Linking Bond and Equity Risk

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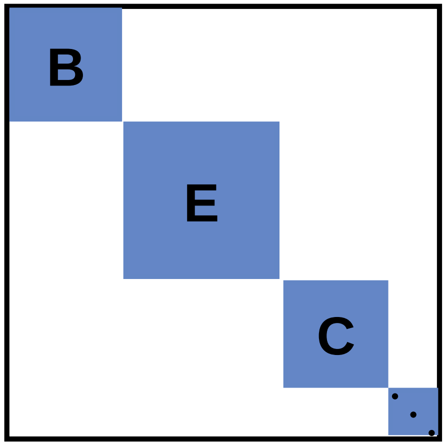
Multi-Asset Class Risk

- Glued together from disparate models
  - Bond models
  - Equity models
  - Commodity models

  …



- Factor blocks estimated from “simple” securities – as liquid and as “pure” as possible
- Complex securities can have exposures to multiple blocks

"Traditional" Interest Rates + Spreads Bond Model

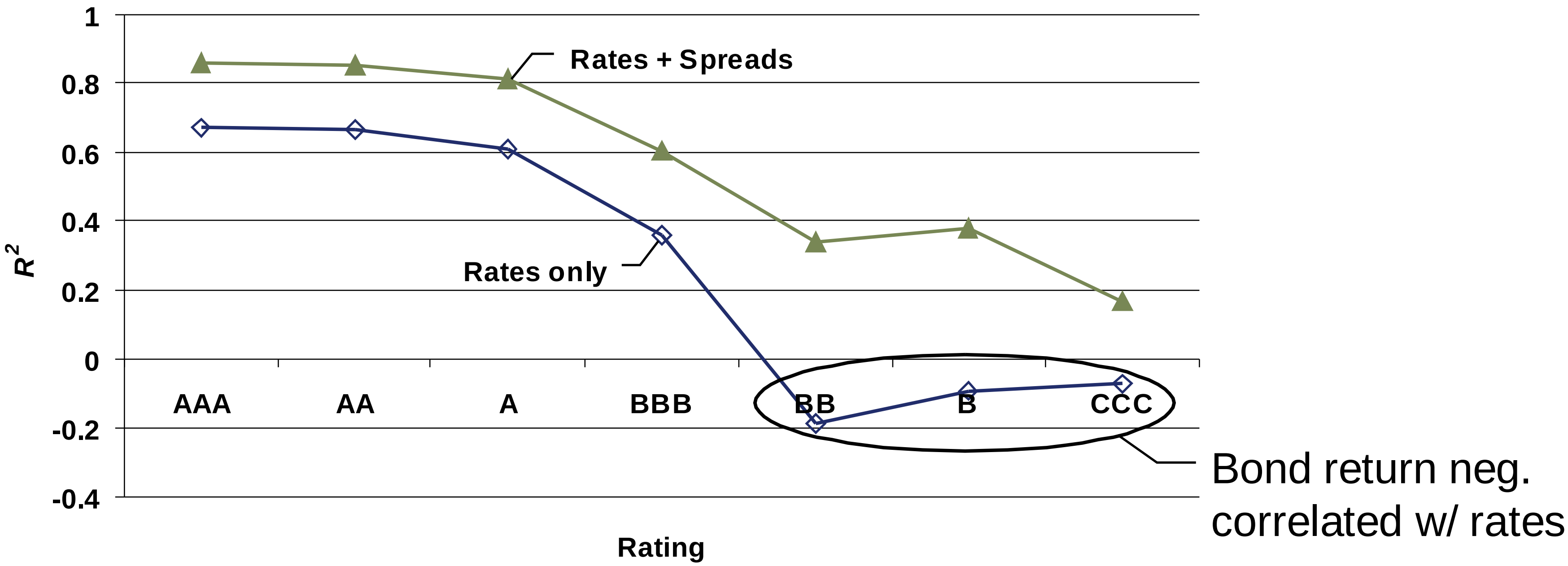
$$r^t_{Bond} = r^t_{GovBond} + (-D^{spd}_B)\Delta s^t_{Factor} + \varepsilon^t_{Bond}$$

spread duration

corporate bond return

default-free bond return

spread factor change



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Empirical Credit Risk

- Use equity returns to “explain” bond returns
- Use historical bond and equity returns to model linkage
- Use bond spread (OAS) to measure credit quality — depends only on market price data
  - Accounts for market “best guess”
  - Incorporates collateralization, seniority, recovery expectations, etc.
- Model of default and recovery rates not required

