DRW
INVESTMENT RESEARCH

Identifying Appropriate Post-Retirement Investment Portfolios

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1. Objective

The purpose of this study is to identify appropriate post-retirement investment portfolios that will provide sustainable, real income to retirees for a period of 20 to 30 years after retirement. Thus, when constructing an appropriate post-retirement investment portfolio what should be the ideal exposures to the different asset classes (equities, properties, bonds and cash), alternatively known as the asset allocation mix?

2. Retirement Income Perspectives

The conventional advice given to retirees is to limit the risky elements in one's post-retirement investment portfolio, notably equity investments. Hence, many investors would opt for a portfolio that consists of 75% plus in fixed interest instruments (cash and bonds), or alternatively to buy a guaranteed annuity from a financial services provider.

The question arises whether this a rational and, most importantly, a sustainable approach? I can put forward at least two reasons why I would seriously challenge this investment strategy.

First, it may be that initially one's retirement income is more than enough to cover basic income needs. In fact, it may even seem so for a considerable period (10 years), but thereafter one may experience loss of purchasing power – the dreaded inflation beast. It is one thing to use the official inflation rate for comparative reasons, but quite a different matter to experience one's *own* inflation rate, which invariably will be heavily weighted towards spiralling high-cost items such as health care and personal security services for especially the older age groups.

The second factor to consider is purely demographic and embraces medical innovations and a general consciousness of healthy lifestyles. We are simply getting much older than we ever would have thought or than our original retirement capital could afford. These days it is quite common to find healthy

80-year old retirees, who would agree that they are outliving their own expectations, and certainly their pension plans. Typically, their retirement income plans, even if annually adjusted by the official inflation rate, as with guaranteed annuity schemes, are not keeping pace with the loss of purchasing power experienced during the post-retirement stage of their lives. Why? Their post-retirement investment portfolios included no or few inflation-beating growth assets.

As noted in a previous research study,[1] where I explored the suitability of including equity investments in one's post-retirement investment portfolio, the historical evidence over the past 45 years has largely indicated that this asset class exhibits sustainable inflation-beating returns when investing for the long term (20 to 30 years). Therefore, I concluded that equity investments should form an integral part of a post-retirement investment portfolio.

But equity returns may be volatile and market valuations may be depressed for a considerable period from time to time, which in a regular withdrawal framework (such as compulsory annuity plans) may be especially detrimental to the longevity of such a plan. Therefore, in addition, I proposed in that study three prerequisites upon which the extensive use of equities in a retirement income portfolio should be considered.

First, that a broadly diversified equity portfolio with a proven long-term track record of dividend payments is predominantly used, for example the FTSE/JSE Top 40 companies. Dividend payments, especially during depressed market conditions are vital to stem the sharp reduction in portfolio valuations that may occur while regular withdrawals are being made. Arguably, blue-chip companies are better equipped to pay dividends during economic recessions than start-up or mid-sized companies.

Second, equity portfolios can be insured against major losses on the stock market by making use of derivative instruments, such as the JSE Top 40 put

[1] DR Wessels, August 2006. *The Appropriateness of Equity Investments in Providing Real Income within a Living Annuity Concept*. Available: www.indexinvestor.co.za

options traded on SAFEX. Some equity investment funds are making use of these derivative overlays to offer their investors constant, absolute returns. However, there are some direct and opportunity costs in using derivatives. The effective management of the derivative overlay is very important to the relative success of these funds; first to keep up with the general market performance during bull markets, and second to prevent large-scale retractions during bear market phases.

Third, the drawdown (withdrawal) rate should ideally be set at 5%, with a maximum level of perhaps 7%. If annuity investors are targeting especially the latter category of drawdown levels it is imperative to make use of protected equity portfolios, as described above. Beyond these rates it is in any event unrealistic to expect one's retirement plan to preserve its purchasing power in the long run.

A further caveat awaits, even if an investor has met the above three conditions pertaining to equity investments. Equities are not always the best performing asset class, even in the medium to long term. For example, over the 10-year period from 1996 to 2006 bonds and especially listed property investments have outperformed equities by considerable margins.[2] Thus, as a starting point, prudent investors should consider including all asset classes in a post-retirement portfolio.[3]

Consequently, this study endeavours to identify suitable asset allocation strategies for post-retirement investment portfolios with high probabilities of being sustainable over a 20- or 30-year lifespan.

[2] DR Wessels, 2006. *Asset Allocation: An Evaluation of Investment Portfolios*. Available at: www.indexinvestor.co.za

[3] Since no tax liabilities originate from interest and rental accruals within compulsory annuity plans, no potential dilution of returns will be experienced by tax-paying investors opting to invest in taxable asset classes, such as bonds and properties.

3. The "Critical Yield" Concept

Theoretically, it is possible to calculate the minimum portfolio return required to sustain a certain income (annuity) stream on a real basis (adjusted for inflation) over a 20- or 30-year lifespan.

For the purpose of this analysis I define the required income (annuity) as the *target income*, which is adjusted every year for inflation. This in turn allows one to calculate the retirement capital needed year by year, and therefore the required portfolio return.

For example, if the target income is set at 5% of the initial retirement capital, and inflation over the period averages 5% per annum, what portfolio return should be yielded to maintain the purchasing power of the annuity income in the long term?

Furthermore, in order to relax the minimum portfolio return requirements I allow the withdrawal rate from the plan to be adjusted upward to a maximum rate of 20% of the retirement capital towards the end of the targeted lifespan of the annuity.

For this purpose I define the "critical yield" as that minimum portfolio return where the target income, for example in year 20, is equal to 20% of the retirement capital value [4] in the beginning of year 20. Once the target income reaches this threshold one can expect thereafter a substantial decline in the retirement capital and possible withdrawals. Effectively, the annuity plan will lose its ability to generate real income once it reaches this threshold.

[4] During the Minister of Finance's annual budget speech in February 2007, it was announced that the minimum and maximum withdrawal rates from annuity plans will be adjusted from 5% and 20% to 2.5% and 17.5% respectively.

This concept is graphically illustrated in the following three examples (charts 1-3). In these examples the initial retirement capital is R100. The target lifespan of the annuity is 20 years and the initial net withdrawal rate is set at 7% (R7). Note that provision is made for administration and advice fees averaging 2%, and since these fees are recovered from the portfolio return the effective or gross withdrawal rate amounts to 9%.[5] An inflation rate of 5% per annum is assumed over the lifespan of the annuity. Thus, the initial withdrawal amount (R7) should escalate every year by 5% – R7.35 after the first year, R7.72 after the second year, and so forth. This figure represents the target income, which is illustrated by the exponential curve (blue line) on the charts.

In the first example the portfolio return equals the "critical yield" – the minimum portfolio return required to maintain the purchasing power of the annuity. The actual income (yellow line) exactly matches the target income (blue line), but towards the end of the plan's lifespan capital is depleted to sustain the income requirements. Note that in year 20 the actual income is 20% of the retirement capital value. This example indicates that the "critical yield" is equal to 11.8% p.a. – nearly 4% above the initial net withdrawal rate.

In the second example the actual portfolio return (9% p.a.) is less than the critical yield (11.8% p.a.). From year 13 onwards the annuity plan breaks down as the actual income did not keep track with the target income with the resultant depletion of capital – in short, this annuity plan cannot provide real income for a specified period of 20 years.

The third example shows the opposite trend and without doubt represents every annuitant's wish as the portfolio return (14% p.a.) surpassed the "critical yield". Capital appreciation takes place as inflation-beating returns provide extra capital beyond those needed to adjust the annual annuity for inflation.

[5] Investors very often neglect the product and advice fees when deciding upon an appropriate withdrawal rate, or alternatively, selecting the investment strategy going forward.

