The Actuarial Profession
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Capital Tranching: A RAROC Approach to Assessing Reinsurance Cost Effectiveness

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Evaluating Reinsurance Cost Effectiveness

- Using the **Industry Standard Approach (ISA)**, we would
  - Use an internal capital model to…
  - Estimate the change in a whole company required capital metric (e.g., 200-yr VaR of Net Income)…
  - Gross versus Net…
  - And call that change **"Capital Released"**
- We multiply Capital Released by some **"Cost of Capital Rate"**
- The product is the **Capital Cost Savings**
- We compare that with the **Ceded Profit Margin** = Ceded Premium – Expenses – Expected Recovery
- Buy reinsurance with **Ceded Profit Margin < Capital Cost Savings**

Key Point #1

- ISA is an example of ***R***eturn ***O***n ***R***isk-***A***djusted ***C***apital or RORAC approach
  - Risk-adjusts the capital with a constant Capital Cost Rate

Comparability with Insurer Capital Management Realities

- ISA required capital is purely theoretical
- No form is assumed—e.g., debt, common stock, preferred stock, surplus note, etc.
- The RORAC "Capital Released" framework suggests a liquid, back-and-forth relationship with the capital providers
- Far from the realities of insurer capital management

Supporting arguments to consider insurer capital **essentially fixed** on an annual basis:

- Insurance companies typically plan one underwriting (or policy) year at a time
- Capital = Assets – Liabilities
  - Most insurers only "value reserves" annually (full reserve review)
- Rating agencies are often a binding constraint for held capital, and their required capital models are only run on an annual basis;
- Mutuals (and reciprocals) have limited means to release or raise capital.

Key Point #2

- RORAC risk-adjusts the capital with a constant Capital Cost Rate
- RAROC risk-adjusts the Capital Cost Rate with fixed capital
- Since insurer capital management realities are more comparable with fixed capital, we can also develop a RAROC approach to assessing reinsurance cost effectiveness

Implications of Using the ISA (1/2)

- Evaluating the benefit of $100MM of high-layer catastrophe coverage. The capital modeling team:
  - uses TVaR99 of earnings for its required capital metric;
  - has run 100,000 trials of its capital model, meaning its TVaR99 uses the 1,000 worst trials as ranked by earnings (call these the “tail scenarios”);
  - Half the tail scenarios have full limit cat recoveries of $100MM, and the other half have no recovery
- Capital savings = $50MM
  - less than $1-for-$1 correspondence with the limit.
- Reasonable assumption of Ceded Profit Margin = $5MM or 5% “on line”
- In order for the cover to make sense under ISA, the Capital Cost Rate would have to be more than $5MM / $50MM or 10%.

Implications of Using the ISA (2/2)

- ISA will not support purchasing any layer with either a higher Ceded Profit Margin on line or less Capital Released.
- Higher rates on line are generally associated with lower attachment points.
- Lower Capital Release are a function of the correlation between the reinsured lines of business and the modeled tail scenarios.
- Generally speaking, the more specific the reinsurance (e.g., individual business units or lines of business), the lower the Capital Released as a Percent of Limit
- General conclusion: ISA will favor high-layer corporate catastrophe covers
  - Supported by observed application of the ISA in the marketplace

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Simple ISA Example: *Single-Event Collateralized Sidecar Reinsurer*

- Providing single-occurrence catastrophe protection
- Assume no reserve or investment risk, and ignore accounting.

→ Sidecar's catastrophe OEP is the Underwriting Loss distribution

→ What we call **Capital Consumption**

→ For simplicity, assume five possible cat events, A through E

Table 1 -- Capital Consumption Distribution

Event	*Prob*	*Cum Prob*	*Capital Consumed*
None	95.0%	95.0%	0
A	1.0%	96.0%	100
B	1.0%	97.0%	200
C	1.0%	98.0%	300
D	1.0%	99.0%	400
E	1.0%	100.0%	500

Event E is the VaR99 or 100-Year PML

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ISA Example: *Net of Five Different Inuring Cat Layers*

Cat Layers 1 – 5 are $100MM limit attaching every $100MM
Beginning with Layer 1 attaching at $0

