Session 31: Stress and Scenario Testing for ORSA, CFT, and Strategic planning – Issues to Consider

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Presenters:
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Imagination and Stress and Scenario Testing

ERM Symposium Session 31 - Stress and Scenario Testing for ORSA, CFT, and Strategic Planning: Issues to Consider
April 20, 2018
Mark E. Alberts, FSA

What is Failure of Imagination?

Failure of imagination is the expectation that current and future opportunities and risks will resemble the past.

https://simplicable.com/new/failure-of-imagination
posted by John Spacey, September 22, 2016

A failure of imagination is a circumstance wherein something seemingly predictable (particularly from hindsight) and undesirable was not planned for.

Wikipedia entry, “Failure of Imagination” accessed 03/12/2018

Not thinking it’s possible is a failure of imagination.

Vinod Khosla
Venture capitalist, founder of Sun Microsystems

ERM Enterprise Risk Management Symposium

September 11, 2001

The most important failure was one of imagination. We do not believe leaders understood the gravity of the threat. The terrorist danger from Bin Ladin and al Qaeda was not a major topic for policy debate among the public, the media, or in the Congress. Indeed, it barely came up during the 2000 presidential campaign.

The 9/11 Commission Report
Final Report of the National Commission on Terrorist Attacks Upon the United States
Executive Summary

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The Sucker’s Problem

… the Black Swan is a sucker’s problem. In other words, it occurs relative to your expectation. You realize that you can eliminate a Black Swan by science (if you’re able), or by keeping an open mind.

Nassim Nicholas Taleb
The Black Swan, p. 44

Discussion Topics

Stress scenario considerations for:

I. Interest Rates
II. Long-Term Economic Growth

Interest Rates

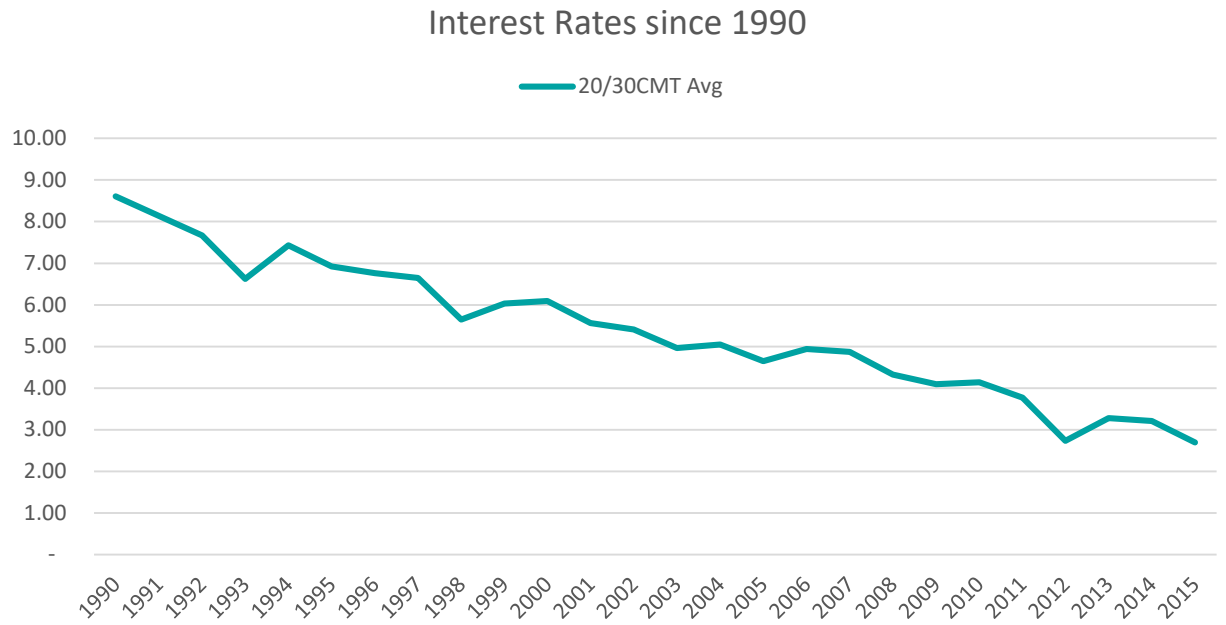
SOA Interest Rate Research

- Sustained Low Interest Rate Environment: Can it Continue? Why It Matters (Rudolph, 2014, https://www.soa.org/research-reports/2014/research-2014-sustained-low-interest/)
- Transition to a High Interest Rate Environment: Preparing for Uncertainty (Rudolph, Jorgensen, Rudolph, 2015, https://www.soa.org/research-reports/2015/research-2015-rising-interest-rate/)
- Modern Deterministic Scenarios for Interest Rates (Alberts, 2017, https://www.soa.org/research-reports/2017/2017-modern-deterministic-scenarios/)
- Negative Interest Rates and the Insurance Industry (Alberts, in process)

Modern Deterministic Scenarios for Interest Rates (MDS)

- Sponsored by Financial Reporting Section, Smaller Insurance Company Section, Committee on Life Insurance Research. Posted September 2017.
- **Primary Research Objective:** Develop a set of deterministic cash flow testing scenarios that may be considered moderately adverse in varying interest rate environments, particularly the current low rate environment
- **Secondary Research Objectives:** Provide considerations in modeling inflation, investment spreads and equity returns
- Methodology:
  - Construct historical data series
  - Empirical CTE analysis on the historical data
  - Scenario algorithms based on CTE analysis

MDS Interest Rate Source Data



Average	1990-	Source:
20/30CMT	5.39	FRB, H.15 Selected Interest Rates

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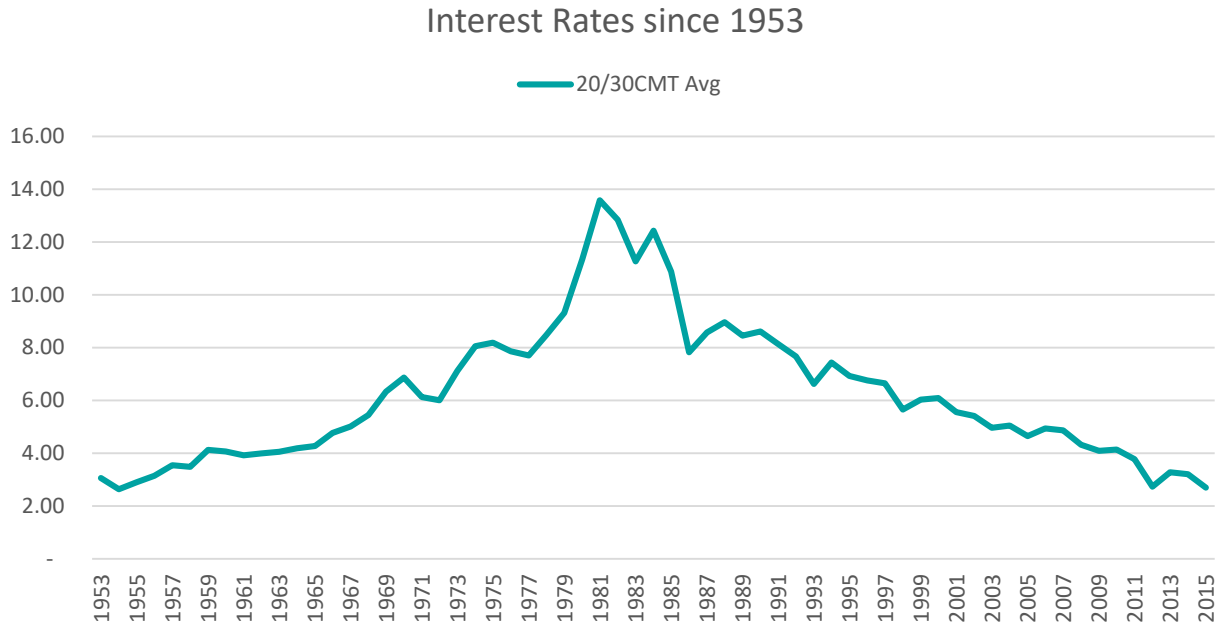
MDS Interest Rate Source Data



Average	1990-	1953-	Source:
20/30CMT	5.39	6.21	FRB, H.15 Selected Interest Rates

CMT = constant maturity Treasury rate

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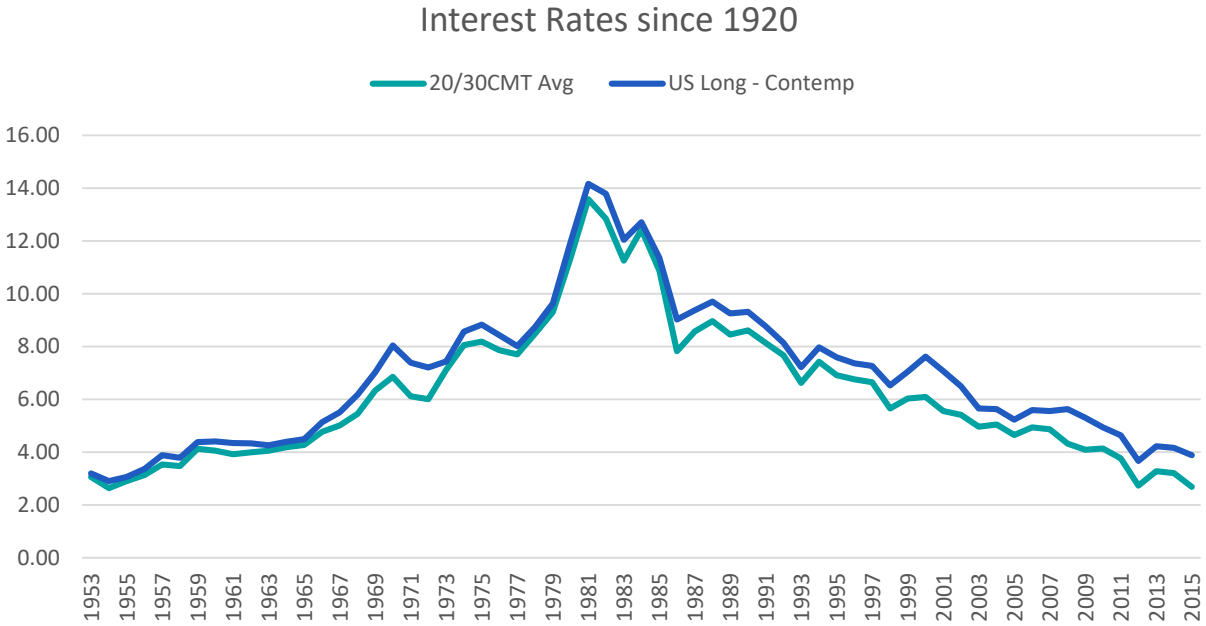
MDS Interest Rate Source Data



