How a Standard Formula Firm can use an Economic Capital Model for Strategic Investment Decisions

Alex Tazov, Conning

19 October 2017

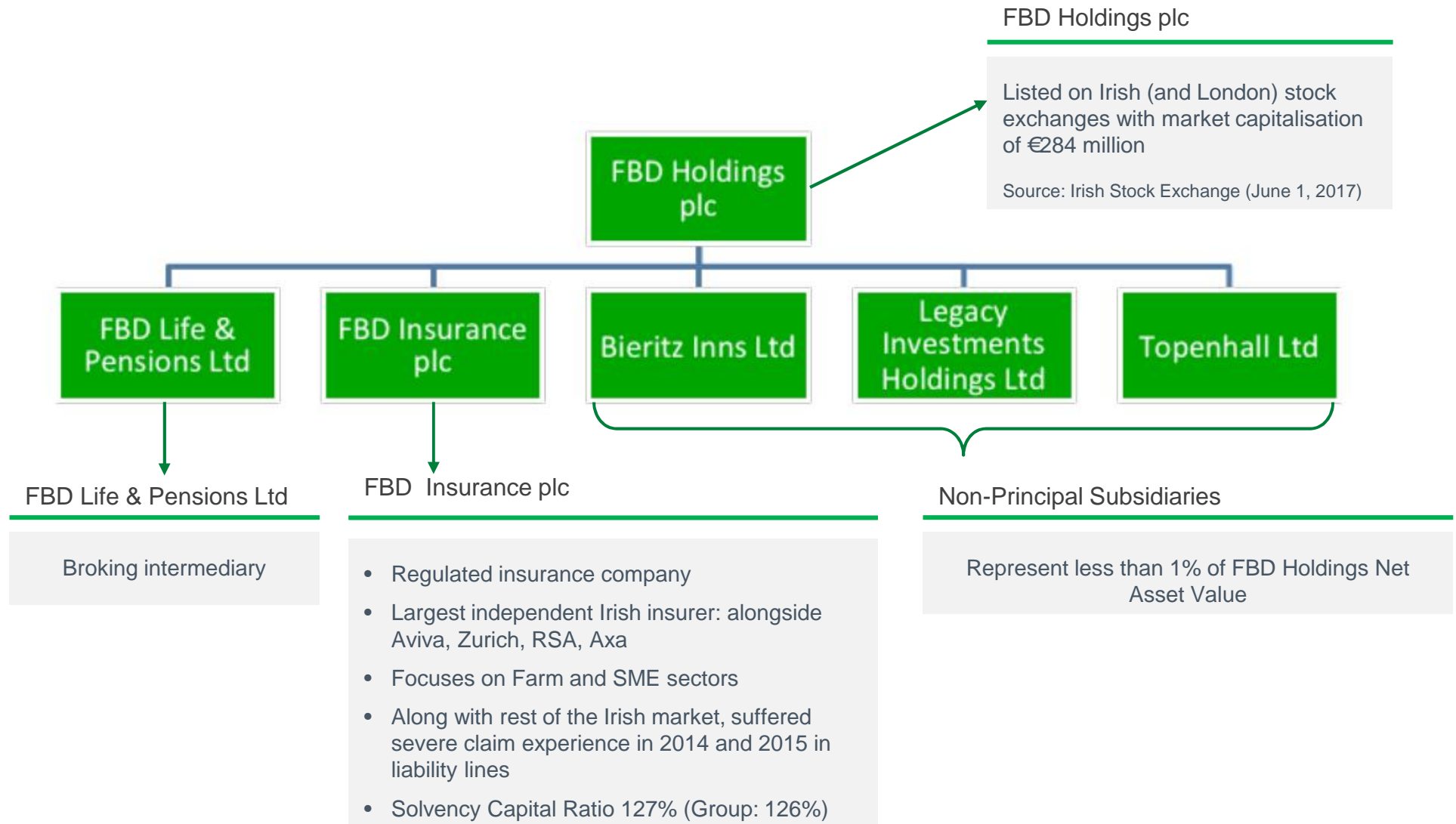# Table of Content

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Who are FBD?

FBD Holdings plc

Listed on Irish (and London) stock exchanges with market capitalisation of €284 million

Source: Irish Stock Exchange (June 1, 2017)

```
                          FBD Holdings
                              plc
      ┌──────────┬────────────┼──────────────┬──────────────┐
  FBD Life &   FBD Insurance  Bieritz Inns   Legacy        Topenhall Ltd
  Pensions Ltd    plc         Ltd            Investments
                                             Holdings Ltd
```

FBD Life & Pensions Ltd

Broking intermediary

FBD Insurance plc

- Regulated insurance company
- Largest independent Irish insurer: alongside Aviva, Zurich, RSA, Axa
- Focuses on Farm and SME sectors
- Along with rest of the Irish market, suffered severe claim experience in 2014 and 2015 in liability lines
- Solvency Capital Ratio 127% (Group: 126%)

Non-Principal Subsidiaries

Represent less than 1% of FBD Holdings Net Asset Value

Source: FBD Holdings plc
2016 Solvency and Financial Condition Report

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FBD: Insurance Business

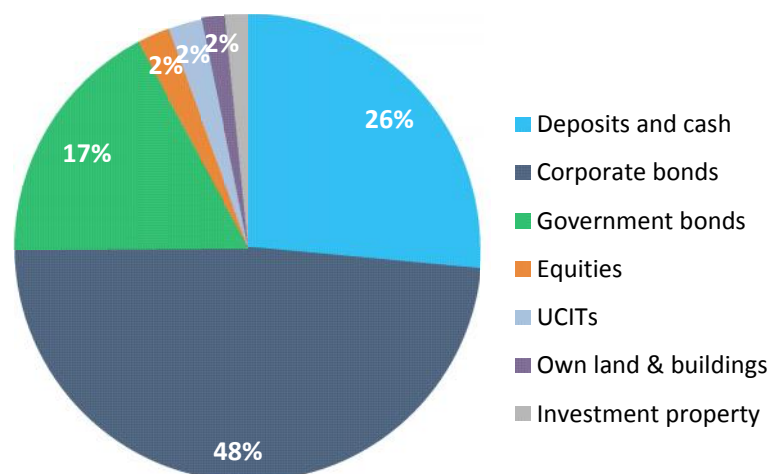**FBD's Gross Written Premium in 2016**
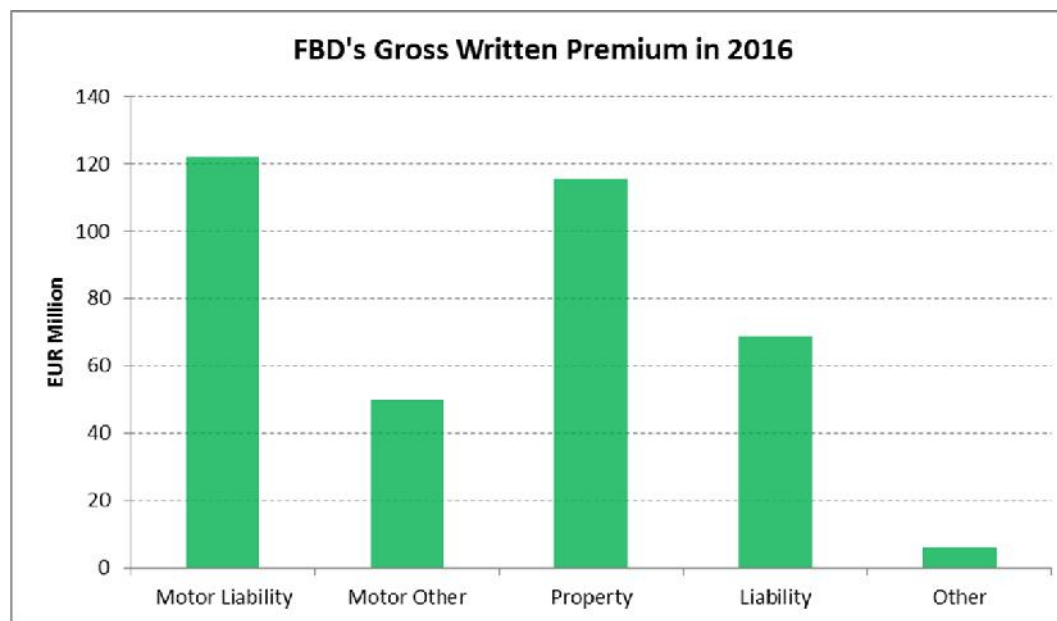
	Motor vehicle liability insurance 2016 €000s	Other motor insurance 2016 €000s	Fire and other damage to property insurance 2016 €000s	General liability insurance 2016 €000s	Other Insurance 2016 €000s	Total 2016 €000s	Total 2015 €000s
Gross Written Premium	122,018	49,839	115,637	68,487	5,817	**361,799**	363,263
Net Earned Premium	107,661	48,547	82,020	64,612	5,387	**308,226**	313,154
Net Claims Incurred including MIBI	(91,342)	(24,408)	(25,166)	(80,601)	(3,741)	**(225,257)**	(352,840)
Expenses net of reinsurance commission	(28,233)	(11,094)	(18,153)	(21,000)	(1,270)	**(79,750)**	(85,725)
Underwriting Profit/Loss	(11,914)	13,045	38,701	(36,989)	376	**3,219**	(125,411)

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FBD: Investment Portfolio
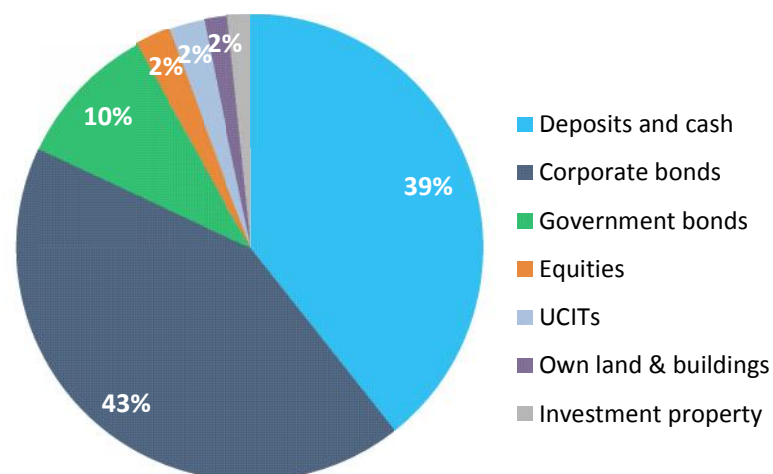
Investment assets	31 December 2016		31 December 2015	
	€m	%	€m	%
Deposits and cash	270	27%	399	39%
Corporate bonds	494	48%	432	43%
Government bonds	177	17%	101	10%
Equities	23	2%	25	2%
UCITs	24	2%	25	2%
Own land & buildings	16	2%	16	2%
Investment property	16	2%	15	2%
Investment assets	1,020	100%	1,013	100%

