# AUTOMATIC ENROLMENT RETIREMENT SAVINGS SYSTEM

Supplement to Paper of 27 May 2019 to Society of Actuaries in Ireland Working Group on AE Investment Options

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**Introduction**

After the meeting of 27 May 2019 with the AE Investment Options Working Group of the Society of Actuaries in Ireland, I made some additional checks on the reasonableness of the model used to derive the simulation results discussed at the meeting. I compared the volatility of projected market values per the model with actual market volatility. This exposed two problems. One is inherent in the Wilkie model; the other is caused by the parameters chosen when applying the model to projected AE cash flows:

i. The Wilkie model, which was used to simulate future market values, assumes that changes in market values (actually, the logarithms of market value changes) are normally distributed. In practice, they have fatter tails, i.e. the probability of a sharp price fall over a short period is higher than assumed in the model.
ii. The Wilkie model also assumes that prices are more likely to rise after a severe fall, and conversely. This is true in real life also, but the level of autocorrelation in the simulations discussed with the Working Group on 27 May is higher than is evident in the real world.

In relation to (i), the lognormal distribution is a core feature of the Wilkie model and cannot be changed. The model is almost 40 years old. The simulations should be re-run using more sophisticated stochastic models now in general use and which allow for the fat-tailed distribution of short-term changes in market values. I don't think the conclusions will be markedly different, as short-term volatility doesn't have a major impact on smoothed returns.

In relation to (ii), one of the key assumptions in the model is the pace at which the dividend yield reverts to the long-term mean. The version of the model discussed at the meeting of 27 May (details of which Brian Woods circulated after the meeting) had a "YA" factor of 60%. This paper uses a "YA" factor of 85%. The change in this parameter causes the dividend yield to revert more slowly to the long-term mean. To illustrate, the previous version of the model gave a 3.4% chance that market values would fall 15% or more over a five-year period; under this version, the probability of a fall of 15% or more over a five-year period has more than doubled, to 7.0%.

**Revised Calculations for Smoothed Investment Returns**

Table 2 of the paper of 27 May showed lowest and highest historic 12-month smoothed returns (from 100 simulations) for Quarters 4 to 12. The average lowest historic 12-month smoothed return for these nine quarters under the revised model is 0.6% lower than the average under the previous version (1.6% now versus 2.2% previously). The highest smoothed return for the same nine quarters is now 1.1% higher on average than under the previous version (11.4% versus 10.3% previously).

**Table 1**

| **Quarter** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
|---|---|---|---|---|---|---|---|---|---|
| Lowest smoothed return over previous 12 months | | | | | | | | | |
| Previous version (YA=60%) | +2.9% | +2.3% | +2.0% | +2.2% | +1.7% | +2.1% | +2.4% | +2.3% | +2.1% |
| New version (YA= 85%) | +2.7% | +1.8% | +1.7% | +1.6% | +1.3% | +1.5% | +1.5% | +1.3% | +1.1% |
| Highest smoothed return over previous 12 months | | | | | | | | | |
| Previous version (YA=60%) | 7.6% | 7.8% | 9.1% | 9.7% | 9.6% | 10.8% | 12.9% | 13.5% | 12.0% |
| New version (YA=85%) | 7.8% | 7.8% | 9.2% | 10.6% | 11.4% | 10.8% | 13.8% | 15.9% | 15.5% |

Table 3 of the paper of 27 May showed the smoothed return figures for Quarters 60 to 68. The average lowest smoothed return for those nine quarters was +0.2% under the previous version of

the model. Under the current version, the average lowest return has fallen 1.3% to -1.1% a quarter. The average highest smoothed return for the same nine quarters under the current version of the model is 2.3% higher than the average under the previous version (14.1% versus 11.8%).

**Table 2**

| **Quarter** | **60** | **61** | **62** | **63** | **64** | **65** | **66** | **67** | **68** |
|---|---|---|---|---|---|---|---|---|---|
| Lowest smoothed return over previous 12 months | | | | | | | | | |
| Previous version (YA=60%) | +0.7% | +0.6% | +0.4% | -0.1% | 0.0% | +0.2% | 0.0% | +0.1% | 0.0% |
| New version (YA= 85%) | -0.3% | -0.5% | -0.3% | -1.2% | -1.3% | -1.3% | -1.5% | -1.7% | -1.7% |
| Highest smoothed return over previous 12 months | | | | | | | | | |
| Previous version (YA=60%) | 11.3% | 10.9% | 11.7% | 12.7% | 13.7% | 13.3% | 11.0% | 10.6% | 10.7% |
| New version (YA=85%) | 11.5% | 12.0% | 12.9% | 14.7% | 16.6% | 17.1% | 15.2% | 14.3% | 12.7% |