Average	1990-	1953-	1920-	Sources:
20/30CMT	5.39	6.21	NA	FRB, H.15 Selected Interest Rates
US Long	6.25	6.87	5.81	Measuringworth.com

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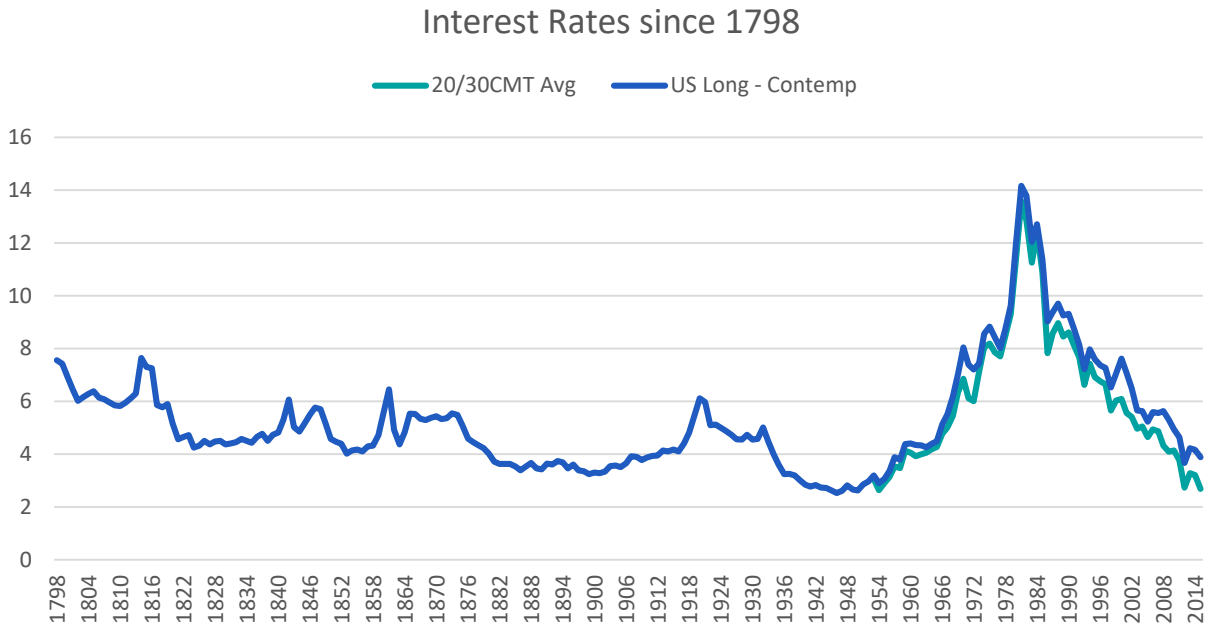
MDS Interest Rate Source Data



Average	1990-	1953-	1920-	1798+	Sources:
20/30CMT	5.39	6.21	NA	NA	FRB, H.15 Selected Interest Rates
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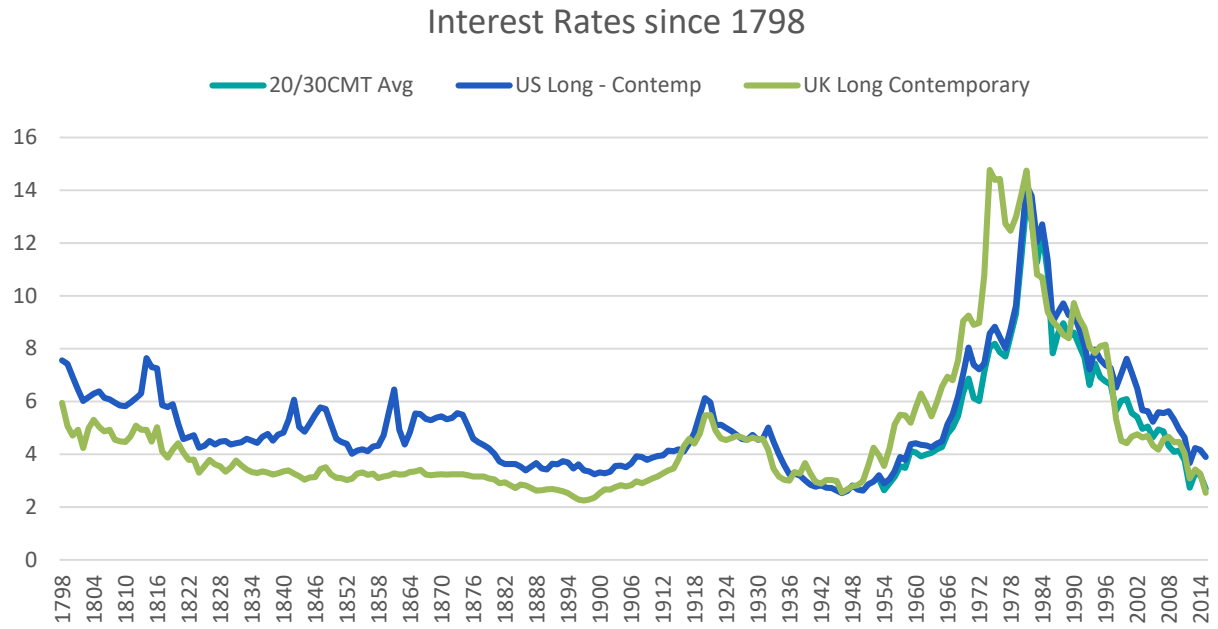

Average	1990-	1953-	1920-	1798+	Sources:
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UK Long	5.49	6.64	5.58	4.66	Measuringworth.com

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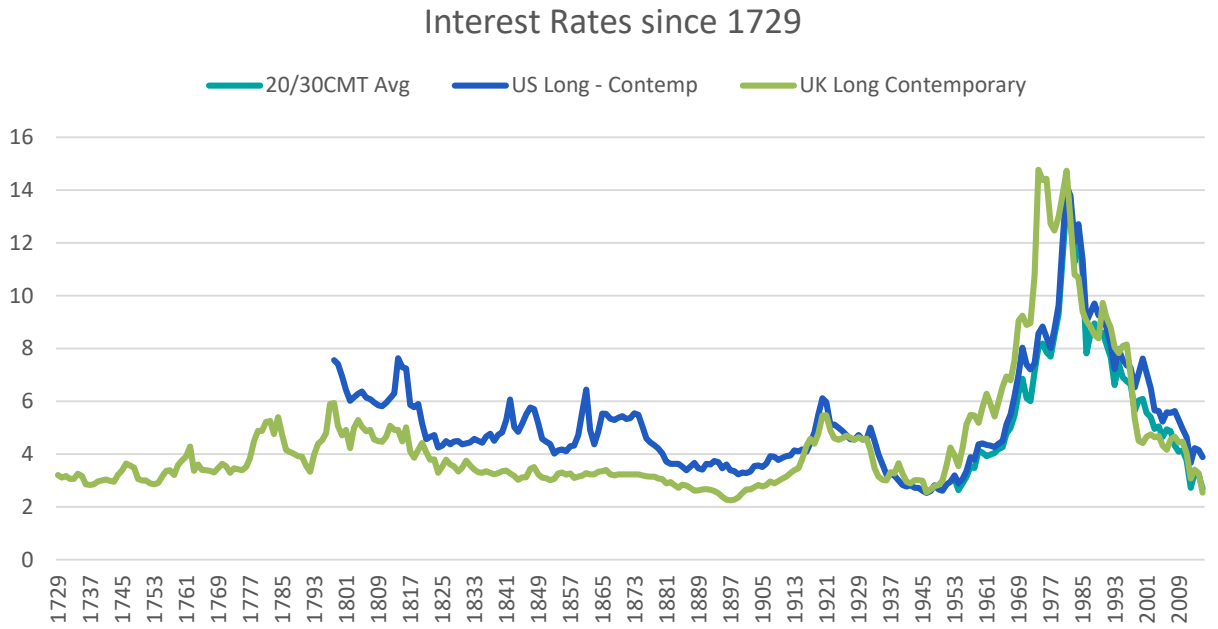
MDS Interest Rate Source Data