Source: FBD Holdings plc
2016 Solvency and Financial Condition Report

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FBD: Maturity Schedule of Fixed Income Investments

Deposits and quoted debt securities, December 2016

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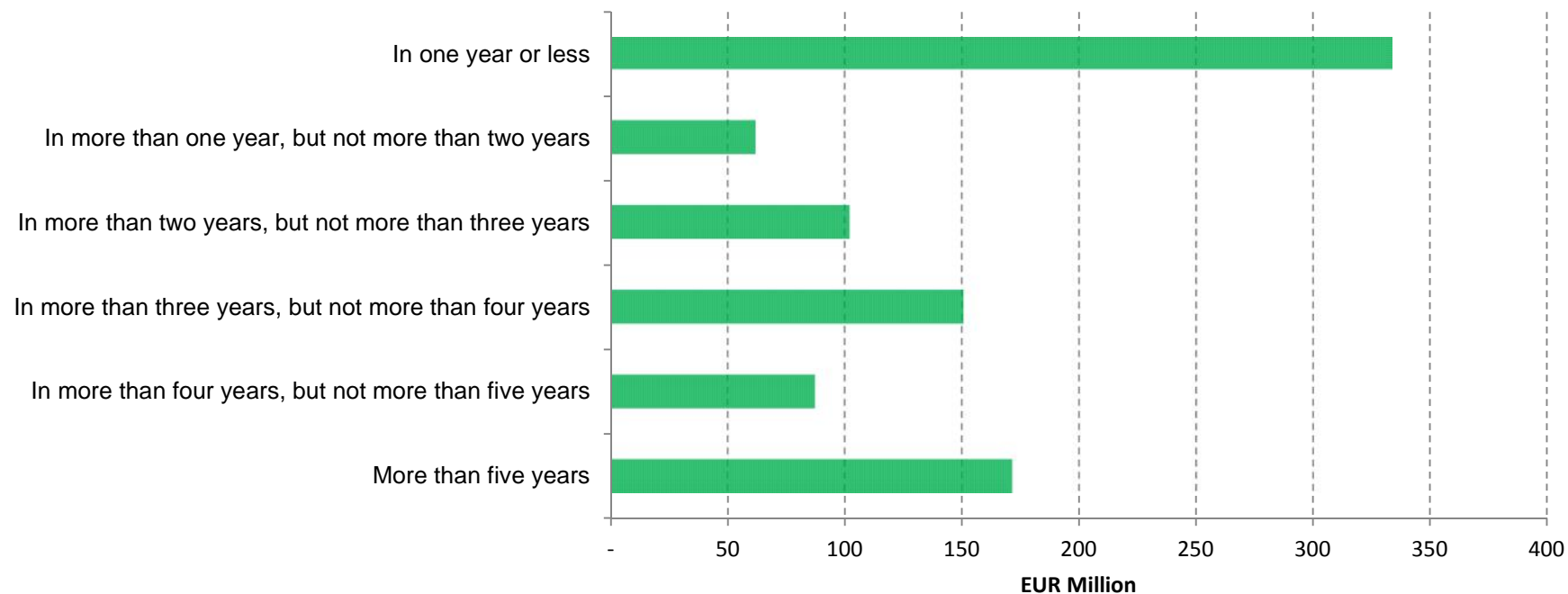
Enterprise Risk and Reward Fundamentals

Framework for setting your Risk Tolerance and Risk Preference

Risk Tolerance (risk limit)

Management's "ability" to take on risk

Risk Preference (risk appetite)

Management's "willingness" to take on risk

While the use of Probability of Ruin and Expected Policyholder Deficit approach for setting risk tolerance differ in important ways, there is a common theme. In each case, the analysis proceeds in these four steps:

1. Select a Financial Variable

2. Select a Time Frame

3. Select a Measure

4. Select a Criterion

Solvency II Example:

1. Financial Variable – Economic Capital

2. Time Frame – One Year

3. Select a Measure – Value at Risk

4. Select a Criterion – 99.5th Percentile (1-in-200)

Sample Probability Distribution Function
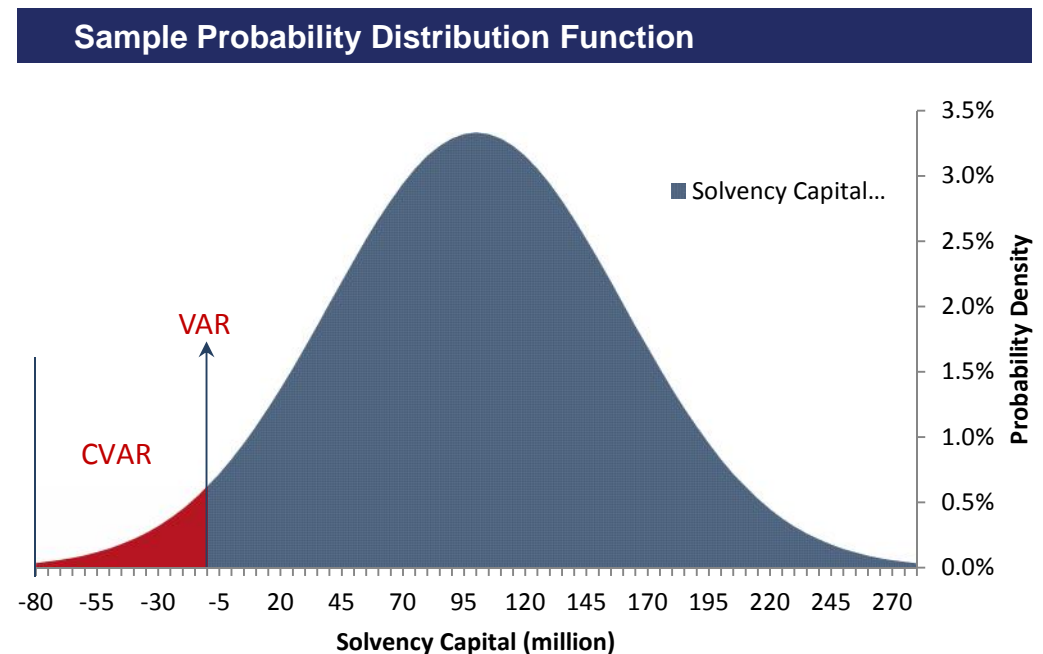
Objective Function – Reward Measures

Objective Function

An equation to be optimized given certain constraints and with variables that need to be minimized or maximized. An objective function can be the result of an attempt to express a business goal in mathematical terms for use in decision analysis, operations research or optimization studies.

An Objective Function Requires:

- A Reward Variable and Measure

- A Risk Measure

Common Reward Measures

Reward measures are typically stated in terms of mean or expected values of a key financial variable such as:

- Annual Investment Return

- Income

  - Investment

  - Operating

- Surplus

  - Regulatory

  - Shareholders' Equity

  - Economic

Risk Measures – Uses and Interpretations

Deviation from Expectation

How much may my results differ from my expectation?

- Uses: Budgeting and Strategic Planning

- Risk Metric: **Standard Deviation**

Probability of Ruin

How likely is it that I will be able to stay in business over a given time period?

- This is a binary process where either the company is ruined or not ruined— there is no contemplation of degree

- Uses: Required Capital

- Risk Metric: **Value at Risk**

Expected Policyholder Deficit

In the event of insolvency, how bad can the insolvency be?

- Ruin Theory only takes into account the probability of insolvency, EPD considers the magnitude of ruin

- EPD incorporates the fact that not all insolvencies are the same. Regulators, policyholders and debtholders care about the amount by which the company will not be able to fully meet its obligations

- The EDP criterion can be stated as either a dollar amount or as a percentage of total obligations

- Uses: Capital Allocation, Bailouts and Recoveries

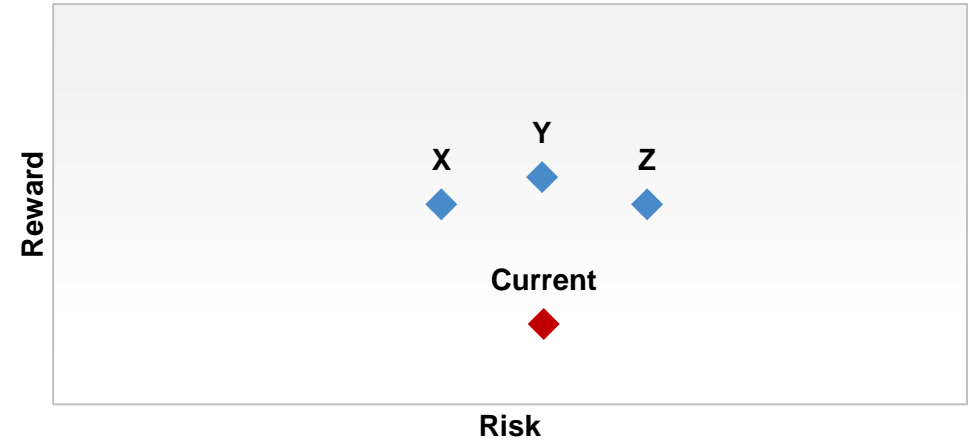- Risk Metric: **Conditional Value at Risk**

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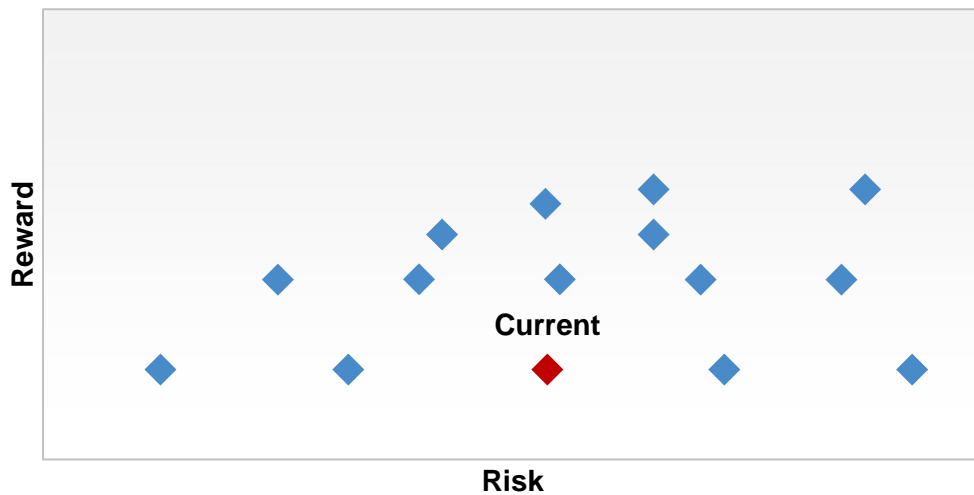# Strategic Asset Allocation Analysis for FBD

