CONNING

Strategic Asset Allocation under Solvency II: The Asset, Liability and Capital Efficient Frontier

GIRO 2016, Dublin

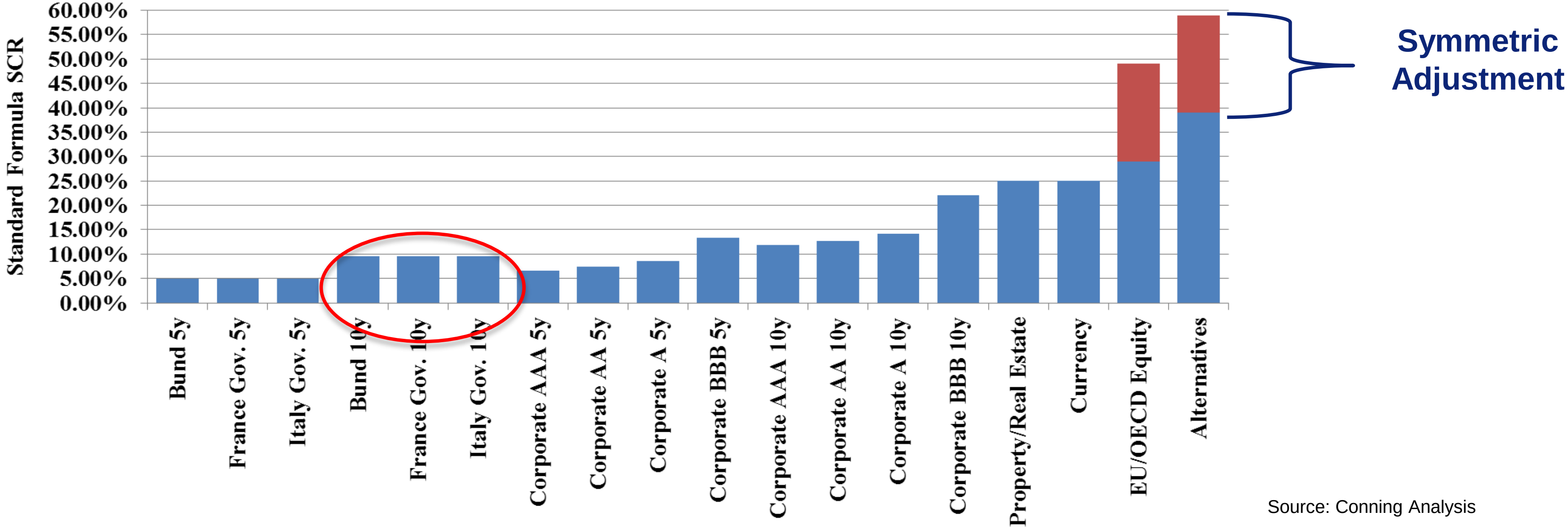
Nigel Hooker and Alexander Tazov, Conning

21 September 2016

Aims

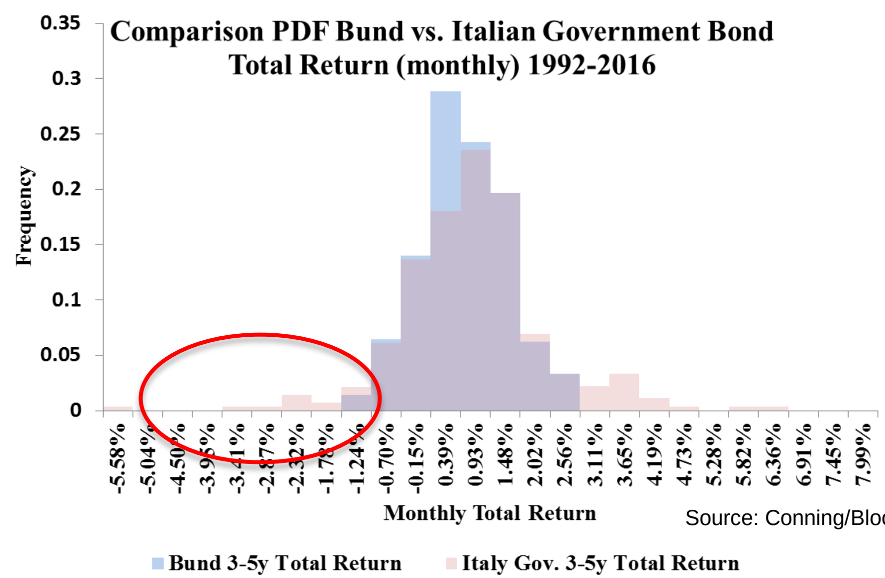
- To answer the following questions
  - How should we measure return and risk under Solvency II and determine the efficient frontier?
  - How sub-optimal are "traditional SAA" techniques under the SII regime?
  - What is the dependence of the efficient frontier on target Solvency Ratio?
  - How do the capital charges on Eurozone government bonds effect the relative ability of German, French and Italian insurers to generate value?

Standard Formula Solvency Capital Charges



Source: Conning Analysis

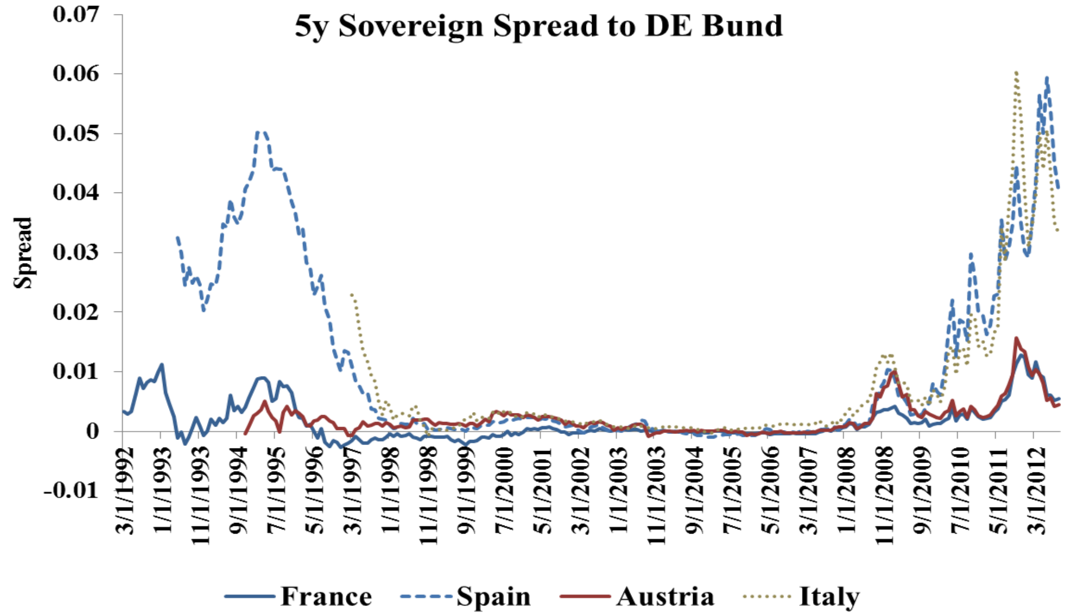
- "Credit risky" EUR denominated sovereign bonds look like a "free lunch"
- But the data shows the additional market risk
- So no free lunch but there might be a sweet spot for investing in the bonds of different member states
  - need good modeling of the market/credit risk
  - must define an appropriate risk/return measure under Solvency II…..

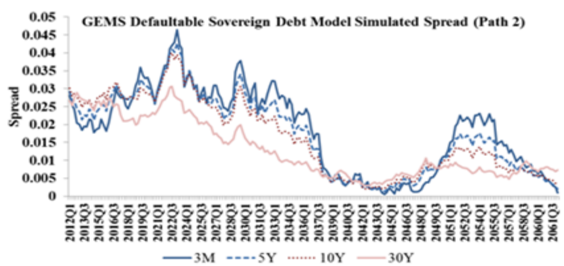


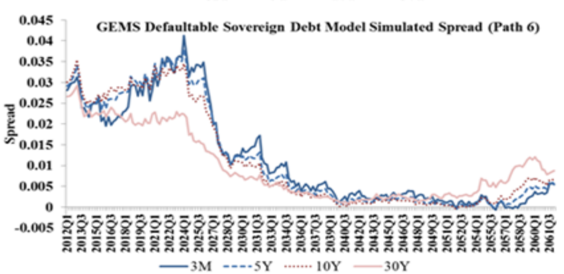
Source: Conning/Bloomberg

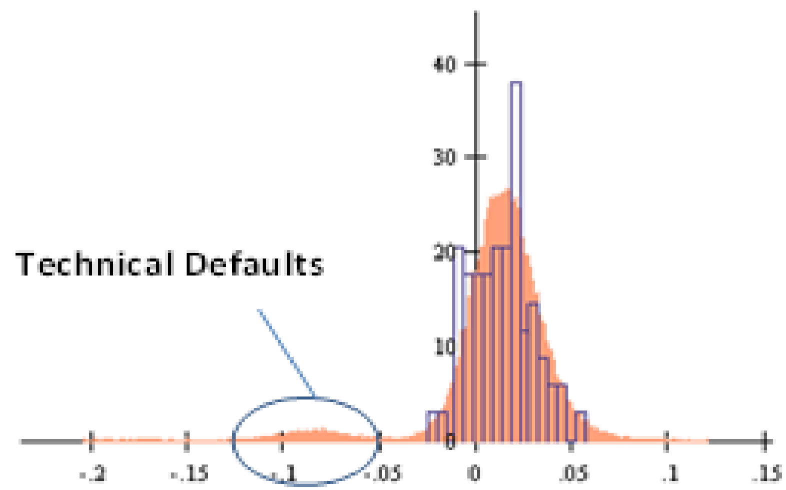
Model of Defaultable Sovereign Debt

- Difficult modeling task
  - Pathwise behavior has somewhat unique characteristics
  - Literature under developed
- 5 factor model + jump
  - Output is a stochastic term structure
  - Arbitrage free bond pricing
  - Model incorporates credit events
  - Credit events lead to an interesting tail structure





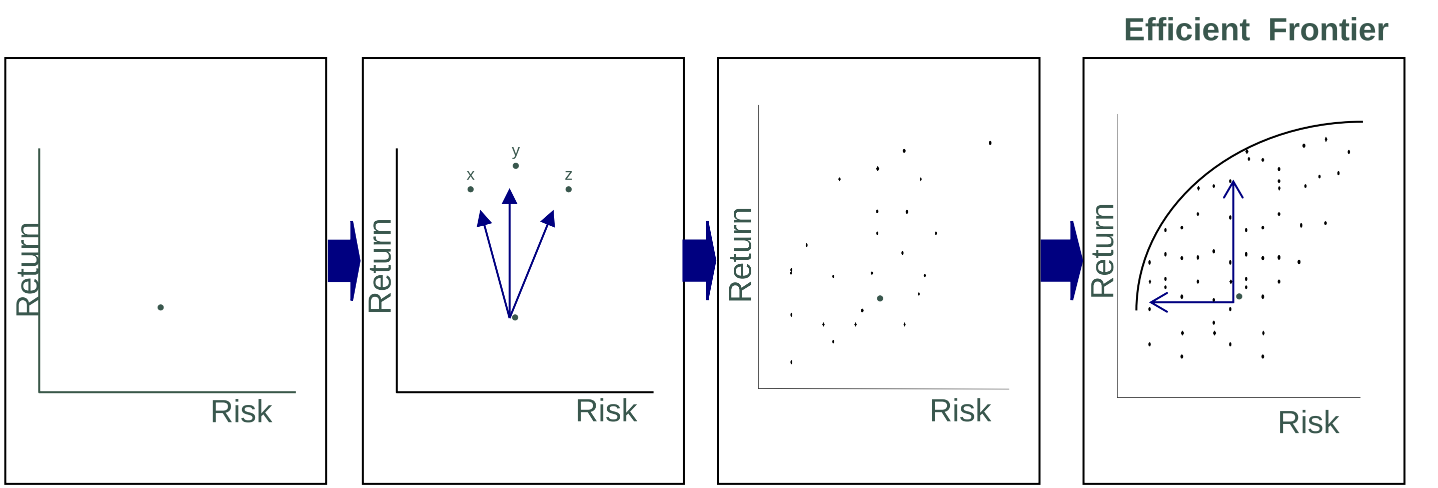




Efficient Frontier

Given the large number of potential investment strategies, how can you determine which is best for your business?

