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# Modelling Defaultable Sovereign Debt

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Conning Risk and Capital Management Solutions





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# Modelling Defaultable Sovereign Debt

Do we need to? What are the challenges?  
What can we learn?

# Agenda

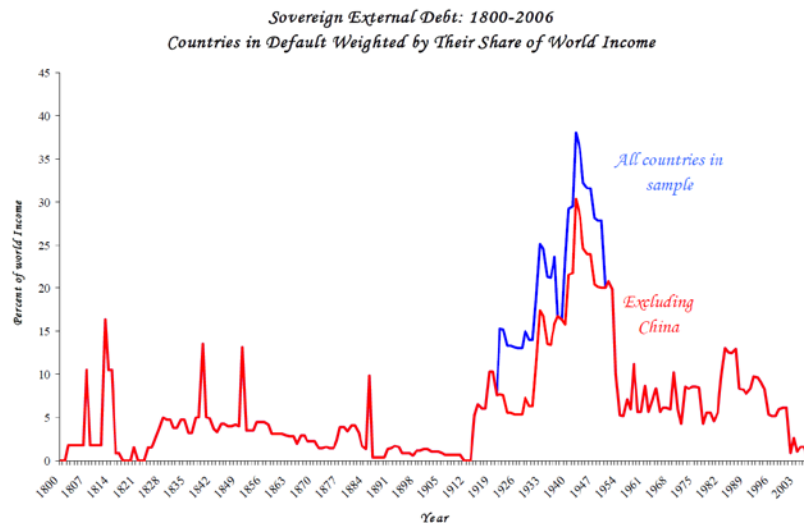
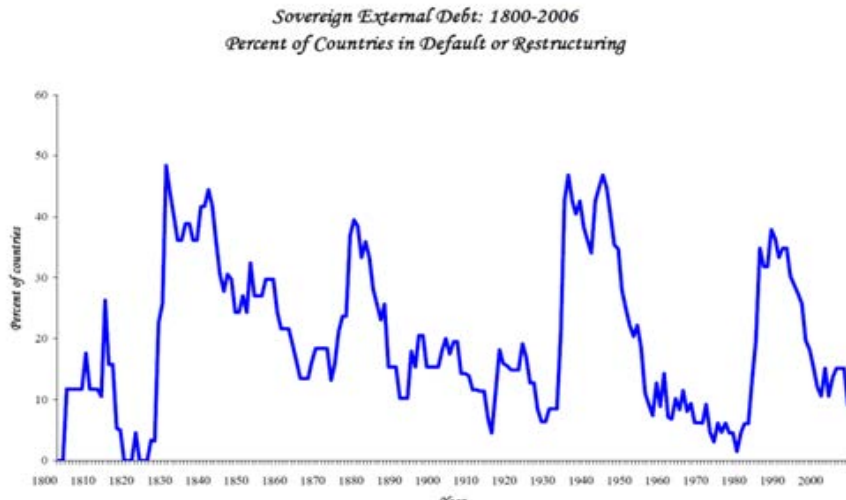
- Sovereign credit overview
- Common modelling approaches
- Some features of a model of sovereign debt
- Quantitative comparison of modelling approaches
- SAA Case Study – is it worth investing in sovereign debt



# Sovereign Debt is Not Default Free

**Sovereign states can and do mismanage their finances**

- Insurance companies and pension funds hold these investments
- Need to assess the risk
- Need to evaluate asset allocation strategies involving this asset class

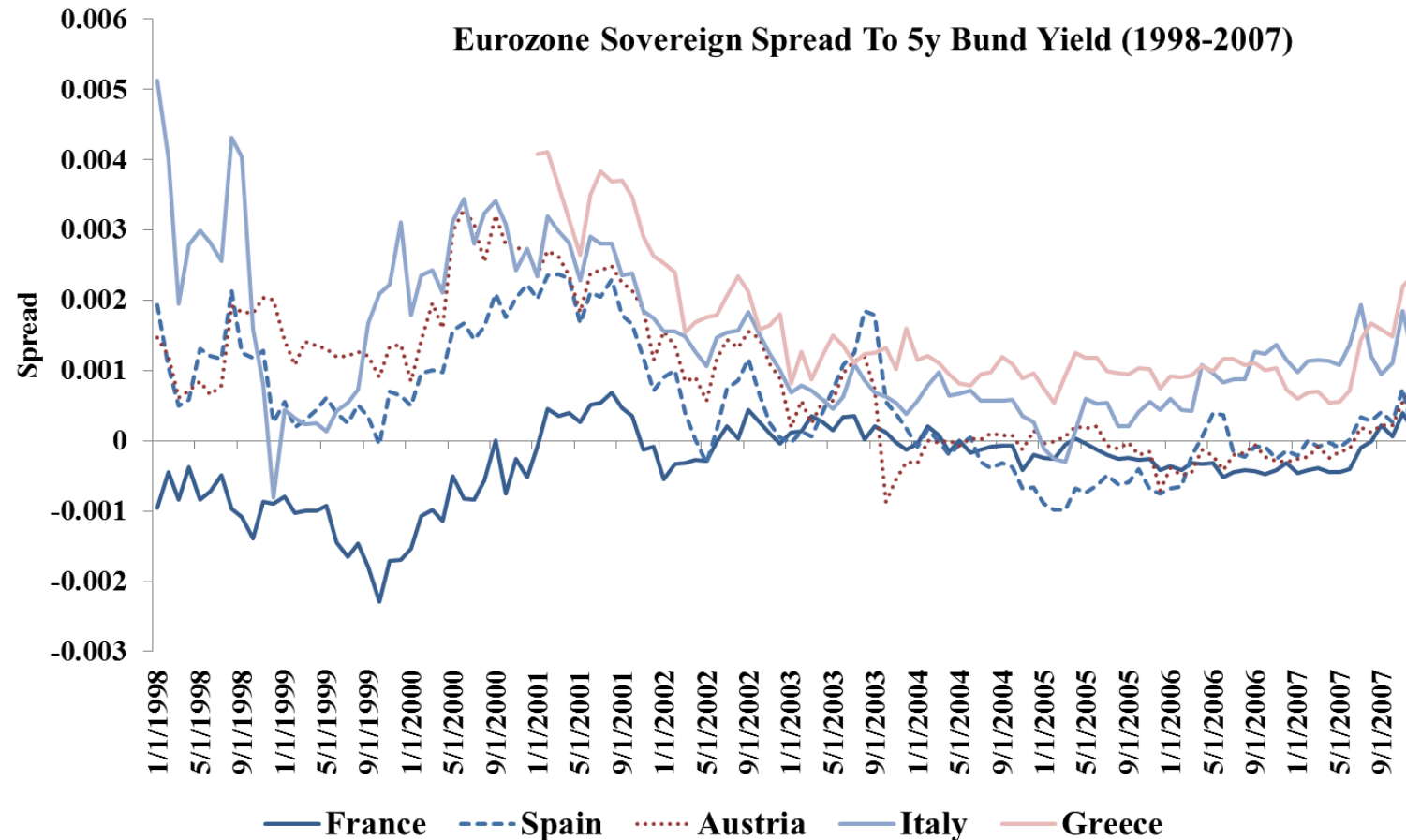


Source: Reinhart and Rogoff "This Time is Different: A Panoramic View of Eight Centuries of Financial Crises"



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# Sovereign Debt is Not Default Free

