



ANNUITIES ALM – A PRACTICAL APPROACH

**(Understanding risk and volatility in the real world
of credit crises)**

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AGENDA

- 1) Introduction – the credit crisis
- 2) Setting the scene
- 3) Attribution model
- 4) Tricks for the beginner
- 5) Conclusion



INTRODUCTION – THE CREDIT CRISIS



The credit crisis

- The recent credit crisis has had a significant impact on fixed interest assets through:
 - Credit spread margin changes
 - Credit rating downgrades (limited)
 - Credit defaults (very limited)
- Credit spreads over government bonds increased by:
 - 133bp for AAA, 171bp for AA (Mar 07 – Mar 08)
- Credit spreads over swap yields increased by:
 - 56bp for AAA, 96bp for AA (Mar 07 – Mar 08)



Impact of credit spread margins - example

Characteristic	Annuity Portfolio
Average Duration (matched)	3 Years
FUM	\$1 billion
Credit Rating of Assets	50% AAA, 50% AA
Expected Profitability	0.1% of FUM

Impact of Credit Spread Changes

Risk Free Rate	Government Bond Yields	Swap Yields
Expected Profit (\$ million)	\$1.0	\$1.0
Capital Loss (\$ million)	(\$45.60)	(\$22.80)



Other impacts

- The investment profit of an annuity portfolio during the credit crisis would also have been impacted by:
 - Losses from credit rating migrations
 - Losses from credit defaults
 - Yield curve changes (if not cash flow matched)
- In practice it is generally difficult to understand the investment profit due to the number of possible factors impacting it.
- Investment profit can be multiples (several) of the expected profit margin.
- Conclusion - need a systematic methodology for attributing investment returns



SETTING THE SCENE



Context - ALM defined

- Understanding and managing the interaction between asset-related risk drivers and liability-related risk drivers
- Objective: align the risks of the asset portfolio and liabilities within the risk objectives and appetite of the business



ALM NOT Matching

ALM includes but is not limited to matching

“Our portfolio is well matched”

What does that mean?

- Duration matching
- Cash flow matching
- Bucket hedging



Assumptions

- Business drivers have been defined:
 - Eg minimising capital, target ROC, target profit and profit volatility
- Investment strategy has been developed according to the nature of the liabilities, taking into account:
 - Expectations of policyholders - return, security
 - Expectations of shareholders - return, volatility, availability and amount of capital



Analysis of profits

- It is assumed that a full analysis is being performed:
 - Profit margins, loss reversal for lifetime annuities, model changes
 - Investments
 - Mortality, expenses, commission etc
- This presentation focuses on the question: what caused the investment profits?
- The actions to be taken as a result are outside the scope of this presentation



Investment profit volatility

- Caused by:
 - IFRS – valuing liabilities using risk-free discount rates and assets at market yields
 - Changes to yield curves
 - Changes to credit spreads
- Need to understand: how much of the investment profit/loss is attributable to which of these reasons (and others...)



ATTRIBUTION MODEL



Attribution analysis

- Objective is to break down the investment profit/loss into:
 - Income factors: unwinding of discount
 - Market value factors: changes in market yields and discount rates
- Forms part of the overall analysis of profit for an annuity portfolio