- Measure of return/reward
- Time horizon
- Measure of risk
- Constraints



Limitations of Mean-Variance Approach

- 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

Insurance and Solvency II Reward Measures

PVDE = Present Value of (Net Income – Solvency II Capital Maintenance)

Asset Only Efficient Frontier

- Standalone asset performance
- Evaluate projection bias

Optimization on Total Return

EV Efficient Frontier

- Assets and liabilities
- MV of assets minus PV of liabilities

PVDE Efficient Frontier

- Assets and liabilities
- Present Value of Distributable Earnings
- Accounting-based profit
- Requires calculation of regulatory capital

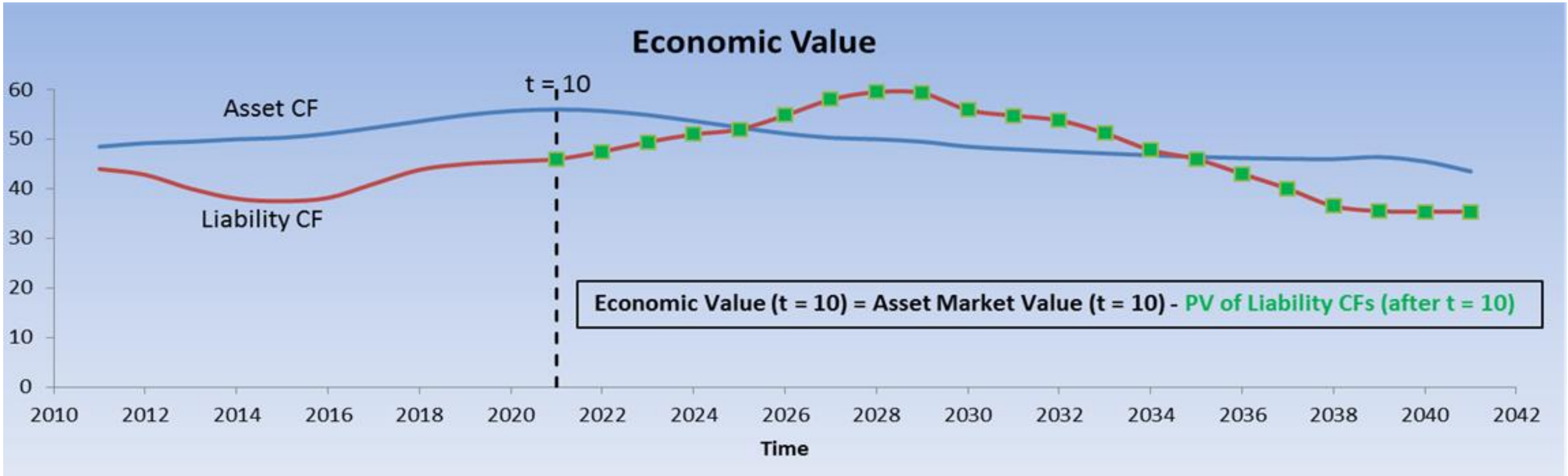
ALM Efficient Frontier

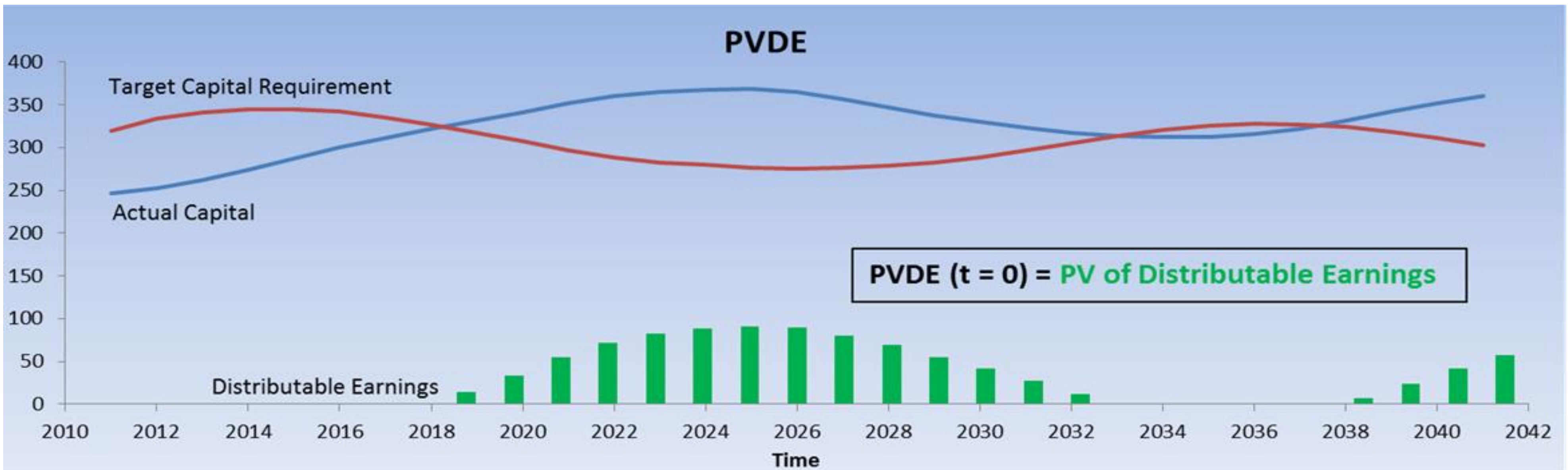
Source: Conning Analysis

Insurance and Solvency II Reward Measures

1	Asset Only	• Total Return $= \sum_{i=1}^{n} Weight_i * Return_i$
2	Economic Value	• $EV_t = Market\ Value\ of\ Assets_t - Market\ Value\ of\ Liabilities_t$
3	Present Value of Distributable Earnings	• $PVDE_{t=0} = PV(Net\ Income - Target\ Solvency\ Maintenance)$

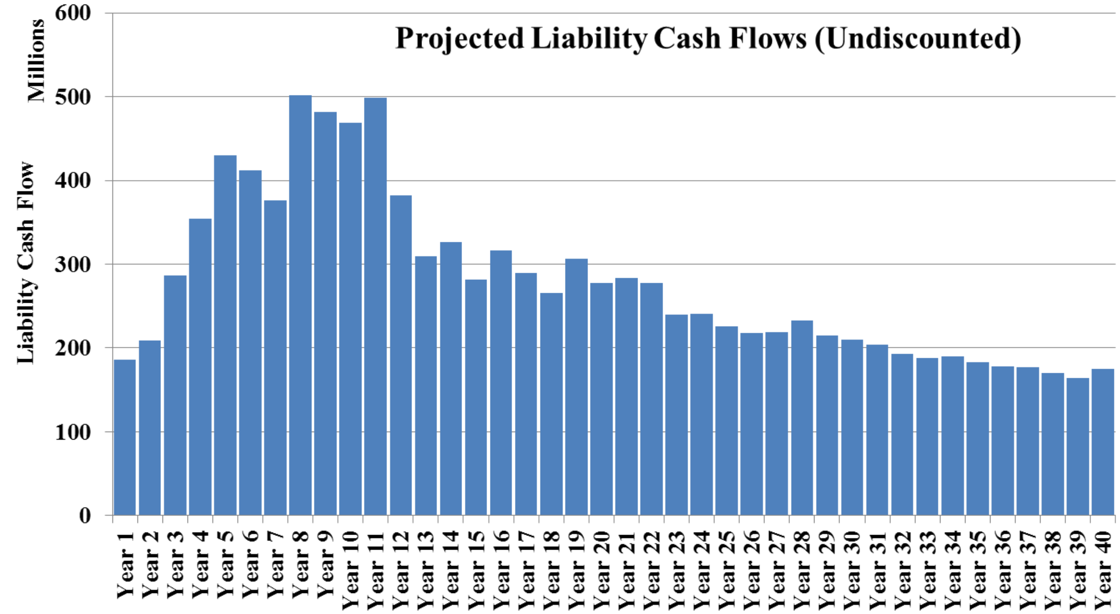
Insurance and Solvency II Reward Measures





Eurozone Study Set-up

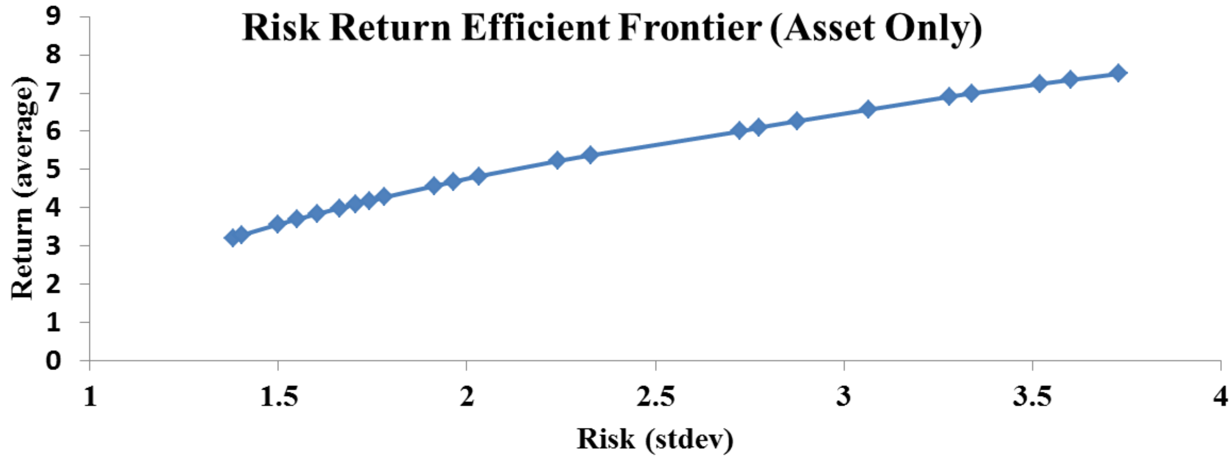
- Relatively simple set-up
- 40 year projected deterministic liabilities
  - Discounted using stochastic discount rates
- 6 broad asset classes to construct the efficient frontiers
- Asset types modelled stochastically using the GEMS ESG
- Optimization minimally constrained
- Use PVDE as reward measure and standard deviation of PVDE as the risk measure

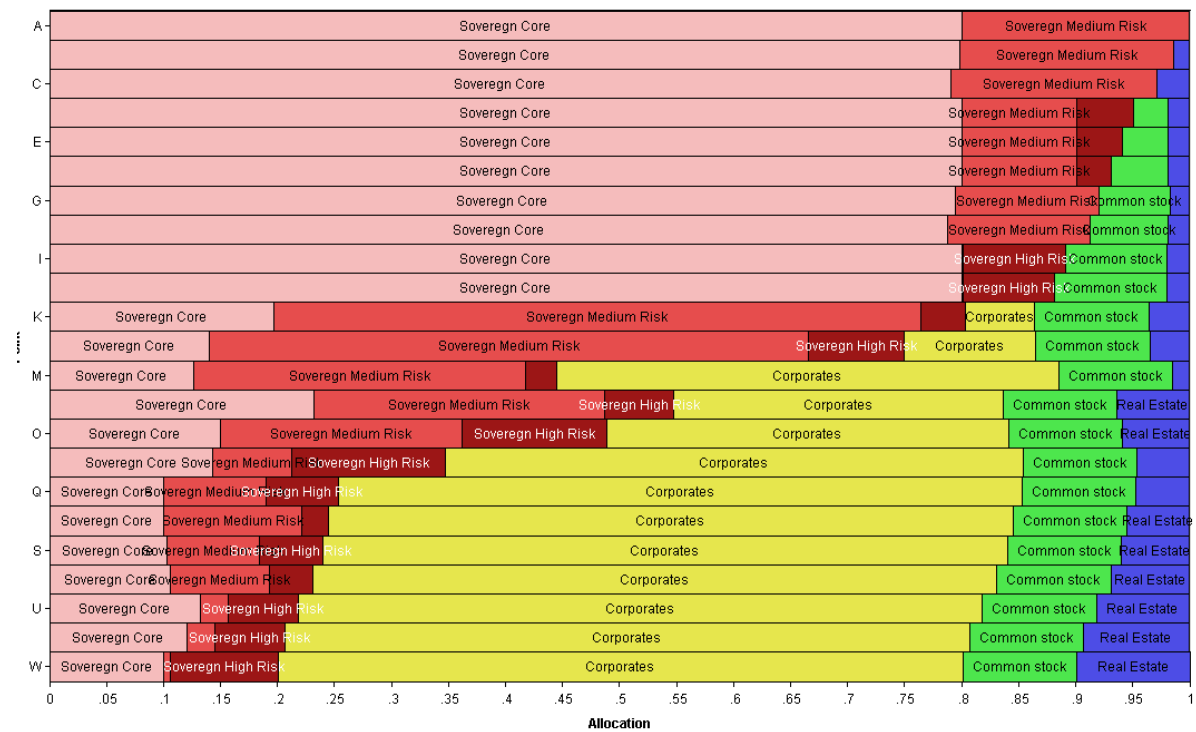


Asset Class	Modeling Approach	Minimum Weight	Maximum Weight
German Bund	3 Factor Affine Model	10.00%	80.00%
French Gov. Bond	GEMS Defaultable Sovereign Debt Model	0.00%	80.00%
Italian Gov. Bond	GEMS Defaultable Sovereign Debt Model	0.00%	80.00%
IG Corporate Bonds	GEMS Corporate Yield with Spread Jumps and Stochastic Transition and Default	0.00%	60.00%
Eurozone Equity	Bates Stochastic Volatility with Jumps Model (Stochastic Dividends)	0.00%	10.00%
Eurozone Real Estate	VaRx Model	0.00%	10.00%

