

# **INSTITUTE AND FACULTY OF ACTUARIES**

## **SUMMARY**

November 2015

**CA2: Model Documentation, Analysis and Reporting**

**Paper 2**

## **Retirement projection options**

### **Introduction and purpose**

The purpose of this project is to compare retirement strategies for our client Mr Brown, who is considering different ways to invest money for his retirement.

He plans to save \$1,000 each year for the next 40 years and is considering three investment strategies based on an equity fund and a bond fund as outlined below.

- **Option A** – Each year, invest \$600 in the equity fund and \$400 in the bond fund.
- **Option B** – Each year, invest \$1,000 and rebalance the portfolio at the end of each year so that the proportion is 60% equity and 40% bonds.
- **Option C** – Each year, invest \$1,000 and rebalance the portfolio at the end of each year so that the proportion in equities each year is calculated as 105% minus Mr Brown's age at that time. Mr Brown is currently 25 so the initial percentage is 80% in the equity fund.

The project compares expected portfolio values at retirement using historic returns and also shows the effect of using funds with lower management charges.

### **Data**

We have projected the fund that Mr Brown may expect after 40 years under each of the options using historic data as a basis for future returns. The data used for this analysis is:

- Values for the Equity 500 index at the end of each year between 1973 and 2013
- Values for the Government 10 year bond index at the end of each year between 1973 and 2013
- Annual Management Charges (AMCs) for the equity and bond funds

The source of the indices' values is the Actuarial National Statistics website.

The index data was checked for reasonableness by eye for any outliers but was assumed to be correct. Also the fund annual management charges look reasonable.

### **Assumptions**

The following assumptions were made:

- The past investment returns are a good indication of future performance and volatility.
- The funds will track the indices perfectly other than for the annual management charge.
- **Investments all happen on Mr Brown's birthday.**

- **The annual investment will always remain at £1,000. It will not increase over time.**
- Fund rebalancing happens at the end of each period and there is no cost for doing this.
- Investment expenses and charges are ignored other than the annual management charges.
- Tax implications are not considered.
- **The AMCs stated under the original and low AMCs scenarios are available for the term of the investment.**
- **Mr Brown only invests in equities and bonds. No other investments or indices are used.**

### **Performance – methodology**

The average annual performance of each of the funds was calculated by dividing the index at 2013 by the value at 1973 and raising this value to the power of  $1/40$ , then subtracting 1 and the relevant AMC. This gives the annual growth rate after the deduction of the annual management charge. The results are below.

The standard deviation of the annual returns was calculated from the returns data.

Finally the minimum and maximum annual performance figures were calculated from the returns data.

To compare the two funds we have rebased the equity fund to 100 in 1973, by dividing all the index values by the 1973 value and multiplying by 100.

### **Performance – results**

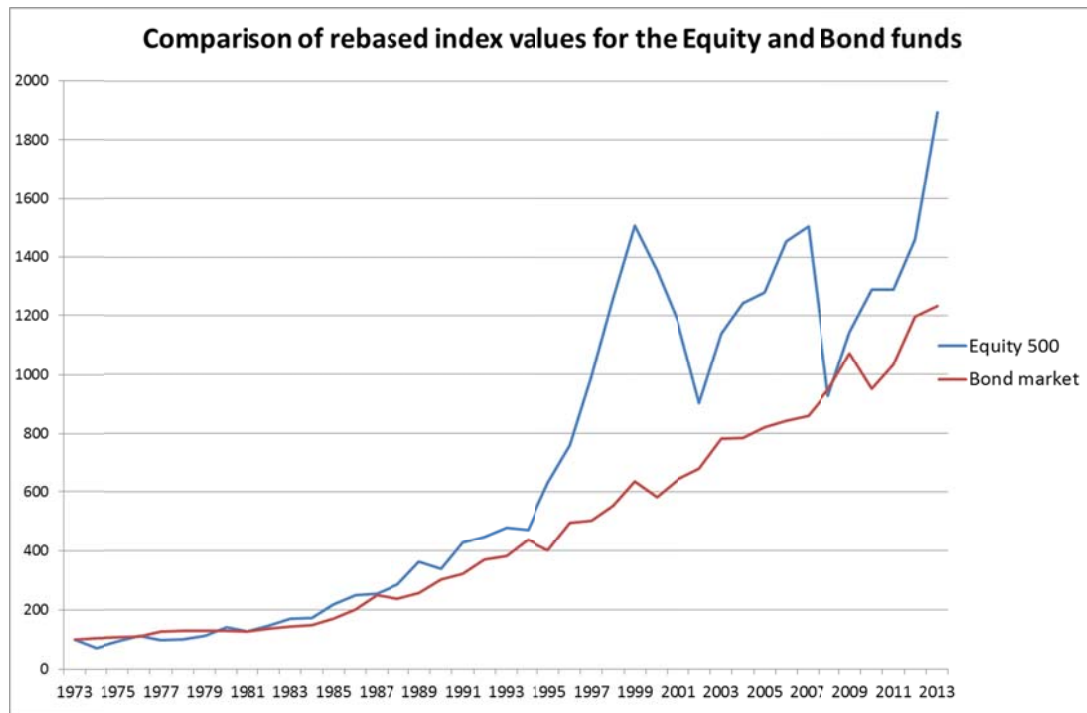
The performance figures calculated for equities and bonds are:

