Economic Scenario Generator and Investment Strategy in a Low Interest Rate World

Presented by

Edward Yao, FCAS, CFA, CERA
Vice President, Risk & Capital Management Solutions

Agenda

- Economic Scenario Generator
- Current Interest Rate Environment and Impact on P&C Insurance Industry
- Investment Strategy for A Sample P&C Insurer
- Q & A

What is an Economic Scenario Generator (ESG)

- A stochastic model in most cases
  - Can be deterministic, but application would be very limited
  - Randomness: Uncertainty in the future
  - A system of stochastic difference/differential equations
- A Monte-Carlo simulator
  - "*Monte Carlo methods (or Monte Carlo experiments) are a broad class of **computational algorithms** that rely on **repeated random sampling** to obtain **numerical results**; i.e., by running simulations many times over in order to calculate those same probabilities heuristically just like actually playing and recording your results in a real casino situation: hence the name.*"
    -- *Wikipedia*
- A generator of future distributions of different economic variables
- A generator of time-series of economic variables
- Not a tool to make forecasts

Purposes of ESG

Why do we need a ESG?

- Business decision making under uncertainty
- Demand of better risk management from regulators and rating agencies
  - Solvency II
  - ORSA
  - S&P
  - AM Best
- Pricing/valuation of contingent cash flows

Clarification of Some Terminology

- Real world
- Initial-to-normative vs. normative-to-normative
- Risk neutral
- Market consistent valuation
- Arbitrage free

Key Features of an ESG

- Key economic variables are being modelled
- Covering a broad range of asset types
- Dynamic relationships among the variables are captured and internal consistency are maintained
- Flexibility and efficiency in calibration and parameter estimation using benchmark data
- Models can be fully validated
- Simulation can lead to unexpected/not-yet-observed but plausible outcome.

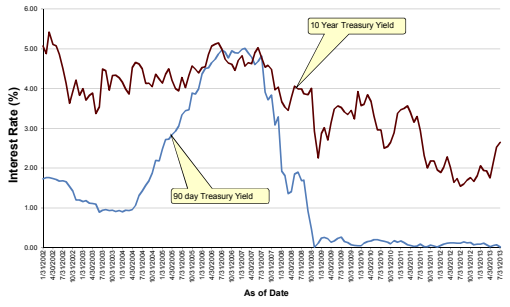
Important decisions for an ESG

- Type of scenarios
  - Real World or Risk Neutral
  - Initial-to-normative or Normative-to-normative
- Model choices
  - Interest Rate Models
  - Credit Models
  - Inflation Models
  - Equity Index Models
  - Models for additional asset classes and economic variables
- Model calibration
  - Expected level, volatility, and correlation
- Simulation properties
  - Frequency: annual, quarterly, or monthly
  - Number of periods
  - Number of paths

Calibration of A Real-World ESG

- Calibration is a process of setting the parameters so that the scenarios generated ESG satisfy certain pre-defined quantifiable characteristics.
- The goal of a real-world ESG is to generate economic and financial time series that are "realistic" and reflect the assumptions of future development of economic and financial variables:
  - Representing the observed dynamics and distributional characteristics of historical data
  - Professional forecasts / Expert opinions

Interest rate environment

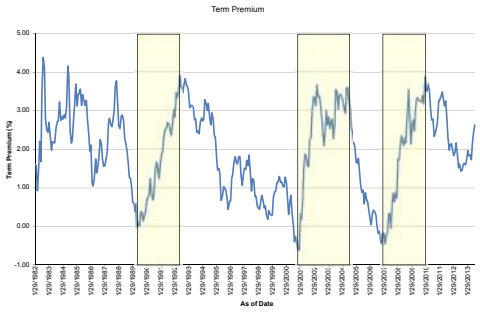


Source: Bloomberg

Interest rate environment

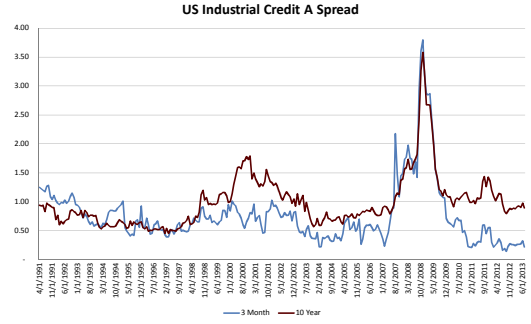
Source: Global Financial Database; Bloomberg

