

The 8th Bowles Symposium, Georgia State University
Second International Longevity Risk
and
Capital Markets Solutions Symposium

Pricing Life Securitizations
and their Place in Optimal ILS portfolios

By

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- ❑ Comments on Longevity Bonds. Is Mortality a Longevity Hedge?
- ❑ Concluding remarks

INDEX vs. INDEMNITY

Class	Index (of Region)	Indemnity (of Closed Book)
Examples	Vita I, Vita II	Queensgate ALPS II
Form	Bond, FRN	ABS
Term	Short term	Longer term, Junior Tranche
Maturity	Fixed	Variable - estimated
Coupon	Spread over LIBOR	Fixed and Floating
Investor Data	Probabilistic, Exp Loss, attachment probabilities	Scenarios, non probabilistic
Risks covered	Mortality, premature death	Mortality, Premature Death Interest rates, lapses etc
Credit Risk	none	In investment portfolio
Desirability	High Alpha	Alpha bundled with Beta

Pricing Life Index Bonds –Vita I

- ❑ Swiss Re issued Vita I in December 2004
- ❑ Amount \$250 million (note \$400 million Shelf)
- ❑ FRN
- ❑ Term; 3 Years 1 Month i.e. Jan 2007
- ❑ Issue Price L + 135 bps
- ❑ Rated A+/A3
- ❑ Coverage 20% XS 130% of expected mortality rate in 3 years
- ❑ EL= 0.016%; PFL= 0.077%; PLL=0.003%

Pricing Life Index Bonds –Vita I

K&M Model

$$\text{Premium} = \text{Gamma} * (\text{EL})^{\text{alpha}}$$

12/31/2004 Estimates

$$\text{Gamma} = 38.65\%$$

$$\text{Alpha} = 49.14\%$$

NOTE

This is very similar to the original **Kreps** and/or Sharpe Ratio model

$$\text{Premium} = \text{EL} + \text{Gamma} * (\text{STD Dev})$$

Where STD Dev is approximately the square root of Expected Loss

Although we do not estimate it, a good approximation rule would be

$$\text{Premium} = \text{EL} + 30\% * (\text{EL}^{0.5})$$

Pricing Life Index Bonds –Vita I

LFC Model

$$\text{Premium} = \text{EL} + \text{Gamma} * (\text{PFL}^{\alpha})(\text{CEL}^{\beta})$$

12/31/2004 Estimates

$$\begin{aligned} \text{Gamma} &= 16.59\% \\ \text{Alpha} &= 39.78\% \\ \text{Beta} &= 4.48\% \end{aligned}$$

Pricing Life Index Bonds –Vita I

Vita Capital Ltd

	Issued Yield		1.35%	<p>Life has traded 50 bps To Cat</p>
	Swiss Re provided Stats			
	PFL	=	0.0770%	
	EL	=	0.0160%	
	PTL	=	0.0030%	
	Derived			
	CEL		20.78%	
Model Prices				
	K&M Price	=	0.53%	
	LFC Price	=	0.91%	
NOTE	Kreps	=	0.40%	
Secondary Market Spread over LIBOR				
	Mid Market		1.20%	

Pricing Life Index Bonds –Vita II

- ❑ Swiss Re issued Vita II in April 2005
- ❑ Amount \$362 million in three classes (note \$2,000 million Shelf)
- ❑ FRN
- ❑ Term; 5 Years i.e. Jan 2010
- ❑ Issue Price A; L + 190 bps, B; L+140 bps, C; L+ 90 bps
- ❑ Rated BBB-, BBB+, A-, A+
- ❑ Coverage A; 5% XS 110% of expected mortality rate in 3 years
5% XS 115%, 5% XS 120%, 20% XS 125% for D, C, B and A resp.
- ❑ EL= 0.145%; EL= 0.041%; EL= 0.0073%; EL= 0.0003%

Pricing Life Index Bonds –Vita II

Vita II Capital Ltd

Issued Yield			TBA	TBA	TBA	TBA
Tranche			A	B	C	D
Swiss Re provided Stats						
	PFL	=	0.0015%	0.0165%	0.0755%	0.2344%
	EL	=	0.0003%	0.0073%	0.0411%	0.1458%
	PTL	=	0.0001%	0.0015%	0.0165%	0.0755%
Derived						
	CEL		20.00%	44.24%	54.44%	62.20%
Model Prices						
	K&M Price	=	0.07%	0.36%	0.84%	1.56%
	LFC Price	=	0.19%	0.51%	0.97%	1.61%
NOTE	Kreps	=	0.05%	0.26%	0.65%	1.29%
Pre-Market Talk - Spread over LIBOR					150	200
Cheapness (in Cat bond terms)					55 bps	40 bps

Life

Vita II Capital Ltd

Issued Yield			TBA	TBA	TBA	TBA
Tranche			A	B	C	D
Swiss Re provided Stats						
	PFL	=	0.0015%	0.0165%	0.0755%	0.2344%
	EL	=	0.0003%	0.0073%	0.0411%	0.1458%
	PTL	=	0.0001%	0.0015%	0.0165%	0.0755%
Derived						
	CEL		20.00%	44.24%	54.44%	62.20%
Model Prices						
	K&M Price	=	0.07%	0.36%	0.84%	1.56%
	LFC Price	=	0.19%	0.51%	0.97%	1.61%
NOTE	Kreps	=	0.05%	0.26%	0.65%	1.29%
Pre-Market Talk - Spread over LIBOR					150	200

Cheapness (in Cat bond terms)

55 bps 40 bps

ACTUAL	NA	90	140	190
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Queensgate

- ❑ Swiss Re issued (via Realic and Admin Re) Queensgate Dec 2004
- ❑ Amount \$245 million in three classes. A \$175, B \$45, C \$25
- ❑ Fixed rate notes
- ❑ Term; 20 Years, however exp term A 3.0 yrs, B 7.6 yrs, C 10.2 yrs
- ❑ Issue Price A 518.9 Bps, B 686.6 bps, C 1350 bps,
- ❑ Rated A+, BBB, BB respectively for A, B, C
- ❑ Closed book of business, five portfolios, 400,000 policies, 60% in force 10 years,
- ❑ Callable at premium to par for 8 years, par thereafter
- ❑ None given – 36 scenario outcomes given by NPV

Queensgate

Priced at

Queensgate A, A+	518.9 bps F	(3 yr Swap @ 375 + 144)
Queensgate B, BBB	686.0 bps F	(7 yr Swap @ 452 + 234)
Queensgate C, BB	1350.0 bps F	(10Yr Swap @ 600+ 750)

Queensgate

How should this be evaluated?

