OliverWyman

NAIC
NATIONAL ASSOCIATION OF
INSURANCE COMMISSIONERS

NAIC GOES MODEL OFFICE ANALYSIS

Scenario Analysis Results

June 12, 2024

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SECTION 1

EXECUTIVE SUMMARY

MODEL AND MODEL OFFICE DEVELOPMENT AND ANALYSIS

Oliver Wyman developed a variable annuity ("VA") AXIS model and "model office toolkit", with the goal of developing a model with adjustable driving characteristics to explain field test results and analyze potential candidate scenario sets

Model build

- VA model developed in AXIS

- Model office creation tool accepts user input regarding benefits and demographics to quickly generate reserves and capital for different archetypes

- Validation tools are used alongside model to ensure accuracy of results

Archetype analysis

- Defined driving characteristics and developed 16 archetypes that make up the model office

- Generated model office testing results based on scenario set 1a[1] from the first GOES field test

- Learnings from model office analysis used to draw additional insights into field test results

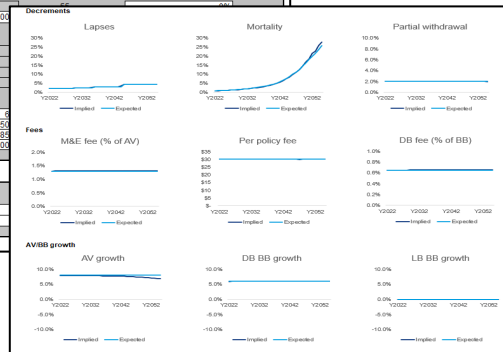## Model office GOES impact analysis

Current phase

- For the second GOES field test, selected 3 of the 16 key archetypes to be representative of a hypothetical industry participant

- Produced results based on AAA ESG, the 5 required scenario sets for the field test (Set 1-5), and the alternative baseline scenario (Set 6)[2]

- Analyzed results and underlying scenarios to understand the drivers of impact
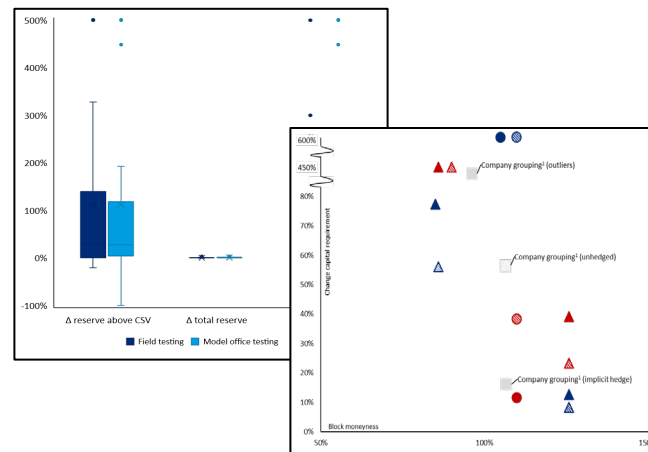
Model office creation tool

Model validation tool

Model office results

Scenario Analysis
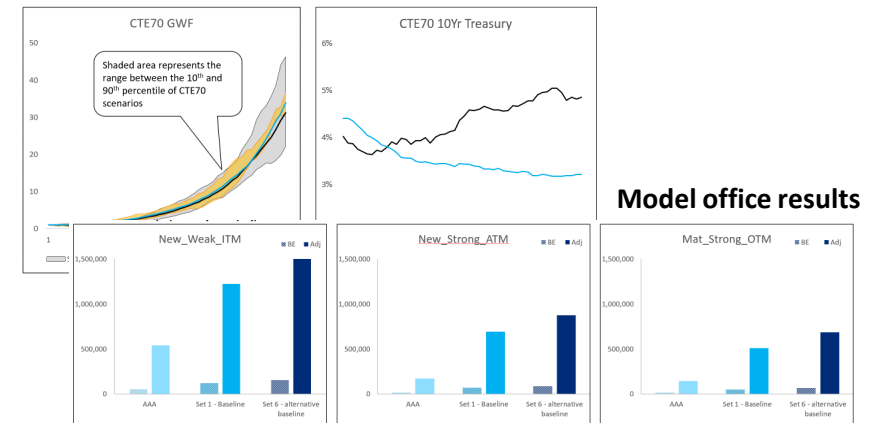
Model office results

1: GEMS Baseline Equity and Corporate model scenarios and Conning Treasury model calibration with generalized fractional floor as of 12/31/21   2. All scenarios are as of 12/31/2023. See slide 15 on descriptions of the scenarios

# EXECUTIVE SUMMARY: MODEL OFFICE GOES IMPACT ANALYSIS

The targeted model office was used to draw insights into field test results and develop a better understanding of how the GOES algorithm impacts projections under a range of starting economic conditions

Analysis performed

Leveraged prior archetype analysis to select 3 key cohorts to analyze under the new field test scenario sets:
1. Mature business / Strong guarantee / At-the-money
2. New business / Strong guarantee / Out-of-the-money
3. New business / Weak guarantee / In-the-money

Produced CTE70 and CTE98 results to analyze changes in VM-21 reserves and capital requirements, consistently with field test requirements. A 1,000 scenario subset was picked based on the significance criteria and all results were produced for 12/31/2023 valuation date.

Key takeaways

1 *Set 1 vs AAA*

Set 1 produces higher reserves than the AAA ESG:
Analysis of tail scenario confirmed that accumulated Gross Wealth Factors ("GWF") are lower in the Set 1 results than in the AAA ESG scenarios and interest rates are lower in earlier years, both of which lead to higher CTEs

2 *Sets 2-5 vs Set 1*

Sensitivity scenario sets produced impacts consistent with expectations:
Lower yield curves lead to higher reserves due to lower reinvestment income, and vice versa; lower equity returns increase reserves due to guarantees becoming more in-the-money

3 *Alternative baseline vs Set 1*

Alternative baseline produces higher reserves than Set 1:
The proposed adjustments to the fit of the yield curve produced higher reserves, given that reinvestment rates are tied to the 10-year Treasury rates and longer tenors do not impact reinvestment rates

CTE70 (adjusted) in excess of CSV by scenario set
Economic scenarios: AAA, GOES Scenario Sets 1-5, alternative baseline
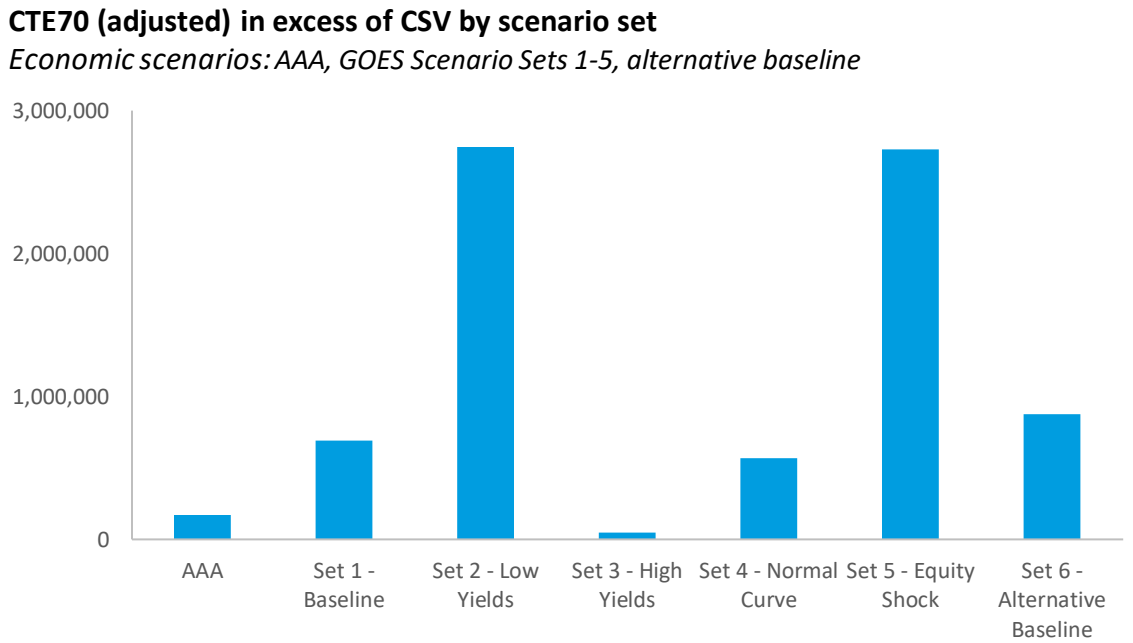
SECTION 2

VM-21 REFRESHER

VM-21 RESERVE REFRESHER: RESERVE COMPONENTS

The primary component of VM-21 reserves is the stochastic reserves, which is based on scenario reserves floored at the CSV

① Stochastic reserves

- Combination of two CTE70s based on different **scenario reserves**
  - Hedged, i.e., CTE (best efforts)
  - Unhedged, i.e., CTE (adjusted)
- Adjusted for error factor
- Simplified terms: Hedged results + Impact of hedging * error factor

Other VM-21 reserve components

② Additional standard projection amount ("ASPA")

- Additional reserve held if company assumptions are too aggressive relative to prescribed assumptions

③ Pre-tax IMR ("PIMR")

- Allocated PIMR attributed to assets selected

Initial model office testing resulted in an ASPA value of zero due to the buffer component; PIMR assumed to be zero

Scenario reserves overview

- **Scenario reserve =** Starting assets required to fund all future liability cash flows, with no intermediate deficiencies, for a given economic scenario

- Building block to the stochastic reserve, made up of a set of scenario reserves

- Calculated and recorded for each economic scenario (equity, bond fund, and interest rate)

- Projected separately on both a hedged and unhedged basis, for a contract grouping

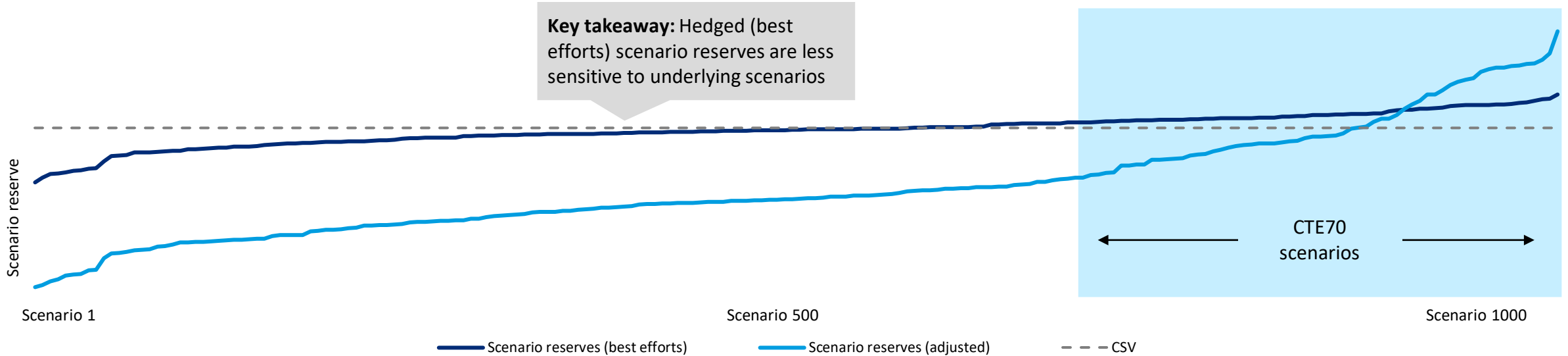- Floored at the cash surrender value

VM-21 RESERVE REFRESHER: STOCHASTIC RESERVE

The stochastic reserve is a combination of CTE70s from scenario reserves on a hedged and unhedged basis

Stochastic reserve = CTE70 (best efforts) + E × max[0, CTE70 (adjusted) − CTE70 (best efforts)]

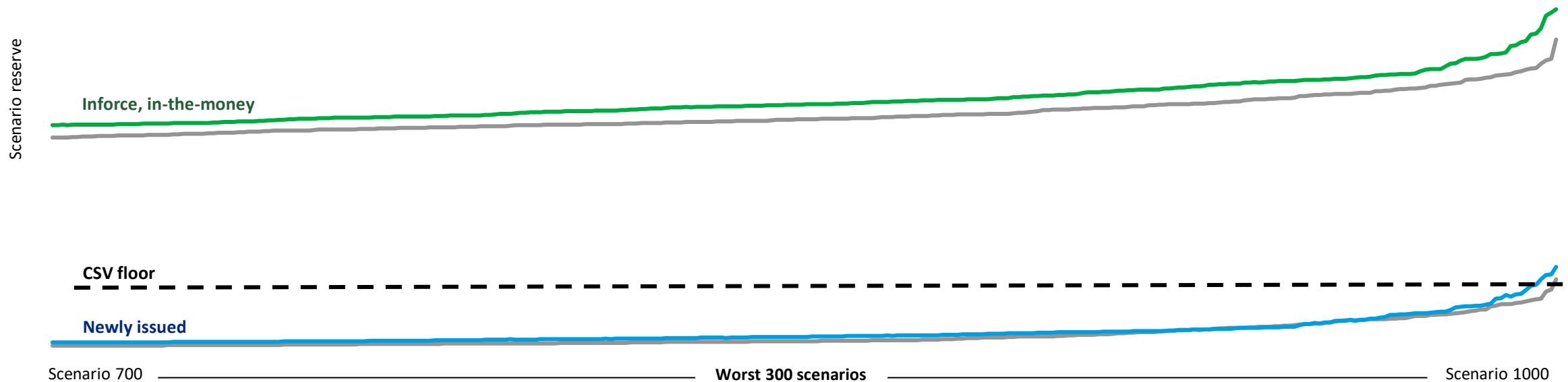| Component	Details
CTE70 (best efforts)	• CTE70 of **scenario reserves (best efforts)** • Scenario reserve calculation reflects future hedging strategy
CTE70 (adjusted)	• CTE70 of **scenario reserves (adjusted)** • Scenario reserve calculation does not reflect future hedging strategy
Error factor (E)	• Accounts for potential overstatement of the impact of the hedging strategy • Between 5% - 100% based on the model's level of sophistications and its ability to reflect the parameters of the hedging strategy

CHANGE IN EXCESS VS CHANGE IN TOTAL SCENARIO RESERVE

Reserves in excess of CSV is the "true" measure of financial impact and more reactive to scenario changes; total reserves do not move much relatively due to CSV being a large component and not impacted by scenarios

Worst 300 of 1000 adjusted scenario reserves

Set1 = colored lines, AAA = gray lines

Illustrative

Scenario reserve

Inforce, in-the-money

CSV floor

Newly issued

Scenario 700 ——— Worst 300 scenarios ——— Scenario 1000

Larger difference when scenario reserves are low relative to the CSV floor

Archetype	Scenario reserve position relative to the CSV floor	Average increase in unfloored scenario reserve	Increase excess reserve	Increase in total reserves
Inforce, in-the-money	High	4%	**8%**	4%
Newly issued	Low	0.2%	**450%**	0.1%

SECTION 3
MODEL AND SCENARIO SETS

MODEL COMPONENTS AND FUNCTIONALITY

Component	Description of functionality
Liability modeling	• Liability cash flows for model office comprised of the following product features: — Base variable annuity contract and a variety of GMxB (GLWB, GMDB, GMIB) with typical features and charges • Modeled on a direct basis only (i.e., without reinsurance)
Asset modeling	• Guardrail VM-21 prescribed strategy: 10-year bonds with ratings A and AA consistent with the guardrail prescribed under VM-21
Calculations	• Outer loop cash flows under best estimate assumptions and input deterministic scenarios • Pre-tax asset and liability projections under input stochastic scenarios reflecting all cashflows under prudent best estimate and VM-21 prescribed assumptions • Inforce asset iteration at valuation date under input stochastic scenarios to achieve no GPVAD • Fair value of living benefit riders on annual timesteps to support implicit hedging approach
Assumption sets	• Best estimate • Prudent best estimate • VM-21 standard projection prescribed
Hedging	• Employs the "cost of reinsurance" method (i.e., implicit method) in the best efforts run, option cost is charged at time 0 and rider fees and claims are removed
Reporting	• Stochastic reserve (CTE70 pre-tax under adjusted and best efforts hedge) • Standard projection add-on under CTEPA method (CTE70 under prescribed in excess of SR, subject to CTE70 – CTE65 unfloored buffer) • C3 at 100% RBC (CTE98 pre-tax and subsequent calculations). Note: C3 will be unsmoothed

DRIVING CHARACTERISTICS: SPECIFICATIONS

In-force archetypes were created using a model office creation toolkit and varied by driving characteristics. A wide range was used in determining variation in driving characteristics in order to capture a range of impacts to compare against field testing

Characteristic	Variations	Values
GMWB guarantee strength	Weak guarantee	**Rollup rate:** 3% **Income rates:** 4.0% - 5.5% based on attained age
	Strong guarantee	**Rollup rate: 7**% **Income rates:** 5.5% - 7.0% based on attained age
Hedging	Hedged	**Hedge modeling:** Implicit method
	Unhedged	**Hedge modeling:** None
Block maturity	New	**Issue year:** 2022 **Average age:** 66 **Percentage of GMWB contracts taking income:** 20%
	Mature	**Issue year:** 2007 **Average age:** 75 **Percentage of GMWB contracts taking income:** 75%
Moneyness	OTM / ATM / ITEM	**OTM:** Benefit Base is 90%-100% of AV **ATM:** Benefit Base is 100%-110% of AV **ITM:** Benefit Base is 110%-140% of AV
Other	Static inputs	**M/F sex split:** 50/50 **Q/NQ split:** 65/35 **Equity allocation:** 70%

IN-FORCE ARCHETYPES: GMWB/GMDB COMBO

16 different GMWB/GMDB combo archetypes were used in the initial model office testing. 3 cohorts outlined below are the focus for this analysis, based on their representativeness of industry results

	Archetype	LB rider	DB rider	Hedging	Guarantee strength	Block maturity	Moneyness
▲	1	Rollup GMWB	ROP GMDB	Implicit	Strong	New	ITM
▲	2	Rollup GMWB	ROP GMDB	Implicit	Strong	New	OTM
●	3	Rollup GMWB	ROP GMDB	Implicit	Strong	Mature	ITM
●	4	Rollup GMWB	ROP GMDB	Implicit	Strong	Mature	ATM
▲	5	Rollup GMWB	ROP GMDB	Implicit	Weak	New	ITM
▲	6	Rollup GMWB	ROP GMDB	Implicit	Weak	New	OTM
●	7	Rollup GMWB	ROP GMDB	Implicit	Weak	Mature	ITM
●	8	Rollup GMWB	ROP GMDB	Implicit	Weak	Mature	ATM
△	9	Rollup GMWB	ROP GMDB	None	Strong	New	ITM
△	10	Rollup GMWB	ROP GMDB	None	Strong	New	OTM
◎	11	Rollup GMWB	ROP GMDB	None	Strong	Mature	ITM
◎	12	Rollup GMWB	ROP GMDB	None	Strong	Mature	ATM
△	13	Rollup GMWB	ROP GMDB	None	Weak	New	ITM
△	14	Rollup GMWB	ROP GMDB	None	Weak	New	OTM
◎	15	Rollup GMWB	ROP GMDB	None	Weak	Mature	ITM
◎	16	Rollup GMWB	ROP GMDB	None	Weak	Mature	ATM

