DEFINED CONTRIBUTION INVESTMENT DECISIONS: USING SMOOTHING TO MEET CONFLICTING OBJECTIVES

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ABSTRACT

This paper seeks to demonstrate the efficiency and effectiveness of smoothing in allowing trustees of defined contribution retirement funds to meet a range of often-conflicting risk and return objectives. It does this by looking at both a historical analysis over the forty years to 31 October 2011, as well as a Monte-Carlo projection analysis over 30 years. The results of these analyses provide a compelling argument for the usefulness of smoothing in meeting retirement funding objectives. The paper also gives a broad explanation of smoothing as a strategy and identifies and addresses a number of objections to smoothing.

KEYWORDS

Smoothing, retirement funds, volatility reduction, investment efficiency, trustee objectives

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1. INTRODUCTION

Most people contributing to a retirement fund in South Africa belong to a Defined Contribution (DC) retirement fund. Many do not have any member-level investment choice (MLIC), although there is a trend toward offering choice to members. Even in those funds with MLIC, in most cases the majority of members remain in the default option selected by the fund's trustees. All this is discussed in a paper by Levitan and Thomson (2007). They make the point that while investment risk lies with the member, for most members the trustees make the investment decision. Hence, the DC investment choice or the default choice in an MLIC fund is critical. Their statement, "Typically, as regulation does not endorse risk-seeking behaviour from trustees, the default investment strategy is conservative," is central to this paper. They go on to propose member-level assessment of risk-appetites, so that at a member level the investment strategy can be found that maximises utility.

This paper recognises pragmatically that the obstacles to member-level risk appetite assessment seem to be prohibitive so that it remains a very uncommon practice. In the absence of what would clearly be a preferable strategy for meeting members' unique needs, this paper focuses on the trustees' default investment strategy decisions.

One could berate trustees for choosing strategies that are too conservative. However, it is not true for all trustees, and many trustees will not consider their strategies to be conservative. One may then question whether, for those trustees, their strategies are conservative enough. Trustee conservatism will have an impact on meeting members' long-term retirement needs. A lack of conservatism will have implications for members' short-term needs, and specifically their exposure to fluctuations in asset values at inopportune times. This paper puts forward smoothing as a strategy that can be employed to effectively meet members' short-term conservatism and long-term need for growth.

This is done by using both a historical analysis and a projection analysis of a simple set of possible strategies. To begin with, the paper includes in section 2 a short literature review. It then lays out in section 3 a framework of trustee decision-making principles that will provide a set of objectives against which to evaluate investment strategies throughout the paper. Then in section 4 the outcome over the 40 years to 31 October 2011 of differing investment strategies is considered. Section 5 looks at Monte Carlo projections over 30 years of the same strategies. In both cases various efficiency statistics are used to compare the past and projected performance of the various strategies. Section 6 lays out the basics of a smoothing strategy, and then section 7 considers the impact on both historical and projection statistics of using an example smoothing strategy. Section 8 considers some of the common objections to smoothing strategies and articulates responses to those. The paper concludes in section 9.

2. LITERATURE REVIEW

There are many papers that address various elements of defined contribution retirement funds, some of which are included in the references list. The papers that were most relevant to the topic of this paper were:

— Byrne et al. (2007) consider default investment funds in the UK using projection simulations to consider the implications for individuals invested in them. They find that the strategies have materially different outcomes and that there is a wide range of strategies so that, depending on the fund you happen to belong to, you could be exposed to a very different range of possible outcomes as a member. "Put simply, well-chosen default funds will benefit members, while poorly-chosen defaults will impose a cost on uninformed members." They also use a phrase "reckless conservatism" to describe a very conservative strategy that is then expected to lead to a very unsatisfactory result at retirement and is consequently not appropriate as a default.

— Basu and Drew (2006) also consider default investments using simulations, but in Australia. They find that strategies with more aggressive allocation to equities consistently outperform more moderate strategies, both in terms of upside potential and in terms of frequency of meeting accumulated wealth targets. They conclude that default strategies should be heavily weighted toward equities "unless plan providers emphasise predictability of wealth outcomes over adequacy of retirement wealth." This is precisely the predicament that retirement fund trustees face and which this paper intends to address.

— Levitan and Thomson (2007) apply expected utility theory to member choice in DC retirement funds. Their paper is discussed in section 1.

3. A FRAMEWORK FOR TRUSTEE DECISION-MAKING

This paper takes a somewhat simplistic view of member objectives and constraints, and corresponding trustee objectives. It is assumed that members have two primary retirement savings objectives, namely:

1. maximise accumulated retirement savings available at retirement; and
2. maximise accumulated retirement savings available on death, disability, retrenchment or resignation.