Source: Conning Analysis

How Inefficient is the Asset Only Efficient Frontier on a SII/PVDE Basis?

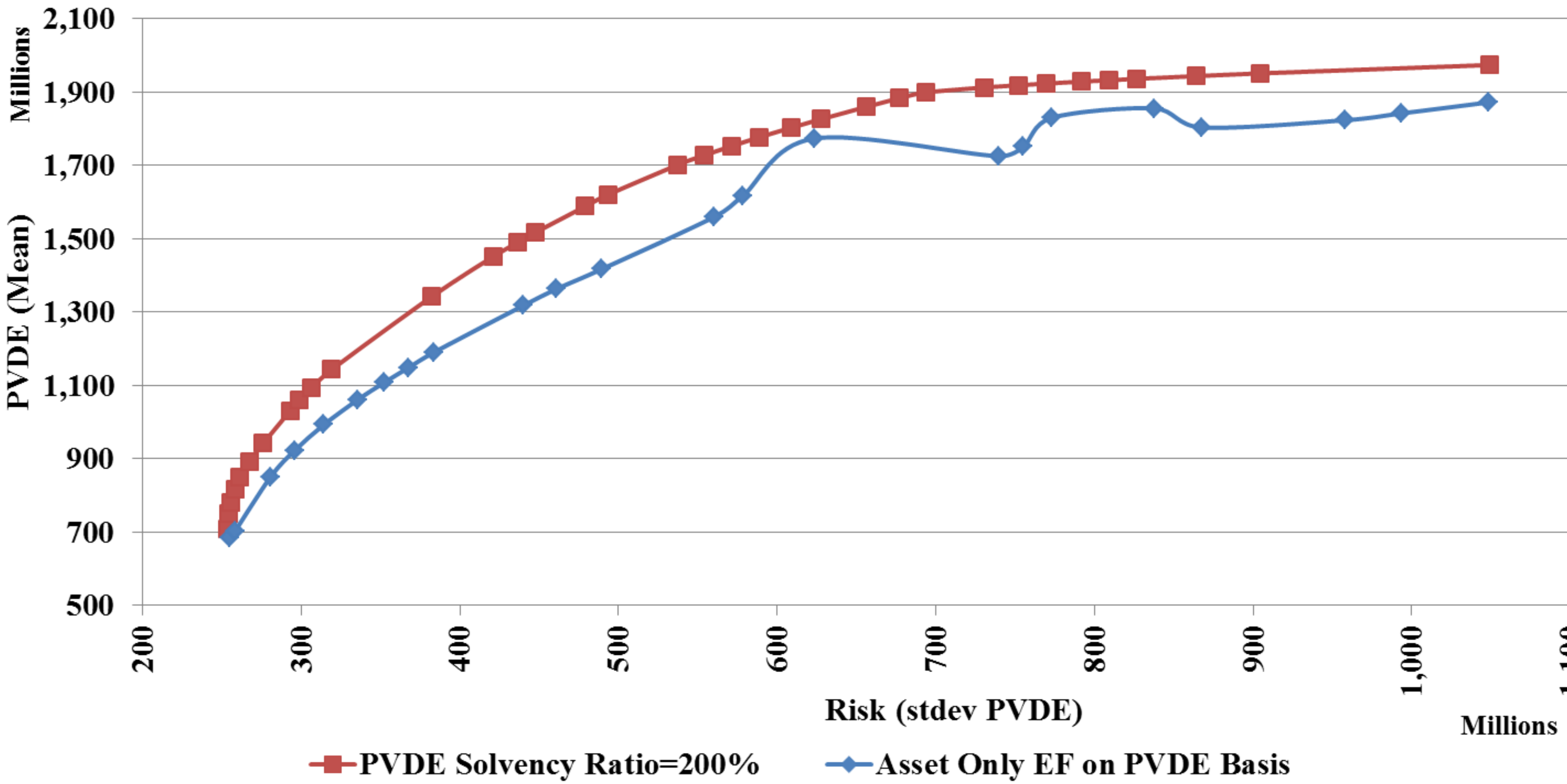




Source: Conning Analysis

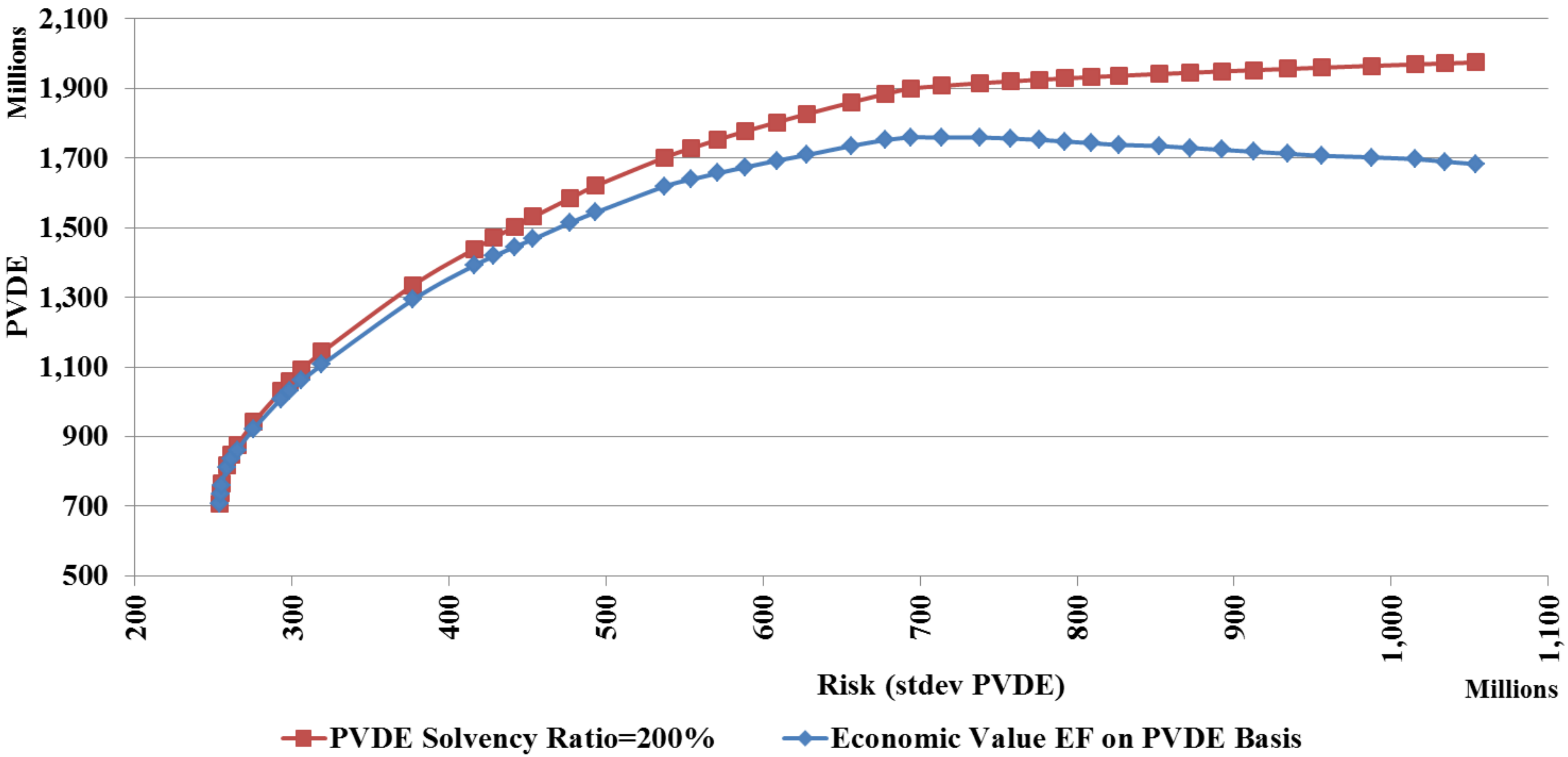
CONNING

How Inefficient is the Asset Only Efficient Frontier on a SII/PVDE Basis?



Source: Conning Analysis

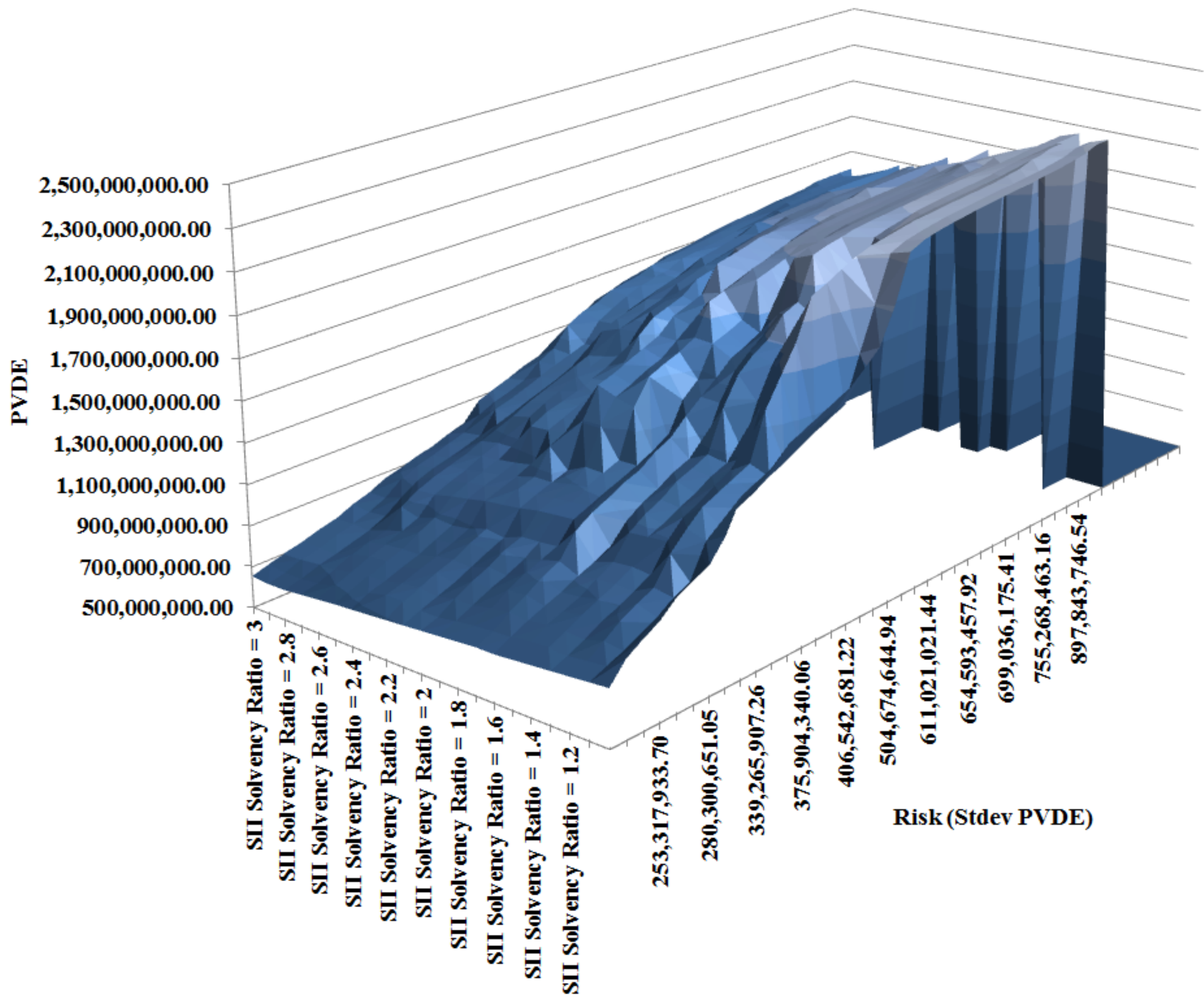
How Inefficient is Economic Value on a PVDE Basis?