Focus for this analysis

FIELD TEST SCENARIO SETS

Model office testing was performed on field test scenario sets 1-6, including the alternative baseline

| Field Test Run	Scenario Sets	Inforce Assets and Liabilities	Comparison Scenario set
AAA	AAA ESG as of 12/31/2023	As of 12/31/23	
Set 1 – GOES Baseline	Conning scenarios as of 12/31/23	As of 12/31/23	Baseline (AAA)
Set 2 – Low Rate Shock	Conning scenarios with a starting UST yield curve as of 3/9/20 but with 12/31/23 starting credit spreads.	As of 12/31/23	Set 1
Set 3 – Up Rate Shock	Conning Scenarios with a starting UST yield curve as of 10/31/89 but with 12/31/23 starting credit spreads.	As of 12/31/23	Set 1
Set 4 – Normal Yield Curve	Conning scenarios with a starting UST yield curve as of 12/31/04 but with 12/31/23 starting credit spreads.	As of 12/31/23	Set 1
Set 5 – Down Equity Shock	Conning scenarios as of 12/31/23 (same as Field Test 1)	As of 12/31/23, but modified for a 25% drop in equity markets	Set 1
Set 6 – Alternative Baseline	Conning scenarios as of 12/31/23 but with the alternative yield curve fitting proposed by ACLI	As of 12/31/2023	Set 1

SECTION 4

MODEL OFFICE RESULTS

BASELINE SCENARIOS – RESERVES COMPARISON

Comparison of VM-21 reserves in excess of CSV for all three cohorts, outlining the difference between the AAA ESG, the GOES baseline, and the alternative baseline reserves

VM21 CTE (best efforts) ("BE") and CTE (adjusted) ("Adj") reserves in excess of CSV
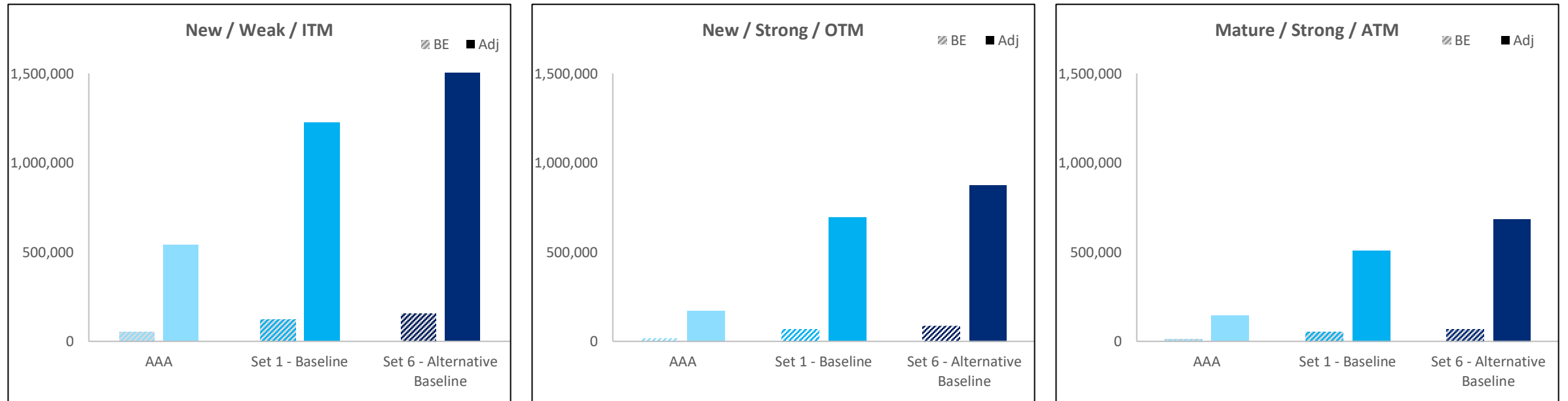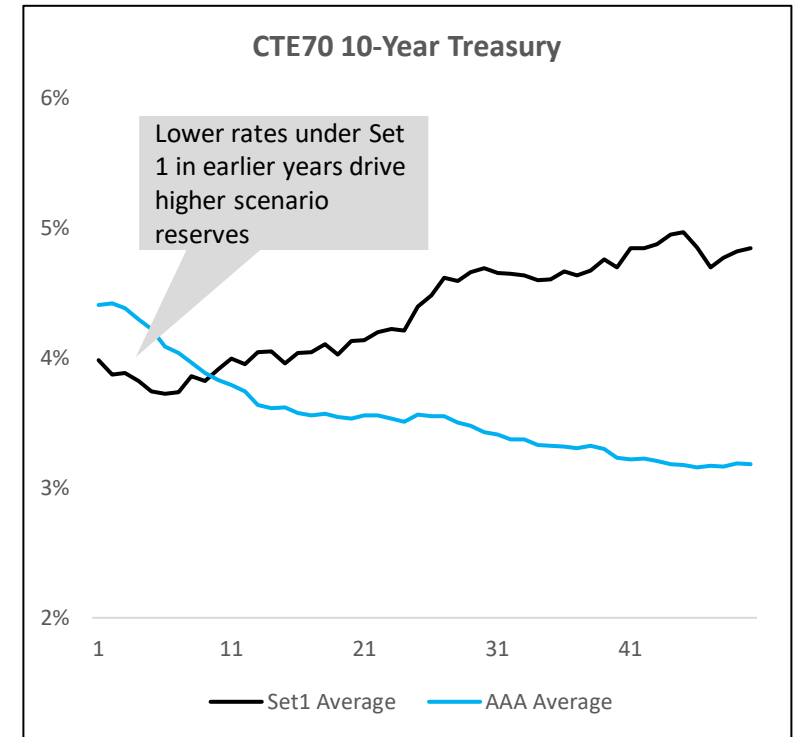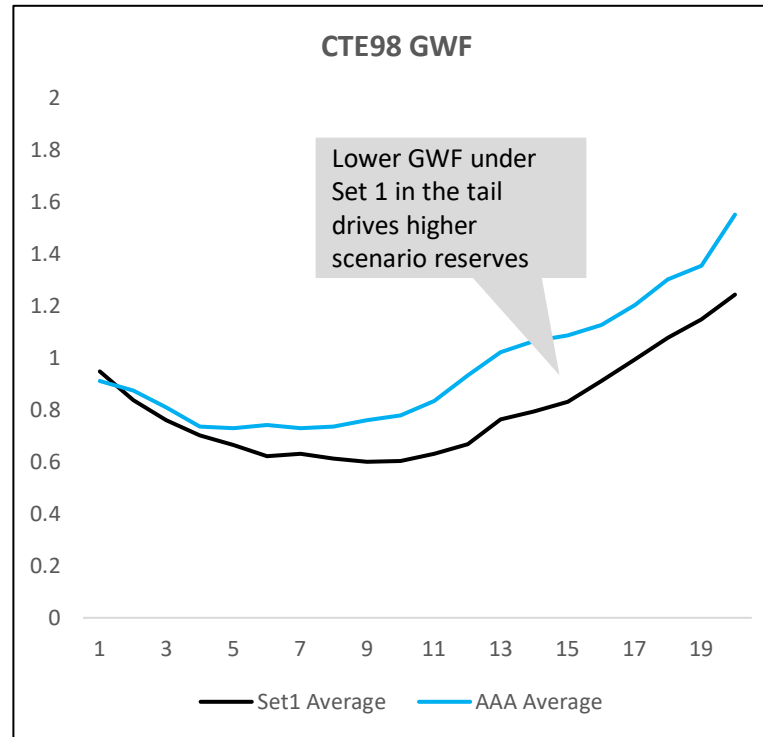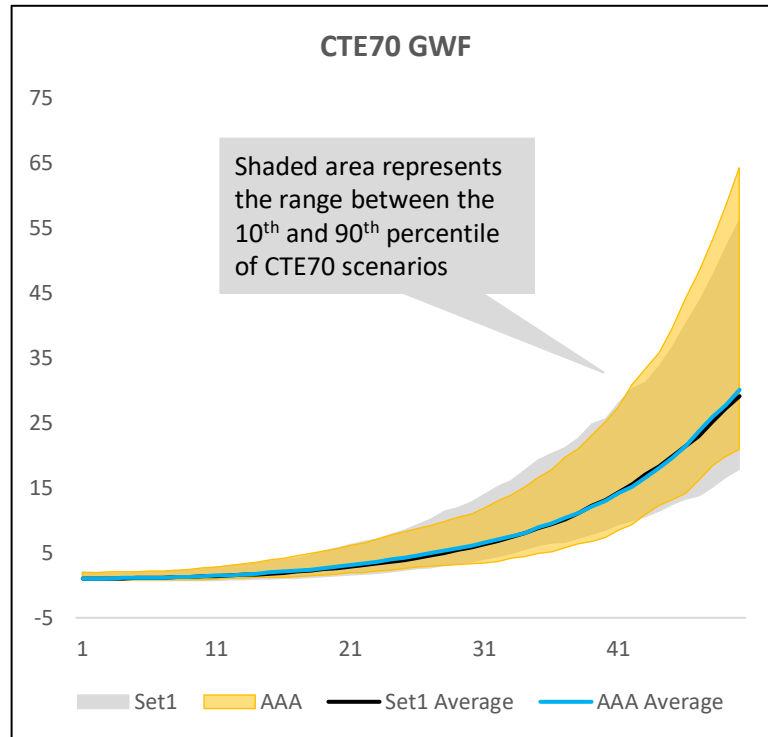

CTE70 (adjusted) by archetype (000s)

Archetype	AAA ESG [A]	GOES Set 1 [B]	Goes Alt. Baseline [C]	([B] – [A]) / [A]	([C] – [B]) / [B]
New / Weak / ITM	540	1,223	1,542	126%	26%
New / Strong / OTM	171	693	876	303%	26%
Mature / Strong / ATM	145	509	684	251%	34%

GOES Set 1 produces higher reserves than the AAA ESG as a result of compressed equity returns in the tail and lower Treasury rates in early durations. The alternative baseline produced similar but slightly more adverse results than Set 1

BASELINE SCENARIOS – SCENARIO ANALYSIS – NEW / WEAK / ITM COHORT

Comparison of average accumulated gross wealth factors ("GWF") and 10-Year Treasury curve for CTE70 and CTE98 scenarios over 50 years of projection for the New / Weak Guarantee / ITM cohort

New / Weak Guarantee / ITM Cohort

CTE70 GWF — Shaded area represents the range between the 10th and 90th percentile of CTE70 scenarios. Legend: Set1, AAA, Set1 Average, AAA Average.

CTE98 GWF — Lower GWF under Set 1 in the tail drives higher scenario reserves. Legend: Set1 Average, AAA Average.

CTE70 10-Year Treasury — Lower rates under Set 1 in earlier years drive higher scenario reserves. Legend: Set1 Average, AAA Average.
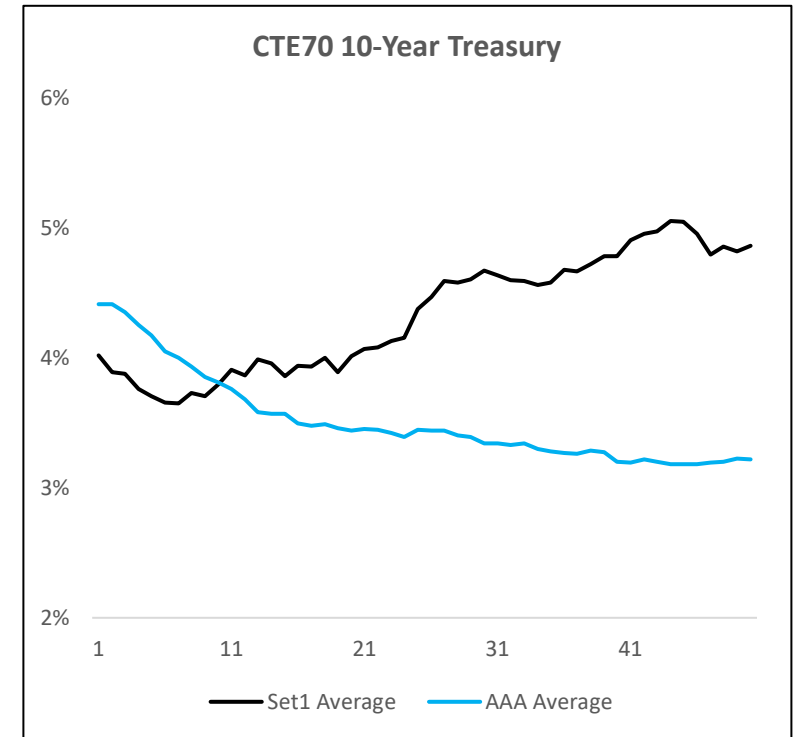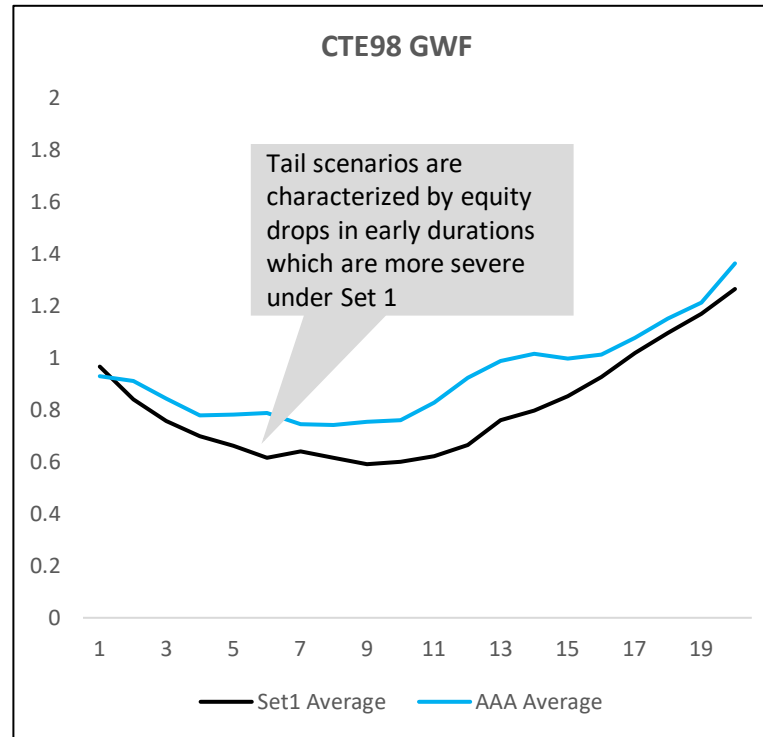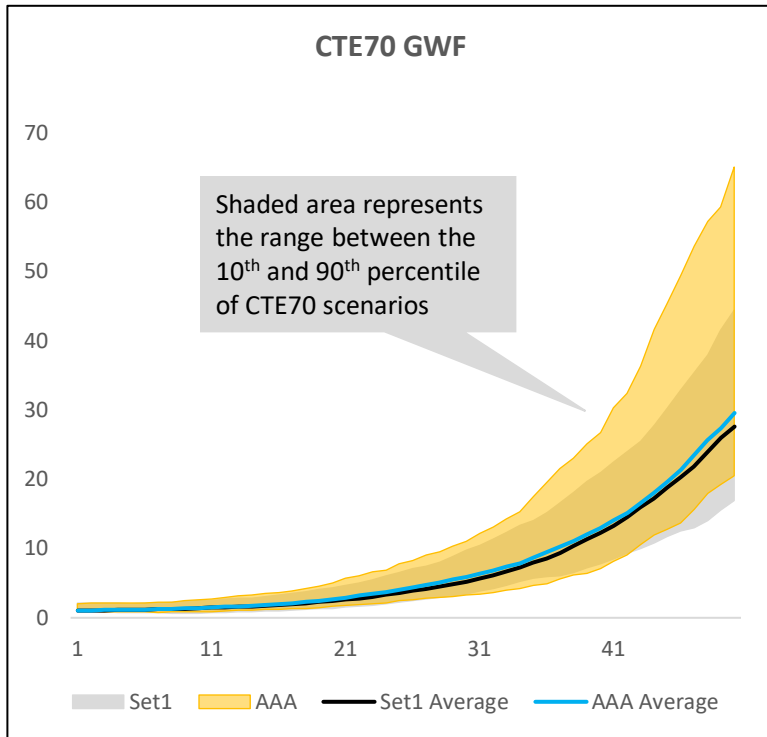
Average equity return from GOES scenarios is similar to AAA ESG at the CTE70 level, however tail scenarios are more adverse; lower GOES rates in earlier years are producing adverse results despite reverting to a higher mean in later years

BASELINE SCENARIOS – SCENARIO ANALYSIS – NEW / STRONG / OTM COHORT

Comparison of average accumulated gross wealth factors ("GWF") and 10-Year Treasury curve for CTE70 and CTE98 scenarios over 50 years of projection for the New / Strong Guarantee / OTM cohort

New / Strong Guarantee / OTM Cohort

CTE70 GWF — Shaded area represents the range between the 10th and 90th percentile of CTE70 scenarios. Legend: Set1, AAA, Set1 Average, AAA Average

CTE98 GWF — Tail scenarios are characterized by equity drops in early durations which are more severe under Set 1. Legend: Set1 Average, AAA Average

CTE70 10-Year Treasury — Legend: Set1 Average, AAA Average

Average equity return from GOES scenarios is similar to AAA ESG at the CTE70 and CTE98 levels, however tail scenarios for GOES are more adverse; lower GOES rates in earlier years are producing adverse results despite reverting to a higher mean in later years

BASELINE SCENARIOS – SCENARIO ANALYSIS – MATURE / STRONG / ATM COHORT

Comparison of average accumulated gross wealth factors ("GWF") and 10-Year Treasury curve for CTE70 and CTE98 scenarios over 50 years of projection for the Mature / Strong Guarantee / ATM cohort

