

Low interest rates – the new normal?

Actuarial Club of Southwest and
Southeastern Actuaries Conference

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The better the question. The better the answer.
The better the world works.



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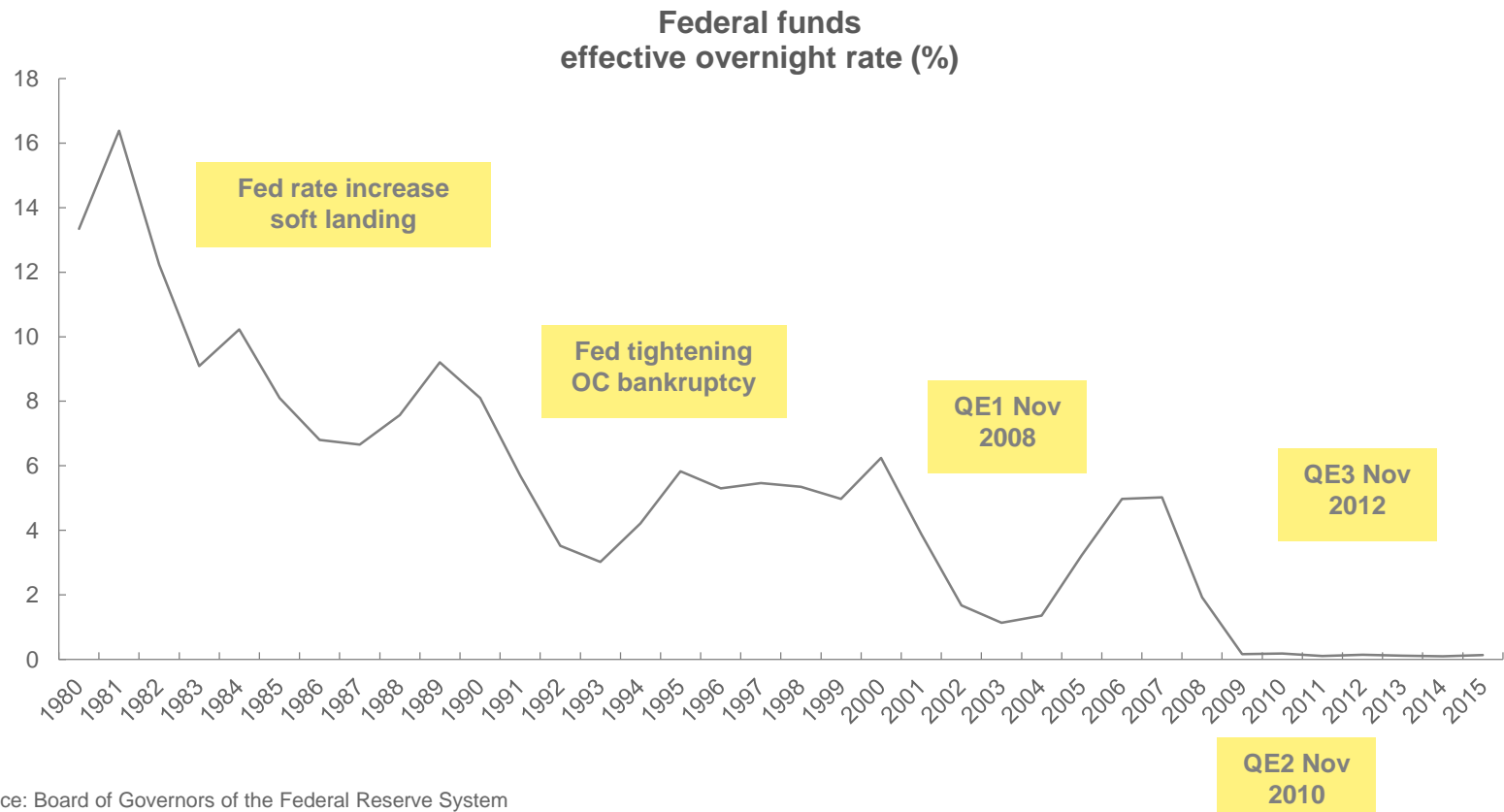
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Key questions

- ▶ What is the current interest rate environment and its outlook in the United States?
- ▶ How do low interest rates impact the life insurance industry?
- ▶ What are the common interest rate assumptions adopted by life insurers?
- ▶ How do commonly used economic scenario generators (ESGs) cope with the current low interest rate environment, and what are their limitations?
- ▶ What alternatives can practitioners explore?

Historical perspective of US interest rates

- ▶ The current environment, with near-zero, short-term rates since 2009, is unprecedented in the history of US interest rates.



Low interest rate environment

Factors influencing interest rates:

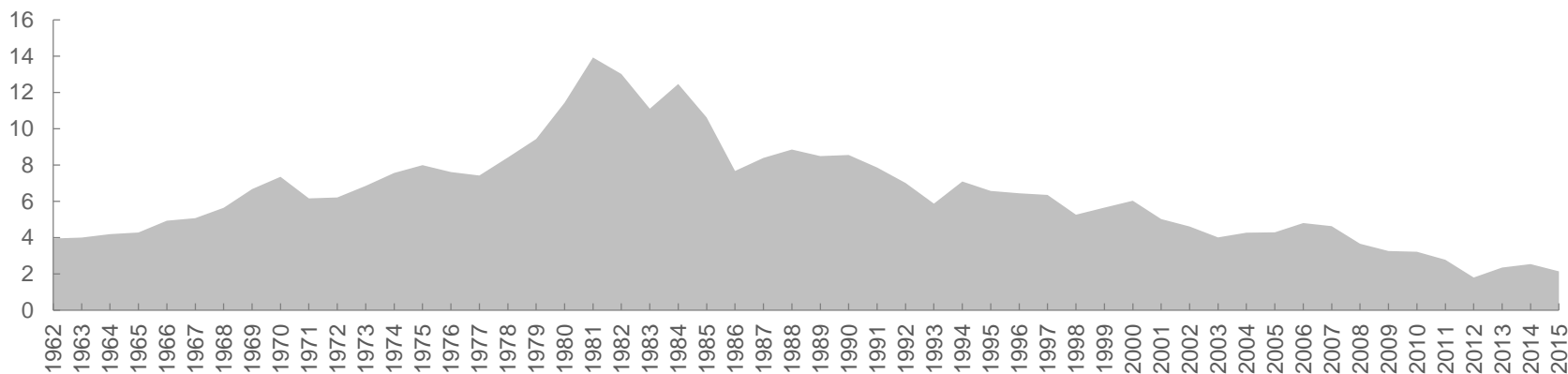
- ▶ Equilibrium, market expectation
- ▶ Inflation expectation
- ▶ Central bank's monetary policy

Current environment:

- ▶ Monetary policy, quantitative easing
- ▶ Conditions in the global economy
- ▶ Deflationary concerns
- ▶ Other headwinds, such as low oil prices

How long do we expect the rates to remain low?

US Treasury securities
10-year constant maturity rates (%)



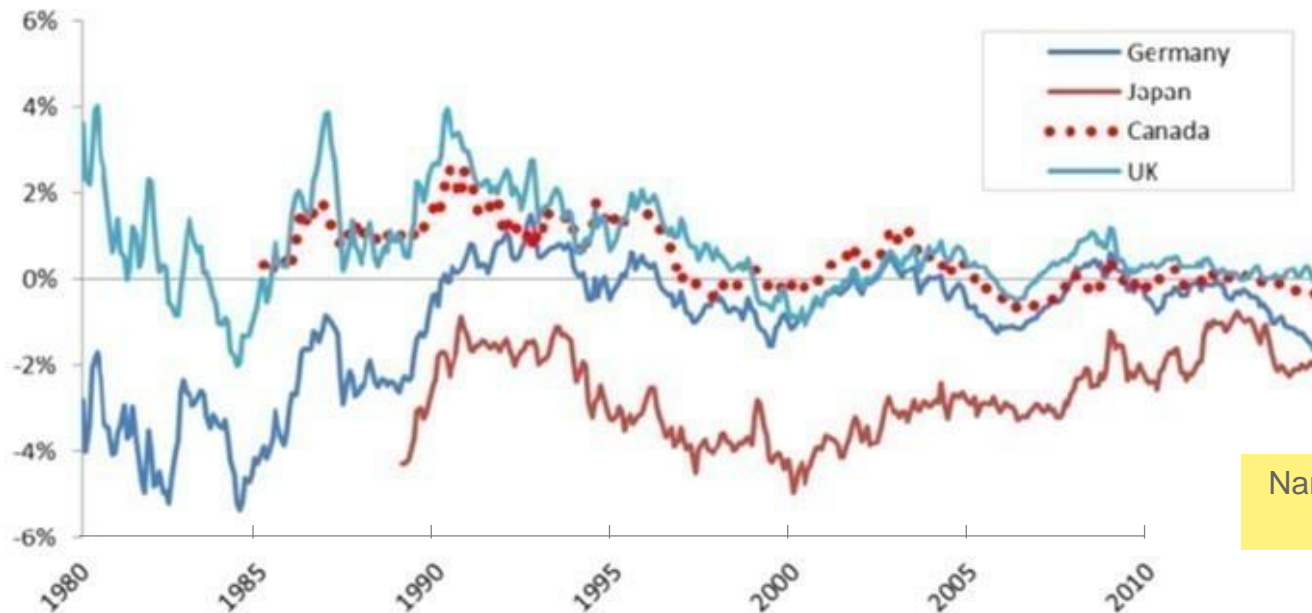
Source: Board of Governors of the Federal Reserve System