Interest rate environment



Source: Bloomberg

Interest rate environment



Source: Bloomberg

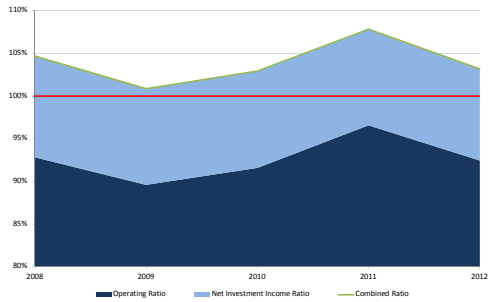
Impact on P&C Insurance Companies

Year	Net investment income earned ($'000)	Net underwriting gain (loss) ($'000)	Net Capital Gains (Losses) ($'000)	Other Income ($'000)	Net Income Before Income Tax ($'000)
2012	49,236,993	(13,438,268)	9,032,838	2,499,107	47,330,669
2011	51,369,890	(35,212,378)	7,579,382	2,415,894	26,152,788
2010	49,861,020	(8,527,901)	8,296,097	979,289	50,608,505
2009	50,918,364	1,314,557	(8,254,481)	887,556	44,865,996
2008	54,421,335	(19,506,667)	(21,222,553)	391,595	14,083,709
2007	58,063,181	22,831,900	8,994,578	(814,688)	89,074,971
2006	55,084,608	35,436,197	3,594,307	2,798,457	96,913,569
2005	51,906,655	(6,220,796)	12,119,428	1,853,805	59,659,092
2004	41,788,071	4,194,824	9,192,055	(323,164)	54,851,786
2003	41,151,925	(2,912,620)	6,518,958	(223,707)	44,534,555
2002	41,097,451	(29,368,464)	2,823,786	(730,465)	13,822,308

Source: A.M.Best.

Impact on P&C Insurance Companies

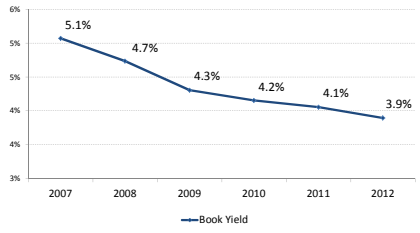
Recent History of US P&C industry's Combined and Operating Ratios



Source: A.M.Best, Conning analytics.

Impact on P&C Insurance Companies

US Property-Casualty Insurance Industry Historical Book Yield Rates



Note: Calculations based on net investment income divided by net investable assets.
Source: A.M.Best, Conning analytics.

How to respond strategically?

Asset Allocation

	2007	2008	2009	2010	2011	2012	Trend
Net Cash	2.1%	2.1%	1.1%	1.8%	1.4%	2.1%	
AAA-A Bonds	76.8%	78.3%	77.6%	75.9%	74.6%	71.9%	
BBB Bonds	4.9%	7.0%	8.0%	8.2%	9.3%	10.7%	
High Yield Bonds	1.7%	1.6%	1.8%	2.2%	2.3%	2.6%	
Common Stock	8.1%	5.0%	5.9%	6.4%	6.4%	7.1%	
Schedule BA	3.5%	3.4%	3.3%	3.4%	3.8%	3.6%	
Investment Real Estate	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	
Other*	2.8%	2.4%	2.1%	2.0%	1.9%	1.9%	

Bond Sector Allocation

	2007	2008	2009	2010	2011	2012	Trend
US Govt	12.7%	12.4%	13.8%	13.6%	13.2%	10.6%	
Corp	23.2%	24.6%	26.9%	29.6%	31.0%	32.9%	
Agency / Muni	40.3%	40.7%	37.4%	35.3%	32.5%	33.7%	
Hybrid	0.0%	0.0%	0.4%	0.6%	0.8%	0.2%	
Other Govt	1.3%	1.0%	1.5%	1.9%	2.3%	2.3%	
Parents / Subs / Affiliates	0.9%	0.9%	0.8%	0.9%	0.8%	0.8%	
Structured Securities	21.6%	20.2%	19.1%	18.2%	19.8%	19.5%	

Bond Market Allocation

	2007	2008	2009	2010	2011	2012	Trend
Publically-traded Bonds	96.4%	96.1%	95.0%	93.7%	92.2%	90.6%	
Private Placement Bonds	3.6%	3.9%	5.0%	6.3%	7.8%	9.4%	

Source: A.M.Best; Conning analytics.

How to respond strategically?