Mature / Strong Guarantee / ATM Cohort
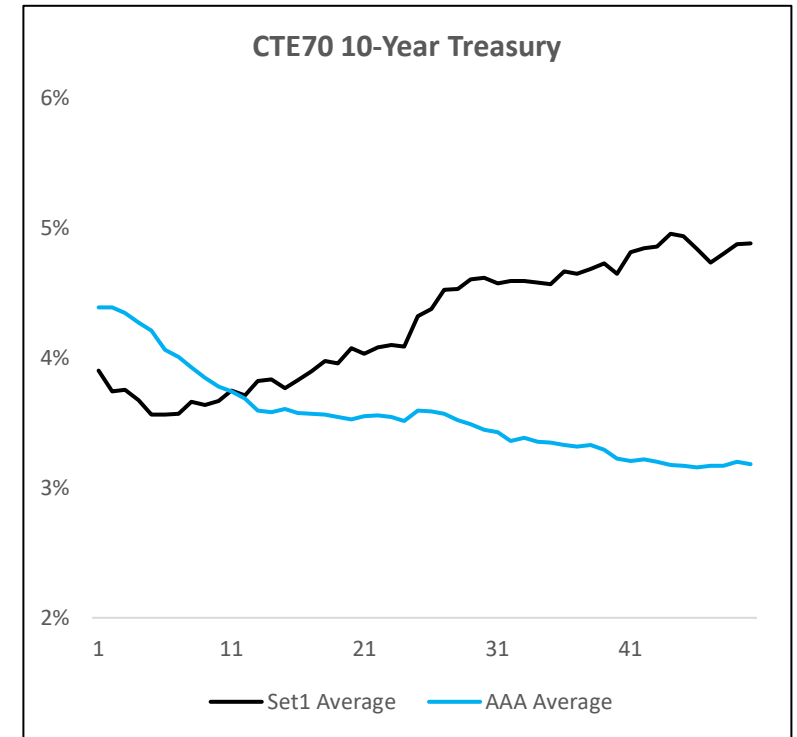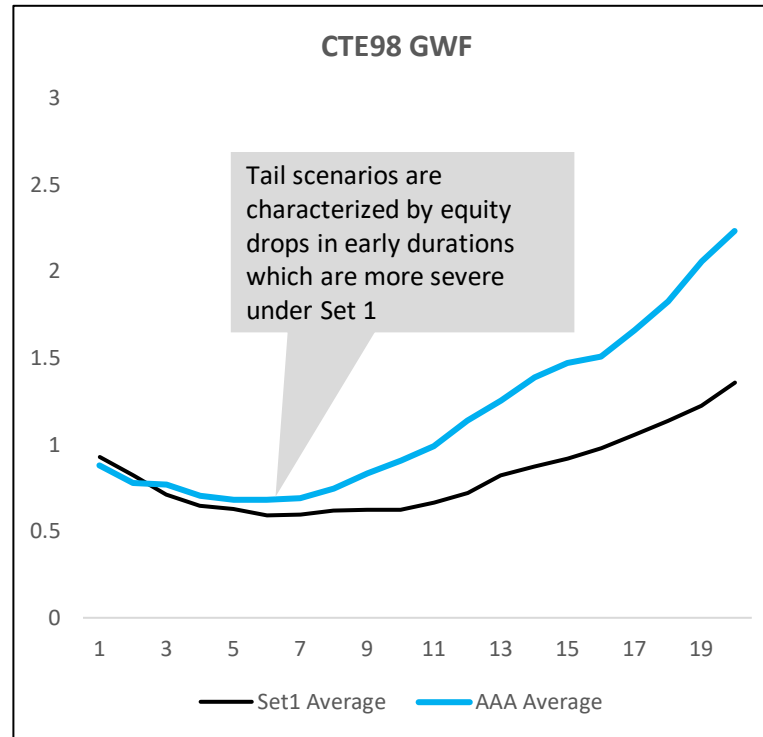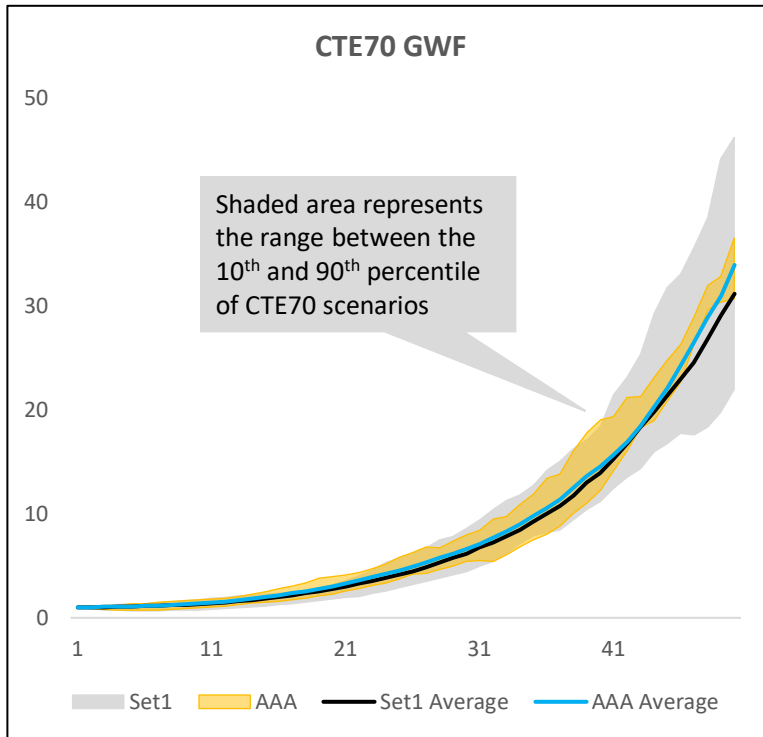
Average equity return from GOES scenarios is similar to AAA ESG at the CTE70 and CTE98 levels but more disbursed and adverse in the tail; lower GOES rates in earlier years are producing adverse results despite reverting to a higher mean in later years

SENSITIVITY SCENARIOS – RESERVES (SET 2)

Comparison of VM-21 reserves in excess of CSV for all three cohorts, outlining the difference between the **GOES baseline**, and the **low starting yield curve** scenario set reserves

VM21 CTE (best efforts) ("BE") and CTE (adjusted) ("Adj") reserves in excess of CSV
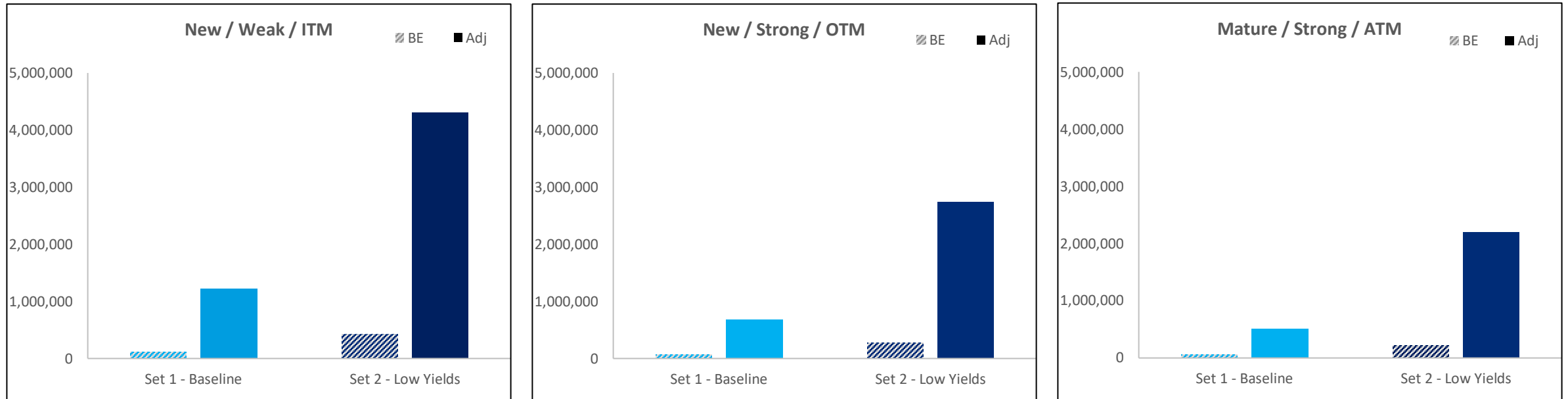
CTE70 (adjusted) by archetype (000s)

Archetype	Set 1 [A]	Set 2 [B]	([B] – [A]) / [A]
New / Weak / ITM	1,223	4,304	251%
New / Strong / OTM	693	2,741	295%
Mature / Strong / ATM	509	2,199	331%

The Set 2 scenarios are producing significantly higher reserves than the baseline scenario set due to the compressed yield curve and high prevalence of negative interest rates for sustained periods

SENSITIVITY SCENARIOS – RESERVES (SET 3)

Comparison of VM-21 reserves in excess of CSV for all three cohorts, outlining the difference between the **GOES baseline**, and the **high starting yield curve** scenario set reserves

VM21 CTE (best efforts) ("BE") and CTE (adjusted) ("Adj") reserves in excess of CSV
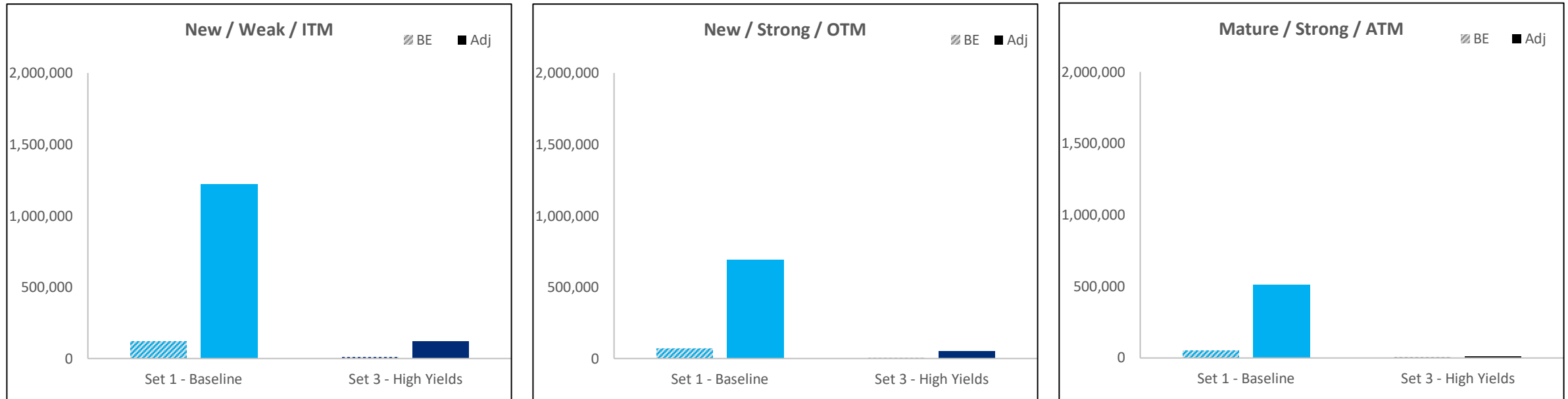

CTE70 (adjusted) by archetype (000s)

Archetype	Set 1 [A]	Set 3 [B]	([B] − [A]) / [A]
New / Weak / ITM	1,223	121	-91%
New / Strong / OTM	693	50	-93%
Mature / Strong / ATM	509	5	-99%

The Set 3 scenarios are producing significantly lower reserves than the baseline scenario set due to the favorable yield curve; we note that a significant portion of scenario reserves are floored at the CSV under this sensitivity

SENSITIVITY SCENARIOS – RESERVES (SET 4)

Comparison of VM-21 reserves in excess of CSV for all three cohorts, outlining the difference between the **GOES baseline**, and the **non-inverted yield curve** scenario set reserves

VM21 CTE (best efforts) ("BE") and CTE (adjusted) ("Adj") reserves in excess of CSV
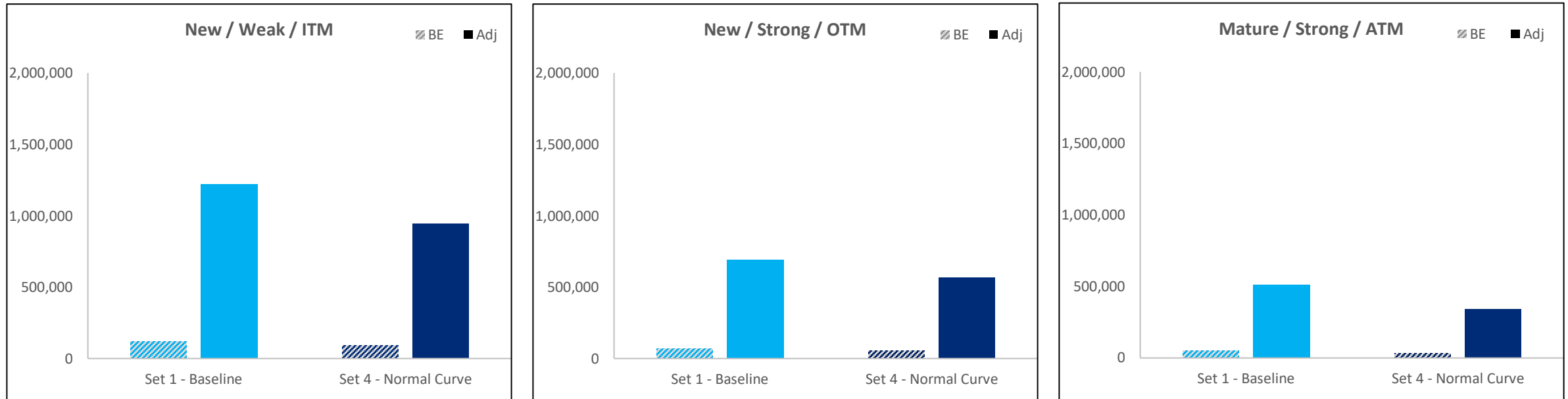

CTE70 (adjusted) by archetype (000s)

Archetype	Set 1 [A]	Set 4 [B]	([B] – [A]) / [A]
New / Weak / ITM	1,223	947	-23%
New / Strong / OTM	693	556	-18%
Mature / Strong / ATM	509	339	-33%

The Set 4 scenarios are producing slightly lower reserves than the baseline scenario set due to slightly higher yields from the non-inverted curve; the reinvestments are anchored to 10-year A & AA Corporate Bond returns

SENSITIVITY SCENARIOS – RESERVES (SET 5)

Comparison of VM-21 reserves in excess of CSV for all three cohorts, outlining the difference between the **GOES baseline**, and the **25% equity shock** scenario set reserves

VM21 CTE (best efforts) ("BE") and CTE (adjusted) ("Adj") reserves in excess of CSV

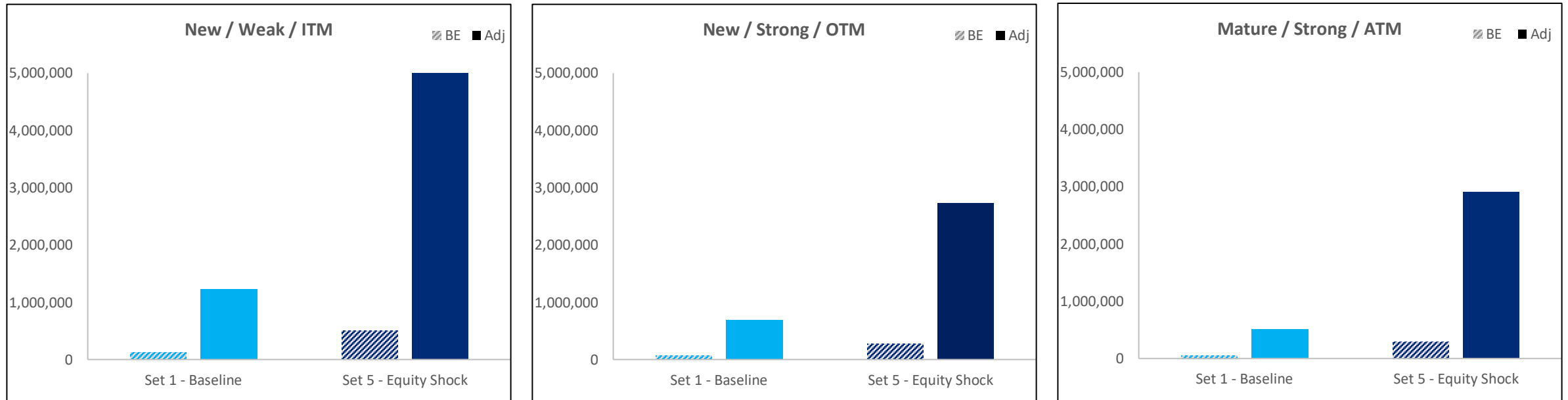**CTE70 (adjusted) by archetype (000s)**

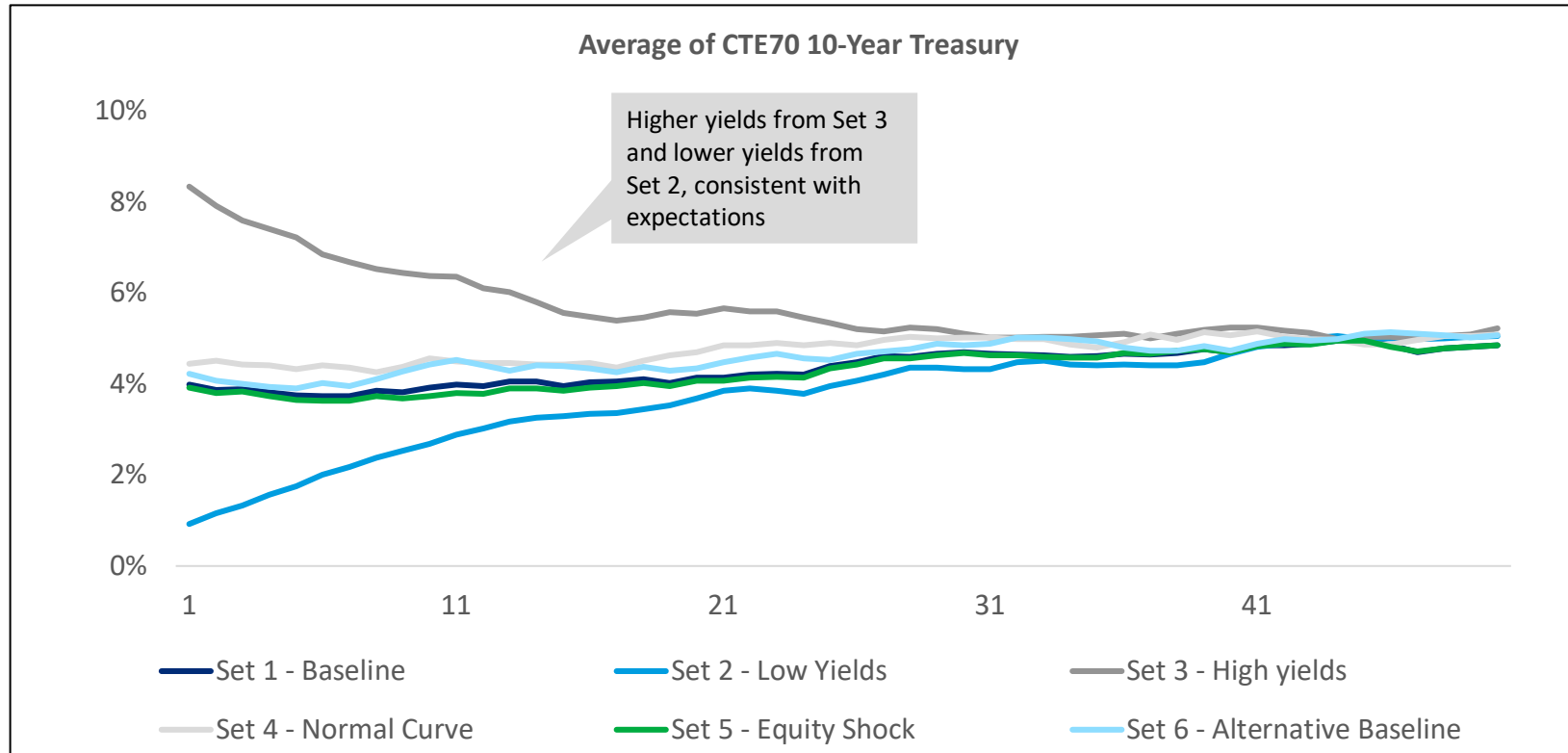| Archetype	Set 1 [A]	Set 5 [B]	([B] − [A]) / [A]
New / Weak / ITM	1,223	5,016	310%
New / Strong / OTM	693	2,726	293%
Mature / Strong / ATM	509	2,899	469%