Efficient Frontier

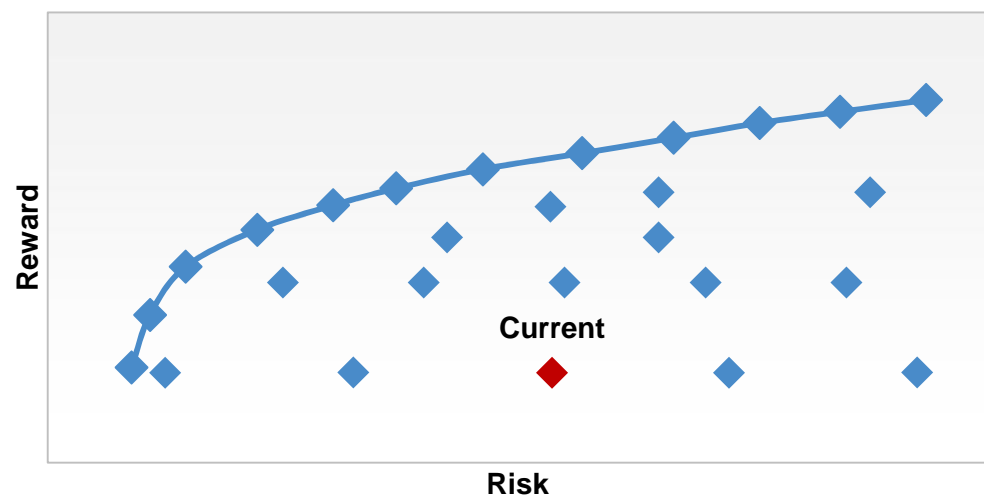Plot the risk and reward of the firm under the current investment strategy

Evaluate alternatives (what if we did x or y or z?)

Identify the highest rewarding strategies for different levels of risk

The collection of strategies that maximize reward for at all possible risk levels is the Efficient Frontier

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Traditional Static Mean-Variance vs Stochastic ALM Approaches

Backward-looking Static approach (versus a multi-period dynamic approach)

- Assumes a single period expected return as measure of reward ignoring portfolio rebalancing

- Stochastic Investment Optimization Approach: forward-looking multi-period cumulative return is used as reward measure

Assumes normal distributions of asset returns

- When skewness and kurtosis of returns are ignored in optimisation process, investors may take more risk than they realise

- Stochastic Investment Optimization Approach: apply stochastic modelling technics to capture more realistic non-normal distributions of returns

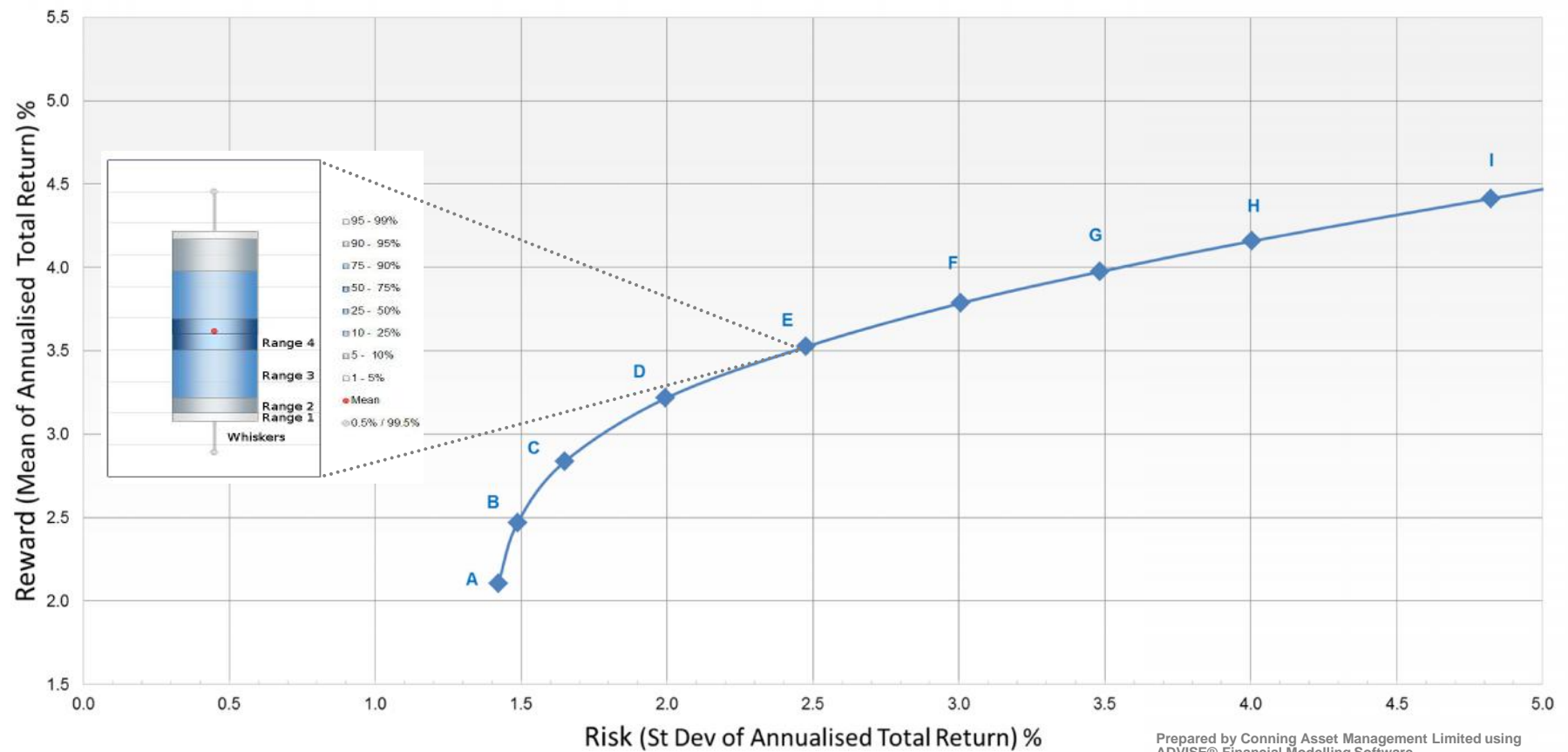## Standard Deviation is the only risk measure used in optimisation

- Not possible to assess downside risk of optimal portfolios

- Stochastic Investment Optimization Approach: variety of downside risk metrics can be used either as side constraints or as main risk metric
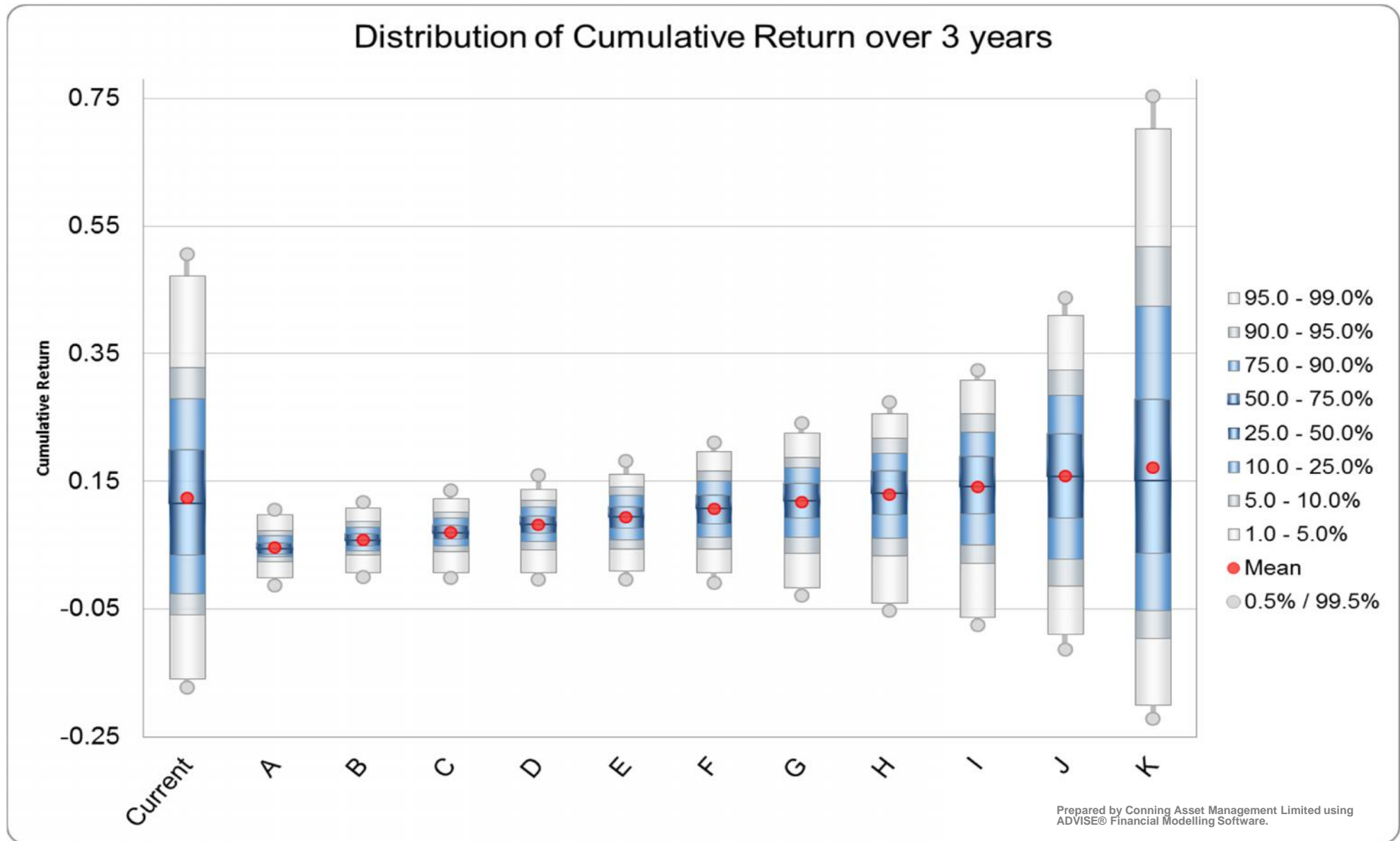
Constant correlation between asset class returns