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Motivation

- Better identification of factors responsible for bond returns
  - Improved risk forecasting for bond, convert, balanced portfolios
  - Improved return attribution
- Better characterization of bond factor exposures
  - Convertible & high-yield bonds
  - Cap. structure arbitrage

Empirical Credit Risk – Model Structure

- Bond return attribution: $r^t_{Bond} = \beta_{IR} r^t_{GovBond} + \beta_E r^t_{Equity} + \varepsilon^t_{Bond}$

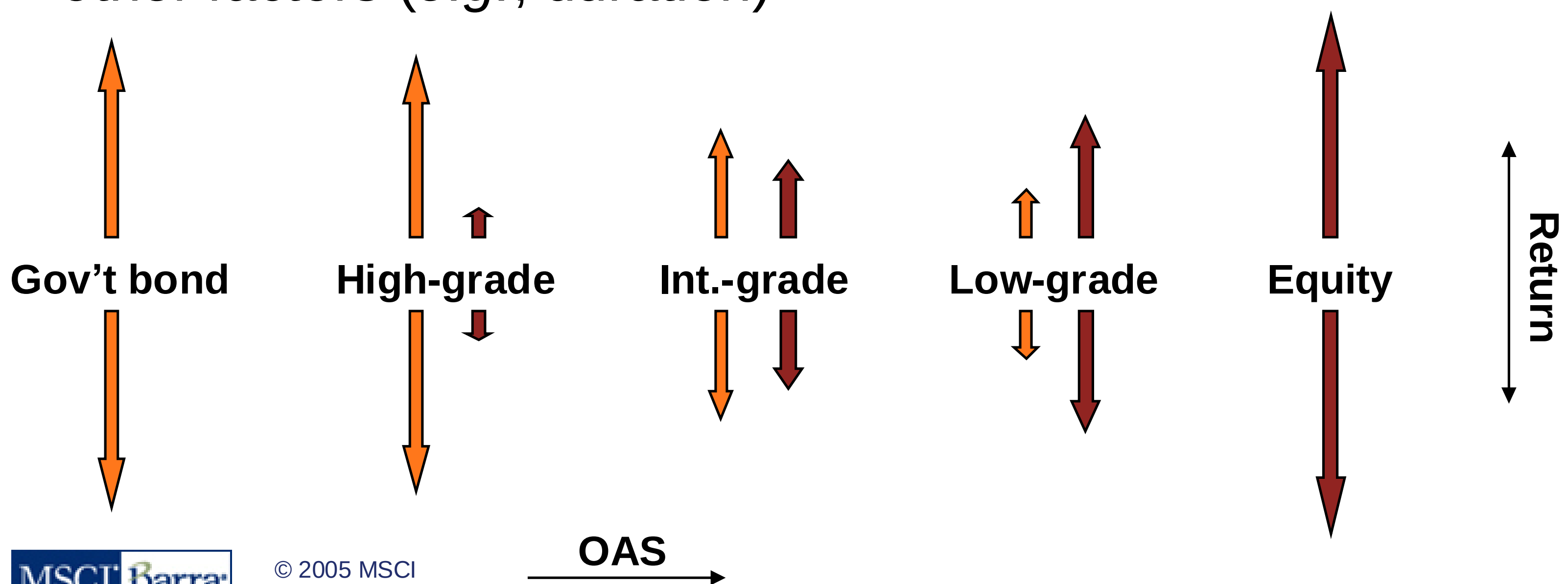
  bond excess return

  default-free bond return

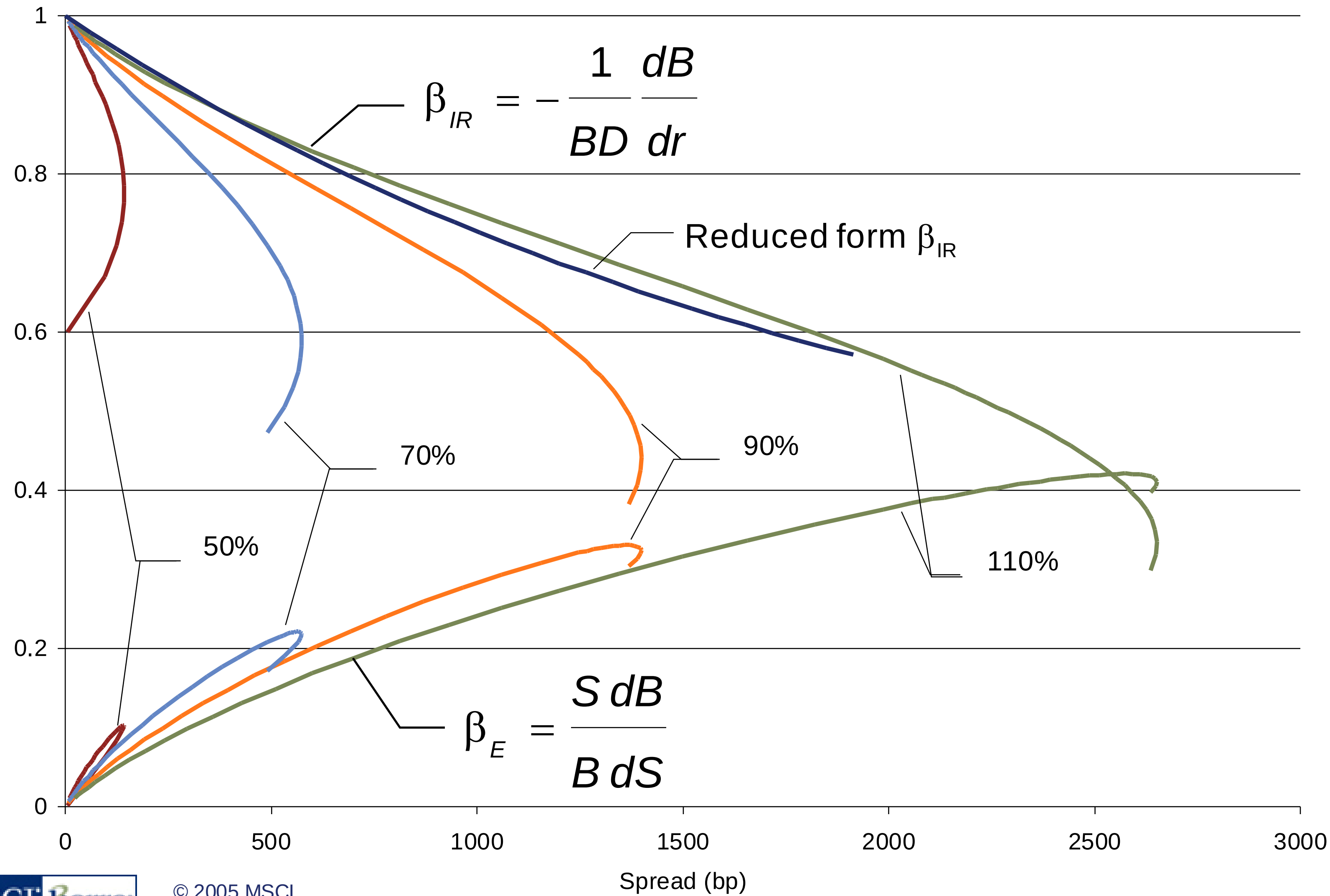
  equity return

  residual

- β_E and β_{IR} functions of spread (OAS) and possibly other factors (*e.g.*, duration)