Comparison to global economic market

These global factors also influence interest rates:

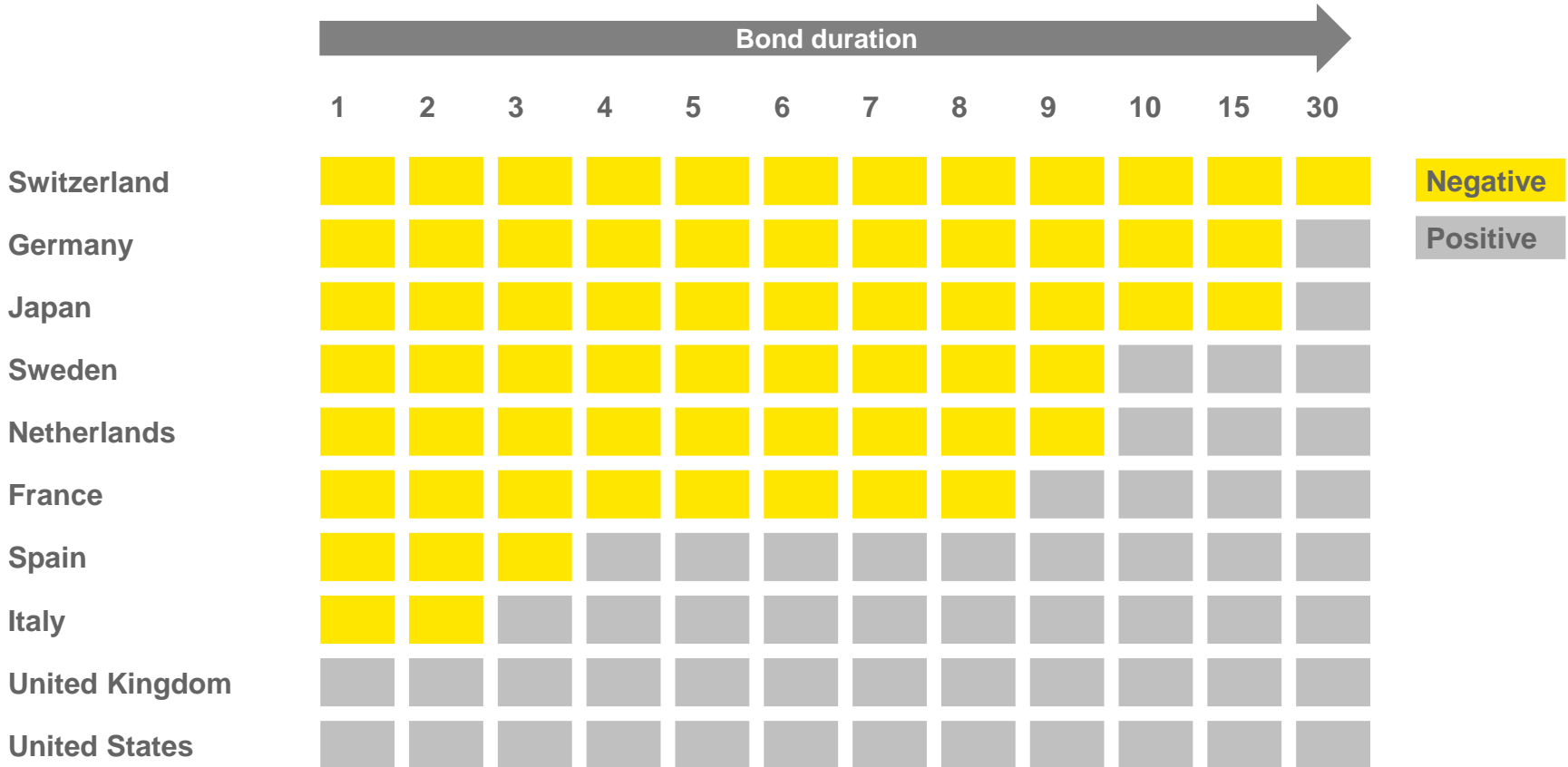
- ▶ Integration and harmonization of global markets
- ▶ Central bank influence
- ▶ Currency consideration: no arbitrage

Month-End Foreign Short-Term Government Yield Minus U.S. Rate



Source: Board of Governors of the Federal Reserve System/FRED

Negative interest rates in global markets

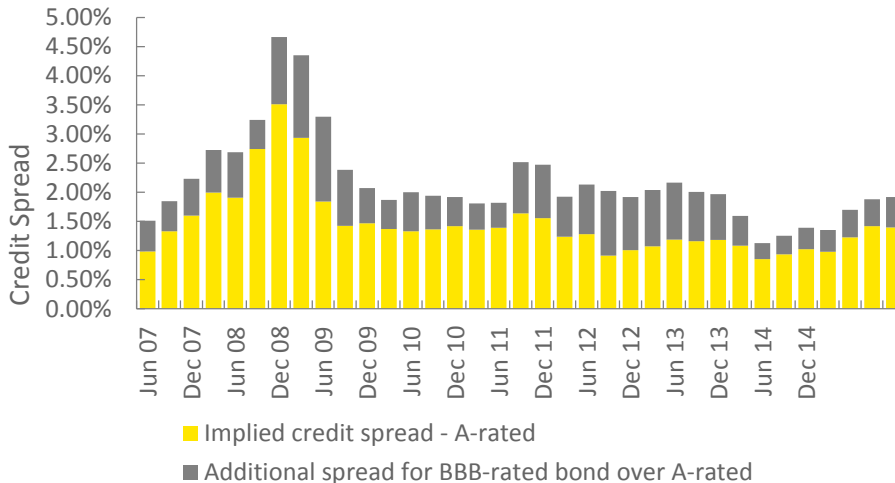
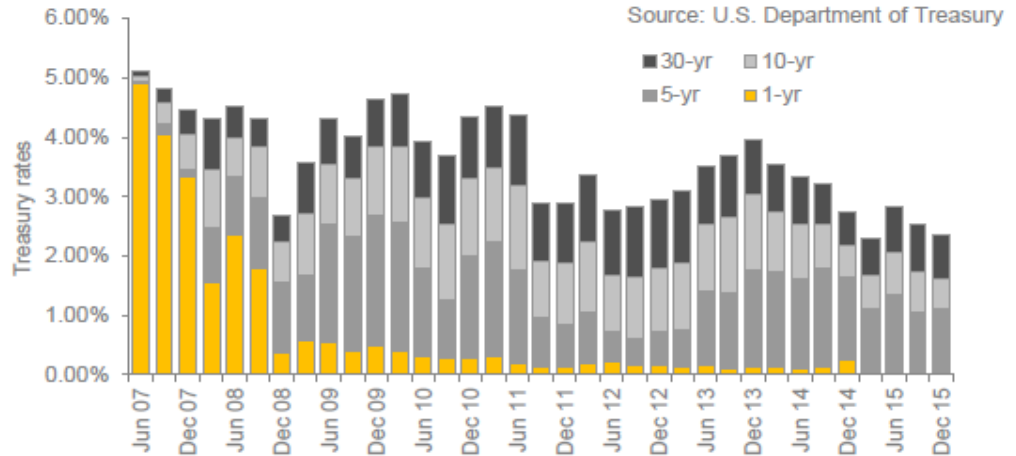


* Source: quartz.com, as of July 6, 2016

- ▶ The Federal Reserve is now requiring systematically important financial institutions (SIFIs) to use negative short-term interest rates in stress testing.