- Assumes linear co-variation across asset classes, while history showed increasing correlations during financial crises

- Stochastic Investment Optimization Approach: non-constant correlation across asset class returns, capturing high tail correlation in extreme economic events
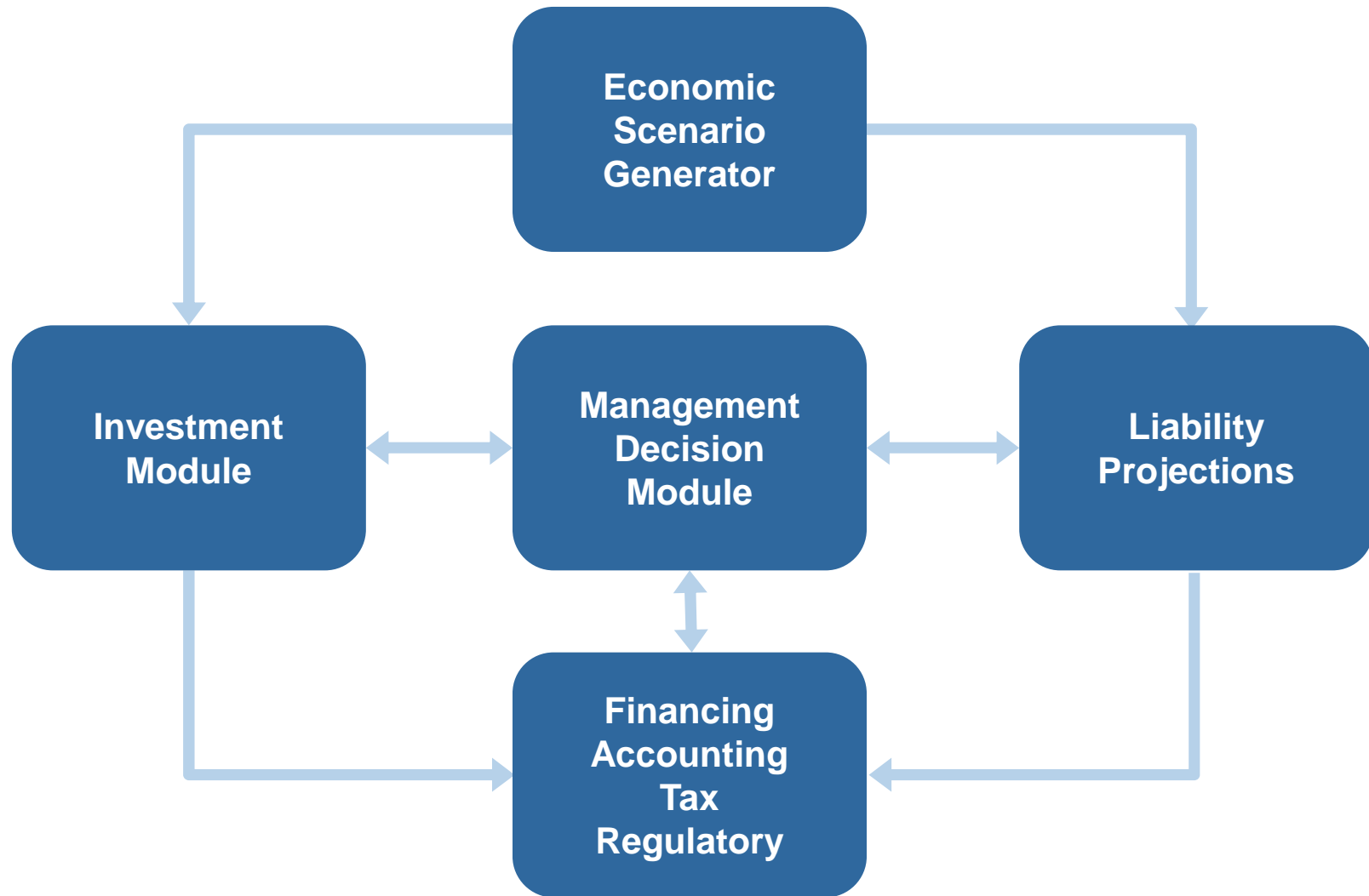
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Conning's Approach to Efficient Frontier Analysis

1	Asset Only	• Total Return $= \sum \quad h \qquad *$
2	Economic Value	• $\quad = \qquad \qquad - $

Prepared by Conning Asset Management Limited using
ADVISE® Financial Modelling Software.

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Conning's Approach to Efficient Frontier Analysis

Distribution of Cumulative Return over 3 years

Integrated ECM/ERM Platform Architecture

Objectives and Methodology

Objective
Find strategic asset allocation (SAA) strategies that:

- Maximise expected Company Economic Value projected at year end 2018 (planning horizon)
- For varying degrees of risk (volatility of the projected year end 2018 Company Economic Value)
- While meeting liquidity and other operational constraints

Find the optimal SAA strategy without regard to solvency capital constraints

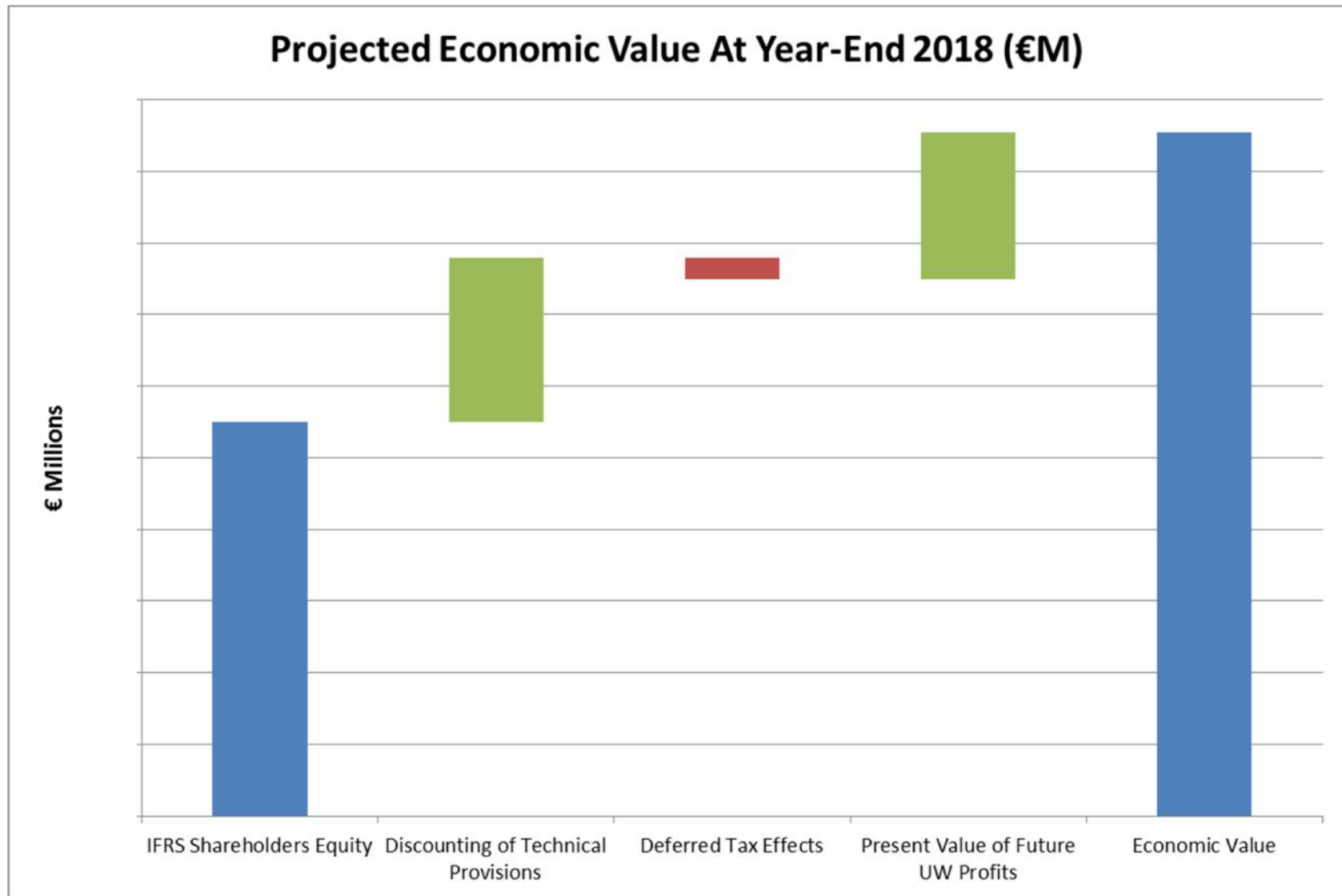Find the optimal SAA for FBD, recognising solvency capital constraints in the long term

