

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 officed 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 #1a¹, 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)

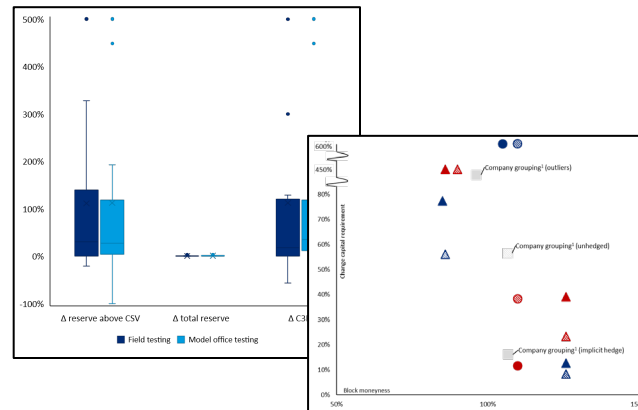
Potential areas identified

- 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 office results



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

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

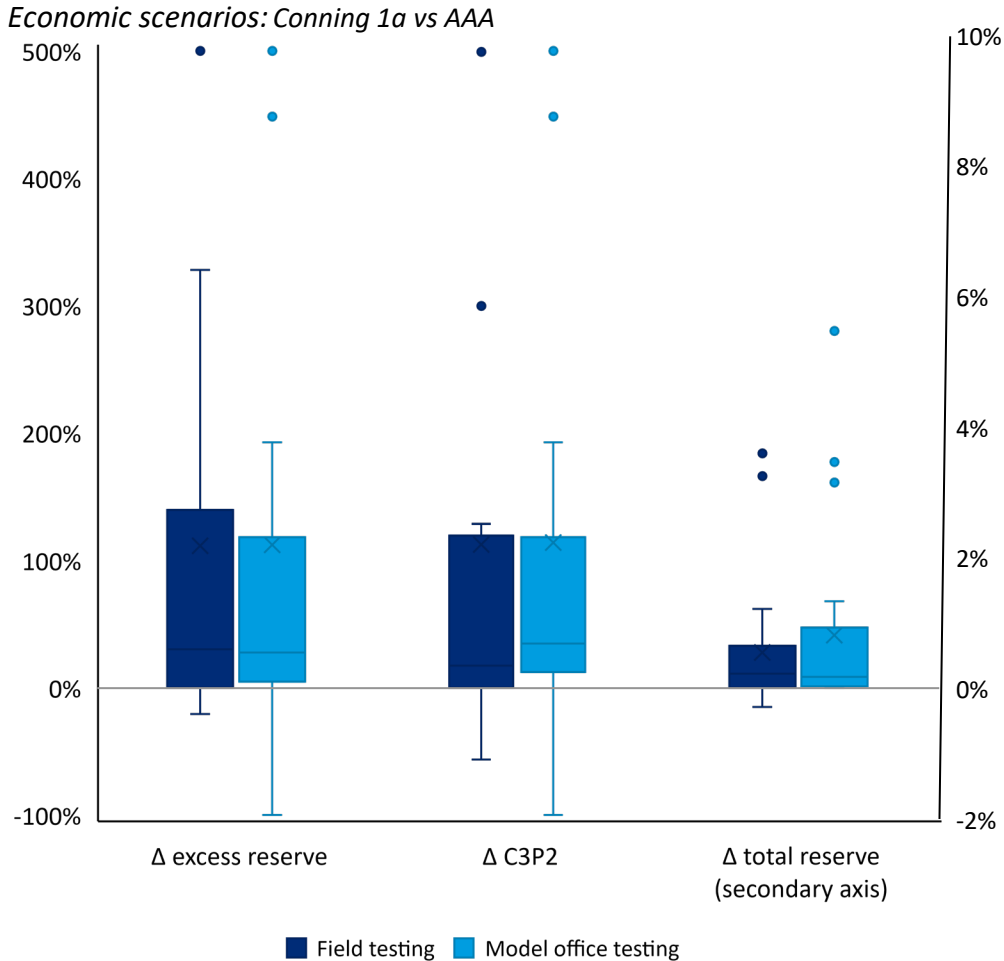
Analysis performed

- 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

- 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
- 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
- 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 levels¹



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

OVERVIEW OF CONTENTS

Section	Summary
	<i>VM-21</i> <ul style="list-style-type: none">• 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
Section 2 VM-21 & GMXB refresher	<i>GMXB</i> <ul style="list-style-type: none">• Overview of GMWB and GMDB riders used in model office testing• Highlights how equity and interest rate scenarios impact the GMXB benefit
	<i>Model office development</i> <ul style="list-style-type: none">• 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
Section 3 Model office development and analysis	<i>Analysis</i> <ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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

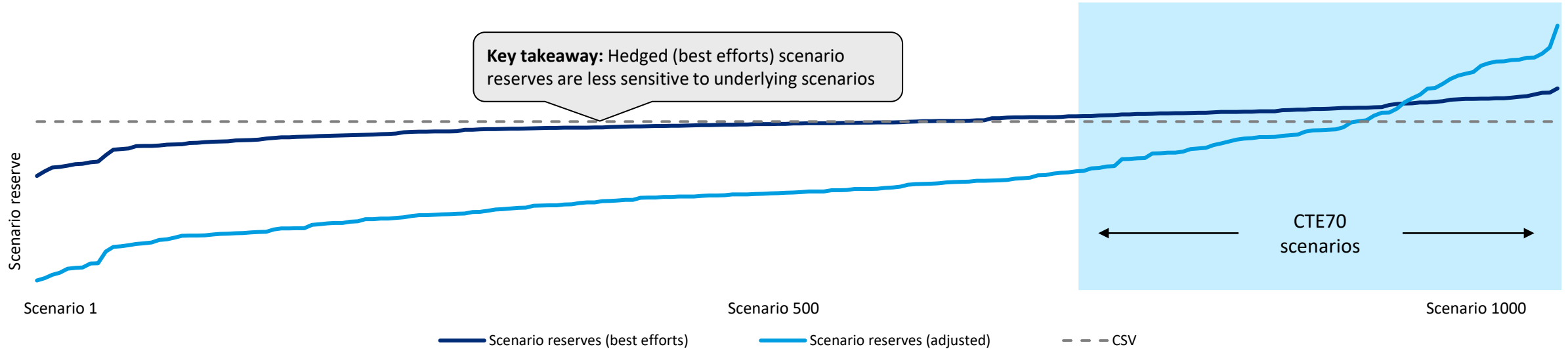
VM-21 RESERVE REFRESHER: STOCHASTIC RESERVE

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

$$\text{Stochastic reserve} = \text{CTE70 (best efforts)} + E \times \max[0, \text{CTE70 (adjusted)} - \text{CTE70 (best efforts)}]$$

Illustrative

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



Component	Details
CTE70 (best efforts)	<ul style="list-style-type: none"> CTE70 of scenario reserves (best efforts) Scenario reserve calculation reflects future hedging strategy
CTE70 (adjusted)	<ul style="list-style-type: none"> CTE70 of scenario reserves (adjusted) Scenario reserve calculation <u>does not</u> reflect future hedging strategy
Error factor (E)	<ul style="list-style-type: none"> 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