Source: Conning Analysis

The PVDE Efficient Frontier and Solvency Ratio

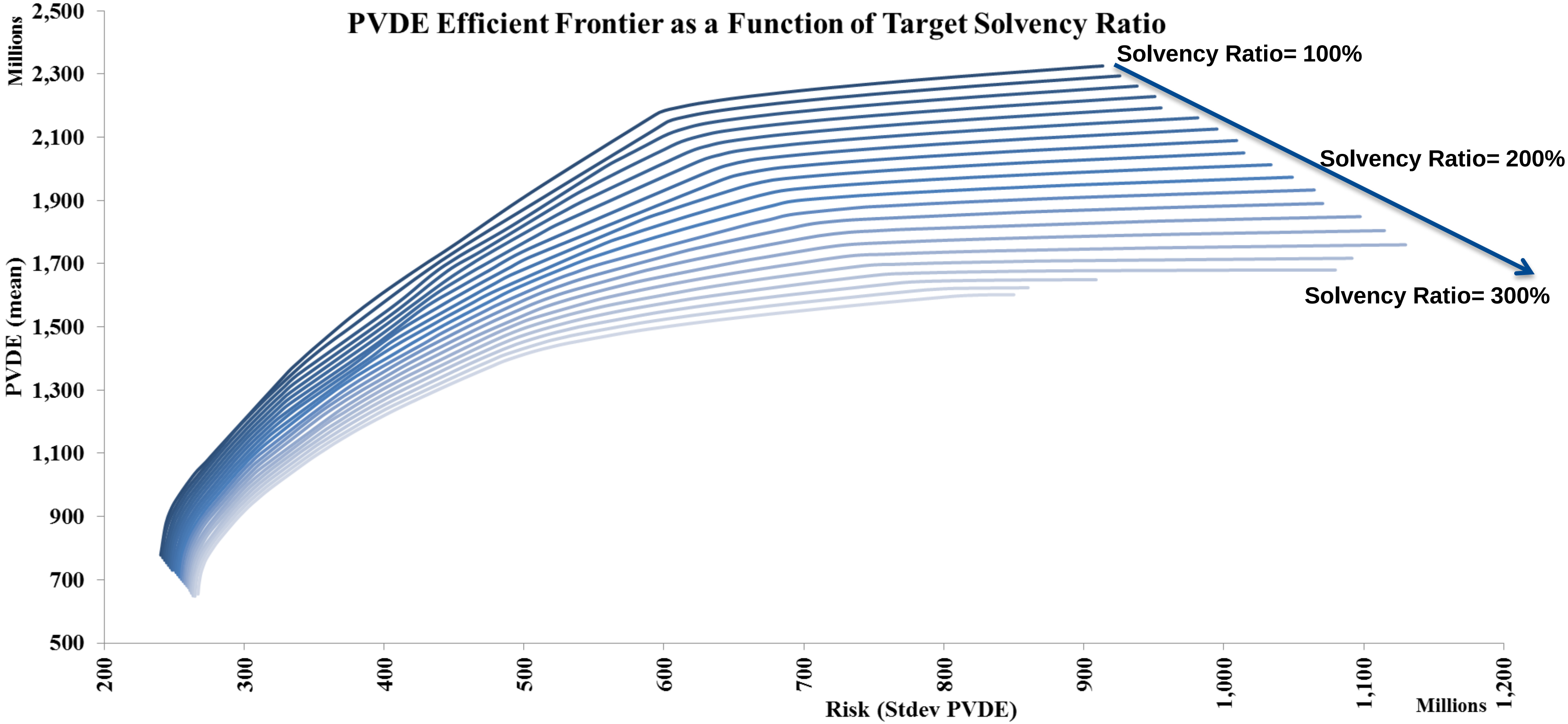
- Overall holding more capital is bad for shareholder value
- As target solvency ratio increases we get less additional shareholder value per unit of risk



Source: Conning Analysis

The PVDE Efficient Frontier and Solvency Ratio

- And in 2 Dimensions….

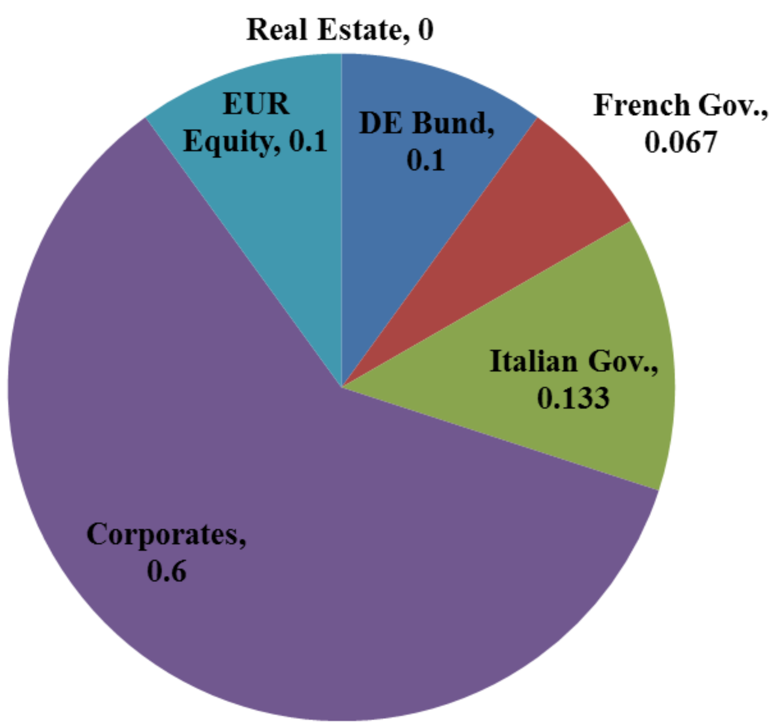


Source: Conning Analysis

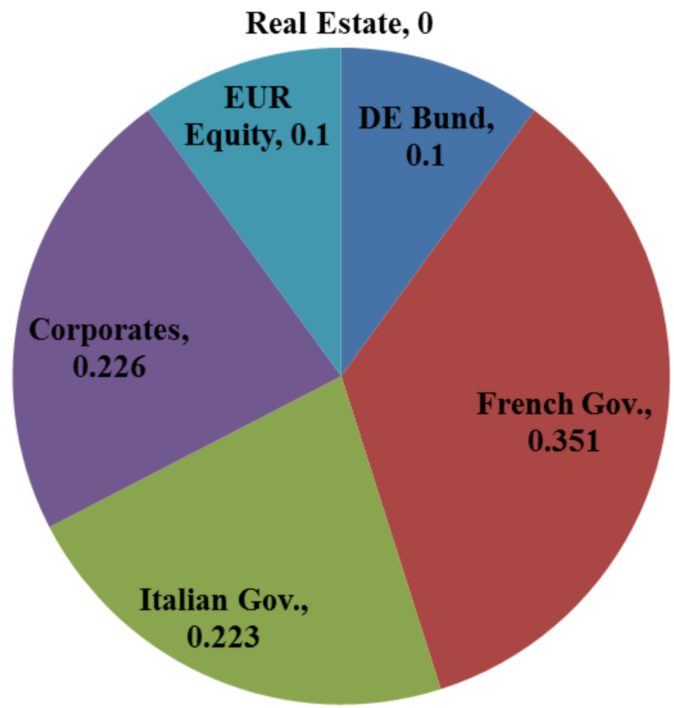
The PVDE Efficient Frontier and Solvency Ratio

- How does target solvency ratio effect the efficient allocation

Target Solvency Ratio = 100%



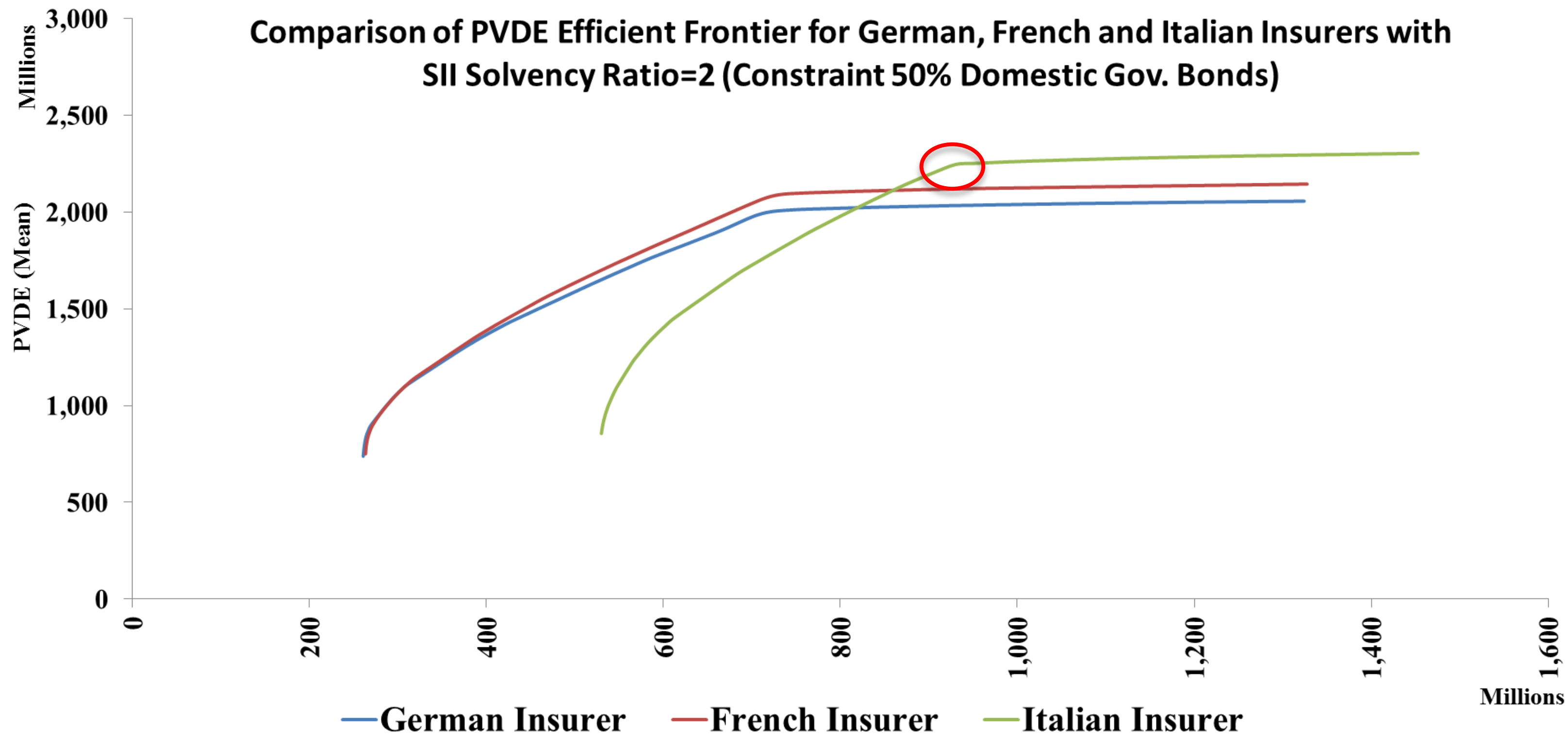
Target Solvency Ratio = 300%



Risk Level (PVDE STDEV)=600,000,000

Source: Conning Analysis

Eurozone Insurer Example



Source: Conning Analysis

- Slightly more realistic example
  - German, Italian and French Insurer each with a constraint to invest 50% in domestic bonds
- How does SII effect the ability of insurers across the Eurozone to generate shareholder value?
- The market risk (spread and credit) dominates the SCR advantage of Italian insurers at low and medium risk
  - There is a sweet spot for higher risk strategies where DE and FR insurers are constrained by lower yields
  - Highlights the need for the volatility and matching adjustments