**Ratio of Smoothed Value to Market Value**

In the early years, the distribution of the ratio Smoothed Value/Market Value (SV/MV) under the current version of the model (with YA=85%) is similar to the previous distribution (with YA=60%) and no further comment is necessary. In later years the ratio is more likely to stay persistently high (or low):

i. The worst result at the end of Q60 is an SV/MV ratio of 150.8%. For this simulation, the ratio stays above 100% for 27 Quarters, from Q53 to Q79.
ii. The worst result at the end of Q61 is an SV/MV ratio of 148.1%. This is the same simulation as (i) above.
iii. The worst result at the end of Q62 is an SV/MV ratio of 140.4%. The ratio stays above 100% for 25 Quarters, from Q56 to Q80.

For the simulation in (i), the average smoothed return is +0.2% a quarter for the 27 quarters during which SV/MV>100%. It is negative in only 8 of the 27 quarters and lower than -0.5% in just one (-0.7% in that Quarter). This should not be a cause for concern, especially as contributors will have had fifteen years of satisfactory performance by then.

For the simulation in (iii) above, the average smoothed return is +0.4% a quarter for the 25 Quarters during which SV/MV>100%. The return is negative for 8 of the 25 quarters and lower than -0.5% in just one (-0.9%). Again, this should not cause any concern.

Thus, the conclusion under this heading is the same as for the previous version of the model (with YA=60%), i.e. the long sequence of SV/MV above 100% should not be a major concern, because smoothed returns in the period are satisfactory.

**Impact of a Long Sequence of Negative Smoothed Returns**

As noted in the paper of 27 May, contributors will be more concerned about a sequence of negative smoothed returns than about the esoteric (to them) ratio SV/MV.

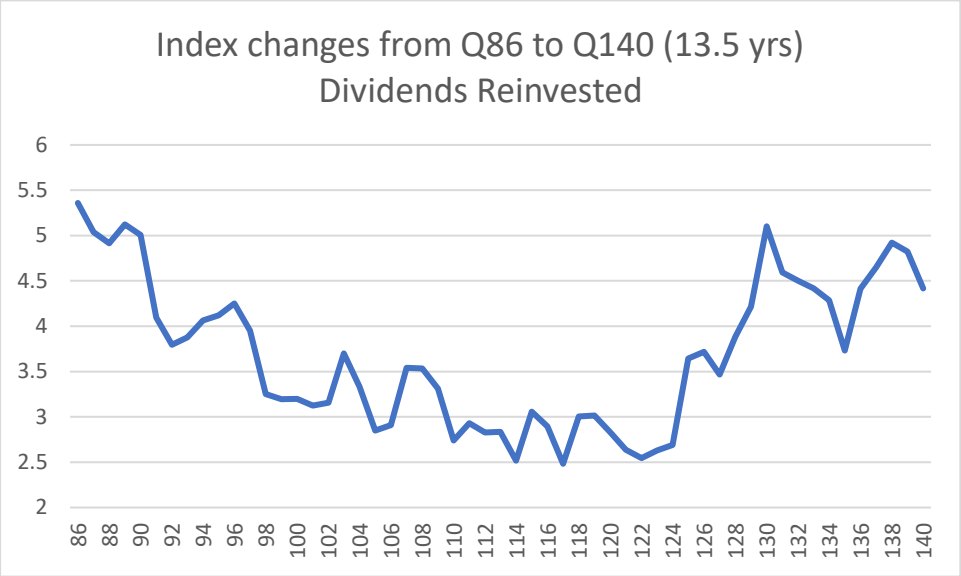
The revised projections show one simulation (out of 100) where the historic 12-month smoothed return is negative for 26 successive quarters. This is a real cause for concern.

The market environment leading to this result is dreadful. The index of market values (with dividends reinvested, net of the 0.5% annual management fee) falls more than 50% over the nine years from Quarter 86 to Quarter 122. To put this in context, the US market fell 37.5% in the nine

years 1928 to 1937. The US market fell almost 70% in the four years 1928-1932, but sharp falls over shorter periods pose less of a problem for smoothing than falls that extend over many years.

Graph 1 below charts the performance of the index for this simulation from Quarter 86 to Quarter 140. It shows that, after 13.5 years, the market hasn't recovered to its starting level.

**Graph 1**




For this simulation, the sequence of negative historic 12-month smoothed returns starts at Quarter 100 (25 years into the projections) and extends to Quarter 125.