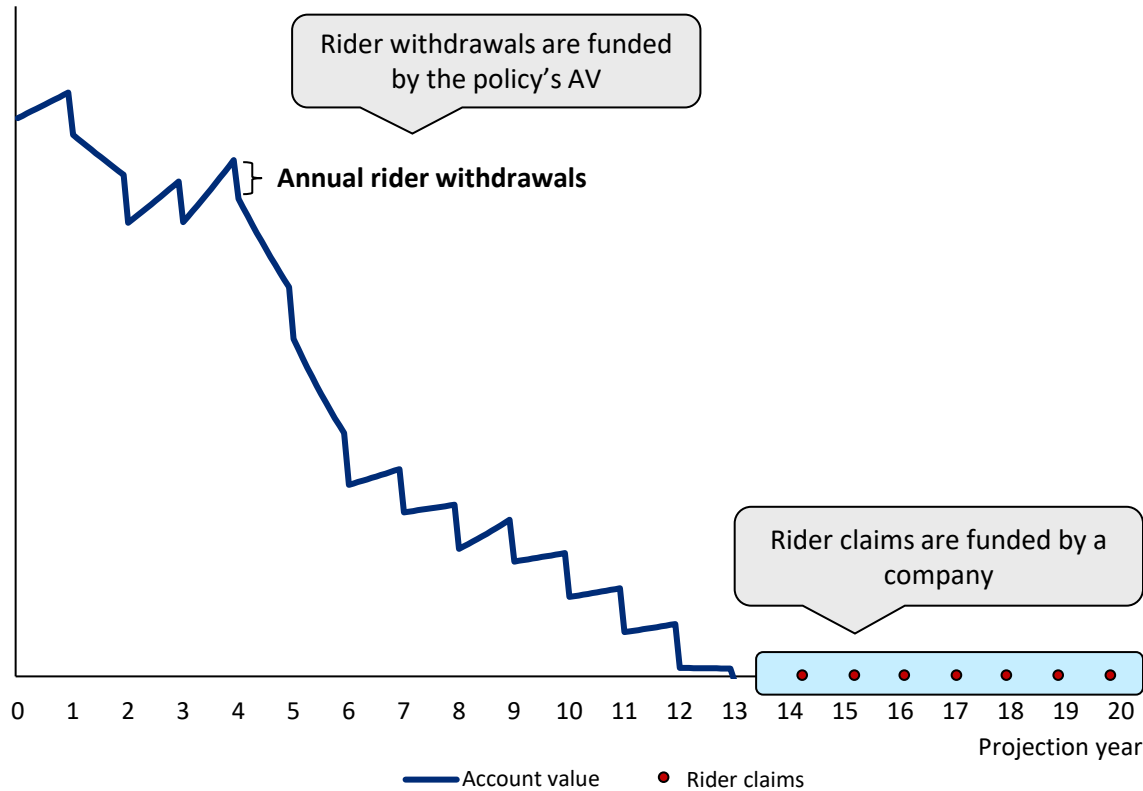
SECTION 2.2

GMXB REFRESHER

GMWB RIDER REFRESHER

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

GMWB illustration

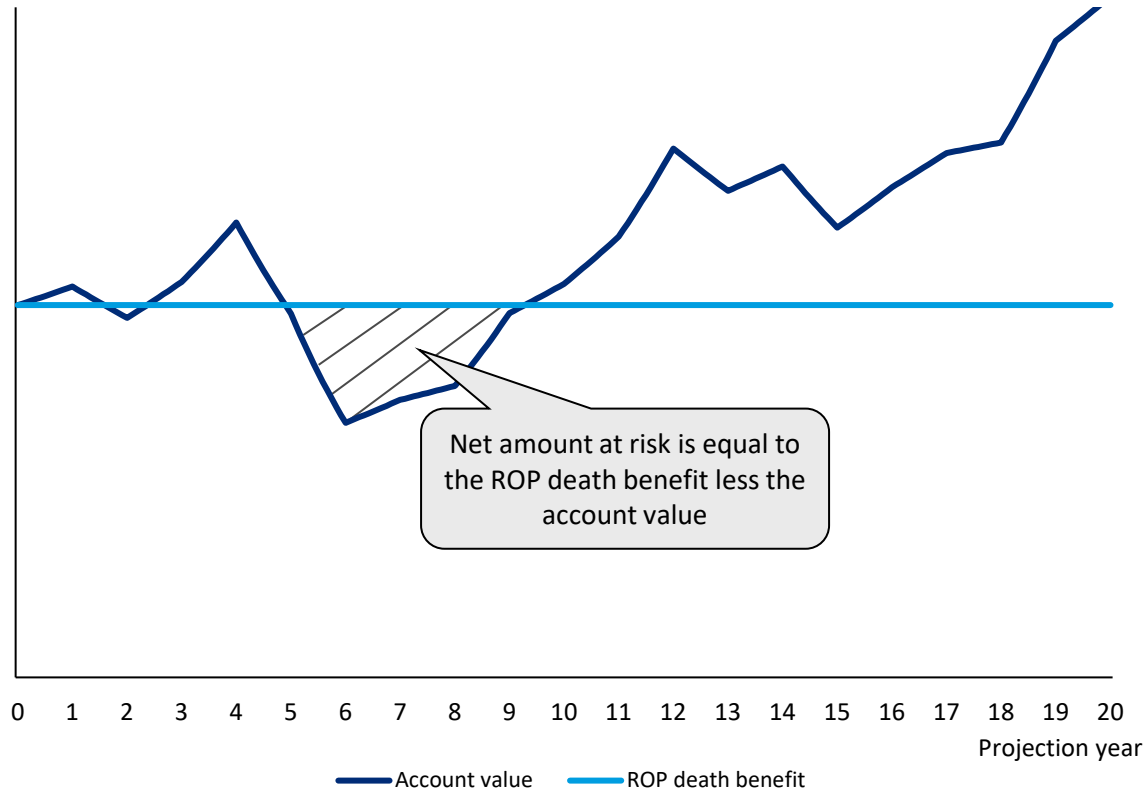


GMWB details	Commentary
Model office	<ul style="list-style-type: none"> Rollup GMWB
GMWB benefit	<ul style="list-style-type: none"> Guarantees a withdrawal amount <u>for life</u> regardless of the account value
Impact of equity scenarios on GMWB value	<ul style="list-style-type: none"> Impacts performance 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	<ul style="list-style-type: none"> 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



GMDB details	Commentary
Model office	<ul style="list-style-type: none"> Return of Premium ("ROP") GMDB
ROP benefit	<ul style="list-style-type: none"> Guarantees the death benefit will be at least equal to the premium deposited, adjusted for withdrawals
Impact of equity scenarios on GMDB value	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none">• The stochastic reserve is a CTE70 valuation based on underlying scenario reserves calculated with and without hedging (<i>pg 12</i>)
2 Scenario reserves	<ul style="list-style-type: none">• Starting assets required to fund all future liability cash flows, with no intermediate deficiencies, for a given economic scenario (<i>pg 12</i>)• Building blocks for the stochastic reserve (<i>pg 12-13</i>)
3 Hedging	<ul style="list-style-type: none">• Hedged scenario reserves are generally less sensitive to the underlying scenarios than unhedged scenario reserves (<i>pg 13</i>)
4 GMXB riders	<ul style="list-style-type: none">• 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 (<i>pg 15-16</i>)• Exposure to underlying equity and interest rate scenarios is different depending on rider type, e.g., GMWB vs GMDB (<i>pg 15-16</i>)

SECTION 3

MODEL OFFICE DEVELOPMENT & ANALYSIS

SECTION 3.1

MODEL OFFICE DEVELOPMENT

OBSERVATIONS FROM FIELD TESTING AND MODEL OFFICE OBJECTIVES

Observations from field testing

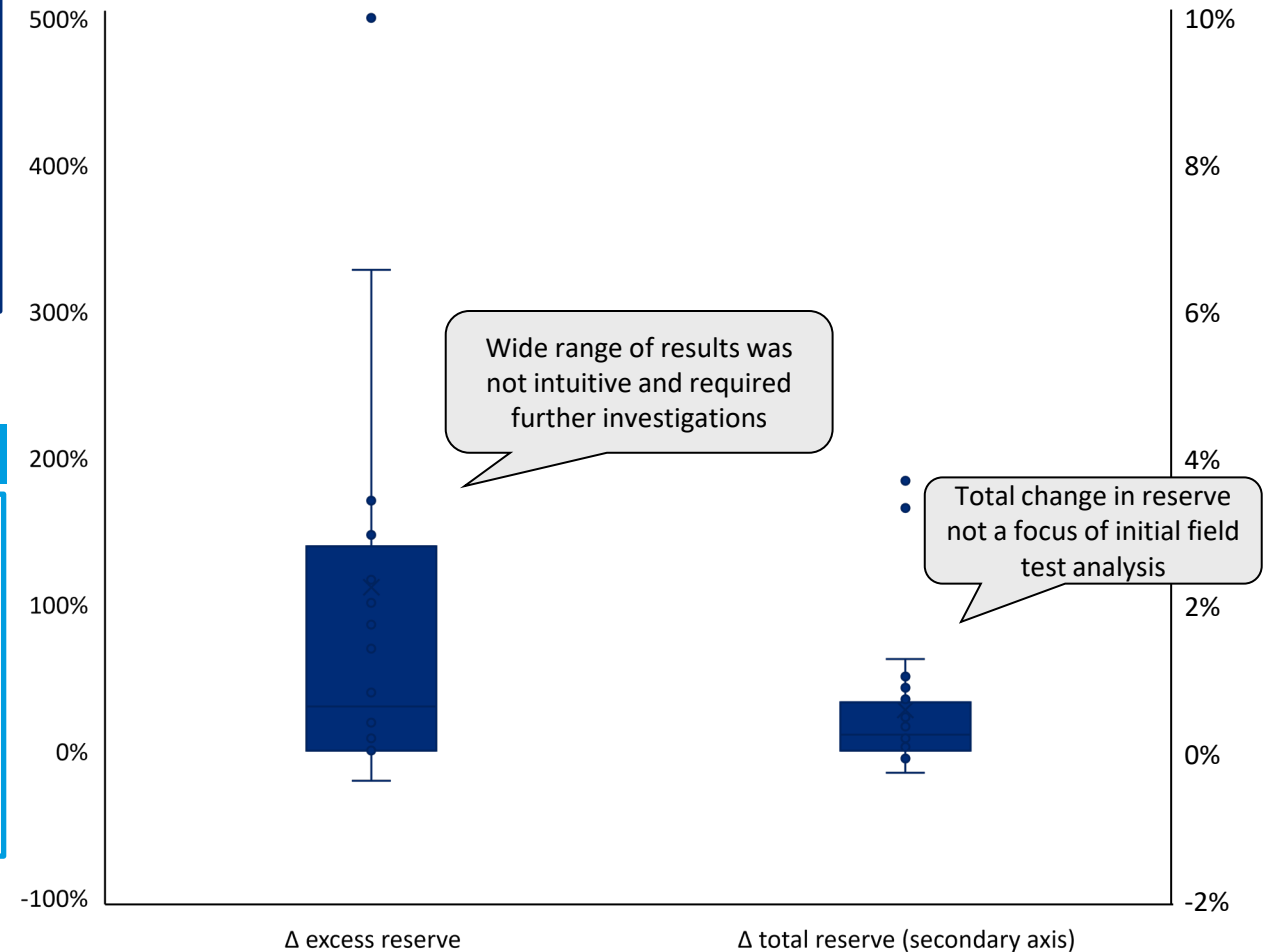
- A wide range of impacts was observed during field testing to the primary metric: increase in excess reserve, between the baseline (“AAA”) and field test scenarios
- Macro level observations, particularly how participants reflected future hedging strategies in VM-21, were identified as potential drivers 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 levels¹

Economic scenarios: Conning 1a vs AAA



1: Results capped at 500%

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 specifications¹

Component	Details
Model	<ul style="list-style-type: none"> AXIS model 50-year projection period
Model assumptions	<ul style="list-style-type: none"> Prudent assumptions developed using a mix of industry benchmarks, industry experience, and prescribed standard projection assumptions
VM-21 assumptions	<ul style="list-style-type: none"> 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 archetypes³

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

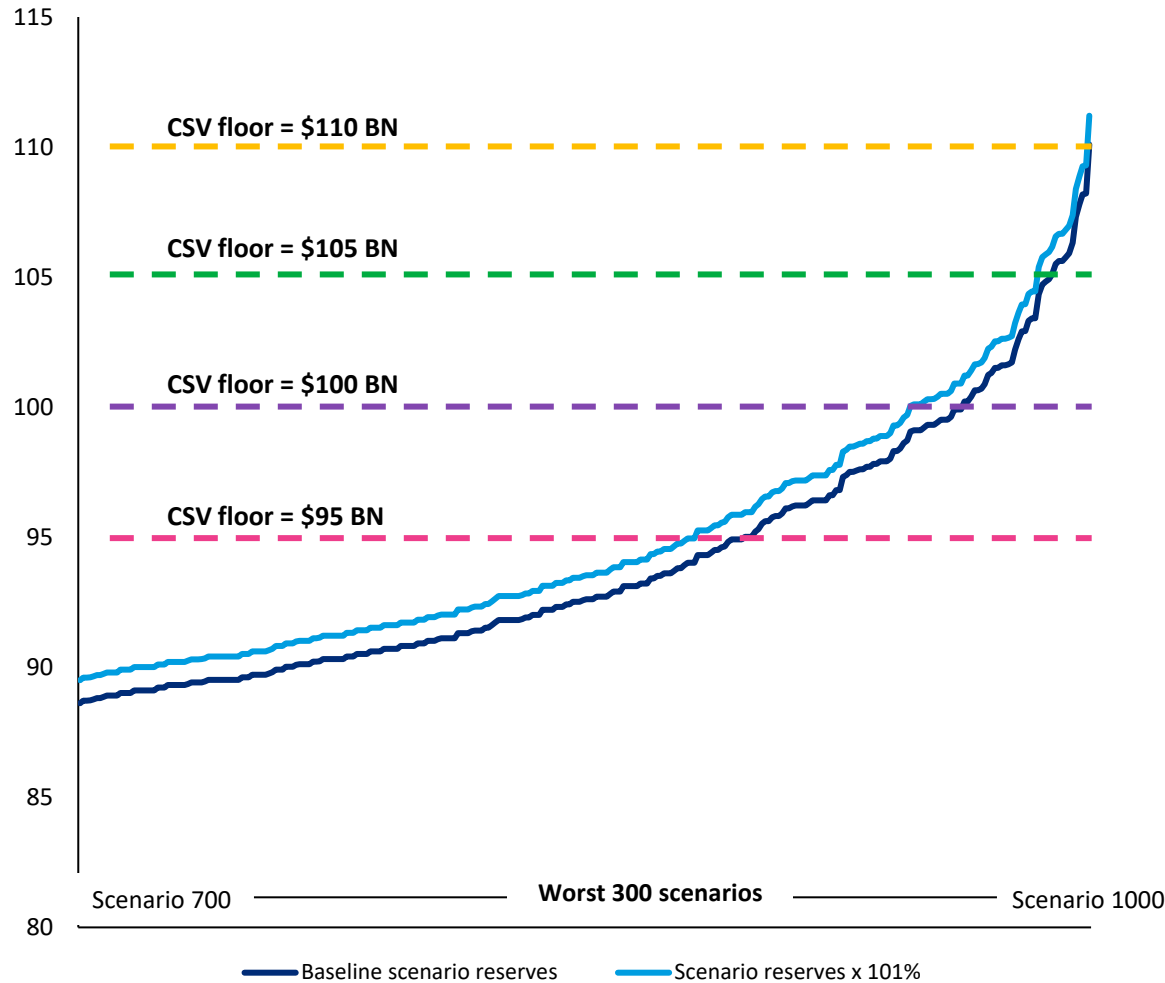
Example archetype:

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

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)



CTE70¹ 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

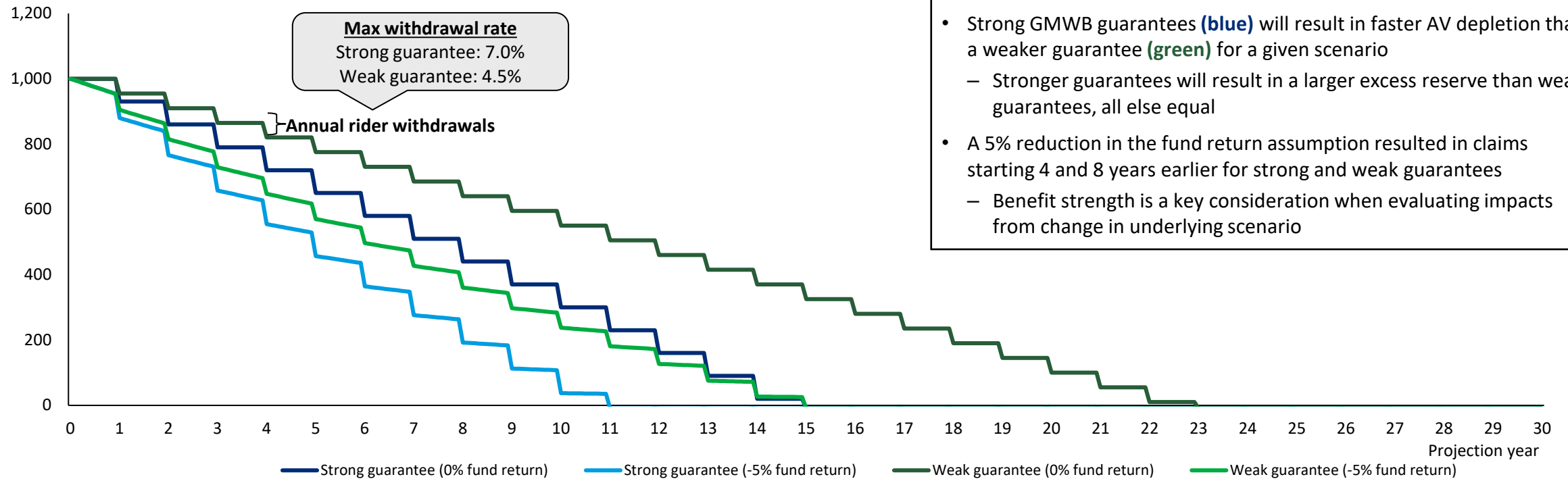
Increase in CTE in excess of CSV decreases as more scenario reserves exceed CSV

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

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

Illustrative¹ AV (in '000s) for weak vs strong guarantees under various fund return assumptions



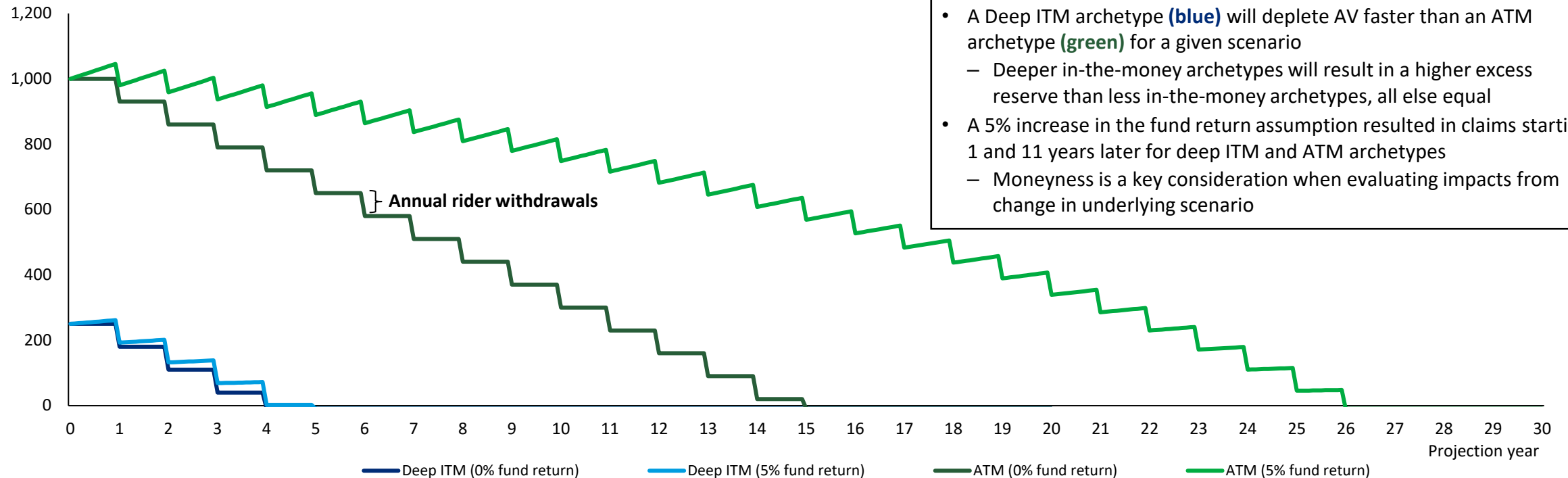
Impact of moneyiness	Strong guarantee (0% fund return)	Strong guarantee (-5% fund return)	Weak guarantee (0% fund return)	Weak guarantee (-5% fund return)
Starting AV	\$1,000,000	\$1,000,000	\$1,000,000	\$1,000,000
Max withdrawal benefit	\$70,000	\$70,000	\$45,000	\$45,000
Claim start year	15	11	23	15

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

DRIVING 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



Impact of moneyiness	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

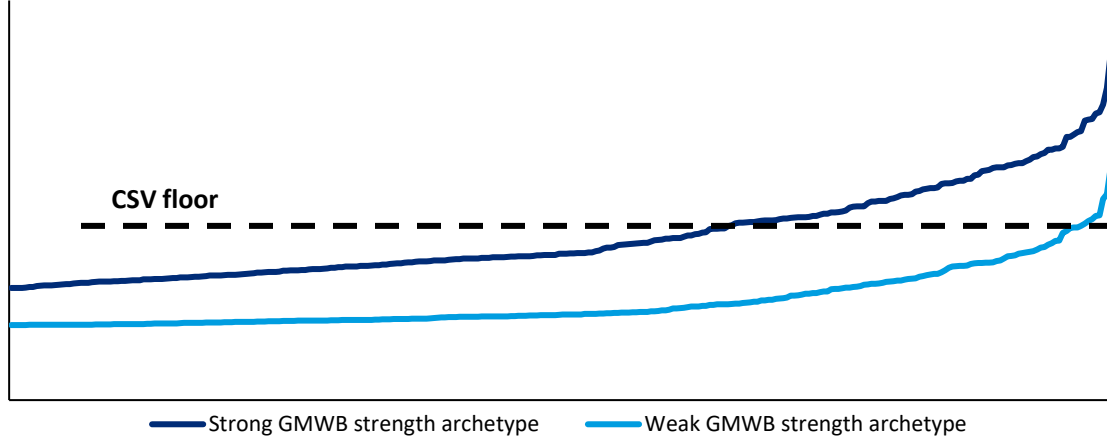
1: Deep ITM defined as a benefit base ratio (benefit base / account value) greater than 140% and ATM defined as a benefit base ratio between 100% and 110%. Illustration assumes the benefit base is equal to \$1,000,000 in all cases.

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

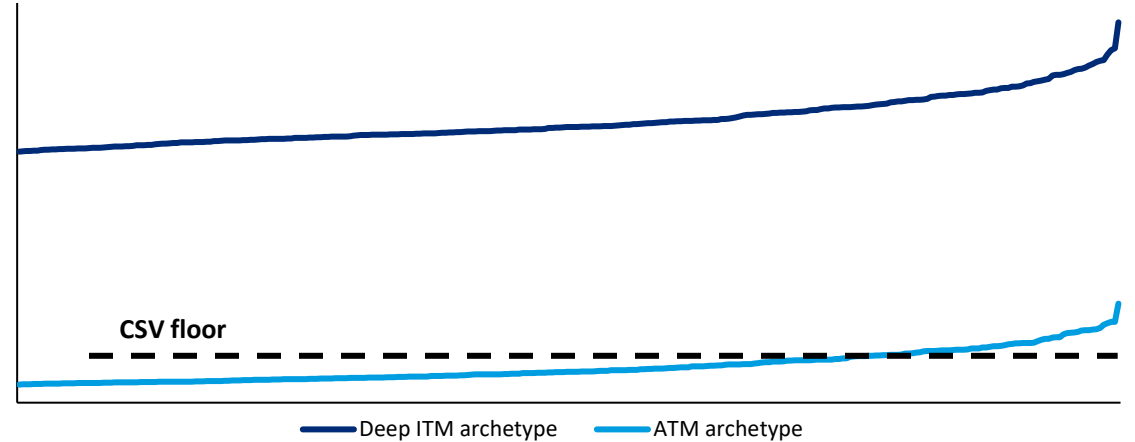
GMWB benefit strength: Strong vs. Weak

Worst 30% of scenario reserves



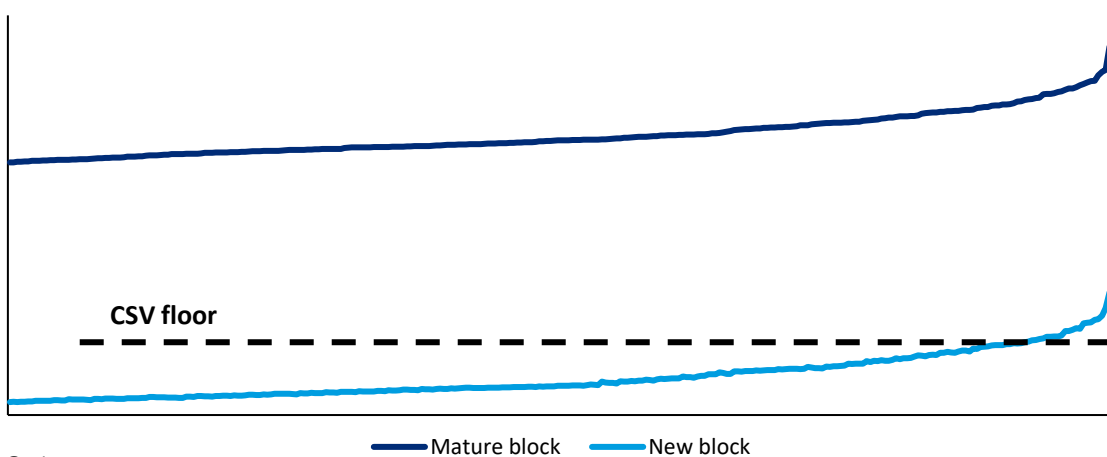
Moneyness: ITM vs. ATM

Worst 30% of scenario reserves



Block maturity: Mature vs. New

Worst 30% of scenario reserves



KEY TAKEAWAYS: MODEL OFFICE DEVELOPMENT

Category	Takeaways
1 Objective, design and archetypes	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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