It is also assumed that members have the following risk constraints:

1. The most important actual risk is long-term underperformance against inflation leading to insufficient assets at retirement to support the targeted standard of living.
2. The next most important actual risk is withdrawing assets (due to death, disability, retrenchment or resignation) at an inopportune time, i.e. when asset values are depressed, and so "locking in" losses that would otherwise have been reversed in time.
3. The most acutely *felt* risk is negative volatility in returns (returns below zero).

Trustees, on behalf of members, and usually with the help of investment consultants, are in the unenviable position of trying to find an investment strategy that meets all of these objectives and constraints. There is a perceived trade-off between pursuing the objectives and satisfying the risk constraints, and given the inherently risk-averse position of the trustee, the investment portfolio will often be one that aims to satisfy the risk constraints at a significantly higher confidence level than it aims to meet the return objectives. For example, the aversion of members to negative returns is difficult to reconcile with a growth portfolio – even though negative returns in the short term, coupled with positive returns in the long term, may in many cases not be detrimental to the long-term needs of the members. A lack of an educated understanding about investments makes it impossible for trustees to explain this and it is therefore a headline risk that is often avoided at all costs.

Taking these objectives and constraints into account, the ideal investment portfolio thus has the following characteristics:

1. It is likely to achieve significant growth above inflation at a sustainable level over the long term
2. It is likely to achieve growth at or above inflation consistently over the medium term (3–6 years)
3. It is likely to avoid negative returns (over rolling one-month or one-year periods)
4. It avoids short-term fluctuations in asset values for members exiting before retirement
5. It avoids short-term fluctuations in asset values for members at or close to retirement

While it is not in the scope of this paper to make judgements on the ideal investment portfolio, it is recognised that investment consultants and asset managers put a great deal of effort into constructing portfolios that have a high probability of achieving some or all of these objectives. The tools available to them for doing this are typically:

— a range of asset classes, and optimising the allocation between these;
— the ability to discover and purchase underpriced investments; and
— a range of risk-mitigating derivative investments such as options and futures.

Whatever the portfolio is that an investment professional finally advises it will include some trade-off between return objectives and risk mitigation. Of the five objectives of the ideal portfolio outlined above, each strategy will place greater emphasis on some, to the relative exclusion of others. For example, a strategy that uses put options to achieve objective 3 (avoiding negative returns), will incur significant costs in doing so which will detract from its ability to meet objective 1 (significant real growth).

The aim of this paper is to show how the trade-off between objectives can be limited by including in the range of trustees' tools a simple strategy of smoothing returns, complementing rather than replacing the use of the other tools available.

3.1 Investment Portfolio Objectives

In order to measure the effectiveness of different strategies in meeting the objectives above, they are expressed in Table 1 as statistics that can then be measured and compared.

Table 1 Investment portfolio objectives

Objective	Description	Statistic
1	Long-term growth	Pr (annual **real** return over rolling 15 year periods > 5.5%)
2.1	Consistency of real returns > 4% p.a. over rolling 5 year periods	Pr (annual **real** return over rolling 5 year periods > 4%)
2.2	Consistency of real returns > 4% p.a. over rolling 3 year periods	Pr (annual **real** return over rolling 3 year periods > 4%)
2.3	Consistency of real returns > 0% p.a. over rolling 1 year periods	Pr (annual **real** return over rolling 1 year periods > 0%)
3.1	Non-negative annual returns	Pr (rolling one year **nominal** return above 0)
3.2	Non-negative monthly returns	Pr (rolling one month **nominal** return above 0)
3.3	Expected size of negative returns	Average negative rolling 1 year return
4 & 5	Investment efficiency	Efficiency statistics: Sharpe ratio and Sortino ratio (with inflation as the minimum acceptable return)

There could be considerable debate over the appropriate level of real return targets and rolling return periods. This paper takes the view that these are reasonable levels for the various objectives, but that one may certainly replicate the analysis using different levels, if they were more appropriately aligned to one's economic outlook and particular approach, and achieve similar result.

Nevertheless, by way of explanation:

— 5.5% long-term real return is used as it is a level anecdotally observed as an explicit target for aggressive balanced funds in the retirement fund investment market. Furthermore, combining the asset allocations and the long-term average real return (set out in section 3.2 below) on each asset class in the projection model used, results in a portfolio expected real return on the aggressive balanced portfolio of 5.5%.

— 15 years is used as a reasonable upper bound for the length of a long business cycle so that the return earned over any 15 year period should reflect periods of both "bear" and "bull" market conditions.

— 4% was used over the medium term as a somewhat arbitrary choice of a return that is below the long-term expected return, but above the return expected from very safe investments (such as cash).