Either compared to similar deals

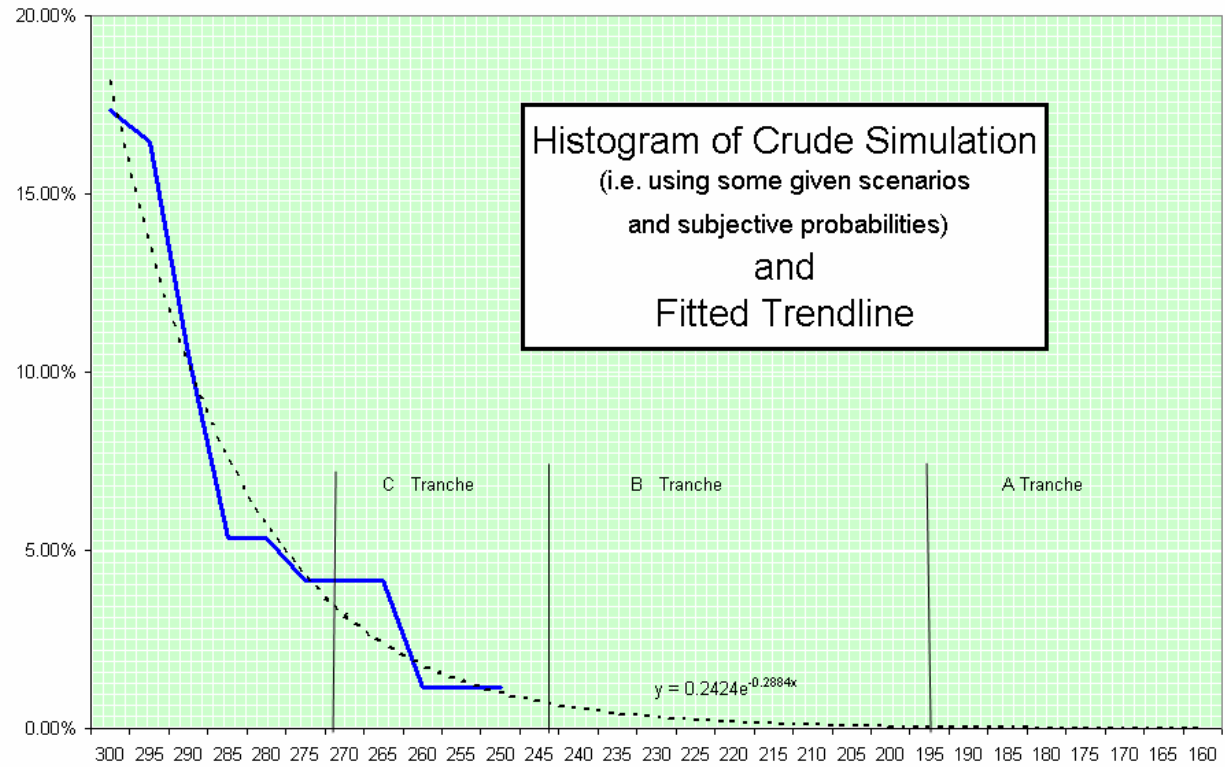
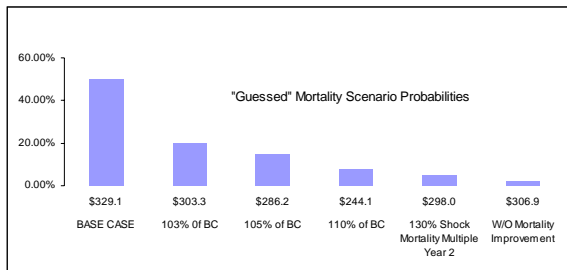
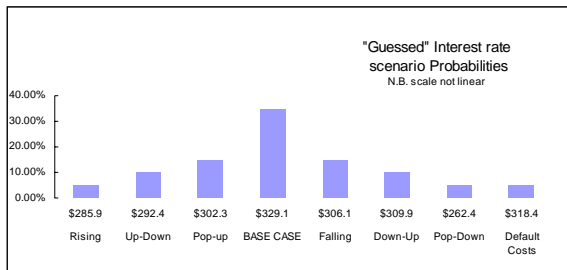
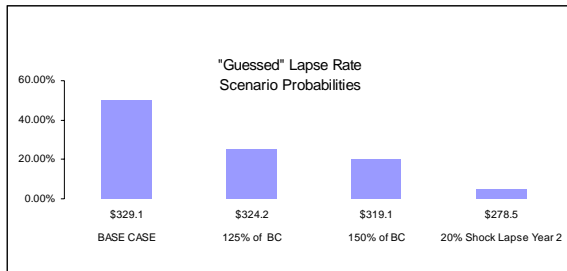
Prudential A, AAA	L+87.5	Q, Series A, A+	L+116.9
Prudential B, AAA	7.245% F	Q, Series B, BBB	6.86%
Prudential C, A	8.695% F	Q, Series C, BB	13.5%
Devlin A, AAA	L+ 40		
Devlin B, AAA (longer term)	L+ 55		

Or possibly by trying to price its component parts

Queensgate

Sensitivity Test Summary (in millions of dollars)			
	Present Value 7.5%	Difference from Base Case	Percentage Difference from Base Case
Base Case	329.1	—	—
Interest Rate Sensitivities			
Rising	285.9	(43.2)	(13.1)%
Up-Down	292.4	(36.7)	(11.1)
Pop Up	302.7	(26.4)	(8.0)
Falling	306.1	(23.0)	(7.0)
Down-Up	309.9	(19.1)	(5.8)
Pop Down	262.4	(66.7)	(20.3)
Default Costs Doubled	318.4	(10.7)	(3.3)
Lapse Sensitivities			
125% of Base Case	324.2	(4.9)	(1.5)%
150% of Base Case	319.1	(10.0)	(3.1)
20% Shock Lapse Year 2	278.5	(50.6)	(15.4)
Interest Rate Sensitivities without Interest Sensitive Lapses			
Base Case	329.1	0.0	0.0%
Rising	303.5	(25.6)	(7.8)
Up-Down	316.6	(12.5)	(3.8)
Pop Up	334.6	5.5	1.7
Falling	306.1	(23.0)	(7.0)
Down-Up	309.9	(19.1)	(5.8)
Pop Down	262.4	(66.7)	(20.3)
Mortality Sensitivities			
103% of Base Case	303.3	(25.8)	(7.8)%
105% of Base Case	286.2	(42.9)	(13.0)
110% of Base Case	244.1	(85.0)	(25.8)
130% Shock Mortality Multiple Year 2	298.0	(31.1)	(9.4)
Exclude Mortality Improvement	306.9	(22.2)	(6.7)
Combination Sensitivities			
105% Mortality, 125% Lapse	285.0	(44.1)	(13.4)%
110% Mortality, 125% Lapse	246.5	(82.6)	(25.1)
105% Mortality, 125% Lapse, Falling Interest Rates	277.3	(51.8)	(15.7)
125% Lapse, Falling Interest Rates	315.6	(13.5)	(4.1)
125% Lapse, Rising Interest Rates	269.0	(60.1)	(18.3)
Additional Interest Rate and Lapse Sensitivities			
Treasury Yields rise 1% the first year and stay level	339.5	10.4	3.2%
Treasury Yields rise 1% the first year and stay level; Crediting Rates remain unchanged	339.5	10.4	3.2%

Queensgate



Queensgate

Priced at

Queensgate A, A+	518.9 bps F	(3 yr Swap @ 375 + 144)
Queensgate B, BBB	686.0 bps F	(7 yr Swap @ 452 + 234)
Queensgate C, BB	1350.0 bps F	(10Yr Swap @ 600+ 750)