A 25% decrease to the S&P 500 market has a significant impact to results due to the significant immediate increase to the moneyness and decrease in fee base, pushing more scenario reserves beyond the CSV floor

SENSITIVITY SCENARIOS – SCENARIO ANALYSIS

Comparison of 10-Year Treasury curve for CTE70 scenarios for all scenario sets. The new / weak guarantee / ITM cohort is shown below. Scenario distributions for other archetypes are very similar and thus not shown

New / Weak Guarantee / ITM Cohort

Average of CTE70 10-Year Treasury

Higher yields from Set 3 and lower yields from Set 2, consistent with expectations

Legend:
- Set 1 - Baseline
- Set 2 - Low Yields
- Set 3 - High yields
- Set 4 - Normal Curve
- Set 5 - Equity Shock
- Set 6 - Alternative Baseline

10-year Treasury rates in earlier years are consistent with the shocks and are largely the driver of reserve impact; over time, all scenarios converge to similar long-term average due to mean reversion

APPENDIX

GOES PRESENTATION 2/17/2024 - PHASE 1 RESULTS

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NAIC GOES MODEL OFFICE ANALYSIS

Phase 1 results

February 7, 2024

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SECTION 1

BACKGROUND | PHASE 1 EXECUTIVE SUMMARY

SECTION 1.1

BACKGROUND

NAIC GOES ECONOMIC SCENARIO SET EVALUATION

Overview of progress to date

In 2022, a field test examining alternative economic scenario sets under statutory reserve and capital frameworks was conducted across life insurance and annuity products. The results highlighted the expected impact to the industry but **left open questions regarding the company-specific drivers** of changes in the reserves over cash surrender value. **Model office analysis** will be performed alongside **an unaggregated field test** to analyze new GOES candidate scenario sets.

2022 GOES Field Test summary and limitations

Field test summary

✓ Between the baseline and field test runs, there was typically a wide range of impacts across participants with some experiencing small changes and others seeing significant increases in excess reserves ("reserves in excess of cash surrender value") and/or capital.

✓ Certain drivers of variation in results across participants were identified, such as variable annuity hedging practices and the relationship of VM-20 modeled reserves to net premium reserves.

Limitations

✗ Resource intensive for companies to participate and for NAIC to compile results

✗ Lack of transparency in to understanding individual company results

✗ Limited participation for certain products/frameworks resulted in unknown applicability to overall industry

Two components for evaluating GOES scenario sets

1. Model office analysis (see next page)

- Phase 1: Proof of concept, variable annuity model office developed to capture a range of archetypes and assist with explaining field test variation and demonstrate potential industry impacts. AXIS model used to run archetypes under both the AAA and Conning 1a scenarios as of 12/31/2021.

- Phase 2: Expand archetypes to represent typical in-force VA blocks across additional scenario sets; expand model office development and analysis to life insurance.

2. Unaggregated GOES Field Test

- Candidate scenario sets are planned to be developed ahead of the 2024 NAIC Spring National Meeting for use in model office testing and in an unaggregated field test where results will be presented by participants in regulator only sessions.

- In the interim, as promising scenario sets are developed and vetted, they will be released publicly for companies to test.

MODEL AND MODEL OFFICE DEVELOPMENT AND ANALYSIS

Oliver Wyman developed a variable annuity ("VA") AXIS model and "model office toolkit" in a proof-of-concept exercise, with the goal of developing a model with adjustable driving characteristics to explain field test results and analyze potential candidate scenario sets

Current phase

Model build (Phase 0)

- VA model developed in AXIS

- Model office creation tool accepts user input regarding benefits and demographics to quickly generate reserves and capital for different archetypes

- Validation tools are used alongside model to ensure accuracy of results

Proof of concept (Phase 1)

- Defined **driving characteristics** and developed **archetypes** that make up model office

- Generated model office testing results across a range of archetypes, for Test #1a[1], to produce a wide range of results

- Learnings from model office analysis used to draw additional insights into field test results

Expanded analysis (Phase 2)

Potential areas identified

- Analyze combinations of archetypes to better represent a hypothetical industry participant

- Include additional scenario analysis, including candidate scenario testing

- Expand archetype analysis to examine additional potential drivers

Model office creation tool

Model validation tool

Model office results

1: GEMS Baseline Equity and Corporate model scenarios and Conning Treasury model calibration with generalized fractional floor as of 12/31/21

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SECTION 1.2

PHASE 1 EXECUTIVE SUMMARY

EXECUTIVE SUMMARY: PROOF OF CONCEPT (PHASE 1)

Phase 1 model office produced a similar range of results to field testing and was used to draw additional insights into field test results

Analysis performed

Identified moneyness, guarantee strength, block maturity, and hedging approach as potential driving characteristics of variance in VM-21 reserves under different economic scenario sets; developed a model office of 16 GMWB/GMDB archetypes and 6 GMDB archetypes to analyze these drivers and compare against field testing

Produced results for change in reserve metrics (VM-21) and capital levels (C3P2) consistent with field testing, Test #1a, using the 1,000 scenarios set comparing AAA vs Conning 1a scenarios as of 12/31/2021

Key takeaways

1 *Consistency of results*

The range of results produced from initial model office testing compare well to field testing: Model office approach is a viable solution to supplement unaggregated GOES field testing and future industry impact testing for variable annuities

2 *Metrics and analysis*

In addition to the change in excess reserve, the primary metric used in field testing, the total change in reserve should be considered when interpreting field test results: Change in excess reserves better highlights the financial impacts while change in total reserves better highlights the impact to the underlying scenario reserves

3 *Drivers of results*

Differing archetypes and hedging strategies will produce a wide range of results: Differing block characteristics will impact scenario sensitivity and interaction with the CSV floor. Hedged blocks will generally be less sensitive to changes in scenarios since they are hedging the market risk

Model office compared to field test: change in reserve levels[1]

Economic scenarios: Conning 1a vs AAA

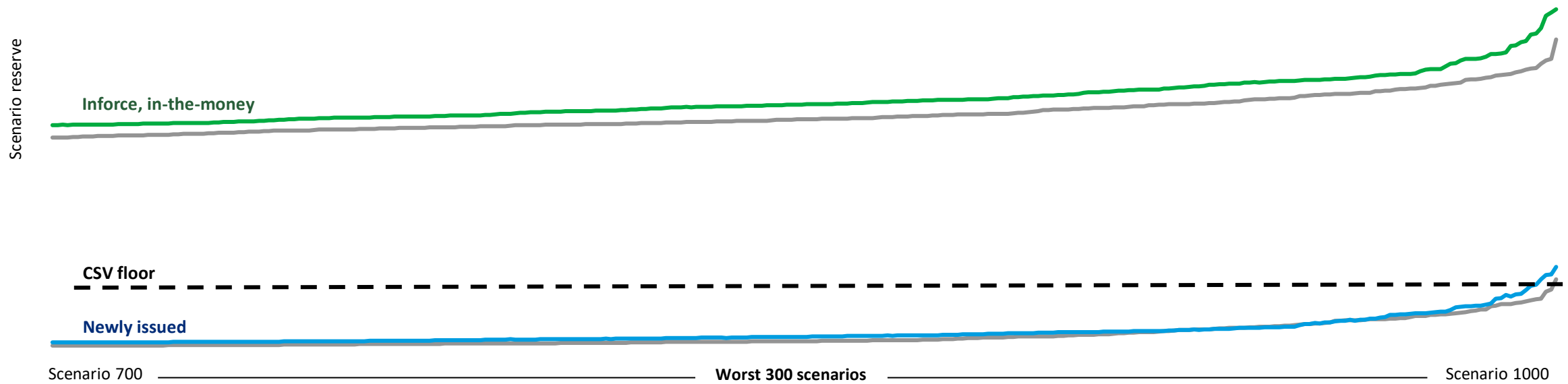Legend: ■ Field testing ■ Model office testing
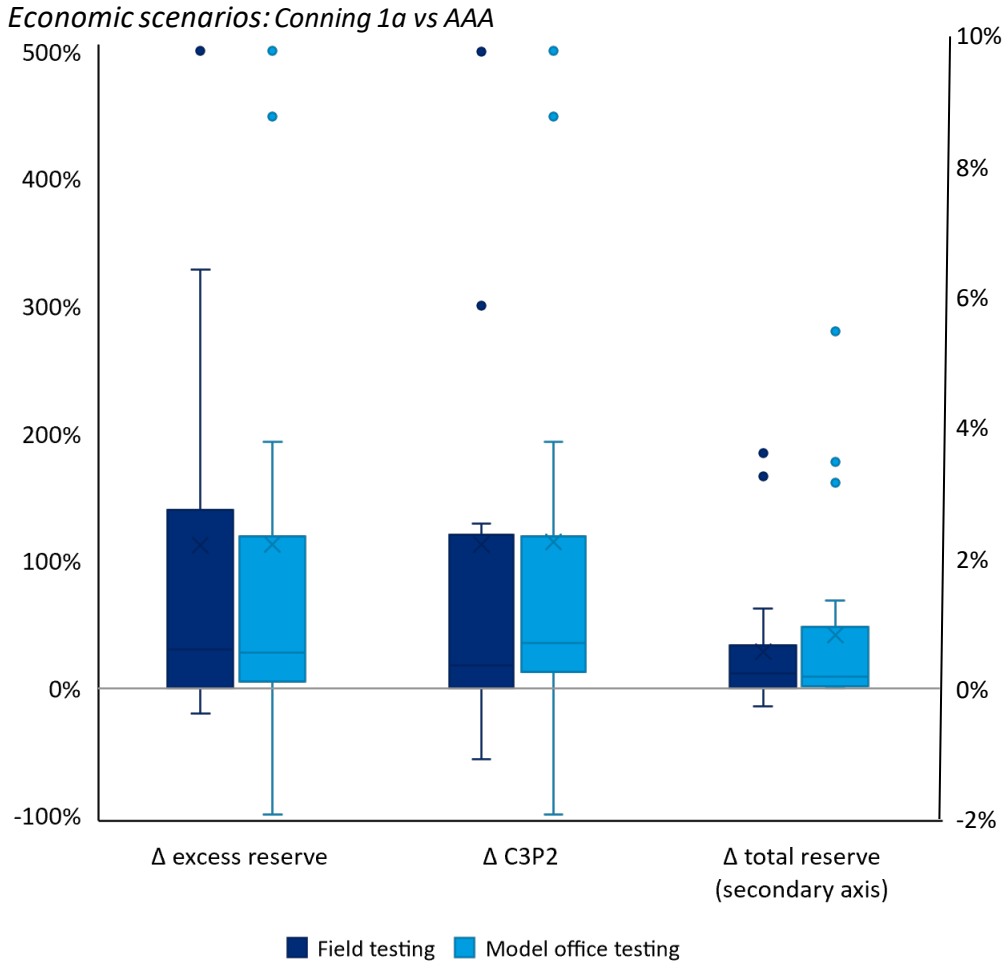
1: Results capped at 500%. Decrease in reserve is a DB only archetype that had zero scenario reserves in excess of CSV for Conning 1a but had one scenario reserve in excess of CSV for AAA

CHANGE IN EXCESS VS CHANGE IN TOTAL SCENARIO RESERVE

Change in excess reserves highlights the financial impacts and is heavily influenced by the CSV floor; change in total reserves highlights the impact to the underlying scenario reserves

Worst 300 of 1000 adjusted scenario reserves

Conning 1a = colored lines, AAA = gray lines

Scenario reserve

Inforce, in-the-money

CSV floor

Newly issued

Scenario 700 — **Worst 300 scenarios** — Scenario 1000

> Larger difference when scenario reserves are low relative to the CSV floor

Archetype	Scenario reserve position relative to the CSV floor	Average increase in unfloored scenario reserve	Increase excess reserve	Increase in total reserves
Inforce, in-the-money	High	4%	**8%**	4%
Newly issued	Low	0.2%	**450%**	0.1%

OVERVIEW OF CONTENTS

Section	Summary
Section 2 VM-21 & GMXB refresher	*VM-21* • Overview of the scenario reserves and stochastic reserve calculation used in VM-21 • Highlight differences between hedged ("best efforts") and unhedged ("adjusted") scenario reserve runs *GMXB* • Overview of GMWB and GMDB riders used in model office testing • Highlights how equity and interest rate scenarios impact the GMXB benefit
Section 3 Model office development and analysis	*Model office development* • Overview of the key driving characteristics and archetypes developed • Demonstrates the impact the CSV floor has in determining the value of the change in excess reserve • Illustrations of how archetype characteristics can impact scenario sensitivity and the relative position to the CSV *Analysis* • Shows range of results from model office testing compared to field testing in aggregate and across archetypes • Provides explanation behind the variety of results seen in both model office testing and field testing • Demonstrates the importance for considering both the change in excess reserve and the total change in reserve
Appendix	• Contains additional analysis and model specifications • Overview of archetypes used in the model office testing • Contains information on the Oliver Wyman team

SECTION 2
VM-21 REFRESHER | GMXB REFRESHER

SECTION 2.1

VM-21 REFRESHER

VM-21 RESERVE REFRESHER: RESERVE COMPONENTS

The primary component of VM-21 reserves is the stochastic reserves, which is made up of scenario reserves

① Stochastic reserves

- Combination of two CTE70s based on different **scenario reserves**
  - Hedged
  - Unhedged
- Adjusted for error factor
- Simplified terms: Hedged results + Impact of hedging * error factor

Other VM-21 reserve components

② Additional standard projection amount ("ASPA")

- Additional reserve held if company assumptions are too aggressive relative to prescribed assumptions

③ Pre-tax IMR ("PIMR")

- Allocated PIMR attributed to assets selected

Initial model office testing resulted in an ASPA value of zero due to the buffer component; PIMR assumed to be zero

Scenario reserves overview

- **Scenario reserve =** Starting assets required to fund all future liability cash flows, with no intermediate deficiencies, for a given economic scenario

- Building block to the stochastic reserve, made up of a set of scenario reserves

- Calculated and recorded for each economic scenario (equity, bond fund, and interest rate)

- Projected separately on both a hedged and unhedged basis, for a contract grouping

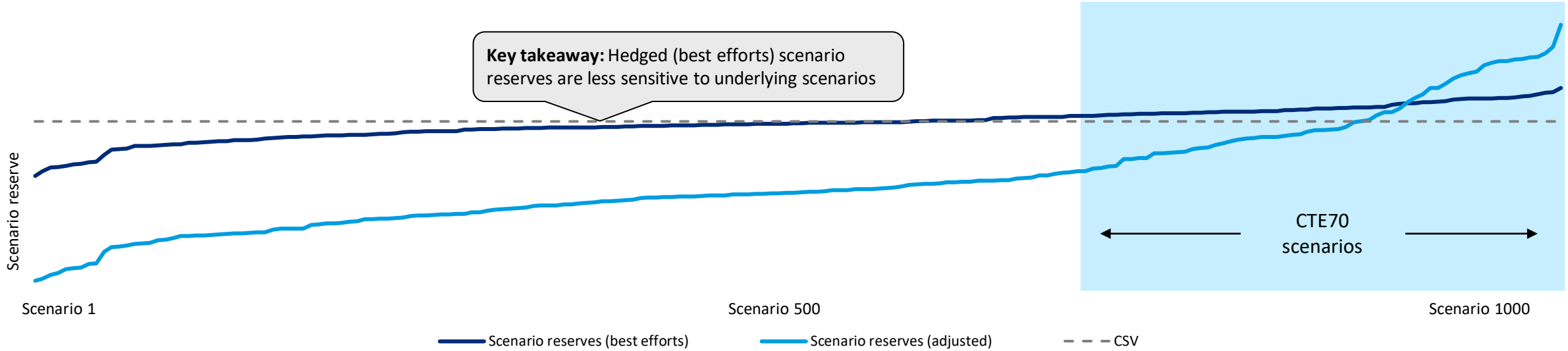- Floored at the cash surrender value

VM-21 RESERVE REFRESHER: STOCHASTIC RESERVE

The stochastic reserve is a combination of CTE70s from scenario reserves on a hedged and unhedged basis

Stochastic reserve = CTE70 (best efforts) + E × max[0, CTE70 (adjusted) − CTE70 (best efforts)]

Illustrative

Key takeaway: Hedged (best efforts) scenario reserves are less sensitive to underlying scenarios