Table 2 -- Capital Consumption Distribution Gross and Net of Cat Layers

Event	*Gross*	*Net of Layer 1*	*Net of Layer 2*	*Net of Layer 3*	*Net of Layer 4*	*Net of Layer 5*
None	0	0	0	0	0	0
A	100	0	**100**	**100**	**100**	**100**
B	200	100	100	**200**	**200**	**200**
C	300	200	200	200	**300**	**300**
D	400	300	300	300	300	**400**
E	500	400	400	400	400	400
			Shaded Cells have Net = Gross			

The tail measure "VaR 99" is 400 under every option
Thus the ISA cannot distinguish among the five cat layers
It is "blind" to Layer Position – a serious weakness

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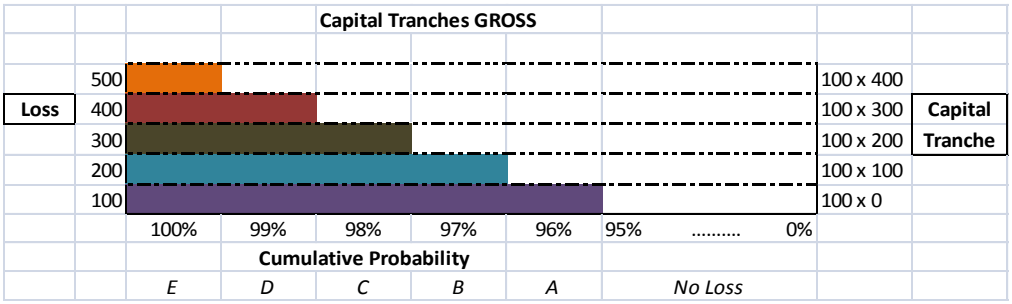
Sidecar Example – Tetris Slides