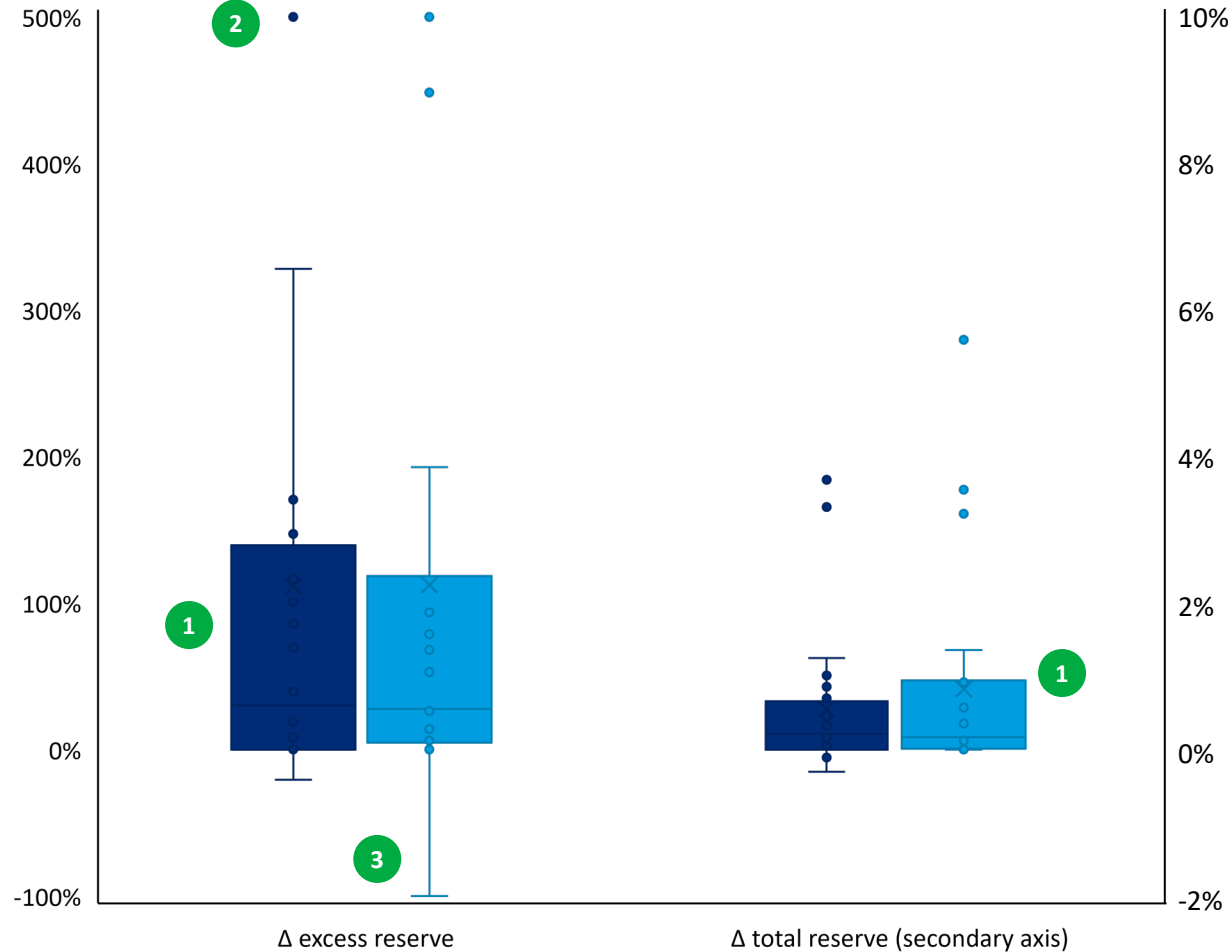
MODEL OFFICE ANALYSIS

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 levels¹

Economic scenarios: Conning 1a vs AAA

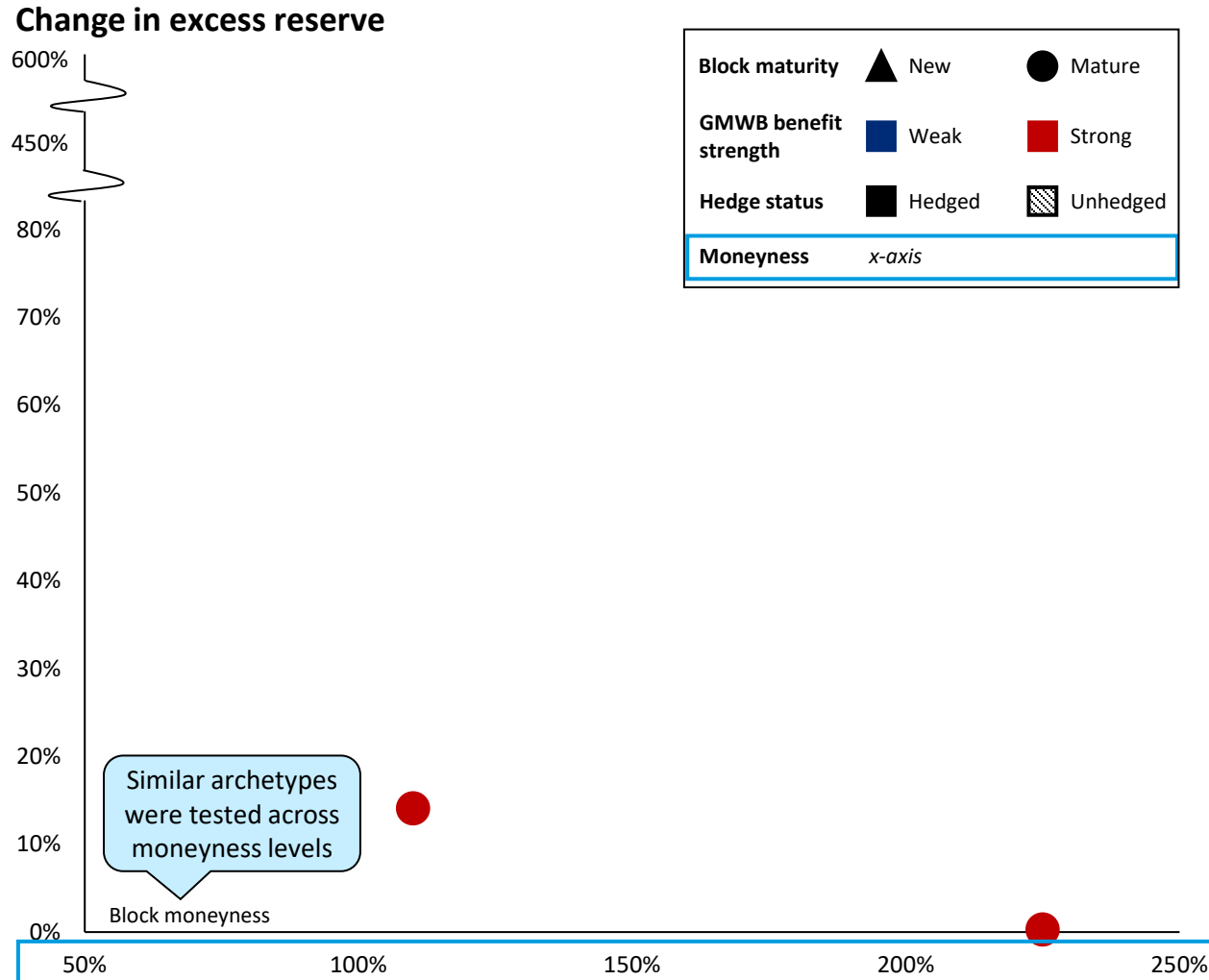


1: Results capped at 500%, includes GMWB combo and GMDB only results

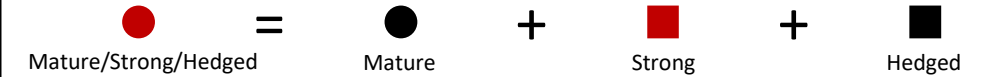
- 1 Model office testing produced a consistent range of results compared to field testing for **both change in excess reserves and change in total reserves**
 - Change in excess reserves has a much wider variance as compared to change in total reserves
 - Range in change in excess reserve is heavily 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