<b>Performance figures</b>		
	Equity 500	Bond market
Annual %	6.6%	6.0%
SD	17%	8%
Min	-39%	-12%
Max	33%	24%

The table above shows that the annual return from the equity fund is higher than the bond fund despite the higher AMC.

As a reasonableness check the overall annual percentage figure was compared to the average of all of the annual figures for 1974–2013 and the differences considered. The results were reasonably similar with more variation in the equity fund due to the higher annual variability.

The graph below shows the relative performance by year in more detail. It shows higher volatility in the equity fund in comparison with the bond fund:



From the graph, the outperformance of equities was only in the later years and the figures will be sensitive to the exact data period used.

- The standard deviation of the results is twice as high for the equity fund compared to the bond fund. To achieve potential higher returns, the investor needs to accept much higher risk.
- The range of annual returns for the equity fund is much larger than the bond fund which is consistent with the higher standard deviation.

## Fund projection – methodology

The annual fund was projected forward by setting up a cashflow model and using the annual performance figures for the three options given.

Option A assumes no rebalancing with \$600 invested in the equity fund each year and \$400 into the bond fund. Starting at time 0 with just these investments for each future time period, the projection for each fund is the previous year's fund balance with the fund performance figure applied to it plus the latest annual cashflows above. There is no investment in the year of retirement.

For Option B, the rebalancing option, the cashflow model is adjusted so that at the end of each time period the total of the two funds is redistributed so the equity fund is now 60% and the bond fund 40%.

For Option C, the rebalancing cashflow model is copied and adjusted so that instead of the equity funds rebalancing to 60% at the end of each year the figure can vary according to Mr Brown's age. The equity fund is set so that it is 105% minus Mr Brown's age at the time. For the first year, when Mr Brown is 25 years old, the percentage in equities is 80%. This will give an average allocation of 60% over 40 years but will be more sensitive to the equity fund performance in the earlier years and to the bond fund in the later years.

For each of the three options an overall internal rate of return (IRR) is calculated from the cashflows. The cashflow projection has 40 years of minus \$1,000 from time period 0 to 39 inclusive and then for year 40 has the final projected fund as a positive cashflow.