Income factors

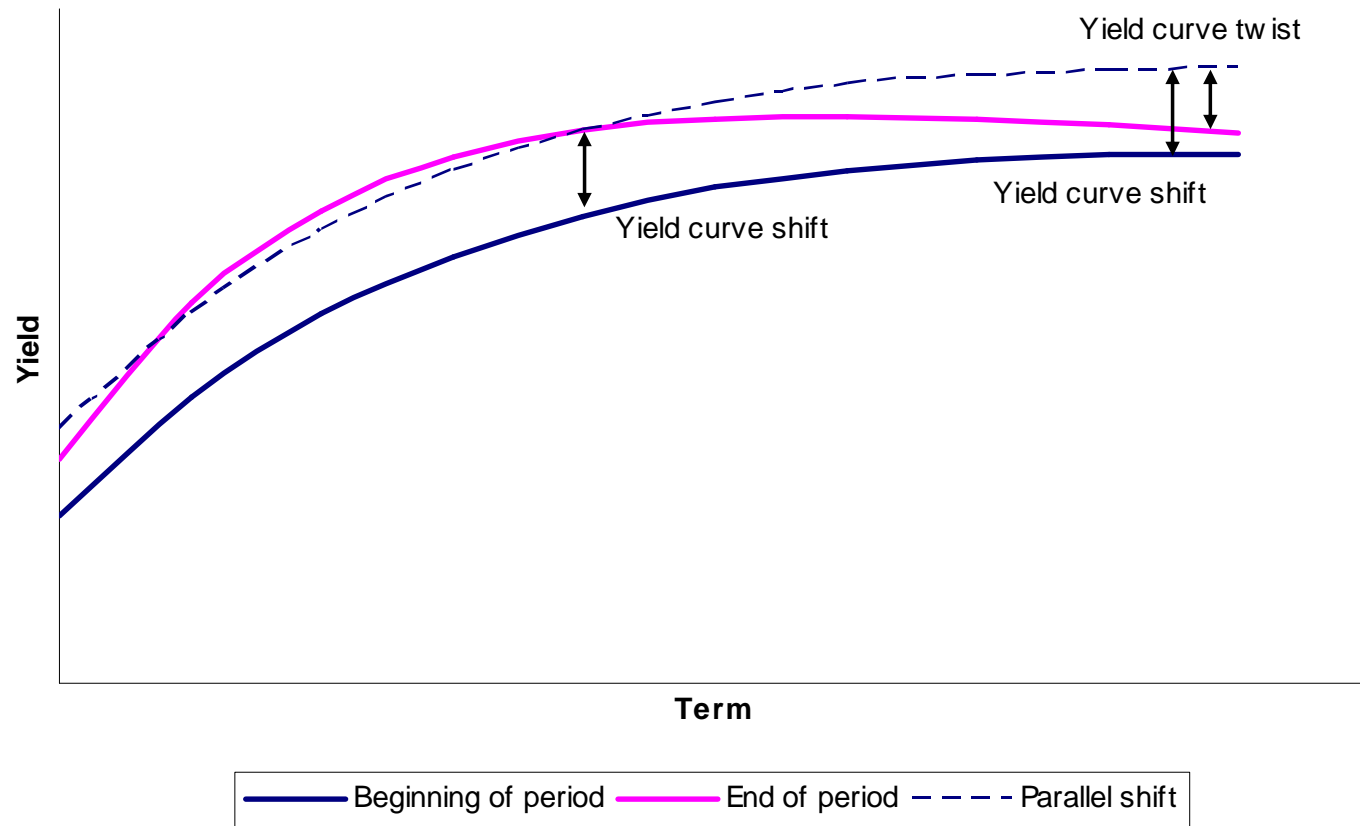
- Unwinding of yield/discount
- Market yield can be broken down further into:
 - the risk-free rate
 - the credit spread
- Residual component, due to shape of the yield curve (“calendar” income)



Market value factors

- Changes due in risk-free yield curve:
 - Parallel movements (“shift” return)
 - Non-parallel movements (“twist” return)
- Changes in credit characteristics:
 - Credit migration
 - Movements in credit spreads
- Changes in inflation assumptions

Main factors





How to do it

- More than one way to do it
- Prerequisite: cash flow projections for assets and liabilities
- Performed at a security (ideal) or portfolio level



How to do it

- Separate asset market yields into risk-free plus credit spread
- Income factors:
 $(MV + \text{Weighted cash flows}) \times \text{Yield}$
- Market value factors
 - Value assets and liabilities using risk-free rates and credit spreads at the start of the period
 - Change these one at a time until they reach the ones applying at the end of the period