— 5- and 3-year terms are in pragmatic recognition of investment horizons of which many trustee boards are acutely aware.
— 1-year return above inflation is included also in recognition of anecdotally observed trustee behaviour which would want to see that even if other targets are not met in the short term, that the assets have at least not lost ground in real terms.
— The 1-year and 1-month periods for negative returns reflect the belief that members and therefore trustees are extremely averse to negative returns. The 1-year statistic is more important than the one month.
— The Sharpe and Sortino ratios are used because they are fairly simple and well-understood statistics that measure investment efficiency. As a proxy for reasonable protection of members who may require benefit encashment at all points during their savings period, it is assumed that the investment that achieves growth at the lowest volatility "cost" is exposing members to as little risk as is reasonable if they intend to meet their growth objectives.

3.2 Investment Portfolios

For the purposes of simplicity three portfolio constructions are used, each with differing levels of exposure to "growth" assets and thus different expected levels of trade-off between expected return and volatility. Again for simplicity only, four asset classes are used: local and international equities ("growth assets"), local bonds, and cash. The portfolios and their compositions are displayed in the figure below. Asset allocation and expected long-term real return on the asset classes are used to arrive at an expected long-term real return for each strategy.

Assumptions about expected long-term real returns (returns above CPI inflation) on the various asset classes have been made and are disclosed in Table 2.

Table 2 Real return assumption

	Local Cash	Local Bonds	Local Equity	International Equity
Expected long-term real return	1.6%	3.5%	6.5%	6.5%

Real return assumptions are of course highly debatable. The actual quantum of these is not critical to the thesis of this paper. What is fundamental to the paper is the theory that assets that display higher price volatility will, in general, be expected to deliver greater long-term returns than more stable assets.

4. HISTORICAL ANALYSIS OF BASIC INVESTMENT STRATEGIES

In order to model the performance of the three investment strategies over a recent 40-year period the following data and assumptions were used:

— Index returns for the asset classes as summarised in Table 3 below.

— Fixed asset allocation, i.e. monthly rebalanced portfolios.
— The analysis is of returns only, i.e. ignoring size and timing of contributions.
— It is recognised that one may be able to significantly improve performance by various applications of asset management skill, for example allowing flexibility in asset allocation on a strategic and tactical basis. However, as the aim here is to demonstrate the relative improvement in performance by overlaying smoothing on to a given strategy, and assuming that an improvement in the performance of the underlying strategy will lead to a roughly constant improvement to the smoothed strategy, a simple investment strategy is considered appropriate.

Table 3 Indices

Asset Class	Index
Local Equity	FTSE/JSE All Share TRI
International Equity	MSCI World (in Rands)
Local Bonds	ALBI Total Return
Local Cash	STeFI (AF Money Market Index before 2000)
Inflation	CPI

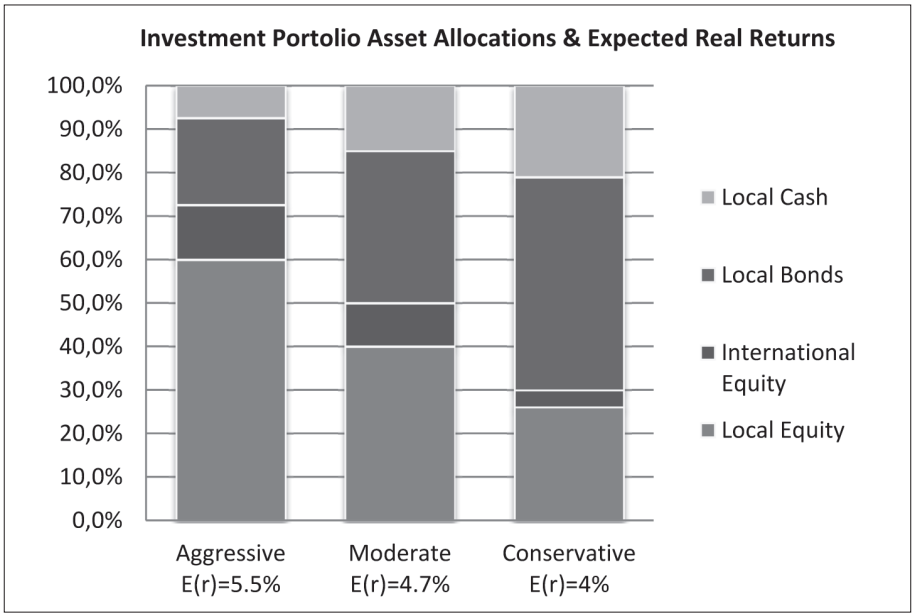

Figure 1 Investment portfolio information

The results displayed in Table 4, are summarised according to the objectives outlined in section 3:

Table 4 Historical results before smoothing

Objective/Inv Strategy	Aggressive	Moderate	Conservative
1: Long-term growth	95.68%	77.74%	52.49%
2.1: Consistency >4% over 5 years	80.76%	77.20%	58.67%
2.2: Consistency >4% over 3 years	67.87%	64.94%	54.83%
2.3: Consistency >0% over 1 year	67.16%	67.80%	68.44%
3.1: Non-negative annual returns	87.85%	90.62%	96.16%
3.2: Non-negative monthly returns	64.17%	69.79%	72.50%
3.3: Expected size of negative returns	–8.97%	–4.43%	–2.33%
4&5 Annual Sharpe	1.18	1.55	1.90
Annual Sortino (above inflation)	6.13	9.40	19.51
Monthly Sharpe	0.35	0.43	0.50
Monthly Sortino (above inflation)	0.60	0.77	0.94

The more aggressive the strategy, the greater the frequency of meeting longer-term return objectives. However, both the frequency and magnitude of negative returns increases too. This is the result that tends to lead decision-makers away from aggressive strategies.