Scenario reserve

CTE70 scenarios

Scenario 1   Scenario 500   Scenario 1000

— Scenario reserves (best efforts)   — Scenario reserves (adjusted)   - - - CSV

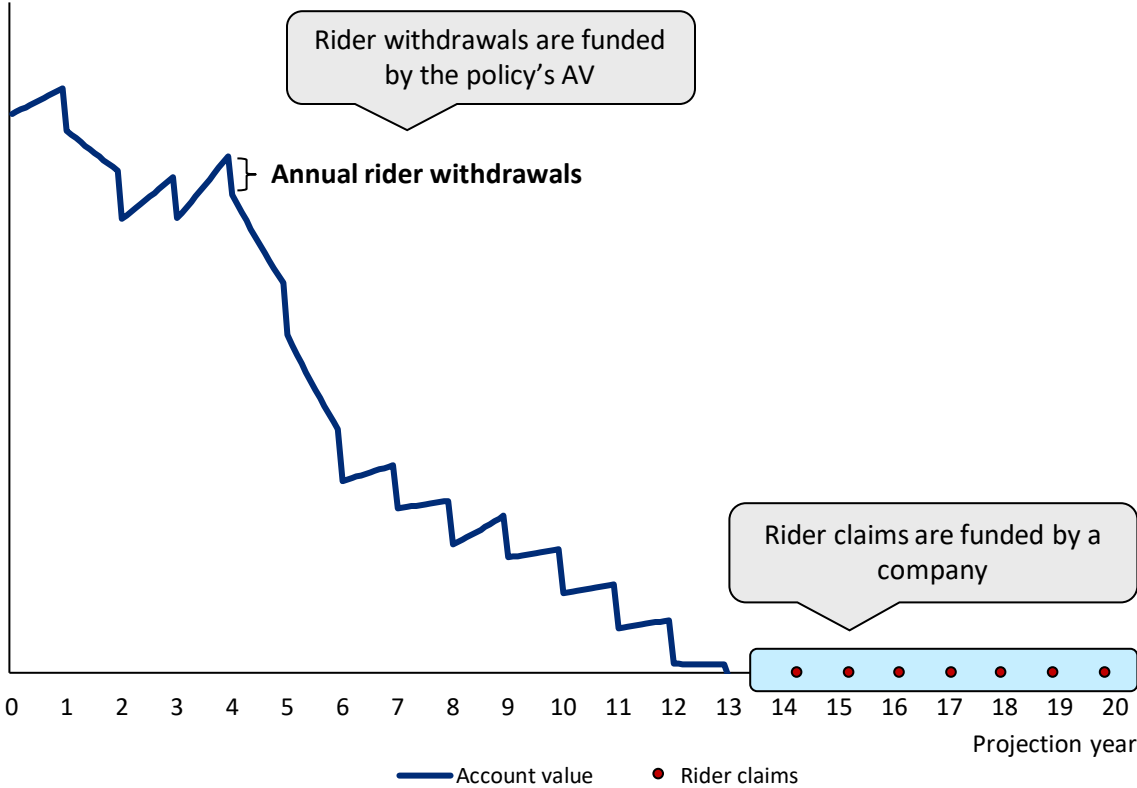| Component	Details
CTE70 (best efforts)	• CTE70 of **scenario reserves (best efforts)** • Scenario reserve calculation reflects future hedging strategy
CTE70 (adjusted)	• CTE70 of **scenario reserves (adjusted)** • Scenario reserve calculation <u>does not</u> reflect future hedging strategy
Error factor (E)	• Accounts for potential overstatement of the impact of the hedging strategy • Between 5% - 100% based on the model's ability to reflect the parameters of the hedging strategy

SECTION 2.2

GMXB REFRESHER

GMWB RIDER REFRESHER

Underlying equity and interest rate scenarios impact both the timing and discounted value of GMWB claims

GMWB illustration

GMWB details	Commentary
Model office	• Rollup GMWB
GMWB benefit	• Guarantees a withdrawal amount <u>for life</u> regardless of the account value
Impact of equity scenarios on GMWB value	• Impacts performance of equity funds in the VA contract • Fund performance influences the timing of account value depletion-when withdrawals become claims
Impact of interest scenarios on GMWB value	• Impacts performance of bond funds in the VA contract • Impacts the present value of future claims

GMDB RIDER REFRESHER

Underlying equity and interest rate scenarios impact both the net amount at risk and discounted value of the death benefit guarantee

ROP GMDB illustration

Net amount at risk is equal to the ROP death benefit less the account value

Account value — ROP death benefit
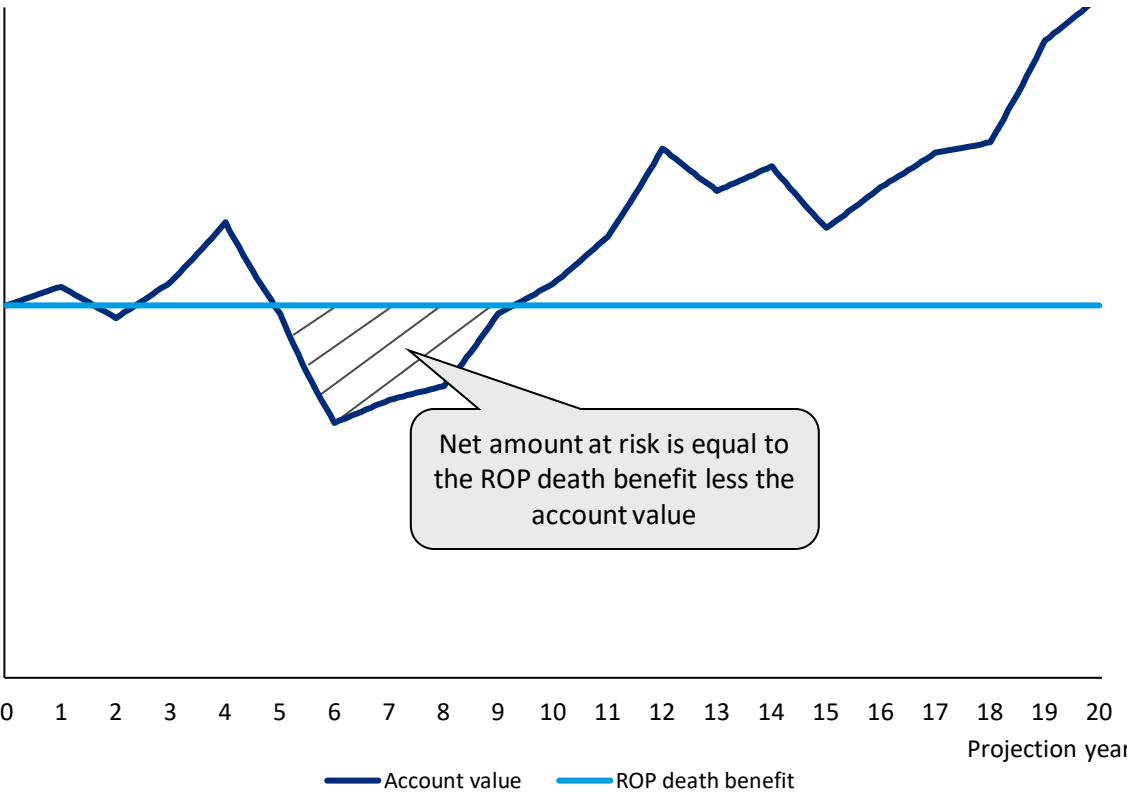
GMDB details	Commentary
Model office	• Return of Premium ("ROP") GMDB
ROP benefit	• Guarantees the death benefit will be at least equal to the premium deposited, adjusted for withdrawals
Impact of equity scenarios on GMDB value	• Impacts performance of equity funds in the VA contract • Fund performance determines the net amount of risk of the GMDB
Impact of interest scenarios on GMDB value	• Impacts performance of bond funds in the VA contract • Impacts the present value of future claims

KEY TAKEAWAYS: VM-21 AND GMXB REFRESHER

Category	Takeaways
1 **VM-21 stochastic reserve**	• The stochastic reserve is a CTE70 valuation based on underlying scenario reserves calculated with and without hedging *(pg 12)*
2 **Scenario reserves**	• Starting assets required to fund all future liability cash flows, with no intermediate deficiencies, for a given economic scenario *(pg 12)* • Building blocks for the stochastic reserve *(pg 12-13)*
3 **Hedging**	• Hedged scenario reserves are generally less sensitive to the underlying scenarios than unhedged scenario reserves *(pg 13)*
4 **GMXB riders**	• GMWB riders provide a guaranteed withdrawal amount for life regardless of the account value; GMDB riders provide a guaranteed benefit upon death, regardless of the account value *(pg 15-16)* • Exposure to underlying equity and interest rate scenarios is different depending on rider type, e.g., GMWB vs GMDB *(pg 15-16)*

SECTION 3
MODEL OFFICE DEVELOPMENT & ANALYSIS
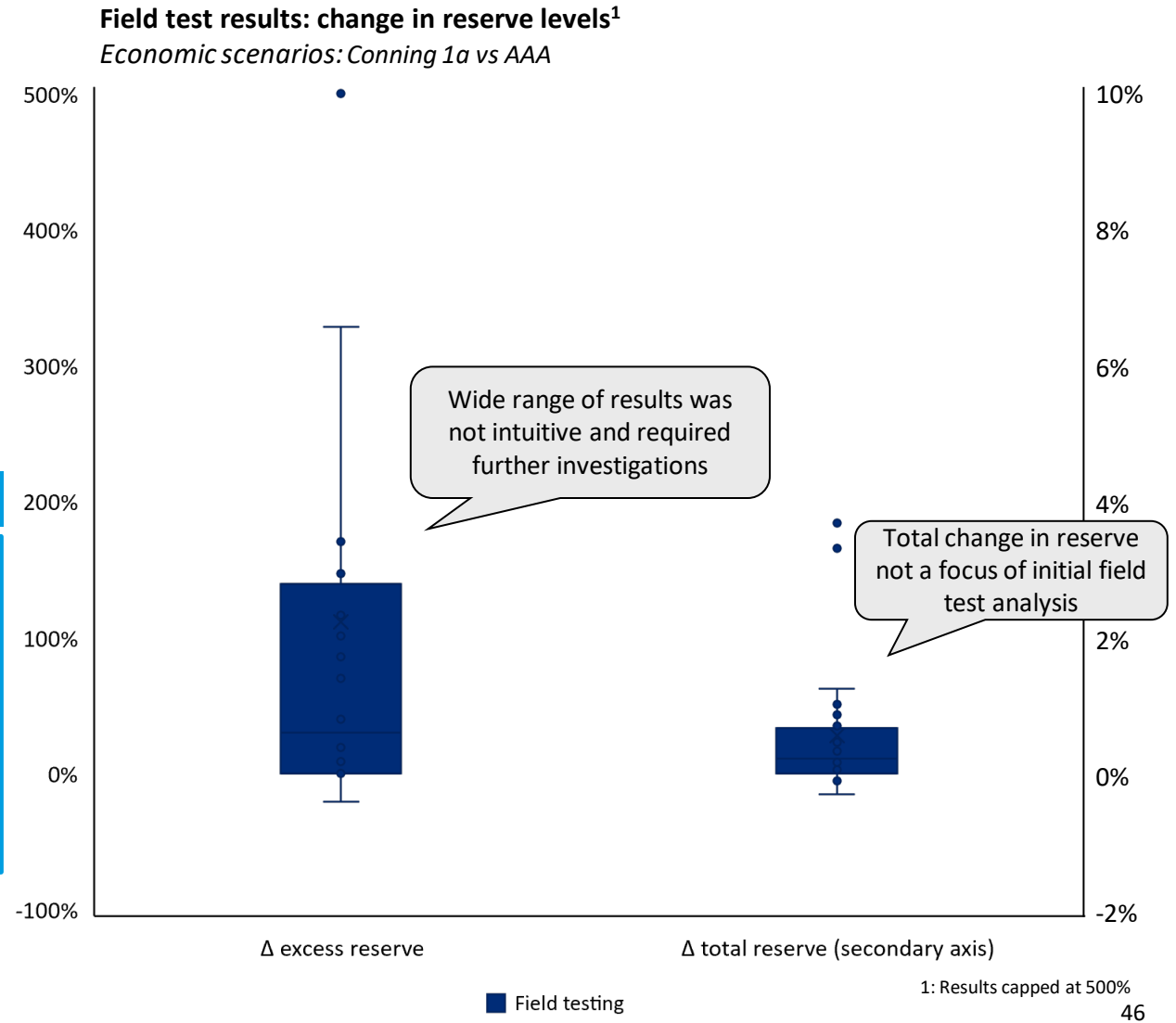
SECTION 3.1

MODEL OFFICE DEVELOPMENT

OBSERVATIONS FROM FIELD TESTING AND MODEL OFFICE OBJECTIVES

Observations from field testing

- A wide range of impacts was observed during field testing to the primary metric: increase in excess reserve, between the baseline ("AAA") and field test scenarios

- Macro level observations, particularly how participants reflected future hedging strategies in VM-21, were identified as potential drivers of variance in field test results

Objectives for Phase 1 model office development

- Utilize AXIS modeling software and Oliver Wyman's model office development tool kit to develop a model capable of producing cash flows and VM-21 reserve/capital components

- Develop potential driving characteristics of a liability profile to generate archetypes for model office

- Evaluate macro level observations and use analysis of driving characteristics to develop additional insights into field test results

Field test results: change in reserve levels[1]
Economic scenarios: Conning 1a vs AAA

Wide range of results was not intuitive and required further investigations

Total change in reserve not a focus of initial field test analysis

Δ excess reserve   Δ total reserve (secondary axis)

■ Field testing

1: Results capped at 500%

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MODEL OFFICE DEVELOPMENT: DESIGN

Variable annuity model developed in AXIS to calculate VM-21 reserves at time 0; field testing was used to inform the rider types, moneyness and hedging characteristics included in the model office

Model specifications[1]

Component	Details	
Model	• AXIS model • 50-year projection period	
Model assumptions	• Prudent assumptions developed using a mix of industry benchmarks, industry experience, and prescribed standard projection assumptions	
VM-21 assumptions	• Direct iteration approach used to calculate scenario reserves • Implicit method used for hedge modeling; 10% error factor	

Model office development

• Defined **driving characteristics** to analyze characteristics that were not available to analyze in field test data

• Withdrawal and death benefit combo (GMWB/GMDB) was the focus based on prevalence in field test (see rider type and combination)

• Developed **16 GMWB combo archetypes** based on combinations of driving characteristics and 6 GMDB only archetypes[3]

Driving characteristics of valuation results

Rider type and combination from field test results	% of separate account value in field testing
Withdrawal / death benefit combo (GMWB/GMDB)	42%
Death benefit only (GMDB)	41%
Income / death benefit combo (GMIB / GMDB)	9%
Other benefit combinations	9%

Included in model office

GMWB guarantee strength
- Strong
- Weak

Moneyness
- In-the-money ("ITM")
- At-the-money ("ATM")
- Out of-the-money ("OTM")

Block maturity
- New
- Mature

Future hedging strategy
- Implicit hedging
- No hedging

Example archetype:

GMWB combo, newly issued, strong guarantee, ATM, hedged

1: Additional model specification in appendix   2. GMAB/GMDB were 0.4% of the other benefit combinations 3. See Appendix A

CTE70 IN EXCESS OF CASH SURRENDER VALUE ("CSV") FLOOR

A 1% change in underlying scenario reserves results in the largest percentage increase to **CTE in excess of CSV** when the cash surrender value floor is highest, as the excess is made up of only a few tail scenarios

Worst 300 of 1000 scenario reserves ($BN)
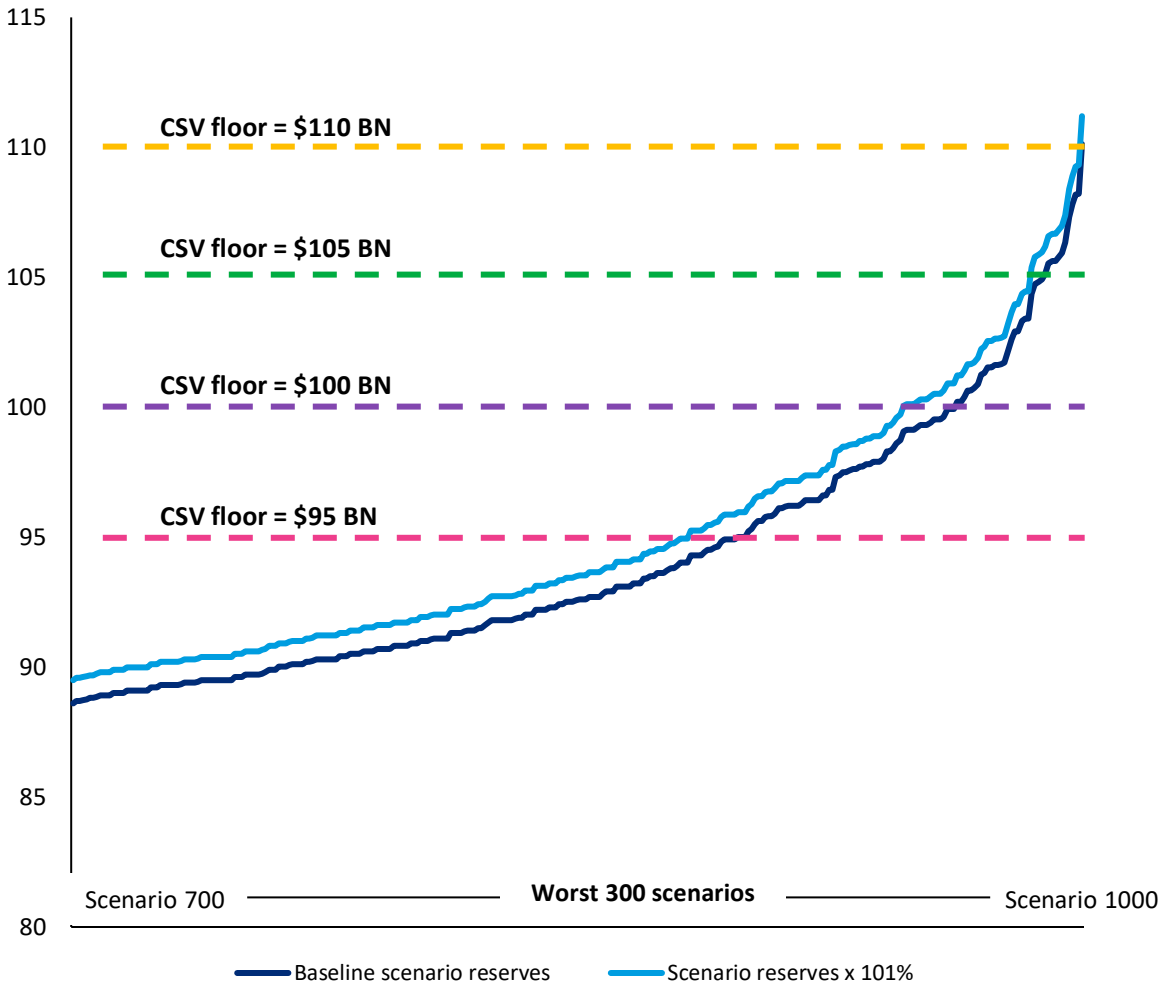
CTE70[1] in excess of CSV ($M)

CSV ($BN)	Baseline	Baseline x 101%	Increase (%)	Number of S.R. > CSV
110	0.5	6	1100%	1
105	107	186	74%	12
100	685	916	34%	38
95	2,424	2,975	23%	103
0	96,282	97,245	1%	1000

Increase in CTE in excess of CSV decreases as more scenario reserves exceed CSV

1. Scenario reserves in VM-21 are floored at the CSV

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DRIVING CHARACTERISTIC: MONEYNESS

ITM GMWB contracts will have a higher max withdrawal relative to their account value compared to ATM and OTM GMWB contracts