How to do it

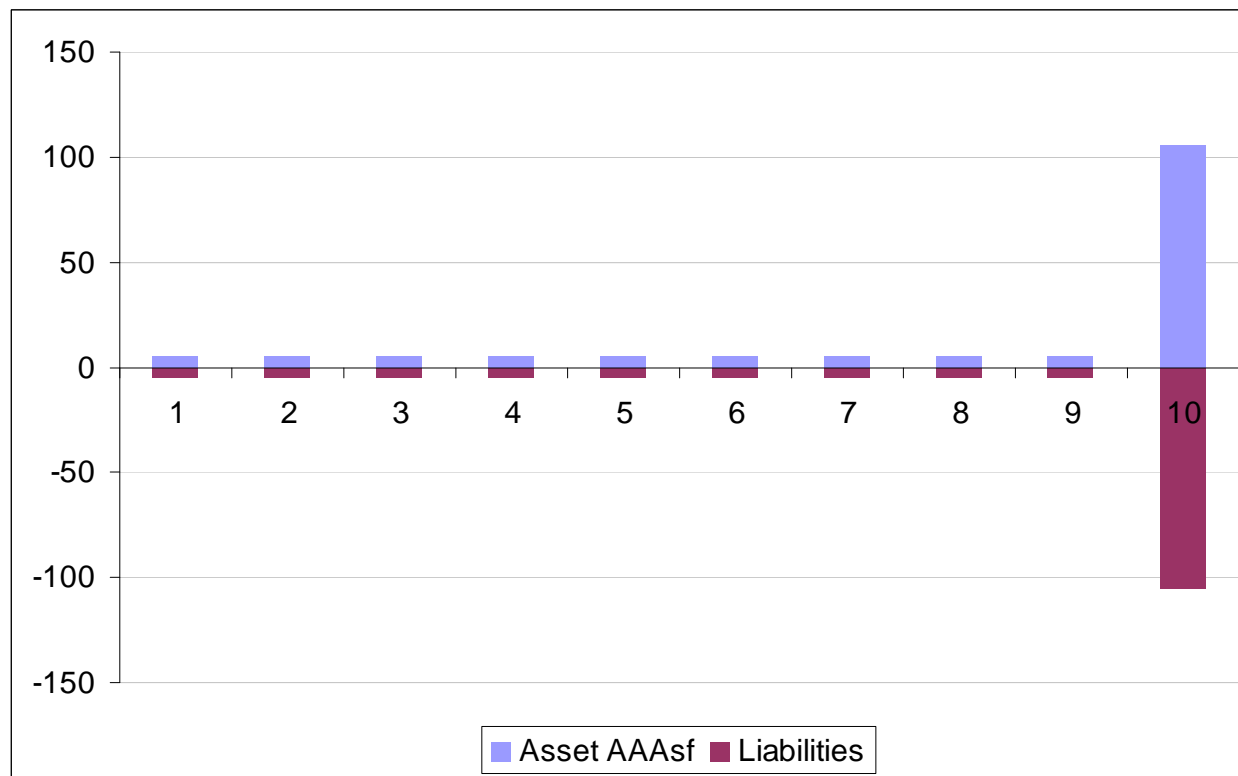
- Profit/loss associated with the factor is:
 - Change in assets – Change in liabilities
- Example: Profit due to parallel yield curve movements
 - Value assets and liabilities using risk-free yield curve at the beginning of period
 - Revalue them using risk-free yield curve shifted up or down by a defined amount (e.g. at portfolio duration)