The conservative strategy scored most highly on all of the efficiency measures used, a result that serves to corroborate the decision to invest more conservatively. This serves to obscure the seriousness of the loss in frequency of meeting the long-term real return targets (from 95.7% for the aggressive strategy to 52.5% for the conservative strategy). The critical finding in this section is that in a conservative fund members may have had a comparatively easy journey, but were far less likely to reach their destination over the last 40 years. This presents an awkward conundrum for trustees and decision-makers.

5. PROJECTION ANALYSIS OF BASIC INVESTMENT STRATEGIES

For the projection analysis, modifications were made to an asset projection model developed by Barrie & Hibbert for Old Mutual South Africa calibrated as at 30 June 2011. The details are given in Appendix 1, but it is important to note that the real return expectations of the asset classes are consistent with those assumed in deriving expected real returns for the investment strategies.

For each simulation the same statistics as for the historical analysis were recorded. The averages of the results over all 5000 scenarios are as follows:

Table 5 Projection results before smoothing

Objective/Inv Strategy	Aggressive	Moderate	Conservative
1: Long-term growth	56.91%	50.55%	40.15%
2.1: Consistency >4% over 5 years	61.83%	60.35%	55.74%
2.2: Consistency >4% over 3 years	59.29%	58.18%	54.57%
2.3: Consistency >0% over 1 year	64.91%	67.26%	68.07%
3.1: Non-negative annual returns	77.43%	82.33%	85.64%
3.2: Non-negative monthly returns	58.55%	60.57%	62.14%
3.3: Expected size of negative returns	–7.86%	–5.58%	–4.26%
4&5 Annual Sharpe	0.79	0.94	1.05
Annual Sortino (above inflation)	6.69	14.93	21.17
Monthly Sharpe	0.24	0.29	0.33
Monthly Sortino (above inflation)	0.44	0.56	0.65

As expected, the more aggressive the portfolio the more frequently it is expected to meet long-term real return targets. However, over shorter periods, and with lower targets, the success frequency drops closer to and then below that of more conservative strategies. More importantly for many, the risk of both frequency and severity of negative returns is greater for more aggressive strategies. This comes through also in the efficiency statistics, which improve as the fund reduces its exposure to growth assets.

The conclusion seems to corroborate what many take as a given – in order to protect members who cannot afford negative returns from volatility, a sacrifice of expected growth potential must be made. Conversely, in order to achieve long-term real growth, one must accept greater volatility and a higher risk of frequency and size of negative returns.

6. THE BASICS OF A SMOOTHING STRATEGY

The basic mechanism of smoothing is to maintain a separate value of liabilities based on which benefit payments are made to members, and to increase this liability value in a measured way through regular bonuses so as to shield members from much of the volatility experienced by the underlying assets.

The liability value is nothing more than a reference value for calculating the value of proportional benefit payments, but benefit payments are still made from actual assets. The difference between the asset value and the liability value may be referred to as the reserve. When benefit payments are made while the liability value is below the asset value, the reserve grows slightly, and vice versa. The philosophy then is that the majority of fund participants alternately absorb the costs and the enhancements

caused by the departure at a stable value of the minority of participants who leave due to specified benefit events. One may recognise this as an application of the principle of insurance.

For the purposes of this paper, a defined bonus formula is used that declares bonuses by targeting the long-term inflation-related expectations of the underlying assets, adjusted for actual experience as reflected in the reserve account. This should mean that as long as assets perform as expected over the medium term, members will see their benefit value increasing at a steady, predictable rate in line with their retirement objectives. Where, over a sustained period, assets under- or out-perform long-term expectations, benefit increases will be adjusted downward or upward respectively to reflect that. The speed with which deficits or surpluses in the reserve account are corrected through bonuses reflects a balance between achieving the dual aims of stable, predictable returns for all members and maintaining reasonable equity between members.

It is worth mentioning, however, that a formula will be designed to "work" in a majority of circumstances, but there will be unusual market periods when intelligent human intervention is preferable to the formulaic outcome. It could be argued that the intervention of an experienced actuary at such times should improve smoothing strategy performance (and the experience of the participating members) but will not be reflected in these results.