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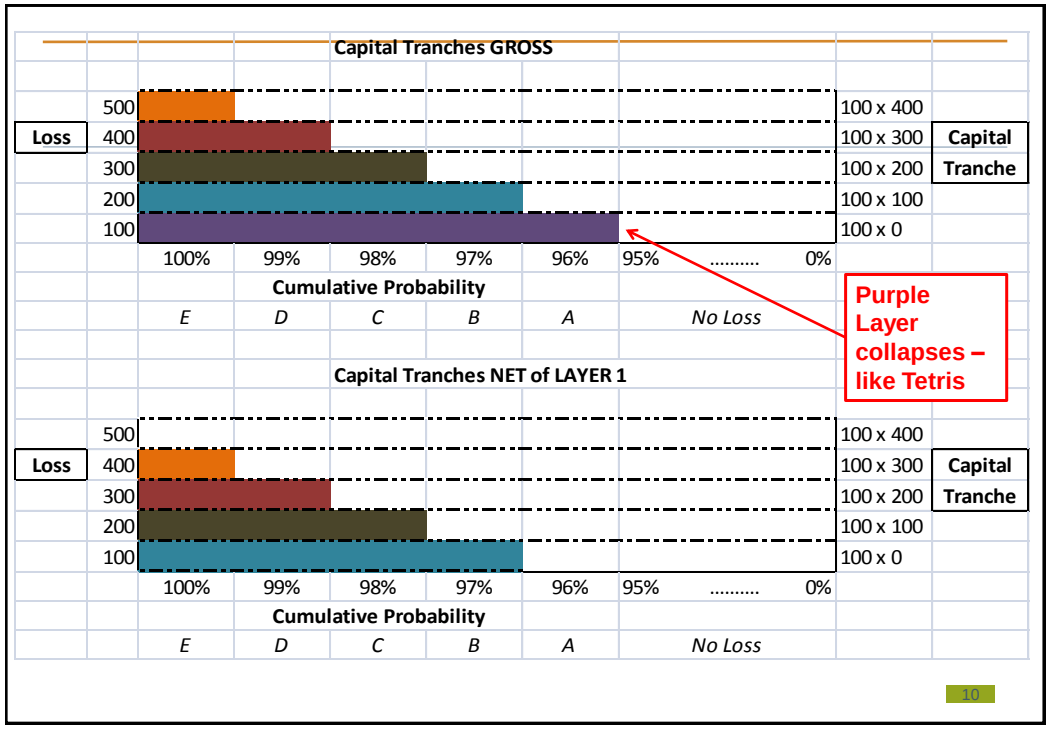
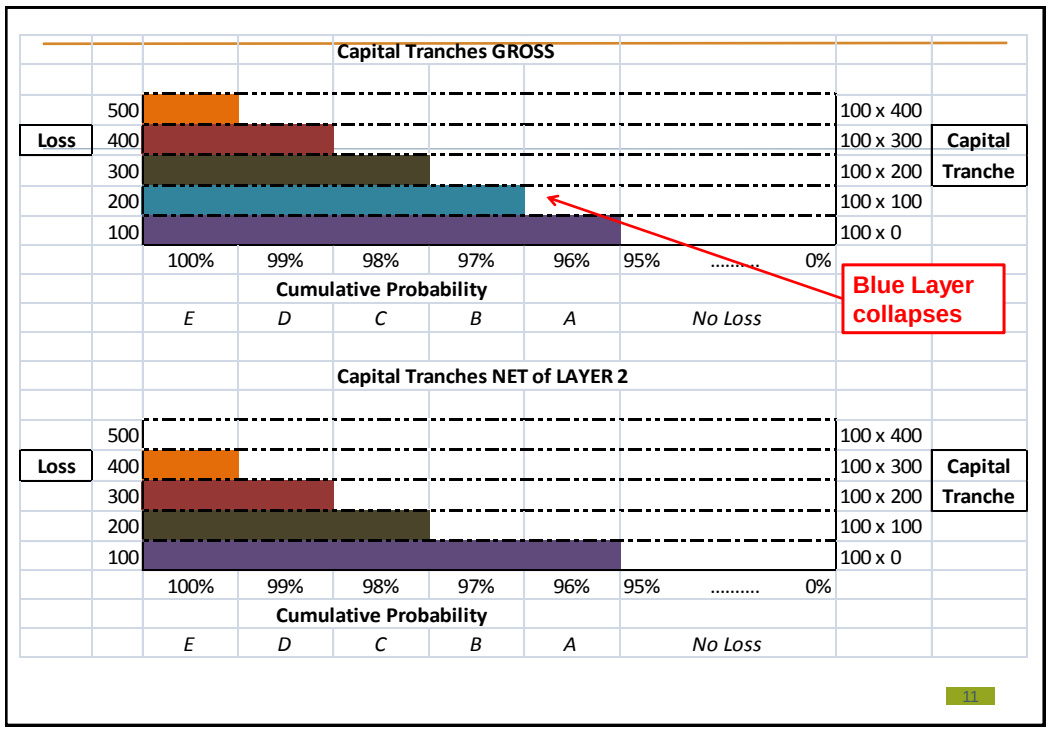