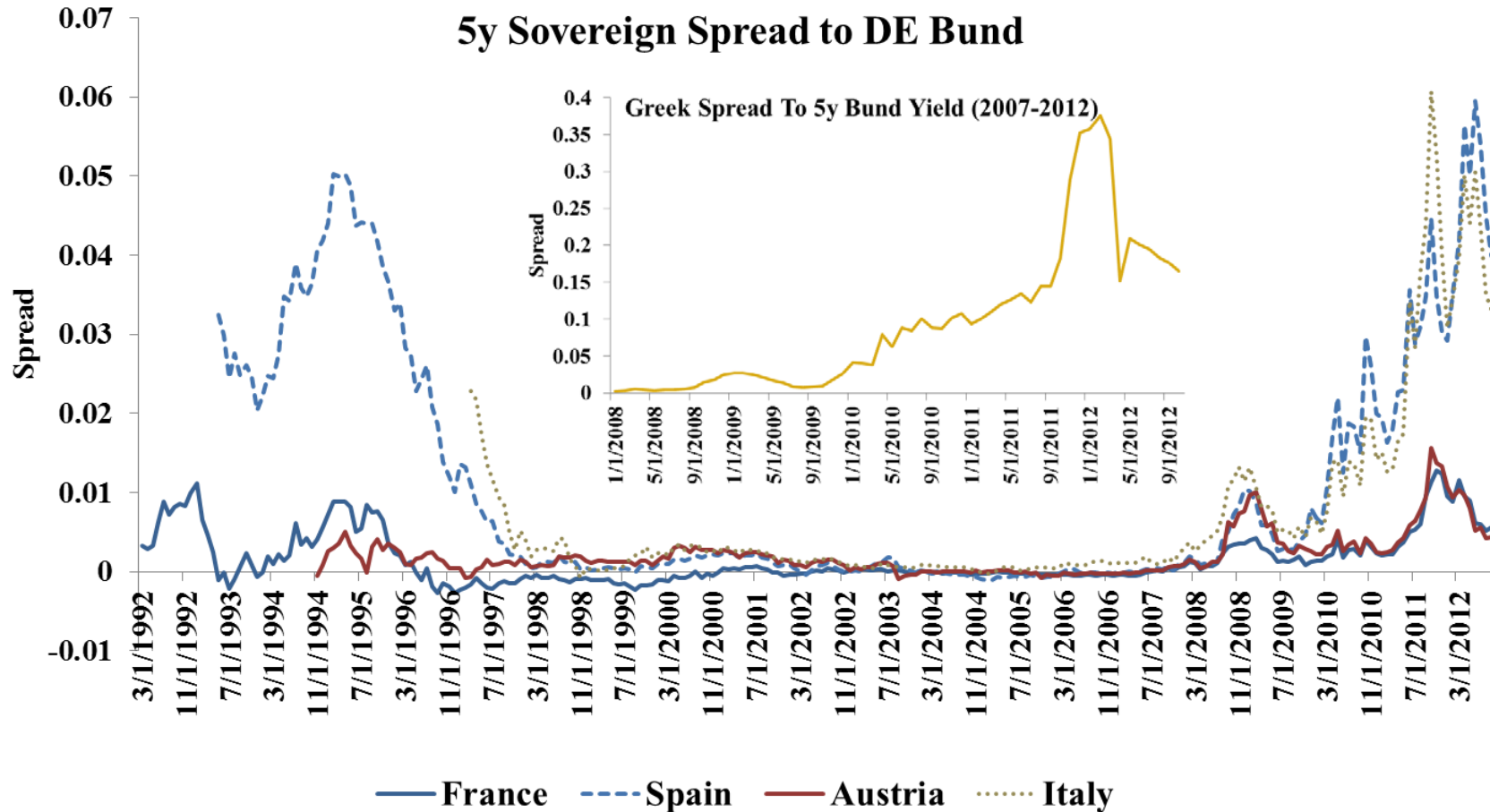


Source: Conning/Bloomberg



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# Sovereign Debt is Not Default Free



Source: Conning/Bloomberg



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# Sovereign Debt – Common Approaches

**Institutional investors investing in this asset class have come under regulatory pressure to adopt a more realistic approach**

**Stochastic simulation using an Economic Scenario Generator is one way forward**

**Several approaches are commonly seen**

- Ignore it and treat them as non-defaultable
- Modelling a return index
- Modelling using a corporate bond model (e.g. Merton, JLT, JLT+, other)

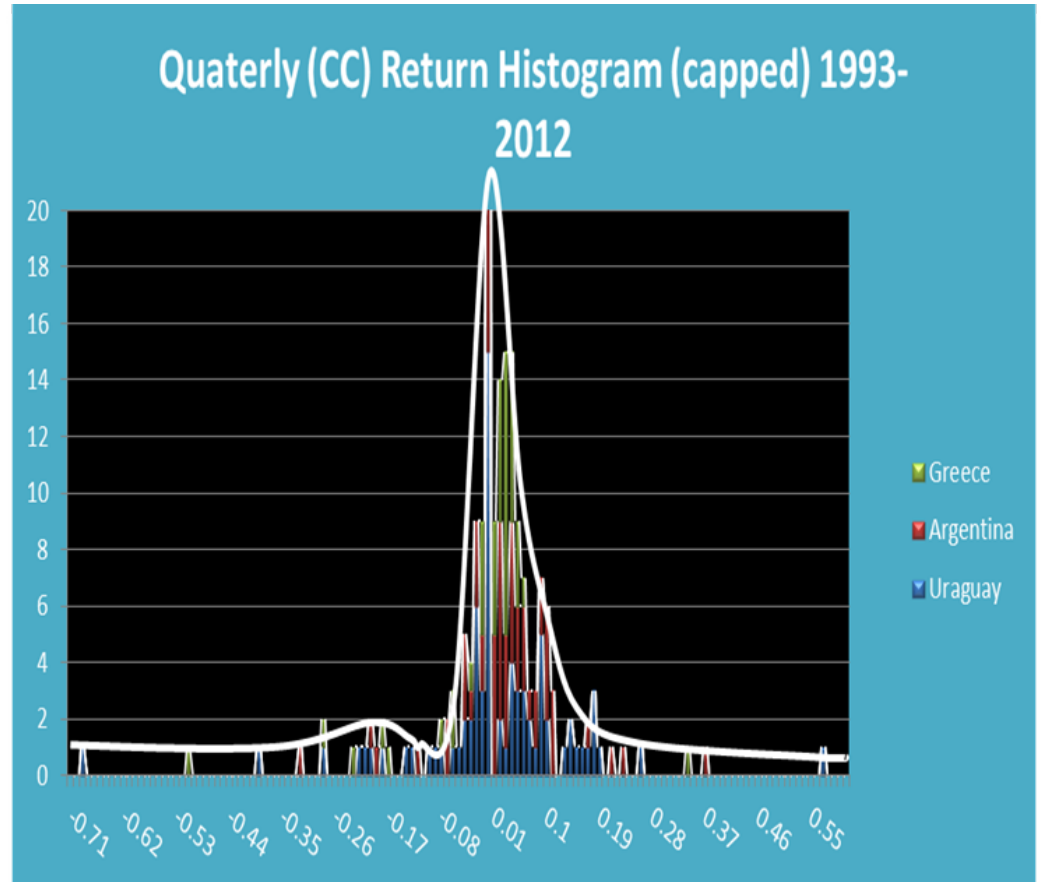
**None of these approaches is particularly satisfying.....**



# Sovereign Debt – Common Approaches

**“High Risk” Sovereign Debt exhibits a marked “default hump” in the tail of the return distribution**

- More pronounced than High Yield Corporates
- Difficult to achieve with index models
- Might imagine given longer histories secondary and tertiary humps due to multiple credit events