Conclusions

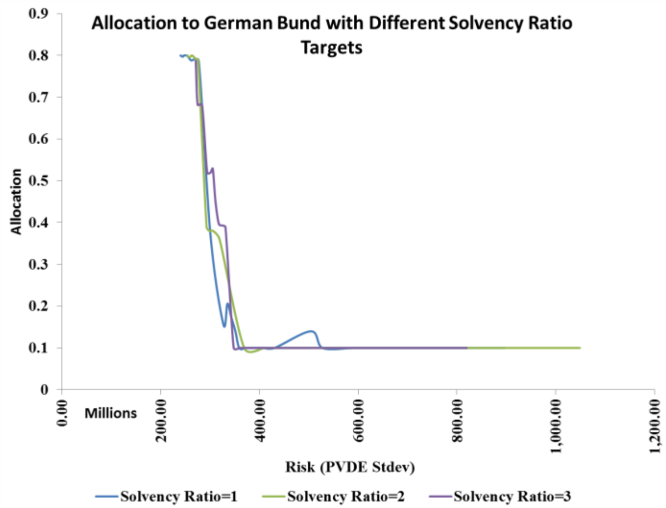
The ability to generate shareholder value in the Solvency II world depends on many factors

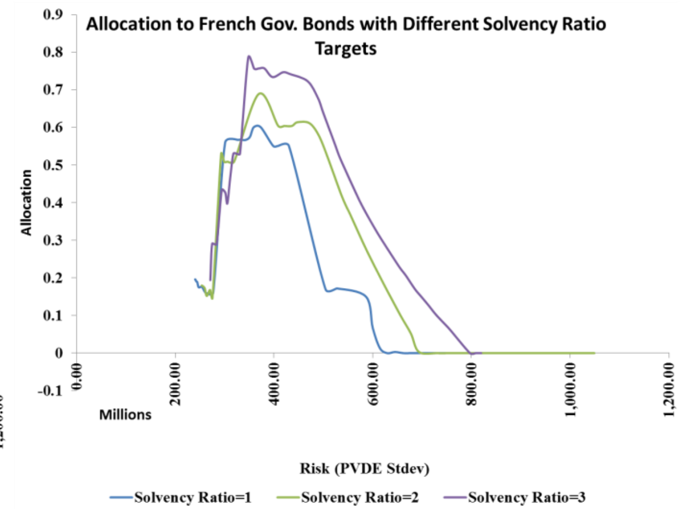
- *risk tolerance,*
- *desired level of capitalisation, and*
- *in which member state the insurer is domiciled*

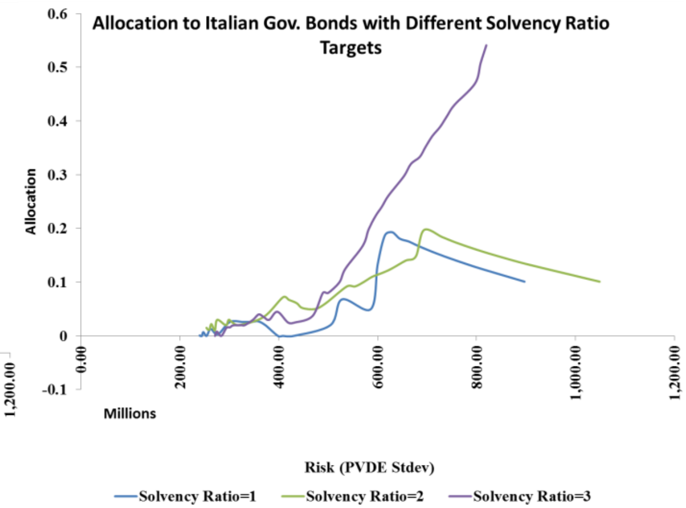
To capitalise on this, we need to

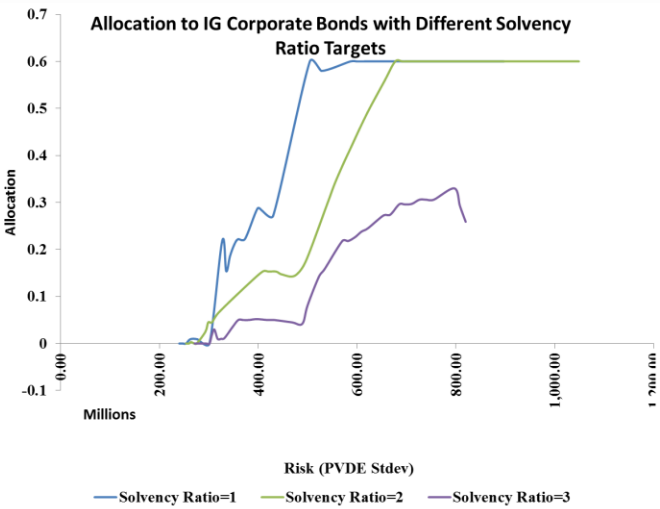
- *adequately model the market and credit risk,*
- *have an appropriate risk reward measure such as PVDE, and*
- *have efficient optimization tools to make these sorts of studies and more complex ones possible*

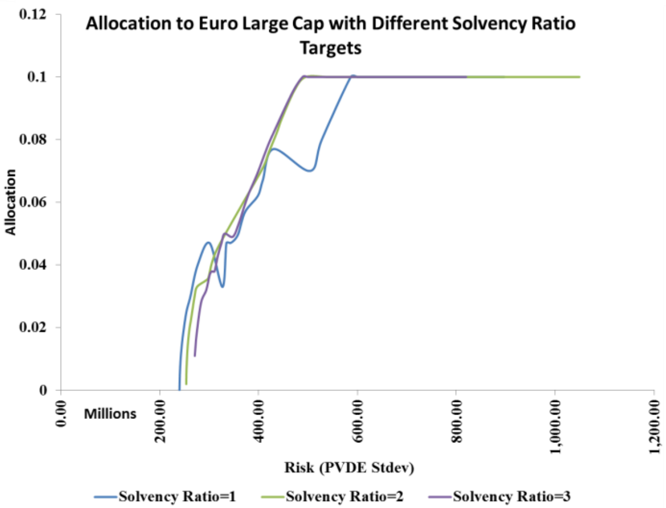
The PVDE Efficient Frontier and Solvency Ratio

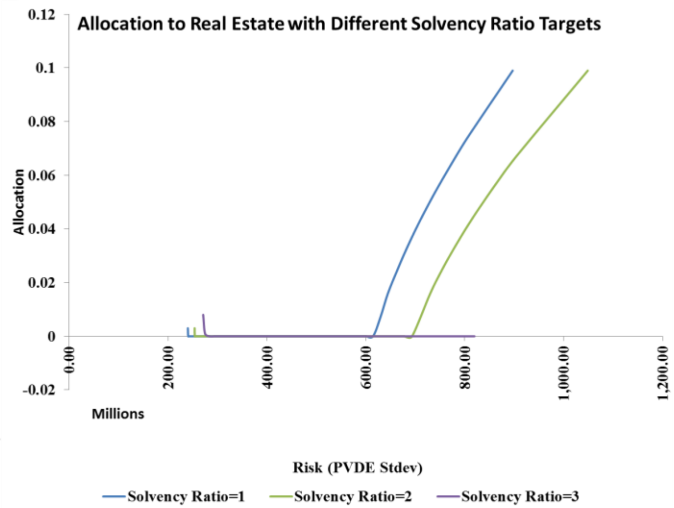








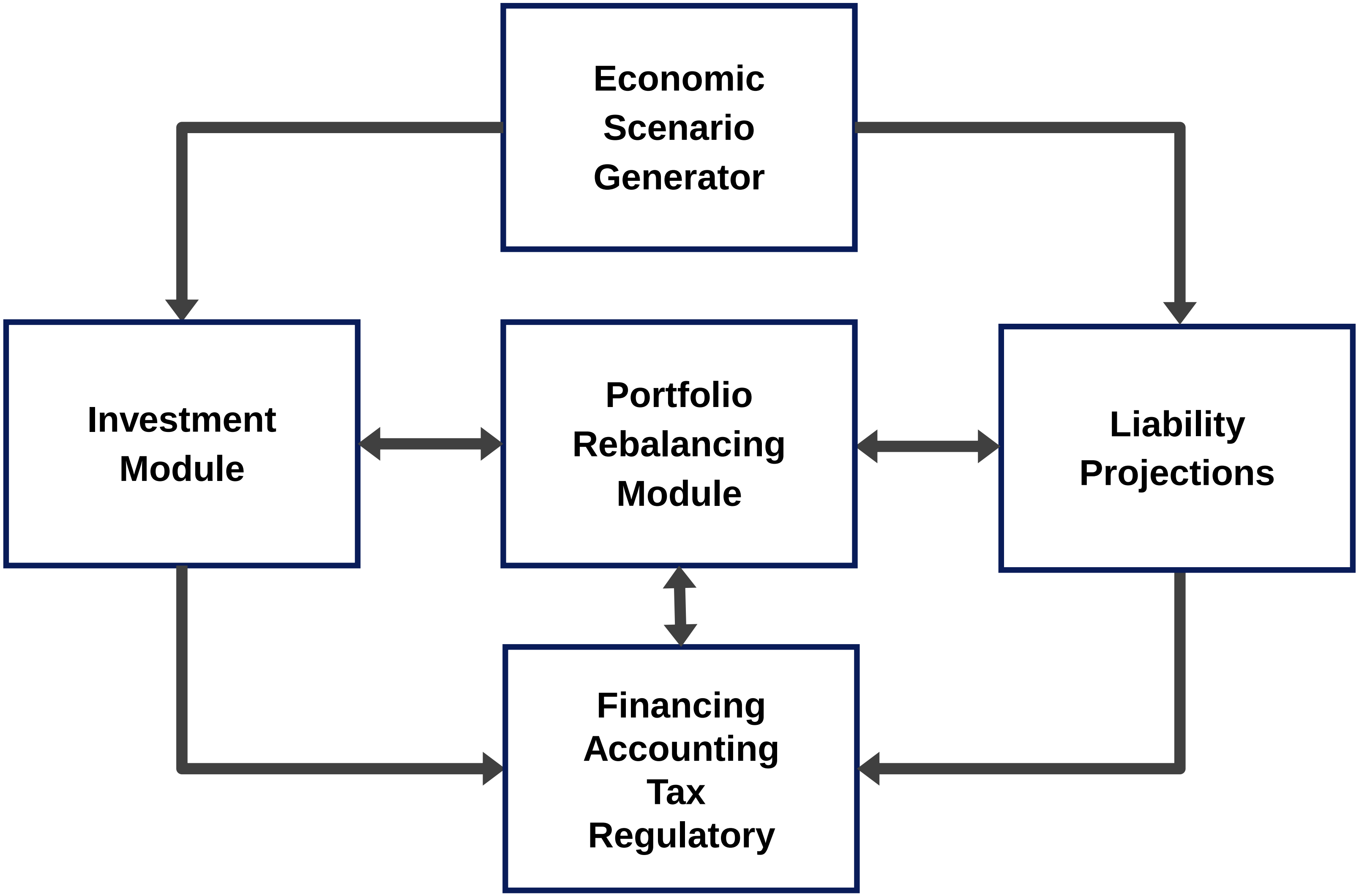




Source: Conning Analysis

SET-UP CONSIDERATIONS

Modeling Platform for Efficient Frontier Analysis



Objective Function — Reward and Risk Measures

Common Reward Measures

- Annual Investment Return
- Income
  - Investment
  - Operating
- Surplus
  - Regulatory
  - Shareholders' Equity
  - Economic
- Enterprise Value