Find an initial step towards the optimal SAA, that reflects immediate solvency capital constraints
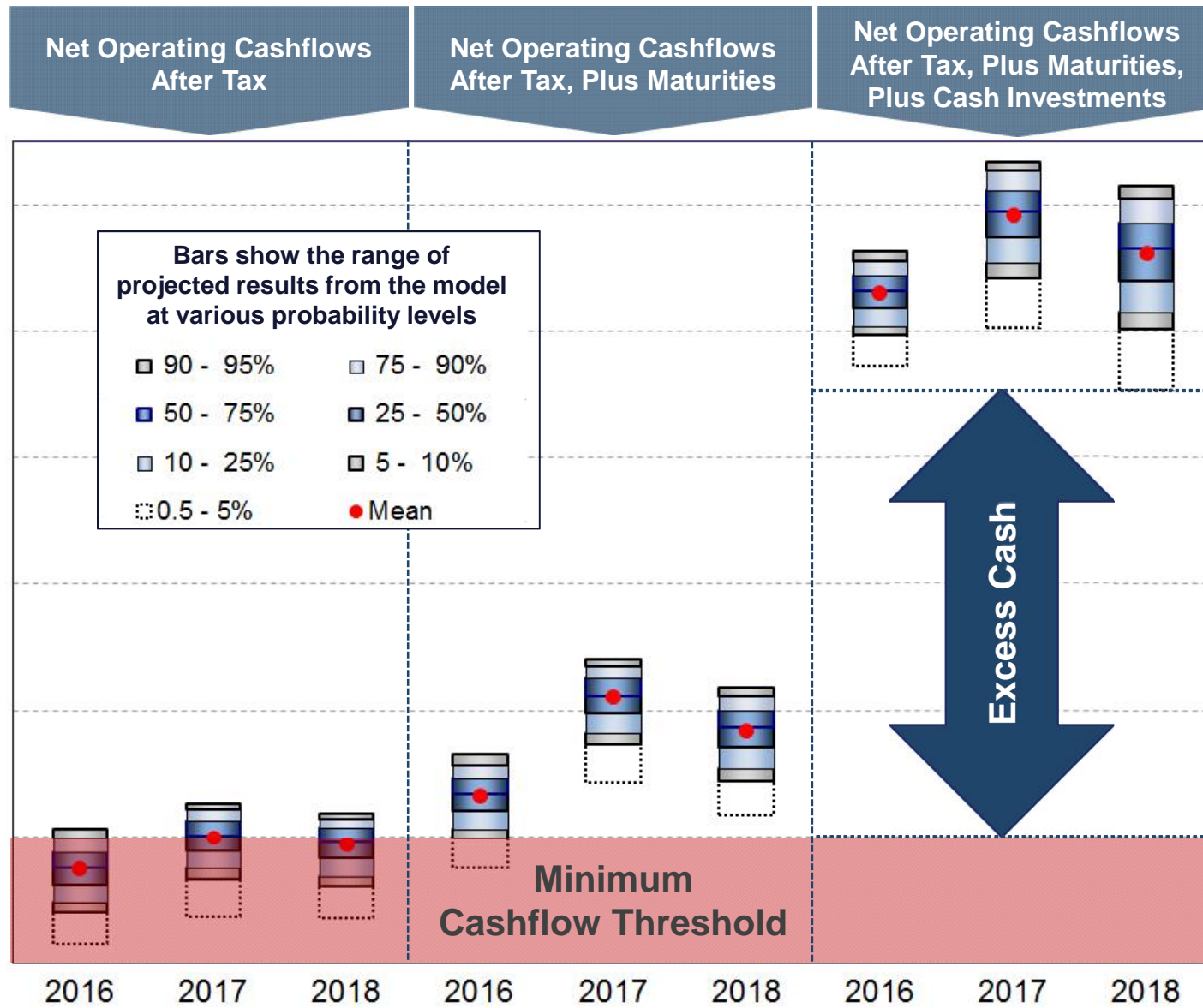
Methodology
The analysis is based on Conning's enterprise financial modeling software that has been widely used in SAA studies for general insurance companies

- Projected insurance results use the business planning assumptions from FBD management together with volatility assumptions consistent with Solvency II capital requirements
- Projected investment results use Conning's capital markets models applied to FBD's current portfolio as well as potential alternative strategies
- The asset classes considered in the model included: Cash, (low risk) Eurozone Government bonds, Investment Grade corporate bonds, High Yield corporate bonds, listed large cap Eurozone equities (Eurostoxx 50), Private equity, Hedge funds, Infrastructure (equities) and others

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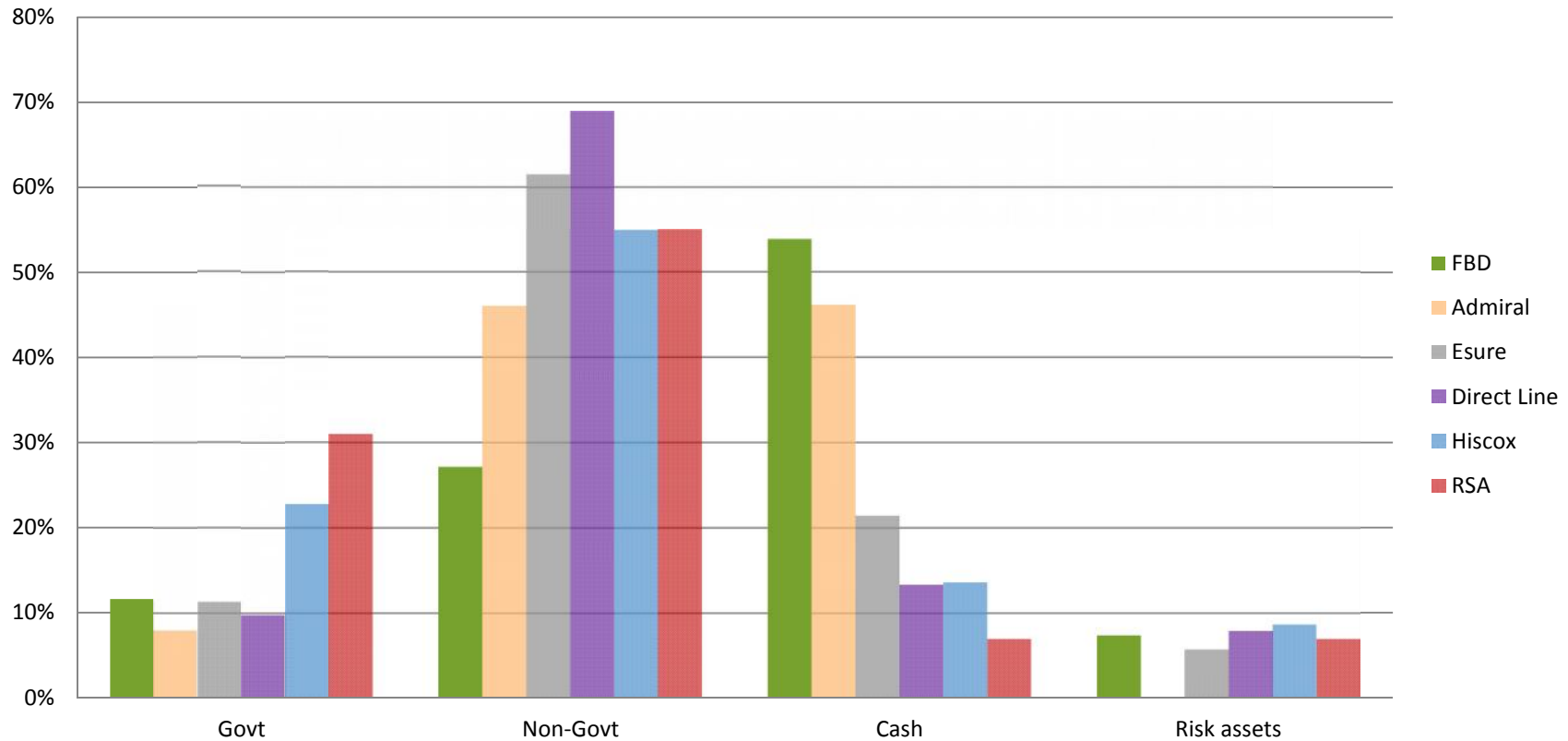
Projected Economic Value at Year-End 2018 (Sample chart)

Projected Economic Value At Year-End 2018 (€M)

€ Millions

IFRS Shareholders Equity | Discounting of Technical Provisions | Deferred Tax Effects | Present Value of Future UW Profits | Economic Value

Liquidity Analysis

| Net Operating Cashflows After Tax | Net Operating Cashflows After Tax, Plus Maturities | Net Operating Cashflows After Tax, Plus Maturities, Plus Cash Investments |

Bars show the range of projected results from the model at various probability levels

- ☐ 90 - 95%
- ☐ 75 - 90%
- ☐ 50 - 75%
- ☐ 25 - 50%
- ☐ 10 - 25%
- ☐ 5 - 10%
- ☐ 0.5 - 5%
- ● Mean

Excess Cash

Minimum Cashflow Threshold

2016 2017 2018 2016 2017 2018 2016 2017 2018

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Peer Analysis – Asset Allocation

Asset Allocation as of June 30, 2015

Highlights:

- Over the past 1.5 years Esure and Hiscox increased allocation to equities from 4% and 7.1% to 6% and 8.7% correspondingly

- Admiral makes a shift in allocation of funds with a greater proportion invested in fixed income and other short dated securities and less in money market funds and deposits

- During 2014 Direct Line introduced two new asset classes (infrastructure, high yield and private placement credit)

Peer Analysis – Bond Portfolio Duration

Esure

Portfolio duration is short at under **1 year**

- In order to preserve capital and to reduce the risk of an investment loss due to interest rate movements it is acceptable for the duration of the asset portfolio to be shorter, but not longer, than the average duration of the liabilities

- The Group also uses government bond futures as a mechanism to adjust investment portfolio duration

Direct Line

Portfolio duration is **1.6 years**

- The average duration at 30 June 2015 of total debt securities was 2.1 years

- The Group swaps a fixed interest rate for a floating rate of interest on its US Dollar corporate debt securities by entering into interest rate derivatives

Hiscox

Bond portfolio duration is **1.6 years**

- The Group may also, from time-to-time, enter into interest rate future contracts in order to minimize the interest rate risk on specific longer duration portfolios

RSA

Average bond duration is **4.2 years**

- RSA does not currently anticipate any further material increases in average duration from the current level

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Peer Analysis – Risk Assets

Asset Class	FBD	Admiral	Esure	Direct Line	Hiscox	RSA
Equities	✓	-	✓	-	✓	✓
Property	✓	-	-	✓	-	✓
UCITs	✓	-	-	✓	-	-
Infrastructure	-	-	-	✓	-	-
Prefs and Loans	-	-	-	-	-	✓

Highlights:

- Direct Line regularly uses the internal economic capital model to determine the capital implications for all asset changes proposed and to support Investment Committee and Board decision making

- Hiscox equity portfolio includes allocation to UK and global equity funds and equity based hedge funds

- RSA continues to examine alternative strategies to enhance the income generated by its investment portfolios. This includes further modest allocations to funds investing in loans backed by property

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Peer Analysis – Solvency II

Admiral

- In July 2014, the Group completed the issue of £200 million of 10 year dated subordinated bonds

- Admiral is developing an internal economic capital model which will be used to calculate regulatory capital. The regulatory approval is not likely to be sought or granted before 2017

Esure

- "The Group's financial position remains strong; the Group remains well capitalised; and is on track for the implementation of Solvency II"

- On implementation, the Group will report using the standard formula, while continuing to develop its internal model