Average	1990-	1953-	1920-	1798+	1729+	Sources:
20/30CMT	5.39	6.21	NA	NA	NA	FRB, H.15 Selected Interest Rates
US Long	6.25	6.87	5.81	5.23	5.23	Measuringworth.com
UK Long	5.49	6.64	5.58	4.66	4.42	Measuringworth.com

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MDS Risk Management Conclusions

- Most of us have grown up since the 1970s, experiencing only rate decreases; return to higher interest rates seems normal
- In a broader historical context, the low interest rate environment of the last 10 years is not so unusual
- Although the 1980s appear to be the outlier, history shows that the worst that has happened is not the worst that can happen

Imagine – long term interest rates below 3% for generations

Negative Interest Rates and the Insurance Industry

- Sponsored by Joint Risk Management Section. In process.
- **Primary Research Objective:** Study and contrast insurance company risk management treatment of negative (nominal) interest rates in jurisdictions that have and have not experienced negative rates
- **Methodology:**
  - Review and summary of existing literature on negative interest rates
  - Series of two surveys to insurance company risk managers to assess attitudes, capabilities, and risk management treatment of negative interest rates

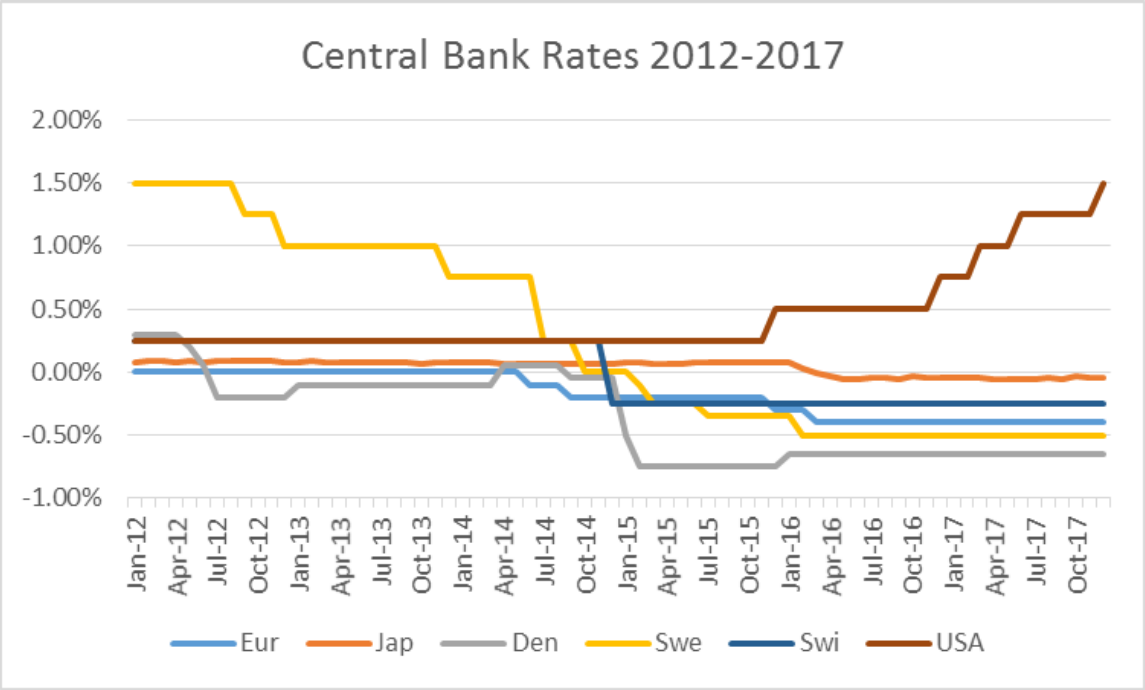
Let me know if you are interested but your company has not been contacted!

Negative Interest Rates and the Insurance Industry

Overview of Negative Interest Rate History

- Jurisdictions with negative rate policies – Denmark, Eurozone, Japan, Switzerland, Sweden
- Reasons for negative rate policies
  - Fighting deflation/stabilizing inflation
  - Currency inflation/capital inflows
  - Stimulating GDP growth
- Negative rates fairly modest in magnitude: -0.05% to -0.75%
- Negative rates correlate with long-term interest rates lower than the U.S. has experienced

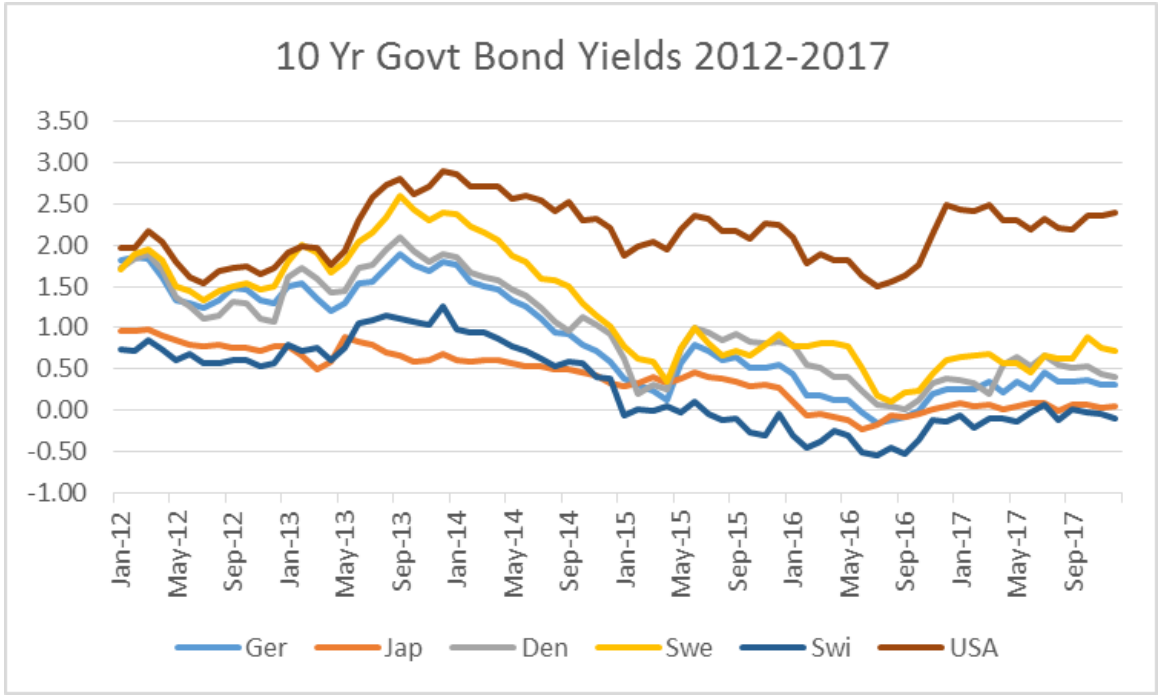
Negative Interest Rates 2012-2017



- 1/2012, all except Sweden clustered 0.00-0.50%.
- Since 1/2016, all except US clustered below 0%.

Sources: Central bank websites; https://fred.stlouisfed.org/ for USA

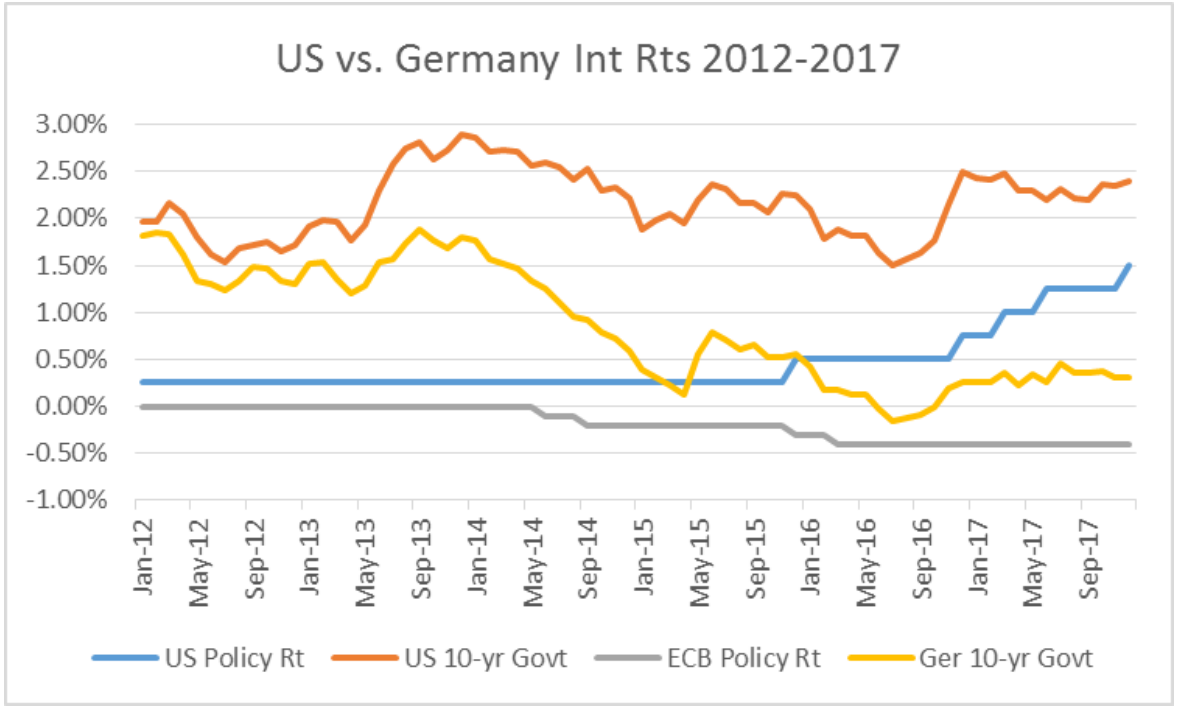
Negative Interest Rates 2012-2017



- 1/2012, all but Japan and Switzerland had 10-yr government bond yields clustered around 2%
- Since then, US rates have risen modestly
- Remaining countries have clustered between -0.50% and 1.50% since negative rate policies