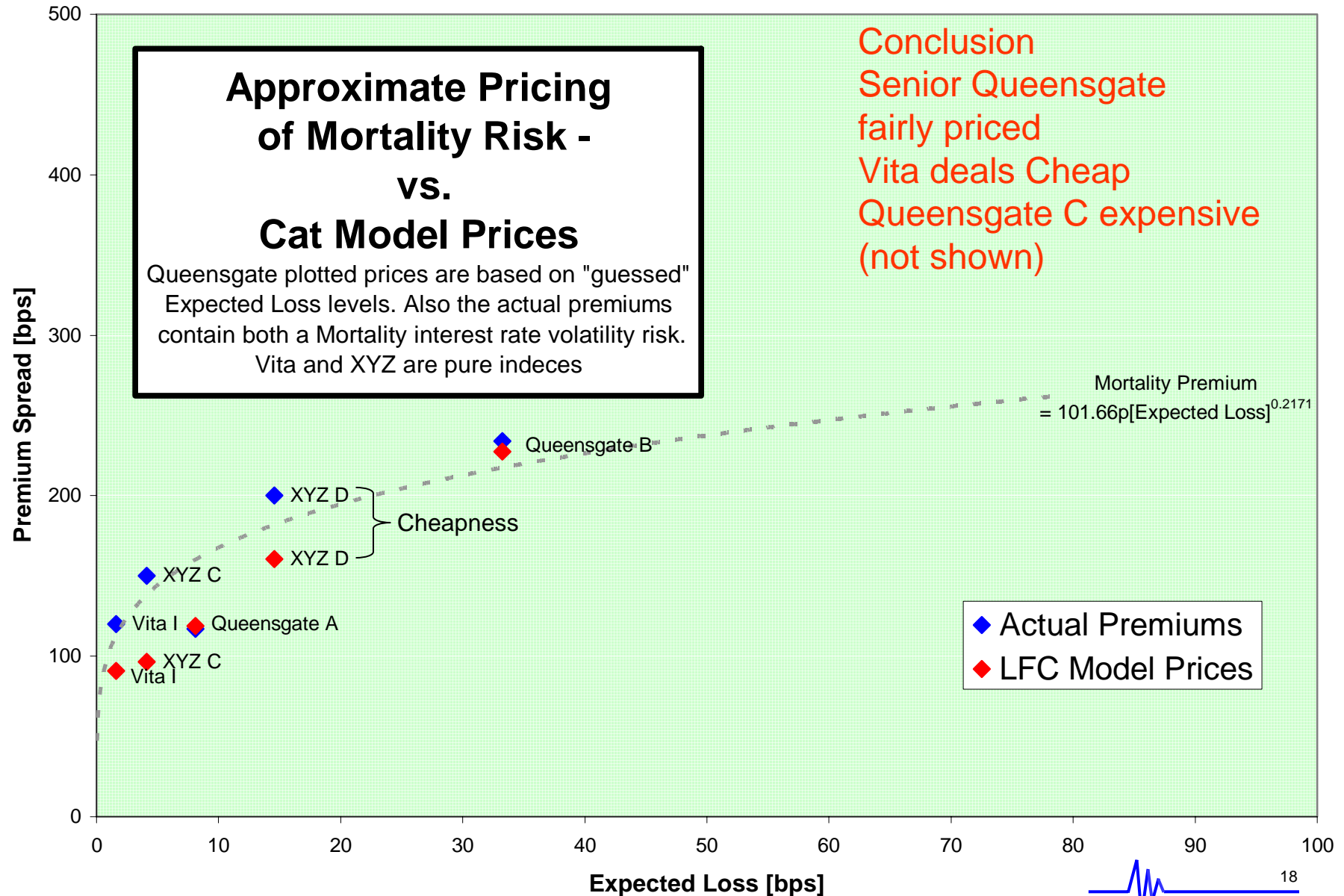
After simulation – or “guesses”

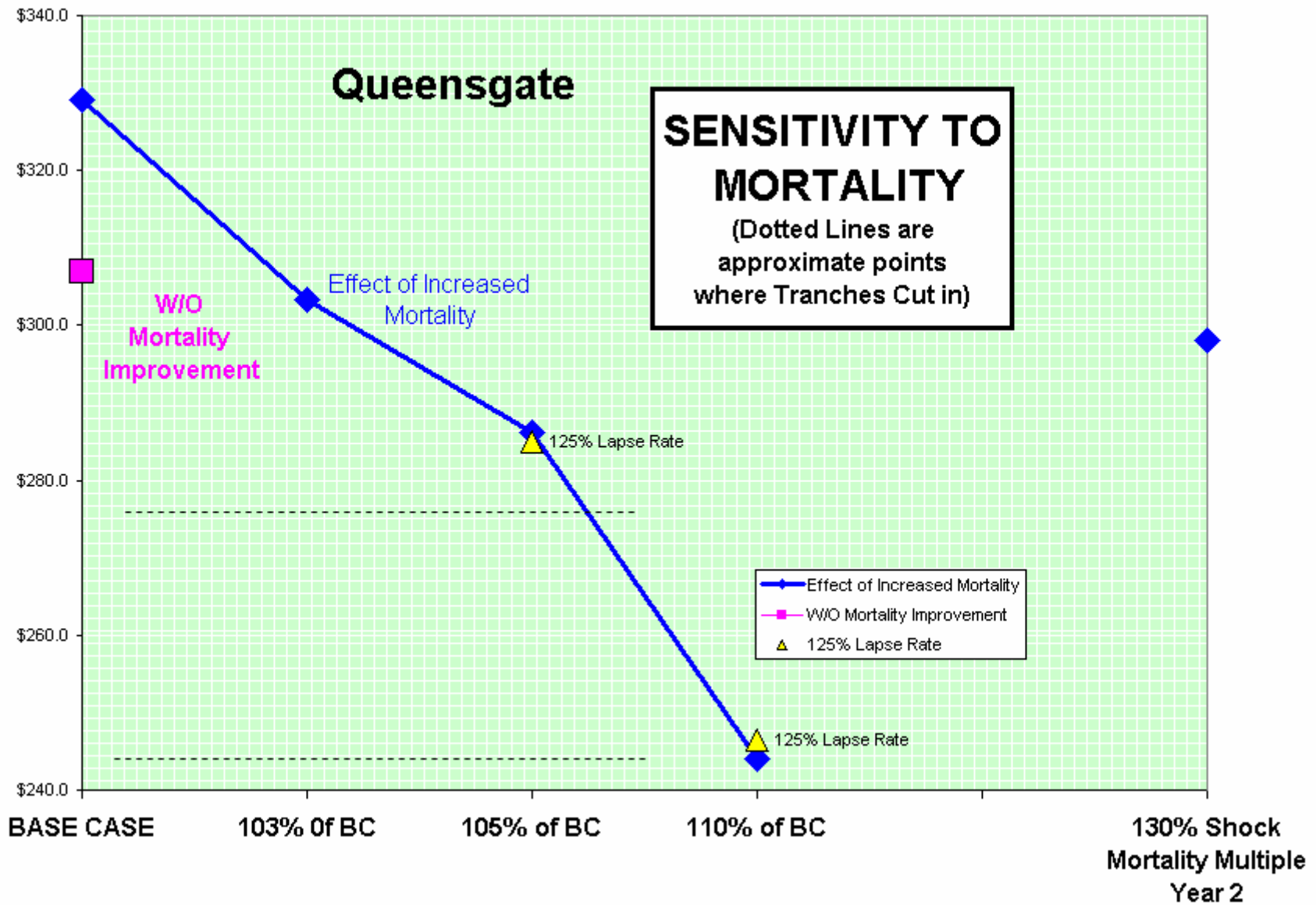
Expected Loss A	0.081%
Expected Loss B	0.332%
Expected Loss C	3.555%