Form of β 's in Merton Model



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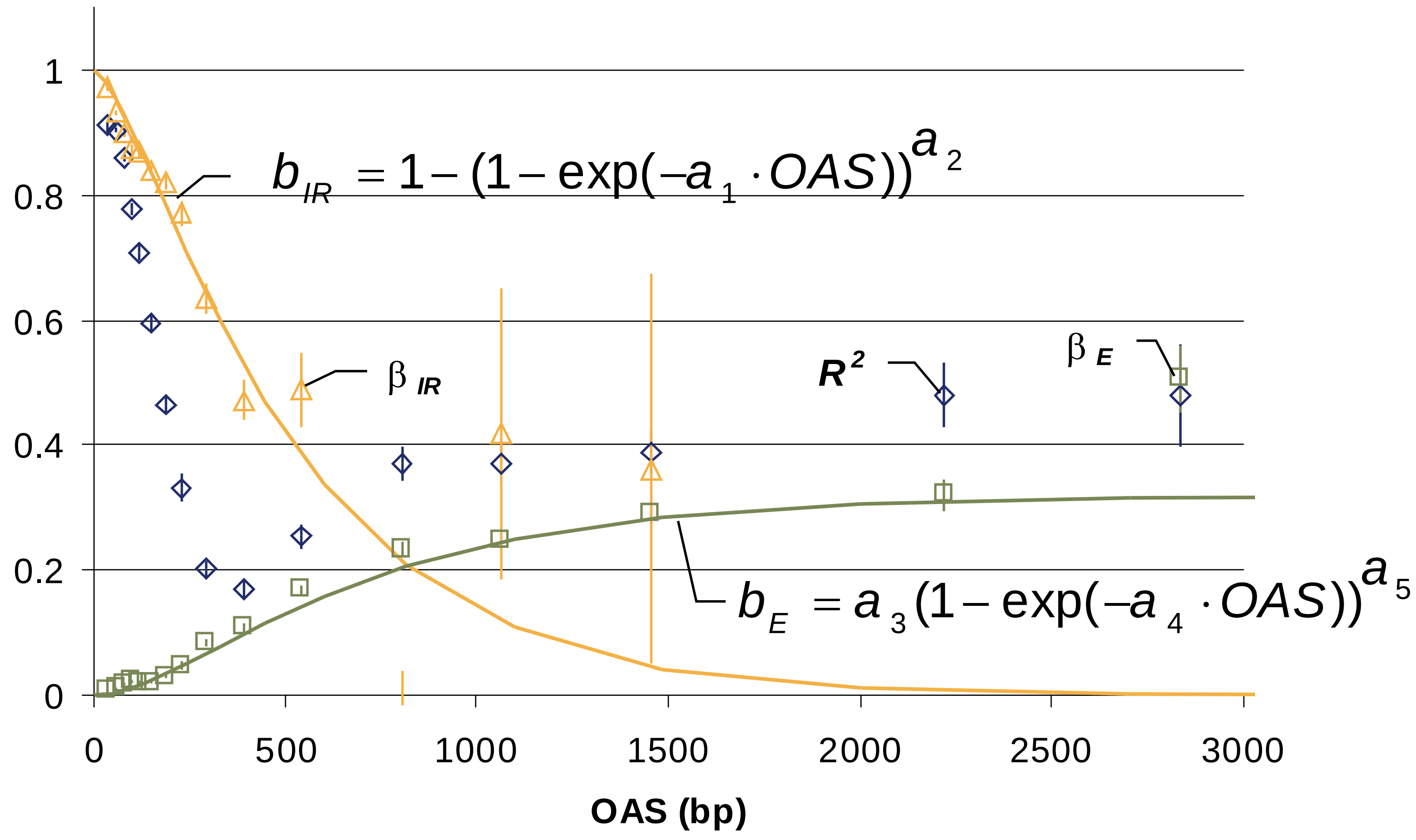