Interest rates since the financial crisis

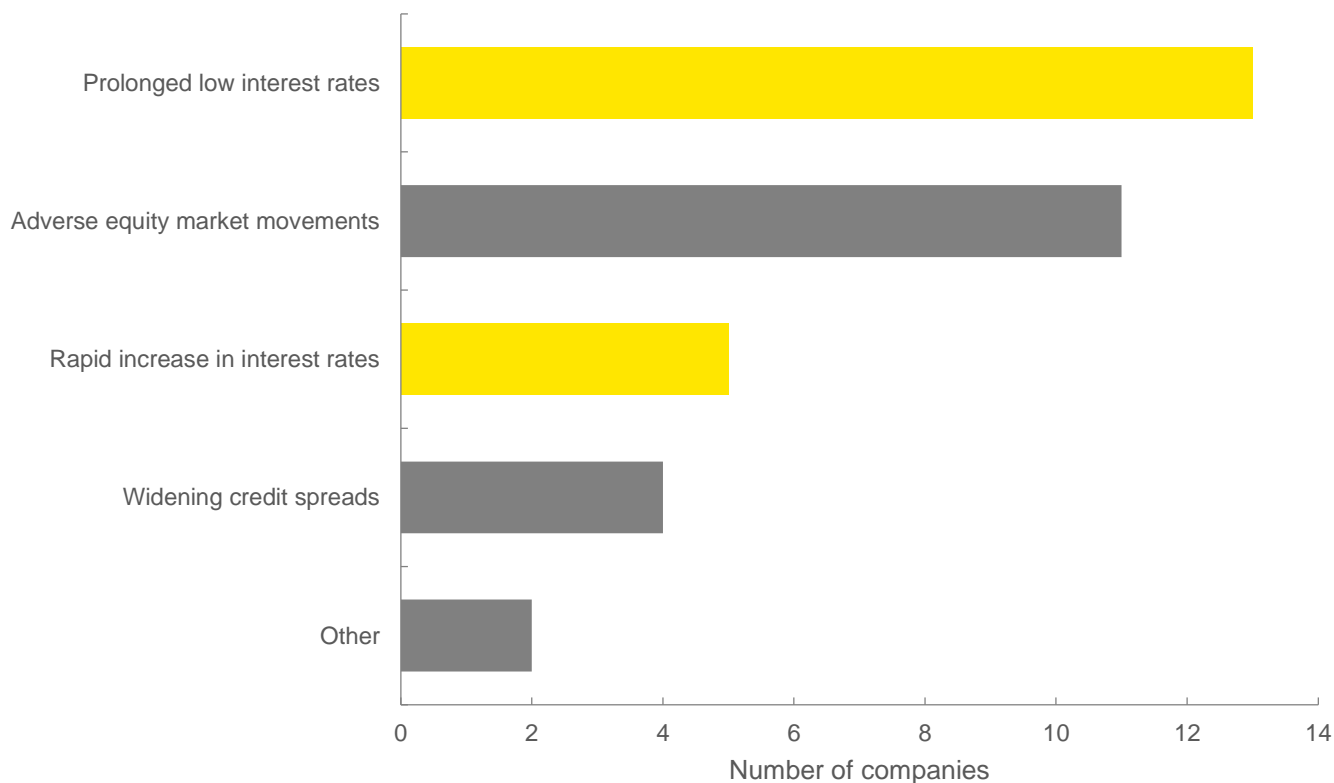
- ▶ Long-term interest rates declined with 10-year Treasury rate just under 2.3%. The yield curve continued to be positively sloped with some steepening around the 5-year tenor.



- ▶ The A and BBB credit spreads have since stabilized post the financial crisis. This, combined with the low Treasury rates, means yields have stayed low for these asset classes insurance companies typically invest in.

Life insurers' main perceived economic risks

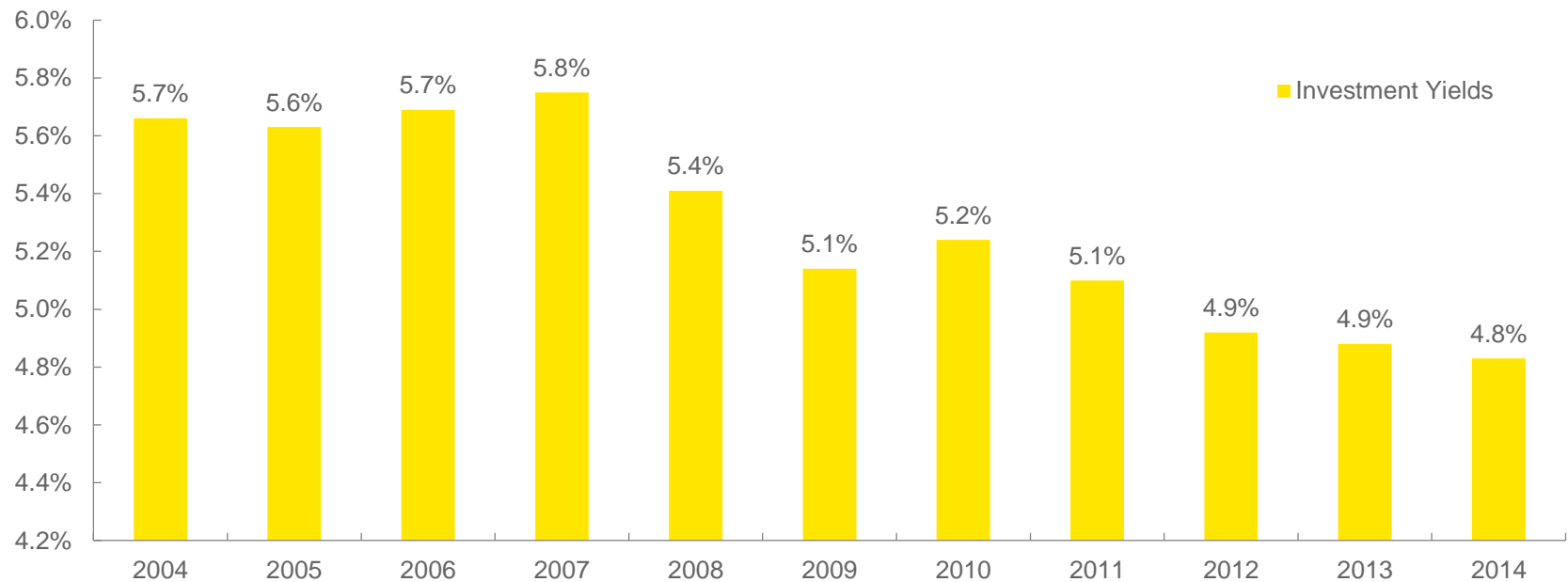
Prolonged low interest rates and a rapid increase in interest rates are among the top three challenges identified by surveyed companies.



Source: EY proprietary survey 2016

US life insurance industry average portfolio rates

The persistent low interest rates are hitting life insurance companies' bottom line, and portfolio rates are expected to continue declining as existing assets mature and proceeds get reinvested in low yield instruments.

