees can also expect to receive reasonable retirement benefits.

Secondly, the design and operation of TBPs are crucial to their effectiveness. The determination of contribution rates, benefit adjustment mechanisms and flexibility in design play pivotal roles in shaping the outcomes of these plans. Legislative policies must provide a supportive framework that allows plan administrators and trustees the flexibility to tailor TBPs to their specific objectives while safeguarding against undue risk.

Thirdly, the declining phase of TBPs calls for particular attention. As the plan matures and the number of active members dwindles, the focus must shift towards safeguarding accrued benefits for all members. Policymakers should explore risk transfer mechanisms to ensure the fulfilment of benefits accrued by members, even in challenging economic conditions.

In conclusion, the findings presented in this paper underscore the promise of target benefit plans as a forward-looking solution for retirement provision. Effective legislative policies that promote transparency, fairness and sustainability are essential to realize the full potential of TBPs. By crafting such policies, legislative bodies can lay the foundation for a retirement landscape that empowers individuals with the confidence that their retirement goals will be met, regardless of the uncertainties that lie ahead.

As we move forward, it is our hope that this paper will serve as a valuable resource for policymakers, plan administrators and researchers alike. By leveraging the insights gained here, we can shape a retirement landscape that stands resilient in the face of change, ensuring that all generations can look forward to a financially secure and fulfilling retirement.

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Appendix A: Contribution rate for the model plan

In the initial setup of the plan, we calculate the contribution rate by dividing (1) the total present value of expected retirement benefits, taking into account the benefit accrual rate and targeted indexation, by (2) the aggregate present value of future pensionable pay, considering all plan members. These present values are computed as of each member's entry age into the plan. The method used in this calculation of the contribution rate is known as the entry age normal cost method, and the resulting contribution rate is sometimes referred to as the normal cost rate (NCR) (Anderson, 1992).

To facilitate our mathematical formulation, we employ the following notation:

- β represents the benefit rate applied to a member's pensionable pay for determining the annual pension accrual.
- $\ddot{a}_y$ denotes the indexed life annuity factor at age y.
- i is the discount rate used in the calculation.
- s denotes the assumed salary increase rate.
- $\bar{h}$ stands for the target indexing rate applicable to a member's accrued pension up to retirement.
- e represents the age at which a member joins the plan. For the model plan, it is assumed that all members join the plan at the same age e.
- y is the assumed retirement age used in the calculation.
- x is the attained age of the member at the date of calculation and is less than y.
- S_x^j denotes member $j's$ annual pensionable pay at age x.
- ${}_np_x$ signifies the probability that a member currently aged x will remain in the plan after n years, computed using a service table.

The formulas for calculating the present value of future benefits ($PVFB$) and the present value of future salaries ($PVFS$) at the inception date of the plan are as follows:

$$PVFB = \sum_{j \epsilon A} PVFB^j = \sum_{j \epsilon A} \left[\left(\sum_{n=0}^{y-e-1} \beta S_e^j \, (1+s)^n \left(1+\bar{h}\right)^{y-e-n} \right) \cdot {}_{y-e}p_e \cdot \ddot{a}_y \cdot (1+i)^{-(y-e)} \right] \qquad (1)$$

$$PVFS = \sum_{j \epsilon A} PVFS^j = \sum_{j \epsilon A} \left(\sum_{n=0}^{y-e-1} {}_np_e S_e^j (1+s)^n \cdot (1+i)^{-n} \right) \qquad (2)$$

Here, A represents the set of members at the plan's inception, and j denotes an individual member within A.

The NCR for the plan, expressed as a percentage of members' pensionable pay, is calculated as follows:

$$NCR = \frac{PVFB}{PVFS} \tag{3}$$

For our model plan, the following parameter values are employed: $\beta = \frac{1}{60}, e = 25, y = 65, {}_kp_e = 1$ for $0 \leq k \leq 40, i = 0.06, s = 0.03, \bar{h} = 0.02$, and $S_e^j = \frac{50000}{1.03^{39}}$ for all $j \epsilon A$. Based on these parameters, the NCR is determined to be 10.8% of members' pensionable pay. This rate is set as the contribution rate, denoted as θ, for the plan, payable annually in advance throughout members' working years.

Appendix B: Calculation of annual indexing rates for the model plan

In this appendix, we provide a detailed explanation of the methodology employed to calculate the indexing rates for our model plan. For convenience, we use some of the notation introduced in Appendix A.