LFC Prices A	119 bps
LFC Prices B	227 bps
LFC Prices C	854 bps

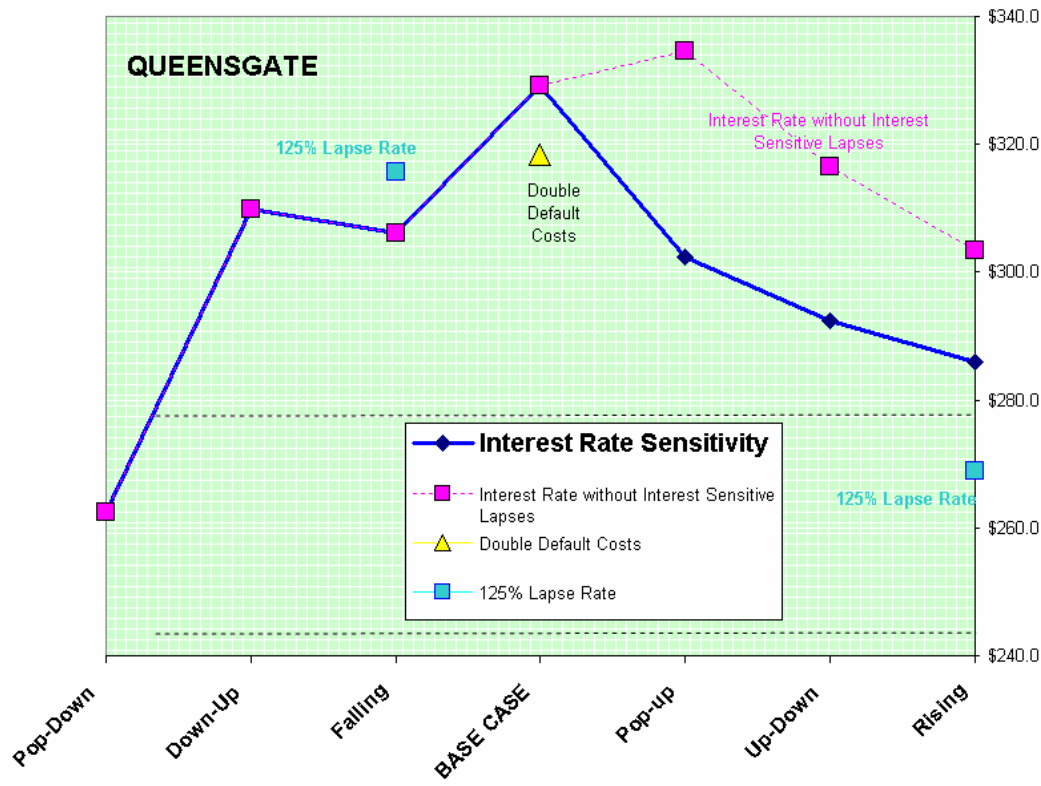
Maybe the C tranche is too expensive.

Queensgate

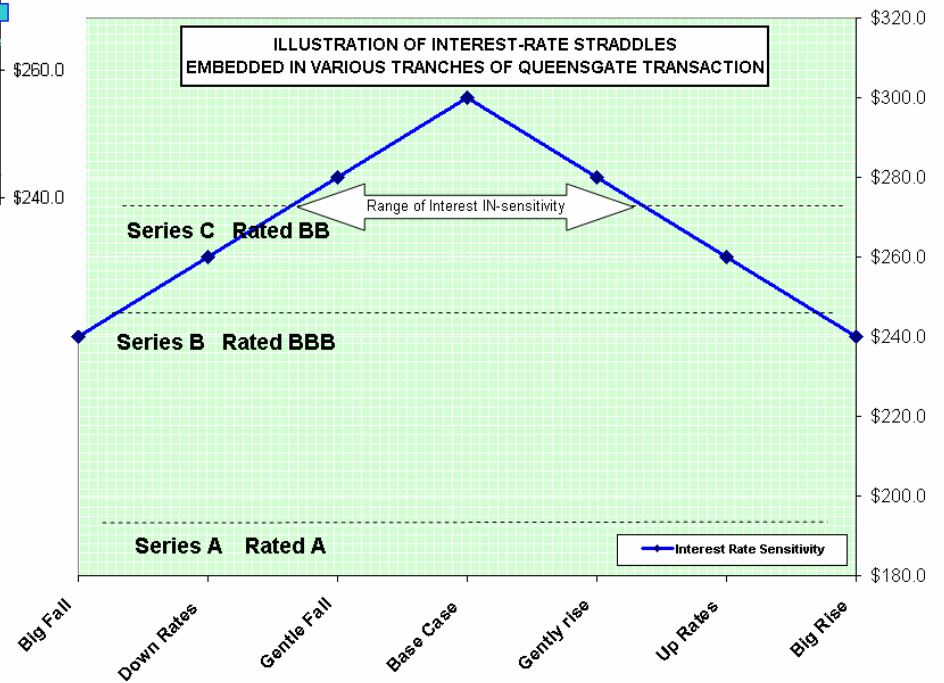




Queensgate



Showing the Embedded Interest Rate Straddle



ALPS II

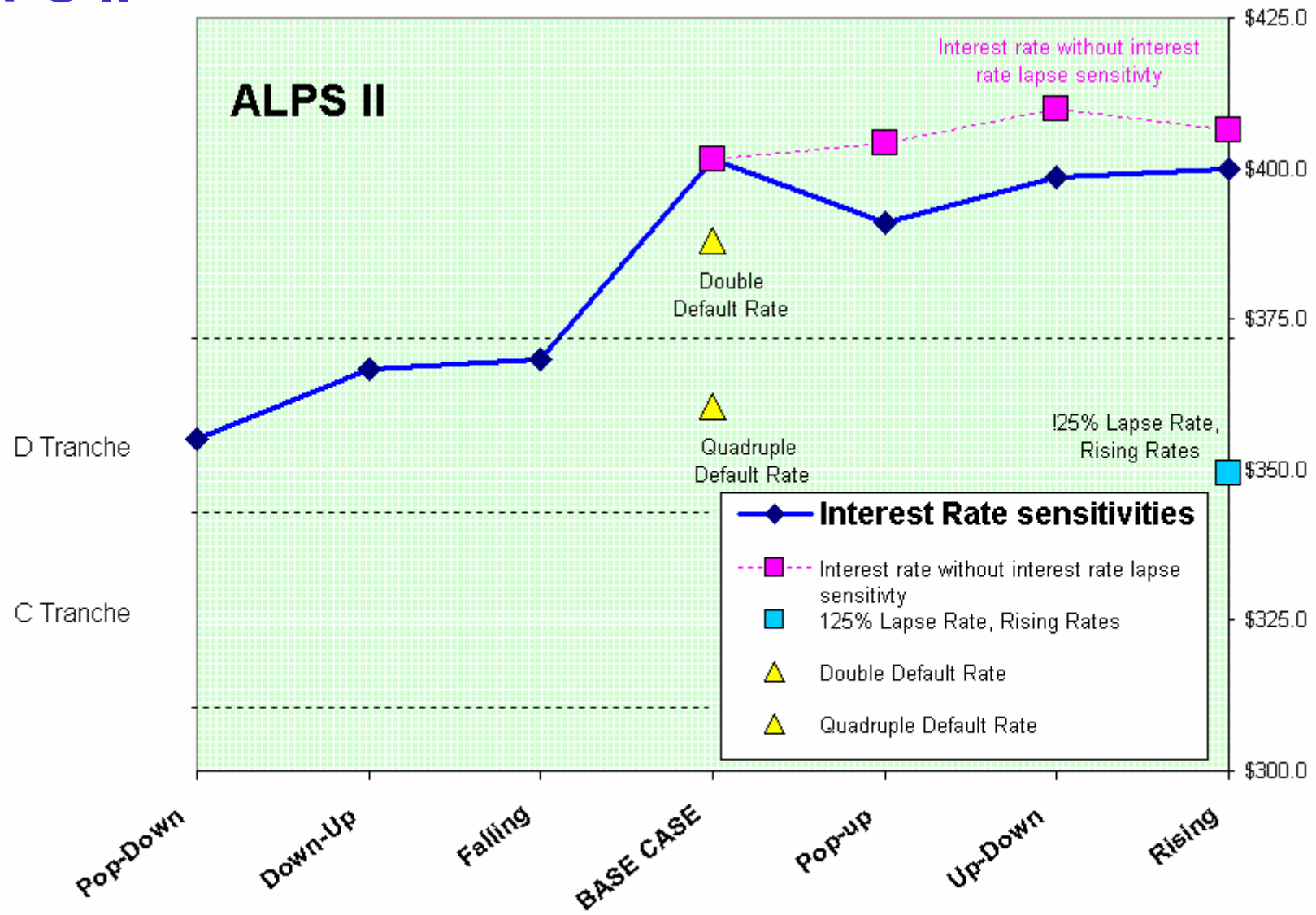
- ❑ Swiss Re issued (via Realic and Admin Re) December 2005
- ❑ Amount \$370 million in 4 classes. A \$220, B \$90, C \$30, D \$30
- ❑ A & B Floating rate notes, C & D Fixed rate notes
- ❑ Term; 20 Years, however exp term A 5.5 yrs, B 9.0 yrs, C 10.5 yrs, D 12
- ❑ Issue Price A L+ 30, B L+ 38, C 716.5, D 1173.5
- ❑ Rated AAA, AAA, BBB, BB respectively for A, B, C and D
- ❑ Closed book of business, five portfolios, 630,000 policies
- ❑ Callable with premium
- ❑ None given – 35 scenario outcomes given by NPV