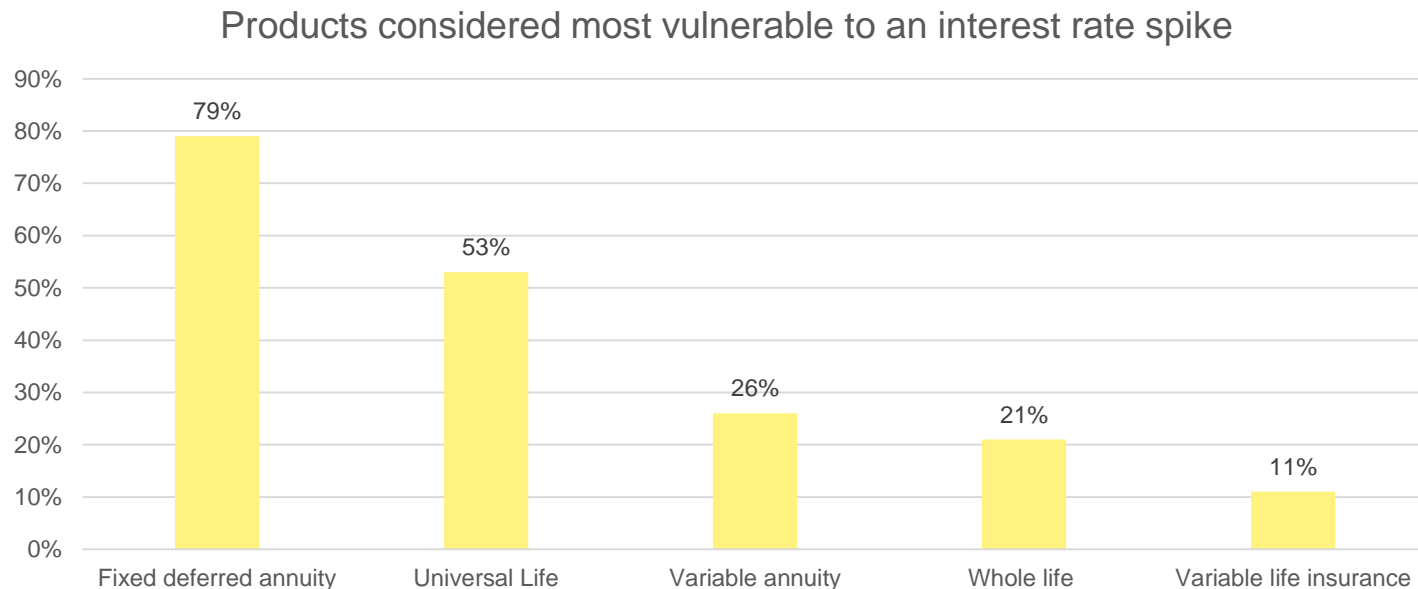


Source: EY proprietary survey 2016

Rising interest rates

Also a risk for life insurance products

An industry survey showed the products companies considered most at risk in a rapidly rising interest rate environment. The main risks included disintermediation, products where the sales focus is on credited rates and products with asset mismatches.



Source: SOA July 2014, survey published in Transition to a High Interest Rate Environment Research

Low interest rate insurer mitigation reactions

In-force management

- ▶ Subsidize new crediting rates with credited rates from legacy business
- ▶ Increase COIs, loads, or adjust the dividend scales for life products
- ▶ On shore captives or off shore reinsurance
- ▶ Restrict level of new premiums in life insurance products
- ▶ Trade interest rate guarantees with LTC, critical illness or death benefit riders

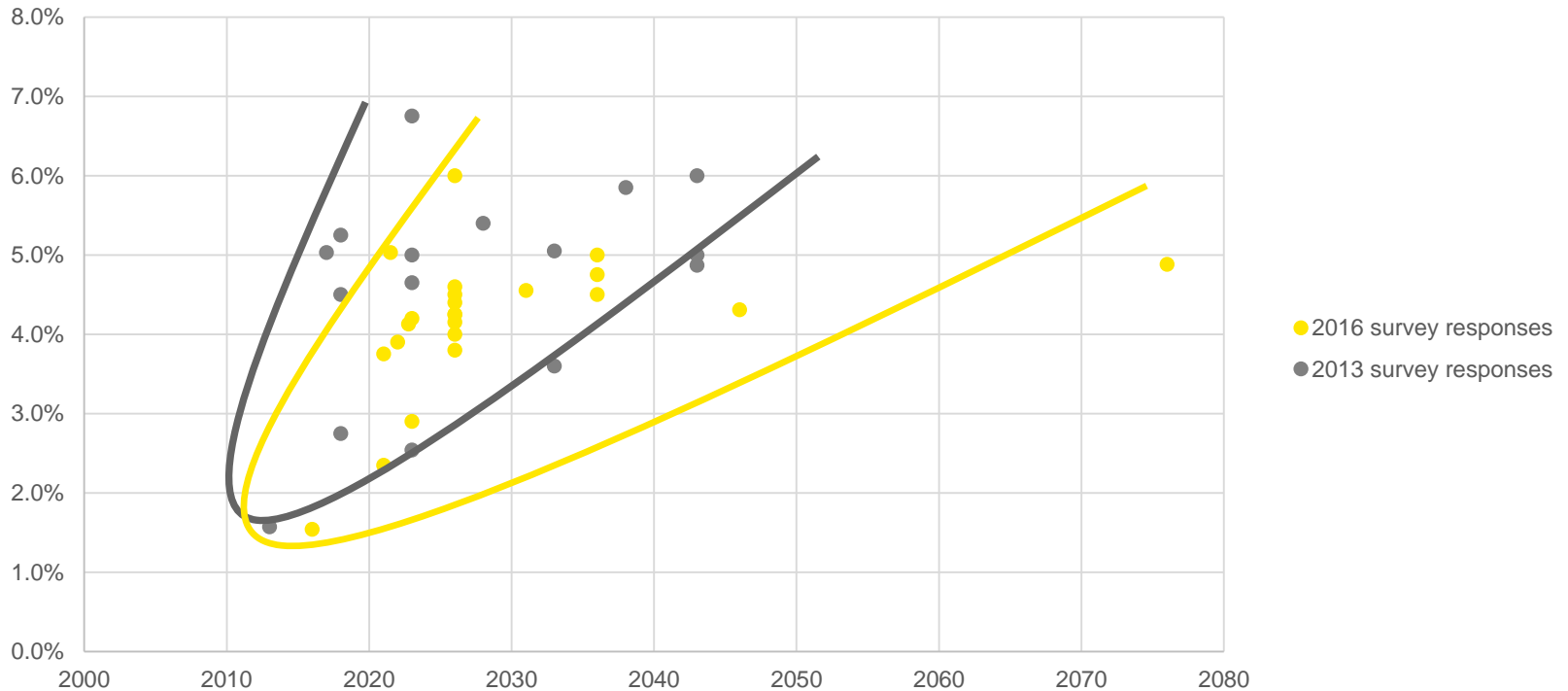
Product development

- ▶ Migrate to indexed products
- ▶ Reduce guaranteed crediting rates
- ▶ Increase secondary guarantee premiums or reduce benefits in Universal Life products
- ▶ Reduce or eliminate return of premium (ROP) guarantees in fixed annuities
- ▶ Include or refine market value adjustments in fixed annuities
- ▶ Reconfigure commission structures to a flatter and more tail-oriented scheme

Long-term interest rate assumptions

There is a wide range of long-term interest rate assumptions among life insurers. This range is shifting over time, as the low interest rate environment persists.

Long term interest rate assumption comparison 2013 vs. 2016

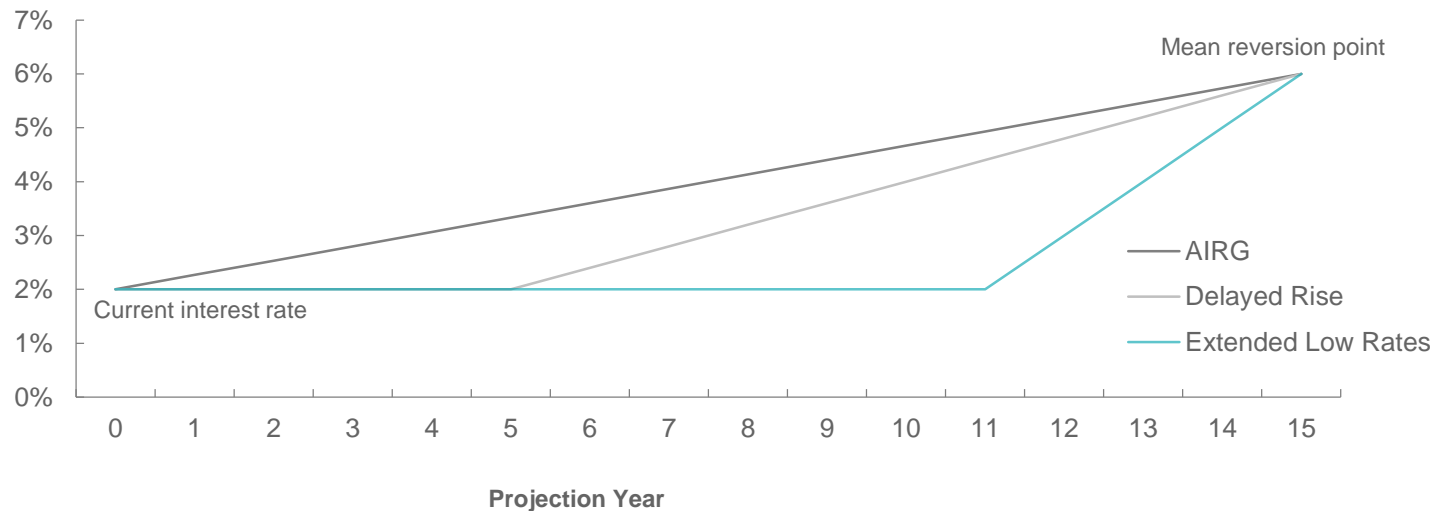


Source: EY proprietary survey 2013 and 2016

Path to long-term interest rates

- ▶ A significant number of economists and actuaries expect that interest rates to stay low in the near future.
- ▶ While there is a general consensus that interest rates will eventually revert to “historical levels,” there are significant disagreements about when and how this will happen