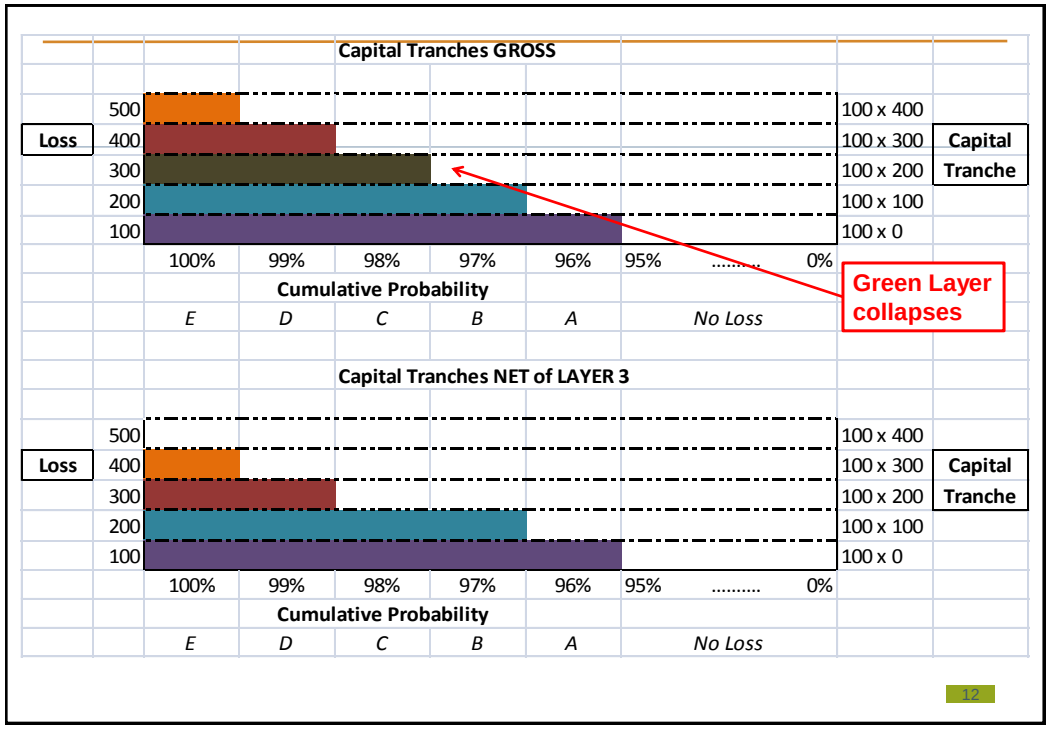
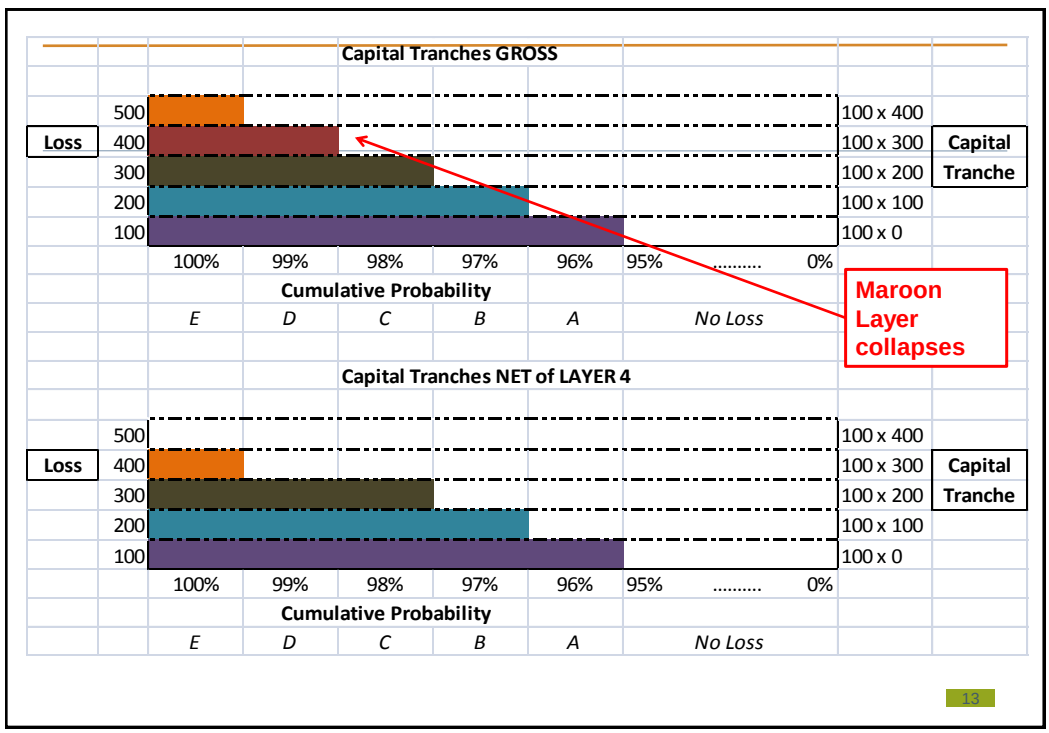
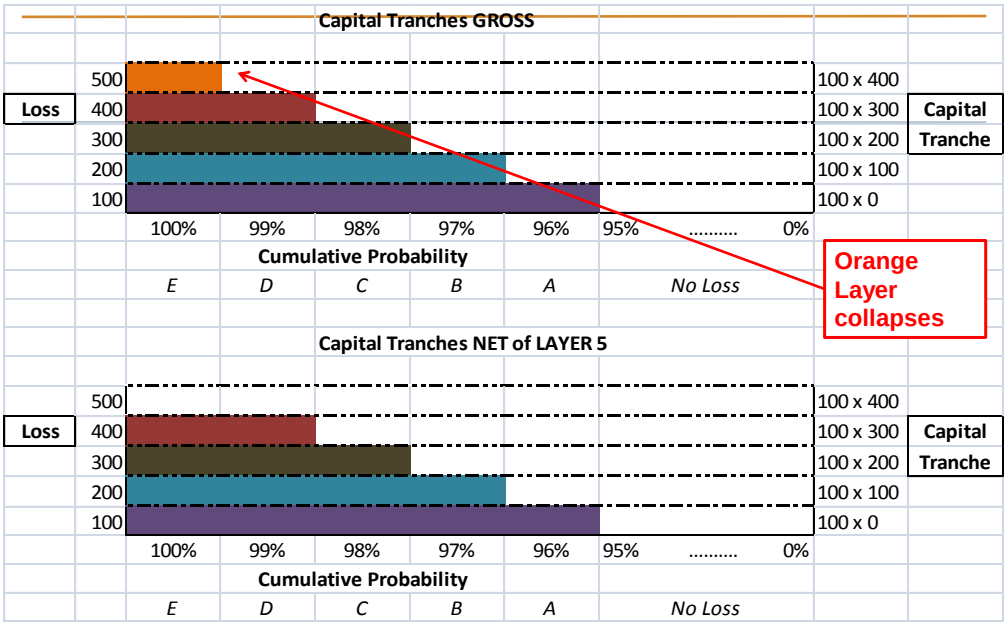