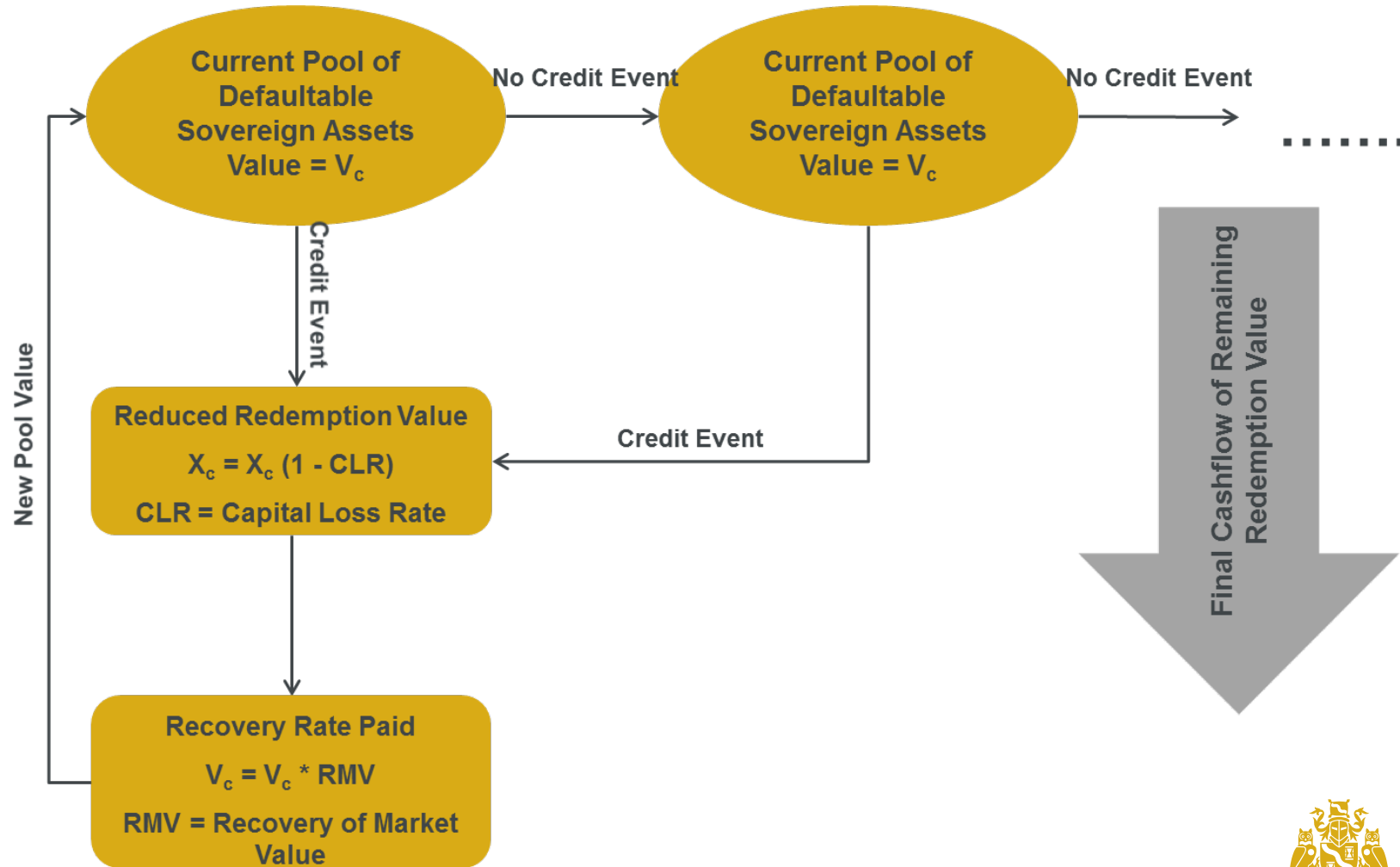
Source: Conning/Bloomberg



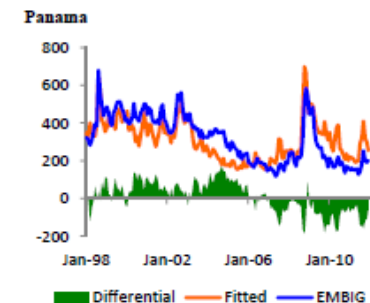
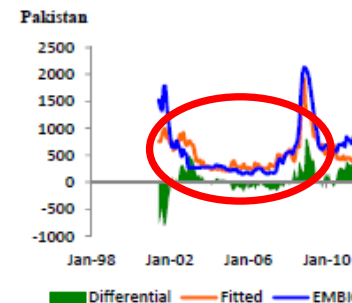
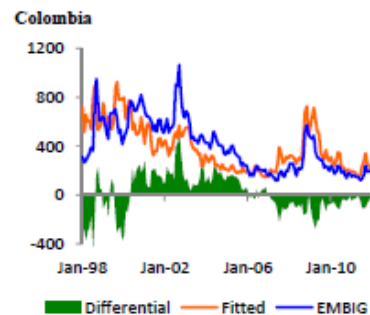
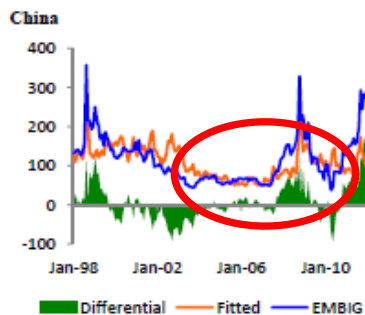
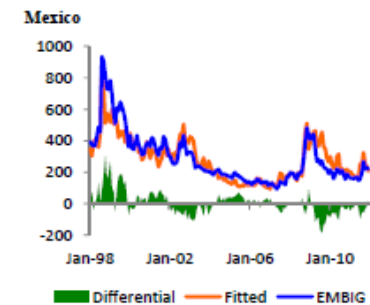
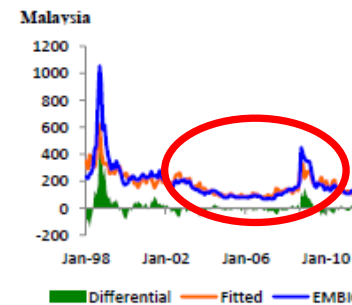
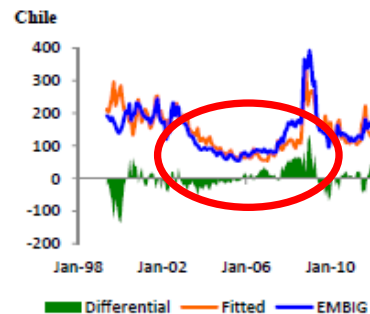
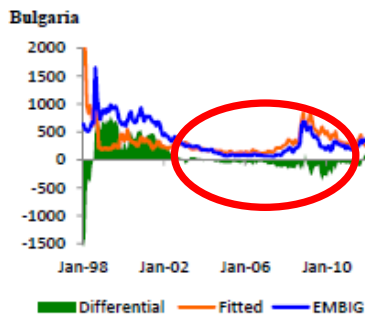
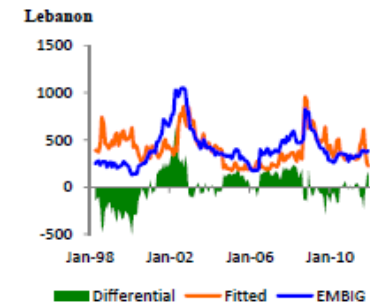
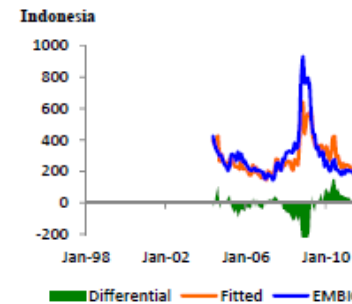
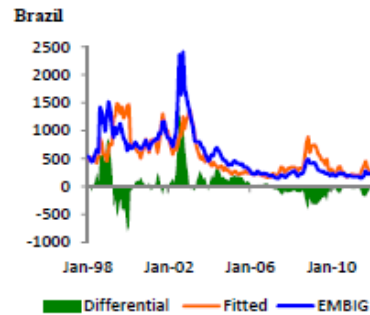
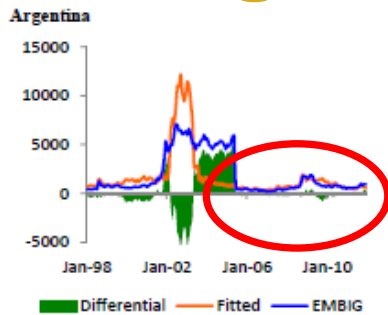
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# Sovereign Debt – Common Approaches



# Sovereign Debt – Common Approaches



Source: IMF Working Paper “Emerging Market Sovereign Bond Spreads: Estimation and Back-testing” (August 2012)



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# How Can We Do Better?



