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The Next Big Thing: Variable Annuities & Guaranteed Minimum Benefit Options?

A2: Pricing & Hedging Guarantees 2

28 September 2007

Presenters: Mark Hills, Lincoln Financial Group (UK)
Sam Nandi, Milliman (US)
Dave Bulin, Lincoln Financial Group (US)

Agenda

- Background to *Lincoln* i2*Live*
  - Mark Hills, Lincoln Financial Group (UK)
- Pricing Variable Annuity Guarantees
  - Sam Nandi, Milliman (US)
- Practical Implementation:
  Hedging for Variable Annuity Guarantees
  - Dave Bulin, Lincoln Financial Group (US)

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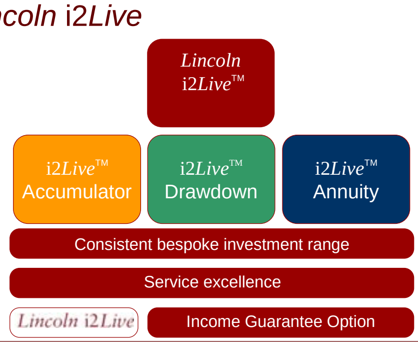
Background

- In 2005 Q4 Lincoln UK initiated work to consider our future growth strategy
- Conclusion was to concentrate on the income in retirement market
- Many potential options were explored and considerable research and analysis was conducted
- Research indicated that an income guarantee was required

Lincoln National Corporation (LNC)

- Our parent (LNC) also operates in a similar market in the US
- Have drawn on and adapted for the UK market the group's heritage and expertise in the US
- LNC wrote about $10bn of VA new business in 2006, of which about 70% has living benefits which are hedged

Lincoln i2*Live*



Income Guarantee Option: How it Works (Brief Summary)

- Guaranteed minimum income (GMI) for life
- Continues on conversion from i2*Live* Drawdown to i2*Live* Annuity
- Based on the 'maximum supportable income' (MSI)
- Can take up income up to MSI (or GMI if greater) each year
- Initial GMI = 75% of initial MSI
- MSI recalculated at the start of each year
- GMI recalculated every 5 years – can go up but not down

Risk Mitigation

- Wanted to minimise financial risks associated with offering the guarantee:
  - UK: reduce risk and volatility of profits by reinsuring income guarantee within LNC group
  - Group: reduce risk and volatility of profits by hedging

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LNC Hedging Experience

- Started hedging living benefits in 2003
- Now has over $20bn of in-force VA business (by unit value) that has living benefits that are hedged – this is about ¼ of all LNC in-force VA business

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Why Hedge?

- Insurance companies traditionally are aggregators of risk, using diversification as a primary risk management tool, but:
  - Capital markets risk is generally non-diversifiable
  - 'Law of Large Numbers' NOT applicable to capital markets risk
  - Increased volumes will not reduce capital markets risk
- Two key ways to manage capital markets risk:
  - Have adequate capital (surplus)
  - Transfer risk to a third-party (hedge or reinsurance)

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History

- Guarantees on Variable Annuities have existed in the US since the 1990's
- Earlier iterations of these guarantees reflected significant underpricing. Guarantees were not being seen as financial options and priced accordingly.
- Equity market drop (2000-2002) increased awareness of the market risks inherent in this business
- Industry practice has shifted dramatically since 2003
  - Pricing as financial options
  - Hedging programs
  - Product designs to limit risk to companies
- Since 2003, the biggest selling guarantee in the US has been GMWB, virtually all of which is hedged

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Pricing Framework

- Pricing of Guarantee

  = Option cost
  + Additional capital cost to cover residual risks
  + Any additional regulatory capital cost
  + Profit margin

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Option Cost (Hedge Cost)

- Value guarantee as if it were financial option
- Use the principle of risk neutral valuation
  - The value of an option equals the expected present value of cash flows generated under risk-neutral scenarios
  - Price consistently with market prices of derivatives
    - Equity futures
    - Equity options
    - Swaptions

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Hedge Cost Inputs

- Capital markets inputs
  - Equity market volatilities
  - Interest rate curve
  - Correlations across fund classes
- Actuarial assumptions
  - Lapse rates
  - Mortality rates
  - Policyholder behavior assumptions
    - Dynamic lapses – policyholders may be less likely to lapse if they are aware that they have a valuable guarantee – that is, when the guarantee is in the money
    - Utilization – policyholders will tend to exercise a benefit with optional exercise when it is in their advantage to do so

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Annualized Costs

Annualized Hedge Cost (in bp)

$$= \frac{\text{PV Guarantee Claims}}{\text{PV of 1bp per year of Unit Value}}$$

- This can be run through the full product pricing model as an expense
- This implicitly assumes that the portion of fees allocated to the guarantee is also hedged

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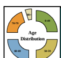
GMDB Hedge Costs (Illustrative – US)



GMDB Designs Expected Annual Hedge Costs (in bps of AV)					
Asset Allocation	**Policy Distribution**	**Return of Premium**	**Annual Ratchet DB**	**5% Rollup Death Benefit**	**Max of Annual Ratchet & 5% Rollup**
Aggressive	11%	14	30	49	59
Moderately Aggressive	25%	9	23	43	51
Moderate	40%	4	14	34	39
Moderately Conservative	17%	1	6	25	27
Conservative	7%	0	2	19	20
Total	**100%**	**6 bps**	**16 bps**	**35 bps**	**41 bps**

* Based on US specific actuarial assumptions and capital market conditions from 2006. Current UK costs may differ.