For example:

Example 1: When Investment Return = Critical Yield

Investment	100
Net withdrawal rate	**7.00%**
Ongoing fees	2.00%
Gross withdrawal rate	9.00%
Inflation	**5%**
Lifespan (years)	20
Investment return pa	**11.8%**

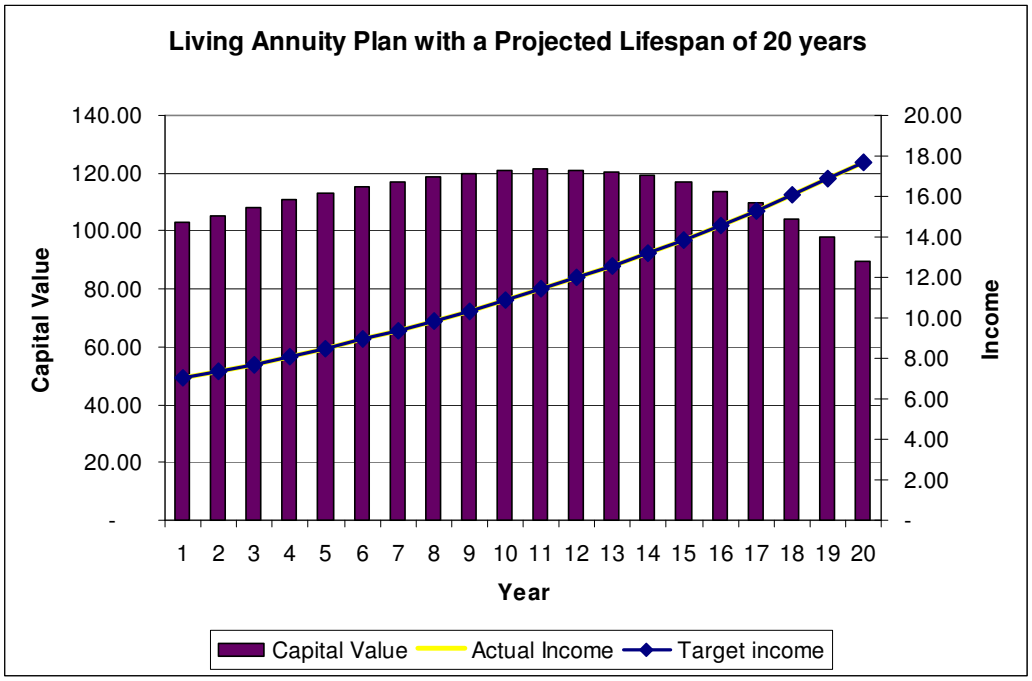


Chart 1

Example 2: When Investment Return < Critical Yield

Investment	100
Net withdrawal rate	**7.00%**
Ongoing fees	2.00%
Gross withdrawal rate	9.00%
Inflation	**5%**
Lifespan (years)	20
Investment return pa	**9.0%**

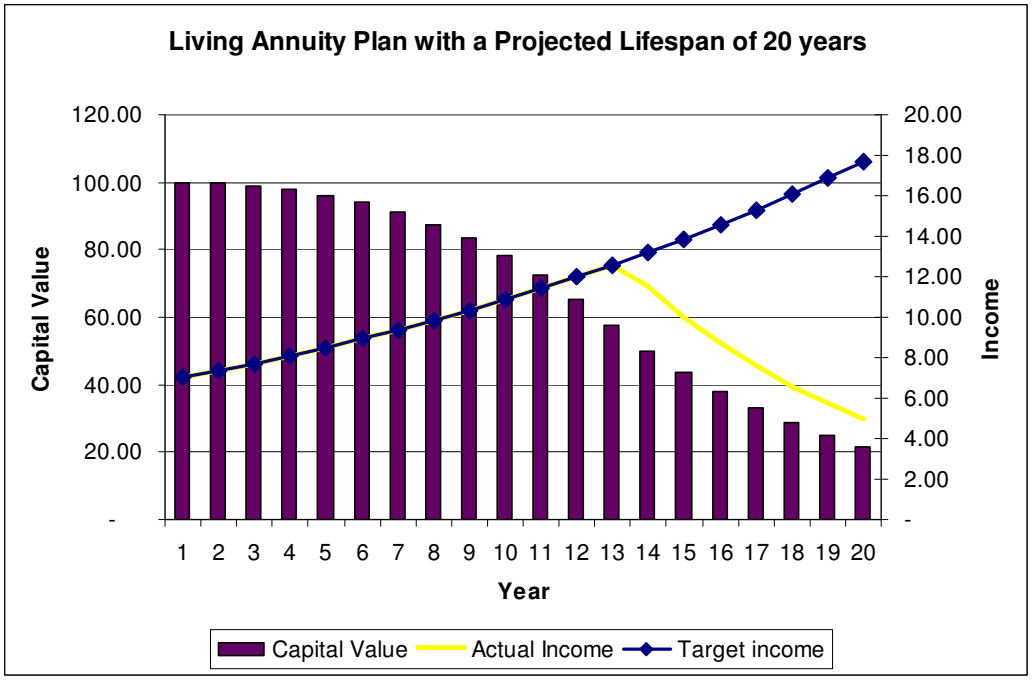


Chart 2

Example 3: When Investment Return > Critical Yield

Investment	100
Net withdrawal rate	**7.00%**
Ongoing fees	2.00%
Gross withdrawal rate	9.00%
Inflation	**5%**
Lifespan (years)	20
Investment return pa	**14.0%**

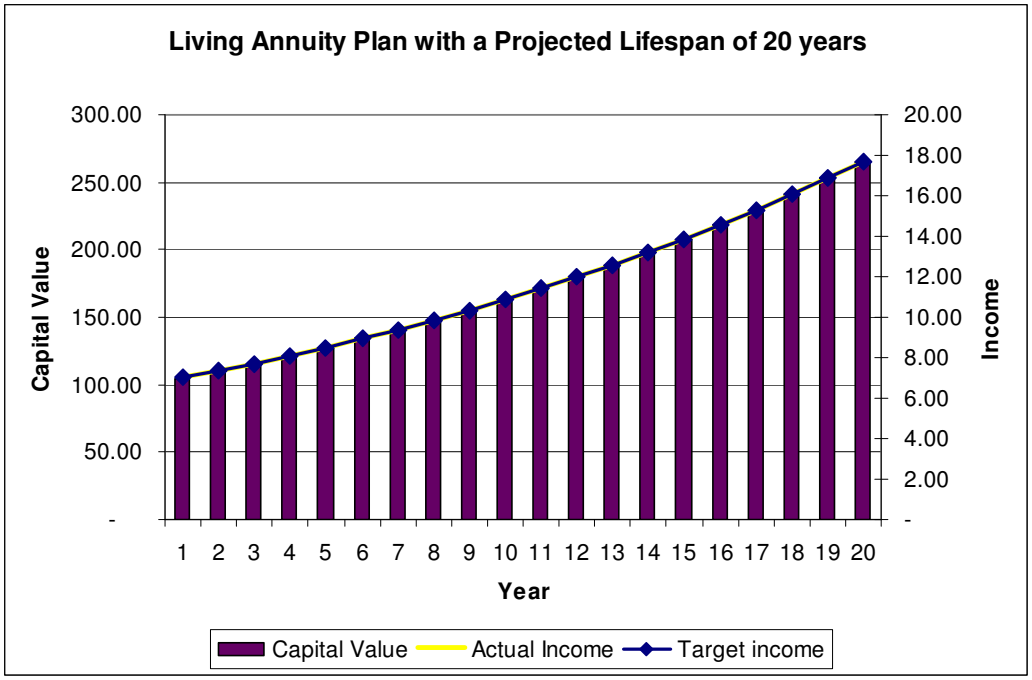


Chart 3

The “critical yield” concept can be extended to various inflation and withdrawal benchmarks over 20- or 30-year lifespans and two such matrices are presented in tables 1 and 2.

The accompanying charts 4 and 5 graphically display the “critical yield” required at different initial withdrawal and inflation rates. Furthermore, distinctions are made between those return areas with a high probability of being realised (darker shaded areas) versus those return areas which are less likely to materialise over time.

From these charts (4 and 5) it is evident, all else being equal, that annuity plans with relatively higher initial withdrawal rates (9% and 10%) are much less likely to be sustained over long-term lifespans than those plans starting off with relatively lower withdrawal rates (5% and 6%).