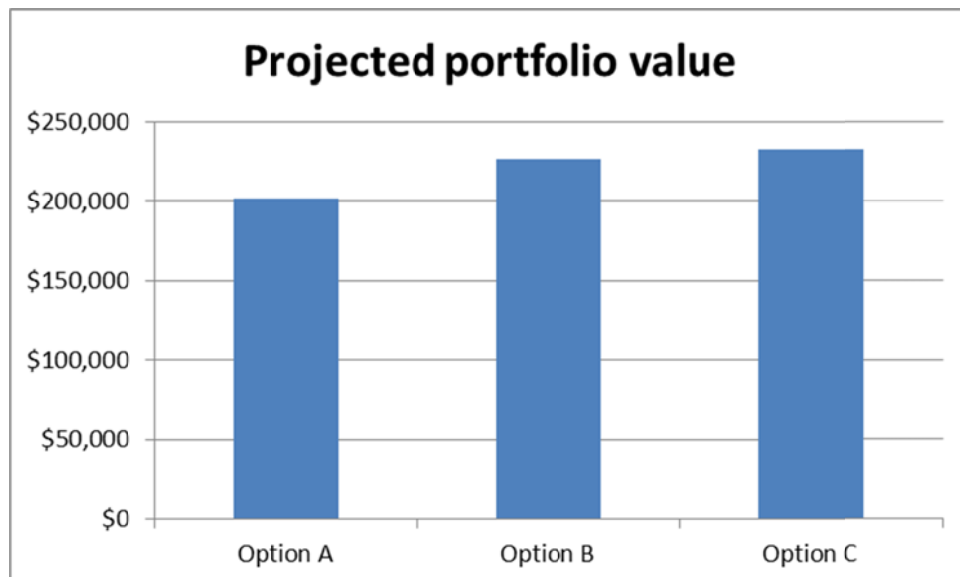
### Fund projection – results

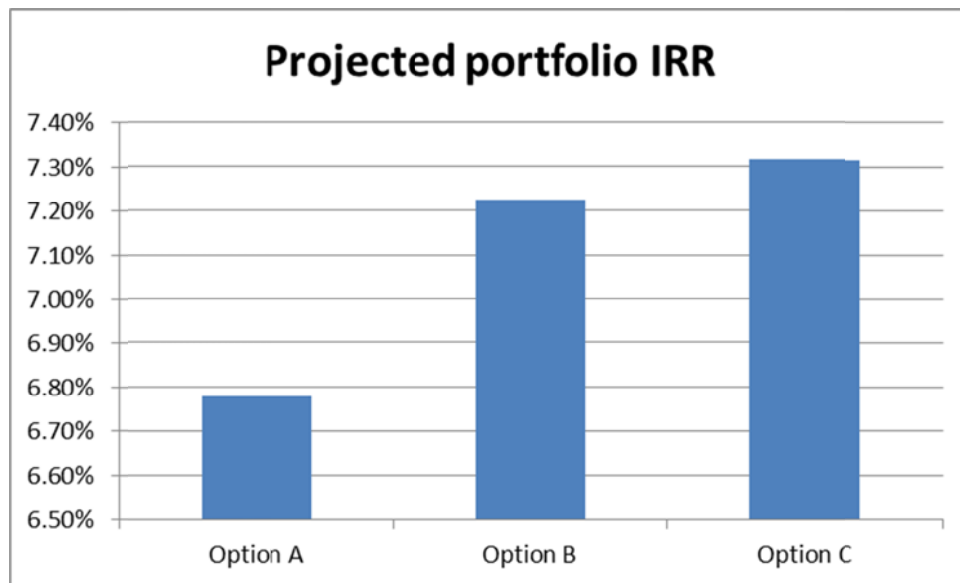
The projected fund values and the IRRs under each of the three options are set out in the table below:

	Portfolio value	IRR
Option A	\$201,480	6.78%
Option B	\$226,720	7.22%
Option C	\$232,425	7.32%

The higher the portfolio value then the higher the IRR should be because the investment cashflows are the same under the three scenarios.

The average return on equities and bonds was approximately 6% / 7% and the internal rate of return results are in line with this at approximately 7%. Also it is reasonable that the internal rate of return result for Option B is higher than Option A as the final fund is higher, and similarly for Option C versus Option B.





### Low annual management charges

There is also the option to invest in funds with low annual management charges (AMCs). The AMCs for this option are 0.3% for the equity fund and 0.15% for the bond fund, compared to 1% and 0.5% respectively.

The analysis above looking at the fund performance for the three options is repeated but with the assumptions of the lower AMCs reflected in the performance of the equity and bond funds. As the AMCs are lower the projected fund values are higher and consequently the IRRs are also higher.

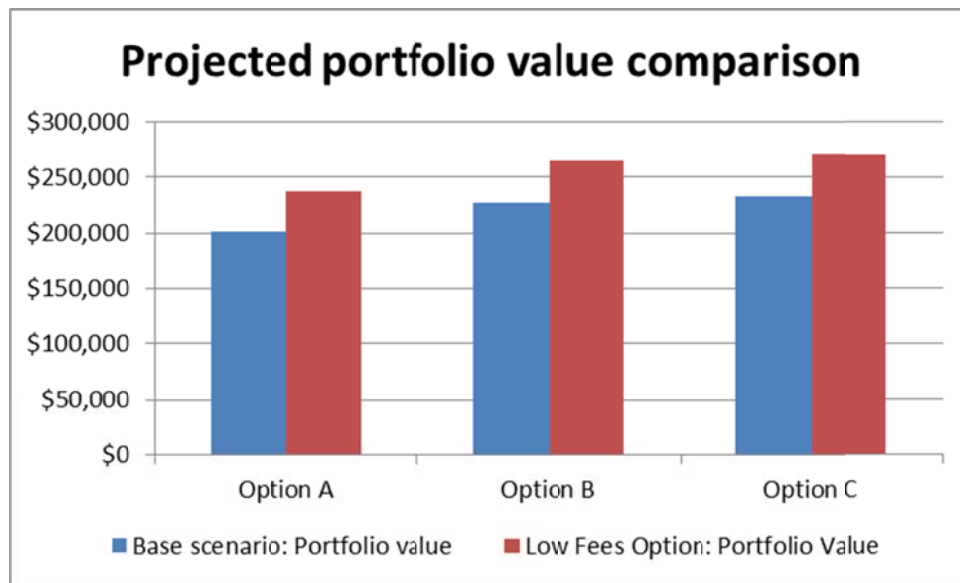
Low fees	Portfolio Value	IRR
Option A	\$237,223	7.39%
Option B	\$264,829	7.80%
Option C	\$270,767	7.88%