Quality Distribution

	2007	2008	2009	2010	2011	2012	Trend
NAIC 1	92.2%	90.1%	88.8%	87.9%	86.5%	84.4%	
NAIC 2	5.9%	8.1%	9.2%	9.5%	10.8%	12.6%	
NAIC 3	1.0%	0.9%	1.1%	1.3%	1.4%	1.5%	
NAIC 4	0.7%	0.5%	0.6%	0.8%	0.9%	1.1%	
NAIC 5	0.2%	0.3%	0.2%	0.3%	0.2%	0.2%	
NAIC 6	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	
Avg.	1.1	1.1	1.1	1.2	1.2	1.2	

	2007	2008	2009	2010	2011	2012	Trend
Investment Grade	98.0%	98.1%	97.9%	97.5%	97.3%	97.0%	
Below Investment Grade	2.0%	1.9%	2.1%	2.5%	2.7%	3.0%	

Maturity Distribution

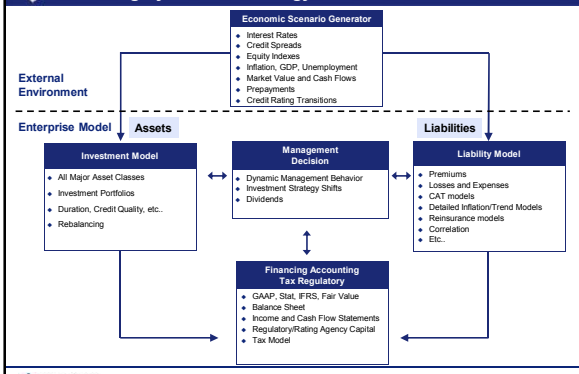
	2007	2008	2009	2010	2011	2012	Trend
<=1 Yr	14.1%	15.6%	15.2%	15.0%	14.2%	15.5%	
1-5 Yrs	30.7%	32.8%	36.9%	40.3%	41.9%	41.3%	
5-10 Yrs	33.0%	29.9%	28.0%	26.5%	26.4%	26.7%	
10-20 Yrs	13.4%	13.2%	12.1%	11.4%	10.7%	10.1%	
>20 Yrs	8.8%	8.6%	7.7%	6.8%	6.9%	6.5%	
Avg.	7.7	7.4	7.0	6.7	6.6	6.4	

Source: A.M.Best; Conning analytics.

How to respond strategically?

- Investment strategy: shorten duration, search for additional yield, buy floating rate assets, use derivatives
- Underwriting strategy: write less long tailed lines, be more selective in risks underwritten, change product features (for life insurers with interest sensitive liabilities)
- Management needs to evaluate a wide range of options in a consistent framework
- The evaluation needs to consider both asset and liabilities, both risk and reward, and a wide range of possibilities

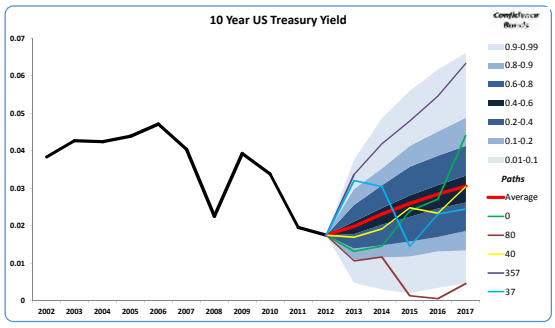
Modelling system for strategy evaluation



Investment Strategies: An Example of A Long Tailed P&C Insurer

- Some key long-term economic and capital market assumptions:
  - US Inflation: 2.5%
  - 3 Month US Treasury Yield: 3.25%
  - 10 Year US Treasury Yield: 4.75%
  - US Large Cap Equity Index Total Return: 8.5%
- Liability assumptions (expected loss and expense ratios and volatility, loss reserve volatility, payment patterns) based on the data of AM Best Workers Compensation Composite with reserve duration about 5 years.
- The future business development assumptions use Conning Research & Publication's forecasts for Workers' Compensation line of insurance.
- The projection horizon is five year.

Simulated Distributions of Economic Variables: Example



Source: Bloomberg, Conning GEMS® model simulation.