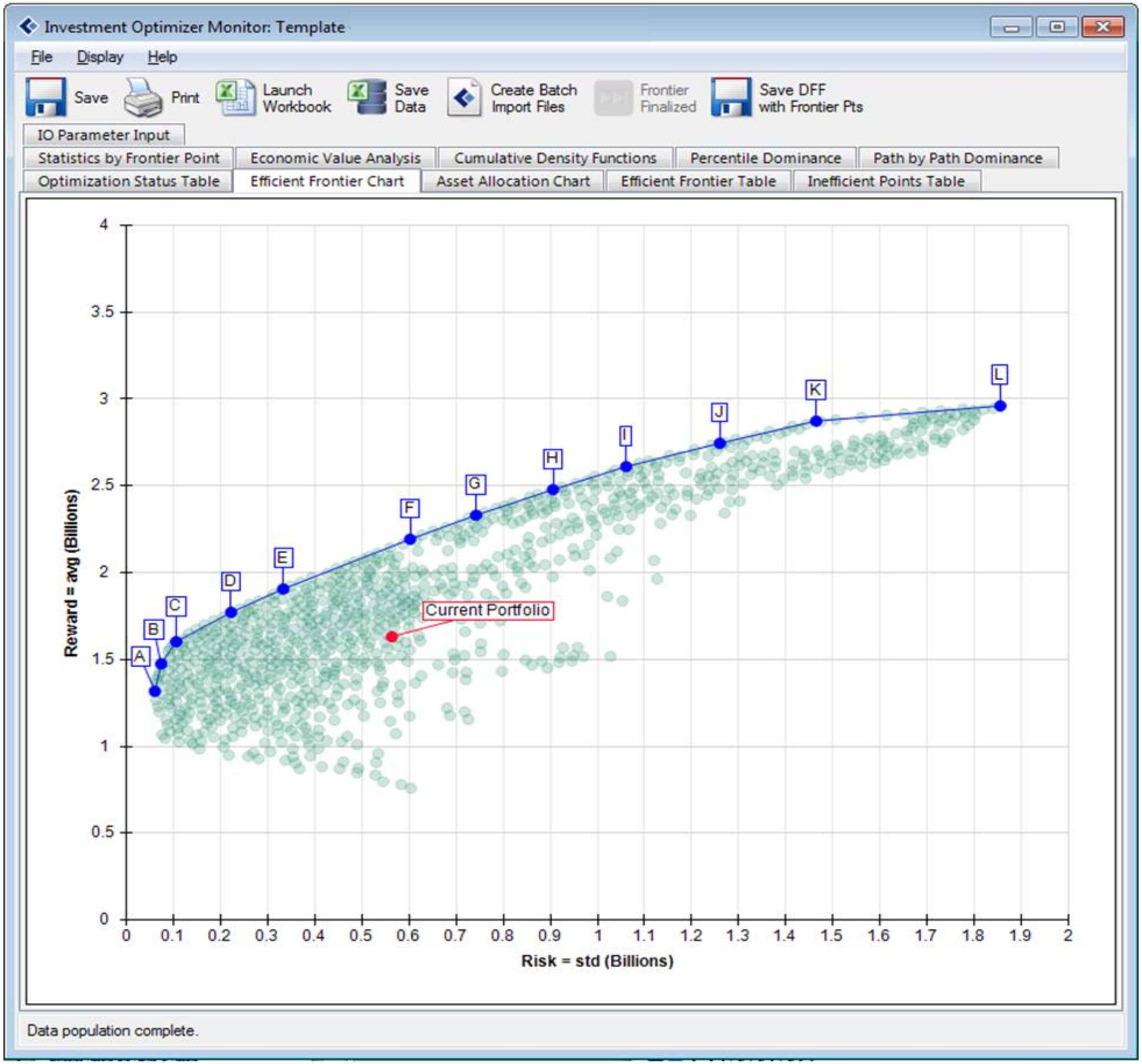
Common Risk Measures

- 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?
  - Uses: Required Capital
  - Risk Metric: Value at Risk
- Expected Policyholder Deficit
  - In the event of insolvency, how bad can the insolvency be?
  - Uses: Capital Allocation, Bailouts and Recoveries
  - Risk Metric: Conditional Value at Risk

Efficient Frontier Optimization

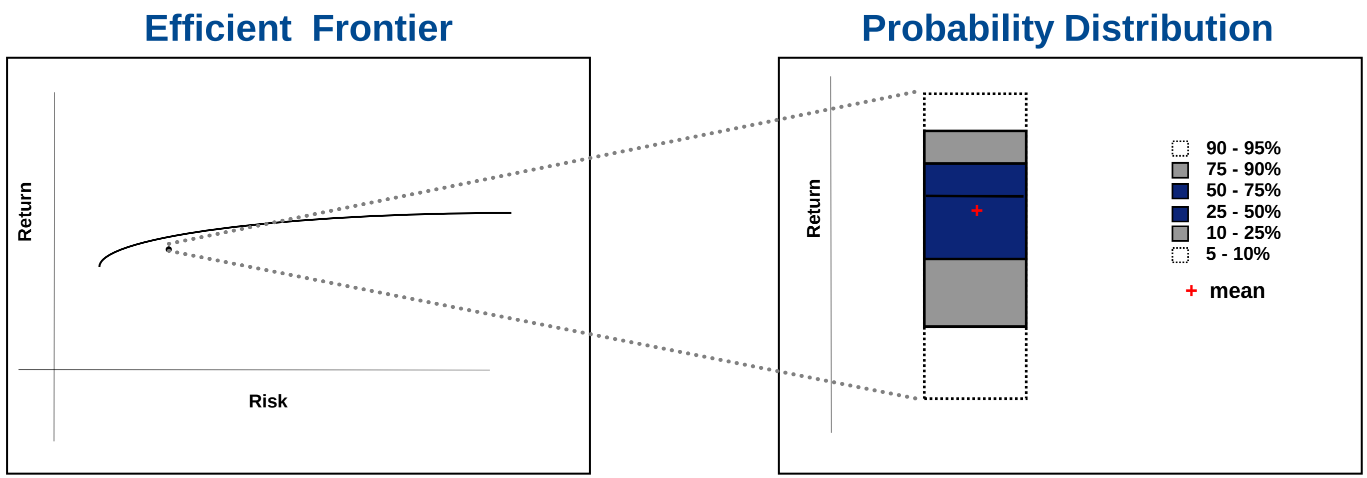
Integrated ALM

- Identify investment strategy to meet specific risk/reward profile
- Maximize economic value — not just investment returns — for various levels of risk
- Provides a platform for aggregating enterprise risks



Prepared by Conning, Inc. Source: ADVISE® model based on hypothetical company data

Explode Results to Full Range of Outcomes

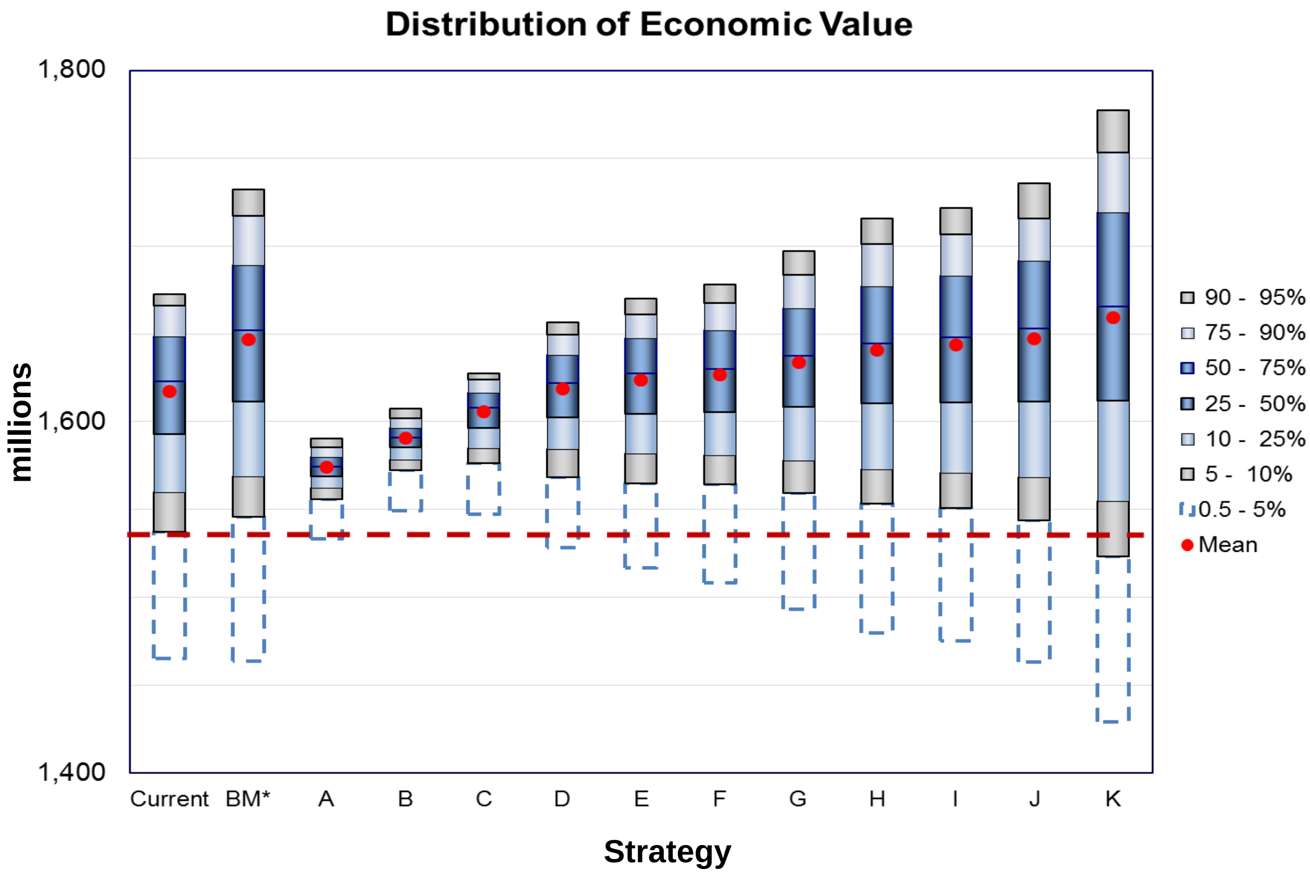


- Each point on the efficient frontier, defined by a single risk and a single reward measure, is based on the results of 1,000s of scenarios
- We usually want the investment strategy that on average gives the "best" reward for a given level of risk
- However, we also want to know the downside risk - how bad could results be?
- We evaluate this risk by looking at the range of potential results; for example, how bad is the 5% probability level (1 year in twenty), and can we accept that much risk?

Distributions of Results along the Economic Efficient Frontier

Observations

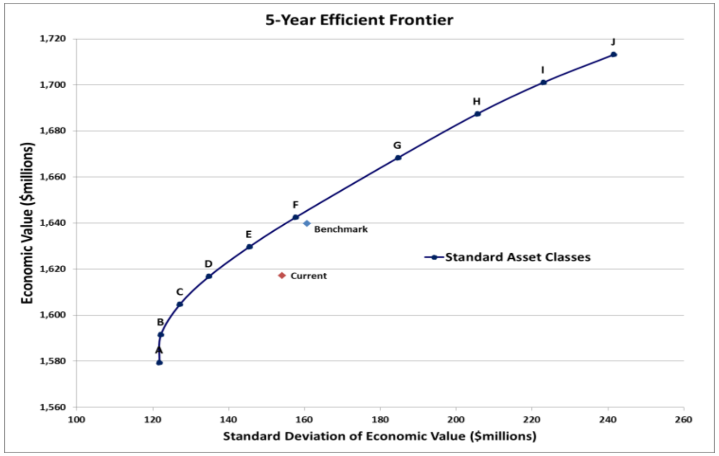
- **Benchmark economic value is improved over the Current allocation at nearly every percentile**
- **Extreme tail events are similar between the Benchmark and Current allocations**
- **Tail risk exceeds the Current allocation in the longest duration and riskiest portfolios J and K**



*Benchmark Strategy

Prepared by Conning, Inc. Source: ADVISE® model based on hypothetical company data.