B.1 Plan membership phases

We first outline the three distinct membership phases over the lifespan of the plan:

- **Growing phase (time 0 to time 39):** During this phase, the membership consists of generations of members who join the plan up to time $t < 40$, denoted as $A_0, A_1, \dots, A_t$. Each generation joins the plan at its respective time.
- **Stationary phase (time 40 to time 119):** From time 40 to time 119, the membership at time t includes generations $A_{t-40}, A_{t-39}, \dots, A_t$. This phase represents a period of stability in the plan's membership composition. Note that, at time t, members of A_{t-40} reach age 65 as all members are assumed to join the plan at age 25 and remain in the plan until retirement at age 65.
- **Declining phase (Time 120 to time 159):** The declining phase begins at time 120 and concludes at time 159. During this period, the membership at time t comprises generations $A_{t-40}, A_{t-39}, \dots, A_{119}$.

B.2 Benefit adjustment mechanism

The model plan employs a benefit adjustment mechanism that relies on comparing the value of plan fund assets with the plan's funding target, which is defined as the total present value of accrued benefits for all members in the plan. The mathematical formulation for this determination is set out below.

Present value of accrued benefits for a single member

Consider the plan at time $t > 0$, which includes generation k, namely A_k(where $\max(0, t-40) \leq k \leq t$), as participants. The attained age of generation k members, denoted as x, is equal to $25 + (t - k)$, given that members of generation k join the plan at time k at the age of 25. The present value of accrued benefits at time t for a member of generation k is calculated recursively from age 25 as follows.

The annual pensionable pay for members at time 0 is denoted as S_0. The pensionable pay for members at subsequent time k, represented as S_k, is calculated as S_0 multiplied by the growth factor $(1+s)^k$.

The benefit related to the contribution made for a member of generation k in the year of age 25, $B_{k,25}$, is equal to βS_k, where β is the benefit rate specified in the plan. The accrued benefit at that age, denoted as $AB_{k,25}$, is equal to $B_{k,25}$.

Let the function $h(u)$ denote the indexing rate applicable at time u. The accrued benefit at an age $l > 25$ for a member of generation k can be derived as follows:

$$B_{k,l} = \beta S_k (1+s)^{l-25}$$

$$AB_{k,l} = AB_{k,l-1}\big(1 + h(k+l-25)\big) + B_{k,l}$$

Specifically at time t (member's attained age is x),

$$B_{k,x} = \beta S_k (1+s)^{x-25}$$

$$AB_{k,x} = AB_{k,x-1}\big(1 + h(t)\big) + B_{k,x}$$

The present value of accrued benefit at time t for a member of generation k where $k < t$, immediately before the benefit $B_{k,x}$ is accrued, is calculated as follows:

$$PVAB_{k,x} = AB_{k,x-1} \cdot \left(1 + h(t)\right)^{65-x+1} \left(\frac{\ddot{a}_{65}}{(1+i)^{65-x}}\right) \quad (4)$$

If $x = 65$, then $k = t - 40$, $B_{t-40,65} = 0$, $AB_{t-40,65} = AB_{t-40,64}\left(1 + h(t)\right)$, and $PVAB_{t-40,65} = AB_{t-40,65} \cdot \ddot{a}_{65}$ representing the retirement benefit payable to a member who reaches age 65 at time t.

Past service liability

The past service liability of the plan at time t, denoted as PSL_t, is calculated as the sum of the present value of accrued benefits for all members in the plan at time t based on the membership phase:

If $0 < t < 40$:

$$PSL_t = \sum_{k=0}^{t-1} \left(\sum_{A_k} PVAB_{k,x}\right)$$

If $40 \leq t < 120$:

$$PSL_t = \sum_{k=t-40}^{t-1} \left(\sum_{A_k} PVAB_{k,x}\right) \quad (5)$$

If $120 \leq t \leq 159$:

$$PSL_t = \sum_{k=t-40}^{119} \left(\sum_{A_k} PVAB_{k,x}\right)$$

The term $\sum_{A_k} PVAB_{k,x}$ in the above formulas represents the sum of $PVAB_{k,x}$ for all members of generation k. It is important to note that the variable PSL_t is a polynomial function of $h(t)$.