Table 1: The Critical Yield Matrix for a target lifespan of 20 years

Inflation	3%	5%	7%	9%
Net Withdrawal Rate	Critical Yield			
5%	6.7%	8.5%	10.4%	12.2%
6%	8.4%	10.2%	12.1%	14.0%
7%	9.9%	11.8%	13.7%	15.6%
8%	11.3%	13.2%	15.1%	17.0%
9%	12.6%	14.6%	16.5%	18.4%
10%	13.9%	15.9%	17.8%	19.7%
15%	19.7%	21.7%	23.6%	25.6%
20%	25.0%	27.0%	29.0%	30.9%

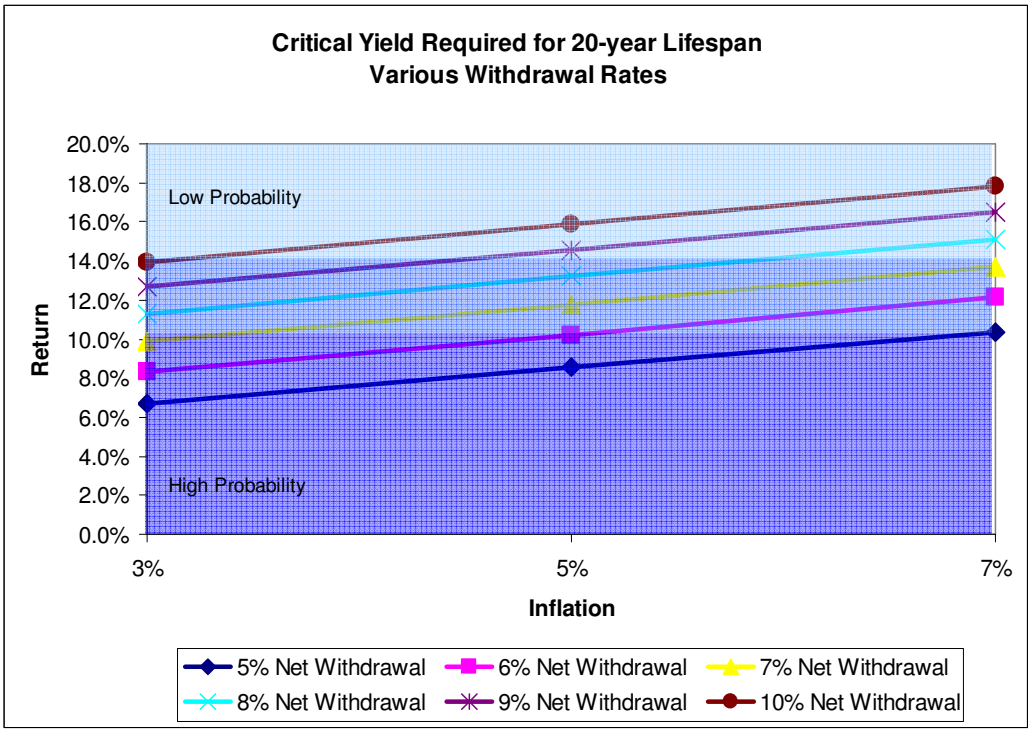


Chart 4

Table 2: The Critical Yield Matrix for a target lifespan of 30 years

Inflation	3%	5%	7%	9%
Net Withdrawal Rate	Critical Yield			
5%	8.45%	10.38%	12.30%	14.22%
6%	9.84%	11.78%	13.72%	15.65%
7%	11.13%	13.08%	15.03%	16.98%
8%	12.35%	14.31%	16.26%	18.22%
9%	13.51%	15.48%	17.44%	19.40%
10%	14.64%	16.61%	18.58%	20.55%
15%	19.93%	21.92%	23.91%	25.90%
20%	25.00%	26.99%	28.99%	30.99%

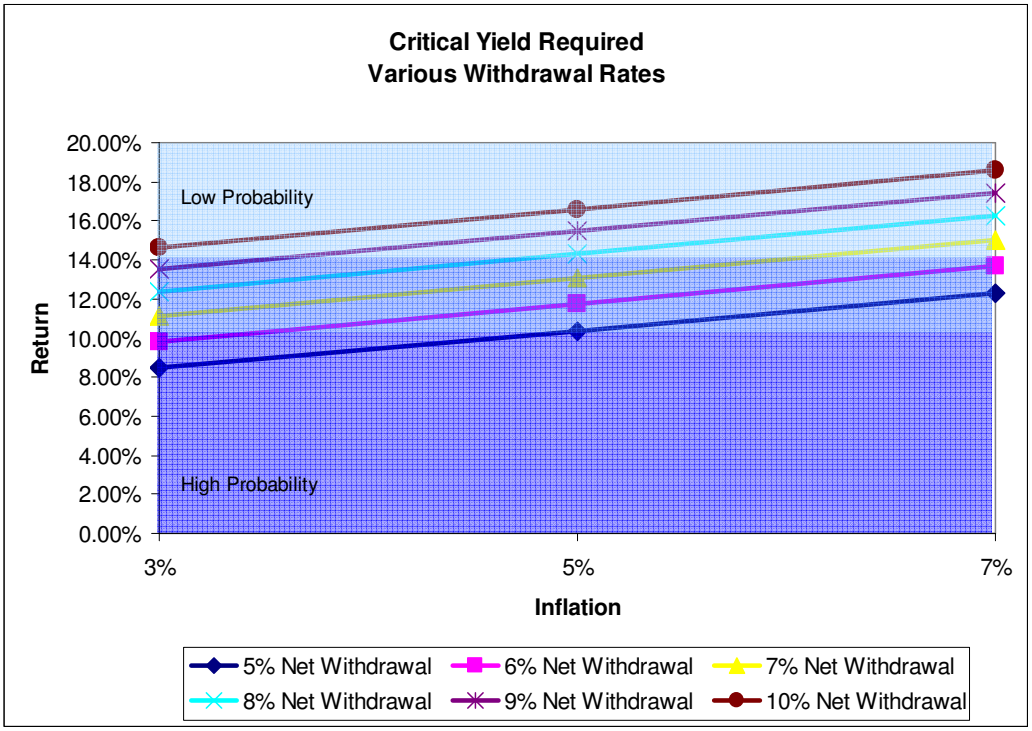


Chart 5

4. Evaluating Different Portfolio Compositions

From tables 1 and 2 one can ascertain the real (above inflation) portfolio return required to sustain an annuity plan at different initial withdrawal rates over a 20-year or 30-year lifespan (see charts 6 and 7).

