Generator of Economic Scenarios (GOES) Stylized Facts and Acceptance Criteria

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NAIC NATIONAL ASSOCIATION OF INSURANCE COMMISSIONERS

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Treasury Model Acceptance Criteria

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Retained Treasury Model Acceptance Criteria

Item	Category	Criteria
T1.	Prevalence of High Rates, Upper Bound on Treasury Rates	a) The scenario set should reasonably reflect history, with some allowance for more extreme high and low interest rate environments b) Upper Bound: i. [20%] is >= [99%]-tile on the 3M yield fan chart, and no more than [5%] of scenarios have 3M yields that go above [20%] in the first 30 years ii. [20%] is >= [99%]-tile on the 10Y yield fan chart, and no more than [5%] of scenarios have 10Y yields that go above [20%] in the first 30 years
T2.	Lower Bound on Negative Interest Rates, Arbitrage Free Considerations	Apply the following guidance for negative rates: a) All maturities could experience negative interest rates b) Interest rates may remain negative for multi-year time periods c) Rates should generally not be lower than -1.5%
T3.	Initial Yield Curve Fit, Yield Curve Shapes in Projection, and Steady State Yield Curve Shape	a) Review initial actual vs. fitted spot curve differences for a sampling of 5 dates representing different shapes and rate levels for the entire curve and review fitted curves qualitatively to confirm they stylistically mimic the different actual yield curve shapes b) The frequency of different yield curve shapes in early durations should be reasonable considering the shape of the starting yield curve (e.g. a flatter yield curve leads to more inversions). c) The steady state curve has normal shape (not inverted for short maturities, longer vs shorter maturities, or between long maturities)

Modified Treasury Model Acceptance Criteria

Item	Category	Criteria
T4.	Low For Long: 12/31/20 Starting Conditions	a) At least 10% of scenarios need a 10-year geometric average of the 20-year UST below **1.45%** b) At least 5% of scenarios need a 30-year geometric average of the 20-year UST below **1.95%** **Note: As part of the model acceptance process, a given calibration of the GOES will be tested at multiple starting dates. This criteria is relevant for the 12/31/20 starting yield curve.**

Additional Treasury Model Acceptance Criteria

Item	Category	Criteria
T5.	Low- and High-For-Long at Varying Starting Conditions	a) For each scenario, calculate the geometric average of the [20-year] UST yield over the first [10] and [30] years of the projection. b) Calculate the [1st] and [99th] percentiles of the distribution of geometric average rates (for both the 10 and 30-year horizons). c) Look up criteria based on the starting level of the 20-year UST yield (interpolate if necessary).

Period	Initial UST20	10-year Geom Avg		30-year Geom Avg	
		1st percentile should be less than:	99th percentile should be greater than:	1st percentile should be less than:	99th percentile should be greater than:
Interim (years 0-10 or 0-30)	1%	0.94%	3.43%	1.50%	6.25%
	2%	1.23%	5.05%	1.68%	7.71%
	3%	1.62%	6.55%	1.86%	8.72%
	4%	2.15%	7.74%	2.06%	9.62%
	5%	2.66%	8.87%	2.26%	10.46%
	6%	3.15%	9.96%	2.50%	11.16%
	7%	3.63%	11.03%	2.78%	11.61%
	8%	4.10%	12.07%	3.06%	11.99%
	9%	4.64%	13.08%	3.34%	12.33%
	10%	5.21%	14.01%	3.65%	12.63%

Note: AAA recommended steady state portion of low- and high-for-long was not included in regulator criteria

Equity Model Acceptance Criteria

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Equity Model Acceptance Criteria

Item	Category	Criteria
E1.	Low and High Accumulated Equity Returns	Use the former C3 Phase II equity model Calibration Criteria as a rough placeholder benchmark when evaluating equity scenarios.

Large Cap (S&P 500) Gross Wealth Factors

Percentile	1 year	5 years	10 years	20 years
2.5%	0.78	0.72	0.79	
5.0%	0.84	0.81	0.94	1.51
10.0%	0.9	0.94	1.16	2.1
90.0%	1.28	2.17	3.63	9.02
95.0%	1.35	2.45	4.36	11.7
97.5%	1.42	2.72	5.12	

Corporate Model Acceptance Criteria

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Corporate Model Acceptance Criteria

Item	Category	Criteria
C1.	Target Steady State Excess Returns and Average Annualized Excess Returns in Years 20-30	a) Set steady state excess return targets for each bond fund according to the criteria below. b) Average annualized excess returns for each bond fund in years 20 through 30 of the projection should be no greater than the steady state excess returns, but no less than the steady state excess returns minus a buffer.