ARCHETYPE DEEP DIVE: MONEYNES

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



Results guide



Moneyiness information

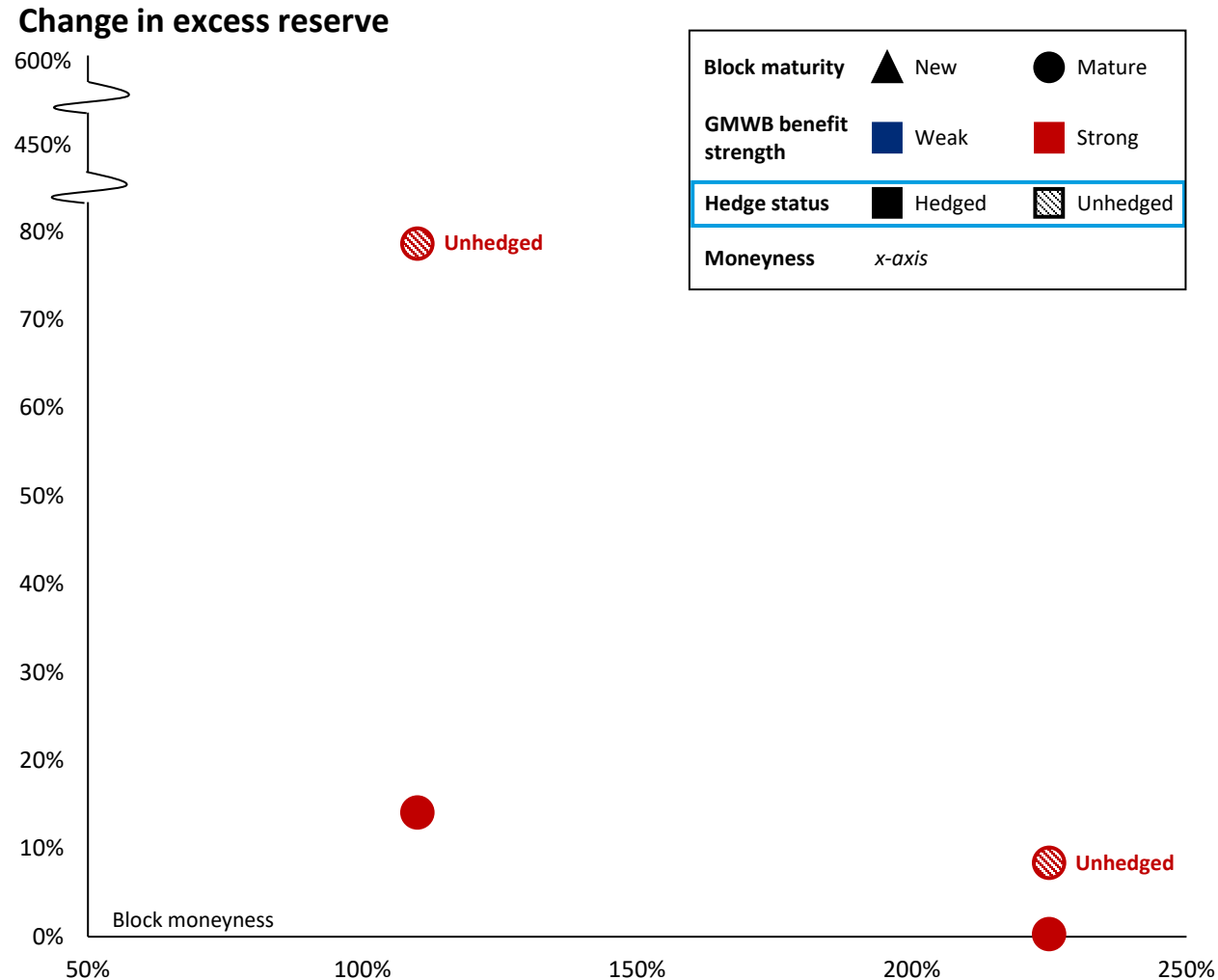
- Moneyiness is defined as benefit base divided by current account value, which is impacted by “historical” fund performance and withdrawals
- A value greater than 100% represents a rider benefit that is larger than account value

Observations

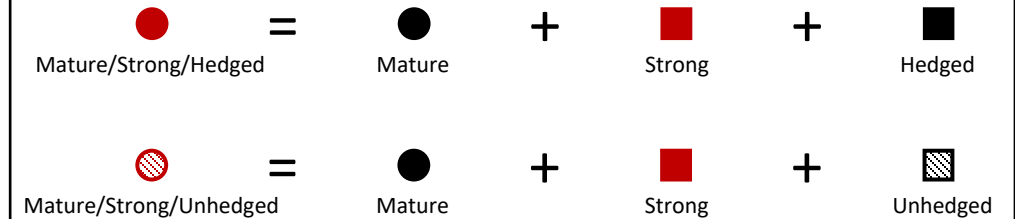
- Model office archetypes with higher moneyiness levels have a larger excess reserve and therefore are less sensitive to changes in underlying scenarios

ARCHETYPE DEEP DIVE: HEDGE STATUS

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



Results guide



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

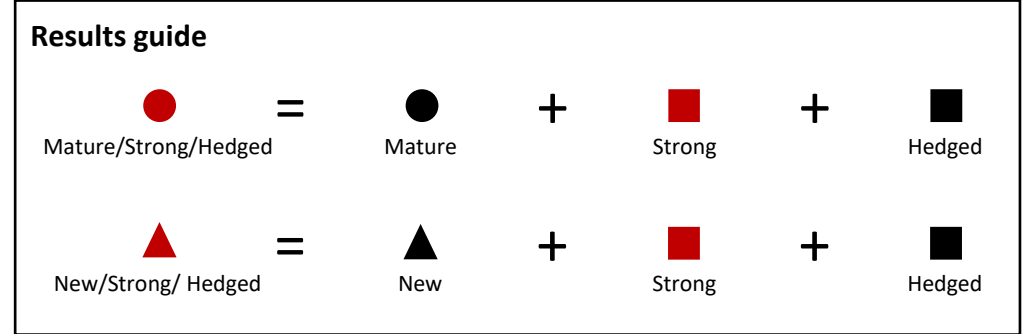
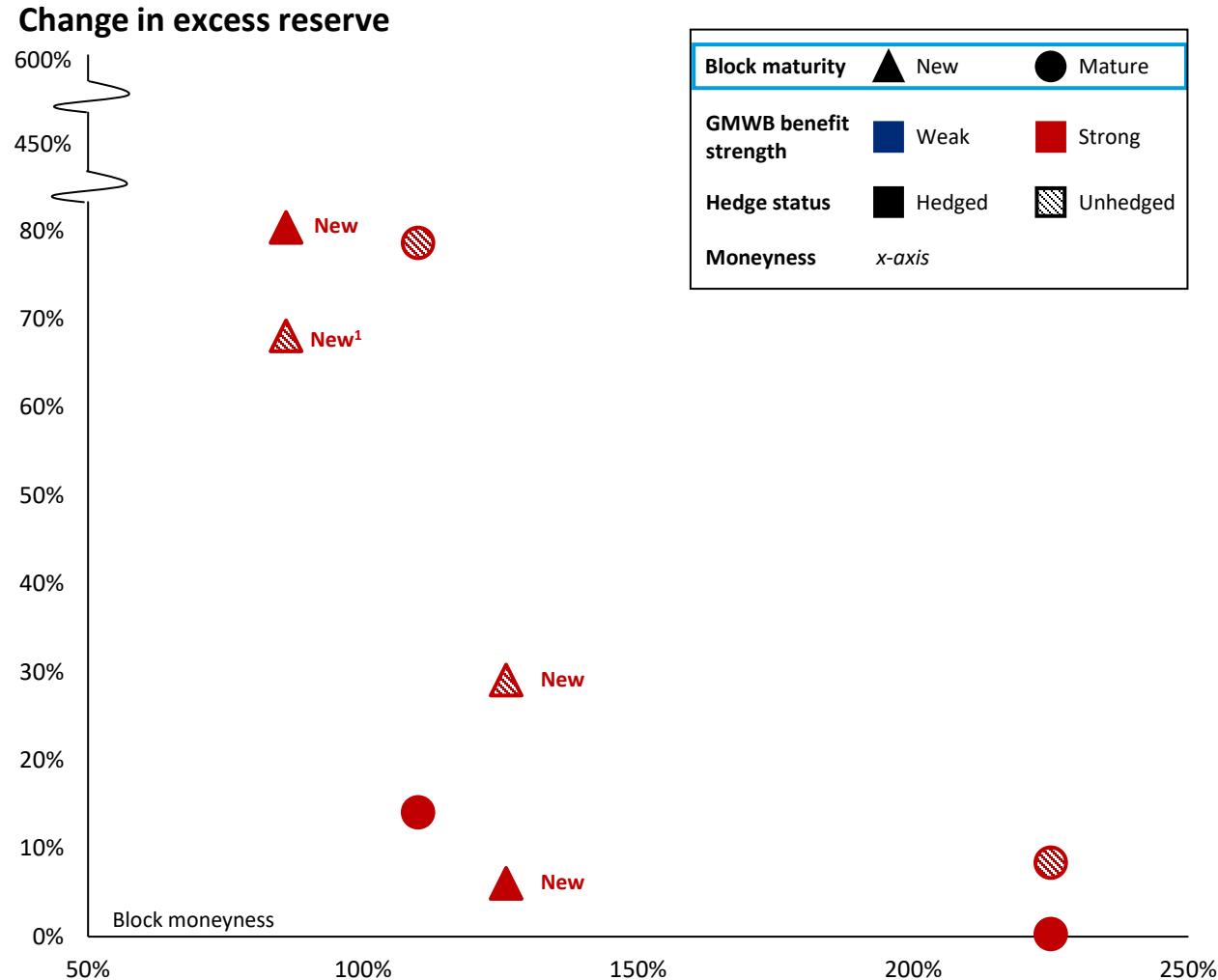
Observations

- 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)