Direct Line

- Direct Line Group seeks to hold capital coverage in the range of 125% -150% of risk based capital requirements

- Internal model approval submission on track for second half of 2015

- The Group is expected to operate under the standard formula for at least the first six months of 2016

RSA

- ECA coverage is 1.3x. Internal model for Solvency II shows higher coverage ratio, subject to regulatory approval

- Solvency II Internal Model application submitted. Target positive outcome in H2

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Sensitivity Analysis

What is Sensitivity Analysis

- Start with the enterprise model and the current investment strategy

- Vary one risk factor of the asset allocation at a time, keeping the other risk factors constant

- Look at the effects of varying these single factors on key performance and risk indicators

Sensitivity Analyses Performed

- Varying the equity allocation

- Varying the allocation to alternative investments

- Varying the allocation of fixed income to Governments and Cash vs Corporate bonds

- Varying the duration of the fixed income portfolio

Key Performance and Risk Indicators

- Investment Income over 3 years

- Solvency Ratio

- Economic Value

- IFRS Equity

Sensitivity Analysis – Chart A

Equity Sensitivity - Investment Income 3Y Horizon
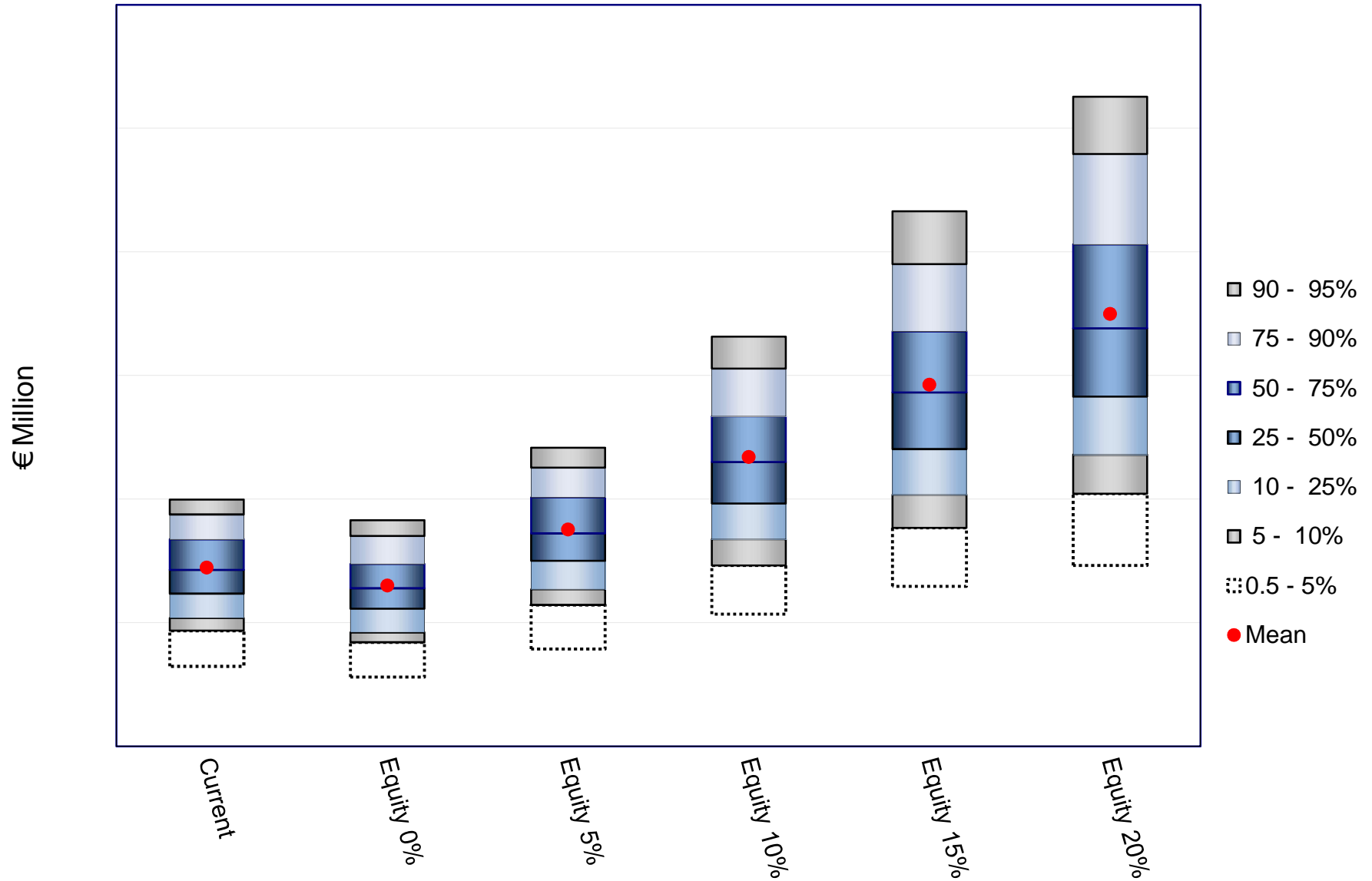
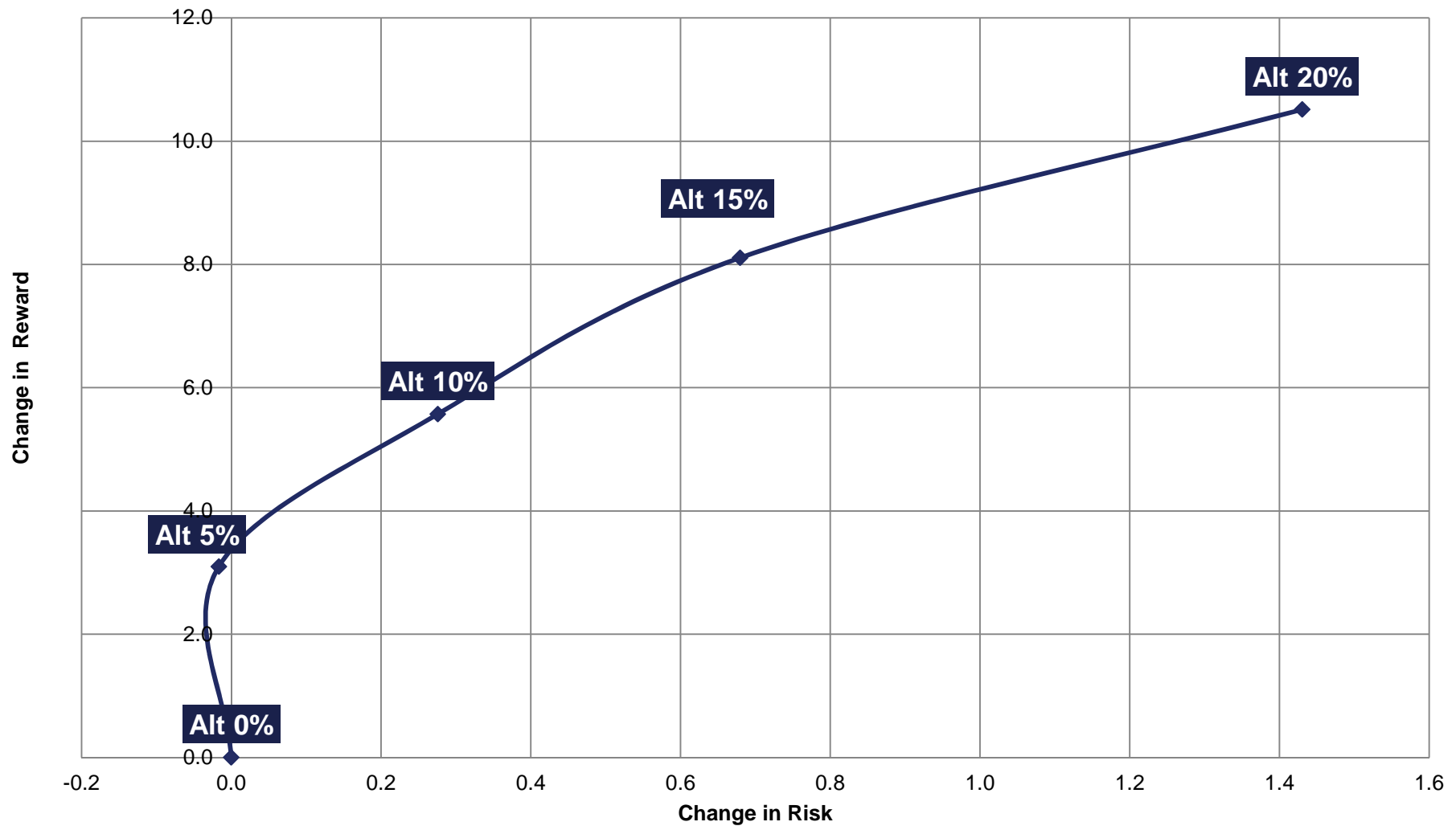# Sensitivity Analysis – Chart B