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# Model Class Candidates

## Reduced Form Credit Model

### Pros:

- Well understood estimation
- Incorporates default
- Could be extended to include CLR

### Cons:

- Spread dynamics not rich enough

## Regime Shifting Model

### Pros:

- Observed spread dynamics could be captured

### Cons:

- Unclear what drives regime switch (overvalued currency, short term debt / currency reserves, commodity prices, debt/GDP)
- Paucity of data

## Specialised Jump Diffusion Default Intensity Model

### Pros:

- Well understood estimation
- High and low spread environments are incorporated

### Cons:

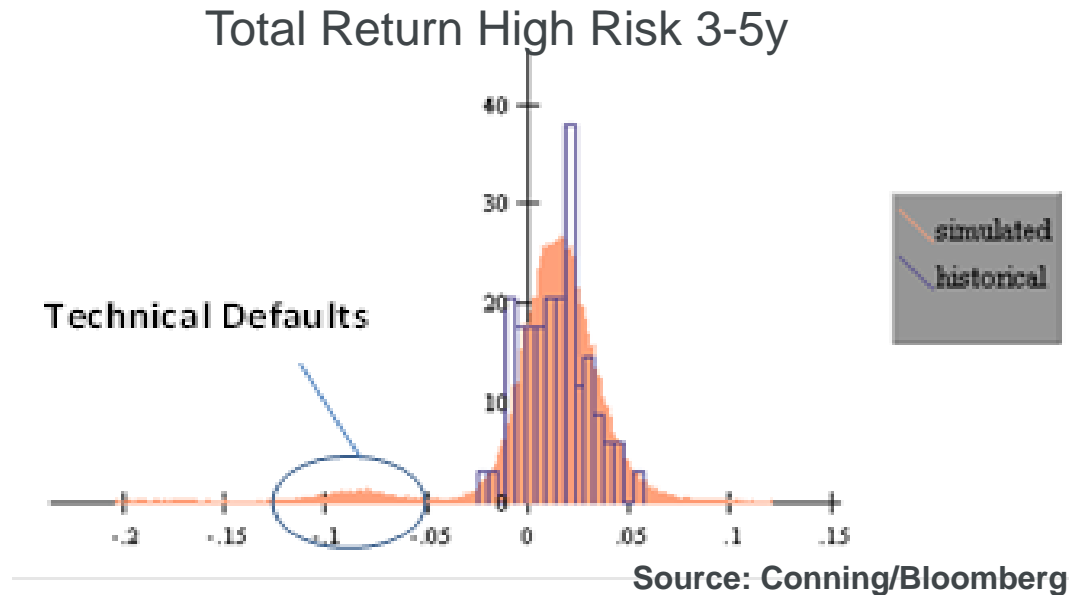
- Jumps are random and not directly driven by external factors



# GEMS<sup>®</sup> Defaultable Sovereign Debt Model

## Model of yields and spreads

- Output is a stochastic term structure
- Stochastic credit events
- Reproduces wide range of observed dynamics
- Correlation (incl. tail correlation) with equity, interest rates, corporate bonds and other asset classes
- CLR and RMV
- Relatively Parsimonious (ca. 12 parameters govern the stochastic processes)



# Dimension Reduction

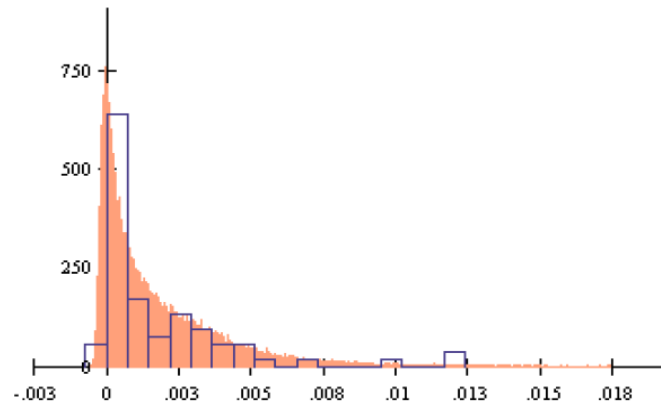
- In reality it is not simple to model each economy separately
  - Lack of data
  - Multiple assumptions (e.g. correlations, RMV's, CLR's))
  - Increased estimation error
- Two classes are modeled “High Risk” and “Medium Risk”
  - The table gives assumptions used for the subsequent studies
- Assumptions still must be made for,
  - the range of probabilities of credit events,
  - capital loss rates (CLR)
  - recovery of Market Value (RMV)

Sector	Country
High Risk	Greece
	Portugal
	Italy
	Spain
	Ireland
Medium Risk	Belgium
	France
	Austria
	Netherlands