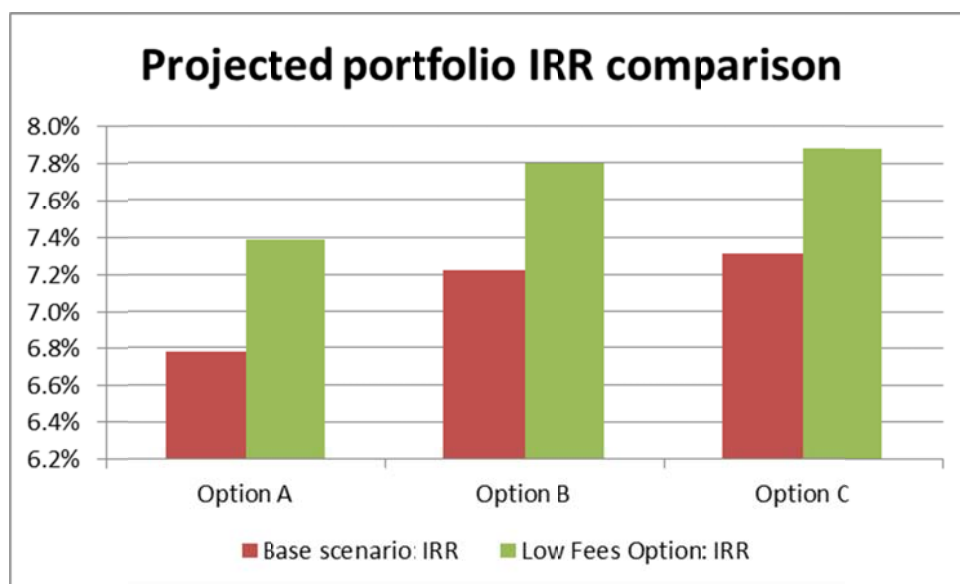
Impact of LOWER fees		
Option A	\$35,744	0.61%
Option B	\$38,110	0.58%
Option C	\$38,341	0.56%

The expected increase in the IRR should be approximately 60% of the difference in the AMCs on the equity fund plus 40% of the difference in the AMCs on the bond fund. On this basis, the difference in the IRRs should be approximately 0.56% which we see it is when we compare the results.

The impact on the projected values is summarised in the graphs below.



The projected values are highest with lower fees for each of Option A, B and C. This is due to more net returns being reinvested into the funds under each option.



The higher the fund value the higher the IRR.

Option A benefits the most from the low fees scenario. However, all options benefit by broadly a similar percentage.

## Conclusions

The rebalancing in Option B, compared to Option A, has meant that funds are re-allocated away from bonds towards equity in the early years, when bonds are performing slightly better than equities (on average). Ordinarily, the original expectation might have been that Option B would have resulted in a lower fund value than Option A, given equities are perceived to be

a riskier investment and thus generate superior returns in the long run. However, the data shows that equities recover and overtake bond growth only at the end of the term.

The analysis above shows the projected fund value after 40 years and the IRR is the highest under Option C. For these reasons, we conclude that the overall best investment strategy is Option C. This option should de-risk the portfolio, moving more of the fund into bonds, as Mr Brown approaches retirement.

The option to invest in low AMCs funds should be considered by Mr Brown as the approach will increase the projected performance by approximately \$38,000 from our analysis.

However it is worth noting that the above analysis is based on historic investment markets and the actual outcome will differ.

### **Next steps**

- Validate the index performance data provided by comparing to a different source
- ....and update to the latest available information.
- Compare the historic performance of the funds to the index values.
- Perform a stochastic analysis of the portfolio projections...
- ....based on the parameters derived above...
- ....and with an appropriate assumption as to the distribution of returns.
- Consider the costs in rebalancing the portfolio.
- Allow for different amounts to be invested, and at different times.
- Perform sensitivity test on the rebalancing percentage.
- Perform sensitivity test on the life-styling parameters.
- Consider other asset classes such as property or money market funds.
- Allow for a non-linear progression in the change in allocation percentage. For example, remaining with a higher equity percentage until within 10 years of retirement and then switching to bonds more quickly.
- Consider any fixed costs with the original or low AMC funds.
- Consider any single funds that offer the combined investment options above.
- Consider different time periods for the investment such as early retirement...
- ....in particular if the early retirement was not anticipated when the Option C parameters were set.
- Consider any other downside protection measures as the fund nears retirement such as options.



- Allow for Mr Brown's investment to increase over time in line with earnings inflation.
- Use the projected fund values to project what Mr Brown's expected annual income in retirement may be.
- Replace the historic investment returns with alternative assumptions for future growth determined by market experts.
- Confirm contribution receipt timing (e.g. may be monthly rather than annual) and remodel if necessary.
- Update model as the client's career progresses to allow for actual investments and returns.
- Allow for taxation if relevant.
- Allow for impact of inflation on the returns.
- Obtain a peer review of the work performed.

**END OF SUMMARY**