Capital Tranches GROSS
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
Purple Layer collapses – like Tetris
Capital Tranches NET of LAYER 1
10


Capital Tranches GROSS
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
Blue Layer collapses
Capital Tranches NET of LAYER 2
11


Capital Tranches GROSS
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
Green Layer collapses
Capital Tranches NET of LAYER 3
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
12


Capital Tranches GROSS
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
Maroon Layer collapses
Capital Tranches NET of LAYER 4
Loss
500
400
300
200
100
100 x 400
100 x 300
100 x 200
100 x 100
100 x 0
Capital Tranche
100%
99%
98%
97%
96%
95%
.....
0%
Cumulative Probability
E
D
C
B
A
No Loss
13



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Cost of Capital = Rate x Amount

- ISA is an example of ***R***eturn ***O***n ***R***isk-***A***djusted ***C***apital or RORAC approach
  - Risk-adjusts the capital with a constant Capital Cost Rate
- We can also ***R***isk-***A***djust ***R***eturn ***O***n ***C***apital or RAROC
  - RAROC risk-adjusts the Capital Cost **Rate** with fixed capital
- We will do that by
  - Treating capital like an **Earnings Stop Loss (ESL)**
  - Everything inures to the ESL's benefit
  - ESL Limit = Company's Capital
  - Layering the ESL (Capital markets call this "**tranching**")
  - Pricing the ESL Layers Gross and Net of program options
  - The difference in the price of the ESL is the Capital Cost Savings

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Back to the Example

- Assume each layer is binary – either no loss or full limit loss – which means
  - Loss on Line = P(Attaching)
  - Std Dev = Sqrt[P(Att) * (1-P(Att))]
  - Rate on Line = LoL + Std Dev * Reluctance *{Kreps 1990}*

Table 3 -- Capital Tranche Pricing						
	ESL Layers					
	1	2	3	4	5	**TOTAL**
Att	0	100	200	300	400	
Lim	100	100	100	100	100	500
P(Att)	5.00%	4.00%	3.00%	2.00%	1.00%	
Loss on Line	5.00%	4.00%	3.00%	2.00%	1.00%	
Std Dev = SQRT(P*(1-P))	21.79%	19.60%	17.06%	14.00%	9.95%	
Reluctance Factor	42.48%	42.48%	42.48%	42.48%	42.48%	42.48%
Price	$ 14.26	$ 12.32	$ 10.25	$ 7.95	$ 5.23	$ 50.00
ROL	14.26%	12.32%	10.25%	7.95%	5.23%	10.00%

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Example Gross Case

- TOTAL column = RAROC = Cost of (Reinsurance) Capital
- Set Reluctance to produce overall ROL of 10%

Table 3 -- Capital Tranche Pricing						
	ESL Layers					
	1	2	3	4	5	**TOTAL**
Att	0	100	200	300	400	
Lim	100	100	100	100	100	500
P(Att)	5.00%	4.00%	3.00%	2.00%	1.00%	
Loss on Line	5.00%	4.00%	3.00%	2.00%	1.00%	
Std Dev = SQRT(P*(1-P))	21.79%	19.60%	17.06%	14.00%	9.95%	
Reluctance Factor	42.48%	42.48%	42.48%	42.48%	42.48%	42.48%
Price	$ 14.26	$ 12.32	$ 10.25	$ 7.95	$ 5.23	$ 50.00
ROL	14.26%	12.32%	10.25%	7.95%	5.23%	10.00%