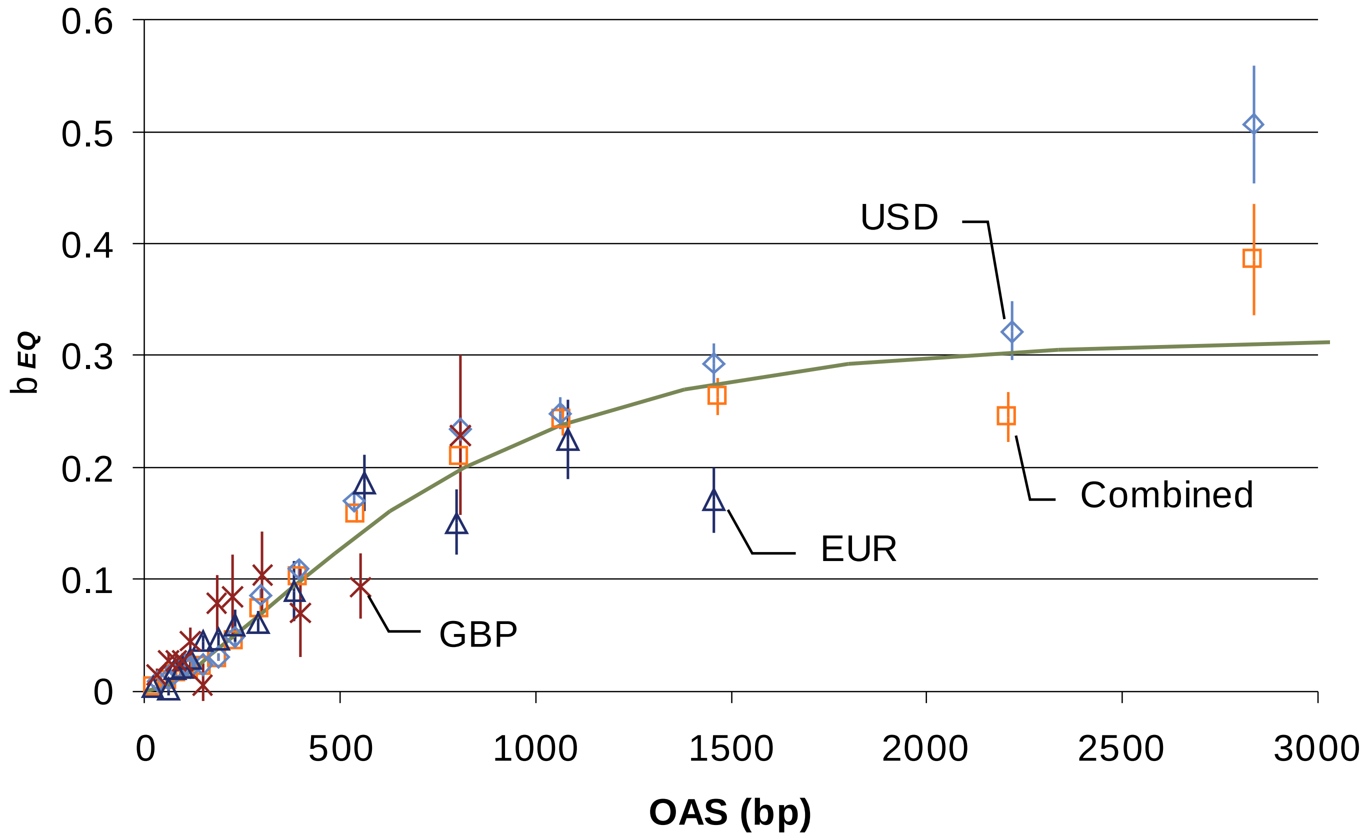
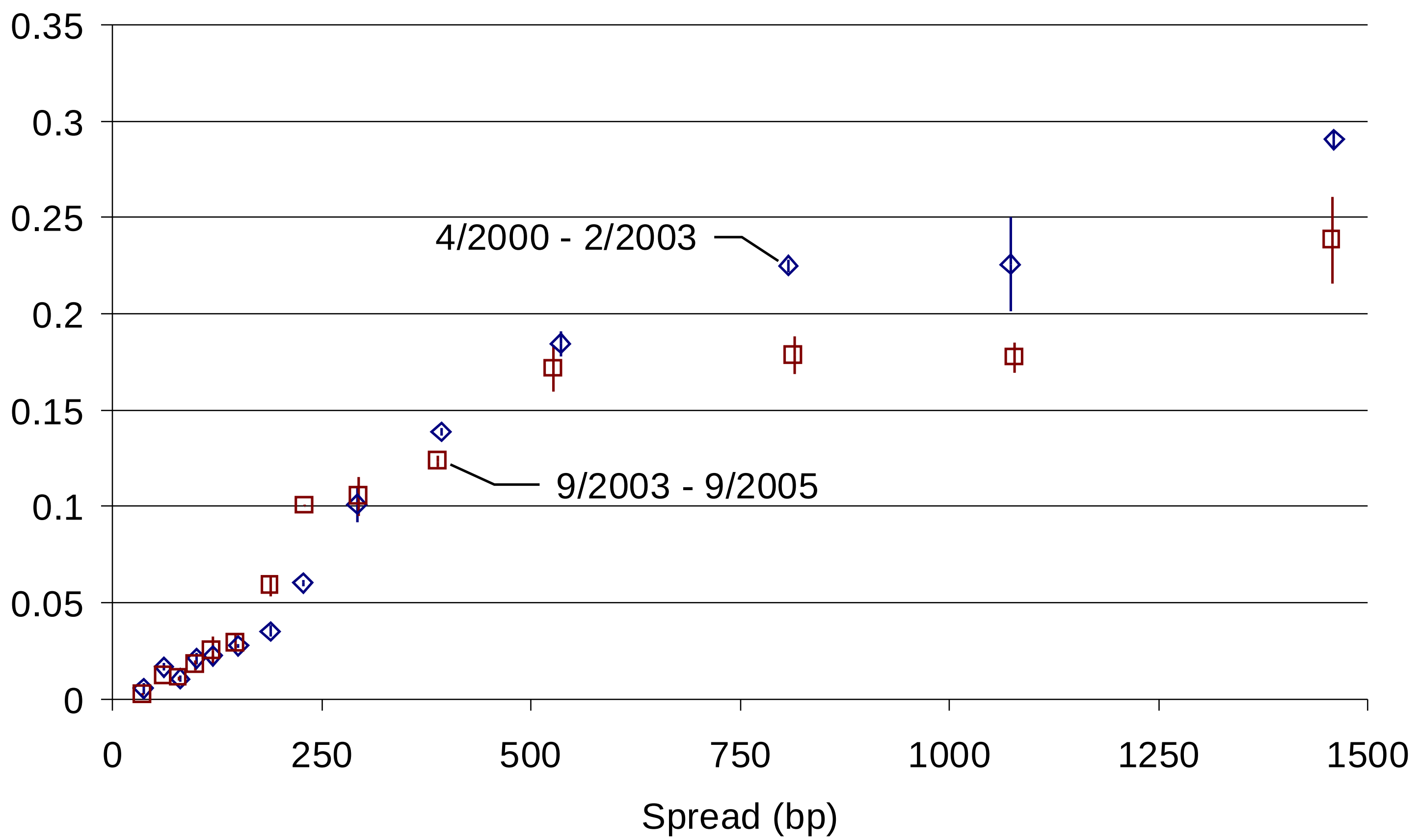
Aggregate Results (US)