7. IMPACT OF SMOOTHING ON HISTORICAL AND PROJECTION ANALYSES

A smoothed strategy was constructed by using the bonus formula mentioned in section 6 and detailed in Appendix B, and the aggressive strategy as the underlying investment portfolio. A charge of 0.2% per annum was levied from the assets monthly to account for the potential cost of implementing smoothing through a policy with an insurer.

The impact of smoothing on the results of the historical analysis is summarised in Table 6 (expanding the summary table from section 4):

Clearly, smoothing significantly enhanced the performance of the aggressive investment strategy on all of these historical measures. Crucial to notice is that the long-term objective was met 100% of the time (even more frequently than the aggressive strategy), while the frequency and magnitude of negative returns is reduced to be only a fraction of that experienced in the conservative strategy. As expected, the efficiency measures all reflect the superiority of the smoothing strategy in achieving returns without increasing risk as measured by the volatility of the benefit payment reference portfolio. The smoothed aggressive strategy was better at both reducing risk and achieving medium and long-term returns than any of the simple strategies considered here over the historical period surveyed.

The impact of smoothing on the results of the projection analysis is summarised in Table 7.

Table 6 Historical results including smoothing

Objective /Inv Strategy	Aggressive	Moderate	Conservative	Smoothed Agg
1: Long-term growth	95.68%	77.74%	52.49%	100.00%
2.1: Consistency >4% over 5 years	80.76%	77.20%	58.67%	86.70%
2.2: Consistency >4% over 3 years	67.87%	64.94%	54.83%	79.78%
2.3: Consistency >0% over 1 year	67.16%	67.80%	68.44%	79.74%
3.1: Non-negative annual returns	87.85%	90.62%	96.16%	99.15%
3.2: Non-negative monthly returns	64.17%	69.79%	72.50%	99.58%
3.3: Expected size of negative returns	–8.97%	–4.43%	–2.33%	–0.72%
4&5 Annual Sharpe	1.18	1.55	1.90	1.90
Annual Sortino (above inflation)	6.13	9.40	19.51	267.16
Monthly Sharpe	0.35	0.43	0.50	1.77
Monthly Sortino (above inflation)	0.60	0.77	0.94	13.36

Table 7 Projection results including smoothing

Objective /Inv Strategy	Aggressive	Moderate	Conservative	Smoothed Agg
1: Long-term growth	56.91%	50.55%	40.15%	55.00%
2.1: Consistency >4% over 5 years	61.83%	60.35%	55.74%	61.98%
2.2: Consistency >4% over 3 years	59.29%	58.18%	54.57%	60.38%
2.3: Consistency >0% over 1 year	64.91%	67.26%	68.07%	73.76%
3.1: Non-negative annual returns	77.43%	82.33%	85.64%	91.31%
3.2: Non-negative monthly returns	58.55%	60.57%	62.14%	96.50%
3.3: Expected size of negative returns	–7.86%	–5.58%	–4.26%	–3.55%
4&5 Annual Sharpe	0.79	0.94	1.05	1.33
Annual Sortino (above inflation)	6.69	14.93	21.17	318.70
Monthly Sharpe	0.24	0.29	0.33	1.17
Monthly Sortino (above inflation)	0.44	0.56	0.65	14.79

Here the effect of the 0.2% p.a. charge over the long term is reflected in the long-term growth measure. The lower overall average is a reflection of the fact that the smoothing strategy will be slower to pass through the returns of the underlying strategy, so that, if assets underperform over the long term, a market-linked strategy will have

shorter periods of major underperformance rather than longer periods of minor underperformance. In other words underperforming periods drop out of long-term rolling period averages more quickly in a market-linked strategy than a corresponding smoothing strategy.

While the smoothing strategy is marginally less effective over the long term and marginally more effective over the medium term at meeting real return targets consistently, the frequency of success improves as the term considered reduces. On the one-year measure, the success frequency is a full 9% better than the market-linked aggressive strategy. Crucially, the risk of both frequency and severity of negative returns is far lower than even the most conservative strategy, and the efficiency statistics are better than any of the others by an order of magnitude.

One could increase the exposure to growth assets in the smoothing strategy even above that of the aggressive strategy in order to target a long-term real return success rate above that of the aggressive strategy while still maintaining statistics on the risk measures better than the conservative strategy.

So it seems that the conclusion of section 5 must be challenged. The best way (of strategies considered here) to protect members from exposure to down-side volatility is also the way to increase the expected frequency of meeting real return targets over every term. There need not be the choice between long-term growth and short-term risk aversion in the particular case where investors only withdraw their funds on defined benefit payment events.

8. OBJECTIONS TO SMOOTHING

Various objections to smoothing have been raised over the years. This paper will attempt to address the most pertinent of these.