Value of fund assets

To calculate the value of fund assets at time t, we first determine the contributions expected to be made for plan members each year. The contribution made for a member of generation 0 in the first year of plan operation is θS_0, where θ is the contribution rate stipulated in the plan. In general, the contribution made for a member of generation k at time t (member's attained age is x) is given by:

$$C_{k,x} = \theta S_k (1+s)^{x-25}$$

Alternatively, this can be expressed as:

$$C_{k,x} = \theta S_0 (1+s)^t$$

The contributions paid by members in the year of time t are calculated based on the membership phase:

If $t < 40$:

$$C_t = \sum_{k=0}^{t} \sum_{A_k} C_{k,x} \quad (6)$$

If $40 \leq t < 120$:

$$C_t = \sum_{k=t-39}^{t} \sum_{A_k} C_{k,x}$$

If $120 \leq t < 159$:

$$C_t = \sum_{k=t-39}^{119} \sum_{A_k} C_{k,x}$$

Next, we determine the benefits paid to retired members at time t.

- For $t < 40$, $B_t = 0$ as none of the members have reached age 65.
- For $t \geq 40, B_t = \sum_{A_{t-40}} PVAB_{t-40,65} = \sum_{A_{t-40}} \left(AB_{t-40,65} \cdot \ddot{a}_{65}\right)$.

Finally, we determine the value of fund assets at time t. The initial value of fund assets is zero, i.e., $F_0 = 0$. For subsequent years ($t > 0$), we determine the value of fund assets using the following recursive formula:

$$F_t = (F_{t-1} + C_{t-1} - B_{t-1})(1 + r) \qquad (7)$$

Here, r represents the annual rate of return of the pension fund, which is assumed to be the same as the valuation interest rate i for the analysis in Section 5 of this paper.

Indexing rate calculation

The indexing rate at time t, $h(t)$, is determined as the solution of the following equation:

$$PSL_t = F_t$$

It should be noted that PSL_t is a polynomial function of the variable $h(t)$, as derived in Equation (5).

B.3 Target retirement benefit

The target retirement benefit for a member belonging to generation k is computed as the accumulated value of contributions with interest i at retirement age 65. This calculation is expressed as follows:

$$ACWI_k = \left(\theta \cdot S_k \sum_{n=0}^{39} (1+s)^n \cdot (1+i)^{(40-n)}\right) \qquad (8)$$

Within this equation, the contribution rate θ is designed to provide the target retirement benefit, based on a benefit rate β and a target annual indexing rate $\bar{h}$ (see Appendix A). Contributions are assumed to be made to the plan fund at the beginning of each year.

The target retirement benefit for generation k is the sum of $ACWI_k$ for all members belonging to that generation.

This concludes our description of the methodology used to derive the indexing rates for the model plan, which we will apply in Section 5 to analyze the benefit payouts across different generations of members.

Appendix C: Alternative benefit adjustment mechanism for the model plan

In Section 6, we introduce an alternative benefit adjustment mechanism which incorporates a funding target that factors in contributions made and benefits accrued for members' future service. This funding target is represented as $PSL + FSL - PVFC$, where PSL denotes the plan's past service liability, FSL represents the plan's future service liability and $PVFC$ signifies the present value of contributions made for members' future service. This appendix provides the mathematical formulations used to compute these components.

Similar to Appendix B, we consider a member of generation k at time t, with an attained age x equal to $25 + (t - k)$. We can express the present value of future benefit accruals and the present value of future contributions for this member as follows:

$$PVFSB_{k,x} = \left(\sum_{n=0}^{65-x-1} \beta S_k \left(1+s\right)^{x+n-25} \left(1+\bar{h}\right)^{65-x-n} \right) \ddot{a}_{65} \cdot (1+i)^{-(65-x)} \tag{9}$$

$$PVFSC_{k,x} = \sum_{n=0}^{65-x-1} \theta S_k (1+s)^{x+n-25} \cdot (1+i)^{-n} \tag{10}$$

Subsequently, we calculate the plan's future service liability (FSL_t) and the present value of future contributions $(PVFC_t)$ at time t by summing $PVFSB$ and $PVFSC$ for all members in the plan at time t based on the plan's membership phase. The calculation formulas are as follows:

If $t < 40$:

$$FSL_t = \sum_{k=0}^{t} \left(\sum_{A_k} PVFSB_{k,x} \right)$$

$$PVFC_t = \sum_{k=0}^{t} \left(\sum_{A_k} PVFSC_{k,x} \right)$$

If $40 \leq t < 120$:

$$FSL_t = \sum_{k=t-39}^{t} \left(\sum_{A_k} PVFSB_{k,x} \right) \tag{11}$$

$$PVFC_t = \sum_{k=t-39}^{t} \left(\sum_{A_k} PVFSC_{k,x} \right)$$

If $120 \leq t < 159$:

$$FSL_t = \sum_{k=t-39}^{119} \left(\sum_{A_k} PVFSB_{k,x} \right)$$

$$PVFC_t = \sum_{k=t-39}^{119} \left(\sum_{A_k} PVFSB_{k,x} \right)$$

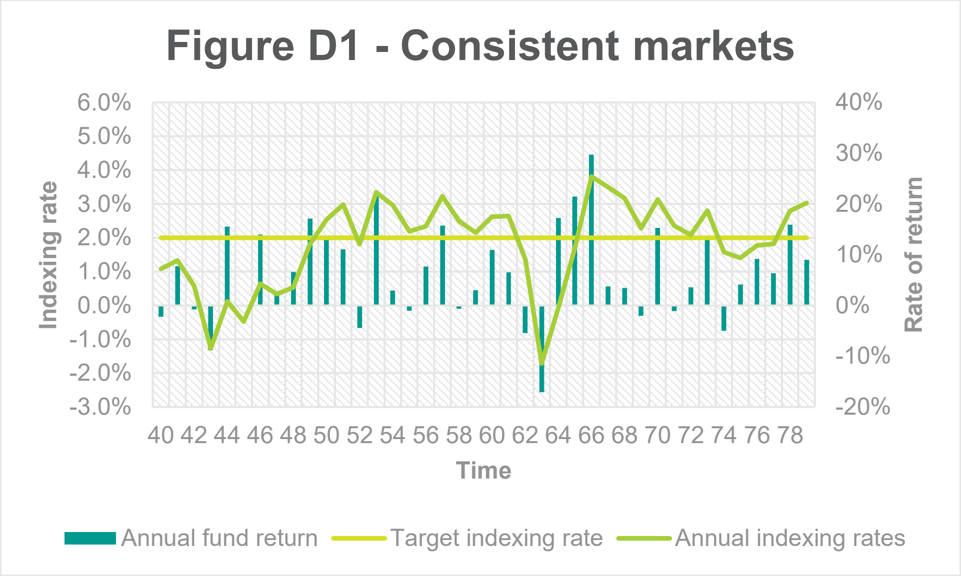
Regarding the plan's past service liability (PSL_t), we can apply the formulas in Equation (5) as provided in Appendix B, with a modification to $PVAB_{k,x}$. Specifically, we replace the variable indexing rate $h(t)$ in Equation (4) with the target indexing rate $\bar{h}$:

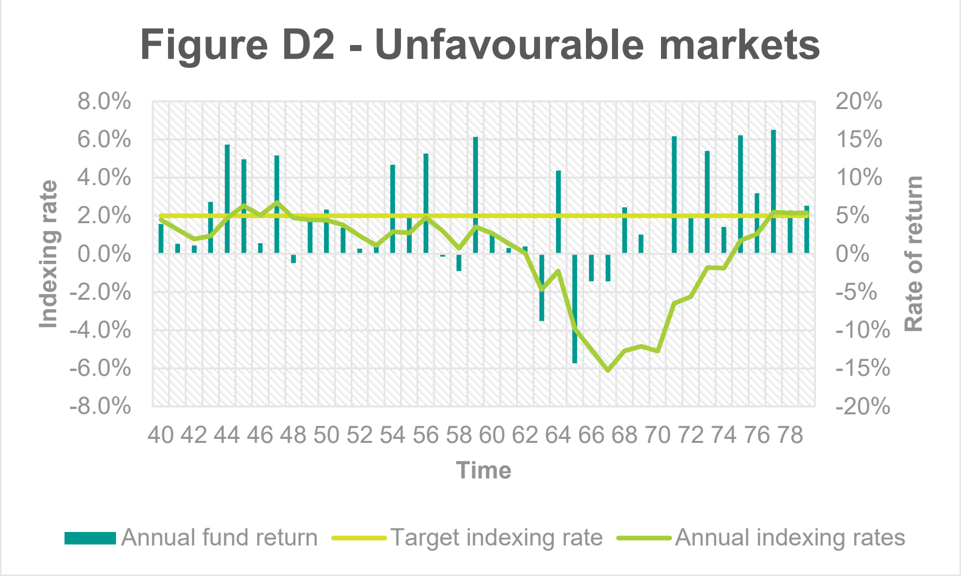
$$PVAB_{k,x} = AB_{k,x-1} \cdot \left(1 + \bar{h}\right)^{65-x+1} \left(\frac{\ddot{a}_{65}}{(1+i)^{65-x}} \right)$$

Once we have calculated $PVFC_t, PSL_t$ and FSL_t, we can proceed to establish a valuation balance sheet for the plan, as outlined in Table 6.1 (Section 6). Subsequently, we can determine the applicable indexing rate $h(t)$ at time t.