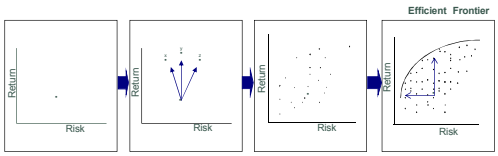
Simulated Asset Class Returns: Example

	Cash Equivalent	US 5 to 7 Year Govt Bond	US 5 to 7 Year Corp Bond	US 5 to 7 Year TE Muni Bond	US Intermediate HY	US Large Cap Equity	Private Equity
Cash Equivalent	1.000						
US 5 to 7 Year Govt Bond	0.017	1.000					
US 5 to 7 Year Corp Bond	0.011	0.927	1.000				
US 5 to 7 Year TE Muni Bond	0.024	0.980	0.909	1.000			
US Intermediate HY	(0.008)	0.549	0.612	0.538	1.000		
US Large Cap Equity	0.085	0.012	0.104	0.037	0.365	1.000	
Private Equity	(0.097)	(0.008)	0.036	(0.009)	0.173	0.478	1.000

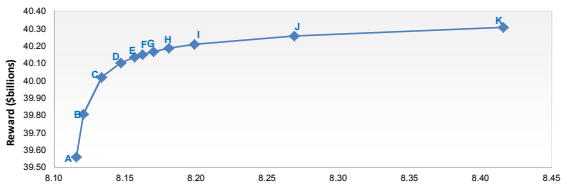
Source: Conning GEMS® model simulation.

Economic Value Efficient Frontier

- Economic Value = Market Value of Assets
  - Discounted Value of Liabilities
  + Value of future business
  - Discounted Value of Taxes
- More objective
- More consistent across entities and countries
- Other measures converge to economic value overtime



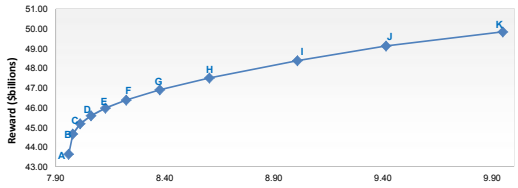
Duration: Rising Interest Rates



	A	B	C	D	E	F	G	H	I	J	K
Duration	3.5	3.5	3.6	3.7	3.7	3.8	3.9	3.9	4.2	4.6	5.4
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	56%	30%	10%	5%	3%	3%	2%	0%	0%	0%	0%
Corporate	44%	70%	90%	95%	97%	97%	98%	100%	100%	100%	100%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		50.5	16.4	6.2	3.4	2.6	2.1	1.8	1.2	0.7	0.3

Source: Conning FIRM® analysis.

Duration: Prolonged Low Interest Rates

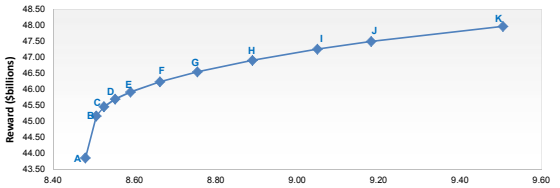


Risk ($billions)

	A	B	C	D	E	F	G	H	I	J	K
Duration	3.3	3.6	3.9	4.2	4.5	4.9	5.3	5.8	6.5	7.2	8.1
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	69%	32%	22%	16%	12%	5%	3%	3%	0%	0%	0%
Corporate	31%	68%	78%	84%	88%	95%	97%	97%	100%	100%	100%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		52.0	15.4	8.2	5.9	4.3	3.4	2.7	2.2	1.8	1.4

Source: Conning FIRM® analysis.

Duration: Normative Condition

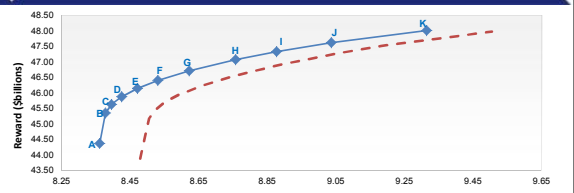


Risk ($billions)

	A	B	C	D	E	F	G	H	I	J	K
Duration	3.3	3.5	3.8	4.0	4.2	4.5	4.8	5.2	5.6	5.8	6.4
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	60%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate	40%	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		49.2	15.6	8.6	5.8	4.3	3.4	2.7	2.2	1.8	1.4

Source: Conning FIRM® analysis.

Impact of Inflation Risk

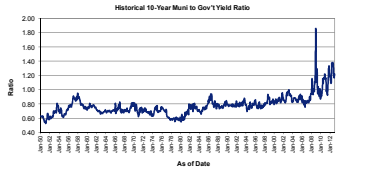


Risk ($billions)

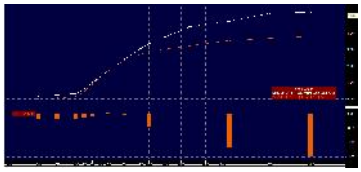
	A	B	C	D	E	F	G	H	I	J	K
Duration	3.1	3.5	3.8	4.0	4.3	4.8	5.0	5.4	5.7	6.0	6.4
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	44%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate	46%	87%	90%	90%	90%	90%	90%	90%	90%	90%	90%
TIPS	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		60.0	15.4	8.5	5.8	4.4	3.3	2.7	2.2	1.8	1.4

Source: Conning FIRM® analysis.