ALPS II

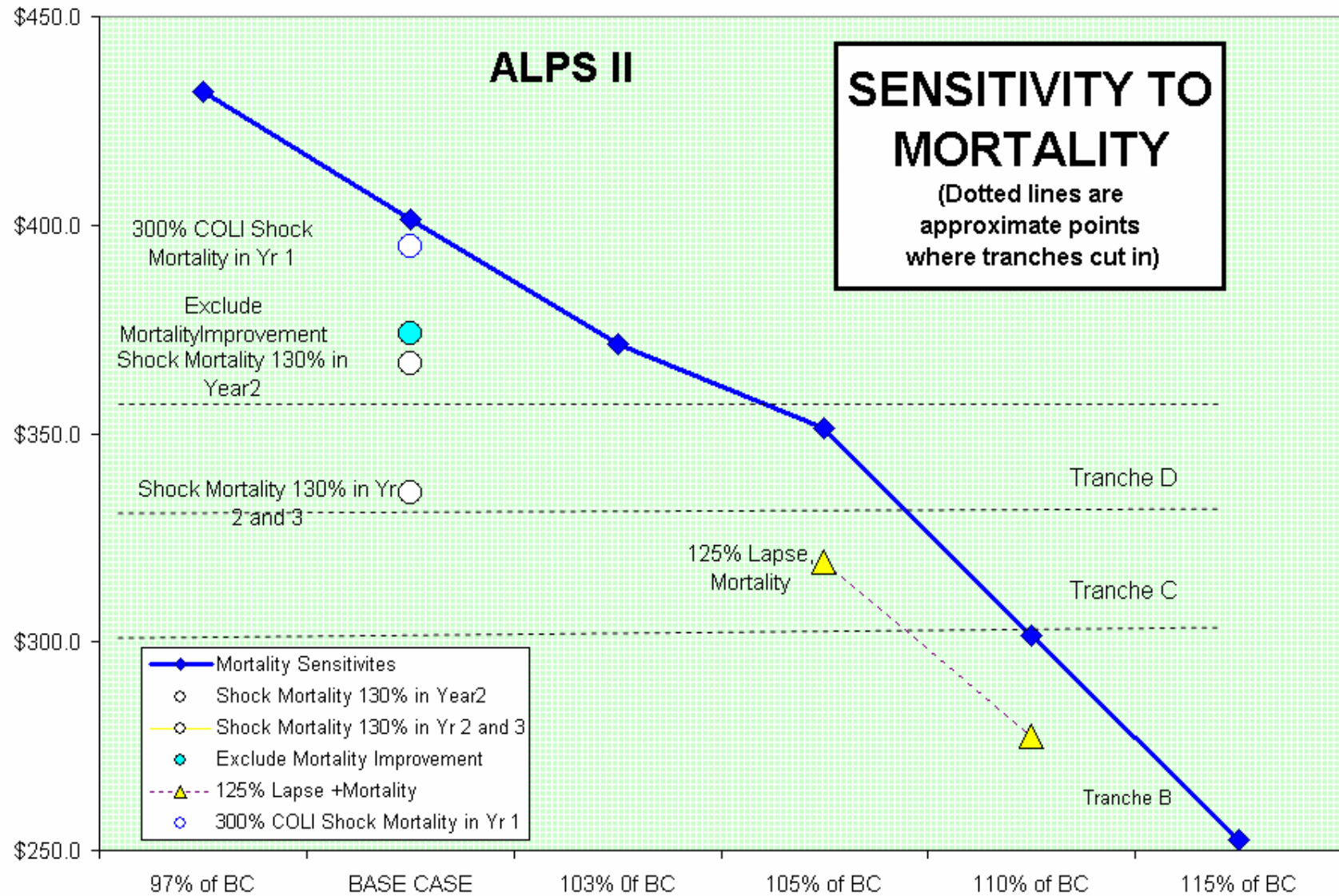
A summary of the Present Value is illustrated below for the Base Case and for all of the sensitivities.

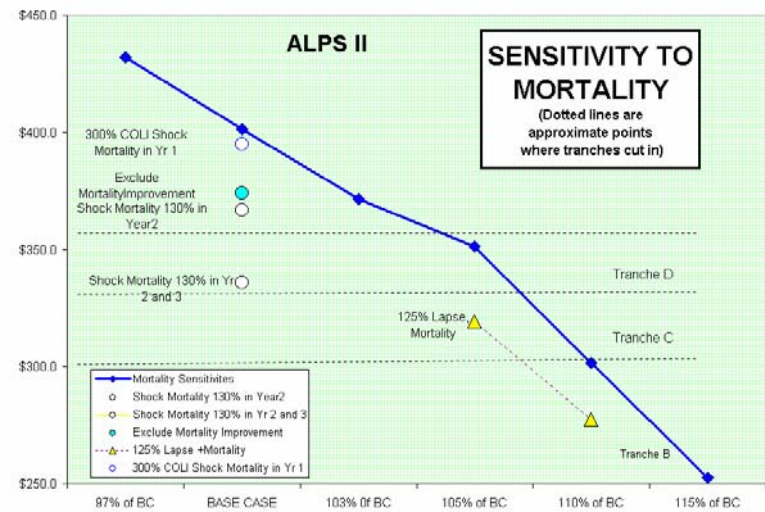
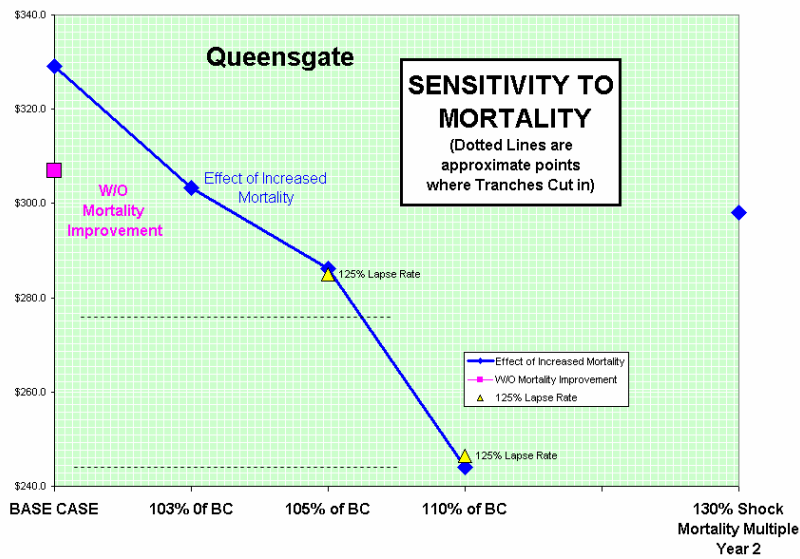
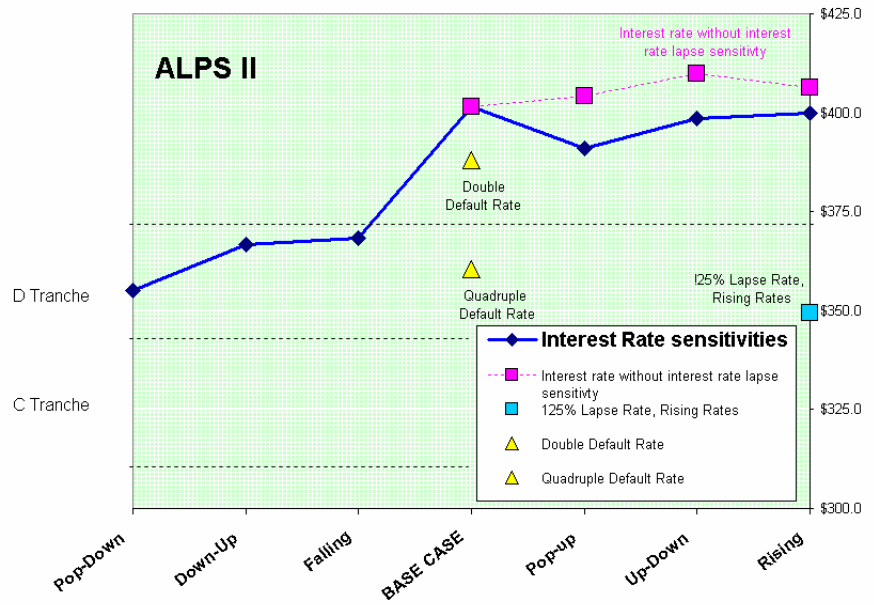
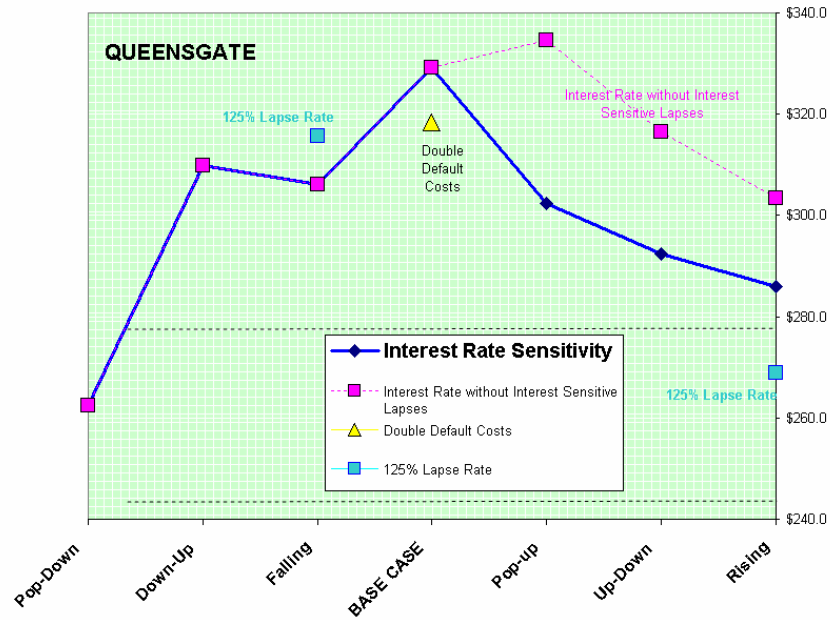
Sensitivity Test Summary (in millions of dollars)			
	Present Value 75%	Difference from Base Case	Percentage Difference from Base Case
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Up-Down	292.4	(36.7)	(11.1)
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ALPS II