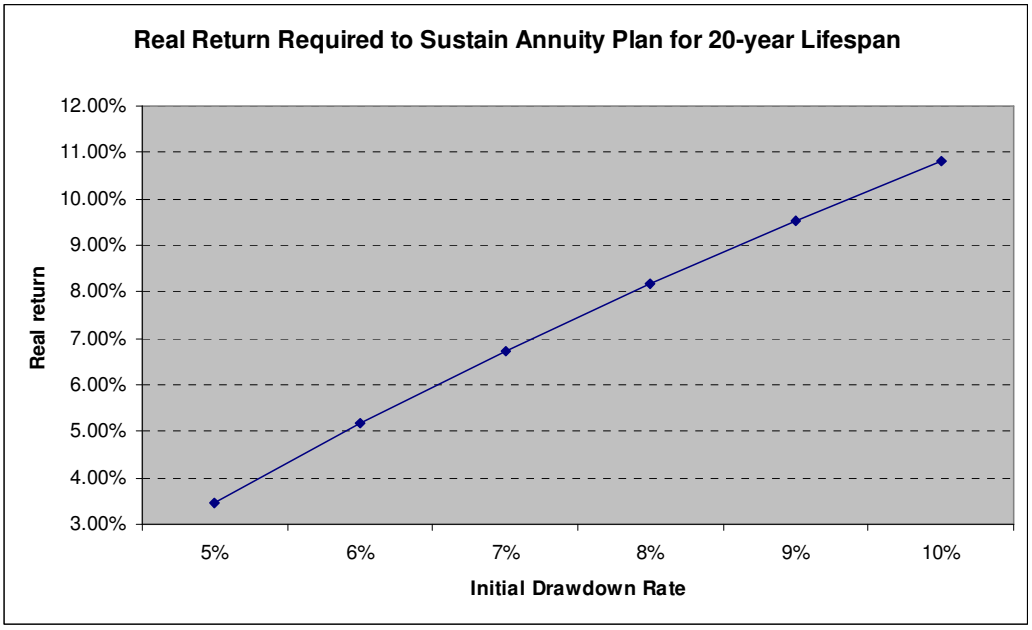


Chart 6

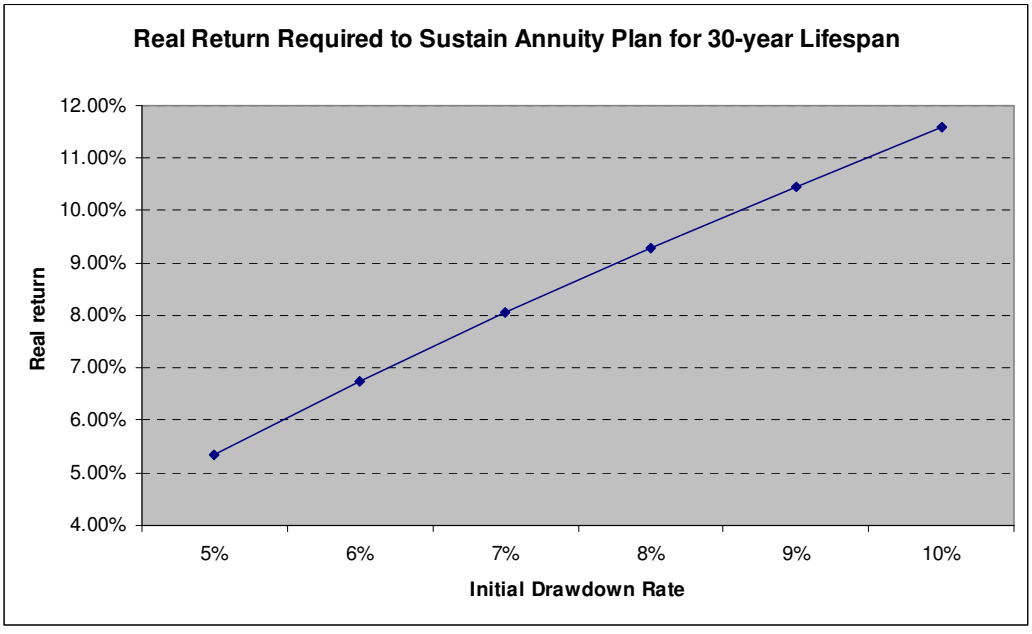


Chart 7

The required real returns, in turn, provide the necessary clues how the portfolio composition – the asset allocation mix – should ideally be constructed.

For example, at the 5% initial withdrawal rate a minimum real return of between 3% and 4% will be required for a target lifespan of 20 years. On the other side of the scale, a 10% initial withdrawal rate would necessitate a portfolio real return of around 11%. Thus, in order to match these vastly different real rates, the respective asset allocation mixes of the two annuity plans should differ in theory, with the inclusion of many more inflation-beating assets, and thus more risky assets, in the 10% withdrawal annuity plan than in the 5% withdrawal plan.

But is this argument reasonable, and more importantly, is this practice sustainable? Does the inclusion of predominantly equity assets in one's post-retirement portfolio enhance the prospects of real portfolio growth beyond those returns that can be reasonably expected over the long term? [6] Then, even at the lower withdrawal rates, what should be the ideal portfolio composition to ensure optimal sustainability of the annuity plan in the long run?

[6] The work of Elroy Dimson, Paul Marsh and Mike Staunton published in *Triumph of the Optimists: 101 Years of Global Investment Returns* indicated that across the globe the real return from equity investments averages about 5% per annum over the long term. See also the work that I have done on South African markets in the study *Asset Allocation: An Evaluation of Investment Portfolios* (April 2006). Available at www.indexinvestor.co.za

5. Methodology

In order to address the issues raised in the previous section, I developed a simulation tool whereby different investment portfolios could be evaluated against variable economic settings. To identify possible investment portfolios I used the simulated results of a previous study [7] in which the optimal or mean-variance efficient portfolios for different real return objectives were formulated based on historical performances of, and the interconnectedness (correlation) between, the different asset classes.

For example, for an inflation (CPI) plus 3% target return, the optimal composition would have been to invest 21% in equities, 5% in properties, 17% in bonds and 57% cash. Table 3 provides a list of three mean-variance efficient portfolios (*CPI +3%*, *CPI +5%* and *CPI +7%*) with their respective asset allocation mixes. In addition, I added two rule-of-thumb portfolios, namely an *equally-weighted portfolio* and a *heuristic portfolio*.

Table 3: Evaluating different investment portfolios

Portfolio Composition	**CPI + 3%**	**CPI + 5%**	**CPI + 7%**	**Equal**	**Heuristic**
Equities	21%	43%	77%	25%	50%
Properties	5%	7%	7%	25%	10%
Bonds	17%	36%	16%	25%	20%
Cash	57%	14%	0%	25%	20%

[7] DR Wessels, April 2006. *Asset Allocation: An Evaluation of Investment Portfolios*. Available at: www.indexinvestor.co.za

Subsequently, I formulated three different economic settings, each with a unique impact on the expected return of an asset class. Table 4 specifies the basic assumptions of the simulation model. For example, the prospect of a good economic outlook is 25% with inflation expected to be 4% that year. The expected return on equities in such conditions is 20%. Note however, that a return variability of 18% (standard deviation) is attached to equity returns, thus a good economic outlook does not necessarily predict good equity returns.

Table 4: Assumptions of the simulation model

Economic Outlook	Inflation Expectations	Probability of Occurrence	Expected Return Equities	Expected Return Properties	Expected Return Bonds	Expected Return Cash
Good	4%	25%	20%	16%	12%	6%
Neutral	5%	50%	14%	10%	9%	7%
Poor	6%	25%	8%	8%	6%	8%
Standard Deviation			18%	16%	8%	2%

6. Simulation Results

An example of a simulation result for a 5% net withdrawal rate is shown in table 5. Each year's economic setting (good, neutral or poor) is randomly selected according to the probability weightings of each setting in the model. This, in turn, predicts the inflation rate. The different asset class returns are generated following the expected return specifications for each asset class. The return of each investment portfolio is then computed by multiplying the asset class return with the respective weights of each asset class in the five different portfolios.

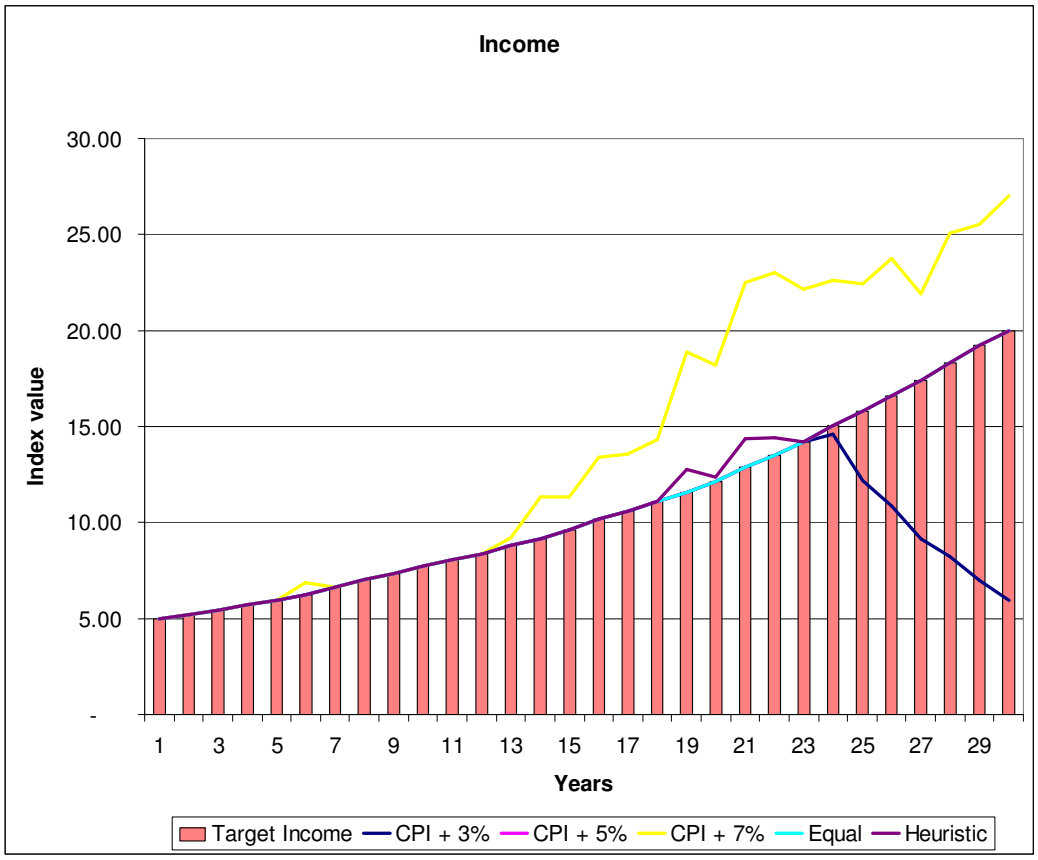
Charts 8 and 9 depict the outcome of this simulation, and more specifically, which portfolios were able to generate inflation-adjusted income streams without depleting capital or breaching the maximum withdrawal level of 20% over the lifespan of the annuity plan.