Path to mean reversion target

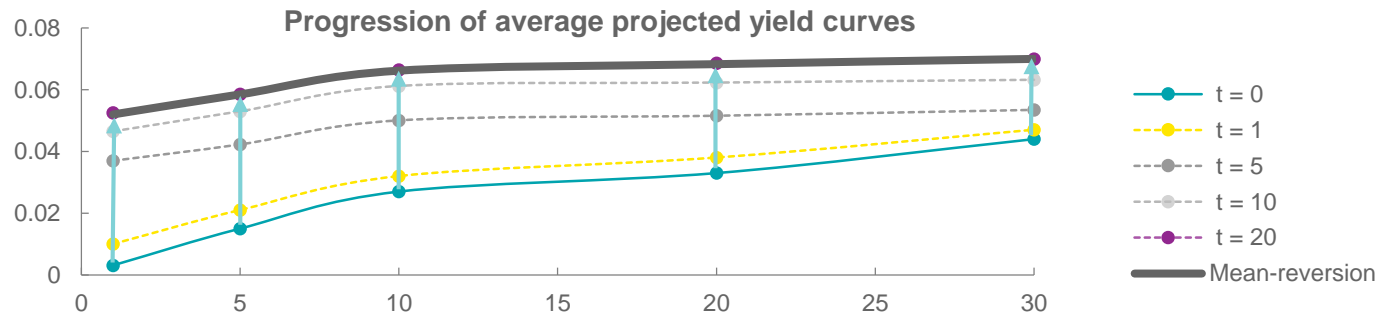


- ▶ Thus, stochastic models become a crucial need for companies to understand the impact of assets and liabilities across multiple interest rate paths.

Key features in real-world stochastic interest rate models

► Mean reversion:

- Most common real-world interest rate stochastic models assume that interest rates will revert toward a specified rate, commonly referred to as the mean reversion target.
- The mean reversion target is the primary driver of best estimate measures.



► Sources of uncertainty:

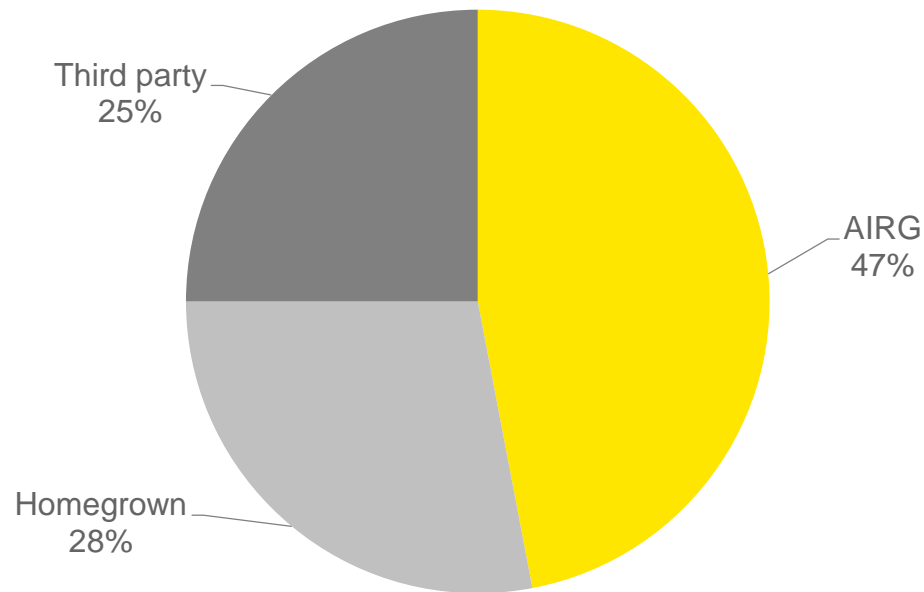
- Instantaneous changes in interest rates are modeled through a volatility parameter and the level of interest rates in the projection. Long-term changes in interest rates are primarily impacted by the mean reversion strength and the assumed volatility level.
- Sources of uncertainty are the primary driver of tail-based measurements.

Model	Stochastic differential equation
Vasicek	$dr = a(b - r)dt + \sigma dZ$
Cox-Ingersoll-Ross	$dr = a(b - r)dt + \sigma\sqrt{r}dZ$
Black-Karasinski	$d\ln(r) = a(b - \ln(r))dt + \sigma dZ$

Economic scenario generation in the life insurance industry

- ▶ The Academy's Interest Rate Generator (AIRG) is the most commonly used ESG in the industry, as it can be directly used to perform principles-based reserves (AG 43) and capital (C-3 Phase I and II) calculations.

ESG used for real-world interest rates

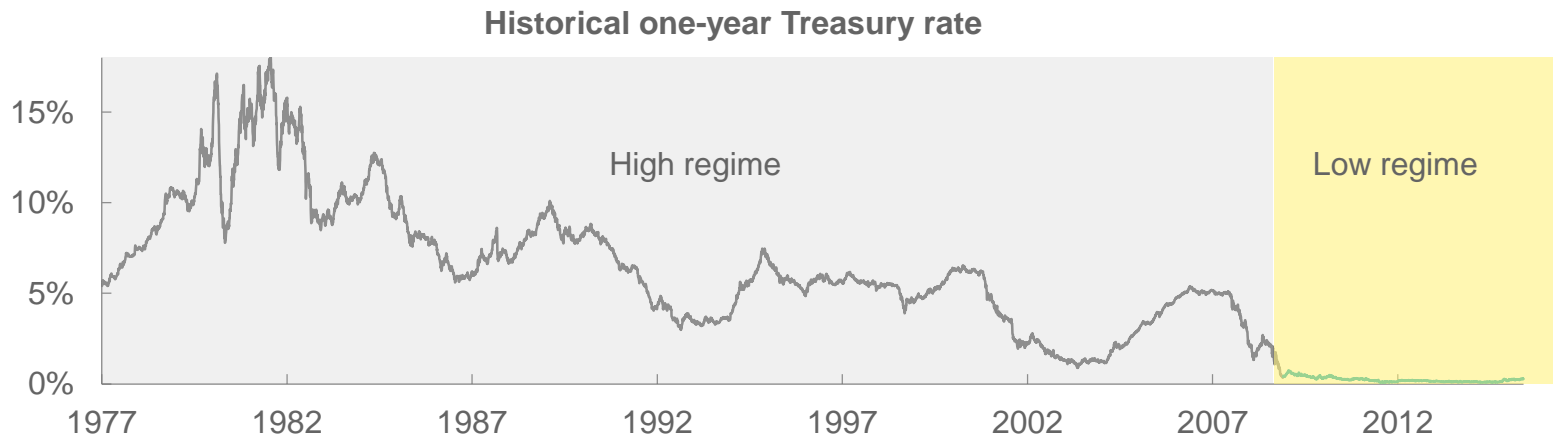


**Based on a proprietary survey of US life insurance companies*

Regime-switching model

Overview

- ▶ Calibrated historical interest rates to two regimes: the current low interest rate environment and the preceding historical period



