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Industrialising Financial Reporting

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Original motivation (1)

- Existing AoS process for annuity business inadequate to provide required understanding within timescales
- Fundamental redesign of process called for
- Issues reconciling AoS items with stresses from ICA



Original motivation (2)

- Existing process depended fundamentally on fixed order in which risks were assumed to occur
- Time-consuming
- Practical difficulties verifying that ordering being applied consistently throughout → reliability issues
- Paper to 2012 IAA Life Section Colloquium:
<http://www.actuaries.org/mexico2012/papers/Lockwood.pdf>
- Working Party established to articulate methodology in a way more accessible to practitioners



Working Party members

- Chair: Oliver Lockwood
- Ravi Dubey
- Margaret Emery
- Kevin Engelbrecht
- Andrew Scott



Reasons for focus on annuity business

- Simple type of business to use to illustrate concepts
- Liability cash flows do not depend on asset performance
- Compulsory annuitisation before 2014 Budget → financially significant



Risk factors

- Start from risk factors in internal model

	GBP	EUR	USD
Interest rates	3	3	3
Inflation	3	3	3
Government bond spreads	3	3	3
Supranational bond spreads	1	1	1
Corporate bond spreads	7	7	7
Currency movements relative to sterling	N/A	1	1



Further detail on risk factors

- Base yield curve = swap yield curve – credit risk adjustment. This is starting point for spreads
- Interest rate, inflation and government bond spread stresses derived by principal component analysis, but with adjustments for smoothing and tapering down to fixed ultimate forward rate
- Government bond spread and inflation stresses are to forward rates. Interest rate stresses are to log forward rates, to avoid negative forward rates
- Level spread movements only
- Corporate bond spread stresses relative to next higher rating rather than risk-free yield curve, to avoid correlations close to 1
- Risk factors are movements in market indices, rather than in specific assets held



Credit migration risk (1)

- Derive a base and a stressed transition matrix by reference to historic rating agency data
- Assets may transition between rating classes at different rates from those in base transition matrix
- Assets transition between spread curves for different ratings
- Partial offset on liability side if matching adjustment (MA) used
 - Only movements in fundamental spreads, the part of the spread relating to default and downgrade risk, go through to own funds



Credit migration risk (2)

- Stressing future transition matrix increases fundamental spreads
 - More assets default
 - More assets are sold on being downgraded below investment grade
- Only applies when fundamental spreads are above floor of 35% of long-term average spreads



Longevity and expense risks

- Can be brought into same P&L attribution framework as asset risks
- Requires look-through to how liability cash flows are derived
- Expense risk relatively straightforward
- Longevity risk more complex - depends on age, gender and possibly block of business



Value metric in which to perform P&L attribution

- Theoretical framework completely general
- Bottom line value metrics, e.g. own funds, most relevant in a reporting exercise
- Useful for illustrating concepts to consider assets and liabilities separately
- In this example:
 - Assets
 - Own funds without MA = Assets – BEL without MA
 - Own funds with MA = Assets – BEL with MA
 - NB: no risk margin as all risks hedgeable (except credit migration risk, for which a bespoke allowance is made)



Taylor series expansion

Change in value metric

= Expected closing value – Opening value

+ Actual closing value – Expected closing value

= Expected change

+ $f(\text{Expected value of variable 1} + \text{Risk factor 1},$

$\text{Expected value of variable 2} + \text{Risk factor 2}, \dots)$

- $f(\text{Expected value of variable 1}, \text{Expected value of variable 2}, \dots)$

= Expected change

+ Sensitivity to risk factor 1 * Risk factor 1

+ Sensitivity to risk factor 2 * Risk factor 2 + ...



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Expected position

- Does not fall out automatically, so needs to be defined
- Needs to be commercially acceptable as a forecast, **but** rigour of P&L attribution process imposes realism
- Definition open to debate subject to meeting these criteria



Expected position example

- Forward rates or spreads:

Year 1	Year 2	Year 3
0.5%	1.0%	1.5%

- Risk-free yield curve after one year:

Year 1	Year 2
1.0%	1.5%

due to no-arbitrage arguments

- A-rated corporate spreads after one year:

Year 1	Year 2
0.5%	1.0%

possibly more appropriate due to rating transitions



Deviation terms (1)

- Shape of yield curve movements will not in general be in line with risk factors
- Define: Deviation term = Actual ZCB price – Expected ZCB price
 - Sensitivity of ZCB price to risk factor 1 * Risk factor 1
 - Sensitivity of ZCB price to risk factor 2 * Risk factor 2 – ...
- Add deviation terms into Taylor series expansion
- Could have a deviation term for:
 - Each month (but potential excessive run time)
 - Each calibration point (but complications with expected roll-forward)



Deviation terms (2)

- Corporate and supranational bond spreads: Similar to yields
- Credit migration experience: Deviation term for each asset and each rating the asset could transition to
- Future credit transitions: Deviation term for each entry of transition matrix
- Inflation experience: Deviation term for each actual emerging RPI figure
 - Need historic RPI figures as well as latest one because of indexation lagging



Solving for the amounts of the risk factors that have occurred – Assumption changes

- Corporate bond spreads, supranational bond spreads, credit migration experience:
 Σ (deviation terms) = 0 gives a linear equation to be solved
- Inflation:
 - Vector of deviation terms should have zero component in direction of each risk factor
 - Gives 3 simultaneous linear equations
- Interest rates and government bond spreads:
 - Need to solve for both at once
 - Gives 6 simultaneous linear equations



Solving for the amounts of the risk factors that have occurred – Experience variances

- Bring experience variance deviation terms into same equations as assumption change deviation terms, rather than setting up separate experience variance risk factors
- Maintains consistency of risk categorisation with internal model
- Can still report experience variances separately when required for presentational purposes



Specimen results – Sterling interest rate risk

	Assets	Own funds without MA	Own funds with MA
Risk factor 1	(58.6)	(1.4)	(1.6)
% of risk factor occurred	47%	44%	45%
Sensitivity to risk factor	(124.7)	(3.2)	(3.6)
Risk factor 2	59.1	(1.2)	(1.2)
% of risk factor occurred	(73)%	(75)%	(76)%
Sensitivity to risk factor	(80.9)	1.6	1.5
...			