Historical Data

Historical averages (1999 to 2021) from Bloomberg *(bps)*	IG 1-5	IG 5-10	IG Long	HY
Option Adjusted Spread *(OAS)*	124	156	1.80	534
Spread Return *(determined from OAS and duration series)*	129	168	1.95	559
Excess Return	98	100	88	311
Frictional Cost *(Spread Return - Excess Return)*	31	68	107	248

Historical OAS split –Frictional Cost vs. Excess Return	IG 1-5	IG 5-10	IG Long	HY
Frictional Cost % of OAS	25%	44%	60%	46%
Excess Return % of OAS	75%	56%	40%	54%

Criteria

Steady state targets *(bps)*	IG 1-5	IG 5-10	IG Long	HY
Target OAS *(avg. VM-20 ult. spread at [12/31/21])*	107	141	163	448
Target Excess Return *(Target OAS * Excess Return % of OAS)*	80	79	66	240
Criteria for avg. annualized Excess Return in years [20-30]	80 -[10]	79 -[10]	66 -[10]	240 -[20]

Stylized Facts

Treasury Model Stylized Facts

1. **The level of interest rates (the cost of borrowing money) changes due to a variety of complex and interrelated factors (e.g., supply of and demand for financing, business cycle, GDP, inflation, central bank actions to stimulate the economy or control inflation**
   a) Short-term rates (which the Fed has more control of) have generally fallen within a range of 0% to 20% and have most often been within the lower part of that range. Long-term rates have generally been within 300 bps of short-term rates.
   b) Negative interest rates are possible (have been observed outside the U.S.) but unlikely due to structural and market differences between the U.S. and other economies.
   c) Interest rates can exhibit multi-year trends (e.g., up, down, low-for-long). Interest rates can stay at very low levels for several years. Short-term rates can stay low and rangebound ~~very near their lower bound~~ for several years while higher long-term rates continue to fluctuate.
2. **The volatility of interest rates varies over time, with periods of both high and low volatility.**
   a) Monthly changes in interest rates are generally limited in size (less than 80 bps) but changes tend to be greater when the level of interest rates is higher.
   b) Monthly changes in short-term rates tend to be larger than monthly changes in long-term rates when short-term rates are not near their lower bound, but the opposite relationship tends to hold when short-term rates are ~~near their lower bound~~ low or negative.
   ~~c) Volatility tends to increase in stressed markets.~~
   d) The standard deviation of monthly rate changes should generally be consistent with the historical data, given the level of interest rates.*
3. **The yield curve embodies the term structure of interest rates and takes a variety of shapes.**
   a) The normal yield curve shape is upward sloping (long-term rates greater than short-term rates) and concave downward. Normal yield curve shapes can persist for extended periods of time.
   b) Non-normal yield curve shapes include inversions (downward sloping), humps, and valleys. Inversions (and other non-normal yield curve shapes) are often associated with key points in the business cycle (e.g., recession indicator) but generally don't persist for extended periods of time.
   c) The slope of the yield curve tends to be lower (even negative/inverted) when short-term rates are at relatively high levels.
   d) Percentile metrics of the slope of the yield curve across scenarios should generally be consistent with history given the starting rate level.**

*added in place of AAA rate volatility criteria
**added in place of AAA rate slope criteria

Equity Model Stylized Facts

1. Equity indices (indeed, all asset classes) tend to exhibit **consistent risk/reward relationships** over long time horizons.
2. Cumulative equity returns tend to exceed the compounded risk-free rate (positive observed **equity risk premium**) over long time horizons, but over short time horizons the equity risk premium fluctuates due to several factors and can be negative.
3. Equities **fluctuate between bull and bear markets** (bubbles tend to burst) – markets can experience significant losses but eventually tend to **move back into positive territory** (cumulative equity returns over long time horizons tend to be positive).
4. Cumulative equity returns ***over long time horizons*** **are not materially impacted by initial market conditions**.
5. The **volatility of equity returns varies over time but has a strong tendency to revert to normative levels**. Changes in volatility over time increase the probability of both extreme gains and extreme losses from one period to the next (i.e., the distribution has fat tails, or ***positive kurtosis***). Furthermore, the **volatility of equity returns is higher in bear markets**. This increases the probability of extreme losses relative to extreme gains (i.e., the distribution has a longer left tail, or ***negative skewness***).
6. Equity markets contain **pathwise dynamics** over long time horizons that aren't present in the distribution of single-period returns. Future equity scenarios should have reasonable distributions of cumulative equity returns over long time horizons (e.g., 10, 20, 30 years), especially since these distributions are key to the performance of long-duration life and annuity products.
7. Future equity scenarios should include events that are plausibly **more extreme than history.**
8. Equity returns have both a **price and dividend component**, and they behave differently – Dividend returns tend to be more stable than price returns.
9. Returns between different equity indices are **generally positively correlated** over **long** time horizons. This correlation may increase sharply in bear markets, but it tends to revert to normative levels in a short period of time.