In this example most investment portfolios performed above the "critical yield" for a 30-year lifespan, which is equal to about 10.4% per annum at an average inflation rate of 5% per annum (see the matrix in table 2). Only the *CPI + 3%* portfolio underperformed this benchmark with a gross annualised return of 9%. The net result is that the target income level was not met from year 24 onwards, with subsequent eroding of capital.

Table 5:

Gross withdrawal rate	7.00%
Ongoing fees	2.00%
Net withdrawal rate	**5.00%**
Escalation	Inflation

Year	Predicted Economy	Predicted Inflation	CPI + 3% Total	CPI + 5% Total	CPI + 7% Total	Equal Total	Heuristic Total
1	Poor	6.0%	4.9%	-1.2%	-4.4%	4.8%	0.0%
2	Good	4.0%	8.7%	15.4%	13.9%	10.5%	12.1%
3	Neutral	5.0%	9.2%	12.2%	18.4%	9.4%	13.8%
4	Neutral	5.0%	9.2%	10.4%	13.8%	9.6%	11.5%
5	Good	4.0%	13.6%	20.8%	31.9%	15.0%	23.1%
6	Neutral	5.0%	0.1%	-6.7%	-17.4%	5.9%	-7.6%
7	Poor	6.0%	4.3%	2.5%	0.3%	4.7%	2.3%
8	Poor	6.0%	20.4%	32.2%	50.0%	21.7%	35.6%
9	Good	4.0%	9.9%	13.1%	15.2%	15.5%	13.8%
10	Poor	6.0%	3.7%	-1.1%	-1.7%	0.4%	0.1%
11	Good	4.0%	13.4%	19.5%	28.1%	15.2%	21.2%
12	Good	4.0%	10.2%	19.6%	24.2%	18.7%	19.3%
13	Neutral	5.0%	15.0%	20.1%	29.8%	20.9%	23.5%
14	Good	4.0%	6.9%	6.9%	7.0%	9.5%	7.4%
15	Neutral	5.0%	14.9%	18.9%	25.4%	17.6%	20.7%
16	Poor	6.0%	8.1%	9.6%	8.1%	10.9%	8.8%
17	Good	4.0%	9.8%	11.7%	12.7%	10.5%	11.5%
18	Neutral	5.0%	14.4%	22.9%	38.9%	7.8%	25.4%
19	Good	4.0%	3.9%	5.9%	3.5%	5.1%	4.1%
20	Neutral	5.0%	15.7%	24.9%	30.3%	15.0%	23.3%
21	Poor	6.0%	6.7%	4.9%	9.4%	4.1%	7.3%
22	Neutral	5.0%	7.0%	6.0%	3.1%	3.1%	4.3%
23	Neutral	5.0%	9.5%	10.0%	9.2%	4.3%	8.4%
24	Poor	6.0%	5.4%	4.9%	6.2%	8.0%	6.2%
25	Neutral	5.0%	11.3%	14.5%	12.9%	13.2%	12.7%
26	Neutral	5.0%	6.0%	2.3%	-0.8%	8.9%	3.0%
27	Neutral	5.0%	12.4%	16.5%	21.6%	14.3%	17.5%
28	Neutral	5.0%	6.6%	5.1%	8.8%	10.1%	8.1%
29	Neutral	5.0%	7.3%	9.9%	12.9%	7.5%	10.2%
30	Good	4.0%	11.3%	15.2%	22.3%	12.5%	17.0%
Average Yield		4.9%	9.3%	11.6%	14.4%	10.5%	12.2%
Annualised Return (income & capital growth)			9.0%	10.9%	13.1%	10.4%	11.5%


Income
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Years
Target Income
CPI + 3%
CPI + 5%
CPI + 7%
Equal
Heuristic