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GMIB Hedge Costs (Illustrative US)

GMIB Hedge Costs Max of 5% Rollup & MAV		
Asset Allocation	**Policy Distribution**	**Hedge Cost (in bps of Account Value)**
Aggressive	15%	65
Moderately Aggressive	30%	51
Moderate	35%	36
Moderately Conservative	15%	25
Conservative	5%	18
Total	**100%**	**39 bps**

* Based on US specific actuarial assumptions and capital market conditions from 2006. Current UK costs may differ.

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GMWB Hedge Cost (Illustrative US)

GMWB Hedging Costs 7% Max GMWB		
Asset Allocation	Policy Distribution	Hedge Cost (in bps of Account Value)
S&P 500	0%	89
Aggressive	15%	57
Moderately Aggressive	30%	37
Moderate	35%	14
Moderately Conservative	15%	2
Conservative	5%	0
Total	100%	25 bps

* Based on US specific actuarial assumptions and capital market conditions from 2006. Current UK costs may differ.

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Understand Product Feature Risks

- Are there hidden options in your product/guarantee that you have not taken into account?
  - for withdrawals
  - Asset allocation flexibility
  - Optional reset provisions
- There is typically no data for constructing credible policyholder behavior functions
  - Price conservatively
  - Put yourself in the policyholder's shoes
  - Monitor experience
  - Dynamic hedging can be more responsive than static to emerging experience

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Dynamic Hedging Residual Risks

- Basis mismatch between underlying funds and hedging indices
- Policyholder behavior risk
- Model risk
- Realized market volatility
- Realized interest rate volatility
- Cross effects (co-movements of market variables)
- Operational risk

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Cost of Capital

- Should cover residual risks that company is left with even with the execution of a hedging program and risks that can not be hedged
- Need to consider any additional regulatory capital that may be required above that necessary to cover economic risks
- Part of this can be based on a stochastic-on-stochastic framework that informs long-term risk associated with tracking error of hedging program

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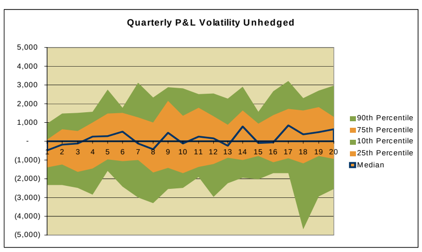
Sample Results (Illustrative US): GMWB Unhedged



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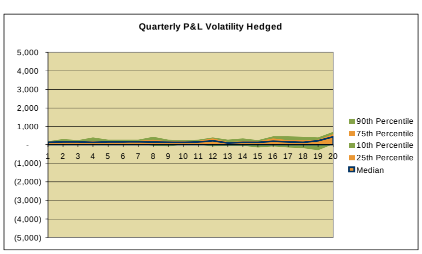
Sample Results (Illustrative US): GMWB Hedged



Delta-Vega-Rho Hedging with Futures, Short & Long Term Puts, & Swaps

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Hedge Program

- Dynamic, not static
- Objective: Change in US GAAP reserve caused by changes in market parameters
  - FAS 133 – fair value / mark-to-market
  - Equity market ("delta")
  - Interest rates ("rho")
  - Implied volatilties ("vega")
- Hedge programs not designed to cover:
  - Policyholder behavior
  - Fund tracking risk

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Hedge Instruments

- Long-dated equity put options
- Interest rate swaps and futures
- Equity futures
- Customized (exotic) hedges

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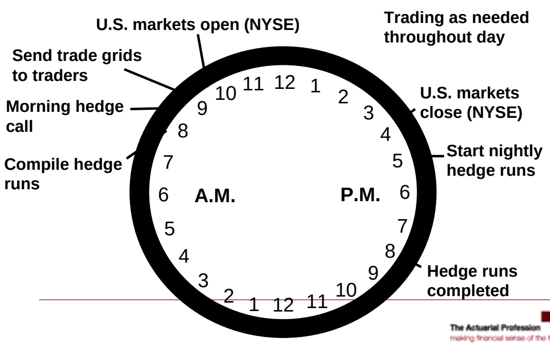
Data and Trading Flows

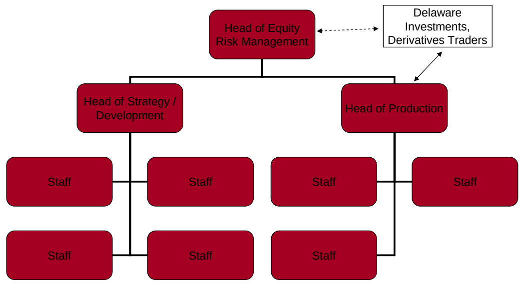
"Day in the Life" – U.S. Program



Morning Hedge Call

- Q1: Did the runs make sense?
  - Reserve roll-forward / attribution
  - Liability Greeks vs. cross-Greek estimate
  - Policy inventory update
- Q2: Did the previous day's trades make sense?
  - Holdings vs. trade activity
  - Hedge vs. liability Greeks – within tolerances?
- Q3: Did the program perform as expected?
  - Daily profit/loss statement
  - Attribution

Staffing



Checks and Balances

- Daily
  - Morning hedge call prep and activity
- Weekly
  - P&L / Attribution
  - Distribution
  - CRO
  - Head of Profitability & Risk Management
- Monthly
  - Earnings / “Dashboards”
  - Derivatives Committee
  - EqRM Committee

Key Issues

1. Clear Expectations - deadlines
2. Feedback Loop - ability to react quickly
3. Effective Communication
4. Understanding of Broad Issues
5. Teamwork

Questions?

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