8.1 Equity between Members

Benefit payments are made according to the liability value, which could be above or below the asset value, but are deducted from the assets. Hence, members who receive benefits while the reserve is positive do not participate in the positive reserve (the full level of assets) and further augment the positive reserve for remaining members. Similarly, when reserves are negative, leaving members receive payouts at a level above that supported by the assets, with the effect of reducing the reserve even further.

Some of the arguments used to justify this cross-subsidisation between members are given below:

— Benefit payments form a small portion of the total asset value for a large smoothing portfolio. Hence, the impact on remaining members of distributing more or less than equivalent asset value to leaving members is not usually significant. For example, *if the reserve = –5%, and 5% of the membership leaves, the reserve after benefit payments will be –5.25%. The impact on remaining members is small (0.25%), but for leavers it is significant (5%).*

— The cross-subsidies occur at random – the liability value is paid on benefit

payments only (i.e. retirement, retrenchment, etc). It would be difficult for a person to time such an event to coincide with a large negative reserve (i.e. where they benefit the most from the transfer). Members thus accept that they could contribute to or draw on the reserve depending on the market circumstances at the time of their withdrawal from the fund, but also that they will not be exposed to the intentional abuse of this cross-subsidisation by others with fewer scruples.

— The reserve will vary around zero and so some will contribute to the reserve and others will draw on it. Further, ongoing contributions will be made at times when the reserve augments the contribution and when it detracts from it. In other words, all members will at various times be on both ends of the deal, and over the long term these ups and downs should accumulate to close to zero.

— Finally, members may feel uncomfortable with the thought of giving up 10% of their growth if they retire while reserves are, say, 10%. Two points should address that concern. The first is that they are just as likely to avoid a sudden –10% drop in their retirement savings – an eventuality that would be profoundly uncomfortable for most people. Secondly, the member is only exposed to the types of assets that could swing up or down by 10% in the short term because by smoothing out fluctuations they were able to invest aggressively, and that for some 30 or 40 years. The accumulated benefit of having been invested as they were for all that time outweighs by many multiples the "loss" of short-term ups (or downs) in their final benefit payment.

One criticism of these arguments will be that smoothing strategies usually target a reserve range that is slightly positive (e.g. 0–5%) so that the reserve effects are skewed towards those experienced during positive reserves. This is usually true, but not hugely significant. It could also be addressed through altering the smoothing strategy to target a long-term reserve of zero (giving the fund less flexibility to withstand serious negative downturns in the market).

Quite simply, the principle of insurance is here at work. It has similar "winners" and "losers" to term insurance – insurance professionals know, however, that every participant is a beneficiary of the increased certainty and modified risk profile that they were able to enjoy. Members of retirement funds should not be led to believe that they are somehow unfairly treated by these cross-subsidies. Each individual may be both the beneficiary and the benefactor, and will most likely be both at various points in the life of the investment, but they all benefit from increased certainty and greatly improved risk profile that they are exposed to.

8.2 Illiquidity

The smoothing mechanism is directed toward members for the purpose of benefit payments. Where decisions are made at a trustee/fund level, the reserve cannot be used to subsidise payments for two reasons: the timing is no longer random (trustees are well-informed and can make a termination decision at any time, to their advantage

and the detriment of remaining members/funds) and the size of flows is no longer immaterial (large flows will have a significant impact on the reserve for those remaining). As a result, in pooled arrangements, funds are able to terminate at the lower of the liability value and the asset value.

It is fairly straightforward to see why the fund cannot take more than the asset value when assets are below liabilities, but not so clear why they cannot get full asset value when liabilities are below assets. The "lower of" rule applies in order to limit anti-selection. If a fund terminates with full assets while reserves are positive, the fund can then immediately reinvest, and in the future will benefit from the inflated bonuses that will emerge from the positive reserve, having already taken their full portion of that reserve on termination. Even if they were prevented from reinvesting directly in the same pooled fund, all other pooled funds in the market should have a similarly healthy reserve level into which they could invest.

These are long-term investments, and should be entered into as such. Their purpose is not to allow tactical switches by trustees, but long-term benefit security for members. That said, the limits on liquidity can be overcome if the trustees have a segregated smoothing portfolio, in which case there are no other "remaining members" to protect. Furthermore, it should be noted that there will be significant liquidity constraints in many structured products that aim to give some down-side protection which may lead to the protection being undermined in the event of a termination and may lead to long lead times before money can be recovered if significant point losses are not accepted, i.e. it is not the case that market-linked investments necessarily include greater liquidity.

Finally, it must be noted that the provider of the smoothing policy does not gain from termination conditions. They are designed to protect members from anti-selection.