Illustrative AV (in '000s) for ATM vs deep ITM archetypes under various fund return assumptions
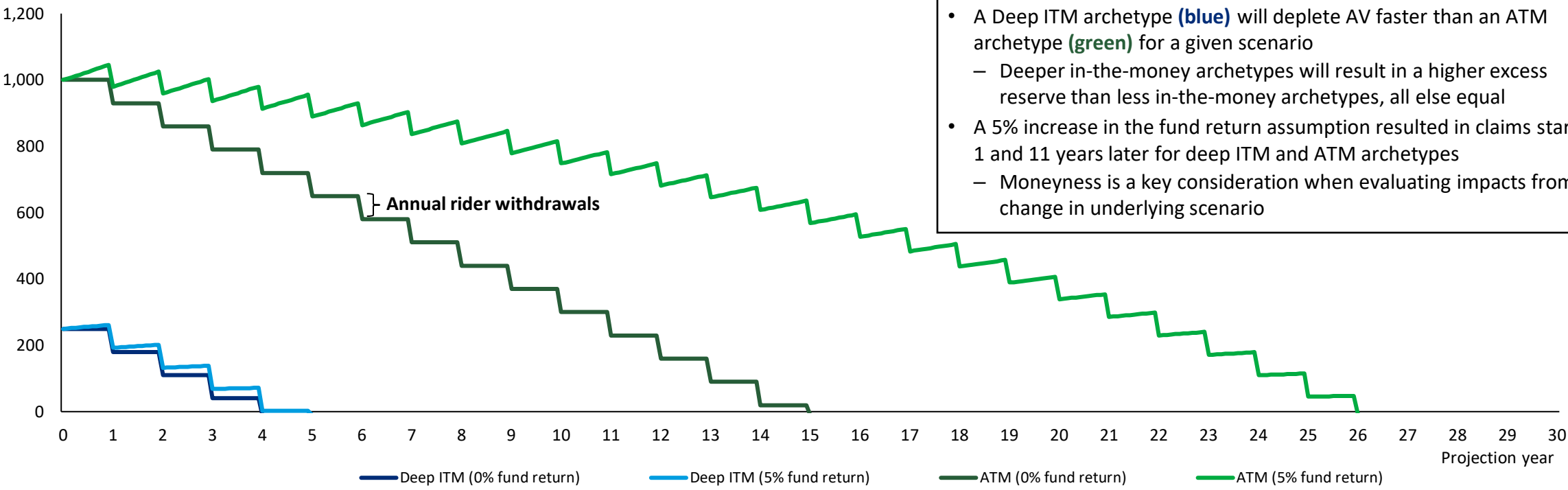
Key takeaways

- A Deep ITM archetype **(blue)** will deplete AV faster than an ATM archetype **(green)** for a given scenario
  - Deeper in-the-money archetypes will result in a higher excess reserve than less in-the-money archetypes, all else equal
- A 5% increase in the fund return assumption resulted in claims starting 1 and 11 years later for deep ITM and ATM archetypes
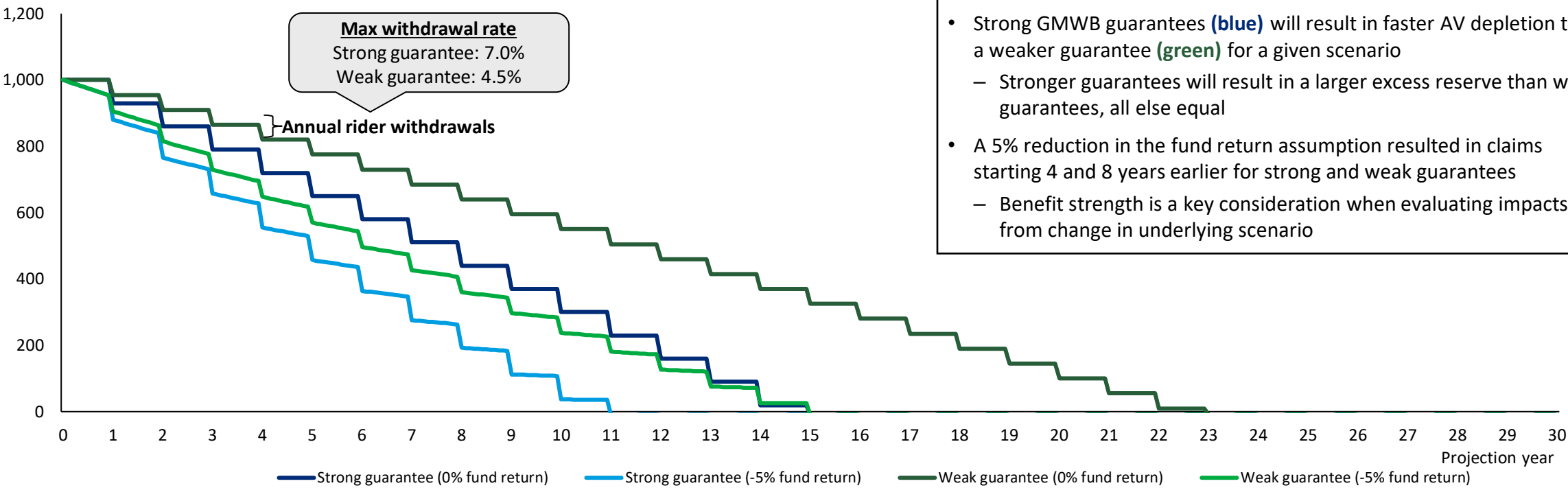 - Moneyness is a key consideration when evaluating impacts from change in underlying scenario

Impact of moneyness	Deep ITM[1] (0% fund return)	Deep ITM[1] (5% fund return)	ATM[1] (0% fund return)	ATM[1] (5% fund return)
Starting AV	$250,000	$250,000	$1,000,000	$1,000,000
Max withdrawal benefit	$70,000	$70,000	$70,000	$70,000
Claim start year	4	5	15	26

1: Deep ITM defined as a benefit base ratio (benefit base / account value) greater than 140% and ATM defined as a benefit base ratio between 100% and 110%. Illustration assumes the benefit base is equal to $1,000,000 in all cases.

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DRIVING CHARACTERISTIC: GMWB BENEFIT STRENGTH

GMWB strength is based on the size of the max withdrawal benefit, driven by withdrawal rates and benefit base features

Illustrative[1] AV (in '000s) for weak vs strong guarantees under various fund return assumptions

Max withdrawal rate
Strong guarantee: 7.0%
Weak guarantee: 4.5%

Annual rider withdrawals

Key takeaways

- Strong GMWB guarantees **(blue)** will result in faster AV depletion than a weaker guarantee **(green)** for a given scenario
  - Stronger guarantees will result in a larger excess reserve than weak guarantees, all else equal
- A 5% reduction in the fund return assumption resulted in claims starting 4 and 8 years earlier for strong and weak guarantees
  - Benefit strength is a key consideration when evaluating impacts from change in underlying scenario

Legend:
— Strong guarantee (0% fund return)   — Strong guarantee (-5% fund return)   — Weak guarantee (0% fund return)   — Weak guarantee (-5% fund return)

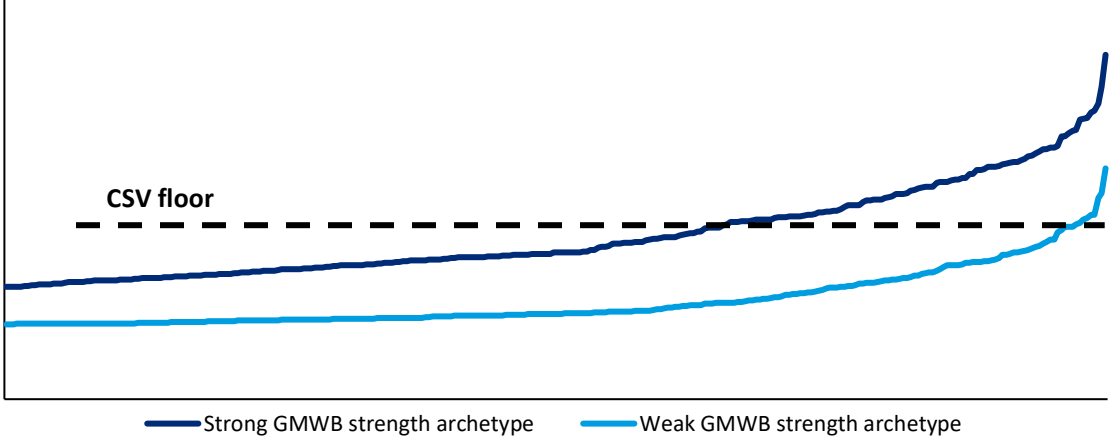| Impact of moneyness	Strong guarantee (0% fund return)	Strong guarantee (-5% fund return)	Weak guarantee (0% fund return)	Weak guarantee (-5% fund return)
Starting AV	$1,000,000	$1,000,000	$1,000,000	$1,000,000
Max withdrawal benefit	$70,000	$70,000	$45,000	$45,000
Claim start year	15	11	23	15

1: Illustration assumes the benefit base is equal to $1,000,000 in all cases.

DRIVING CHARACTERSTICS: SCENARIO RESERVES AND CSV FLOOR

Archetype characteristics impact the scenario reserves relative position to the CSV which impacts change in CTE70 in excess of CSV
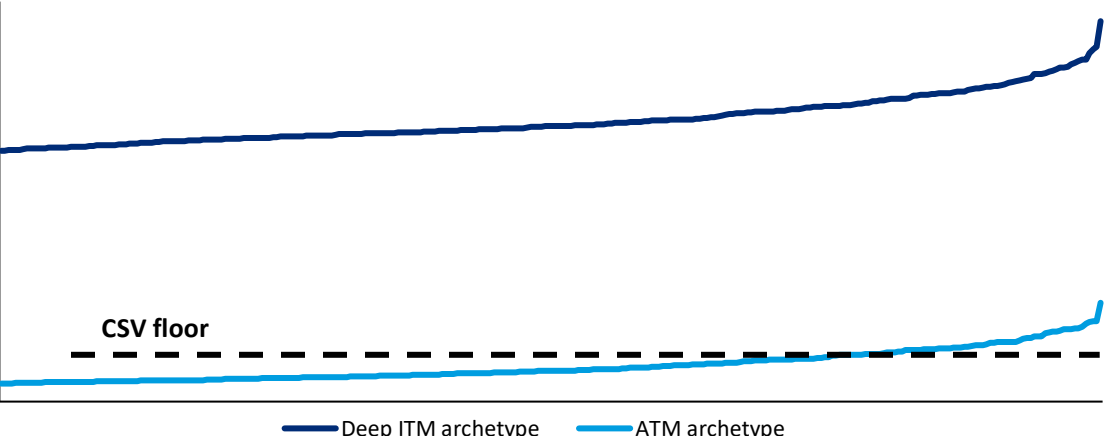
GMWB benefit strength: Strong vs. Weak
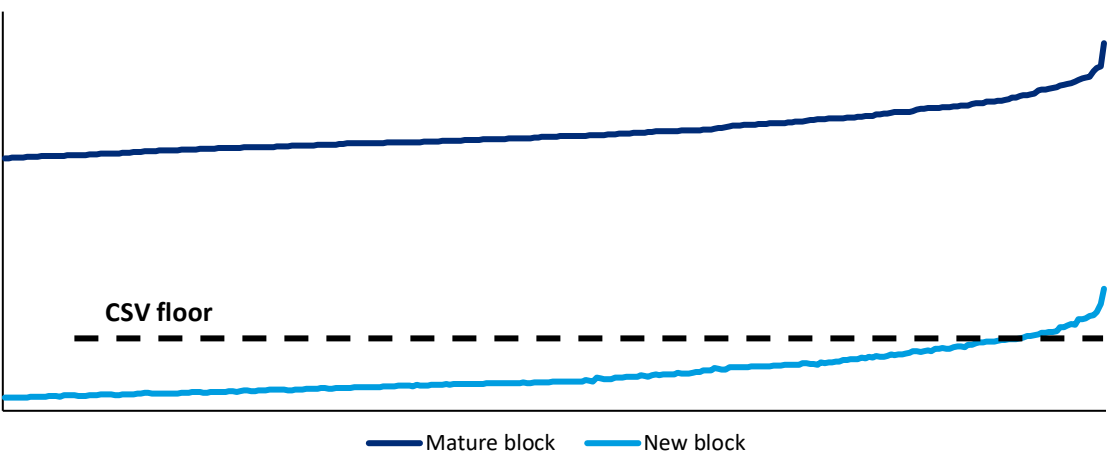Worst 30% of scenario reserves

Moneyness: ITM vs. ATM
Worst 30% of scenario reserves

CSV floor

— Strong GMWB strength archetype   — Weak GMWB strength archetype

CSV floor

— Deep ITM archetype   — ATM archetype

Block maturity: Mature vs. New
Worst 30% of scenario reserves

CSV floor

— Mature block   — New block

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KEY TAKEAWAYS: MODEL OFFICE DEVELOPMENT

| Category	Takeaways
1 **Objective, design and archetypes**	• Model office archetypes were developed to evaluate macro level observations and develop additional insights into the wide range of results in the primary metric, change in CTE70 in excess of CSV, used to analyze field test results *(pg 20-21)* • Archetypes analyzed are GMWB/GMDB combo riders with a combination of driving characteristics (moneyness, guarantee strength, block maturity) and hedging approach *(pg 21, Appendix B for full listing of archetypes)*
2 **CTE70 in excess of CSV floor**	• The relative position of scenario reserves compared to the CSV floor plays a major factor in determining the value of the change in excess reserve *(pg 22)*
3 **Driving characteristics and archetypes**	• Driving characteristics that make up archetypes have an impact on both relative position of scenario reserves compared to CSV and the sensitivity to changes in underlying scenarios *(pg 23-25)* • Understanding impacts of driving characteristics is a building block for archetype analysis and comparisons to field testing

SECTION 3.2

MODEL OFFICE ANALYSIS

MODEL OFFICE RESULTS COMPARED TO INDUSTRY: CHANGE IN RESERVE

Impact of updating economic scenarios from AAA to Conning 1a across archetypes/industry

Model office compared to field test: change in reserve levels[1]

*Economic scenarios: Conning 1a vs AAA*

1: Results capped at 500%, includes GMWB combo and GMDB only results
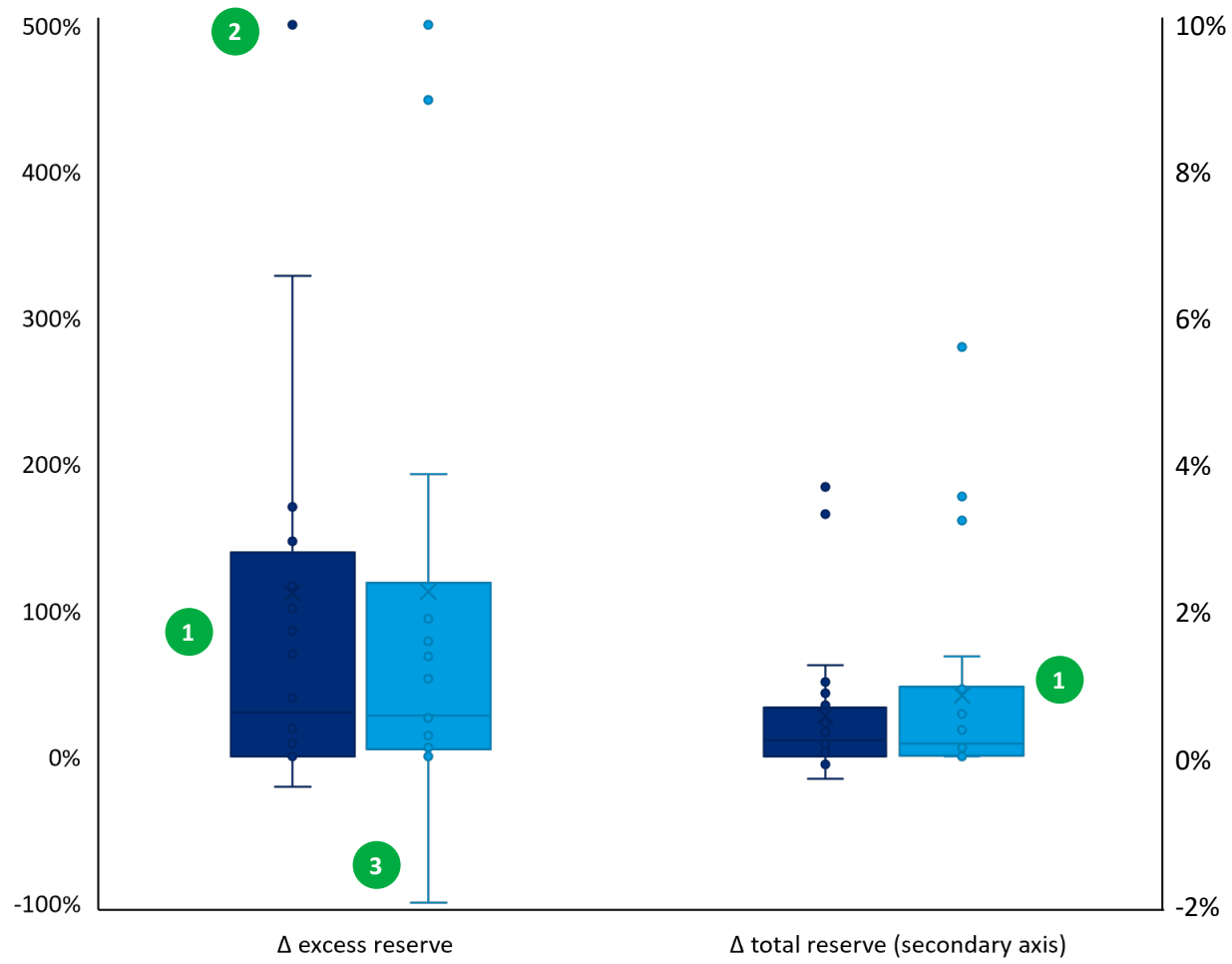
1 Model office testing produced a consistent range of results compared to field testing for **both** **change in excess reserves** and **change in total reserves**

- Change in excess reserves has a much wider variance as compared to change in total reserves
- Range in change in excess reserve is heavily influenced by interaction with CSV floor

2 **Extreme impacts to change excess reserve are present in both model office testing and field testing**

- Business with excess reserves near zero fall into this category (e.g., new cohorts, weak guarantees, OTM cohorts)
- Impact to total change in reserve are much less pronounced

3 **Excess reserves and total reserves increased in almost all cases under the Conning 1a scenarios**

- Examples of decreases in reserves occurred in both model office testing and field testing
- Model office GMDB-only product had one AAA scenario and zero Conning 1a scenarios in excess of CSV

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Field testing   Model office testing

ARCHETYPE DEEP DIVE: MONEYNESS

Similar archetypes with different **moneyness** level are displayed at different positions on the x-axis; level of moneyness combined with other characteristics influence impact