Solvency II Ratio 3Y Horizon
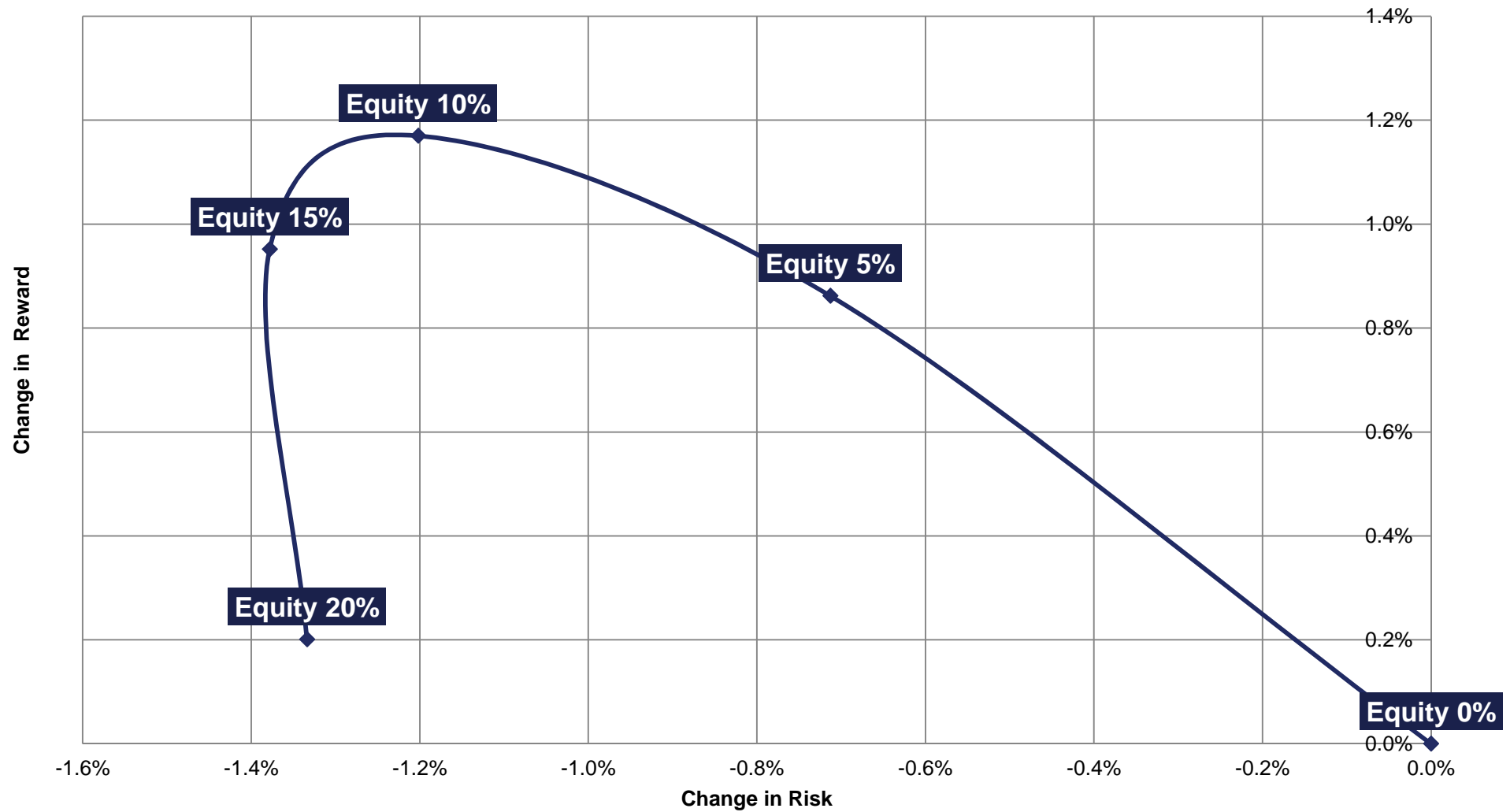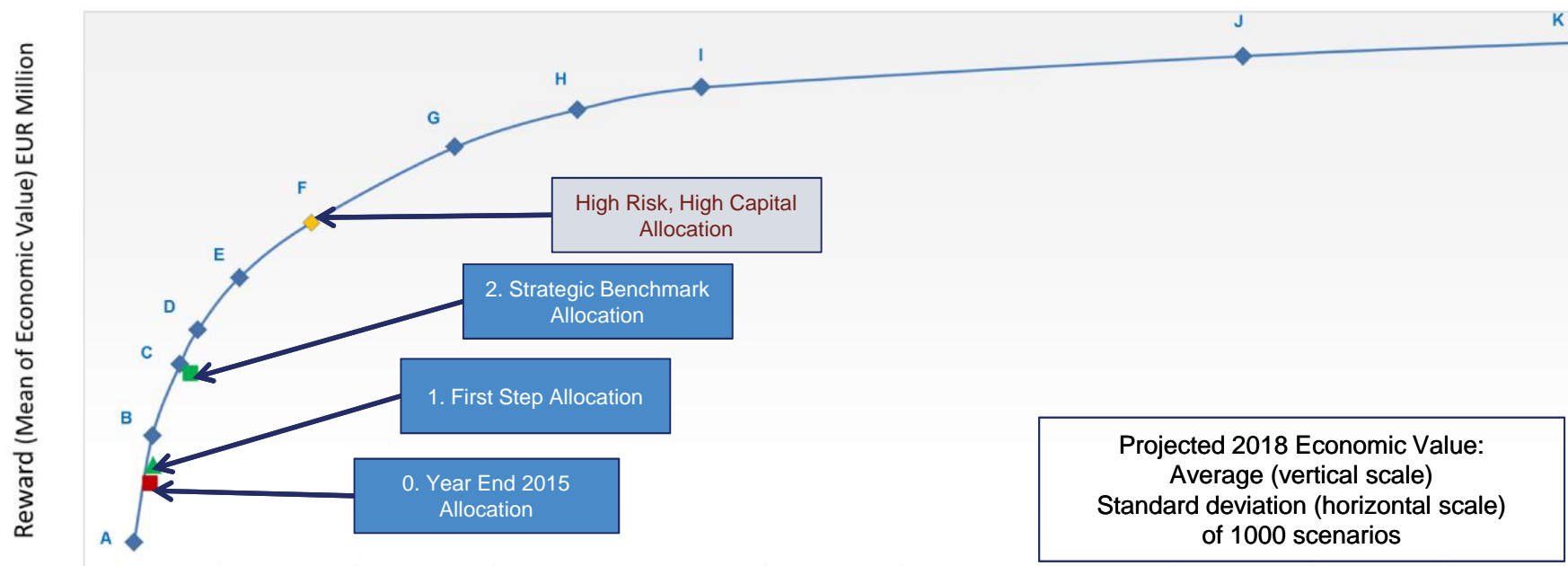
Sensitivity Analysis – Chart C

Solvency II Ratio 3Y Horizon
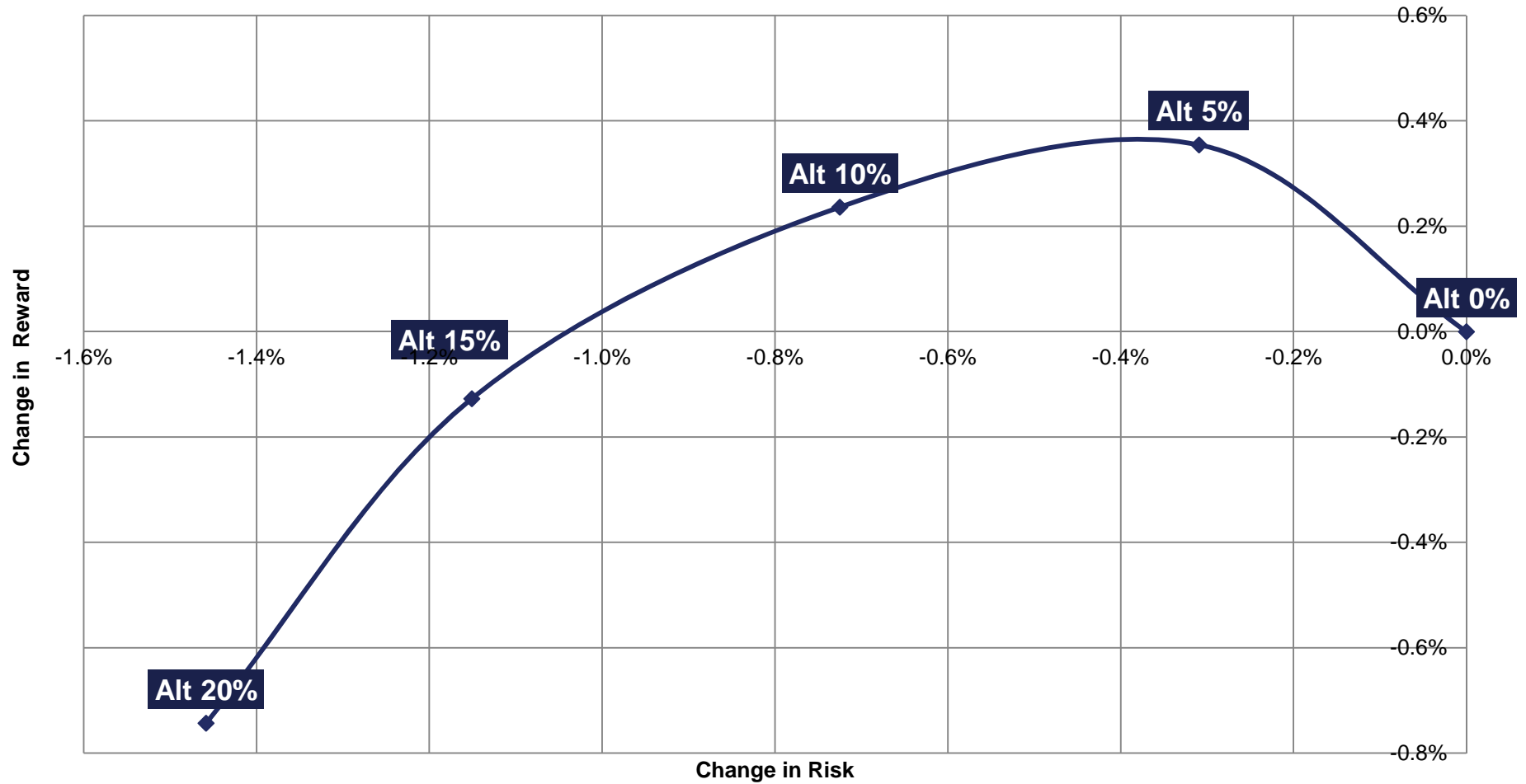
Sensitivity Analysis – Chart D

Economic Value 3Y Horizon (€M)

Efficient Frontier – Projected Economic Value, Year End 2018

Reward (Mean of Economic Value) EUR Million

High Risk, High Capital Allocation

2. Strategic Benchmark Allocation

1. First Step Allocation

0. Year End 2015 Allocation

Projected 2018 Economic Value:
Average (vertical scale)
Standard deviation (horizontal scale)
of 1000 scenarios

Risk (St Dev of Economic Value) EUR Million

Prepared by Conning Asset Management Limited using ADVISE® Financial Modelling Software.