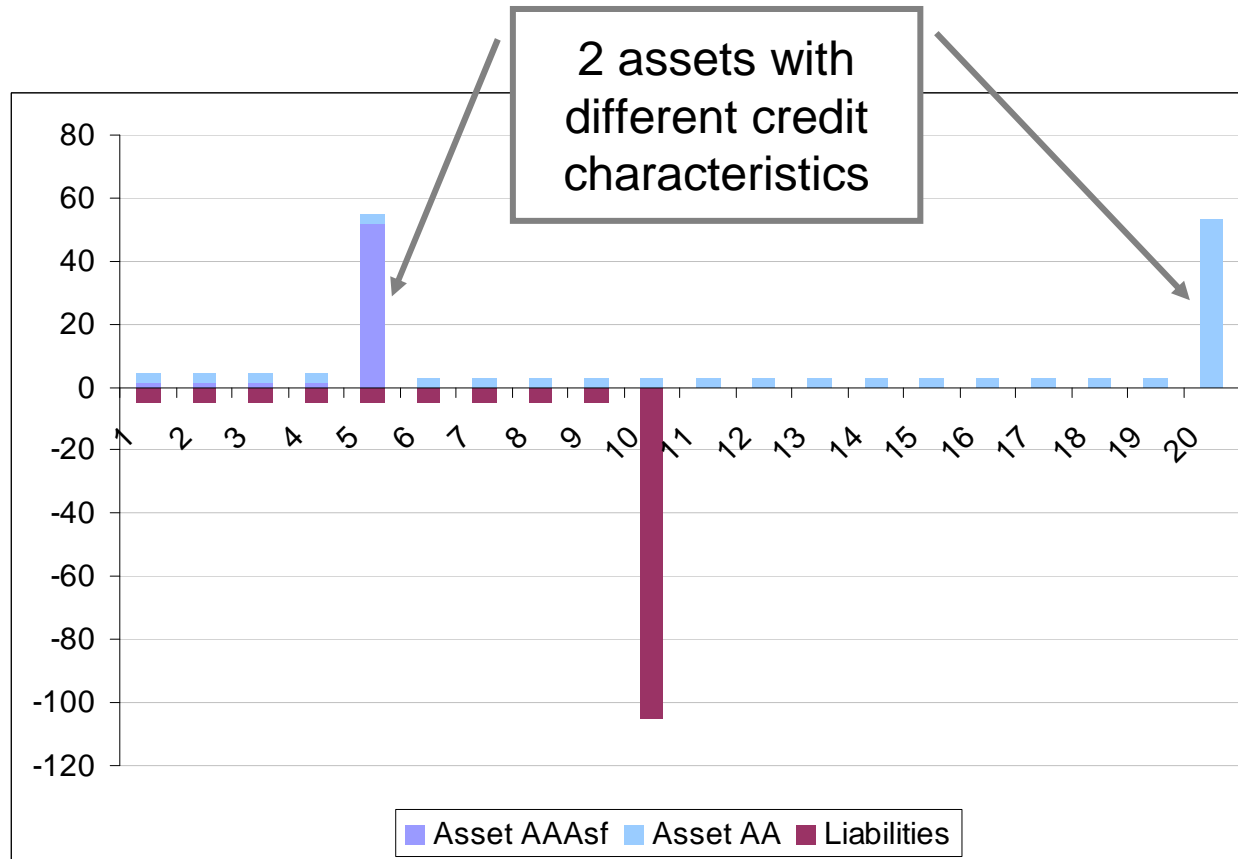
Simple example

- How different matching approaches deliver different profit and loss outcomes
- How attribution analysis can be used to explain these outcomes to management