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

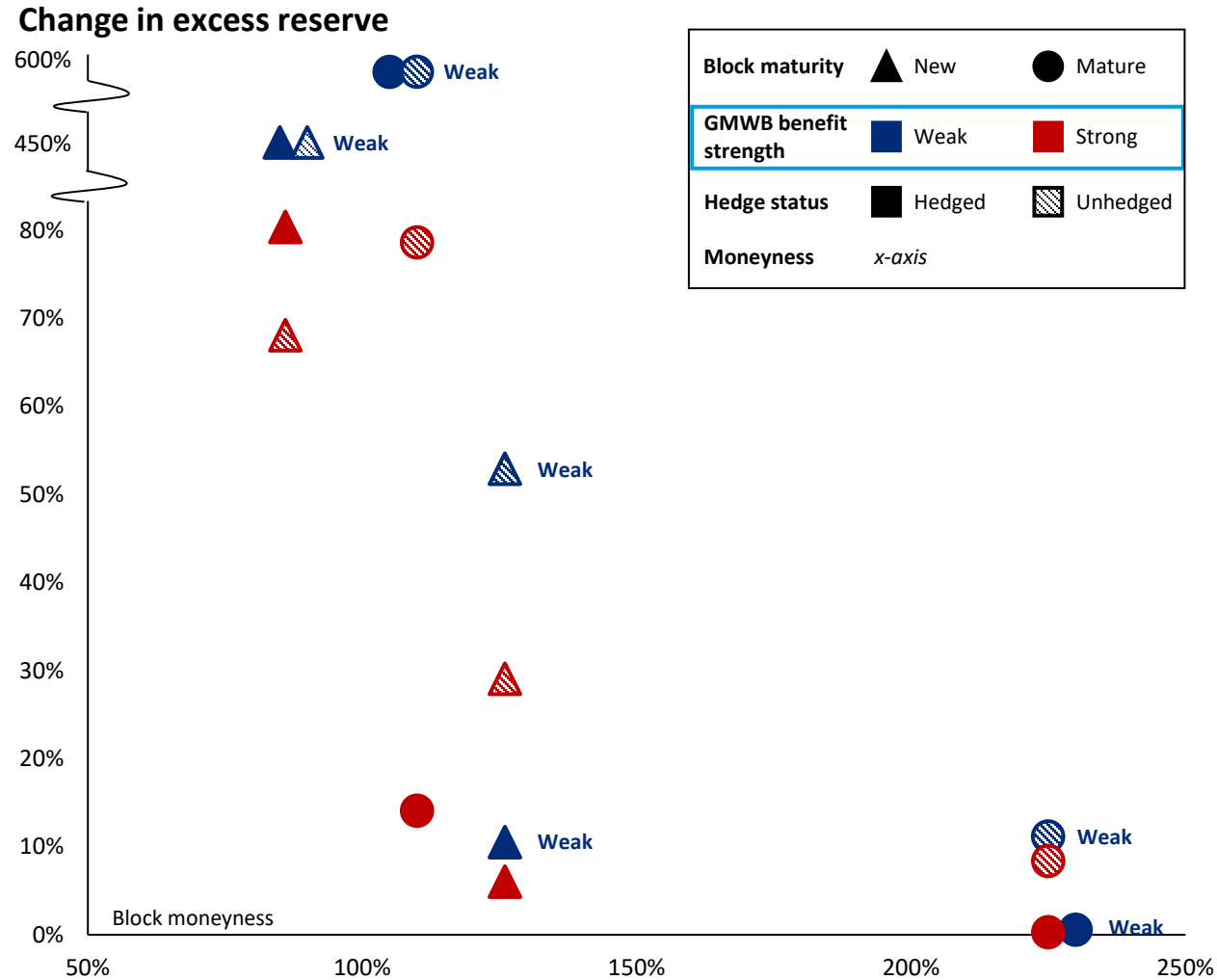
Observations

- “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

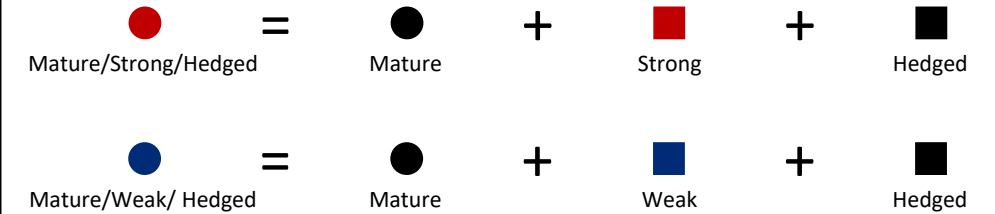
1: The unhedged archetype has a greater dollar change in excess reserve but a lower percentage change relative to the hedged archetype because a larger majority of best efforts scenario reserves, which only impact hedge results, are below the CSV floor.

ARCHETYPE DEEP DIVE: GMWB BENEFIT STRENGTH

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



Results guide



GMWB benefit strength information

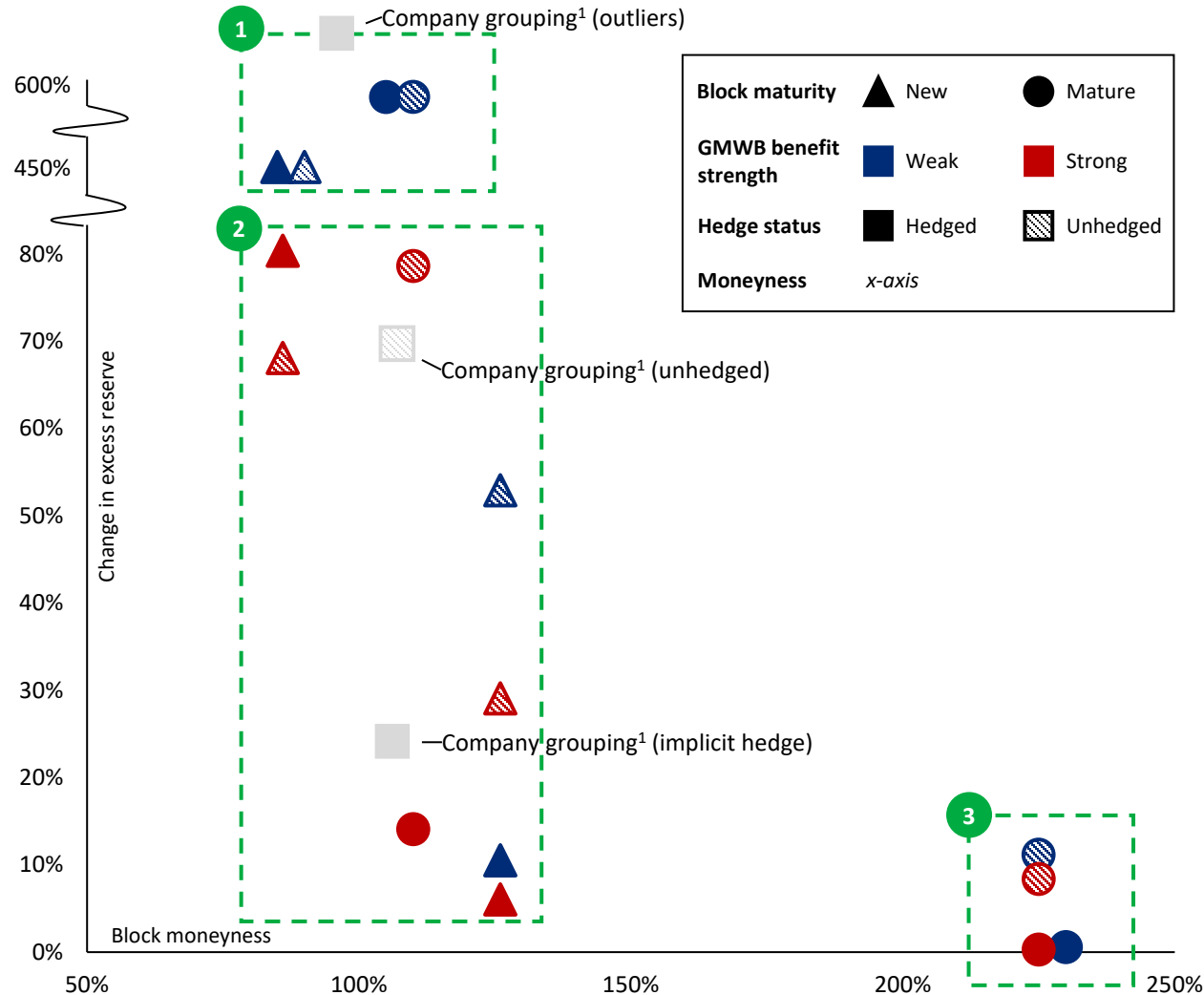
- Weak (strong) archetypes have lower (higher) GMWB rollup and guaranteed withdrawal rates compared to strong (weak) archetypes

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

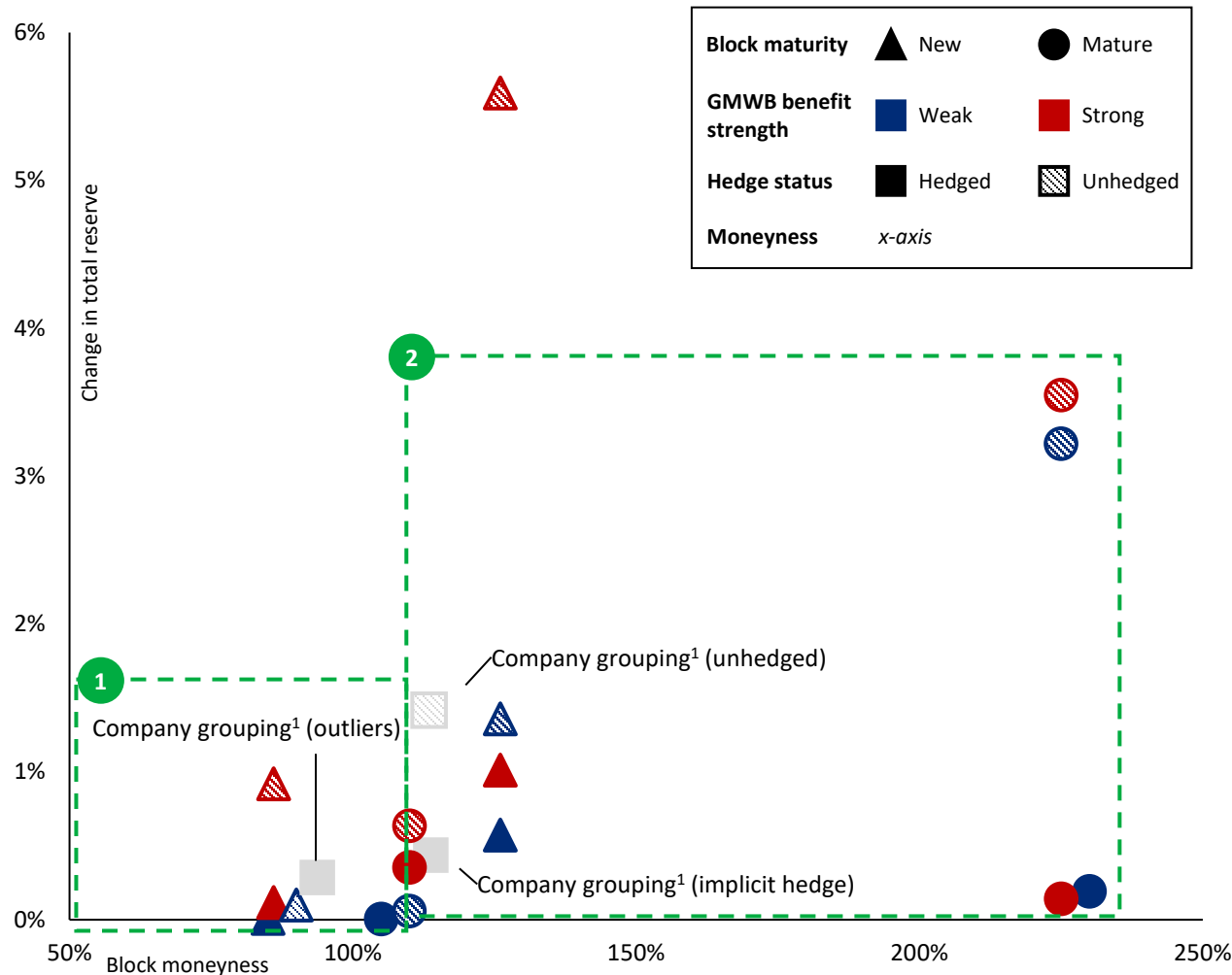


- 1 Outlier company grouping include companies with **reserves in close proximity to CSV** and had the largest change in excess reserves
 - Model office archetypes that produce similar effects: newer business, weaker benefits
- 2 Company groupings are made up of a distribution of key characteristics 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