Source: https://fred.stlouisfed.org/

US vs. Germany 2012-2017



- Rates comparable through mid-2013
- German 10-yr rates begin falling coincident with negative rate policy
- Spread between U.S. and German 10-yr rates increased from 100bps to 200bps since negative policy rates

Sources: European Central Banks, https://fred.stlouisfed.org/

Negative Interest Rates - Observations

Effects of Negative Interest Rate Policies

- Effectiveness has been modest according to most commentators, as have unintended consequences
- Floor of interest rates has been demonstrated to be sub-zero
  - Floor relates to cost of holding cash – thought to be above -1.00% currently
  - Policymakers might reduce the floor further by increasing costs/barriers of cash
- Long-term rates have declined dramatically
  - Yield curve has tended to flatten, with 10-year rates becoming negative in some cases
  - Little evidence of corporate spreads widening to offset
  - Cause/effect difficult to establish

Negative Interest Rates - Observations

Future of Negative Interest Rate Policies

- Lack of adverse consequences increases likelihood of future use
  - Might adverse consequences yet occur?
- Efforts by policymakers to lower the effective floor are reasonable to expect
- Adverse consequences may yet arise

Imagine – the Federal Reserve adding negative rates to its toolbox

Economic Growth

SOA Research

- Series of papers on impact of demographics on asset values and returns (Doug Andrews, lead researcher)
  - Future Equity Patterns and Baby Boomer Retirements (2015, https://www.soa.org/research-reports/2015/Future-Equity-Patterns-and-Baby-Boomer-Retirements/)
  - Investigating the Link between Population Aging and Deflation (2016, https://www.soa.org/research-reports/2016/2016-investigating-population-aging-deflating/)
  - Population Aging, Implications for Asset Values, and Impact for Pension Plans: An International Study (in process, prelim output 2018, https://www.soa.org/research-reports/2016/2016-population-aging-implications-impact/)
- The Insurance Industry and Pension System in a Low-Growth World (Alberts, Rudolph, in process)

The Insurance Industry and Pension System in a Low-Growth World

- Sponsored by SOA Research Expanding Boundaries pool. In process.
- **Primary Research Objective:** Study the potential implications of a long-term low-growth future on the insurance and pension systems and their risk management programs
- **Methodology:**
  - Review and summary of existing literature on limits to economic growth
  - Evaluate insurance company risk management implications of one or more low growth scenarios

Long Term Economic Growth

This economy isn’t just built for speed…

Long Term Economic Growth

This economy isn’t just built for speed…

It’s built for acceleration!

Economic Growth Theories

But Can Anything Accelerate Forever?

- Classical economics
  - All economies will reach a steady state – marginal ROI => 0
- Neoclassical economic growth theory
  - Per capita GDP approaches a steady state absent productivity growth
  - Productivity growth is exogenous to the model
  - Demand assumed to grow with production
- Ecological economics
  - Earth is in a steady state (inflows of energy and matter equal outflows)
  - As the economy becomes a larger part of the whole earth, it becomes more subject to the earth's limits

Factors that could limit growth

Demographics

- World population growth and aging (https://esa.un.org/unpd/wpp/)

	Population (000s)		Growth Rate		Pop age 20-69 (000s)		Growth Rate		% age 20-69	
Year	World	N. Amer	World	N. Amer	World	N. Amer	World	N. Amer	World	N. Amer
1950	2,536,275	172,603			1,354,490	105,413			53.4%	61.1%
2015	7,383,009	356,004	1.7%	1.1%	4,463,446	230,320	1.9%	1.2%	60.5%	64.7%
2030	8,551,199	395,453	1.0%	0.7%	5,208,571	242,442	1.0%	0.3%	60.9%	61.3%
2050	9,771,823	434,655	0.7%	0.5%	5,917,277	260,462	0.6%	0.4%	60.6%	59.9%
2100	11,184,368	499,198	0.3%	0.3%	6,609,596	279,779	0.2%	0.1%	59.1%	56.0%

- Workforce participation – women entering the labor market

Factors that could limit growth

Productivity

- Markets and technological innovation will always prevail?
- Slowdown in productivity growth?
  - Some recent research indicates a slowdown from first half of the 20th century
  - Automobile, lightbulb, telephone - transformative
  - Computing, mobile technology, internet - incremental
- Role of energy in productivity growth
  - Conflicting views of role of cheap energy in productivity growth
  - Can economic growth be de-coupled from energy use?

Factors that could limit growth

Environmental Limits

- Sources and sinks
  - Productive limits to renewable and non-renewable resources
  - Consequences of environmental degradation
- Overshoot
- Climate change consequences
- Sustainable economy
  - Consumption of renewable resources limited to rate of renewability
  - Consumption of non-renewable resources limited to rate of replacement with renewables

Factors that could limit growth

Other factors

- Income inequality – demand side limits
- Limited growth movements
  - The sharing economy
  - Steady state economy
  - Degrowth movement

Limited growth implications

Growth economy vs. economy with growth

- Economy structurally dependent on growth
  - Debt as the means of money creation
  - Growth as an imperative to allow debt repayment
- Whither fixed income under limited growth?
  - Impact on debt supply and demand
  - Impact on interest rates
- Scenarios could look very different
  - Demographic stagnation
  - Environmental crash
  - Debt crisis

Limited growth implications

What could it mean to insurers?

- Same dependence on growth as other sectors
- Investment availability, risk, return
- Mortality and morbidity
  - Opioid crisis; diseases of despair
  - Reduced investment in healthcare sector

Imagine – a world without growth!

More to Come

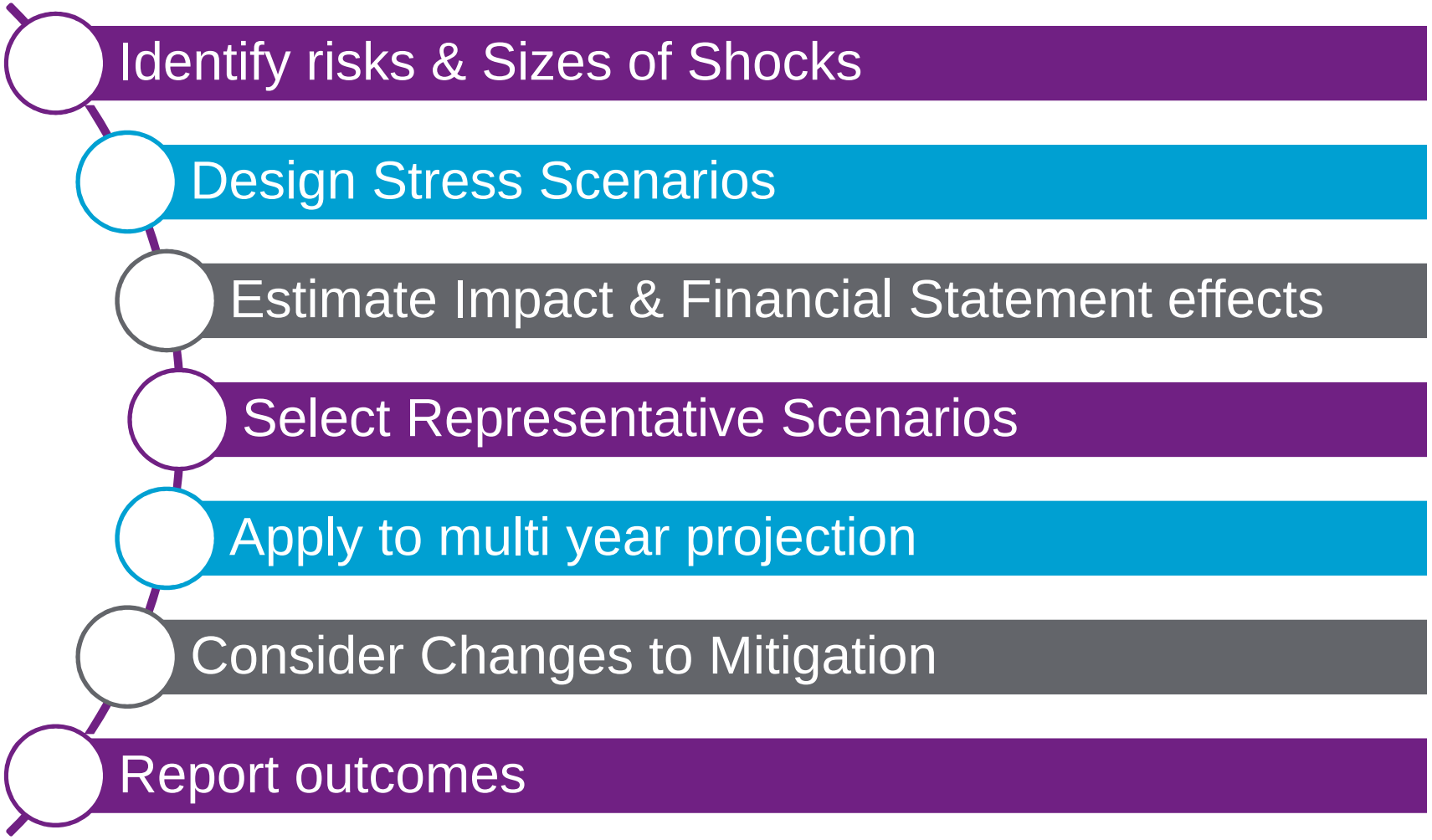
Thank you for your attention.