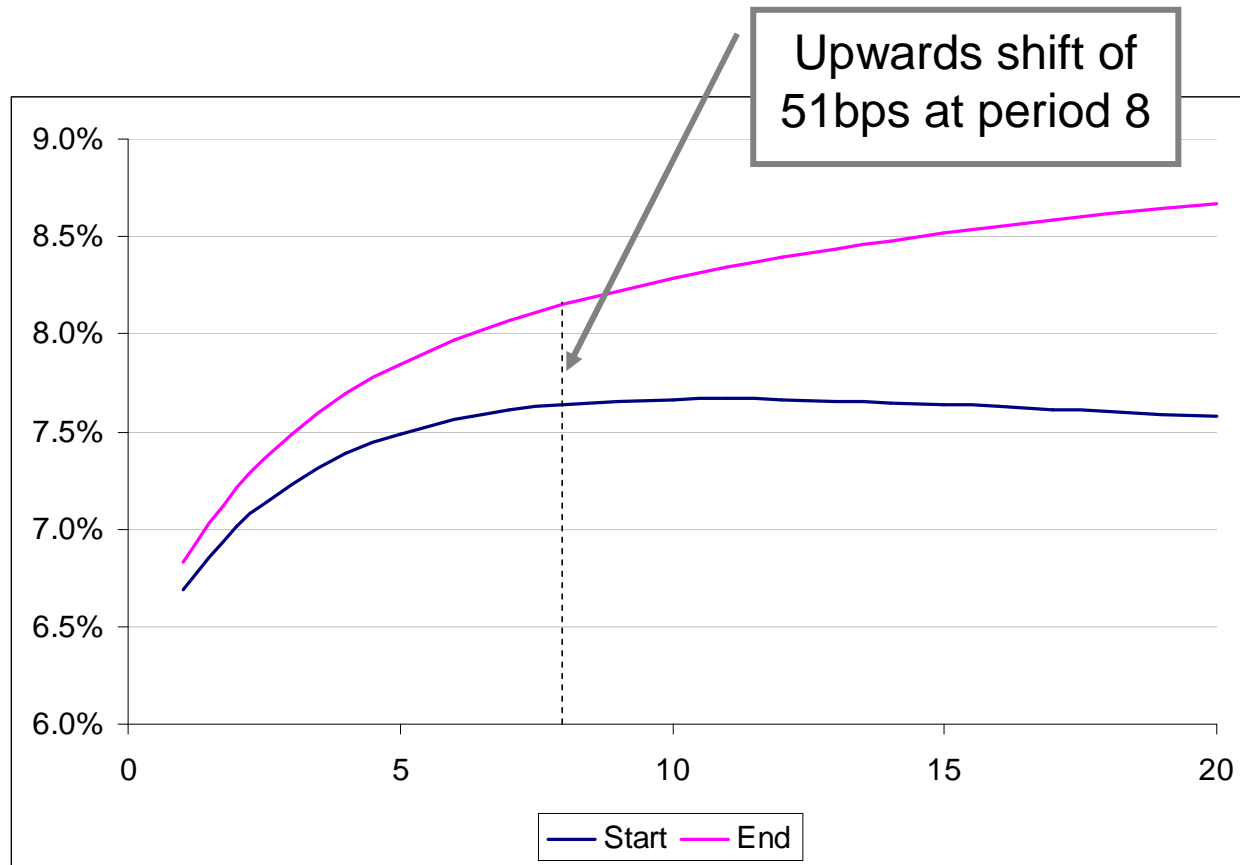
Portfolio 1: Cash flow matched



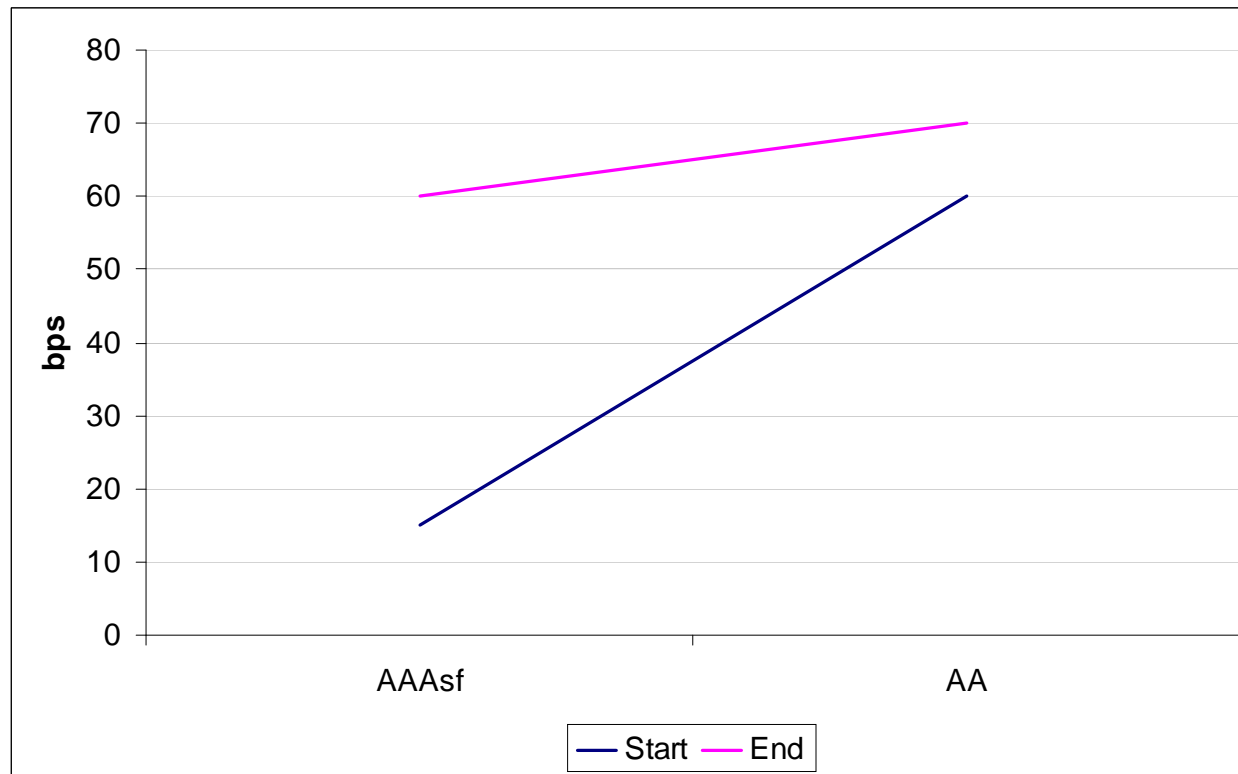
Portfolio 2: Duration matched



Yield curve movements



Spread movements



Results: Portfolio 1

Item	Assets	Liabilities	Profit
Risk free income	6.2	6.3	-0.1
Credit income	0.1	0.0	0.1
Calendar income	0.1	0.1	0.0
Shift return	-2.8	-2.8	0.0
Twist return	-0.4	-0.4	0.0
Spread return	-2.3	0.0	-2.3
Residual	-0.1	-0.1	0.0
Total	0.8	3.0	-2.2

No impact from yield curve movements...

... but credit spreads can still provide significant impact

P&L impact can be significant when compared against an asset value of about 80

Numbers may not add up due to rounding.

Results: Portfolio 2

Item	Assets	Liabilities	Profit
Risk free income	6.1	6.3	-0.2
Credit income	0.3	0.0	0.3
Calendar income	0.1	0.1	0.1
Shift return	-2.8	-2.8	0.1
Twist return	-1.2	-0.4	-0.8
Spread return	-1.0	0.0	-1.0
Residual	-0.2	-0.1	0.0
Total	1.4	3.0	-1.6

Duration matching provides some protection against parallel shifts of yield curve (51 bps) ...

... but not non-parallel twists, ...

... plus additional impact from credit spreads

Numbers may not add up due to rounding.



Findings

- Almost all investment income can be broken down to a number of factors
- Duration matching may not provide protection during significant volatility in interest rate markets



Stress testing

- The same process can be used to test the portfolio, using stressed yield curve and credit spread scenarios



TRICKS FOR THE BEGINNER



Practical issues

Alignment with management reporting

- Ensure asset values in attribution model agree with values in investments asset registry system and in general ledger