Economic Value (EV) Asset Allocation



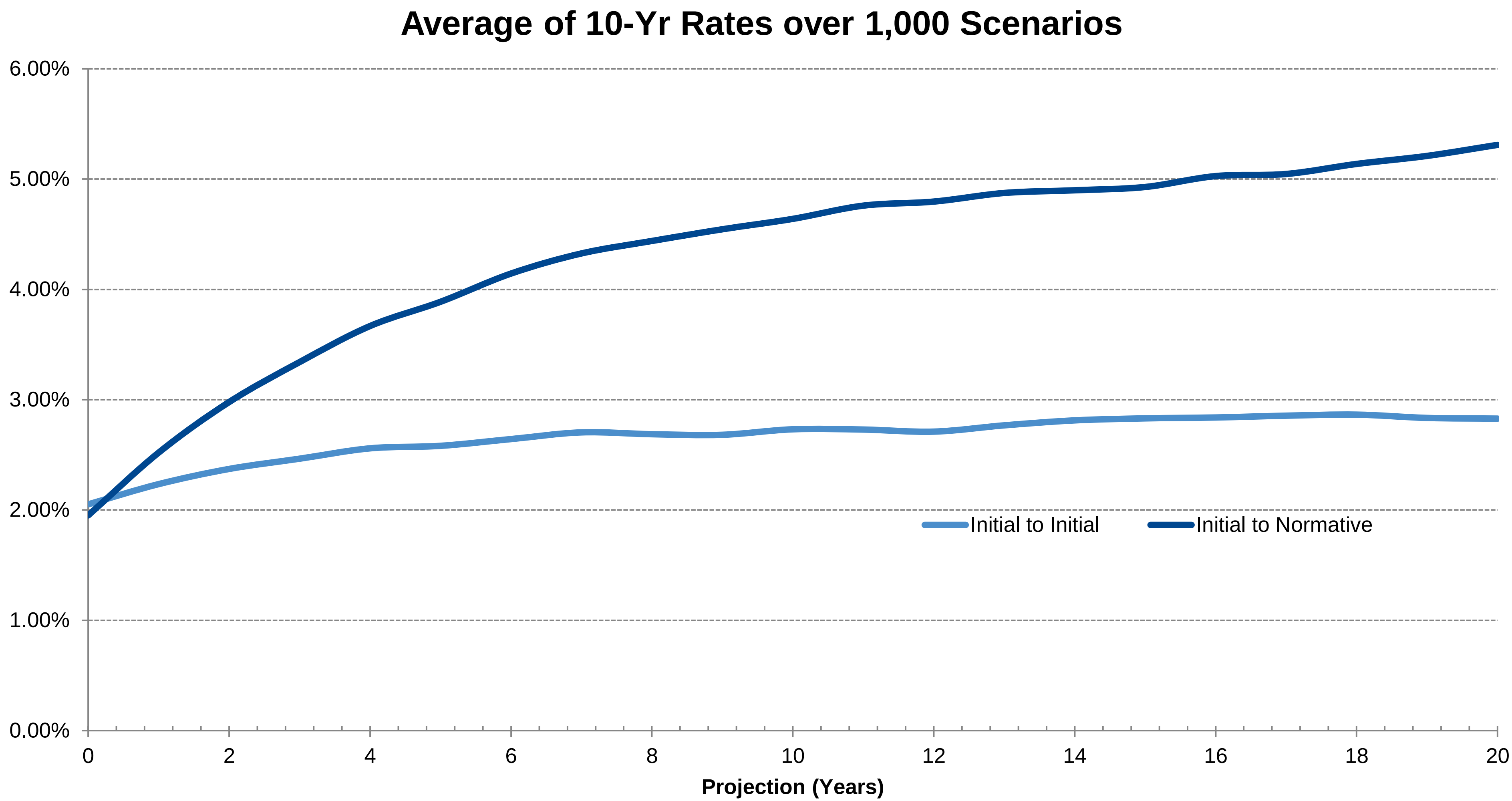
	Current	Benchmark	A	B	C	D	E	F	G	H	I	J
Cash and Gov't	5%	4%	43%	16%	8%	6%	1%	-	-	-	-	-
Corporate	65%	49%	21%	43%	44%	35%	48%	50%	44%	44%	45%	50%
Structured	16%	19%	36%	40%	32%	28%	19%	17%	21%	19%	17%	16%
Property/Privates	11%	21%	-	1%	15%	29%	30%	30%	30%	30%	30%	26%
High Yield	3%	3%	-	-	-	1%	1%	2%	2%	3%	3%	3%
Equity	-	1%	-	-	-	-	-	-	-	1%	2%	2%
Alternative Assets	-	3%	-	-	1%	1%	1%	1%	3%	3%	3%	3%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Overall Duration	7.1	8.1	6.7	6.8	6.6	6.8	7.4	7.7	8.5	9.7	11.0	12.2
Economic Value (£MM)	1,617	1,640	1,579	1,591	1,607	1,618	1,632	1,642	1,669	1,689	1,703	1,715
Risk (£MM)	154	161	122	123	126	138	149	159	187	209	224	246

- **Credit Risk**
- **Illiquidity Exposure**
- **Alternative Assets**
- **Prepayment Risk**
- **Diversification**
- **Duration Targeting**

Prepared by Conning, Inc. Source: ADVISE® model based on hypothetical company data

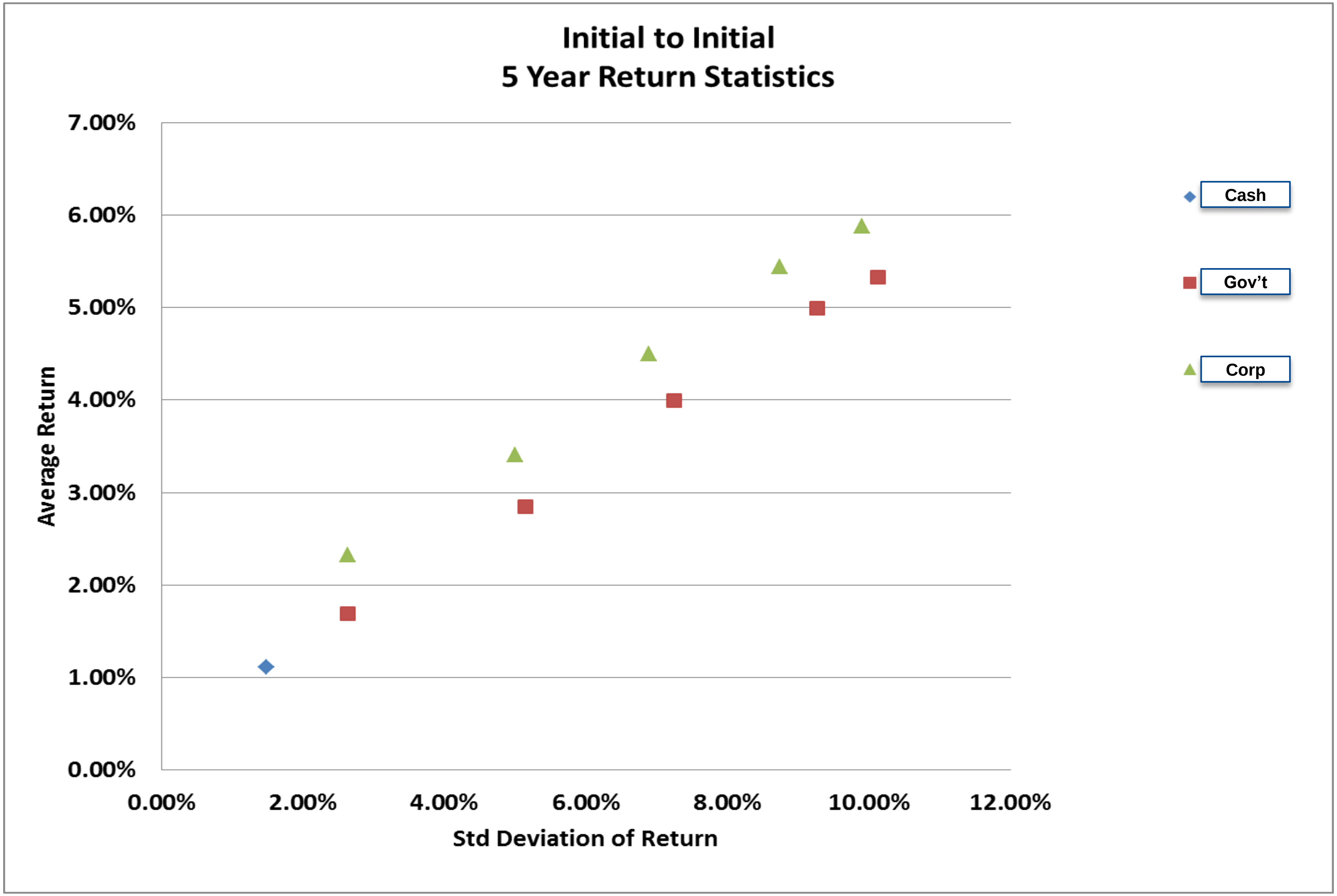
ESG CALIBRATION CONSIDERATIONS

Initial-to-Initial vs. Initial-to-Normative



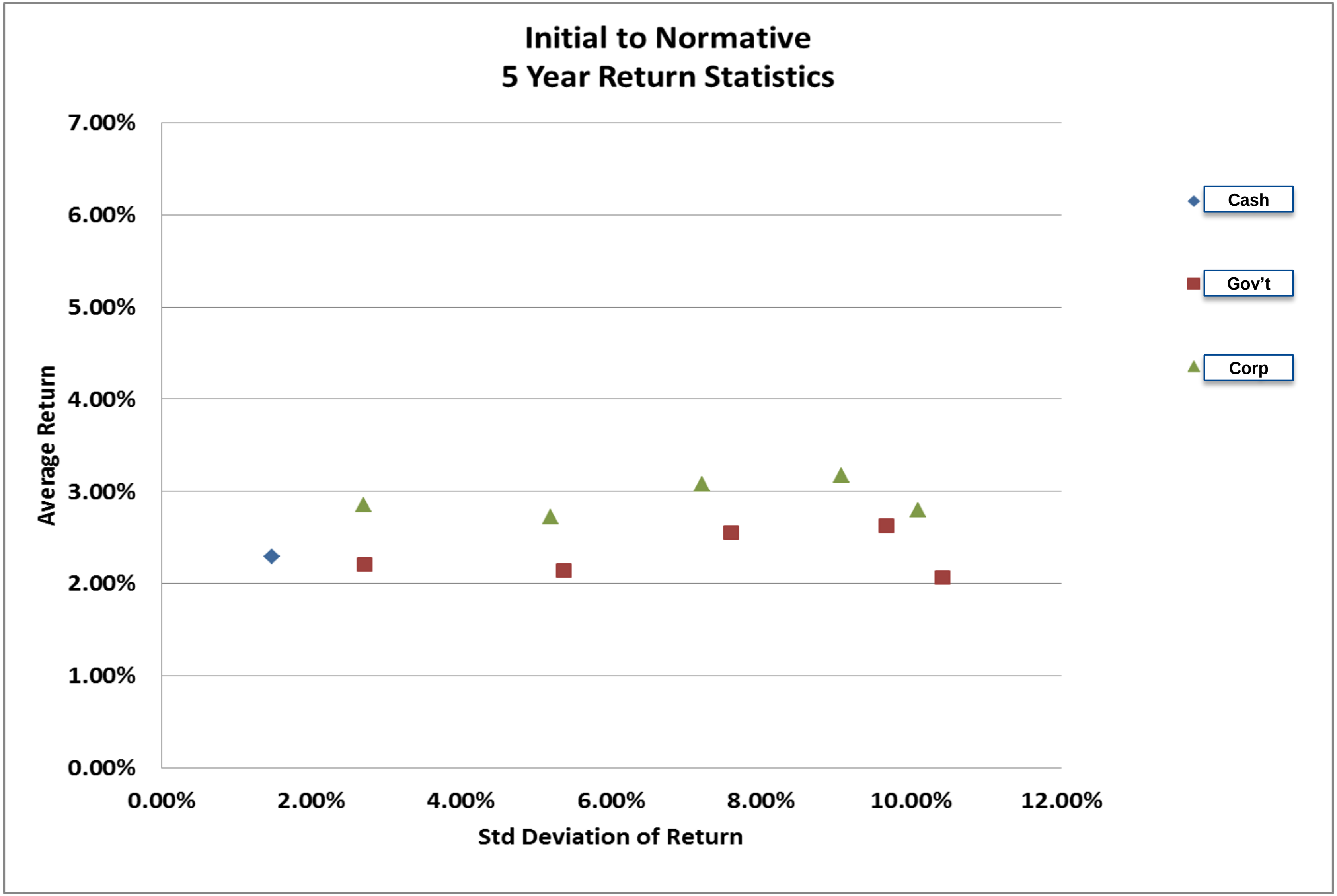
Prepared by Conning, Inc. Source: GEMS® Economic Scenario Generator scenarios.