Chart 8

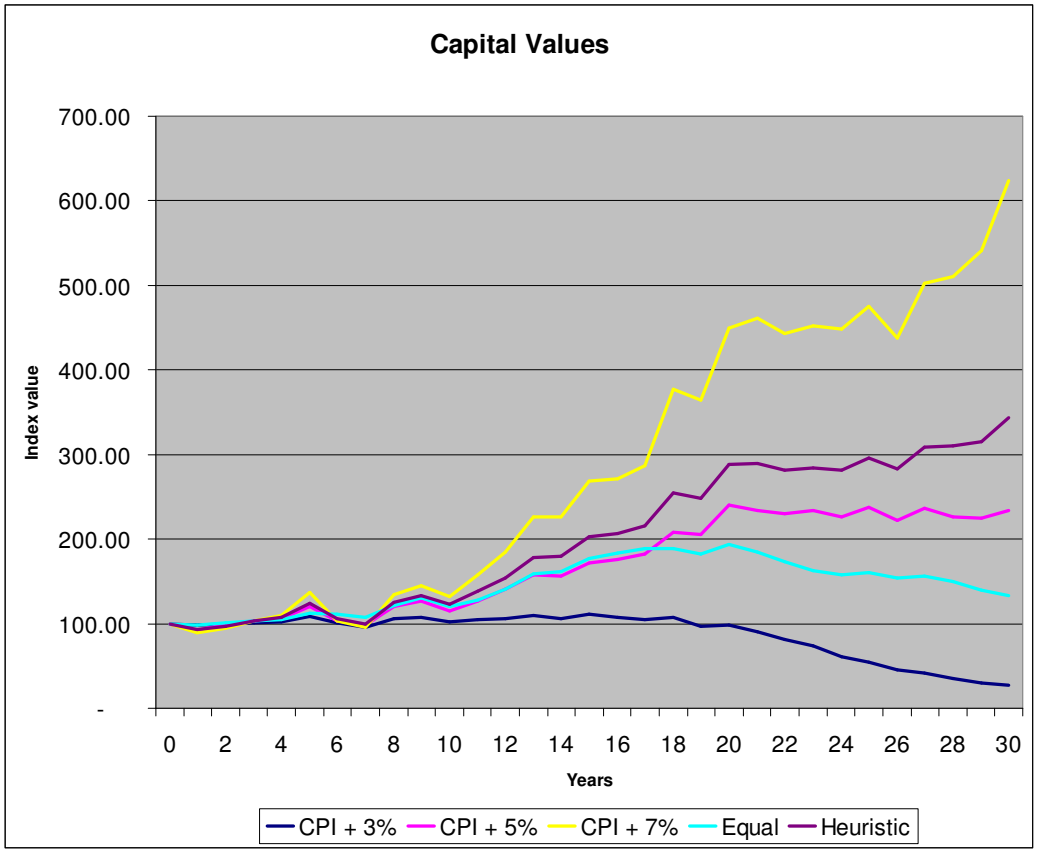


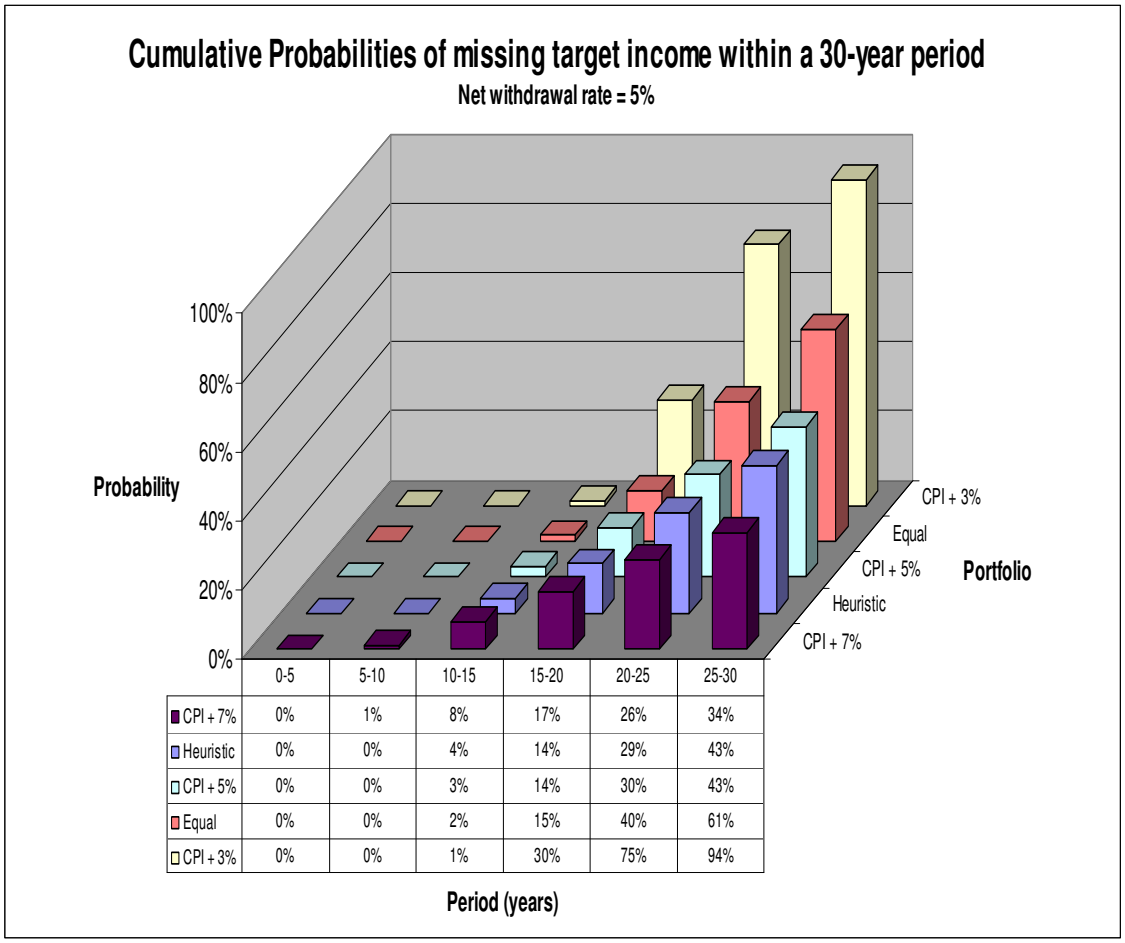
Chart 9

This simulation process was repeated 500 times. Hereby a probability distribution of the different portfolio strategies succeeding or alternatively failing (not meeting the "critical yield") at various time intervals could be developed. This probability distribution then would indicates which portfolio strategies are likely to fail at specific time intervals.

The aggregate outcomes of these multiple simulations at a 5% net withdrawal, 7.5% net withdrawal and 10% net withdrawal are displayed in exhibits 1, 2 and 3 respectively.

Exhibit 1:

5% Net Withdrawal

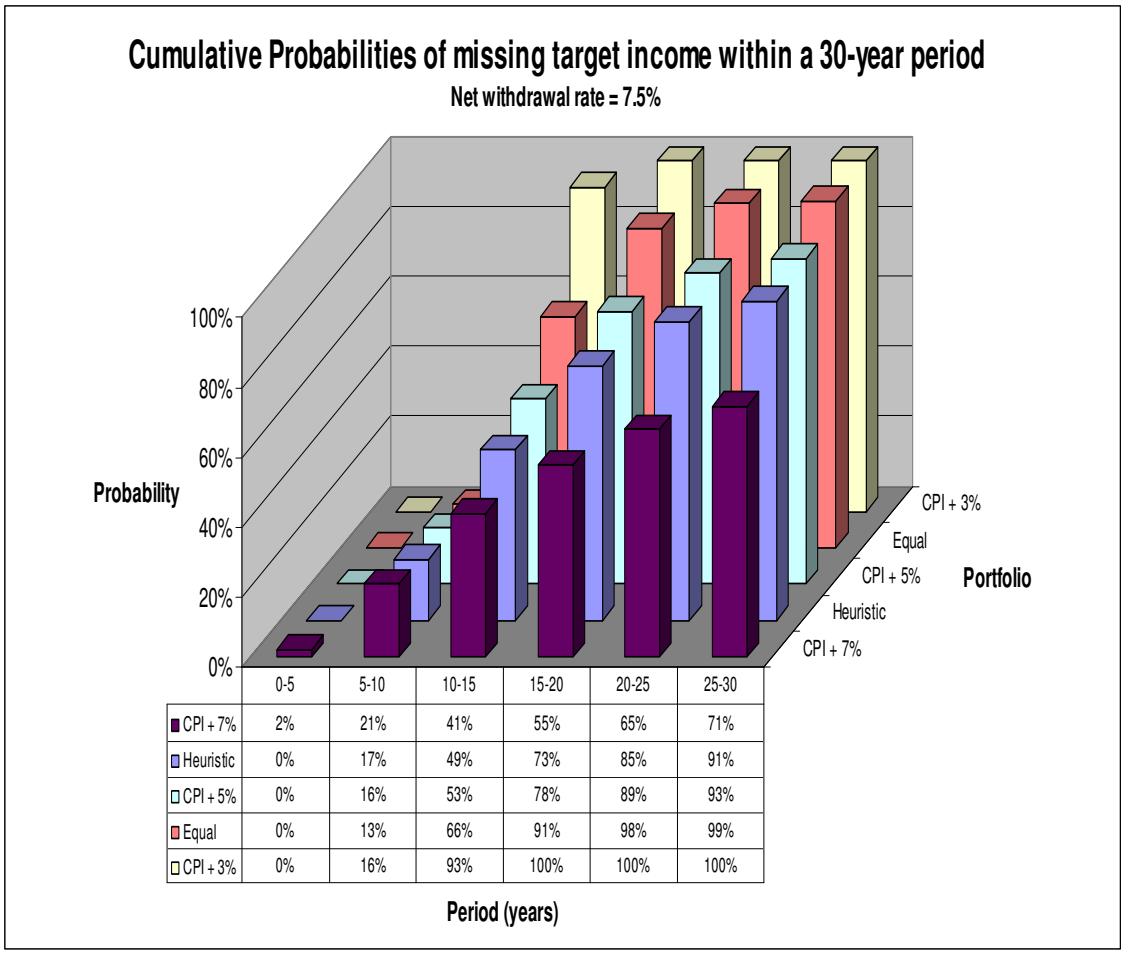


Cumulative probability of succeeding at 5% withdrawal

	CPI + 3%	Equal	CPI + 5%	Heuristic	CPI + 7%
Success >10 years	100%	100%	100%	100%	99%
Success >15 years	99%	98%	97%	96%	92%
Success >20 years	70%	85%	86%	86%	83%
Success >25 years	25%	60%	70%	71%	74%
Success >30 years	6%	39%	57%	57%	66%

Exhibit 2:

7.5% Net Withdrawal



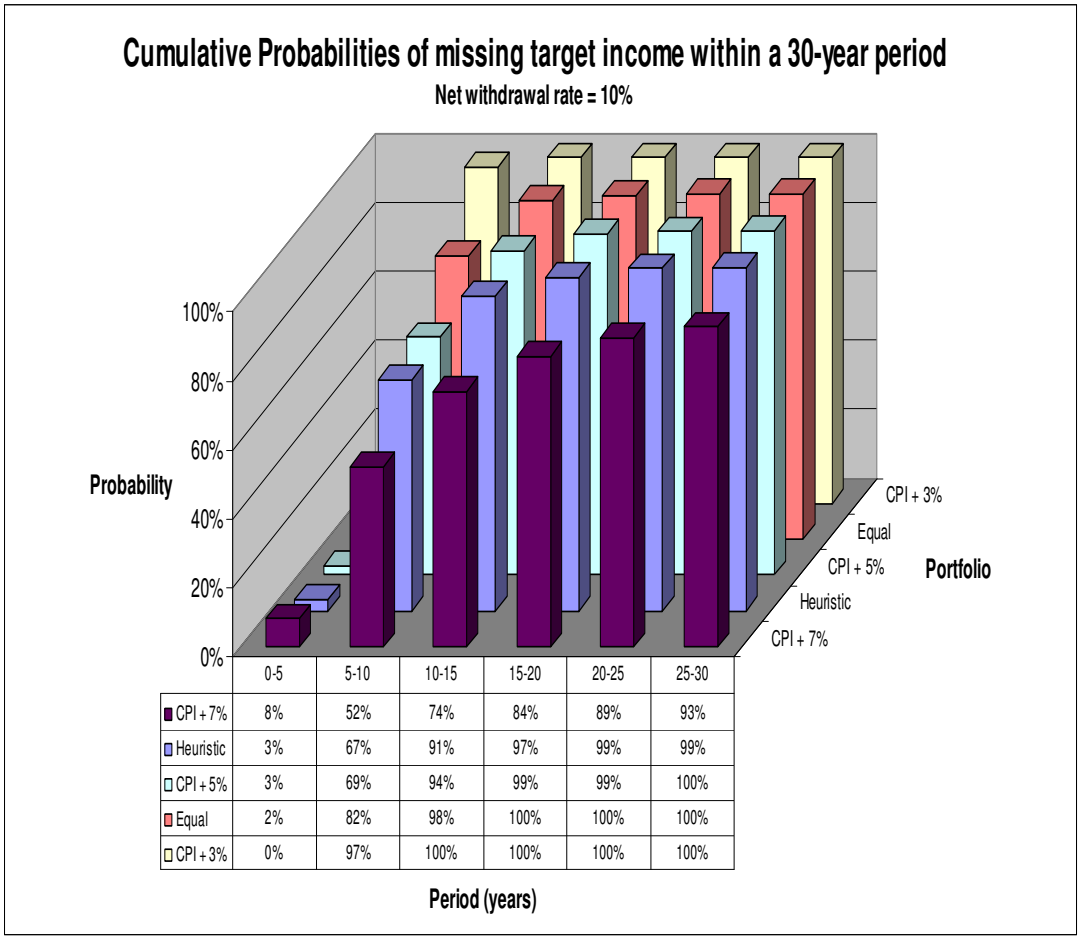
	0-5	5-10	10-15	15-20	20-25	25-30
CPI + 7%	2%	21%	41%	55%	65%	71%
Heuristic	0%	17%	49%	73%	85%	91%
CPI + 5%	0%	16%	53%	78%	89%	93%
Equal	0%	13%	66%	91%	98%	99%
CPI + 3%	0%	16%	93%	100%	100%	100%

Cumulative probability of succeeding at 7.5% withdrawal

	CPI + 3%	Equal	CPI + 5%	Heuristic	CPI + 7%
Success >10 years	84%	87%	84%	83%	79%
Success >15 years	7%	34%	47%	51%	59%
Success >20 years	0%	9%	22%	27%	45%
Success >25 years	0%	2%	11%	15%	35%
Success >30 years	0%	1%	7%	9%	29%

Exhibit 3:

10% Net Withdrawal



	0-5	5-10	10-15	15-20	20-25	25-30
CPI + 7%	8%	52%	74%	84%	89%	93%
Heuristic	3%	67%	91%	97%	99%	99%
CPI + 5%	3%	69%	94%	99%	99%	100%
Equal	2%	82%	98%	100%	100%	100%
CPI + 3%	0%	97%	100%	100%	100%	100%

Cumulative probability of succeeding at 10% withdrawal

	CPI + 3%	Equal	CPI + 5%	Heuristic	CPI + 7%
Success >10 years	3%	18%	31%	33%	48%
Success >15 years	0%	2%	6%	9%	26%
Success >20 years	0%	0%	1%	3%	16%
Success >25 years	0%	0%	1%	1%	11%
Success >30 years	0%	0%	0%	1%	7%

From exhibit 1: All portfolios are very likely to meet the target income level during the first 15 years. However, after 20 years the *CPI + 3%* (low equity) portfolio lags the other portfolios in its ability to meet the target income. In fact, after 30 years such a portfolio has a very slim chance of meeting the target income at that stage. Also, at a target lifespan of 25 or 30 years the equally-weighted portfolio has a significantly lower success rate than the other three portfolios.

Interestingly though, there is not much difference in the success rates of the *CPI + 5%*, *heuristic* and the *CPI + 7%* portfolio over the long lifespan targets, despite the significant difference in exposure to equities (43%, 50% and 77% respectively). Thus, it may indicate that despite the attractive attributes of including large equity holdings in one's portfolio, it remains a risky prospect, especially if regular withdrawals are made. Also, it implies that a certain "critical mass" of equity holdings is nonetheless required to ensure the sustainability of the post-retirement plan.

From exhibit 2: During the first 10 years all the plans have a reasonable chance of keeping track with the target income level. However, shortly thereafter the *CPI + 3%* (low equity) portfolio fails, closely followed by the equally-weighted portfolio. After 20 years and more, all portfolios are likely to fail. The *CPI + 7%* (high equity) portfolio shows a significantly better success rate than the other portfolios, but the probability of success is below 50%, which makes it also likely to fail at those lifespan targets.

From exhibit 3: All plans show a dismally low probability of matching the required "critical yield" even within the first 15 years after retirement. The *CPI + 7%* (high equity) portfolio yielded the best success rate of all plans, but in absolute terms it offers a low probability of succeeding. The logical conclusion from this result is that a 10% withdrawal (and more) is not a viable option if the investor has any hope that the post-retirement plan would provide a real income stream for the rest of his/her life. A guaranteed annuity is a much better choice for these investors.

7. Summary

The net results of the multiple simulations at three different withdrawal rates are shown in charts 10, 11 and 12.