8.3 Sudden Liability Value Falls

A very important distinction must be made between smoothing and guarantees. Where smoothing is provided without guarantees there is no charge for the capital required to back a guarantee. However, it means that the smoothing policy provider is simply providing an accounting, platform and bonus methodology service – if the assets of the fund fall to zero, as in any market-linked strategy, the members will have zero assets to withdraw. Less apocalyptically, if assets fall below a level from which they can reasonably be expected to recover in a short period then the cross-subsidisation to leaving members becomes material and the negative reserve must be restored to a more reasonable level. This could be implemented through a negative bonus. This is all theoretically acceptable, and members are not put in a position worse than they would be in an unsmoothed market-linked strategy; however, members who have become accustomed to non-negative, smooth returns will be ill-prepared to deal with a fall in the nominal value of their savings. This is certainly a risk that must be understood and appropriately mitigated and/or communicated by trustees.

Possible mitigation avenues include:

— Purchasing explicit capital guarantees. These alter the risk-return profile of the portfolio further than smoothing only. As one moves toward 100% guarantees, the charge for that will reduce the expected returns while the volatility (and down-side volatility in particular) declines. There should be a point at which the portfolio is appropriate to the risk appetite of the group.

— Adjusting the smoothing formula. This can be to either introduce negative bonuses earlier in a market down-turn, sensitising the members to negative returns while still cushioning the portfolio to a large extent from the full swings of the underlying portfolio; or, by smoothing more conservatively so that positive reserves after market rallies are released more slowly so as to increase the buffer when the portfolio drops dramatically. This, of course, increases the level of cross-subsidisation between members – a factor that must be carefully weighed up.

8.4 Last Man Standing

A smoothing portfolio becomes difficult to manage as the size of benefit payments become large relative to the remaining assets. Taken to the extreme, the last man standing in a smoothed portfolio could either gain or lose on a large scale.

In reality, this difficulty would need to be managed by either undoing the smoothing structure as the portfolio becomes too small, or by combining the portfolio with a larger fund. This should be relatively easy to accomplish at a neutral time for investors as long as markets are mean reverting over the medium to long term.

It must, however, be made clear that if the returns on assets underlying a smoothed portfolio are continuously negative, resulting in a reserve that is always negative, there will never be a reversal of the built-in cross-subsidy mechanism. Each leaving member will benefit to the detriment of remaining members who will never recover that cost from future benefit payments or contributions if returns never turn positive. This is an apocalyptic scenario, but it is one where the remaining members are increasingly worse off for being in a smoothed portfolio, and is theoretically possible. If one is in fact concerned about such a scenario, it would be appropriate to explore guarantee options. Comparing the worse outcome for remaining members compared to if they had been in a market-linked balanced fund in such a scenario is like comparing a house that is flooded with one metre of water versus one flooded with 1.2 metres; it is surely the fact of the flooding that is the greater inconvenience, and the risk to be mitigated.

9. CONCLUSION

The conclusion of this paper is that smoothing is an efficient and effective tool for achieving the often-conflicting aims of retirement fund trustees. It has shown the effect of a simple smoothing formula on an aggressive balanced fund investment strategy that resulted in it performing better (sometimes exceptionally so) than the full range

of aggressive to conservative strategies on both a historical and projection basis. That outperformance was on all the trustee objectives identified, while other strategies had relative areas of strength or weakness over each other. The implication of this is that where trustees are foregoing some objectives for the sake of others, it is quite possible that they need not do so if they open their investment universe to include smoothing.

Many legitimate concerns around smoothed bonus products arose in the mid 1990s, leading to a popular move away from them. Many of these can be addressed by product design (e.g. monthly rather than annual bonuses, more explicit and transparent product rules, etc), but much can be addressed by simply improving clarity of understanding, leading to realistic and appropriately managed expectations. Understanding how smoothing transforms an investment strategy and what constraints that introduces is crucial. Seeing the separate role of guarantees (not addressed in any detail in this paper) and assessing those on their own merits against value-for-money and risk-tolerance criteria is also key. It is perhaps a drawback of the insurance industry in South Africa that this clarity of thought has not always been provided. Nevertheless, there is an opportunity for fund trustees, and particularly those who advise them, to apply smoothing where appropriate with full clarity of understanding so as to enable retirement fund members to more consistently and effectively meet their retirement goals.

BIBLIOGAPHY

Antolin, P, Payet, S, Whitehouse, ER & Yermo, J (2011). The Role of Guarantees in Defined Contribution Pensions. OECD Working Papers on Finance, Insurance and Private Pensions, No. 11

Ashcroft, J & Stewart, F (2010). Managing and Supervising Risks in Defined Contribution Pension Systems. International Organisation of Pension Supervisors Working Papers on Effective Pension Supervision, No. 12

Bateman, H, Lai, A & Stevens, R (unpublished). Analysis of Risk Presentations in Retirement Investment Choices Under Prospect Theory. Network for Studies on Pensions, Aging and Retirement International Pension workshop, Amsterdam, 2012

Blake, D, Byrne, A & Harrison, D (2007). Defined Contribution Pensions: Dealing with the Reluctant Investor. The Pensions Institute Practitioner Reports, Cass Business School, City University London

Bodie, Z & Prast, H (unpublished). Rational Pensions for Irrational People: Behavioral Science Lessons for the Netherlands. A Network for Studies on Pensions, Aging and Retirement event: Report on Macroeconomics of Pension Reform, The Hague, 2010

REFERENCES

Basu, A & Drew, M (2006). Appropriateness of Default Investment Options in Defined Contribution Plans: The Australian Evidence. Queensland University of Technology. http://mpra.ub.uni-muenchen.de/3314/1/MPRA_paper_3314.pdf.