Watch for upcoming SOA research.

Stress Testing Framework

Willis Re

Stress Testing Framework

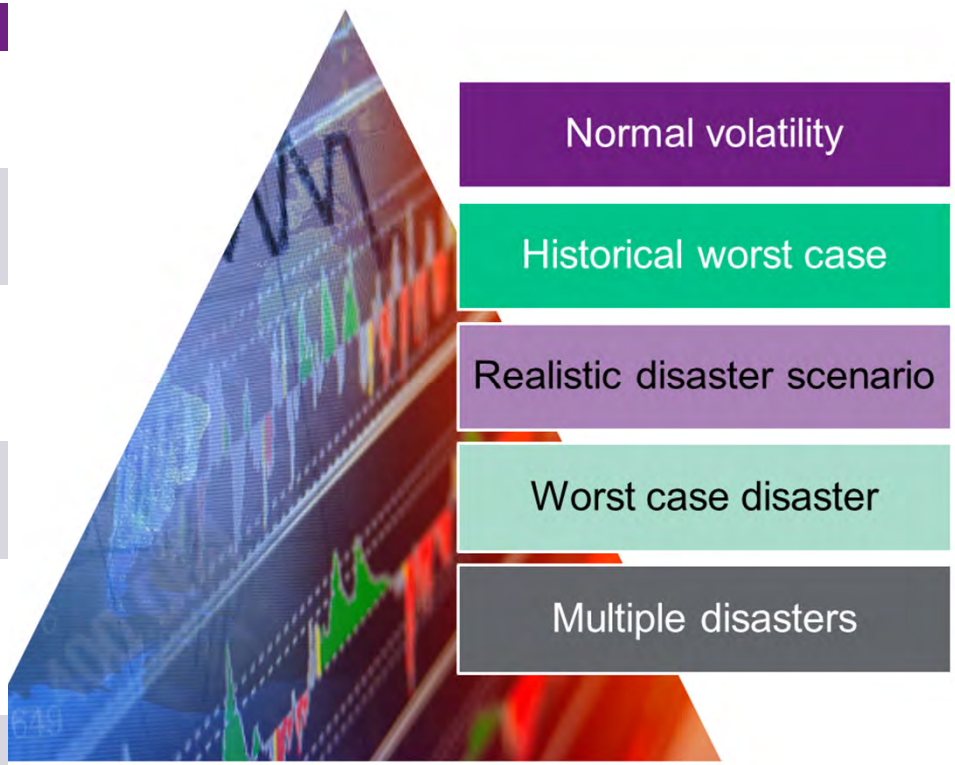


Identify Risks & Sizes of Shocks

§ Risks Tied to Risk Register

Risk Category	Type
Market	§ Interest Rate Increase § Stock Market Decline § Decline in Equity & Increase in Rates
Credit	§ Reinsurer Default § Bond Default § Agency/Policyholder Default
Underwriting	§ Natural Catastrophe § Inadequate/Soft Pricing § Adverse Reverse Development § Regulatory/Legislative/Judicial
Operational	§ IT Failure/ Cyber Breach § Home Office Catastrophe § Employee Training/Succession/Turnover
Strategic	§ Increased Competition § Excessive Growth § Loss of Agent/Distribution Channel § Loss of AM Best's FSR
Liquidity	§ Catastrophe Related § Municipal Bond Market Collapse § Bond Default/Credit Sources Disappear

§ Sizes of Shocks



Design Stress Scenarios

Normal Volatility

What happened the worst year in last ten for this risk? What has changed that would cause different outcome with same underlying events?

Historical Worst Case

What happened the worst year in last 20 for this risk? What has changed that would cause different outcome with same underlying events? Is there a much worse event more than 20 years in the past?

Realistic Disaster

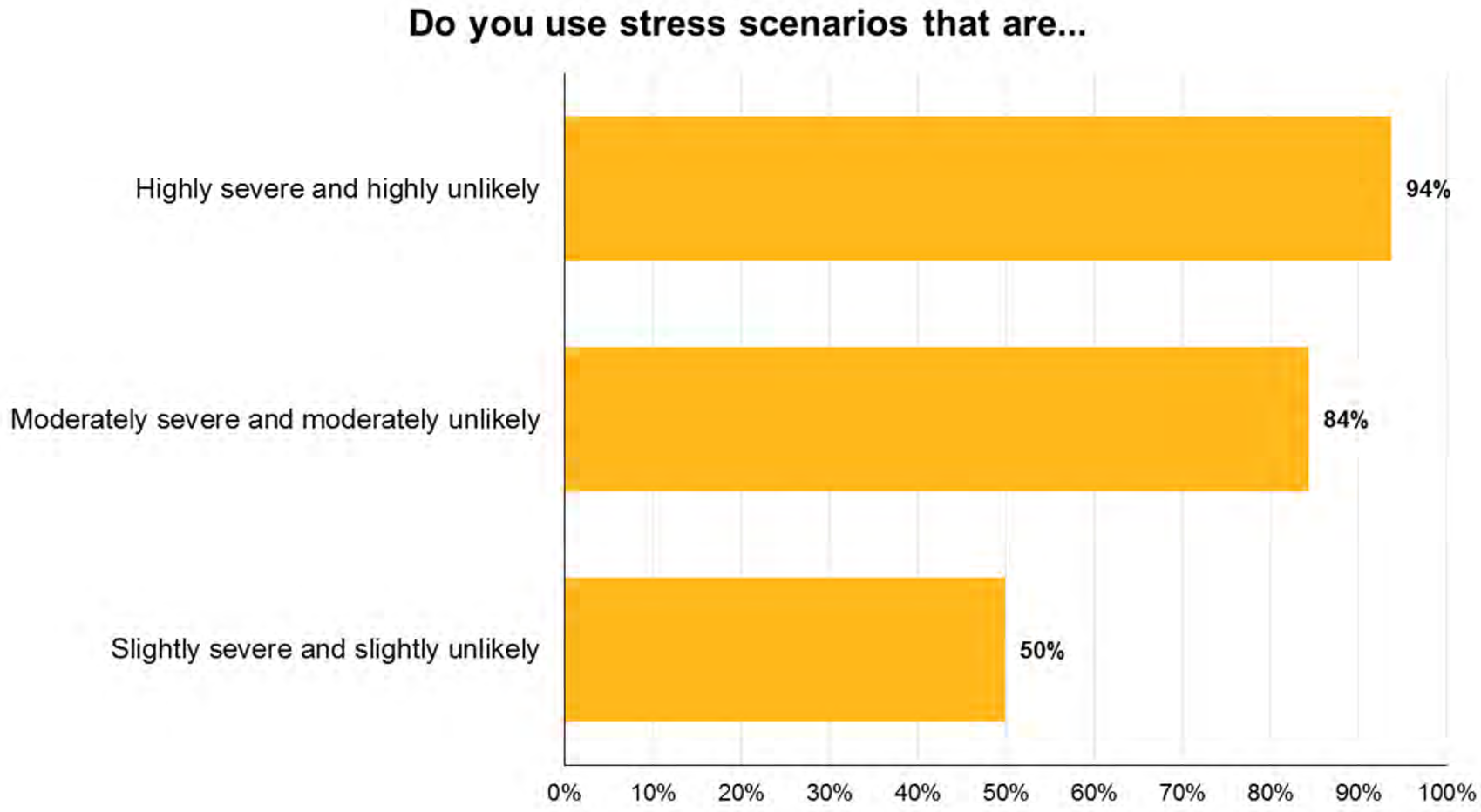
Was the Historical Worst Case actually a once in a lifetime loss event or was it just a little worse then the second worse event? If the later, consider doubling Historic Worst Case to get RDS.

Worst Case

Imagine a scenario that is much worse than RDS. Usually not a plausible event. Will not necessarily use this scenario for business planning. But will look for contingency plan ideas.