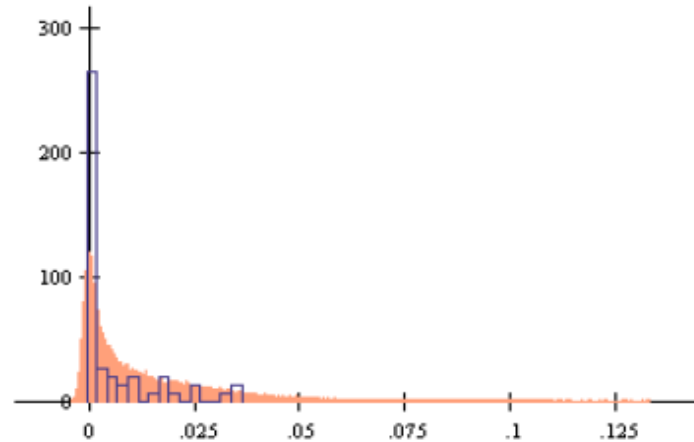


# Some Select Model Validation

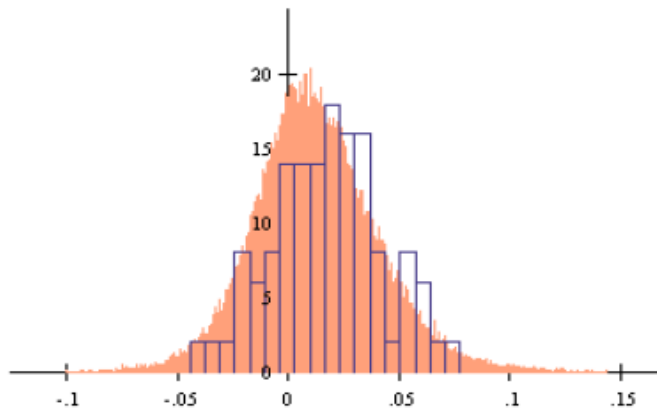
Medium Risk 6M Spread to Bund



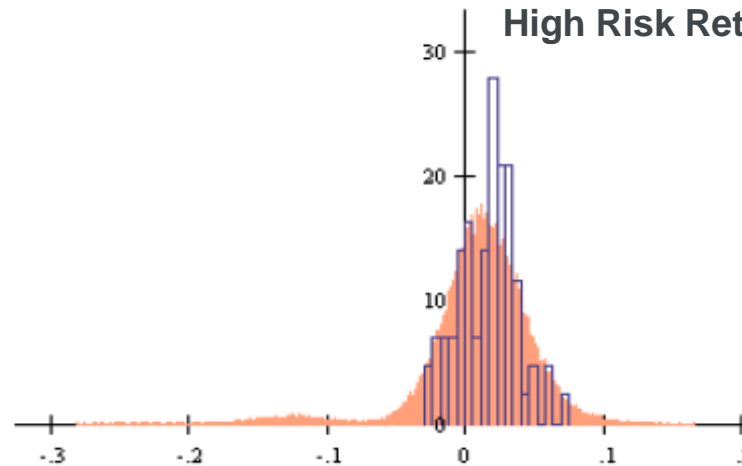
High Risk 1Y Spread to Bund



Medium Risk Return



High Risk Return



Source: Conning/Bloomberg



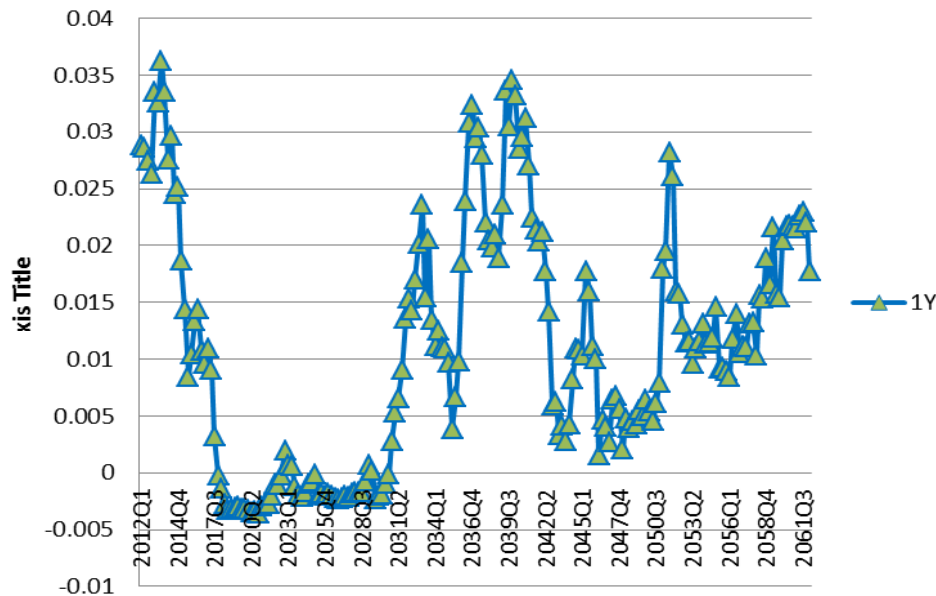
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# Sample Pathwise Spread Evolution

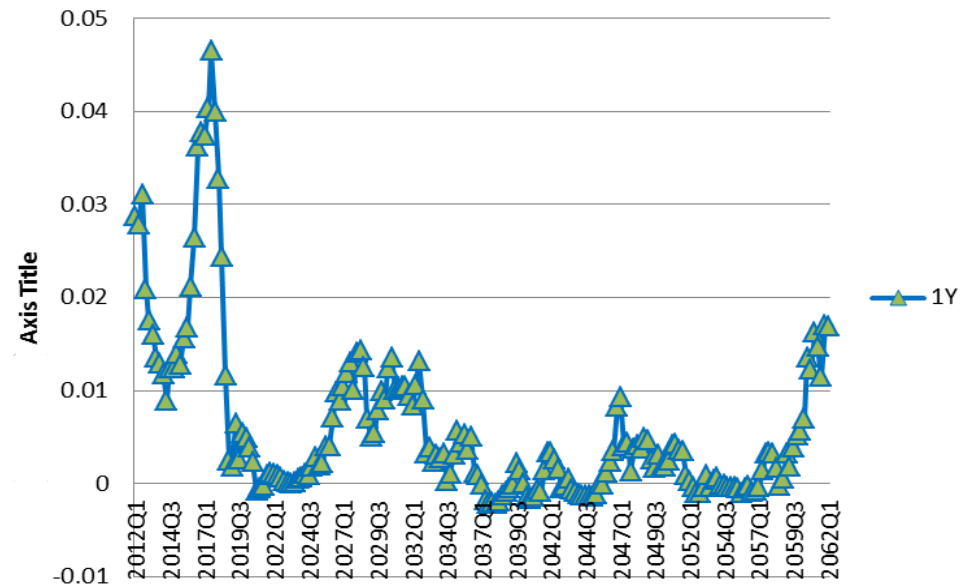
Inter Crises Lull and No Return to Pre Crisis Levels