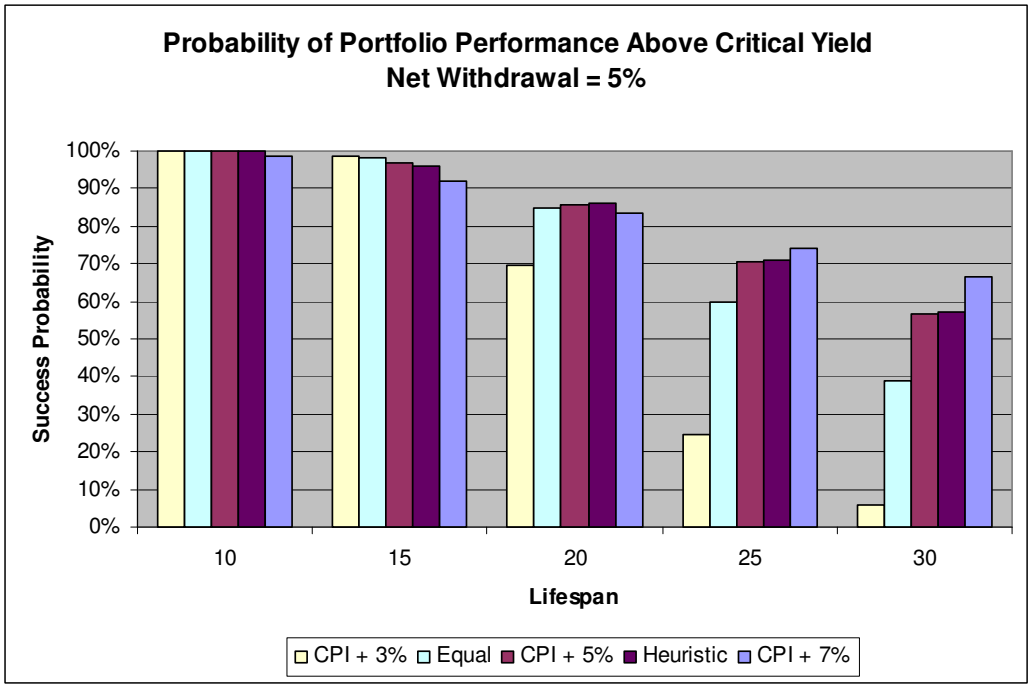


Chart 10

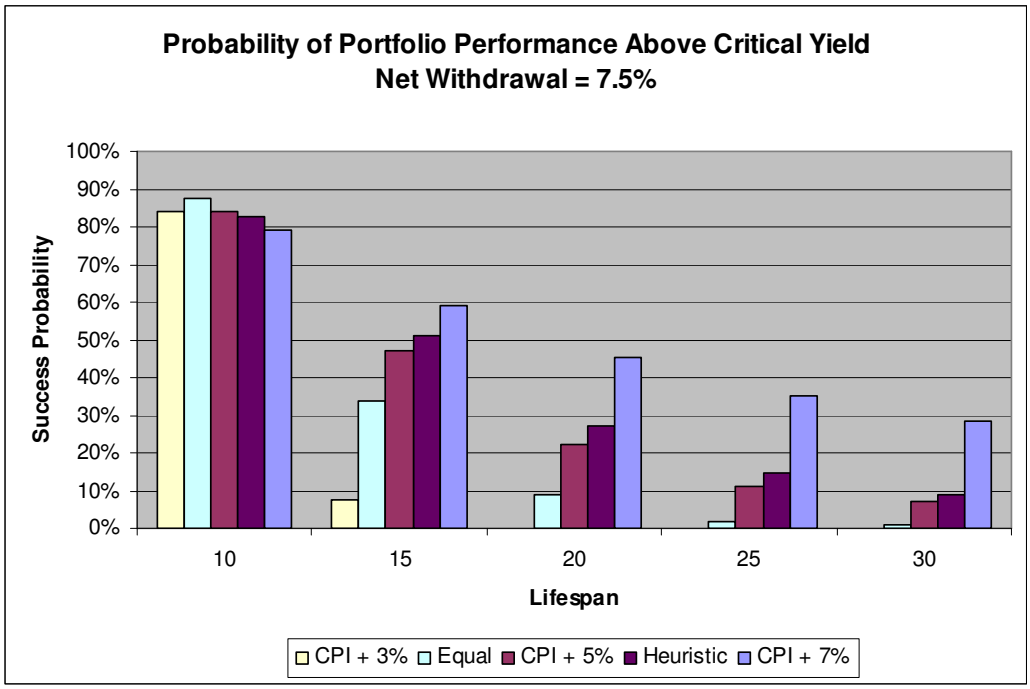


Chart 11

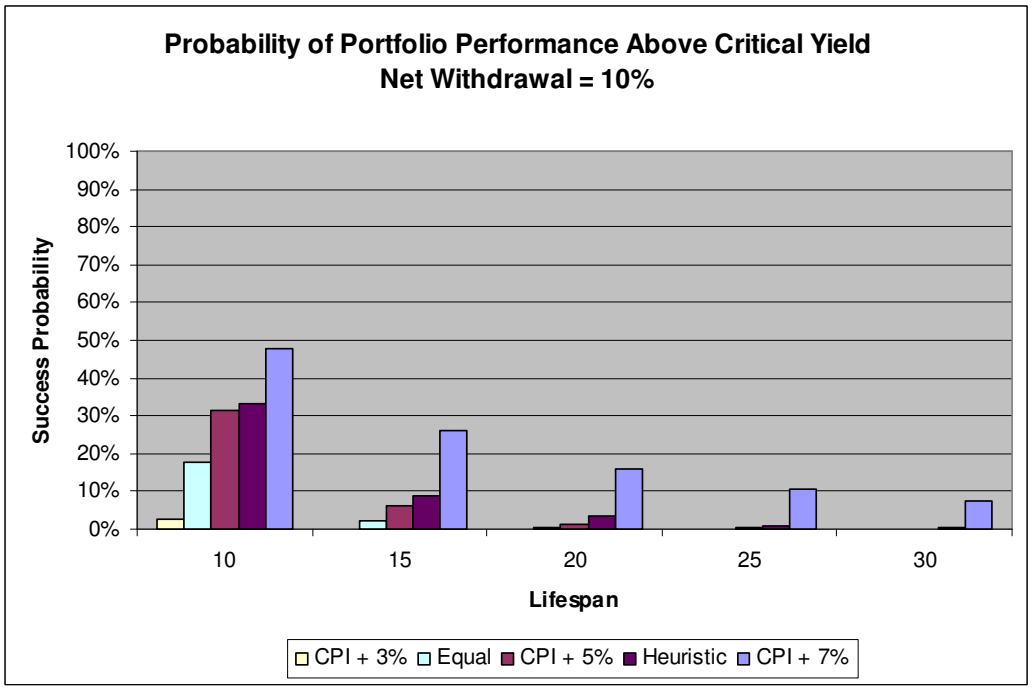


Chart 12

1. The living annuity concept is ideally suited for retirees not requiring withdrawing more than 7% initially (maximum). Beyond these drawdown rates a guaranteed annuity will offer better value for annuitants.

2. At the 5% net withdrawal rate (and less) a low probability exists of not keeping track with the inflation-adjusted income requirements for any strategy within the first 15 years of post-retirement. Thereafter, one can expect that the conservative strategies (low equity options) will default first. While the *CPI + 3%* portfolio has a 70% probability that the portfolio return will meet the critical yield after 20 years, it drops to 25% after 25 years and to around only 5% in year 30.

   On the other side of the scale, the more aggressive (high equity) portfolios have a much better chance of outstripping the critical yield, but there is always an outside probability that an investor may experience a severe market correction (bad run of equity returns). Such an event will seriously impede the riskier strategy's ability to sustain the target income levels, even within the first 15 years after retirement.

3. At the 7.5% net withdrawal rate more or less equal probabilities (around 80%) exist for the different portfolios to sustain the target income within the first 10 years. Within the next five years a substantial decline in the success probabilities of the conservative portfolios is experienced, but after a period of 20 years all portfolios exhibit relatively low probabilities of success, maybe with the exception of the *CPI +7%* portfolio. Yet, even in this case, the probability of success is lower than the probability of failure.

4. With initial withdrawal rates of 10% and more no portfolio exhibits any real chance of sustaining the annuity plan in the long run. Although the *CPI + 7%* portfolio shows the highest success rate, it is at such low probabilities of meeting the required "critical yield" that such a strategy is probably not worthwhile selecting in the first place.

8. Conclusion

In contrast to conventional wisdom one should view annuities as a long-term investment plan that should be geared towards generating real income over time. It is not only about providing sufficient income for one's immediate and foreseeable needs, but also about yielding income for the next 20 or 30 years. Typically, one tends to avoid volatility and uncertainty, but essentially that is short-term in nature; over a 20- or 30-year time span the biggest risk is inflation.

Hence, as this study has shown, it is imperative that retirement portfolios should include inflation-beating growth asset classes, such as equities, but then also at significant levels (probably 40% plus).

However, since equity performances are volatile, and returns could be irrationally depressed for extended periods of time, one should ideally hedge the downside risk of equities in one's annuity portfolio. Therefore, I propose two possible strategies to negate the adverse effects of bearish market conditions:

First, do not follow too aggressively tilted equity allocation strategies, such as the *CPI + 7%* portfolio, which despite the best success rate in the simulation study, also proves to be the most risky in defaulting within the first 10 to 15 years after retirement. In this respect the medium equity (40-50%) strategies provide perhaps a more prudent solution.

Second, use equity strategies and managers with successful track records of protecting portfolio valuations, especially during bear markets. Typically, these managers are making use of derivative overlays to minimize the effects of severe market corrections, which unfortunately occur, and always unannounced, from time to time in investment markets.

By following these guidelines I am confident that annuity plans will provide retirees with a real income solution for the long term (more than 20 years) without depleting capital resources and taking unduly risks.

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