ALPS II





% Change in Secondary Market ILS Yields

Sorted by Peril/Zone (6/30/2005 - 3/31/2006)

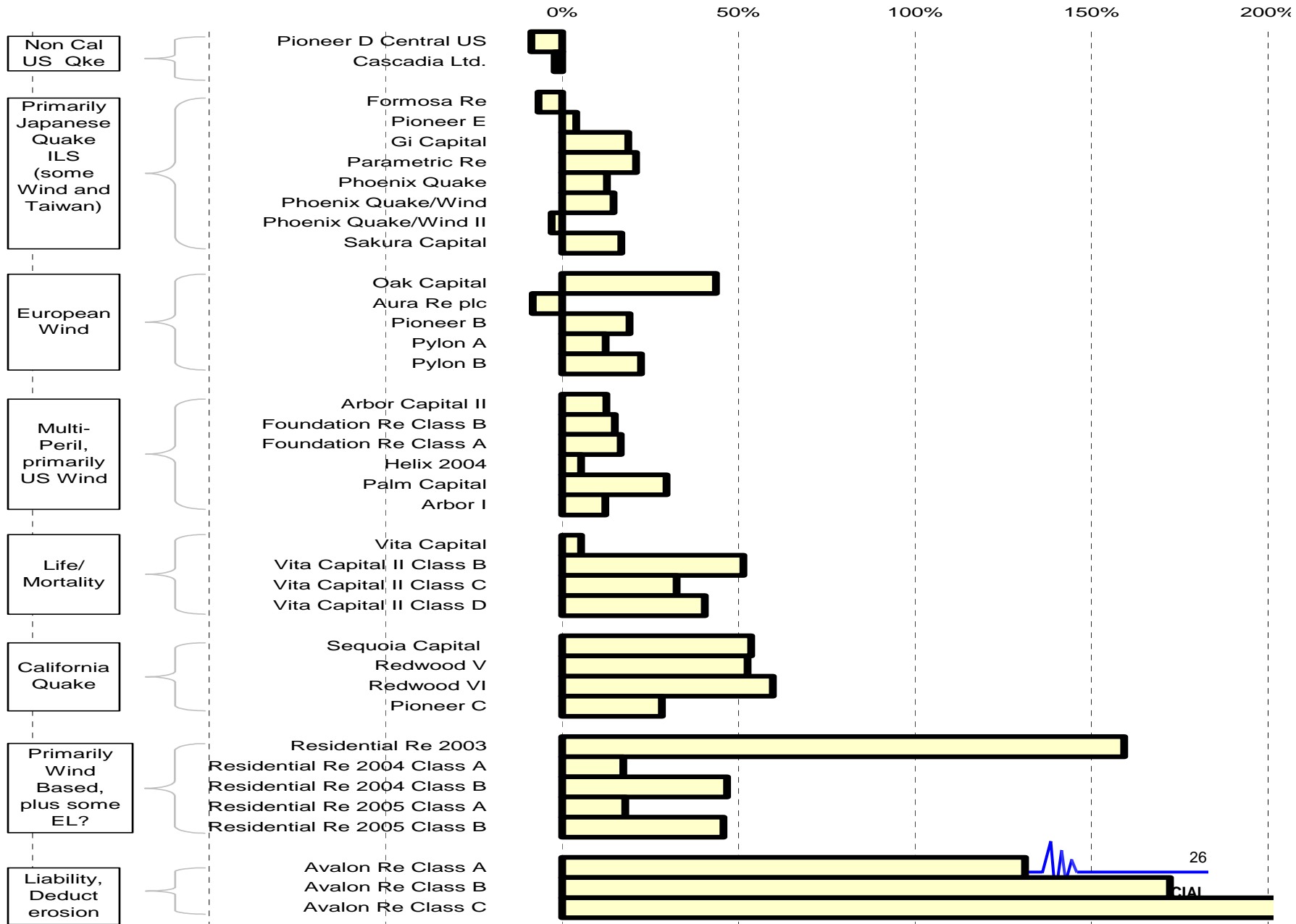
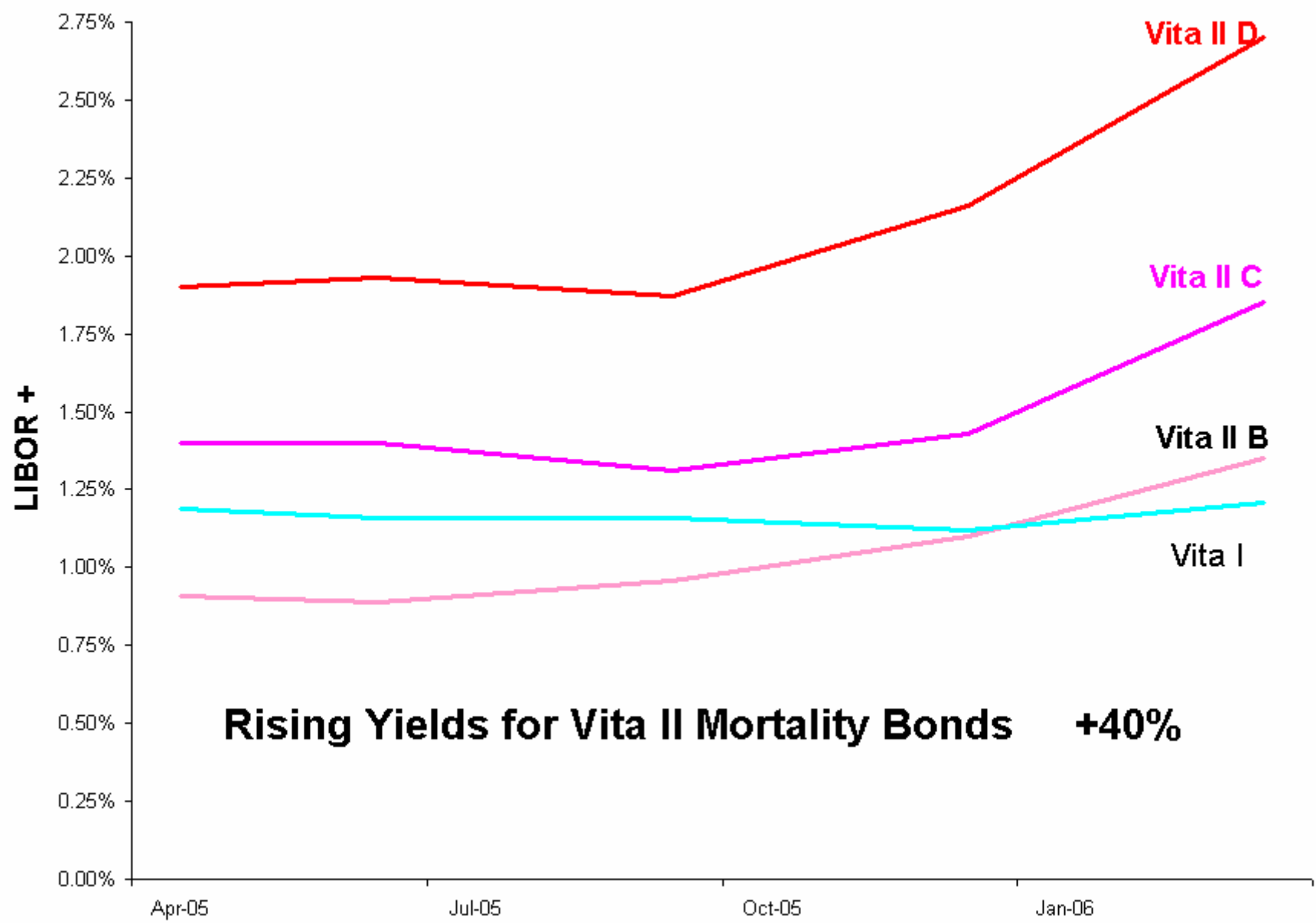