Return to Pre Crises level for Extended Periods of Time

Spread Path 5



Spread Path 2



Source: Conning GEMS ESG

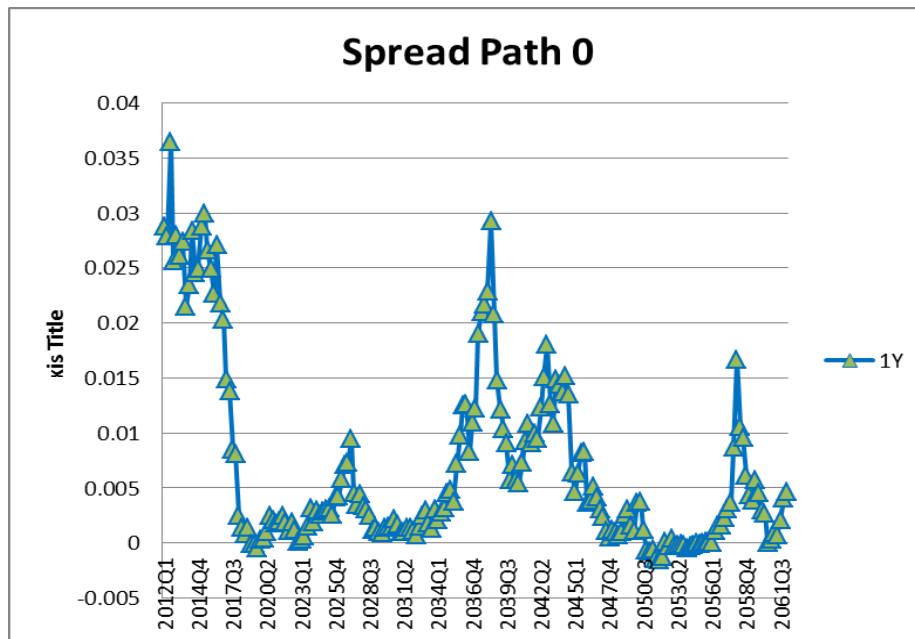


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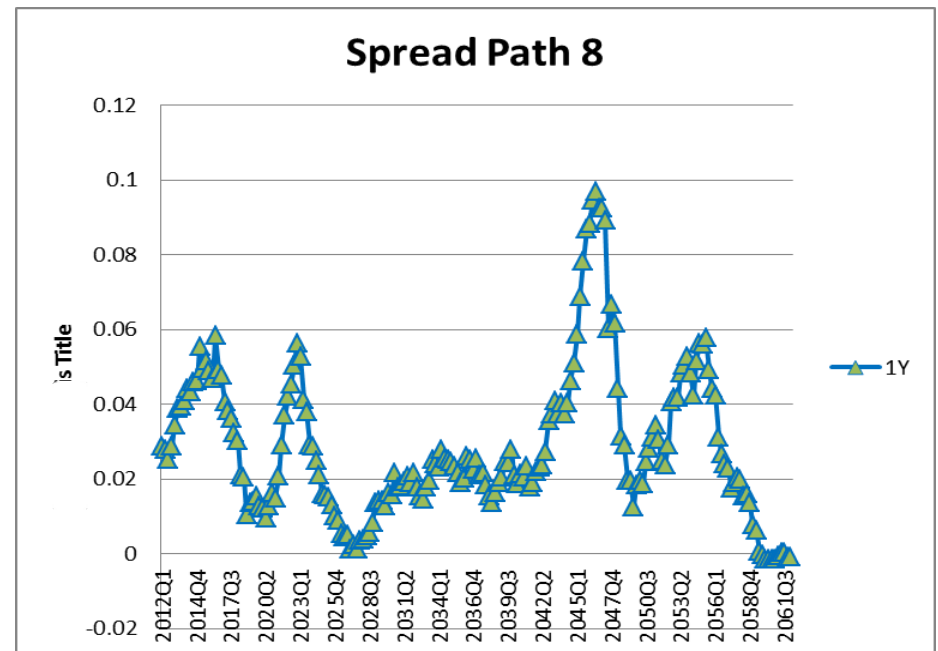


# Sample Pathwise Spread Evolution

Periodic Crises Followed by  
Return to Pre Crisis Levels



Record Crisis Spreads and High  
Default Rates



Source: Conning GEMS ESG



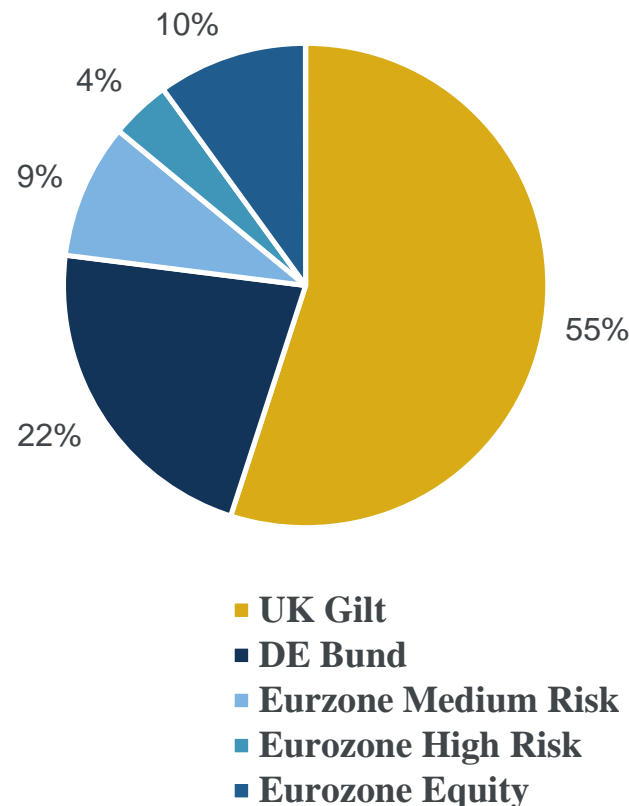
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# Does Modeling Approach Matter?

## Look at Several Portfolios:

- Start from universe of active bonds from UK, DE, ES, IT, GR, IE, AT, FR, NL, and BE (at 31/03/2013)
- Consider portfolios with modified durations from 3 to 10 years, initial value GBP 1bn
- Hold duration and asset allocation constant
- Model the Sovereign Debt 3 ways
  - Non Defaultable
  - AA or BBB Corporate
  - Defaultable Sovereign Model

Study Asset Allocation



# Other GEMS® Models Used for the Analysis

**Some other models incorporated into the GEMS ESG are used for this analysis**

- Non Defaultable Term Structure – 3 Factor Affine Model
- Equity – Stochastic Jump Diffusion Model
- Corporate Bonds – Reduced form Stochastic Spread Model with Jumps
- FX – Stochastic Volatility Model

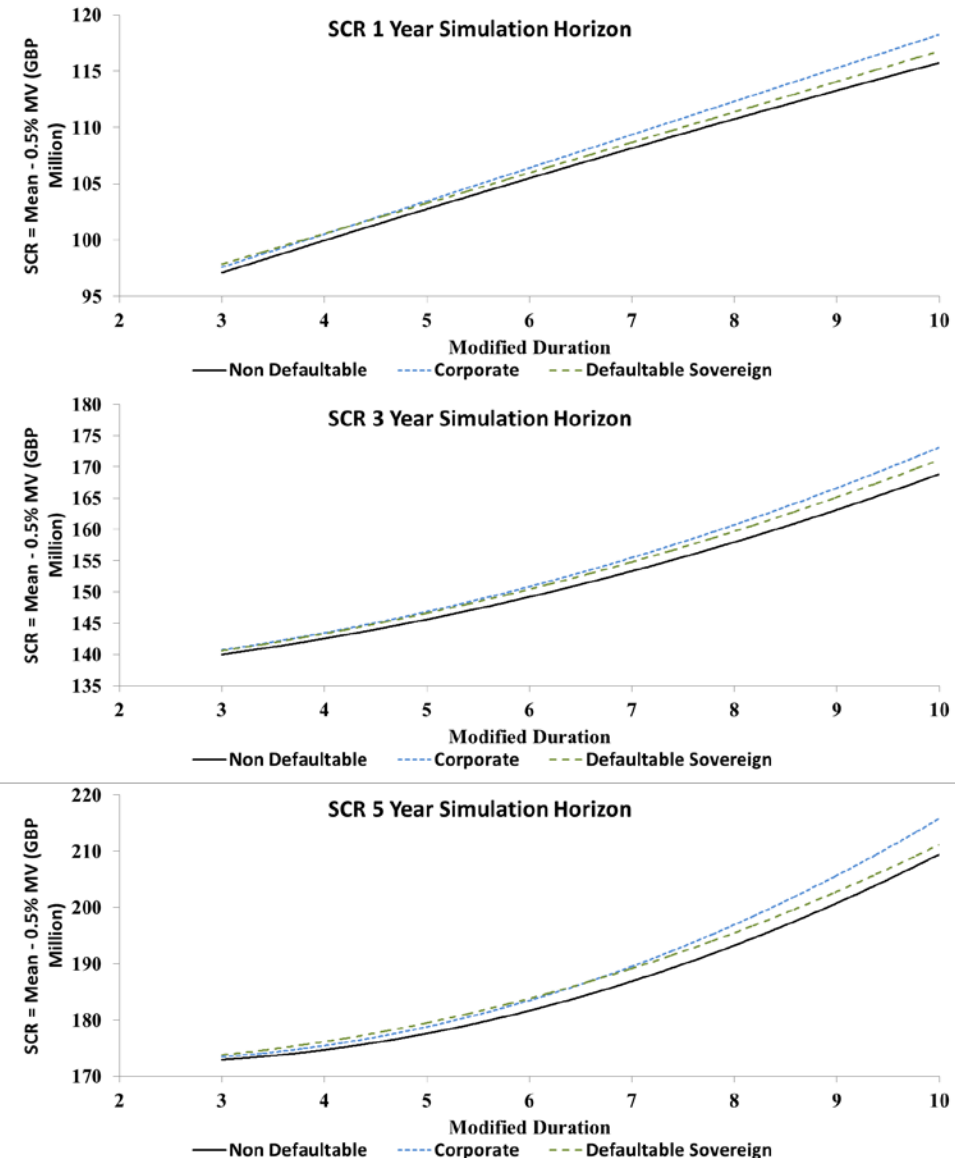


# Result

## Differences in cost of capital over 1, 3 and 5 year horizons:

- Low duration portfolios show the smallest differences (ca. GBP750k)
- As duration increases model selection is increasingly important (ca. GBP 1m)
- Corporate bond models generally overestimate the risk
- Non defaultable models underestimate it
- For longer time horizons some interesting features emerge