High regime

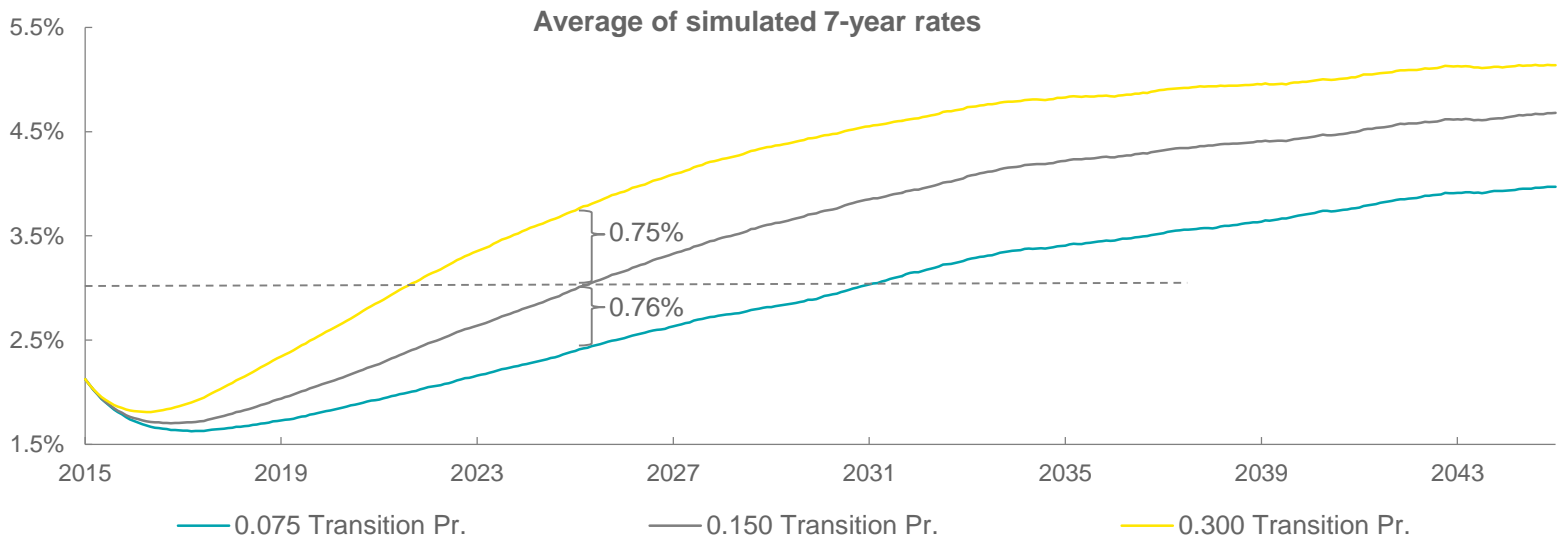
- ▶ Simulates an interest rate environment similar to the 1977–2008 period
- ▶ Mean reversion point (MRP) closer to historical average
- ▶ Interest rates move toward MRP with high volatility and low mean reversion strength

Low regime

- ▶ Simulates interest rates based on the post-financial crisis environment (2009–2015)
- ▶ Lower MRP and stronger mean reversion strength
- ▶ Interest rates move around the MRP with low volatility

Prolonged low interest rate environment

- ▶ Transition probabilities can be used to reflect different views of how long we will stay in the current low interest rate environment.
 - ▶ Using a 15% transition probability translates to an average of 6.7 years before transitioning out of the low interest rate environment.
 - ▶ A user can increase/decrease the transition probability to reflect a particular view of how long the current low interest rate environment will persist.



Alternative ESG

Regime-switching, key-rate Cox-Ingersoll-Ross model

- ▶ Regime-switching: uses a Markov chain process to model the transition between regimes

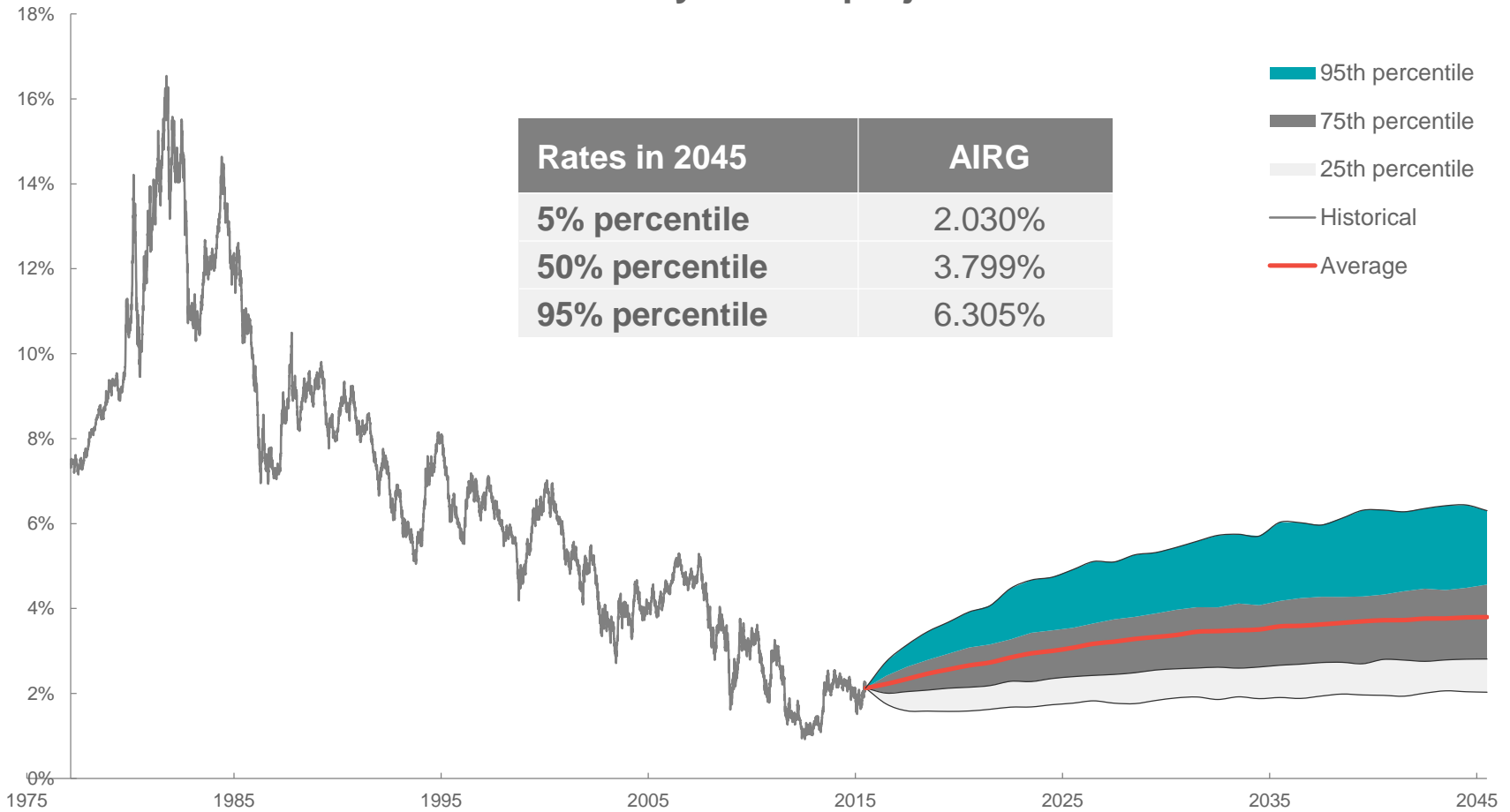
Annual transition probability	To low regime	To high regime
From low regime	85.0%	15.0%
From high regime	2.1%	97.9%

- ▶ Key rate: models each spot rate on the curve individually:
 - ▶ Advantage: increased flexibility, precision and control over desired outcomes
 - ▶ Disadvantage: complexity and large number of parameters
 - ▶ Alternatives: function-based models (i.e., Nelson-Siegel)
- ▶ Uses the Cox-Ingersoll-Ross (CIR) stochastic differential equation in each regime
- ▶ Calibrates the model with maximum likelihood estimates (MLE) based on historical Treasury rates
- ▶ Complies with the AIRG calibration criteria