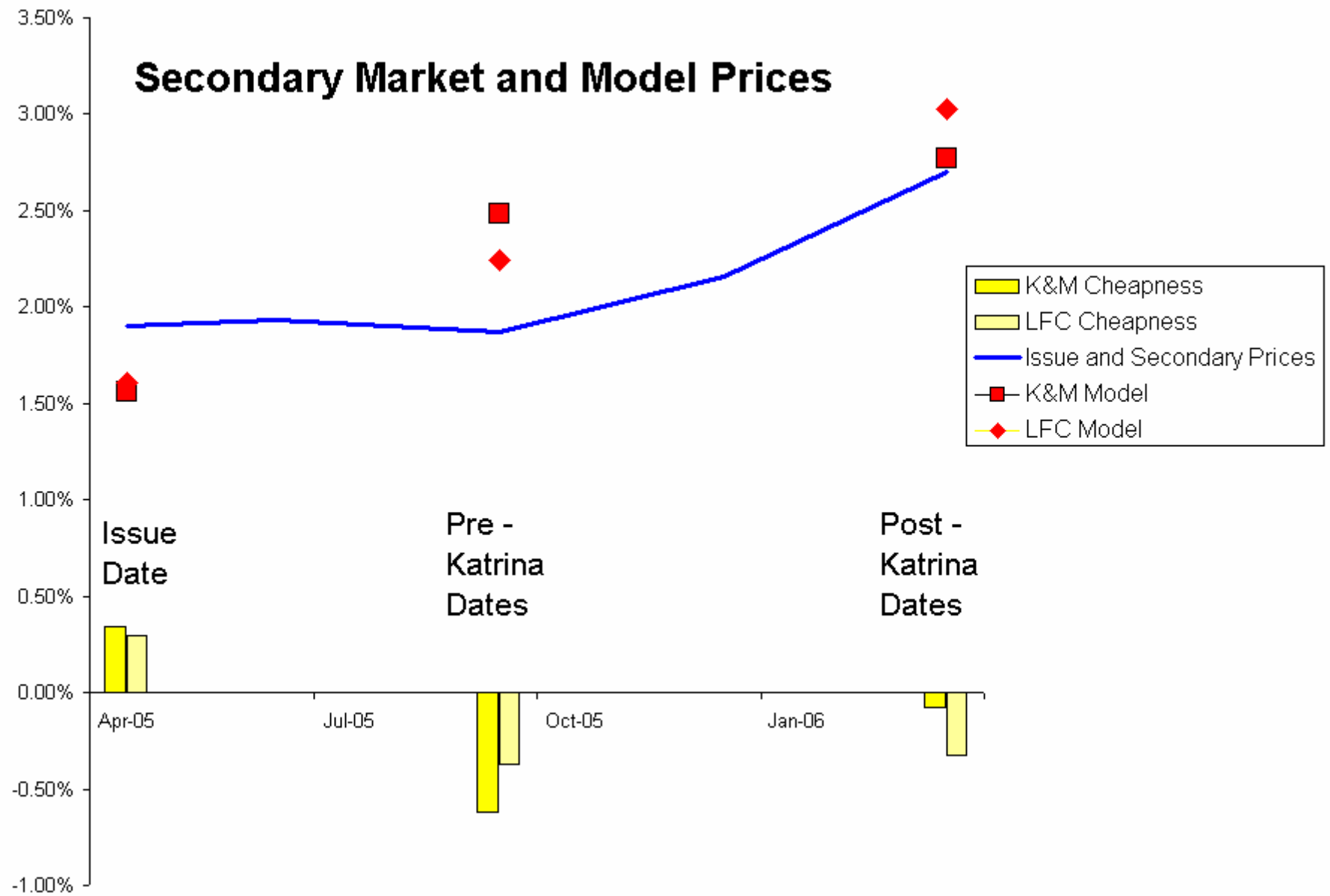
Table 1

Decomposing the components of shifting yields	Non California US Quake	Japanses Quake	European Wind	Multiperil	Life / Mortality	Residential Re	Avalon
Reason for higher yields (lower prices)							
Cost of Risk Capital	50%	50%	50%	50%	50%	50%	50%
Shifting future EC			10%	20%	20%	30%	30%
Erosion of Deductible							100%
Estimate of possible loss						10%	
Current estimate of known loss							
Execution of a contingency							
Seasonality							
Offsets							
Diversification Credit	-60%	-40%	-40%		-40%		
Structural Features e.g. risk re-sets						-30%	
	-10%	10%	20%	70%	30%	60%	180%
Actual % change in yield by group	-5%	10%	18%	15%	32%	49%	183%