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Example Net of Cat Layer 1

- ESL 5 has P(Att) = 0 → ROL = 0
- Cat Layer 1 **replaced** ESL 1
- ESL {1 – 4} Net = {2 – 5} Gross

- ESL 1 cost $14.26MM
- $50MM – $14.26MM = $35.74MM

Table 4 -- Capital Tranche Pricing Net of Cat Layer 1						
	ESL Layers					
	1	2	3	4	5	**TOTAL**
Att	0	100	200	300	400	
Lim	100	100	100	100	100	500
P(Att)	4.00%	3.00%	2.00%	1.00%	0.00%	
Loss on Line	4.00%	3.00%	2.00%	1.00%	0.00%	
Std Dev = SQRT(P*(1-P))	19.60%	17.06%	14.00%	9.95%	0.00%	
Reluctance Factor	42.48%	42.48%	42.48%	42.48%	42.48%	
Price	$ 12.32	$ 10.25	$ 7.95	$ 5.23	$ -	$ 35.74
ROL	12.32%	10.25%	7.95%	5.23%	**0.00%**	7.15%

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Summary of All Five Cat Layers

- ISA measured identical capital impact of Cat Layers 1 – 5

- Capital Tranching clearly distinguishes among the different Cat Layers

Table 6 -- Capital Tranching Evaluation of Cat Layers 1 to 5								
	ESL Layers						*Evaluation*	
	1	2	3	4	5	**TOTAL**	**Capital Cost Savings**	**Price**
Gross	14.26%	12.32%	10.25%	7.95%	5.23%	10.00%		
Net of Cat Layer 1	12.32%	10.25%	7.95%	5.23%	0.00%	7.15%	$ 14.26	$ 14.26
Net of Cat Layer 2	14.26%	10.25%	7.95%	5.23%	0.00%	7.54%	$ 12.32	$ 12.32
Net of Cat Layer 3	14.26%	12.32%	7.95%	5.23%	0.00%	7.95%	$ 10.25	$ 10.25
Net of Cat Layer 4	14.26%	12.32%	10.25%	5.23%	0.00%	8.41%	$ 7.95	$ 7.95
Net of Cat Layer 5	14.26%	12.32%	10.25%	7.95%	0.00%	8.95%	$ 5.23	$ 5.23

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Summary of All Five Cat Layers

- Capital Cost Savings = Price because we priced both the Cat Layers and ESL's with the same Reluctance
- If Reinsurer capital is cheaper, Reluctance is lower, Price is lower, Cat Layers look better
- Or vice-versa for more expensive

Table 6 -- Capital Tranching Evaluation of Cat Layers 1 to 5

	ESL Layers						*Evaluation*	
	1	2	3	4	5	TOTAL	Capital Cost Savings	Price
Gross	14.26%	12.32%	10.25%	7.95%	5.23%	10.00%		
Net of Cat Layer 1	12.32%	10.25%	7.95%	5.23%	0.00%	7.15%	$ 14.26	$ 14.26
Net of Cat Layer 2	14.26%	10.25%	7.95%	5.23%	0.00%	7.54%	$ 12.32	$ 12.32
Net of Cat Layer 3	14.26%	12.32%	7.95%	5.23%	0.00%	7.95%	$ 10.25	$ 10.25
Net of Cat Layer 4	14.26%	12.32%	10.25%	5.23%	0.00%	8.41%	$ 7.95	$ 7.95
Net of Cat Layer 5	14.26%	12.32%	10.25%	7.95%	0.00%	8.95%	$ 5.23	$ 5.23

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Conclusions

Table 7 -- Comparing ISA and Capital Tranching Approaches to Evaluating Reinsurance Effectiveness

Item	***ISA***	***Capital Tranching***
Input Distribution	Gross and Net Capital Consumption distribution from Internal Capital Model	
Required Capital Amount	**Variable (risk-adjusted)**	**Fixed**
Capital Released	**Change in Required Capital**	N/A
Cost of Capital Rate	Fixed	**Variable (risk-adjusted)**
Capital Cost Savings	Product of Capital Release and Cost of Capital Rate	Product of Capital Amount and Change in Cost of Capital Rate
Cost-Effectiveness Evaluation	Ceded Profit Margin < Capital Cost Savings	

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Questions or comments?

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