Stress Severity

2018 Willis Re Stress Testing Survey



Estimate Impact & Financial Statement Effects

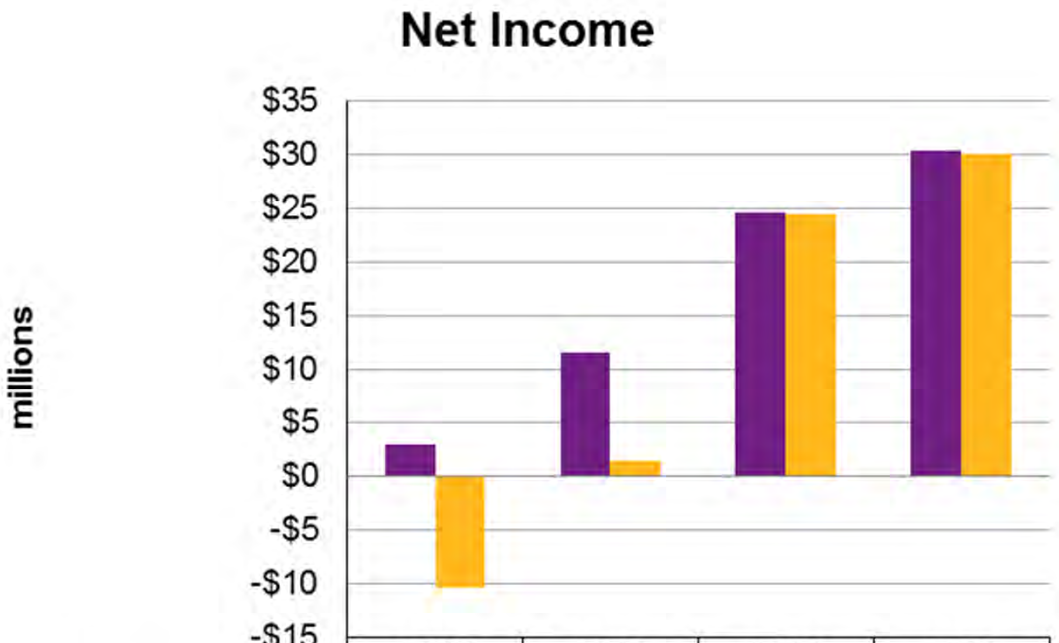
Impact – Initial Estimate	
Scenario 1	$75
Scenario 2	$175
Scenario 3	$104
Scenario 4	$85
Scenario 5	$225
Scenario 6	$750
Scenario 7	$25
Scenario 8	$70
Scenario 9	$50
Scenario 10	$60
Scenario 11	$525

Scenario #1

	Year 1	Year 2
Revenue	Decrease	Decrease
Claims	Decrease	Decrease
Expenses	Neutral	Decrease
Income	Decrease	Decrease
Loss Ratio	Increase	Neutral
Expense Ratio	Increase	Neutral
Investment Income		
Capital Gains	Decrease	Decrease

Select Representative Scenarios

Apply to Multi Year Projection



	2017	2018	2019	2020
Base Scenario	2.9	11.6	24.6	30.3
Stress Scenario 3	(10.4)	1.5	24.4	30.1

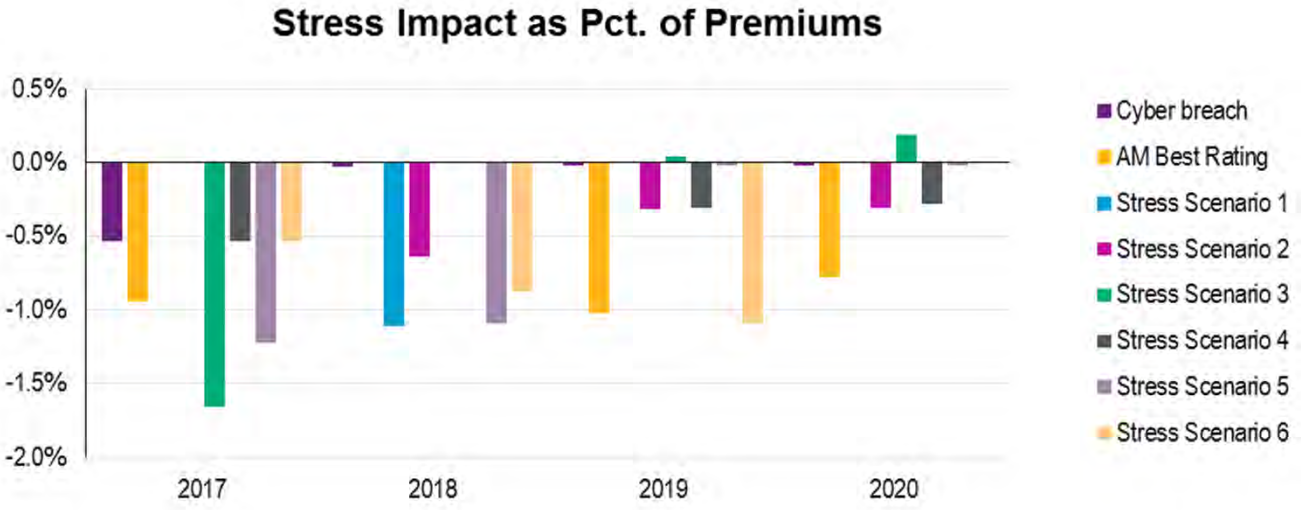
Consider Changes to Mitigation

Risk	Cyber Breach
Current Mitigation	§ Firewalls § Mandatory password updating § Complex passwords required § Need-to-access rules § Restrictions on Own Devices § Optional Cyber Security Training
Enhanced Mitigation	§ More frequent threat assessment § Mandatory Cyber Security Training § Multi key access § Broad communication of Incident log § 3rd Gen Intrusion Detection Software § More frequent anti virus updating

Report Outcomes

Stress Summary

	Net Income ($millions)					Stress	% Base
	2017	2018	2019	2020	Sum	Impact	Income
Base	$2.90	$11.60	$24.60	$30.30	$69.40	NA	NA
Cyber breach	($2.90)	$11.30	$24.40	$30.10	$62.90	($6.50)	-9%
AM Best Rating	($7.40)	$11.60	$14.50	$35.50	$54.20	($15.20)	-22%
Stress Scenario 1	$2.90	$1.30	$24.60	$30.30	$59.10	($10.30)	-15%
Stress Scenario 2	$2.90	$5.60	$21.40	$27.10	$57.00	($12.40)	-18%
Stress Scenario 3	($15.10)	$11.60	$24.40	$30.10	$51.00	($18.40)	-27%
Stress Scenario 4	($2.90)	$11.60	$21.40	$27.10	$57.20	($12.20)	-18%
Stress Scenario 5	($10.40)	$1.50	$24.40	$30.10	$45.60	($23.80)	-34%
Stress Scenario 6	($2.90)	$3.60	$14.50	$30.30	$45.40	($23.90)	-34%

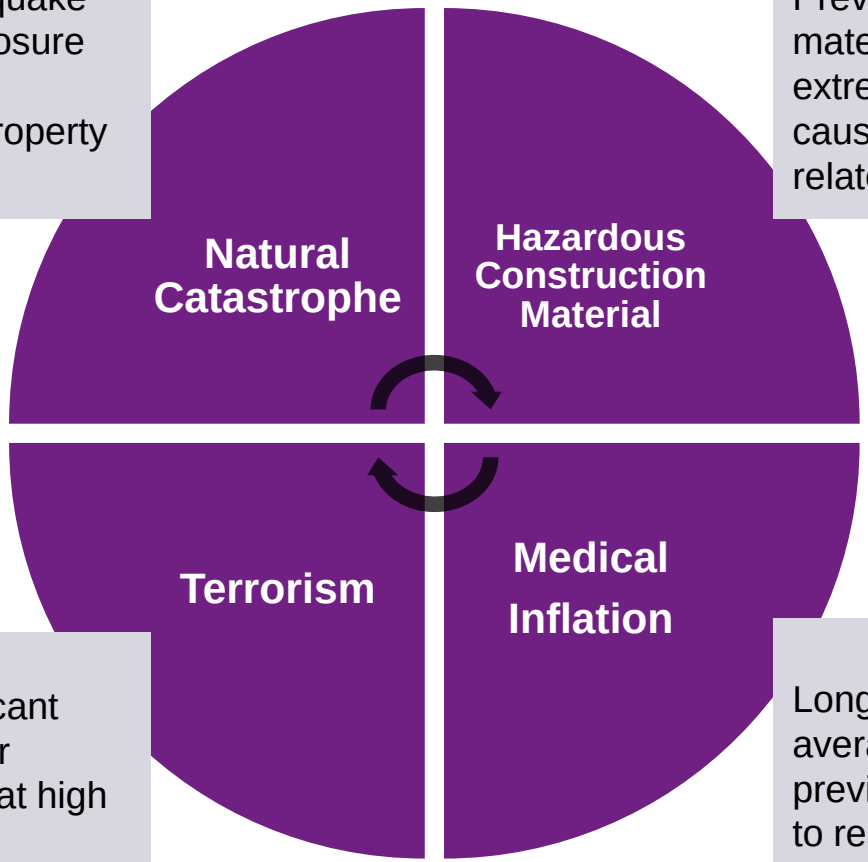


Stress Test Examples

Examples of insurance risk scenarios

§ Property & Casualty

Major hurricane or earthquake hits area of high risk exposure and results in significant underwriting losses for property business.



Prevalent construction material found to be extremely hazardous and causes systemic insurance related losses.

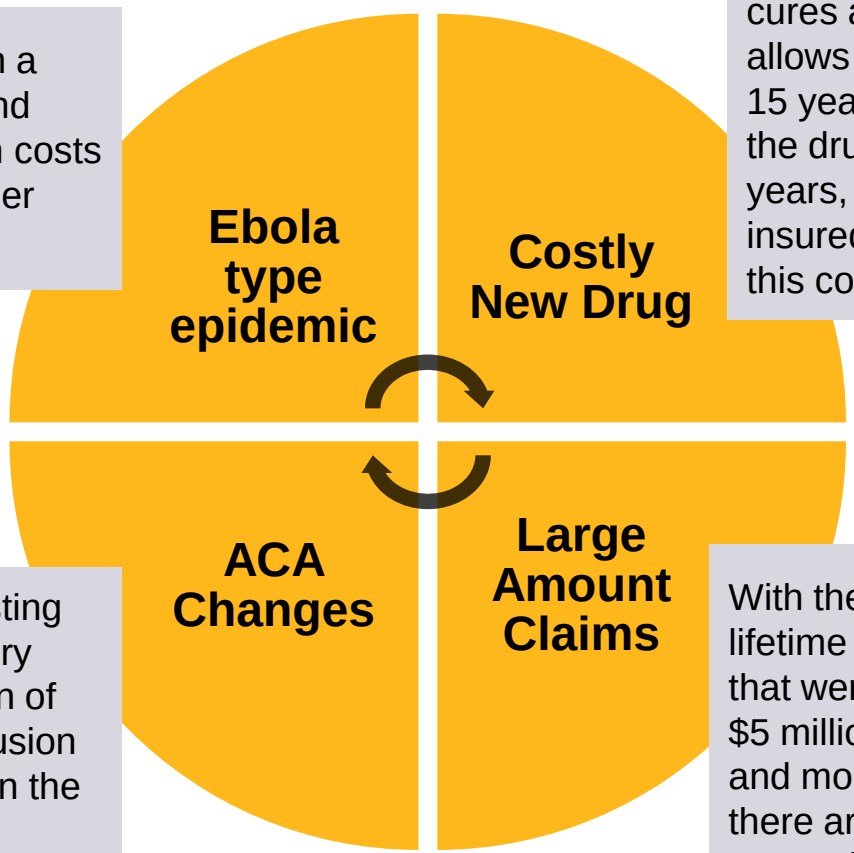
5 ton bomb with a significant blast radius causes major property and WC losses at high risk target.