- Small own funds sensitivities due to close matching
- Takes account of more assets needing to be held to back BEL when there is no MA
- Risk factor %'s slightly different in each column due to weighting differences



Specimen results – Sterling inflation risk

	Assets	Own funds without MA	Own funds with MA
Risk factor 1	28.3	0.8	0.8
% of risk factor occurred	65%	62%	64%
Sensitivity to risk factor	43.6	1.3	1.2
Risk factor 2	13.2	(0.4)	(0.4)
% of risk factor occurred	48%	46%	46%
Sensitivity to risk factor	27.4	(0.9)	(0.8)
...			

- Similar sensitivities to sterling interest rate risk, but smaller magnitude of asset stresses because:
 - Inflation stresses only apply to inflation-linked assets and liabilities
 - Lower volatility of risk factors



Specimen results – Currency risk

	Assets	Own funds without MA	Own funds with MA
EUR currency risk	1.8	1.8	1.8
% appreciation of EUR	9%	9%	9%
Sensitivity to a 1% appreciation	0.2	0.2	0.2
USD currency risk	1.1	1.1	1.1
% appreciation of USD	(11)%	(11)%	(11)%
Sensitivity to a 1% appreciation	(0.1)	(0.1)	(0.1)
...			

- Zero liability sensitivities, as liabilities denominated in sterling in this example
- Small asset sensitivities, in view of hedging
- Similar comments apply to overseas interest rate and inflation risks



Specimen results – Spread risks

	Assets	Own funds without MA	Own funds with MA
GBP supranational bond spreads	(1.4)	(1.4)	0.1
Spread widening occurred	0.21%	0.21%	0.21%
Sensitivity to a 1% widening	(6.8)	(6.8)	0.4
GBP A-rated corporate bond spreads	9.5	9.5	0.2
Spread widening occurred	(0.32)%	(0.32)%	(0.32)%
Sensitivity to a 1% widening	(29.7)	(29.7)	(0.7)
...			

- NB: material spread risk may remain after MA in some circumstances, because of regulatory restrictions on credit for MA for certain types of asset, e.g. callable bonds



Specimen results – Credit migration risk

	Assets	Own funds without MA	Own funds with MA
Credit migration risk	(14.4)	(14.4)	(3.6)
% of risk factor occurred	36%	36%	36%
Sensitivity to risk factor	(40.0)	(40.0)	(10.0)

- Only partial offset via MA when migration experience is different from that expected
- May also be changes in future fundamental spread assumptions, affecting MA only
- No changes in future fundamental spreads in this example, as equal to floor



Unexplained

- Only two possible causes:
 1. Data changes not mapped to a risk factor
 2. Higher-order terms in Taylor series
- If unexplained too large, then attempt to rule out 1. before quantifying higher-order terms
 - Data errors
 - Risks not allowed for in internal model
- Consider structure of risk factor definitions to identify which higher-order terms are likely to be significant



Extension to new business risks

- Suggest bringing these into P&L attribution in same way as any other type of risk
- Expected position would use:
 - Sales volumes in line with business planning forecasts
 - Levels of profitability targeted by pricing process
- Independent verification that level of profitability targeted by pricing process is being achieved in practice
- Risk factors for:
 - Variance in sales volumes against those expected
 - Variance in profitability against that expected



Extension to value metrics that do not vary smoothly

- Examples:
 - Fundamental spreads only vary with credit transition matrix when they are above floor
 - Limited price indexation
- Similar problem in Economic Capital modelling – cannot sensibly fit smooth formulae to quantities that do not vary smoothly
- Can be dealt with by adding indicator variables as additional risk factors



Extension of remit of Working Party

- SII/Economic Capital modelling generally uses instantaneous stresses
- Only difference is that instantaneous stresses are calculated on an actual balance sheet, P&L attribution coefficients on an expected rolled-forward balance sheet
- Gives means of quantifying instantaneous stresses without a separate model run on each set of stressed assumptions
- Significant opportunity to improve efficiency of SII/Economic Capital reporting processes



Developing an Excel-based tool

- Import asset data and liability cash flows to provide a P&L attribution and calculate instantaneous sensitivities for any annuity fund
- Not yet released outside Working Party, as limited testing on actual data carried out
- Release publicly once a reasonable amount of testing has been performed
- Wikipedia-like model
- Macro to analyse dependency structure of variables and identify those needed for current application
- Version control process



Common code for all risk factors

- e.g. Sensitivity of matching adjustment = Sensitivity of asset-based discount rate – Sensitivity of risk-free rate
- Useful to be able to specify this simultaneously for all risk factors and all deviation terms
- Creates flexibility to use alternative risk categorisations
 - Different companies will use different categorisations in internal models and/or be on Standard Formula
 - Internal model categorisations not always most useful categorisations for managing the business, e.g. monitoring investment performance
 - Not all applications require most granular categorisation



Renaming of Working Party

- Renamed to 'Industrialising Financial Reporting WP'
- Techniques applicable to all forms of financial reporting, and to any type of business
- Opportunity for increased consistency and transparency of reporting practices
- Techniques unlikely to be developed separately by each company, for resourcing reasons



Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.

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