Tax-advantaged Municipal Bond



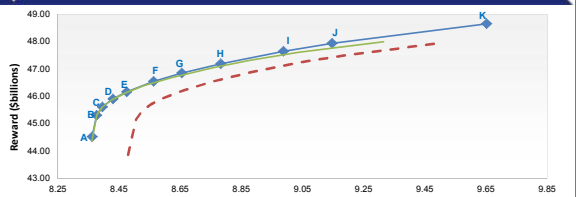
- Historically muni yields had been lower than US Treasury yields due to tax-exempt status.



- Currently muni yields are above US Treasury yields.

Source: Global Financial Database; Bloomberg.

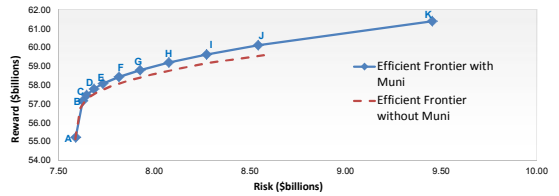
Tax-advantaged Municipal Bond



	A	B	C	D	E	F	G	H	I	J	K
Duration	3.4	3.5	3.8	4.0	4.2	4.5	4.8	5.2	5.7	6.0	6.7
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	39%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate	51%	87%	90%	87%	84%	78%	76%	74%	71%	69%	59%
Municipal	0%	0%	0%	3%	6%	12%	14%	16%	19%	21%	31%
TIPS	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		53.3	15.8	8.5	5.9	4.3	3.3	2.7	2.2	1.8	1.4

Source: Conning FIRM® analysis.

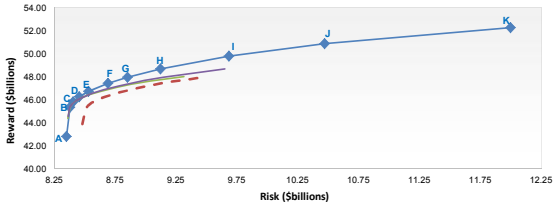
Tax-advantaged Municipal Bond – more profitable underwriting



	A	B	C	D	E	F	G	H	I	J	K
Duration	3.0	3.3	3.5	3.8	4.0	4.3	4.6	5.0	5.4	5.9	7.1
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	72%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate	13%	73%	68%	61%	57%	55%	47%	45%	40%	37%	24%
Municipal	5%	16%	22%	29%	33%	35%	43%	45%	50%	53%	66%
TIPS	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		53.7	14.9	8.5	6.0	4.3	3.3	2.7	2.2	1.8	1.4

Source: Conning FIRM® analysis.

Equity and Alternative Investments



	A	B	C	D	E	F	G	H	I	J	K
Duration	3.2	3.5	3.8	4.1	4.4	4.7	5.2	5.7	6.6	7.2	7.8
Cash	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Government	33%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Corporate	47%	87%	89%	85%	79%	70%	66%	62%	52%	38%	12%
Municipal	6%	6%	0%	3%	8%	15%	18%	20%	27%	37%	55%
TIPS	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Common Stock	0%	0%	1%	2%	3%	5%	6%	8%	11%	14%	21%
Private Equity	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	2%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
ΔReward / ΔRisk		95.7	16.5	9.0	6.1	4.4	3.3	2.6	2.0	1.4	0.9

Source: Conning FIRM® analysis.

What else to consider

- What would happen to the other key financials?
- What is the risk tolerance and what metrics to use?
- What would happen in the extreme scenarios?
- What if the key assumptions are wrong?
- Should we move to the strategic targets quickly?
- To what extend can we tolerate the investment portfolio deviating from the strategic targets?

Conclusion

- As a tool to develop strategy, an ESG is necessary but not sufficient.
- There is no one-size-fits-all solution and there is no silver bullet solution.
- Interest rate is just one risk factor and has to be considered together with other risk factors.
- For an insurance company's investment strategy, liability matters and it has to manage underwriting and investment strategies together in a coordinative fashion to perform well.
- The strategy development also needs to consider both likely and unanticipated future events.
- The key is to find the right balance of risk and reward, avoid overreaction, and diversify.

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