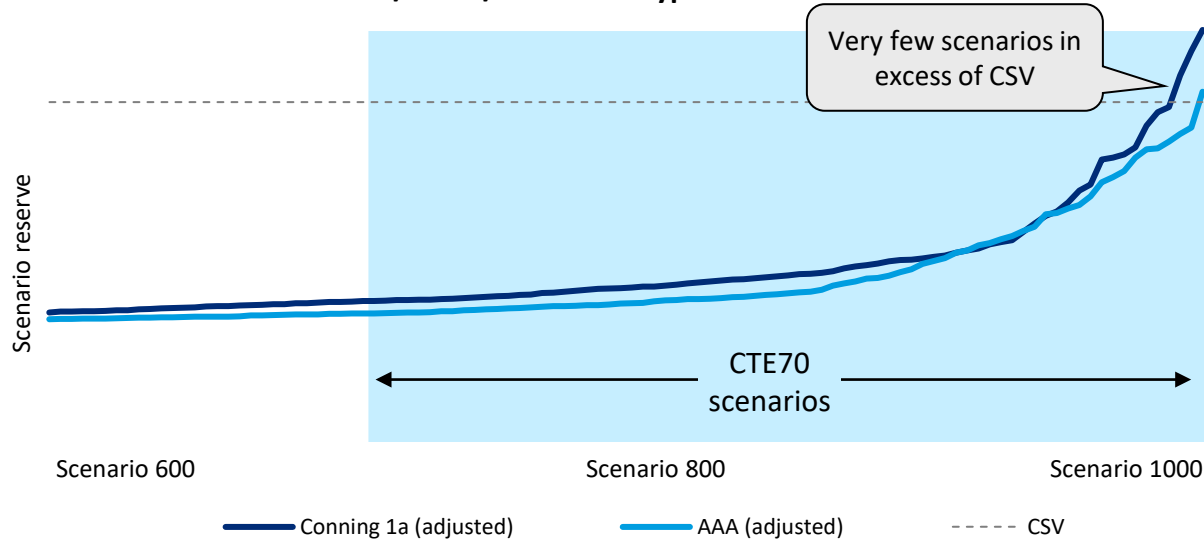
- 1 “Outliers” company grouping for change in excess reserve are no longer outliers, indicating a similar pattern of scenario reserves between scenario sets
- 2 The range of change in total reserve in both model office testing and field testing is much tighter compared to change in excess reserve
 - 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. Moneyiness 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



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%

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%

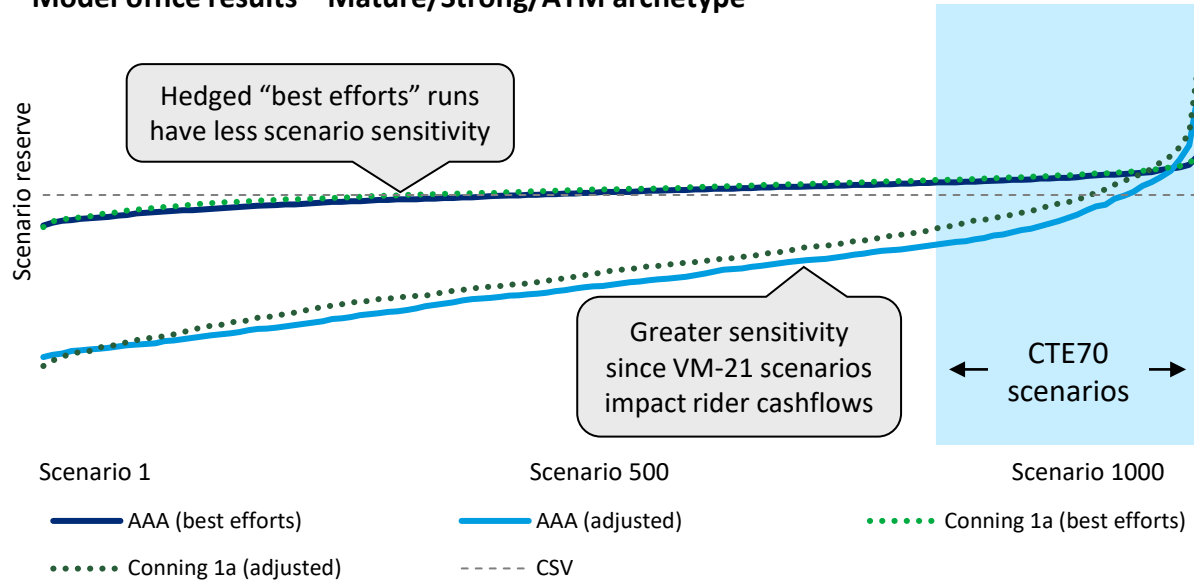
Change in total reserve is minimal in these cases

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



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)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none">• 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 (<i>pg 28</i>)
2 Impact of archetypes	<ul style="list-style-type: none">• Archetype analysis demonstrates how liability characteristics and hedging practices can drive the relative impact to change in excess reserves (<i>pg 29-32, 36</i>)• Characteristics that drive excess reserves to lower levels: Newer business, weaker benefits, ATM/OTM (<i>pg 29-33</i>)
3 Excess vs total reserve	<ul style="list-style-type: none">• 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) (<i>pg 28, 34</i>)• Change in excess reserves highlights the financial impacts to the industry while change in total reserves highlights the impact to the underlying scenario reserves

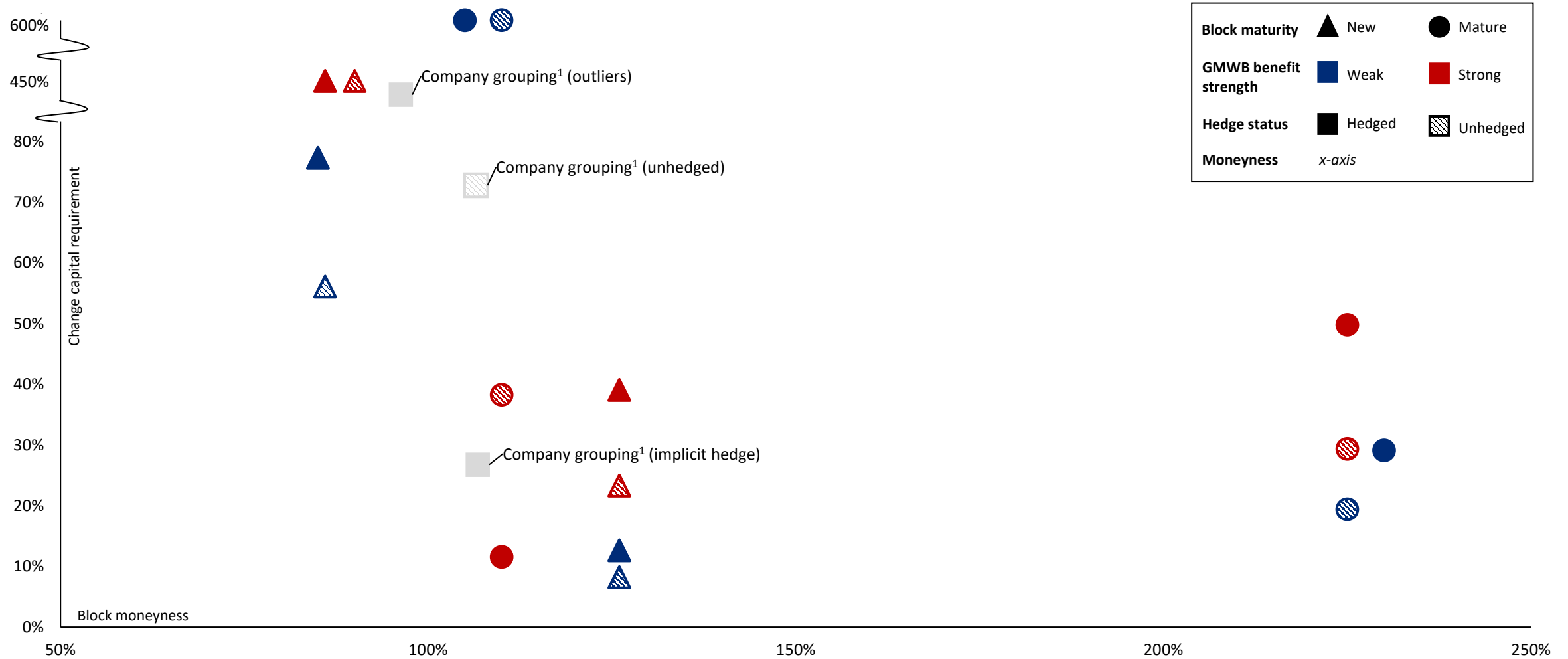
APPENDIX

A

ADDITIONAL ANALYSIS

RESULTS BY ARCHETYPE : CHANGE IN CAPITAL REQUIREMENT

Comparison of model office results for GMWB with ROP GMDB riders to field testing results. Change in capital requirement based on AAA vs Conning 1a scenarios

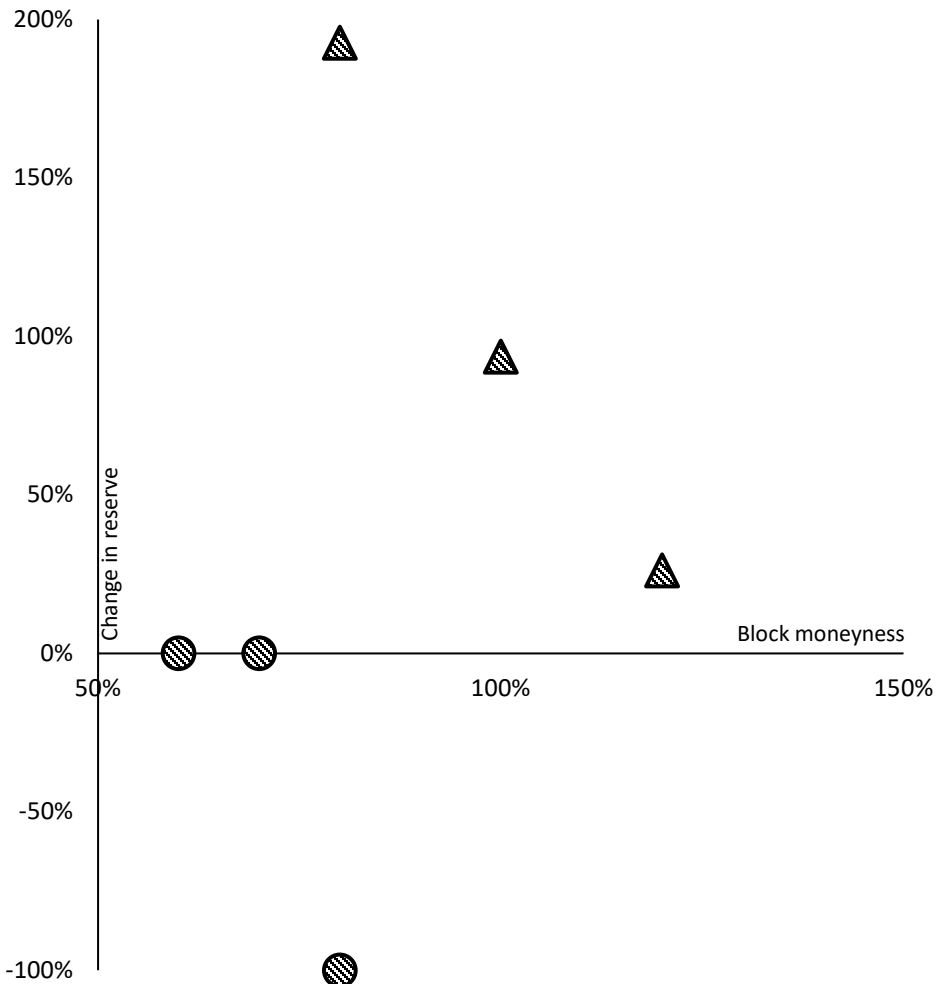


1: Grouping of data points from field test results. Each grouping is made up of 3+ normalized data points. Moneyness level for company groupings is based on the reported GMDB/GMWB combo and is calculated using a simple average.