Appendix D: Annual indexing rates for three sample investment scenarios

In Section 8, we examine the benefit payouts for IDC and TBP members across three distinct investment scenarios: **consistent markets**, **unfavourable markets** and **favourable markets**. Figures D1, D2 and D3 below illustrate the rates of fund returns and the corresponding indexing rates applied to the TBP under these scenarios. Each annual fund return depicted at a specific time denotes the rate of returns on the pension fund during the preceding 12 months.





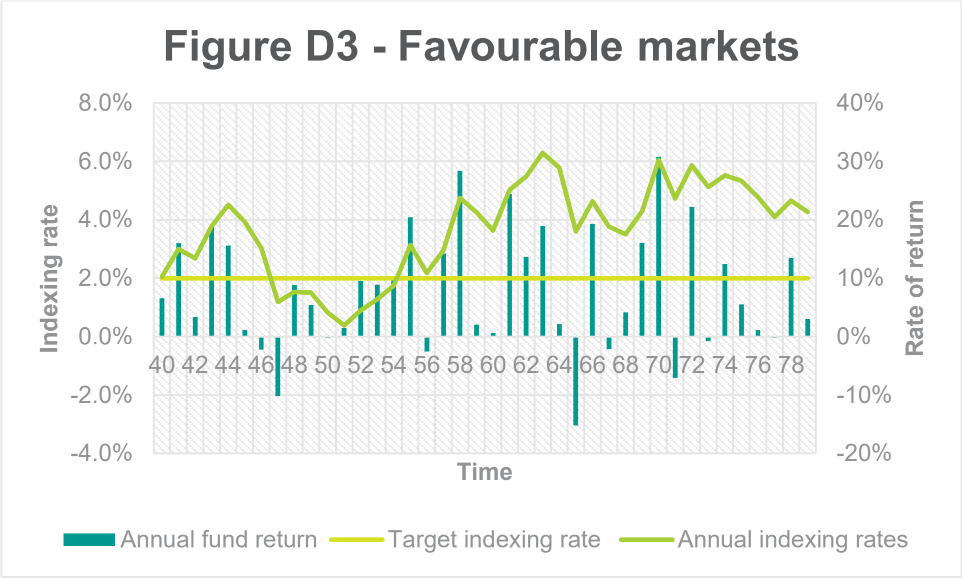


Figure D3 - Favourable markets
8.0%
6.0%
4.0%
2.0%
0.0%
-2.0%
-4.0%
40%
30%
20%
10%
0%
-10%
-20%
Indexing rate
Rate of return
40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78
Time
Annual fund return
Target indexing rate
Annual indexing rates

Appendix E: Peer Review of *Balancing Act: Exploring Intergenerational Risk in Target Benefit Plans*

By David Vanderweide, FSA
February 2024

George Ma's paper *Balancing Act: Exploring Intergenerational Risk in Target Benefit Plans* demonstrates three mechanisms leading to cross-generational subsidies in a model target benefit plan (TBP) similar to the Royal Mail Collective Defined Contribution (CDC) Scheme in the United Kingdom (UK). The paper builds on the Institute and Faculty of Actuaries' study "Inter-generational cross-subsidies in the UK's first CDC pension scheme" (Donnelly, 2022) by further illustrating how the subsidies arise and impact different generations of participants and proposing an alternative approach to preventing one of the subsidies.

Context

TBPs have gained attention in recent years as an alternative retirement benefit design that aims to address some of the shortcomings of both defined contribution (DC) and defined benefit (DB) approaches. The pooling of risk is central to these designs, but pooling that includes subsidies across generations has raised concerns. So far, adoption of TBPs and plans with similar features under different labels has been limited to the Netherlands, Denmark, the Royal Mail scheme in the UK, a small number of plans in Canada and some public-sector plans in the United States.

The Royal Mail CDC Scheme is a model for other UK CDC schemes because it was the first one approved and the general approach of conditionally indexing a career average DB is common in many other TBPs in other countries, so the subsidies described in the paper are of potential concern to policymakers and actuaries designing and managing TBPs in other countries. If the mechanisms for benefit adjustments in TBPs are not explicitly understood in advance and if members do not understand the implicit actual and potential subsidies, it will be difficult to build and maintain support for these plans. Ma's research into these subsidies is thus timely and likely to be useful to a variety of stakeholders involved in the development of these plans.