Example — Asset Model Calibration Parameters



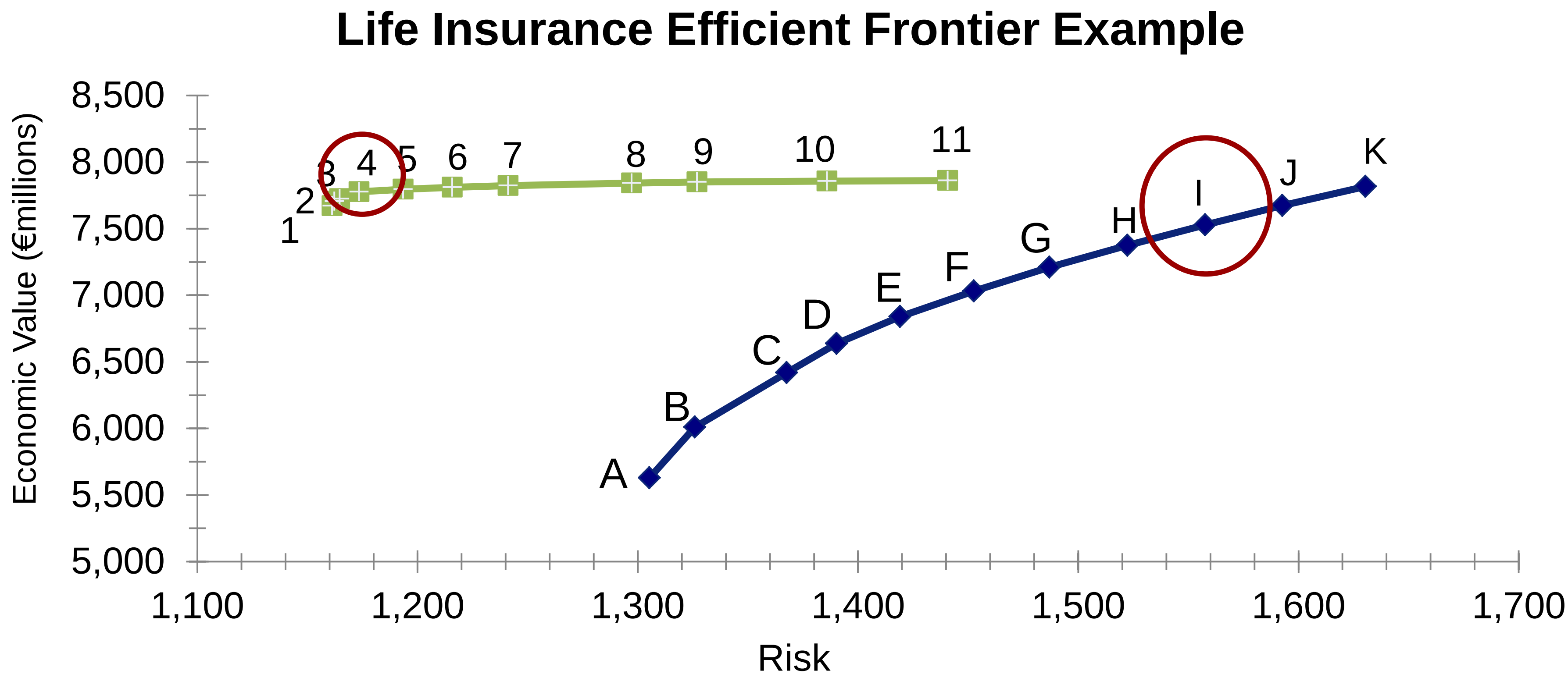
Prepared by Conning, Inc. Source: GEMS® Economic Scenario Generator scenarios.

Example — Asset Model Calibration Parameters



Prepared by Conning, Inc. Source: GEMS® Economic Scenario Generator scenarios.

The Question — to Extend or Not Extend?



Initial to Initial

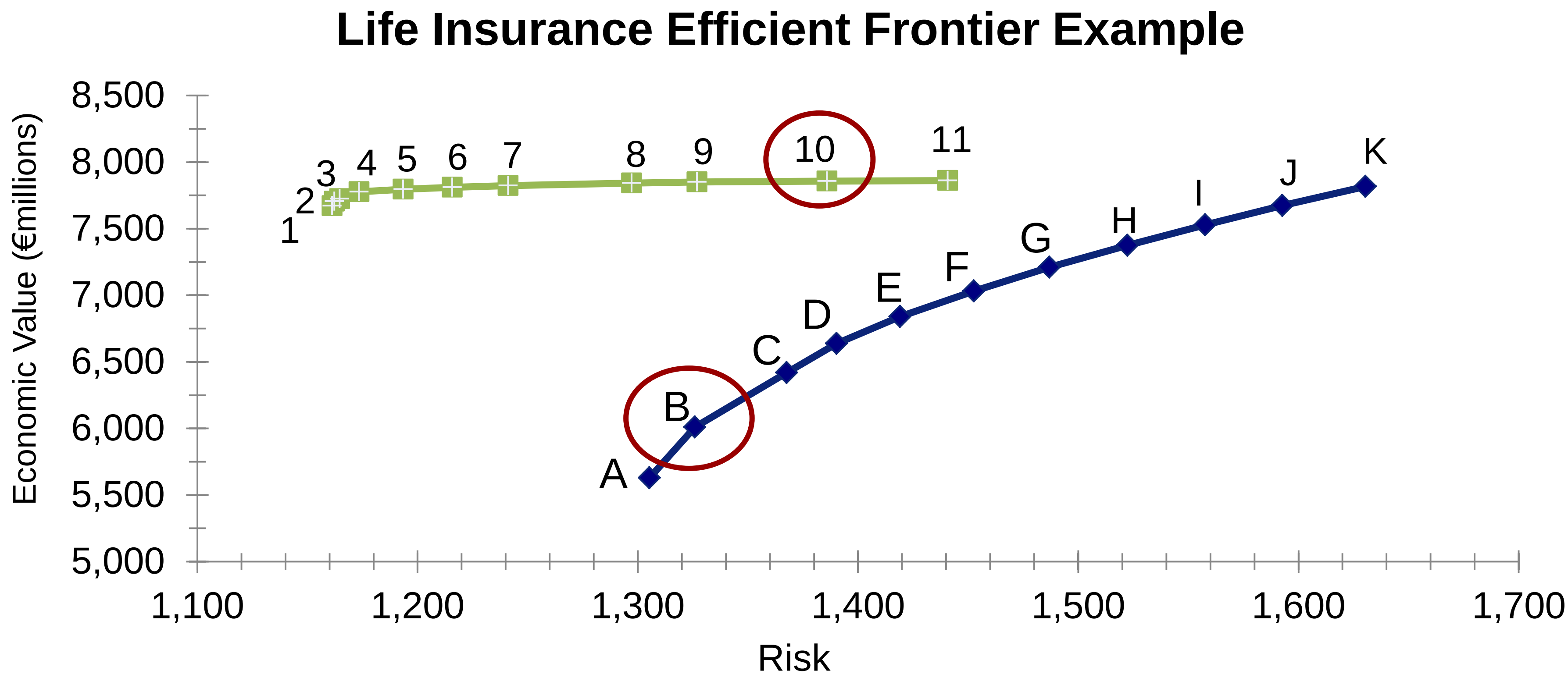
Asset Allocation:	A	B	C	D	E	F	G	**H**	**I**	**J**	K
Overall Duration	3.6	4.5	5.9	6.5	7.1	7.7	8.3	**8.9**	**9.5**	**10.1**	10.7

Initial to Normative

Asset Allocation	1	2	3	**4**	5	6	7	8	9	10	11
Overall Duration	2.7	3.3	3.6	**4.7**	5.3	5.9	6.5	7.7	8.3	9.5	10.7

Prepared by Conning, Inc. Source: ADVISE® model based on hypothetical company data

The Question — to Extend or Not Extend?



Initial to Initial

Asset Allocation:	A	**B**	C	D	E	F	G	**H**	**I**	**J**	K
Overall Duration	3.6	**4.5**	5.9	6.5	7.1	7.7	8.3	8.9	9.5	10.1	10.7

Initial to Normative

Asset Allocation	1	2	3	4	5	6	7	8	9	**10**	11
Overall Duration	2.7	3.3	3.6	4.7	5.3	5.9	6.5	7.7	8.3	**9.5**	10.7

Prepared by Conning, Inc. Source: ADVISE® model based on hypothetical company data

Disclosures

Conning, Inc., Goodwin Capital Advisers, Inc., Conning Investment Products, Inc., a FINRA-registered broker dealer, Conning Asset Management Limited, Conning Asia Pacific Limited and Octagon Credit Investors, LLC are all direct or indirect subsidiaries of Conning Holdings Limited (collectively, “Conning”) which is one of the family of companies owned by Cathay Financial Holding Co., Ltd., a Taiwan-based company. Conning has offices in Hartford, New York, Boston, London, Cologne, Hong Kong and Tokyo.

Conning, Inc., Conning Investment Products, Inc., Goodwin Capital Advisers, Inc., and Octagon Credit Investors, LLC are registered with the Securities and Exchange Commission (“SEC”) under the Investment Advisers Act of 1940 and have noticed other jurisdictions they are conducting securities advisory business when required by law. In any other jurisdictions where they have not provided notice and are not exempt or excluded from those laws, they cannot transact business as an investment adviser and may not be able to respond to individual inquiries if the response could potentially lead to a transaction in securities.

Conning Investment Products, Inc. is also registered with the Ontario Securities Commission. Conning Asset Management Limited is Authorised and regulated by the United Kingdom's Financial Conduct Authority (FCA#189316), and Conning Asia Pacific Limited is regulated by Hong Kong’s Securities and Futures Commission for Types 1, 4 and 9 regulated activities. Conning primarily provides asset management services for third-party assets. Conning predominantly invests client portfolios in fixed income strategies in accordance with guidelines supplied by its institutional clients.

All investment performance information included within this material is historical. Past performance is not indicative of future results. Any tax related information contained within this presentation is for informational purposes only and should not be considered tax advice. You should consult a tax professional with any questions.

For complete details regarding Conning and its services, you should refer to our Form ADV Part 2, which may be obtained by calling us.

Legal Disclaimer

This document contains information that is confidential or proprietary to Conning (or their direct and indirect subsidiaries). By accepting this document you agree that: (1) if there is any pre-existing contract containing disclosure and use restrictions between your company and Conning, you and your company will use this information in reliance on and subject to the terms of any such pre-existing contract; or (2) if there is no contractual relationship between you and your company and Conning, you and your company agree to protect this information and not to reproduce, disclose or use the information in any way, except as may be required by law.

This material is for informational purposes only and should not be interpreted as an offer to sell, or a solicitation or recommendation of an offer to buy any security, product or service, or retain Conning for investment advisory services. This information is not intended to be nor should it be used as investment advice and should not be copied or distributed without the prior consent of Conning.

C#4200354