- Ensure investment income being analysed agrees with investment income in ledger
- Ensure liability values in attribution model agree with actuarial valuation



Swap curve

- Need continuous swap curve to derive appropriate discount rates but swap rates are only available at certain points
- Consider interpolation methods
- Consider how to set assumptions for long term liabilities (eg beyond 20 years) where swap curve data is poor



Inflation

- Potential mismatch between quantum of indexed-linked assets and CPI-linked liabilities
- Mismatch of cash flows of indexed assets and liabilities
- Differences among:
 - Inflation assumed in current market value of indexed-linked assets
 - Future inflation assumption for cash flows of indexed-linked assets
 - Future inflation assumption for CPI-linked liabilities



Transactions and cash flows

- Analysis typically based on end of month data
- Adjustment required for new business during the period under review
- Adjustment required for asset transactions during the period



Frequency of analysis

- Monthly results more accurate as assumption changes and residual items of the attribution have less impact
- Assumptions on cash flows are less accurate if analysis is over longer period
- Monthly analysis is more labour intensive than producing results on a YTD basis



CONCLUSION

- For annuities the investment profit can be very large, relative to other experience items.
- Attribution model provides insight into causes of investment profit/loss
- This enhances management's understanding of drivers of business
- Leads to review of risk appetite, investment strategy