Change in excess reserve

Results guide

Mature/Strong/Hedged = Mature + Strong + Hedged
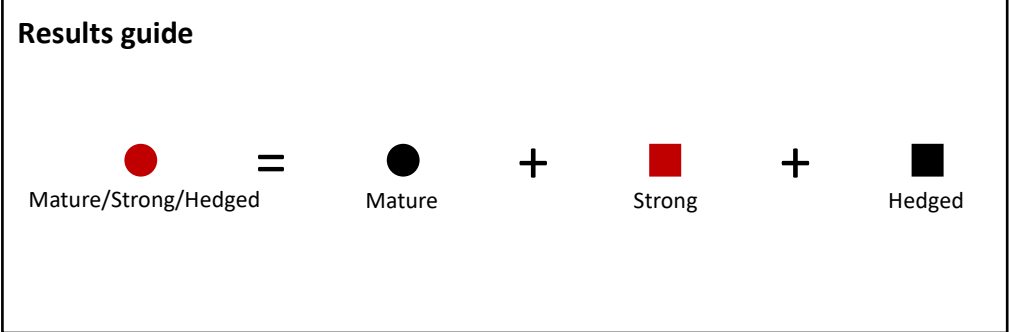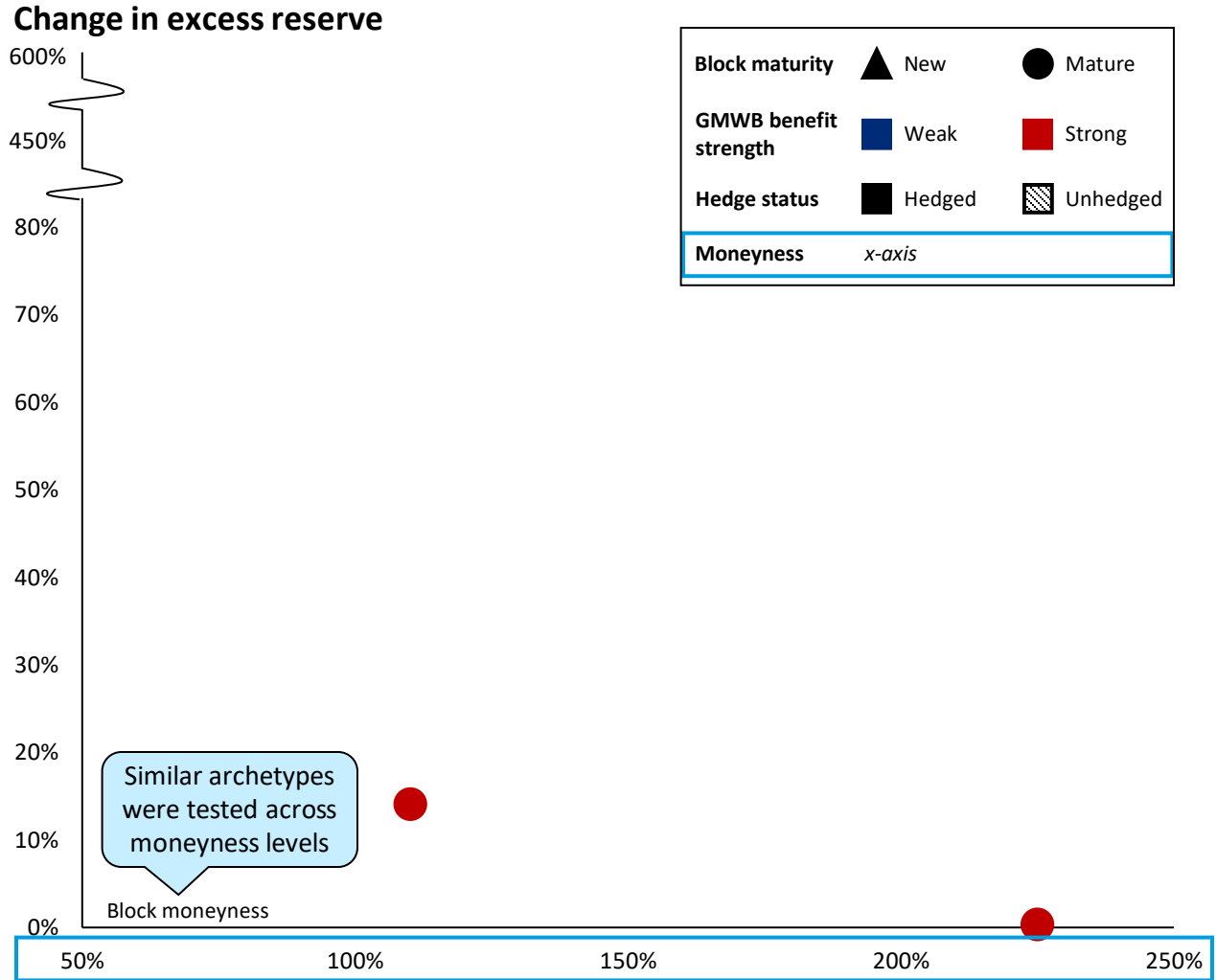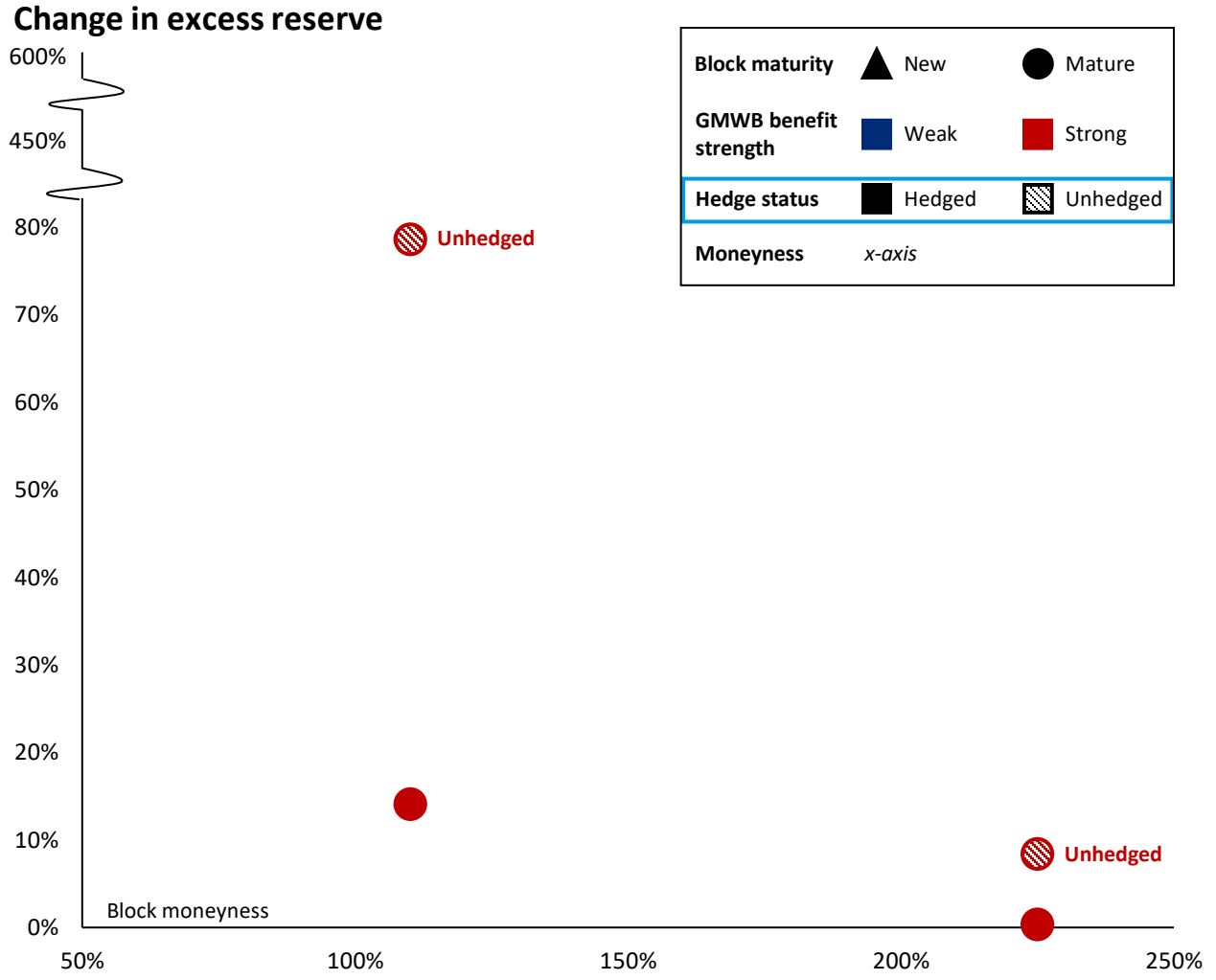
Moneyness information

- Moneyness is defined as benefit base divided by current account value, which is impacted by "historical" fund performance and withdrawals
- A value greater than 100% represents a rider benefit that is larger than account value

Observations

- Model office archetypes with higher moneyness levels have a larger excess reserve and therefore are less sensitive to changes in underlying scenarios

ARCHETYPE DEEP DIVE: HEDGE STATUS

Hedge status is indicated using shading; solid results are hedged and shaded results are unhedged

Change in excess reserve

Legend:

Block maturity	▲ New	● Mature
GMWB benefit strength	■ Weak	■ Strong
Hedge status	■ Hedged	▨ Unhedged
Moneyness	*x-axis*	

Results guide

● = ● + ■ + ■
Mature/Strong/Hedged = Mature + Strong + Hedged

▨ = ● + ■ + ▨
Mature/Strong/Unhedged = Mature + Strong + Unhedged

Hedge status information

- Hedged results are calculated using a weighted average of both a hedged ("best efforts") and unhedged ("adjusted") CTE70

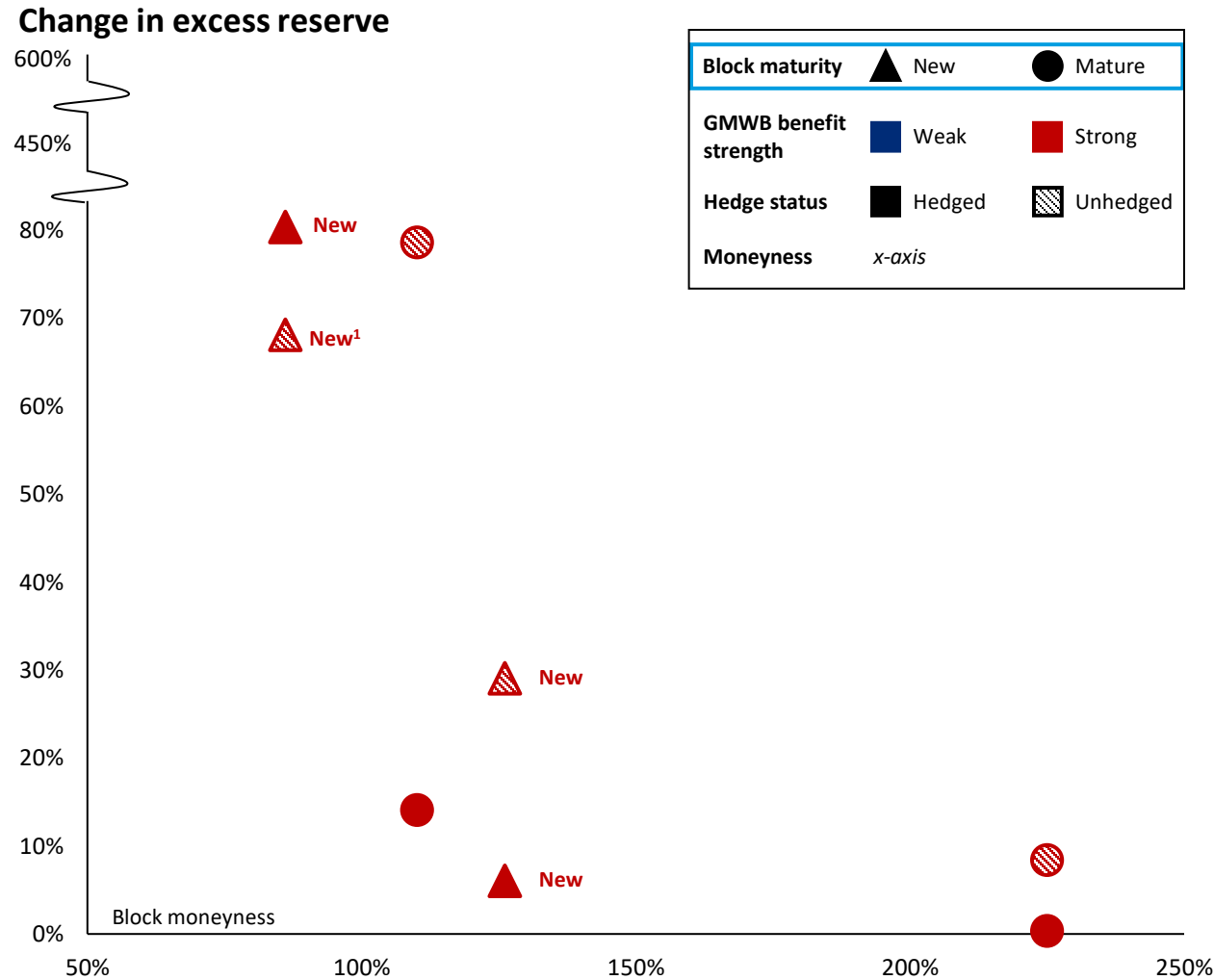- Unhedged archetypes only incorporate the unhedged CTE70 calculation when calculating stochastic reserve

Observations

- Model office archetypes that are unhedged have greater sensitivity to a change in the underlying scenarios than similar hedged archetypes

- Hedging of future capital market risks generally mutes the impact of changes to underlying scenarios

ARCHETYPE DEEP DIVE: BLOCK MATURITY

"New" and "mature" archetypes are indicated by a triangle and circle, respectively

1: Excess reserve ($M): AAA: $0.1 (hedged), $1.3 (unhedged) , Conning 1a: $0.2 (hedged), $2.2 (unhedged)

Change in excess reserve

Block maturity ▲ New ● Mature

GMWB benefit strength ■ (blue) Weak ■ (red) Strong

Hedge status ■ Hedged ▨ Unhedged

Moneyness x-axis

Results guide

● = ● + ■ + ■
Mature/Strong/Hedged = Mature + Strong + Hedged
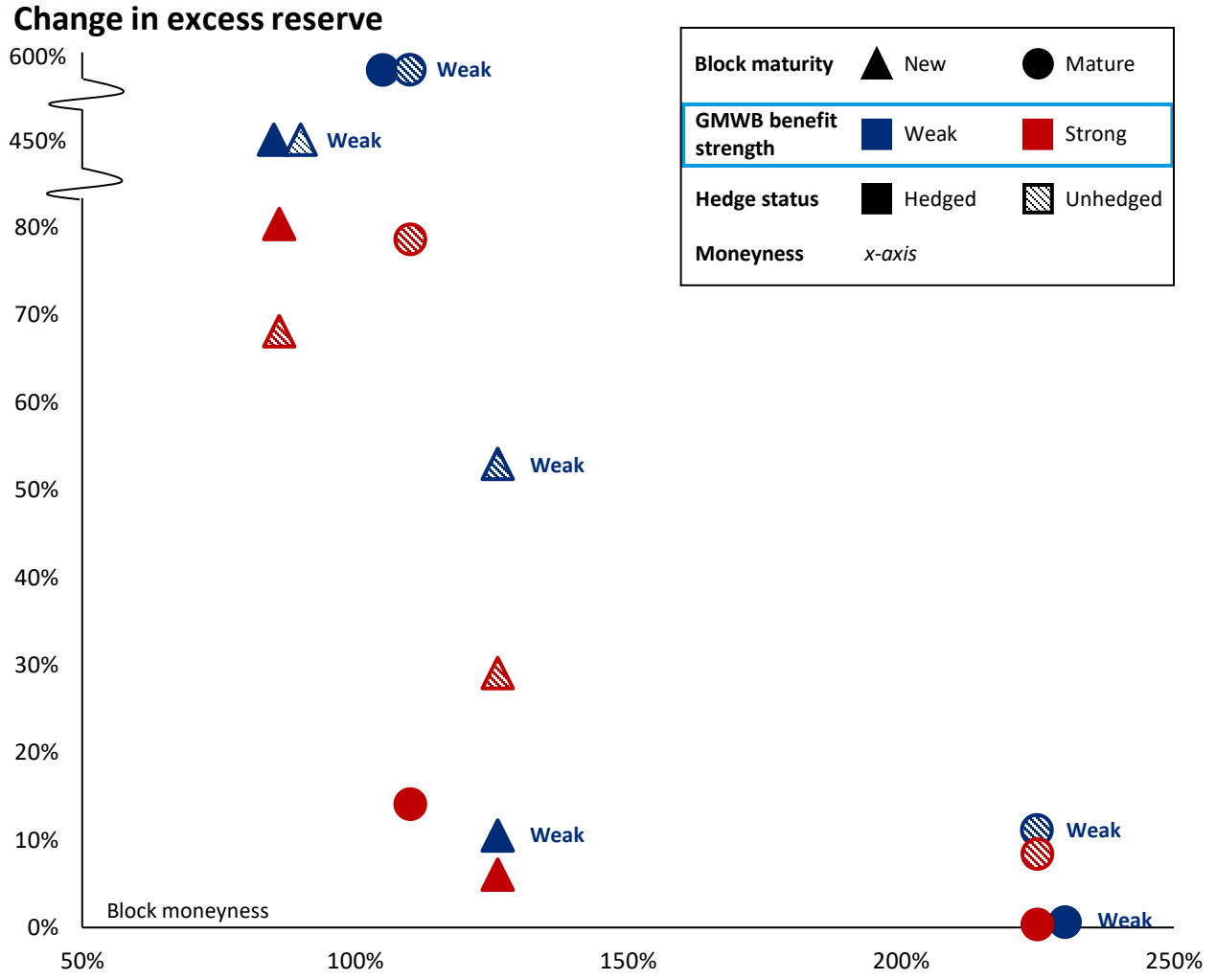
▲ = ▲ + ■ + ■
New/Strong/ Hedged = New + Strong + Hedged

Block age information

- "New" archetypes used in model office testing were assumed to be issued more recently, had a younger average age, and smaller number of active withdrawers compared to "mature" archetypes
- "Mature" archetypes used in model office testing were assumed to be issued longer ago, had an older average age, and larger number of active withdrawers compared to "new" archetypes

Observations

- "New" archetypes are less in-the-money compared to similar mature blocks since less contracts are taking withdrawals, leading to smaller excess reserve and more sensitivity to changes in underlying scenarios

1: The unhedged archetype has a greater dollar change in excess reserve but a lower percentage change relative to the hedged archetype because a larger majority of best efforts scenario reserves, which only impact hedge results, are below the CSV floor.