Comparison to past CIA research

1. *An Actuarial Balance Sheet Approach to Assessing Sustainability of Target Benefit Plans* (Ma, 2017)

This paper concludes that the closed group unit credit method traditionally applied to DB plans is not appropriate for TBPs, nor is simply using an open group approach. It proposes that TBPs should instead use an actuarial balance sheet that takes into account future contributions and benefit accruals for determining the status of the plan and whether adjustments are needed to bring it back into balance. Ma largely follows the same approach in subsection 6.1 of his new paper to avoid the first type of cross-generational subsidy he identifies.

2. *Report of the Task Force on Target Benefit Plans* (CIA Task Force on Target Benefit Plans, 2015)

This task force defined and described the range of TBPs, illustrated their basic mechanisms through sample plans and discussed their regulation, including issues that should be addressed with future regulation. The report discusses intergenerational risk in a qualitative way, not specific to a particular plan design, and highlights the importance of applying intergenerational risk sharing deliberately and transparently. It also notes the tradeoff between intergenerational transfers, cost and risk.

Ma provides a detailed illustration of how intergenerational transfers arise in a specific model plan. He quantifies the magnitude of these transfers and the time period over which they occur, providing more directly applicable results for TBP stakeholders, decision makers and actuaries within the broader environment described in the report of the task force.

Model construction

Ma develops a model plan that is used to illustrate and quantify how several different features and scenarios lead to three types of cross-generational subsidies in certain TBPs:

1. Greater upward benefit adjustments granted to earlier generations of participants due to the valuation mechanism used to calculate the indexation of their benefits. The paper proposes an alternative valuation mechanism to avoid this subsidy.
2. Lower benefits for earlier generations due to the use of conservative investment return assumptions. As actual returns exceed the assumption, future generations benefit more from the resulting adjustments. While the model is based on investment return assumptions, the impact of other conservative assumptions should be similar. This demonstrates the importance of using a central estimate methodology in designing many TBPs.
3. Higher or lower benefits, relative to an individual defined contribution plan (IDC), due to investment gains or losses. By design, TBPs pool investment risk to some extent across generations, leading to cross-generation subsidies in either direction. While the model is based on investment return gains or losses, the impact of other gains or losses should be similar.

The model plan in the paper has several features designed to isolate and better illustrate cross-generational subsidies. In particular:

- All members enter the plan at age 25 and retire at age 65.
- Benefits are paid as a lump sum at retirement equivalent to the lifetime pension amount inclusive of future indexing.
- Constant salary increases of 3% per year.
- The plan experiences three distinct phases: Growing phase with no retirements, stationary phase with new members entering the plan and older members retiring, and declining phase with no new entrants.

Without these simplifications in the model, it would be very difficult to separate subsidies inherent in the design from actuarial noise. Even with these simplifications, the model is still able to capture some of the most common cross-generational subsidies found in TBPs. However, decision makers who are designing or managing a specific TBP should use a more robust model of that TBP, including its detailed benefit features and participant data, as well as a greater variety of favourable and adverse scenarios.

Opportunities for further research

Future research could explore other actual or potential cross-generational subsidies by adjusting the model as follows:

- Assuming some entrants after age 25 and some terminations prior to age 65. This would particularly illustrate cross-generational subsidies inherent in defining the benefit as a fraction of each year's compensation payable as a lifetime benefit at age 65. Such subsidies appeared to be problematic in many Dutch CDC plans.
- Assuming benefits are paid in annuity form throughout retirement instead of in a lump sum. The cross-generational subsidies inherent in conditional post-retirement indexing of benefits are common in some public-sector DB plans that are not labeled as TBPs, but that operate similarly. The nature of the subsidies would be similar to those illustrated in the paper through pre-

retirement indexing but would differ in their magnitude and the number of years over which benefit values deviate from benefits under an IDC.

- Assuming members participate only during retirement, as in a decumulation-only CDC. While the outcomes of such a plan would share some similarities with the model plan used in the paper, it would be useful to quantify the scale of subsidies and timeframe over which they would be resolved. Such plans may also have particular appeal in some jurisdictions, leading to a greater practical interest in modelling such plans.
- Including a buffer in the design that is used with a "no action" range, but that may result in larger adjustments once it is depleted or if the design or plan membership changes significantly.

Future innovations in TBP design may generate new types of cross-generational subsidy that cannot be envisioned today. Ma's approach to modeling and illustrating these subsidies is likely to prove valuable in these cases as well.

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