If contributors experience negative smoothed returns continuously for seven-and-a-half years, they will probably stop contributing altogether to the smoothed scheme and will withdraw funds to the extent allowed by the rules. In order to explore what a complete cessation of contributions would do to the fund's finances in this scenario, we show first the progression of the ratio smoothed value to market value (SV/MV) and of smoothed returns for years 26 to 33 on the (artificial) assumption that cash flows are unaffected by the negative smoothed returns:

**Table 3**

| Year | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|
| Assumed cash flows | Net inflow of approximately €2 billion a year | | | | | | | |
| Ratio SV/MV at end: | 140% | 129% | 156% | 147% | 147% | 149% | 106% | 97% |
| Smoothed Return | -0.4% | -0.6% | -1.4% | -1.5% | -1.1% | -1.6% | +3.2% | +6.6% |

The table shows SV/MV staying above 100% until the end of year 32. For that entire period, therefore, payments to withdrawing members exceed the market value of their interest in the fund. Generous benefits to leavers are being subsidised by incoming contributors buying at the same inflated smoothed values.

Assume that, in the "worst case" scenario, employees cease contributing entirely from end Quarter 100 (i.e. end year 25) and retired contributors withdraw close to the maximum possible from the fund. Assuming (conservatively) that, during this period, 20% of the fund is attributable to

retired/retiring/ dying contributors and that they each withdraw 10% of smoothed value per annum, then net outgo from Quarter 100 is 2% of the fund per annum (10% of 20%), or 0.5% per quarter.

In this scenario, contributors withdrawing at smoothed value will no longer be subsidised by incoming contributors. Instead, the trustees will be forced to redeem assets from the fund at market value and pay out the higher smoothed values. The cost, equal to the difference between the two values, will be taken from the fund and so will be borne by continuing contributors through a lower smoothed return than in the "business as usual" scenario.

A solvency event would be precipitated if ongoing excess payments over market value to retired/retiring contributors were to deplete the assets of the fund to such an extent that they prevented it from returning to equilibrium, ultimately causing an insolvency spiral: the more that's withdrawn at smoothed value, the more market values are depleted and the bigger the gap that needs to be bridged to keep the fund afloat for continuing members.

In order to ascertain the likelihood of an insolvency spiral, smoothed returns and SV/MV ratios were recalculated assuming negative cash flows as above from year 26. The following are the results for years 26 to 33:

**Table 4**

| Year | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|
| Net cash flows | -€1.0b | -€0.9b | -€0.9b | -€0.9b | -€0.8b | -€0.8b | €-0.8b | -€0.8b |
| SV/MV at end: | 144% | 136% | 168% | 162% | 164% | 170% | 120% | 108% |
| New Smoothed Return | -0.7% | -1.2% | -2.1% | -2.5% | -2.3% | -3.0% | +1.1% | +4.3% |

This table shows the SV/MV ratio, after reaching a high of 170%, falling back to 108% at end year 33, having dipped below 100% (to 94%) midway through the year 33. Thus, by this stage the fund has recovered its equilibrium and a solvency event has been avoided.

Insolvency has been avoided at a cost. Smoothed returns for continuing contributors are lower than if cash inflows hadn't dried up. The following table compares smoothed returns on the new (negative) cash flows with the corresponding returns assuming "normal" cash flows:

**Table 5**

| Year | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|
| **Smoothed return:** | | | | | | | | |
| On original cash flows: | -0.4% | -0.6% | -1.4% | -1.5% | -1.1% | -1.6% | +3.2% | +6.6% |
| On new cash flows: | -0.7% | -1.2% | -2.1% | -2.5% | -2.3% | -3.0% | +1.1% | +4.3% |
| Original minus new: | +0.3% | +0.6% | +0.7% | +1.0% | +1.2% | +1.4% | +2.1% | +2.3% |

It's not an attractive outcome for contributors, but the smoothing approach still works even in the extreme adverse circumstances of this simulation. It's probably a small consolation, but contributors would probably have fared equally badly, if not worse, in an unsmoothed fund in the adverse circumstances described in this scenario.

It helps that this adverse scenario occurs 25 years into the projections. The suggestion at the end of the paper of 27 May, that consideration be given to setting aside a small amount "for the rainy day" in any quarter in which the (unsmoothed) investment return is (say) 10% or more above the risk-free rate, would help in this scenario. For this simulation, the quarterly return exceeds 10.5% (the

threshold quarterly return assuming a bond yield of 2% per annum) in 15 quarters in the 24 years leading up to the start of the long sequence of negative yearly returns. This would allow a reasonably-sized reserve fund to be accumulated.

**Conclusion**

This paper shows that, even in the extreme simulation where market values fall more than 50% over a nine-year period, and new contributions dry up completely, the smoothing formula still delivers satisfactory results, but more work is required to prove this assertion:

a) The assumptions on sensitivity of cash flows to market conditions need to be tested rigorously and;
b) the simulations need to be re-done using modern models for simulating market value movements on a portfolio that includes international real estate and infrastructure.

A final important caveat is that there has been no peer review of this paper nor of the previous one dated 27 May.