Sector	0. Year End 2015 Allocation	1. First Step Allocation	2. Strategic Benchmark Allocation	A	B	C	D	E	High Risk, High Capital Allocation
Cash	38%	18%	15%	51%	39%	17%	10%	10%	10%
Govt	10%	30%	30%	26%	14%	19%	20%	6%	0%
Corporate	45%	45%	40%	23%	38%	48%	50%	63%	65%
European Equity	3%	3%	5%	0%	0%	0%	0%	1%	5%
Alternatives	4%	4%	10%	0%	9%	16%	20%	20%	20%
Fixed Income Duration (including cash)	2.0	3.3	4.0	1.9	3.1	4.3	4.7	5.8	7.1
Reward (Expected Economic Value) € Million									
Risk (Volatility of Economic Value) € Million									
Improvement in reward per € of additional risk									
IFRS Capital - Expected Value (€ Million)									
IFRS Capital - Volatility (€ Million)									
SII Coverage Ratio - Expected Value (Percent)									
SII Coverage Ratio - Volatility (Percent)									

Key performance figures not displayed here due to confidentiality

Duration figures illustrative, not actual

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Strategic Asset Allocations – Selected Alternative Strategies

Asset Class Allocation and Key Metrics:

Selected Alternative Strategies

	Year End 2015 Allocation	First Step Allocation	Strategic Target Allocation	High Risk, High Capital Allocation
Asset Class (% of Total Market Value)				
Cash	38%	18%	15%	10%
Government Bonds	10%	30%	30%	0%
Corporate Bonds (Investment Grade)	45%	45%	40%	65%
Large Cap Equity	3%	3%	5%	5%
Alternative Investments	4%	4%	10%	20%
Duration* (Years)				
Cash and Fixed Income	2.0	3.3	4.0	7.1
Required Solvency Capital (31/12/2015)				
Market Risk, Undiversified € M	€ XYZ M	€ XYZ M	€ XYZ M	€ XYZ M
Market Risk, Diversified € M	€ XYZ M	€ XYZ M	€ XYZ M	€ XYZ M
Market Risk, Div. as % of Total, Div.	XYZ%			XYZ%
Total Risk Capital, Undiversified € M	€ XYZ M	€ XYZ M	€ XYZ M	€ XYZ M
Total Risk Capital, Diversified € M	€ XYZ M	€ XYZ M	€ XYZ M	€ XYZ3 M

Key performance figures not displayed here due to confidentiality

Duration figures illustrative, not actual

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Key Financial Metrics (Projections from Financial Model)

Selected Asset Allocation	Year End 2015 Allocation	First Step Allocation	Strategic Benchmark Allocation	B	C	D	E	High Risk High Capital Allocation
Sector (% by Market Value)								
Cash	38%	18%	15%	39%	17%	10%	10%	10%
Government	10%	30%	30%	14%	19%	20%	6%	0%
Corporate	45%	45%	40%	38%	48%	50%	63%	65%
European Equity	3%	3%	5%	0%	0%	0%	1%	5%
Alternatives	4%	4%	10%	9%	16%	20%	20%	20%
Fixed Income Duration (including Cash)	2.0	3.3	4.0	3.1	4.3	4.7	5.8	7.1
IFRS Shareholder Equity (Year End 2018)								
a) Expected Value (Average) €M	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ
b) Volatility (Standard Deviation) €M	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ
c) Volatility as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
d) Downside Deviation* (1.5% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
e) Downside Deviation* (2% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
f) Downside Deviation* (15% level) as % (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
Investment Income (2018)								
a) Expected Value (Average) €M	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ	XYZ
b) Volatility (Standard Deviation) €M	XYZ					XYZ	XYZ	XYZ
c) Volatility as % of (a)	XYZ%					XYZ%	XYZ%	XYZ%
d) Downside Deviation* (1.5% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
e) Downside Deviation* (2% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
f) Downside Deviation* (15% level) as % (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
Solvency Ratio (Year End 2018)								
a) Expected Value (Average) in Percentage Points	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
b) Volatility (Standard Deviation) in Percentage Points	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ	XYZ%
c) Volatility as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ	XYZ%
d) Downside Deviation* (1.5% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ	XYZ%
e) Downside Deviation* (2% level) as % of (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%
f) Downside Deviation* (15% level) as % (a)	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%	XYZ%

Key performance figures not displayed here due to confidentiality

Duration figures illustrative, not actual

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Year-End 2015 SCR and Solvency Ratio

FBD Solvency Capital Requirement comes predominantly (75%+) from Non-Life underwriting risk

- There is also the diversifying effect between liabilities and investments

  - Every €1 of additional market risk contributes only around €0.50 to the overall SCR

	Current	First Step: relative Δ from current	Optimal: relative Δ from current	Optimal (without SII constraints): relative Δ from current
Interest Rate	*XYZ*	++	++	++
Equity	*XYZ*	0%	+	+
Property	*XYZ*	0%	+	++
Spread	*XYZ*	-	-	+
Currency	*XYZ*	0%	+	+
Concentration	*XYZ*	--	--	--
Market SCR	***XYZ***	**+**	**+**	**++**
Counterparty Default	***XYZ***	**-**	**-**	**-**
Non-Life Underwriting	***XYZ***	**0%**	**0%**	**0%**
Non SLT Health	***XYZ***	**0%**	**0%**	**0%**
Basic SCR	***XYZ***	**0%**	**4%**	**+**
SCR	***XYZ***	**+**	**+**	**+**
Own Funds	***XYZ***	**0%**	**0%**	**-**
Solvency Ratio	***XYZ%***	**-1%**	**-4%**	**-17%**

Implementation of the SAA Conclusions

Path to Implementation

	Observations
1	We are holding too much cash: we don't need to have €350m in cash, €50-150m is more than adequate
2	We should increase the duration of our assets
3	Allocating a portion of the portfolio to riskier asset classes will provide greater returns, but also increase capital requirements and increases our potential volatility
4	1, 2 can be implemented immediately in 2016; 3 requires a capital budget
5	By increasing allocation to Governments bonds we can reduce cash position and increase duration – ensuring we meet ALM objective
6	Conning work builds on the modelling work undertaken in 2015 & previously presented to the board
7	Provides affirmation of the work done and direction taken in 2015

Iterative Risk Framework is required to manage risk/reward trade

	2015	**2016**	**2017**
Risk Metrics	■ Research risk metrics	■ Pick risk metrics ■ Set parameters ■ Data	■ Embed risk metrics in reporting
Investment	■ VAR is used to Manage Corporate bond portfolio	■ Standard Deviation ■ VAR ■ cVAR	■ Risk metrics are used to inform decisions making and create tolerances for risk limits ■ Develop appropriate benchmarks and metrics for a risk dashboard that allows FBD to judge is it being rewarded for the risk it is taking
Enterprise		■ Standard deviation is used for budgeting and Strategic planning	■ Pick risk metrics for enterprise ■ Set parameters ■ Data

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Summary of SAA Process

Steps to conduct Strategic Asset Allocation Analysis

Insurance Knowledge

- Objectives
- Risk tolerance
- Claims payments
- Business plan
- Historical financials
- Actuarial reports

Presentation of Findings

Sensitivity Testing

Model Analysis

Generation of Model Runs
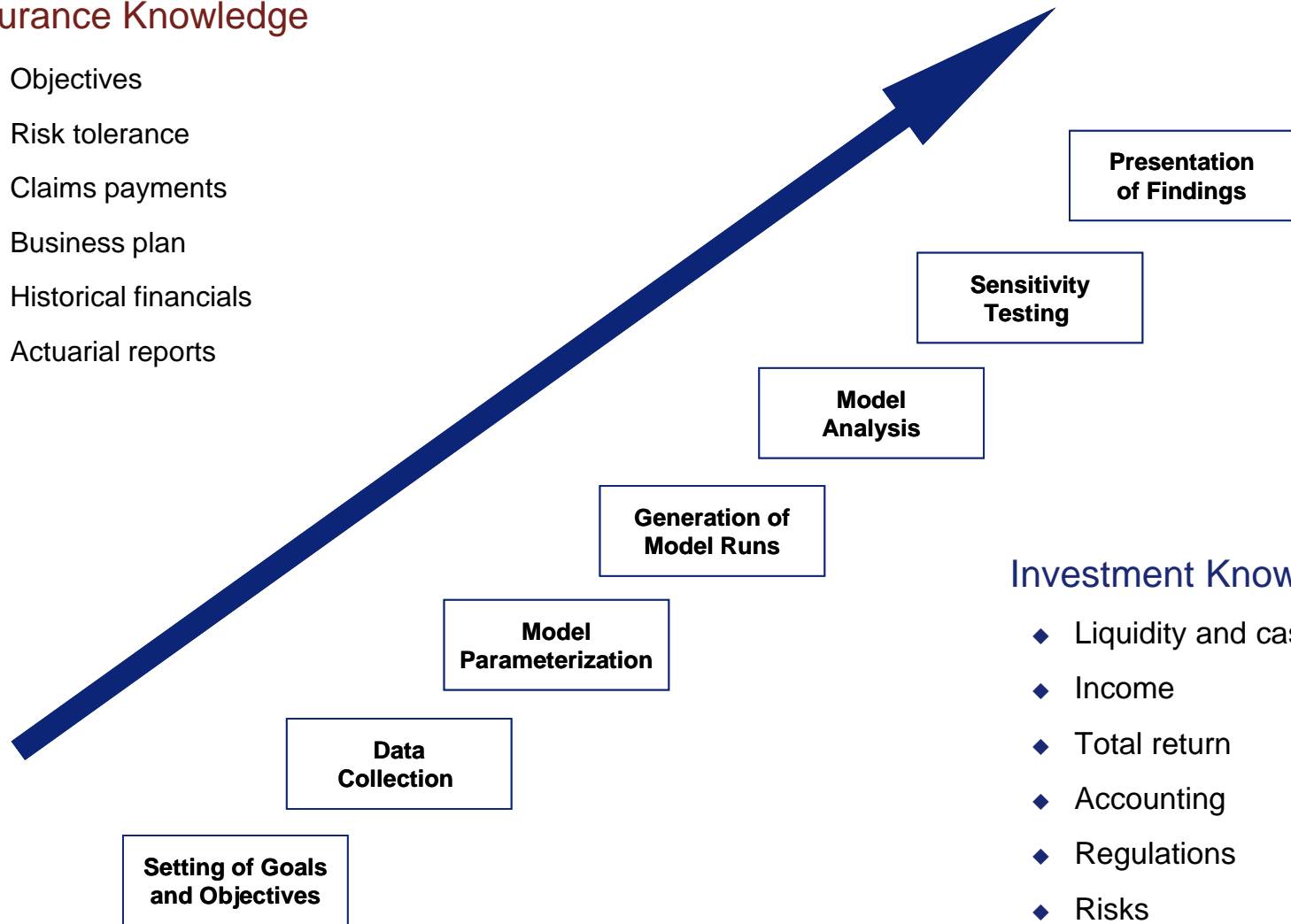
Investment Knowledge

- Liquidity and cash flows
- Income
- Total return
- Accounting
- Regulations
- Risks
- Opportunities

Model Parameterization

Data Collection

Setting of Goals and Objectives

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