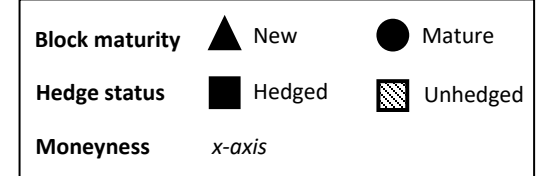
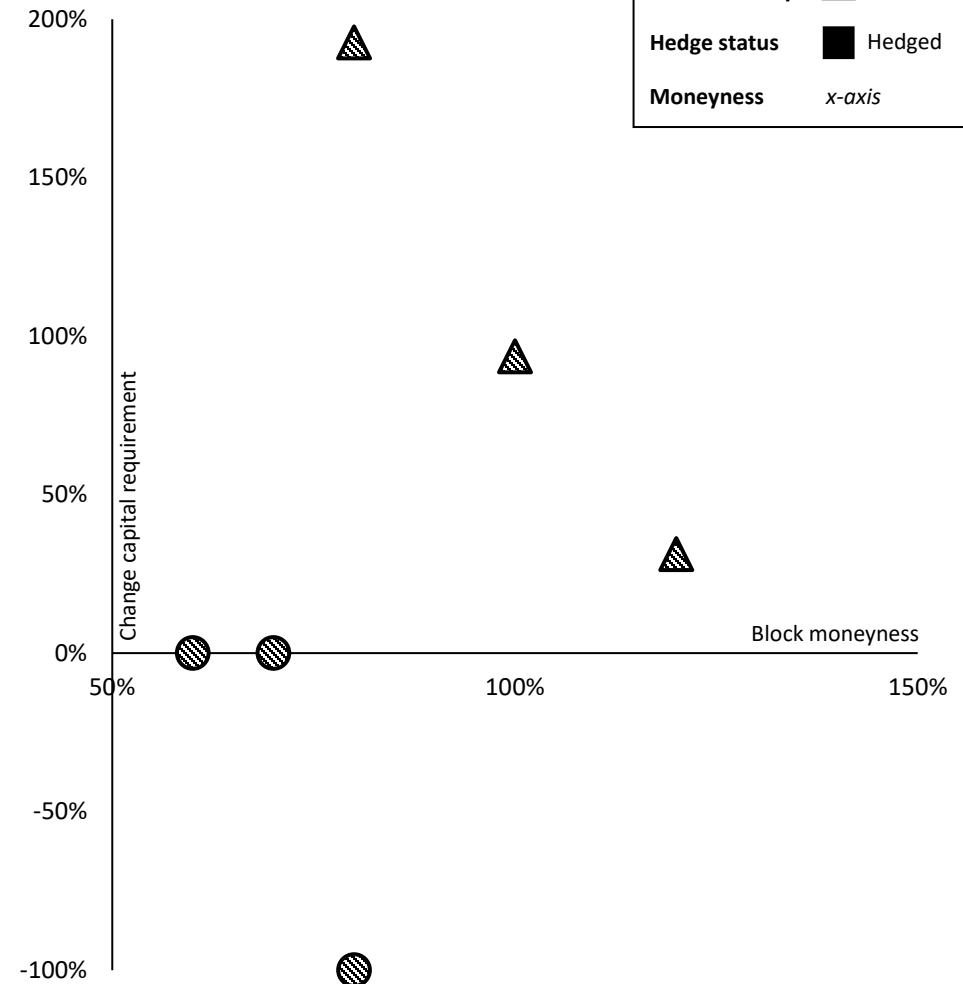
RESULTS BY ARCHETYPE : G MDB ONLY SENSITIVITIES

Model office results for ROP G MDB riders. Changes based on AAA vs Conning 1a scenarios. The relative change in reserves (CTE70) and capital (CTE98) are consistent since a majority of scenario reserves outside of the 98th percentile are lower than CSV

Change in excess reserve



Change in capital requirement



B

DRIVING CHARACTERISTICS AND ARCHETYPES











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: 2020 Average age: 66 Percentage of GMWB contracts taking income: 20%
	Mature	Issue year: 2005 Average age: 75 Percentage of GMWB contracts taking income: 75%
Moneyiness	Varies	Moneyiness values: Vary from 60% to 225% depending on riders
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 model office testing

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

IN-FORCE ARCHETYPES: GMDB ONLY

6 different GMDB only archetypes were used in model office testing

Archetype	DB rider	Hedging	Block maturity	Moneyness
 1	ROP GMDB	None	New	OTM
 2	ROP GMDB	None	New	ATM
 3	ROP GMDB	None	New	ITM
 4	ROP GMDB	None	Mature	OTM – 60%
 5	ROP GMDB	None	Mature	OTM – 70%
 6	ROP GMDB	None	Mature	OTM – 80%

C

MODEL SPECIFICATIONS

MODEL COMPONENTS AND FUNCTIONALITY

Component	Description of functionality
Liability modeling	<ul style="list-style-type: none">• Liability cash flows for model office comprised of the following product features:<ul style="list-style-type: none">– 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	<ul style="list-style-type: none">• Guardrail VM-21 prescribed strategy: 10-year bonds with ratings A and AA consistent with the guardrail prescribed under VM-21
Calculations	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Best estimate• Prudent best estimate• VM-21 standard projection prescribed
Hedging	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• 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

LIABILITY BEST ESTIMATE ASSUMPTIONS (1/2)

Assumption	Active rider	Best estimate assumption	Prudent margin
Mortality	GMDB only	Baseline * VM-21 attained age factor (higher mortality than baseline)	+5% base, -5% MI
	GMDB + living benefit	Baseline * VM-21 attained age factor (lower mortality than baseline)	-5% base, +5% MI
		Base lapse: SC Period = 1%-4%, SC+1 = 20%; SC+n = 10%	
	GMDB only	Dynamic lapse: multiplicative factor based on moneyness level Lapse floor post-SC: 2.0%	-5% (multiplicative)
Surrender	GMDB + GLWB or Hybrid GMIB	Base lapse: SC period same as DB; SC+1=15%; SC+n=8% Dynamic lapse: multiplicative factor based on moneyness level, varies by withdrawal status Lapse floor post-SC: 1.5% if withdrawing, 2.0% if deferring	-5% multiplicative on lapse rate (post dynamic adjustment) and floor
	GMDB + traditional GMIB	Base lapse: same as GLWB Dynamic lapse: multiplicative factor based on moneyness level Lapse floor post-SC: 2%	
Withdrawals (non-rider)	GMDB only	Partial withdrawal: 2% (<i>+consideration for tax status</i>)	No PAD
	GMDB + living benefit	GLWB: 0%; GMIB: 2%	

LIABILITY BEST ESTIMATE ASSUMPTIONS (2/2)

Assumption	Active rider	Best estimate assumption	Prudent margin
GMIB utilization	GMDB + hybrid GMIB (standard projection assumption)	<p>Base utilization: Varies by year, GAPV value of non-annuitization benefits, and withdrawal status</p> <p>Dynamic utilization: Adjustment based on moneyness level</p>	10% (multiplicative)
	GMDB + traditional GMIB	<p>Base utilization: FY exercisable = 15%, subsequent years = 3%</p> <p>Dynamic utilization: Adjustment based on moneyness level</p>	10% (multiplicative)
GLWB / withdrawal utilization	GMDB + living benefit	Use VM-21 WDCM with lower never withdrawal cohort ("NWC")%: 5.0%/15% Q/NQ	NWC %: -2.5%/-5% additive for Q/NQ (i.e. 2.5%/10% as PE)
Withdrawal efficiency	GMDB + living benefit	90% with no excess withdrawal	5.0% additive

ASSET AND REINVESTMENT MODELING

Component	Notes
Inforce assets	<ul style="list-style-type: none">• Inforce assets are made up 50/50 mix of 10-year bond with ratings A/AA• Assets are assumed to be purchased on valuation date and fully scalable to match time zero reserve requirement• Inforce assets will rotate into reinvestment strategy below as they reach maturity
Inforce asset assumptions	<ul style="list-style-type: none">• Investment expenses: 10bps• Default rate: 15bps• Spreads: VM-20 prescribed
Reinvestment strategy	<ul style="list-style-type: none">• Reinvestment assets: 50/50 mix of 10-year bonds with ratings A/AA (consistent with the guardrail defined under VM-21)• Reinvestment frequency: Annual, assumes intra-year cash and borrowing at 3 month UST• Disinvestment: buy negative reinvestment assets• Other: duration matching is not currently considered in the reinvestment strategy
Reinvestment assumptions	<ul style="list-style-type: none">• Investment expenses: 10bps• Default rate: VM-20 prescribed• Spreads: VM-20 prescribed

ADDITIONAL MODEL SPECIFICATIONS AND FUNCTIONALITY

Item	Details	Values
Riders	The model can model the following riders	GMDB: ROP and rollup GMIB: rollup, hybrid, combo GMWB: rollup
Investment accounts	The following investment accounts are utilized in the model	Investment accounts: US equity, international equity, bond, money market, fixed
Fees	Base contract	M&E: 130 bps Per policy: \$30 Percentage of GMWB contracts taking income: 20% Fund expense ratio: 1.00%
	Rider	GMDB: 0 bps – 35 bps GMIB: 85 bps – 145 bps GMWB: 130 bps

SCENARIO RESERVE: HEDGE MODELING TECHNIQUES

Implicit hedging is used for model office analysis due to the relative simplicity and transparency compared to explicit hedging

Explicit Hedging

Existing hedging strategy

Include asset cashflows from existing hedge instruments in the projection

Future hedging strategy

Hedging positions and their resulting cash flows are included in the stochastic cash-flow model used to determine the scenario reserve

Field test participants

8

Model office criteria

Precision



Transparency



Complexity



Implicit Hedging¹

Hedge positions held on the valuation date replaced with cash and/or other general account assets equal to aggregate market value of the hedge positions

A risk-neutral upfront cost replaces future claims and/or rider fees in the projection, subject to an effectiveness factor

7



1. Also referred to as the "cost of reinsurance" method

D

OLIVER WYMAN TEAM

OLIVER WYMAN TEAM



Dylan Strother, FSA

Senior principal
Engagement manager

dylan.strother@oliverwyman.com



Carson Cook, FSA

Manager
Lead Modeler

carson.cook@oliverwyman.com



Alex Potocki, FSA

Senior Manager
Annuity SME

alex.potocki@oliverwyman.com



Nick Farber, ASA

Consultant
Automation SME

nick.farber@oliverwyman.com

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