Rising Yields for Vita II Mortality Bonds +40%

Secondary Market and Model Prices



Where the correlations lie. Each distribution (peril) is independently generated. Deals pick up correlations from scenarios	Independent Distributions (or perils) from which scenarios are generated						
	Credit	Alternative	US Wind	Euro Wind	US Quake	Japan Quake	Mortality
Credit-Portfolio	◆						
Alternative-Portfolio		◆					
Kamp-Re			◆		◆		
Palm			◆				
Oak				◆			
Sequoia					◆		
Sakura						◆	
Arbor-I			◆	◆	◆	◆	
Vita-IID							◆
Vita-IIC							◆
Vita-IIB							◆

SOLUTION SUMMARY

CASE	1	2	2A	3	4
Assumptions					
Risk Capital	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000
Borrowing Possible	NO	YES	YES	YES	YES
Borrowing Cost	-	0%	0%	0.25%	0.25%
Solutions					
Credit-Portfolio		\$15,995	\$250	\$13,710	\$33,816
Alternative-Portfolio		\$500	\$250	\$500	\$500
Kamp-Re	\$250	\$250	\$250	\$239	\$250
Palm	\$250	\$208	\$250	\$168	\$250
Oak	\$12	\$250	\$250	\$250	\$250
Sequoia	\$46	\$250	\$250	\$250	\$250
Sakura	\$43	\$250	\$250	\$250	\$250
Arbor-I	\$149		\$25		\$250
Vita-IID	\$250	\$250	\$250	\$250	\$250
Vita-IIC		\$250	\$250	\$250	\$250
Vita-IIB		\$250	\$250	\$250	\$250
Total Investment	\$1,000	\$18,453	\$2,525	\$16,117	\$36,566
Debt	\$0	\$17,453	\$1,525	\$15,117	\$35,566
Interest		\$0	\$0	\$38	\$89
CVar Constraints					
4%	-25%	-25%	-25%	-25%	-
1%	-100%	-100%	-100%	-100%	-100%
0.40%	-125%	-125%	-125%	-125%	-125%

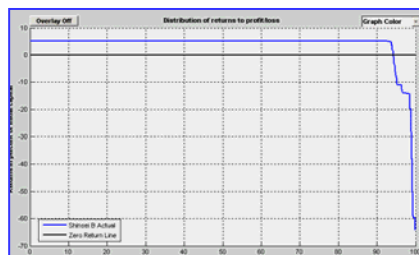
Investable Limits (equal to \$39,500 for credit, \$500 for alternative and \$250 each ILS)

except Case 2A when all equal

RoE
 3.70%
 Marginal RoE
 1.69%
 Marginal RoCash
 8.56%

COMMENTS:

- Diversification
- Trade-off – Arbor I
- Relative value
- Binding CVar 4%
- Leverage zero

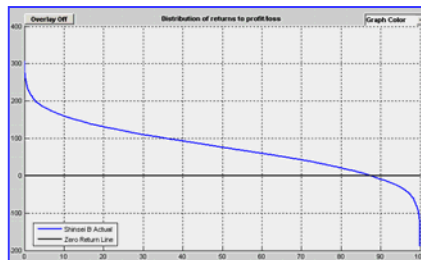


Case I Solution	Purchased (Mil)	Maximum Allowable Purchase (Mil)	A Priori Expected Return	Risk Adjusted Expected Return
Credit-Portfolio			2.27%	0.62%
Alternative-Portfolio			2.52%	0.89%
Kamp-Re	\$250	250	3.87%	0.55%
Palm	\$250	250	3.78%	0.31%
Oak	\$12	250	2.24%	
Sequoia	\$46	250	3.28%	
Sakura	\$43	250	3.21%	
Arbor-I	\$149	250	7.07%	
Vita-IID	\$250	250	1.69%	0.01%
Vita-IIC		250	1.33%	-0.38%
Vita-IIB		250	0.90%	-0.84%
Total Investment	\$1,000	Solution	4.00%	Var
Debt	\$0		1.00%	-38.01%
Interest	\$0		0.40%	-59.74%
				Cvar
				-25.00%
				-55.15%
				-59.94%

RoE
 75.82%
 Marginal RoE
 68.46%
 Marginal RoCash
 68.89%

COMMENTS:

- Credit marginal
- Plenty of Risk to do all
- Relative value-alt.
- Binding CVaR 1%
- Leverage 35.5 :1



Case 4 Solution	Purchased (Mil)	Maximum Allowable Purchase (Mil)	A Priori Expected Return	Risk Adjusted Expected Return	
Credit-Portfolio	\$33,816	39500	2.27%		
Alternative-Portfolio	\$500	500	2.52%	3.80%	
Kamp-Re	\$250	250	3.87%	3.65%	
Palm	\$250	250	3.78%	2.02%	
Oak	\$250	250	2.24%	1.33%	
Sequoia	\$250	250	3.28%	1.15%	
Sakura	\$250	250	3.21%	4.50%	
Arbor-I	\$250	250	7.07%	2.16%	
Vita-IID	\$250	250	1.69%	2.43%	
Vita-IIC	\$250	250	1.33%	1.82%	
Vita-IIB	\$250	250	0.90%	1.09%	
Total Investment	\$36,566		Solution	Var	Cvar
Debt	\$35,566		1.00%	-79.81%	-100.00%
Interest	\$89		0.40%	-97.89%	-118.15%

Other Life Activity

Longevity Bonds

- **Is this a hedge for life insurers?**
- **Prices so far inadequate**

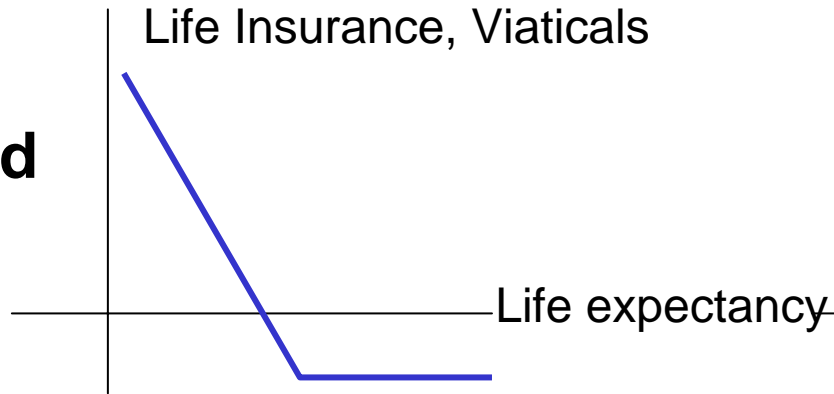
Life Settlements

- **So far not securitized in tradable instruments**

Mortality Premature Death

Life Insurance, Viaticals

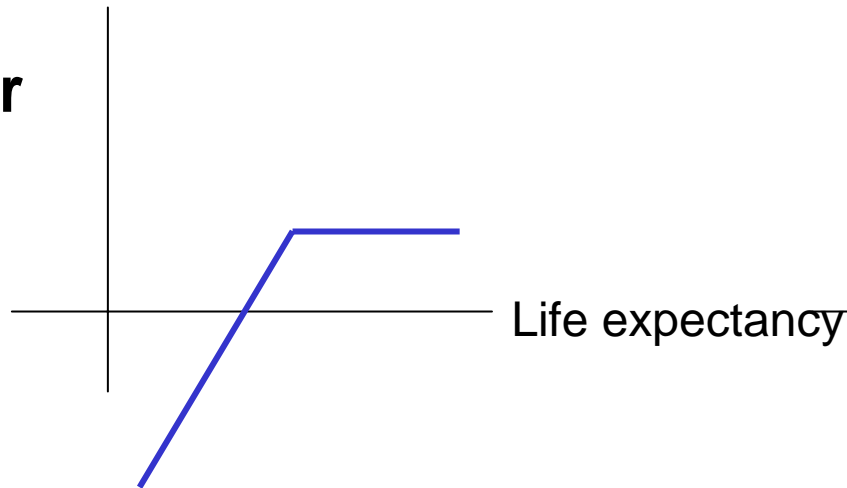
Insured



Longevity Postponed Death

Annuities, Pensions

Insurer



END