Projected interest rates

AIRG

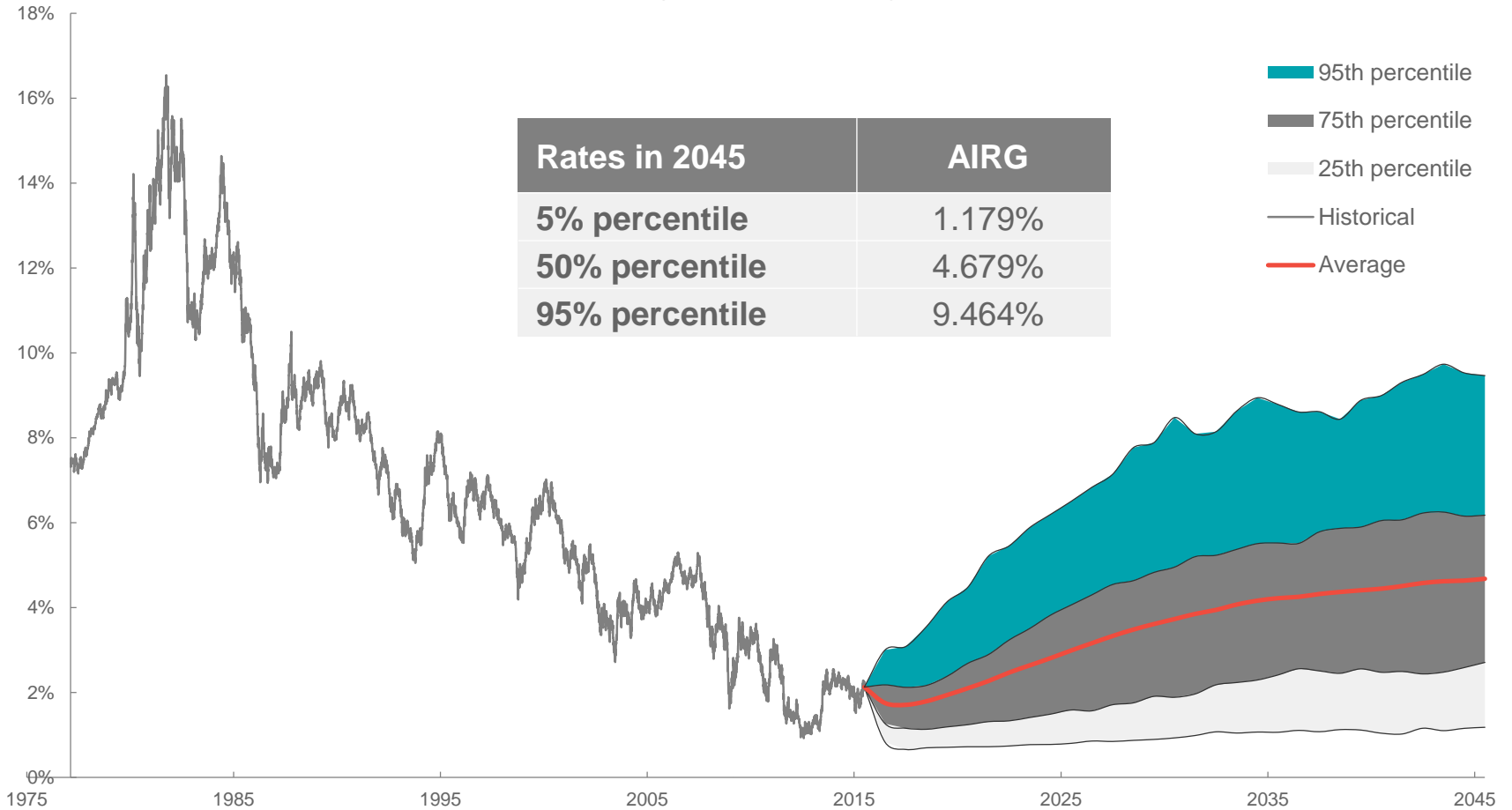
AIRG 7-year rate projection



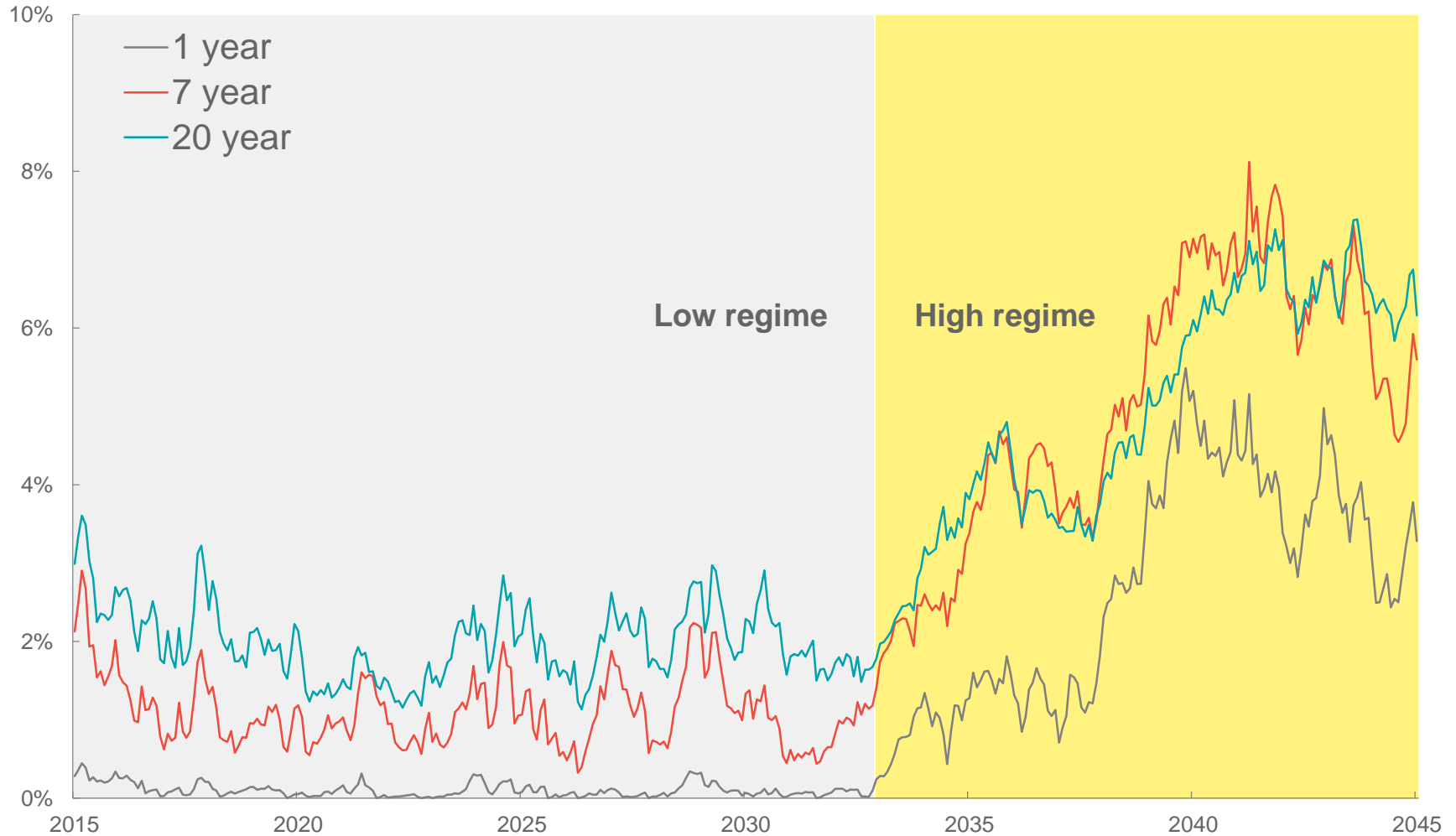
Projected interest rates

RSCIR

RSCIR 7-year rate projection



Sample RSCIR scenario



Cash flow testing

Deterministic scenarios

- ▶ We built a deferred annuity (DA) model and ran cash flow testing projections.
 - ▶ Minimum guarantees ranging from 1% to 4%
- ▶ We tested the deterministic NY7 scenarios in the DA model.