Long term medical inflation averages are 3% higher than previously assumed, leading to reserve strengthening.

Health insurance scenarios

Hundreds of infections with a requirement for isolation and specialized equipment with costs averaging over $500,000 per patient.

New drug comes on line with a $50,000 annual cost that cures a fatal condition and allows people to live for 10 to 15 years longer, but require the drug each year. In recent years, over 100 of your insureds die each year from this condition.



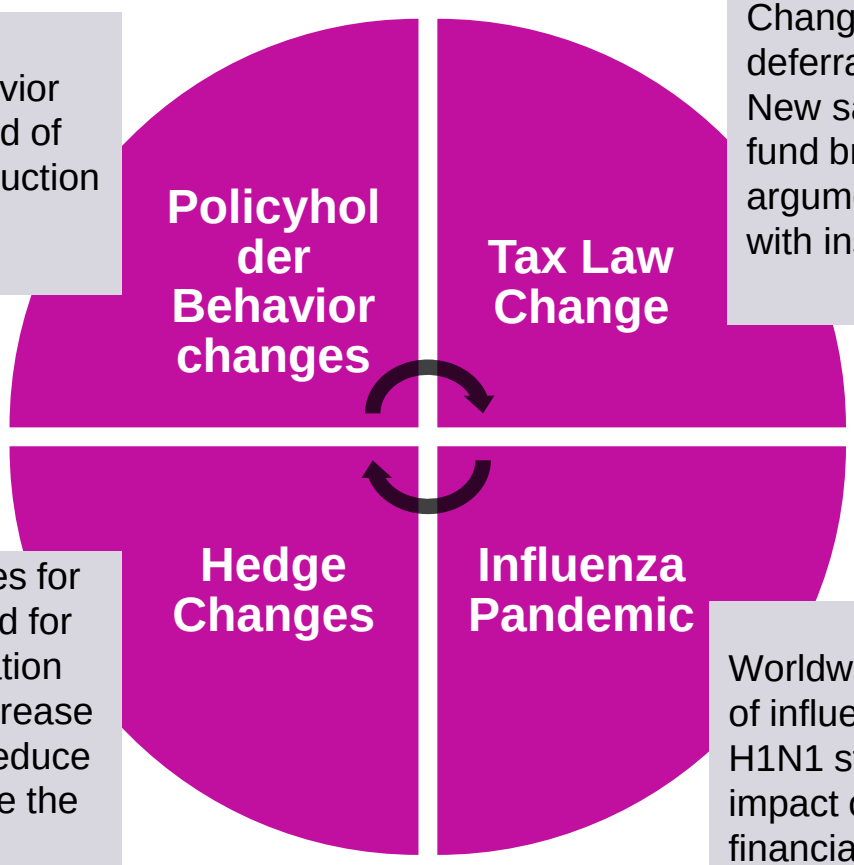
Claims costs for some existing business segment to be very high due to ACA elimination of pre-existing condition exclusion and this is not anticipated in the rates.

With the ACA eliminating the lifetime claims limits, claims that were previously capped at $5 million are becoming more and more common. What if there are suddenly 25 times as many claims in the $5 to $10 million range?

Life insurance scenarios

Average policyholder behavior changes over a short period of time resulting in a 50% reduction of liability duration.

Changes to tax law make FIT deferral much less valuable. New sales drop and mutual fund brokers start to perfect argument against products with inside build-up.

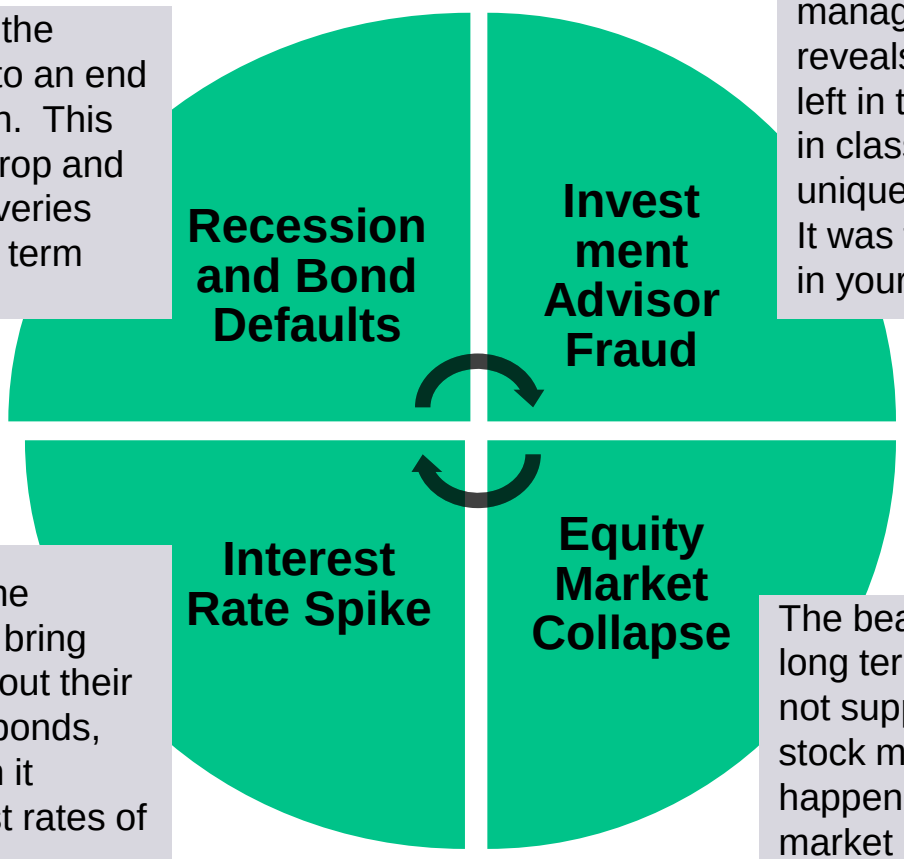


Regulators of counterparties for the hedge instruments used for variable product risk mitigation impose restrictions and increase capital requirements that reduce the availability and increase the cost of hedging variable products with guarantees.

Worldwide outbreak of a strain of influenza that is similar to H1N1 strain in 1918. Has impact on health, mortality and financial markets.

Investment scenarios

The long recovery from the Financial Crisis comes to an end with an official recession. This includes stock market drop and bond defaults with recoveries that are lower than long term averages.



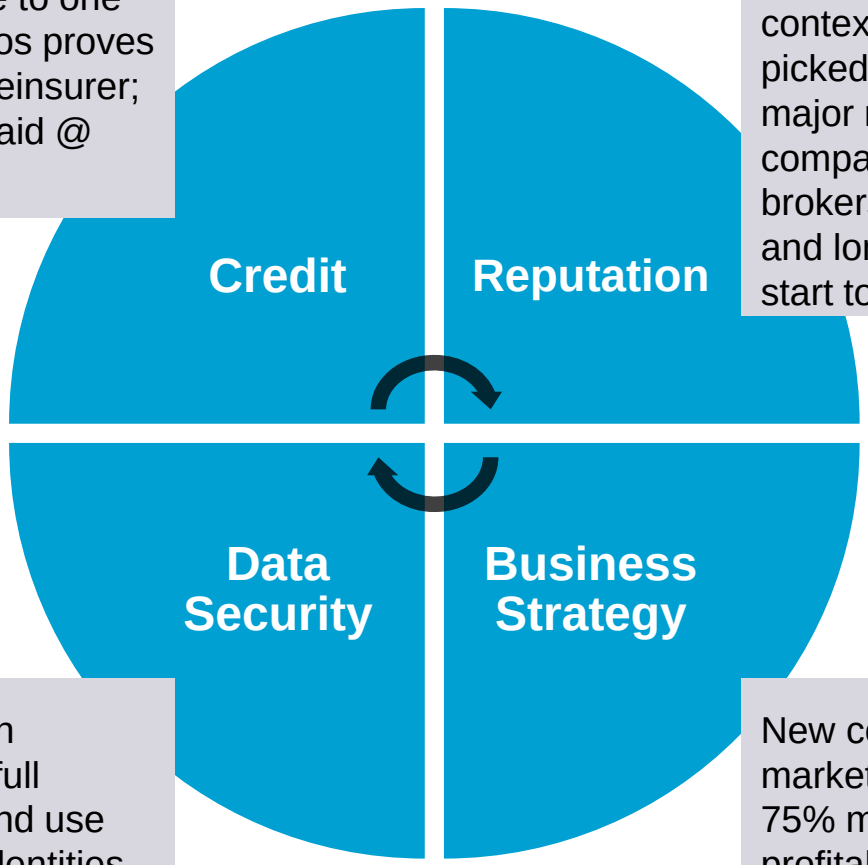
Bernie Madoff of the fund management business reveals that there is no money left in their fund (with its best in class track record and unique custody arrangement). It was the most popular fund in your VA product.