Blake, D, Byrne, A, Cairns, A & Dowd, K (2007). Default Funds in UK Defined Contribution Pension Plans. *Financial Analysts Journal*, **63**:40–51

Levitan, S & Thomson, R (2007). The Application of Expected-utility Theory to the Choice of Investment Channels in a Defined-contribution Retirement Fund. Submission for the 17th International AFIR Colloquium to be held in Stockholm, Sweden, 12–15 June 2007

APPENDIX A

Asset Model

The model used for projections is a Barrie & Hibbert (B&H) stochastic-volatility, jump-diffusion (SVDJ) model calibrated to South African market data as at 30 June 2011. The SVJD model allows implied volatility to differ by strike price. Interest rates and yield curves were generated using a monthly version of the Libor Market Model. The model generates 80 years of asset returns, with only the first 30 years used for analysis. The 5000 generated scenarios were then tweaked by adding a fixed amount to each monthly return such that for each asset class the average over all scenarios of the annualised compound return equalled that assumed in the portfolio construction in Section 3.2.

Further details of the B&H calibration are given below.

The yield curve is derived from market data for the first 30 years, and then is extended to 120 years using the Nelson Siegel functional form, with long-term nominal returns a function of expected inflation and expected global long-term real interest rates (from analysis of historical global data).

The swaption volatility term structure is derived from market data up to the second year, with pseudo option prices used to extrapolate the term structure beyond the second year. The pseudo option prices are derived by using a combination of market data and B&H's real world unconditional volatility term structure of forward rates at long horizons.

The equity volatility term structure is assumed to follow an exponential form. The term structure is fitted using market data for the first three years together with a long-term (30 year) volatility target. The long-term volatility target is derived using realised market index volatility data and judgement.

Results across the 5000 projections scenarios are summarised in Tables 8 and 9 below.

Table 8 Average compound annual return over the asset classes over 30 years

Asset Class	Average compound annual return (30 yrs)
Inflation	6.0%
SA Bonds	9.6%
SA Equity	12.5%
SA Cash	7.66%
Int Eq	12.5%

Table 9 Portfolio average compound annual return over 30 years

Portfolio	Average compound annual return (30 yrs)
Aggressive Balanced	12.25%
Moderate Balanced	11.5%
Conservative Balanced	10.65%
Smoothed (excluding remaining reserve)	11.8%

APPENDIX B

Bonus Formula

The bonus formula used is a slightly modified version of a formula applied for an existing product offered by Old Mutual. It follows a discontinuous approach depending on the level of reserves. When reserves are positive it targets a bonus equal to the long-term real return expectation. In this case, it is assumed that a long-term achievable real return for an aggressive portfolio is 5.5%. After deducting a 0.2% charge for administering the strategy, the long-term real return targeted is 5.3%.

When reserves are positive:
Monthly bonus = Max [(1+annualised rolling 3-year CPI+5.3%)^(1/12)–1+X,Y]

where X is an adjustment to allow for the level of the reserves, taken from the following Table 10.

Table 10 Bonus adjustments

Reserve	Average three-year CPI is less than or equal to 6%	Average three-year CPI is greater than 6%
0% (incl) to 5%	0.00%	–0.50%
5% (incl) to 10%	0.50%	0.00%
10% (incl) to 15%	0.75%	0.25%
15% (incl) to 20%	1.00%	0.50%
20% (incl) to 25%	1.25%	0.75%
25% (incl) to 30%	1.50%	1.00%
> 30% (incl)	1.75%	1.25%

Y is a minimum to ensure that the bonus can at least cover management fees. Y= 0.05%

When reserves are negative, the monthly bonus is drawn from the Table 11.

Table 11 Bonus when reserves are negative

Reserve	Monthly Gross Bonus
–2.5% (incl) to 0%	0.49%
–5.0% (incl) to –2.5%	0.24%
–7.5% (incl) to –5.0%	0.05%
–15% (incl) to –7.5%	0%
–20% (incl) to –15%	–1%
–25% (incl) to –20%	–2%
–30% (incl) to –25%	–4%
–35% (incl) to –30%	–8%
–40% (incl) to –35%	–10%
Below –40%	–20%