CFT Results: 30-year projections, in millions \$		
NY7	Description	Ending Surplus
1	Level	969
2	Increasing	3,787
3	Up/Down	1,272
4	Pop Up	3,247
5	Decreasing	(522)
6	Down/Up	625
7	Pop Down	(592)

Cash flow testing

Stochastic scenarios

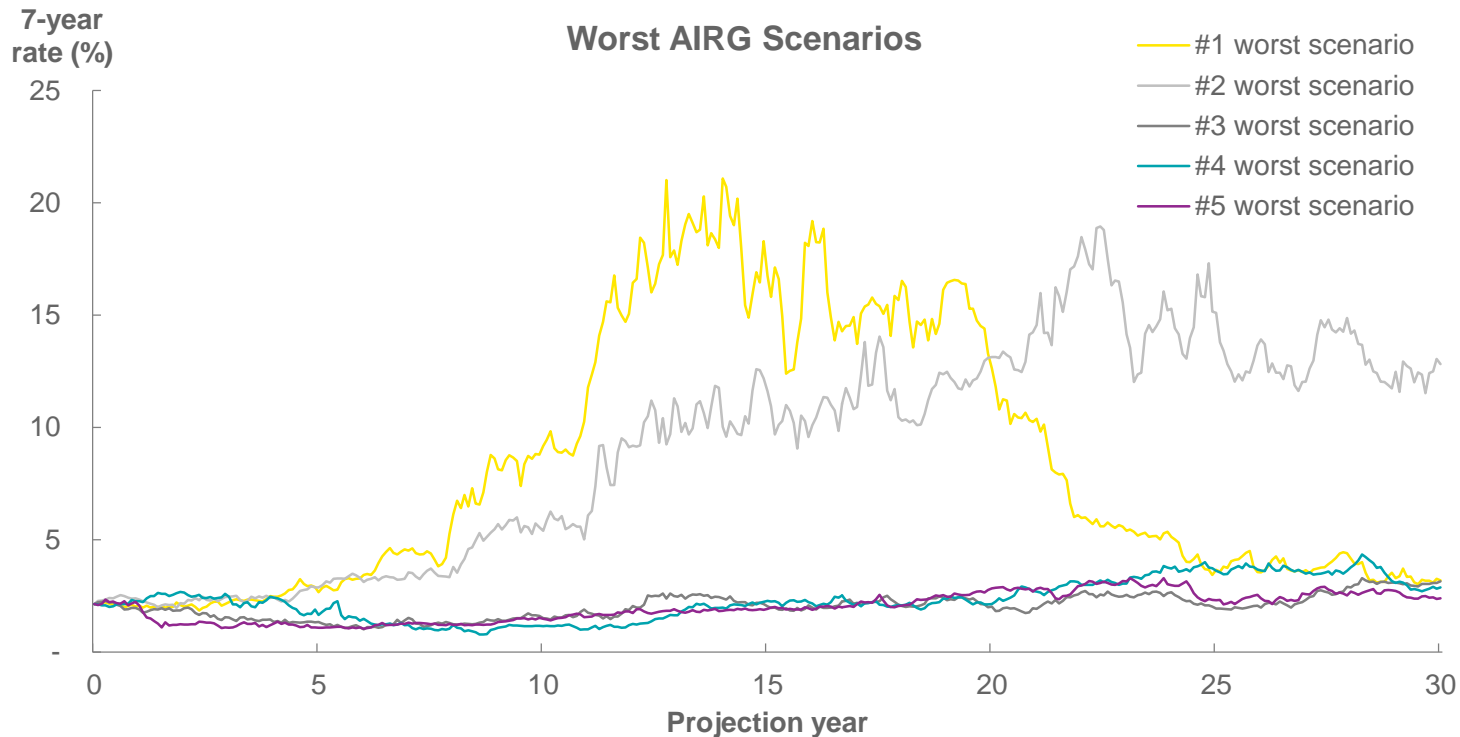
Ending Surplus: 30-year projections, in millions \$				
VaR	AIRG	RSCIR 7.5% trans. pr.	RSCIR 15% trans. pr.	RSCIR 30% trans. pr.
50.0%	1,417	650	1,024	1,426
70.0%	1,151	375	605	973
95.0%	575	(166)	(62)	77
99.0%	226	(430)	(470)	(557)
99.5%	102	(489)	(693)	(721)

- ▶ Compared to the AIRG, RSCIR produced results with:
 - ▶ Higher probability of asset deficiency
 - ▶ Increased tail risk

Worst scenarios

AIRG

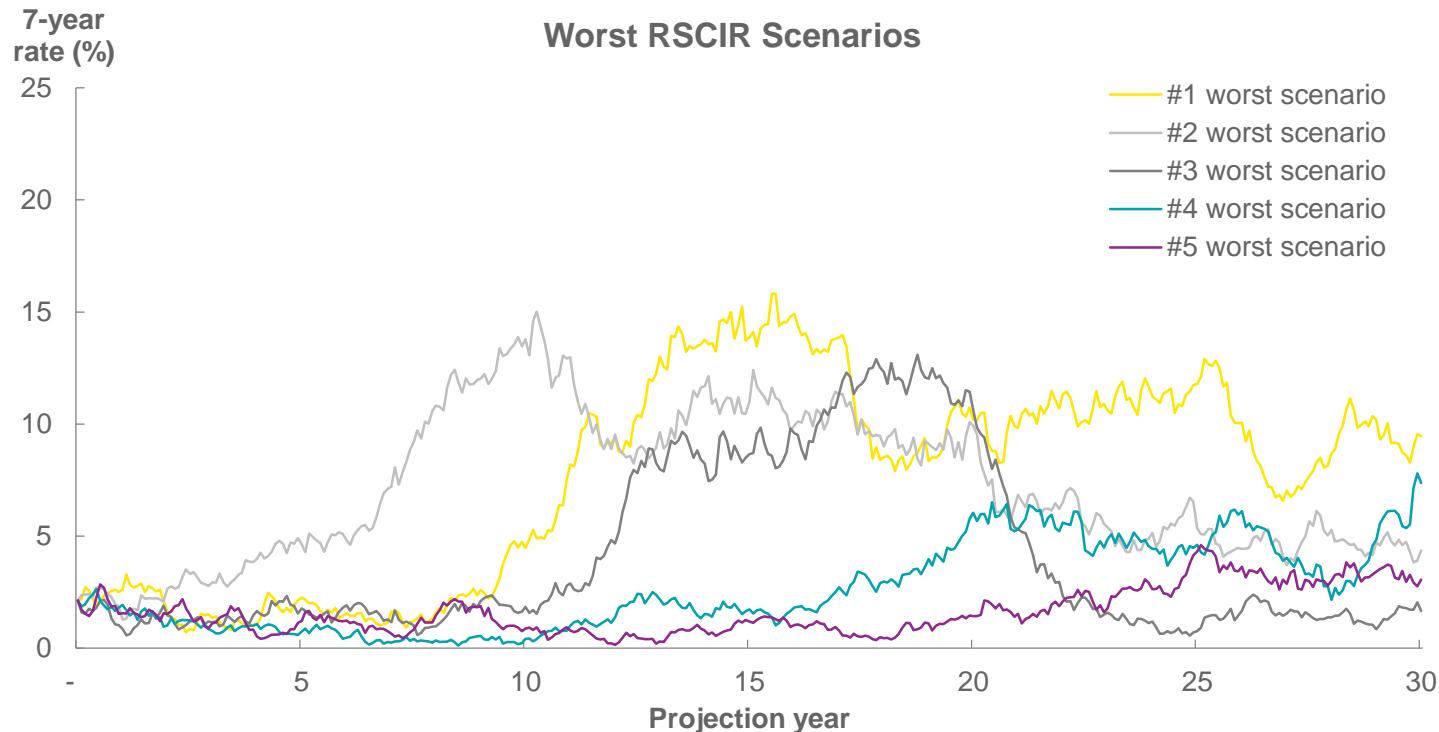
- ▶ Only 2 out of the 1,000 scenarios generated negative ending surplus.
 - ▶ The worst scenarios are the ones with extremely high rates (20%+ 7-year rate)
 - ▶ Scenarios where rates stay low are the next group of worst scenarios



Worst scenarios

RSCIR

- ▶ The worst scenarios under RSCIR captured the scenarios that companies considered to be the most significant risks:
 - ▶ Prolonged low interest rates
 - ▶ Rapid increase in interest rates at different projection periods



Takeaways

Key questions

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Takeaways

- ▶ Interest rates have stayed low, and there is a lot of uncertainty on where the rates are headed.
- ▶ The exact impacts are company specific but low interest rates have generally been hurting the bottom line and forcing companies to rethink their investment strategy and value proposition.
- ▶ Companies often assume rates will revert to historical averages, but there is a wide range of assumptions on how exactly this will happen.
- ▶ Commonly used ESGs may not fully address the unique challenges presented by the current low interest rate environment.
- ▶ Practitioners need to understand the inherent assumptions underlying their tools and enhance their analyses with alternative tools, such as regime-switching features.

Questions?

- ▶ We are interested in hearing your thoughts



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