Personnel changes in the Federal Reserve Board bring with them new ideas about their role. The economy responds, spurring growth but with it comes a jump in interest rates of 2%.

The bears were right. Actual long term corporate profits do not support the increases to the stock market that have happened in recent years. The market realizes that and stock prices drop by 30%.

Common general risk scenarios

Major spike in claims due to one of the Insurance Scenarios proves to be too much for your reinsurer; reinsurance claims are paid @ 60% after long delay.



Something is taken out of context by the press and then picked up on Twitter that has a major negative impact on company reputation with brokers. New sales plummet and long term policyholders start to move their business.

Hackers are able to patch into IT system and steal full records from all clients and use the information to steal identities.

New competitor disrupts market landscape and takes 75% market share of your most profitable business.

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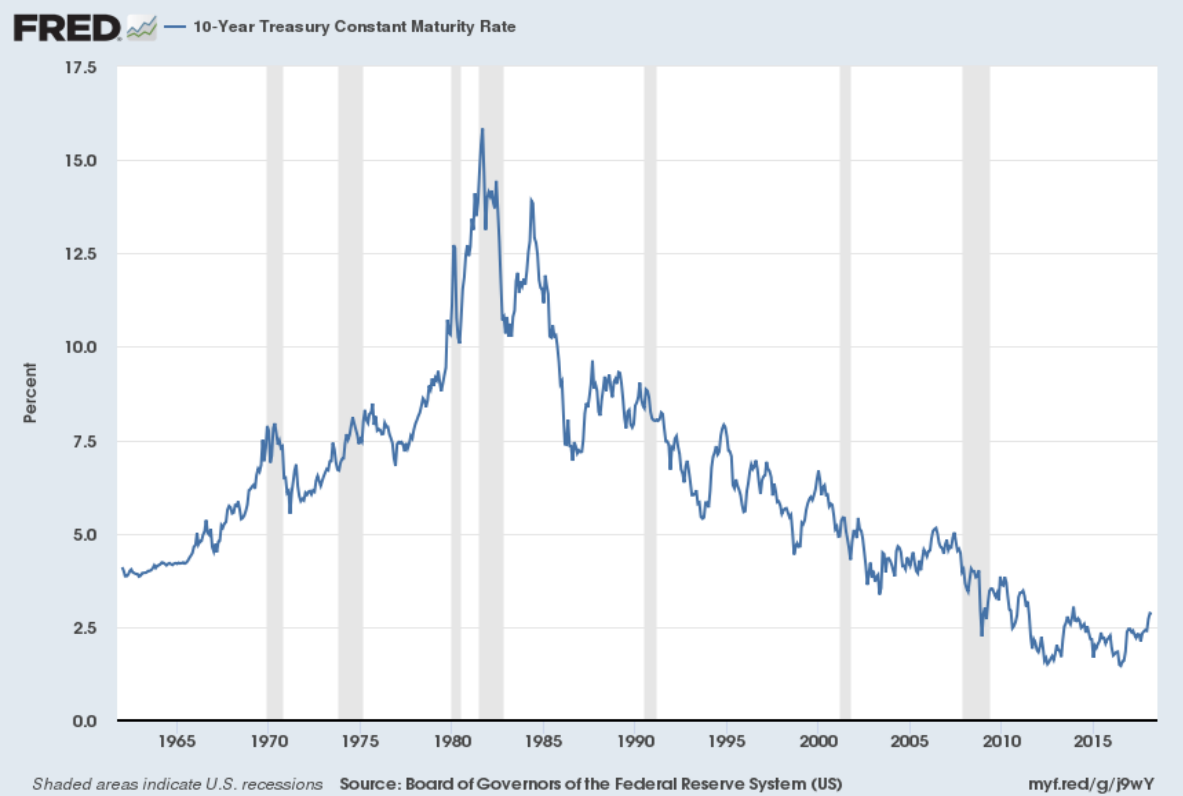
Stress and Scenario Testing for ORSA, CFT, and Strategic Planning: Issues to Consider

Session 31

April 20, 2018 @ 1:45 pm

Max J. Rudolph, FSA CFA CERA

Interest Rates



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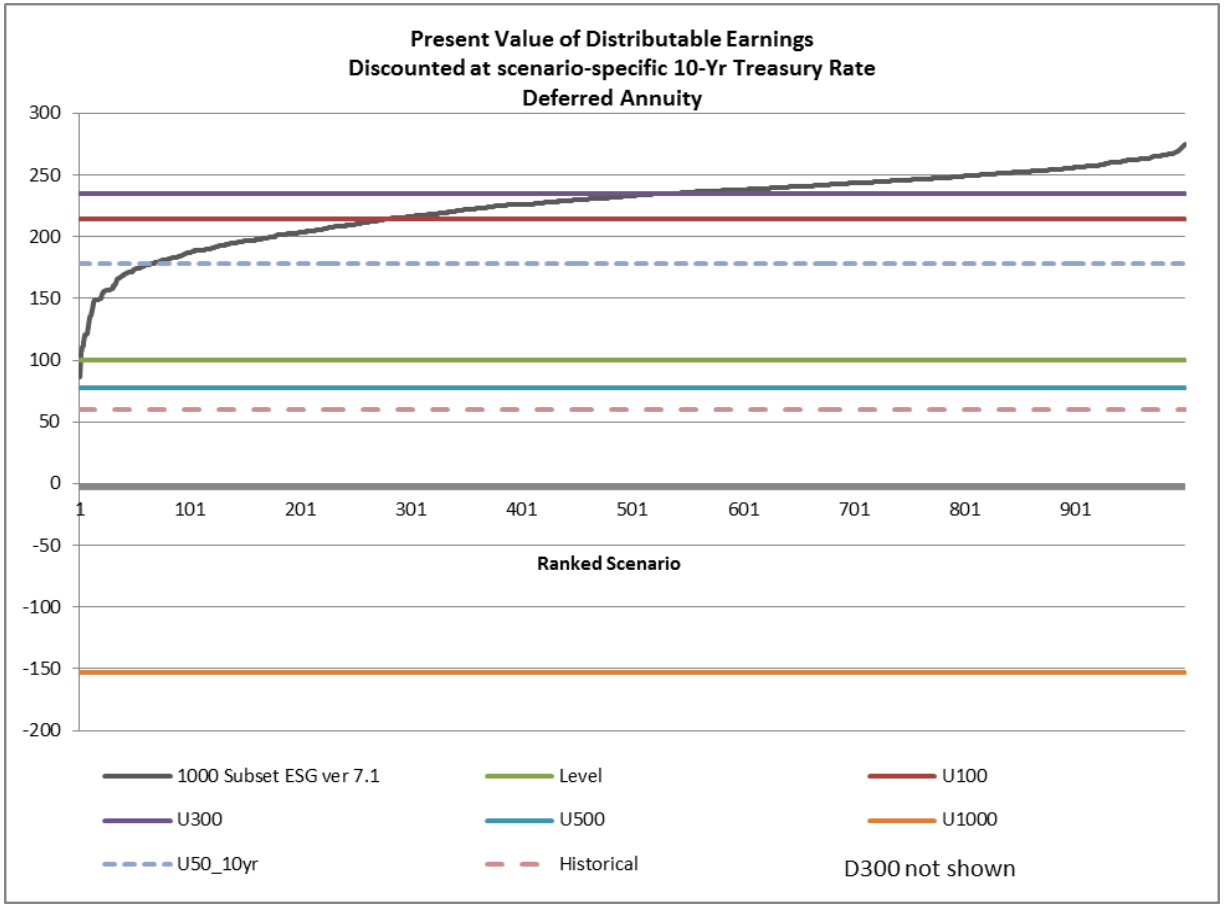
Driver of Low Rates - Demographics

- Aging population
  - Buys services
  - Fewer workers, lower support ratio
  - Role of immigration
  - Can change quickly
  - Interacts with other risks (e.g., geopolitical conflicts, rising oceans)
- Lower growth, lower rates

Driver of High Rates - Debt

- This Time is Different - Reinhart/Rogoff
- **Inflation spikes (into hyperinflation) when**
  - **Debt becomes large**
  - **Central bank monetizes the fiscal debt**
  - **Debt is owed to foreign sources**
- Does this sound familiar?
  - Timing not predictable
- Monetary policy works best with balanced budget (above 90% debt/GDP reduces growth) – 104% currently


Present Value of Distributable Earnings
Discounted at scenario-specific 10-Yr Treasury Rate
Deferred Annuity
300
250
200
150
100
50
0
-50
-100
-150
-200
1
101
201
301
401
501
601
701
801
901
Ranked Scenario
1000 Subset ESG ver 7.1
Level
U100
U300
U500
U1000
U50_10yr
Historical
D300 not shown

Latticework of mental models

- *I'd rather have decent answers to the right questions than great answers to irrelevant questions.*

  Alfred Marshall, Director of Net Assessment

- **Beware of models that are easy to work with**

The Last Warrior. 2015. Krepinevich and Watts.

Thank you!
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