Corporate Model Stylized Facts

1. **General nature of credit markets and credit spreads**
   a) Credit markets tend to be cyclical with elevated defaults and migrations at the end of credit cycles. Credit-related losses tend to be "lumpy" or episodic.
   b) Credit spreads are positive and have a strong tendency to revert to long-term normative levels (generally within three to four years).
   c) Credit spreads exhibit volatility clustering (i.e., regimes of high and low volatility), and volatility has a strong tendency to revert to long-term normative levels.
2. **Corporate Credit Spreads: Relation across qualities and maturities**
   a) As a bond's credit quality decreases credit spreads, spread volatility, and the risk of loss increase.
   b) Longer maturity bonds generally have higher credit spreads than shorter maturity bonds. However, the credit spreads on shorter maturity bonds are more sensitive to current market conditions, so during market stresses credit spreads on shorter maturity bonds may increase more than credit spreads on longer maturity bonds.
   c) Credit spreads for different qualities and maturities tend to be strongly correlated (e.g., 80% or more).
3. **Corporate Credit Spreads: Relation to other market variables**
   a) Credit spreads tend to be higher and more volatile in equity bear markets (i.e., strong positive correlation to equity volatility, strong negative correlation to equity returns).
   b) Credit spreads tend to be negatively correlated with Treasury rates (i.e., flight to quality during market stress).
4. **General nature of bond index funds**
   a) A corporate bond fund is generally actively managed (regularly rebalanced) to meet defined maturity and quality targets (e.g.,- 5 to 10-year investment grade bonds) by trading individual bonds into and out of the fund. Such trading tends to increase when the corporate bond market experiences high levels of credit migration.

Corporate Model Stylized Facts (continued)

5. Bond index fund return dynamics

a) Bond index fund total returns reflect the impact of risk-free rates (and changes in risk-free rates) as well as credit-related returns in "excess" of risk-free rates.

- Total return = Risk free return + Excess return
- Excess return = Spread-based return -Frictional costs
- Spread-based return reflects credit spread income and price returns (i.e., changes in market price due to spread movement).
- Frictional costs reflect costs due to defaults (net of recoveries), migrations (e.g., selling downgraded bonds at a loss when they no longer meet the fund's quality targets), and rebalancing.

b) Bond index fund returns vary with the credit cycle.

- Spread-based return tends to decline significantly when spreads explode but then recover as spreads mean revert and migrations/defaults occur (i.e., the portfolio is purged).
- Frictional costs (which are generally not recoverable) tend to cluster and accumulate rapidly as bonds migrate/default, with severity depending on the magnitude and duration of the credit cycle.

6. Bond Index Fund Returns: Relation to other asset classes

a) Bond funds have risk/reward relationships that are generally consistent with other asset classes over long horizons.

b) Credit spreads for bond funds held in the separate account should be consistent with economic assumptions for bonds held in the general account.

Timeline for Testing and Major Milestones

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Timeline for Testing and Major Milestones

5-Oct	Expose Interest Rate, Equity, and Corporate Model Stylized Facts and Acceptance Criteria until 11/10.
10/12 or 10/19	Expose Corporate Model Quantitative and Transparency/Documentation Comparisons until 11/10.
Oct-Early Nov	Conning Recalibrate Models based on exposed Stylized Facts and Acceptance Criteria. NAIC Model Office Improvements.
29-Nov	Review Stylized Facts and Acceptance Criteria Comments, Conning Scenarios after re-calibration in Orlando. Potentially Adopt Final Stylized Facts and Acceptance Criteria. Review Corporate Model Comparisons. Potentially select Corporate Model.
Nov-Feb	NAIC Model Office Testing. Circulate any promising scenario sets. Individual Companies with capacity that wish to do so are encouraged to test using their own models and share results with regulators. GOES Subgroup calls to review scenario statistics against acceptance criteria, review model office results. Adopt Final Stylized Facts and Acceptance Criteria if regulators have substantial edits. Conning recalibrations, if so.
3/14/2024	Present Model Office Results, Expose Scenario Set(s).
March-June	Unaggregated GOES Field Test (VM-20, VM-21/C3P2, and C3P1), If Needed
June-July	Reg-Only Company Presentations of Unaggregated GOES Field Test (VM-20, VM-21/C3P2, and C3P1) Results, If Needed
July-Sept	VM-22 Field Test

Note: Timeline is subject to change