Source: Conning GEMS ESG

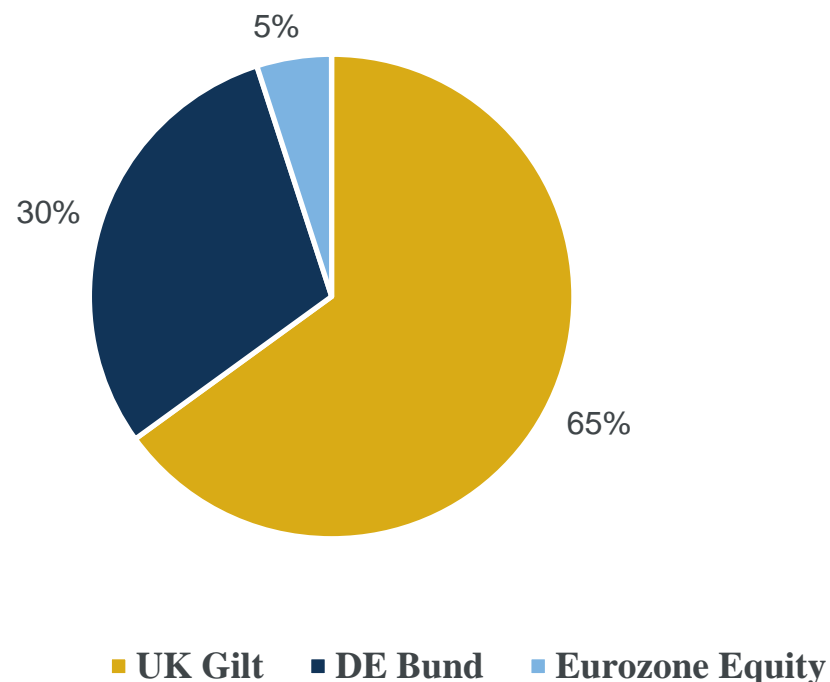


# Is it Worth Investing in Eurozone Sovereign Debt?

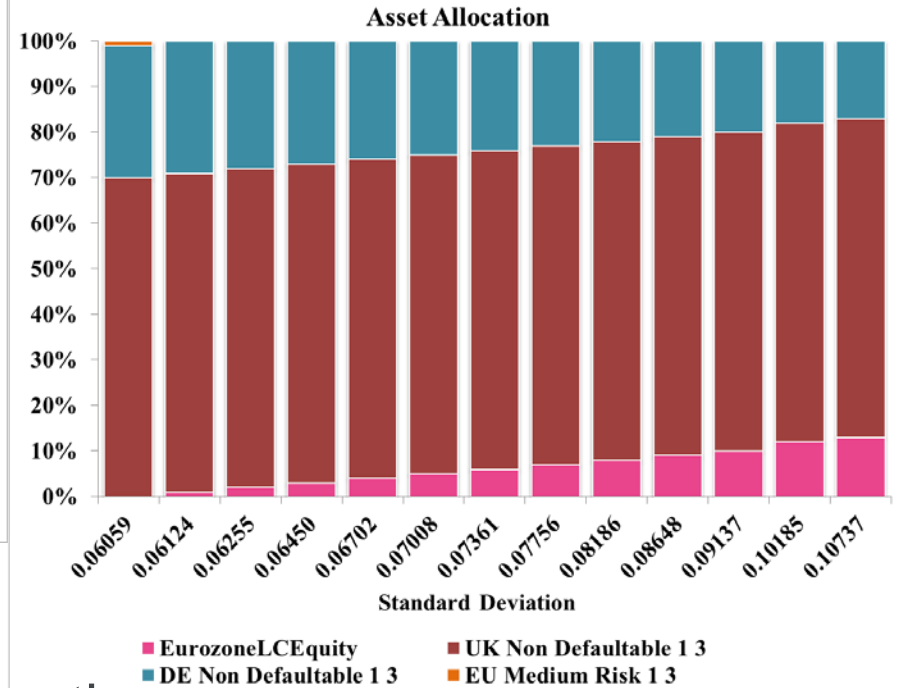
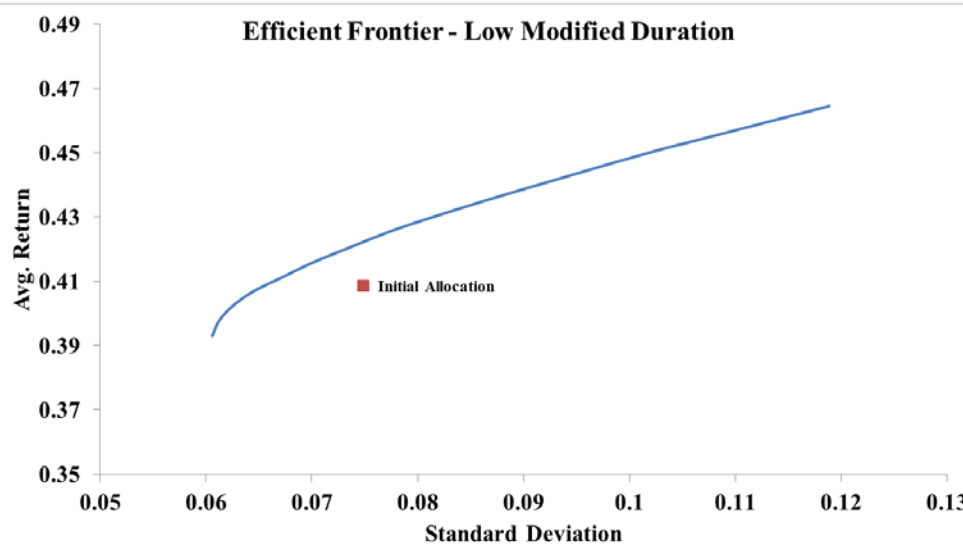
## Strategic Asset Allocation (SAA) Study:

- Start with a simple allocation
- Consider 3 duration strategies (Low (=1-3, medium=3-5, and high =6-8)
- Run an SAA optimisation (5 year horizon)
- Allow optimiser to allocate to both high and medium risk defaultable sovereign debt
  - Keep mean duration in initial target range