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ARCHETYPE DEEP DIVE: GMWB BENEFIT STRENGTH

"Weak" and "strong" archetypes are indicated by colors **blue** and **red**

Change in excess reserve

(scatter plot with x-axis "Block moneyness" from 50% to 250%, and y-axis from 0% to 600%)

Legend:

Block maturity	▲ New	● Mature
GMWB benefit strength	🟦 Weak	🟥 Strong
Hedge status	⬛ Hedged	▨ Unhedged
Moneyness	*x-axis*	

Results guide

🔴 = ⚫ Mature + 🟥 Strong + ⬛ Hedged
Mature/Strong/Hedged

🔵 = ⚫ Mature + 🟦 Weak + ⬛ Hedged
Mature/Weak/ Hedged

GMWB benefit strength information

- Weak (strong) archetypes have lower (higher) GMWB rollup and guaranteed withdrawal rates compared to strong (weak) archetypes

Observations

- Model office archetypes with weak GMWB strength are more likely to have a greater change in excess reserve
- Weaker rider benefits lead to a smaller excess reserve and more sensitivity to changes in underlying scenarios

CHANGE IN EXCESS RESERVE: ARCHETYPE & FIELD TEST GROUPING

Range of results across archetypes demonstrate model office versatility and are informative when compared to field test impacts
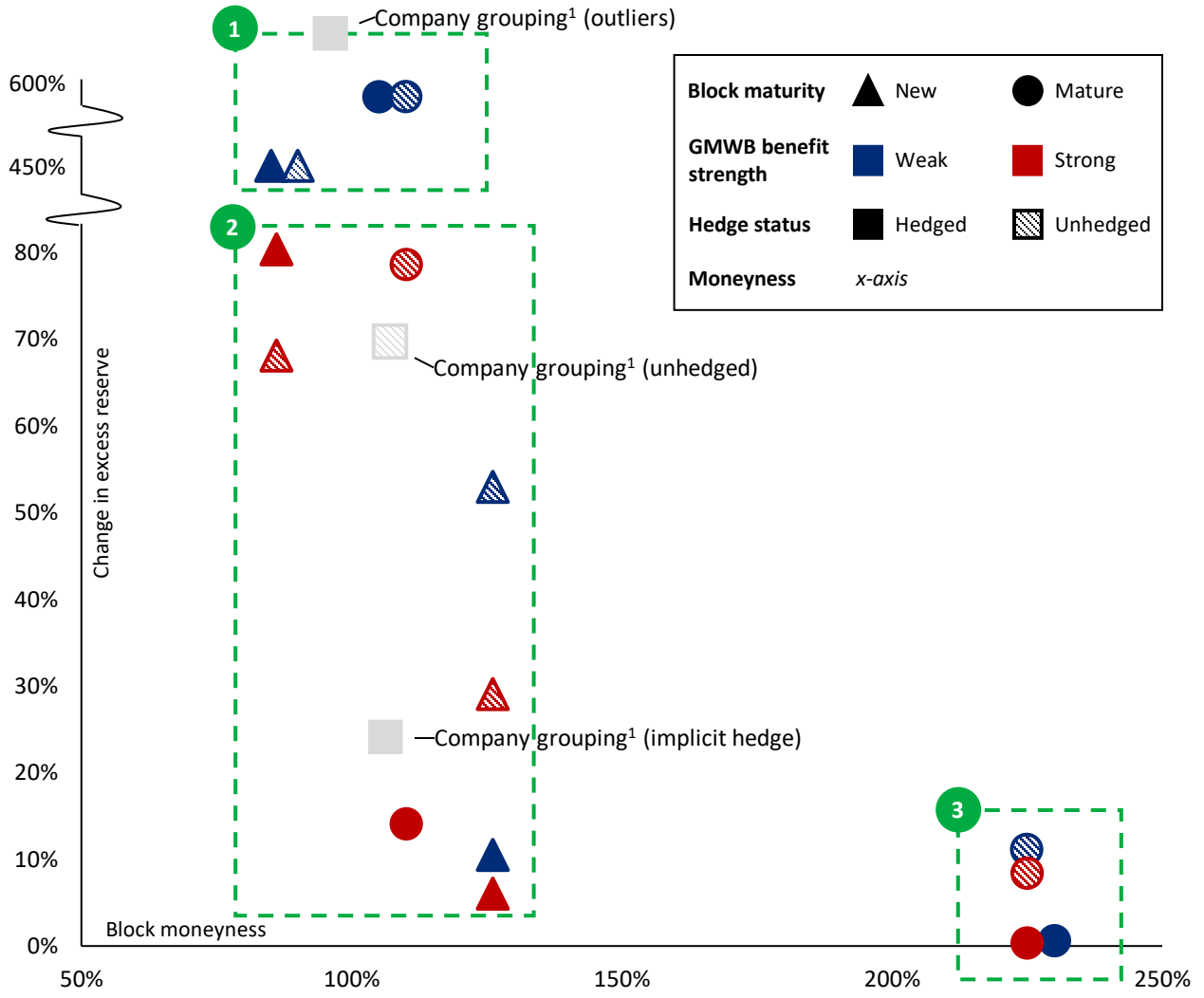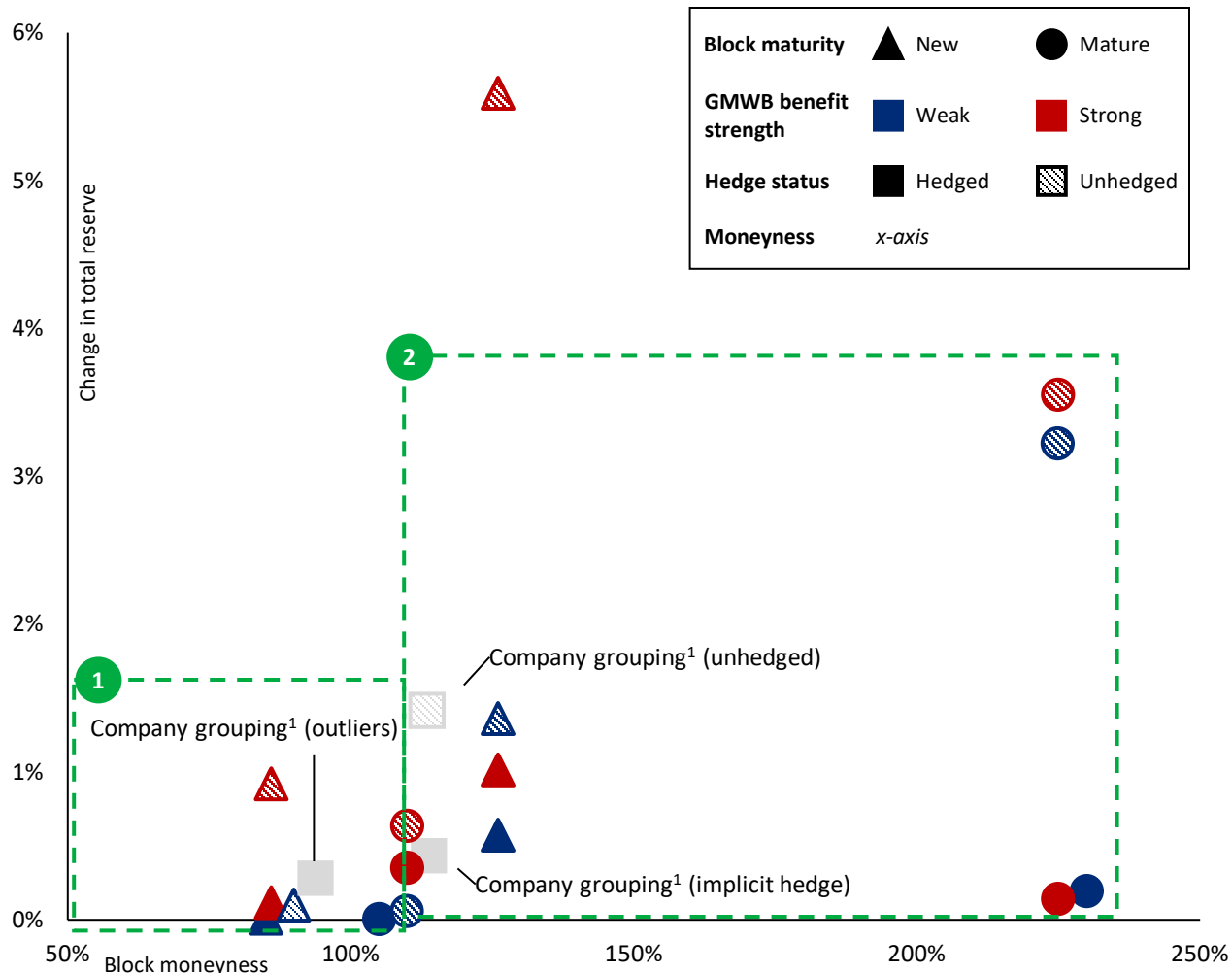

1. Outlier company grouping include companies with **reserves in close proximity to CSV** and had the largest change in excess reserves
   – Model office archetypes that produce similar effects: newer business, weaker benefits

2. Company groupings are made up of a distribution of key characteristics and rider types, leading to wide range of impacts
   – Model office testing confirms that hedging practices (hedged vs unhedged) lead to variations in results

3. Deep-in-the-money (>140%) or mature "runoff business" have a lower change in excess reserves since most scenario reserves are above the CSV floor. Examples of this in field test results were limited but present

1: Grouping of data points from field test results. Each grouping is made up of 3+ normalized data points. Moneyness level for company groupings is based on the reported GMDB/GMWB combo and is calculated using a simple average.

CHANGE IN TOTAL RESERVE: ARCHETYPE & FIELD TEST GROUPING

Excess reserves provide a view of potential financial impact to change in underlying scenarios; however, change in total reserves highlights the impact to the underlying scenario reserves
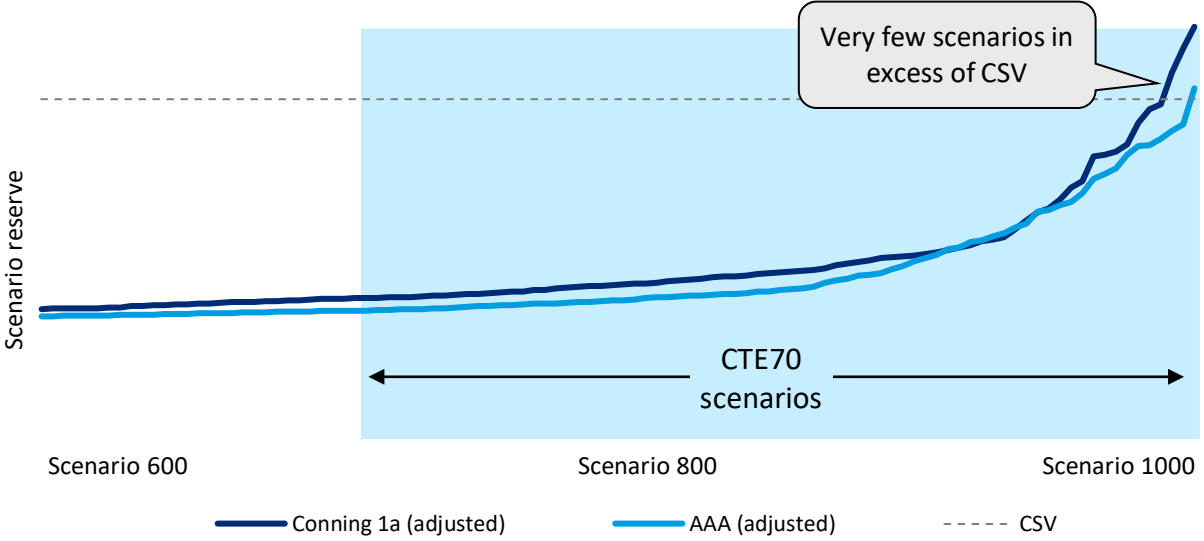

Legend:

Block maturity	△ New	● Mature	
GMWB benefit strength	■ Weak (blue)	■ Strong (red)	
Hedge status	■ Hedged	▨ Unhedged	
Moneyness	*x-axis*		

Chart labels:
- Company grouping[1] (unhedged)
- Company grouping[1] (outliers)
- Company grouping[1] (implicit hedge)
- Y-axis: Change in total reserve (0% to 6%)
- X-axis: Block moneyness (50% to 250%)

(1) "Outliers" company grouping for change in excess reserve are no longer outliers, indicating a similar pattern of scenario reserves between scenario sets

(2) The range of change in total reserve in both model office testing and field testing is much tighter compared to change in excess reserve
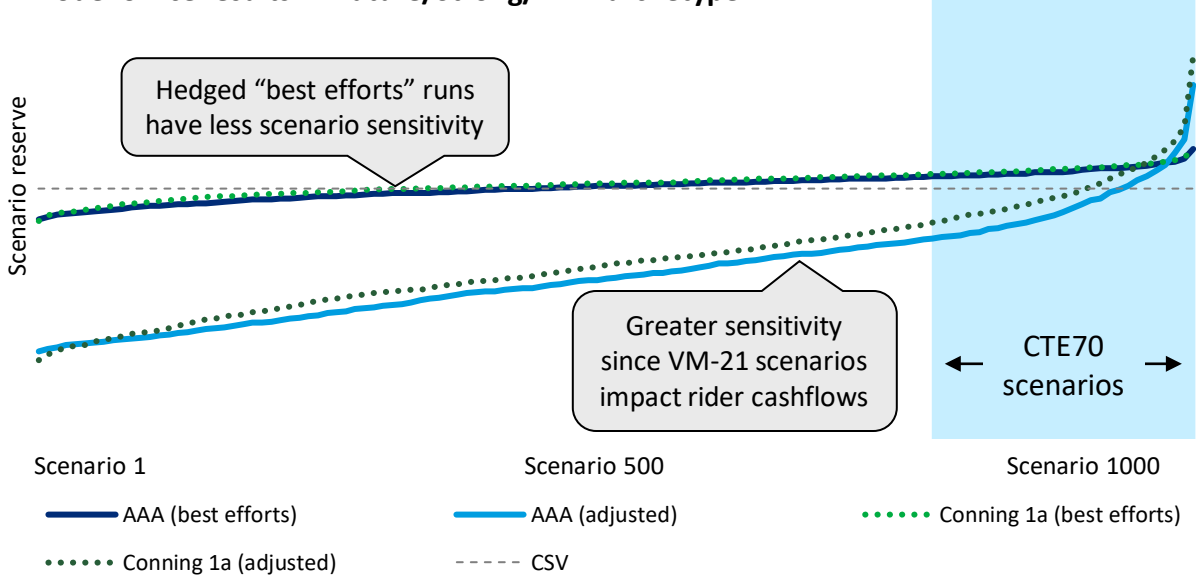 - Limited industry data was available to compare to deep ITM business

1: Grouping of data points from field test results. Each grouping is made up of 3+ normalized data points. Moneyness level for company groupings is based on the reported GMDB/GMWB combo and is calculated using a simple average.

EXPLANATION OF RESULTS: OUTLIERS

The extreme changes in reserve levels are a result of CSV flooring and more likely to be observed in new or OTM blocks. Outliers were observed in both model office testing and field testing

Model office results – New/Weak/OTM archetype

Very few scenarios in excess of CSV

CTE70 scenarios

Scenario 600   Scenario 800   Scenario 1000

—— Conning 1a (adjusted)   —— AAA (adjusted)   - - - - CSV

Model office results – New/Weak/OTM archetype

Component	AAA	Conning 1a	Change
Floored CTE70 (best efforts)	unhedged	unhedged	NA
Floored CTE70 (adjusted)	94,021	94,116	0.1%
Excess reserve	21	116	449%
Total reserve	94,021	94,116	0.1%

Change in total reserve is minimal in these cases

Model office and field-testing results

Cohort	Source	Change in excess reserve	Total change in reserve
New/Weak/OTM/Unhedged archetype	Model office	449%	0.1%
Mature/Weak/ATM/Hedged archetype	Model office	631%	0.0%
Field test grouping[1]	Field testing	1025%	0.4%

1: Grouping of data points from field test results. Each grouping is made up of 3+ normalized data points

EXPLANATION OF RESULTS: HEDGED VS UNHEDGED

Hedging programs reduce scenario sensitivity. This trend was observed in both model office testing and field testing

Model office results – Mature/Strong/ATM archetype

Hedged "best efforts" runs have less scenario sensitivity

Greater sensitivity since VM-21 scenarios impact rider cashflows

CTE70 scenarios

Scenario 1   Scenario 500   Scenario 1000

─── AAA (best efforts)   ─── AAA (adjusted)   •••• Conning 1a (best efforts)

•••• Conning 1a (adjusted)   ----- CSV

Best effort runs are less sensitive to VM-21 scenarios due to hedging

Implicit hedging example	Commentary
Risk-Neutral value of Riders (Used in the best efforts calculation)	• Defined as the average PV(rider claims) – average PV(rider fees) under stochastic risk neutral scenarios • Value is **independent from VM-21 underlying scenarios**
Best efforts scenario reserves	• Risk-neutral value of riders is an upfront cost in the projection, future rider claims and fees are not modeled • Less sensitive to VM-21 scenarios due to the removal of rider cashflows

Model office and field-testing results

Cohort	Source	Change in excess reserve	Total change in reserve
Mature/Strong/ATM/Unhedged archetype	Model office	78.7%	0.6%
Field test grouping[1] – unhedged	Field testing	69.8%	1.3%
Mature/Strong/ATM/Hedged archetype	Model office	14.1%	0.4%
Field test grouping[1] – hedged (implicit)	Field testing	23.8%	0.3%

1: Grouping of data points from field test results. Each grouping is made up of 3+ normalized data points

KEY TAKEAWAYS: MODEL OFFICE ANALYSIS

Category	Takeaways
1 **Model office approach**	• Model office approach produced a range of results across archetypes that align well with initial field test results, making it an appropriate tool to supplement unaggregated GOES field testing *(pg 28)*
2 **Impact of archetypes**	• Archetype analysis demonstrates how liability characteristics and hedging practices can drive the relative impact to change in excess reserves *(pg 29-32, 36)* • Characteristics that drive excess reserves to lower levels: Newer business, weaker benefits, ATM/OTM *(pg 29-33)*
3 **Excess vs total reserve**	• In addition to change in excess reserves over CSV, additional metrics and results should be considered when evaluating field test results (e.g., total change in reserve, change in scenario reserves) *(pg 28, 34)* • Change in excess reserves highlights the financial impacts to the industry while change in total reserves highlights the impact to the underlying scenario reserves

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QUALIFICATIONS, ASSUMPTIONS, AND LIMITING CONDITIONS