Initial Asset Allocation



# SAA Analysis – Low Duration



## Low Duration Strategy

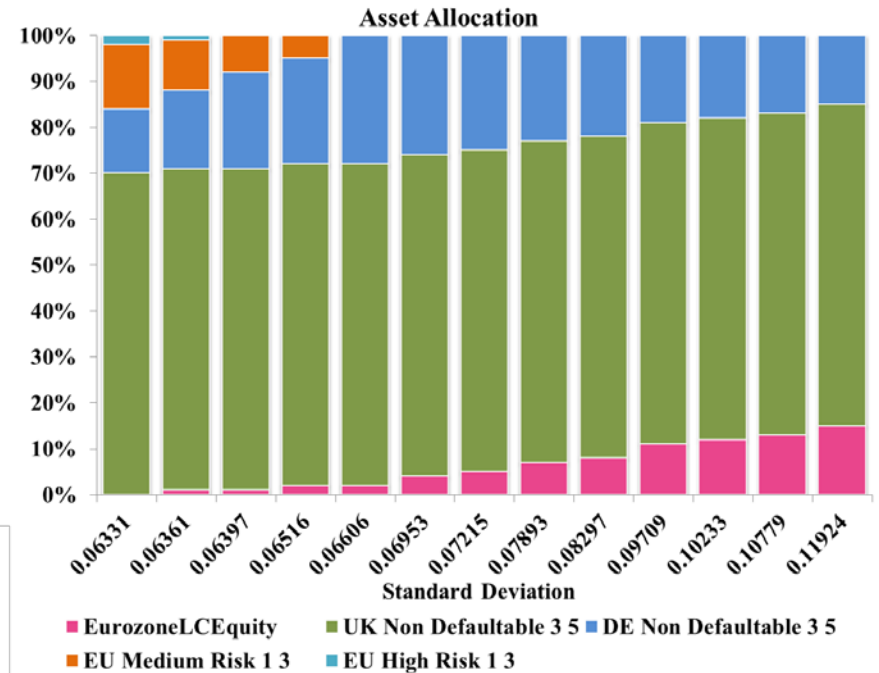
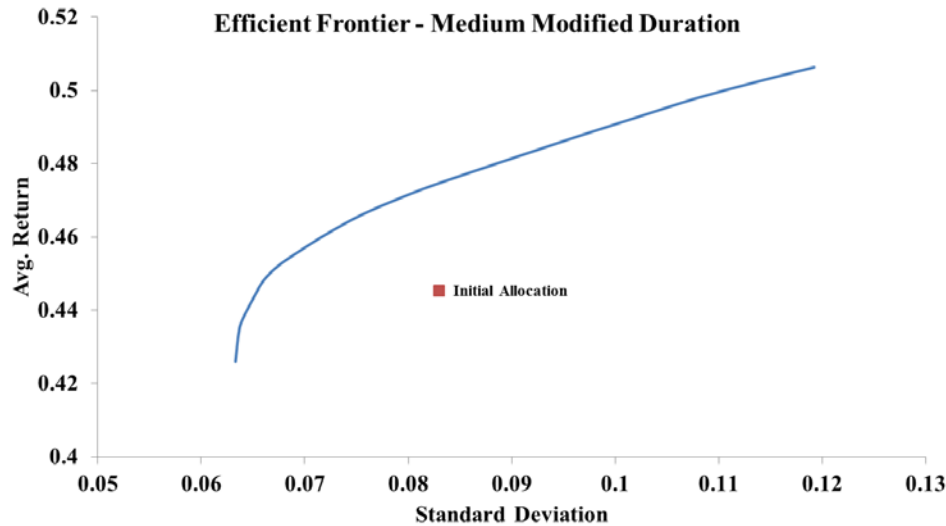
- Minimal advantage is gained by investing outside of non-defaultable
- In line with the previous study
- Equity diversifies more than Sovereign

Source: Conning RCMS



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# SAA Analysis – Medium Duration



## Medium Duration Strategy

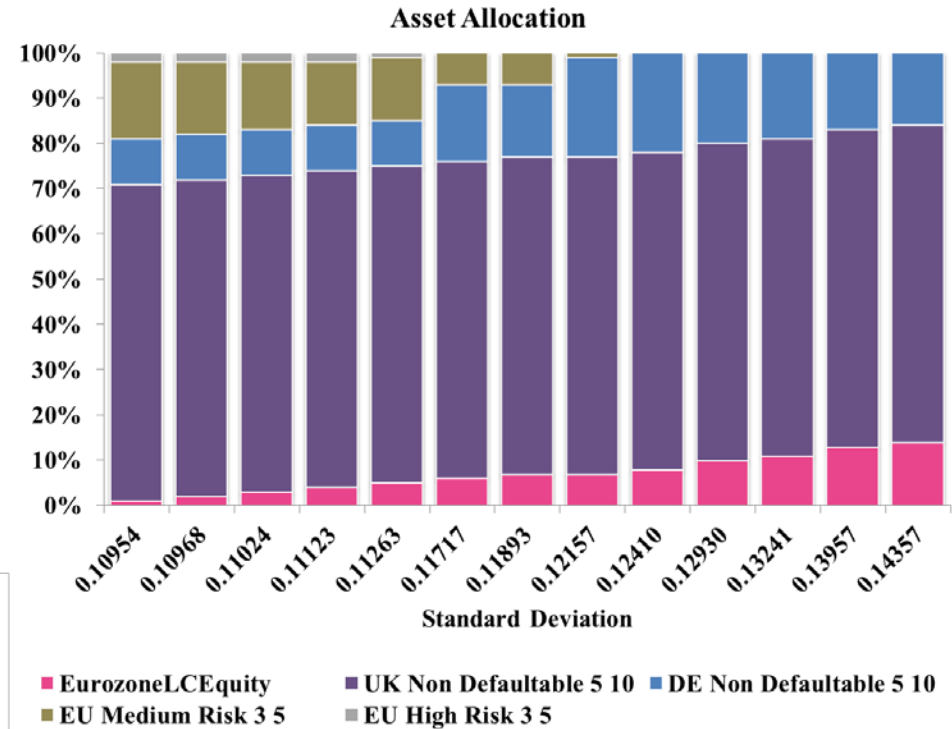
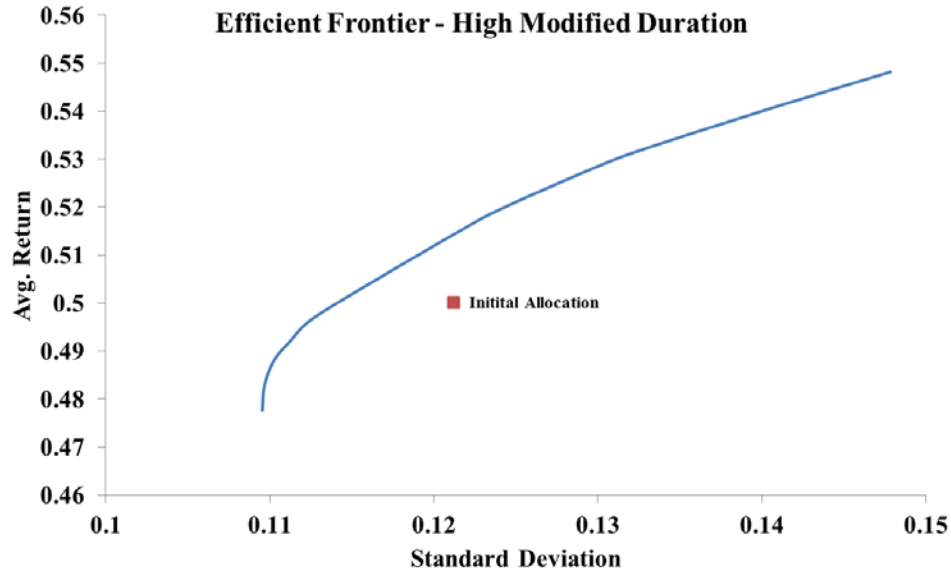
- Some additional yield gained by investing in both medium and high risk asset classes
- More interest rate risk to diversify as duration increases

Source: Conning RCMS



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# SAA Analysis – High Duration



Source: Conning RCMS

## High Duration Strategy:

- Some additional yield gained by investing in both medium and high risk asset classes



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# Summary

## **Sovereign debt has a credit risk component**

- Historical and recent history bears this out

## **Sovereign credit differs from corporate credit in a number of important ways**

- Return distributions – “loss tail hump”
- The precise details of future cash flows post credit events
- Spread behaviour – dormant/active “cycles”

## **Some aspects of a model incorporating these features were presented**



# Summary

## How important is model selection?

- Comparisons with other modelling approaches showed significant differences -> differences become larger with increasing duration

## Is it worth investing in defaultable sovereign debt?

- Model implies an allocation to medium risk issuers in some circumstances over the time horizon studied (5 years)
- Model implies little advantage in allocation to high risk issuers except for high duration investors

***Ultimately we should always aim to use the most realistic granular models, because the effect of model choice on risk measurement and investment strategy is not simple to estimate, and is not intuitive for multi asset class and currency applications***



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# Questions

# Comments

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The views expressed in this presentation are those of the presenter.



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