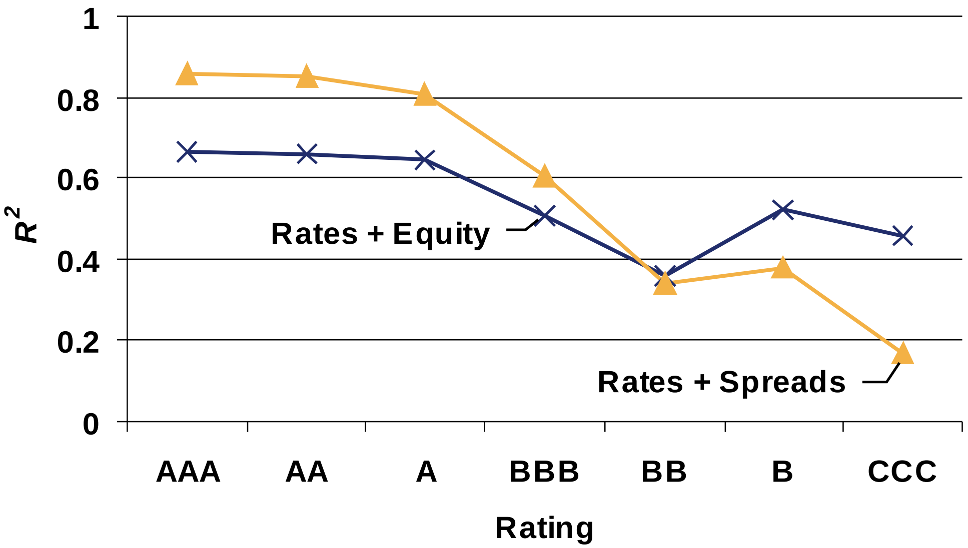
Cross-Market Comparison (US, UK, Euro)



Sample Period Dependence



Model of Residuals



- Spreads are explanatory in Rates + Spreads model
- Fit a sector/rating model to residuals

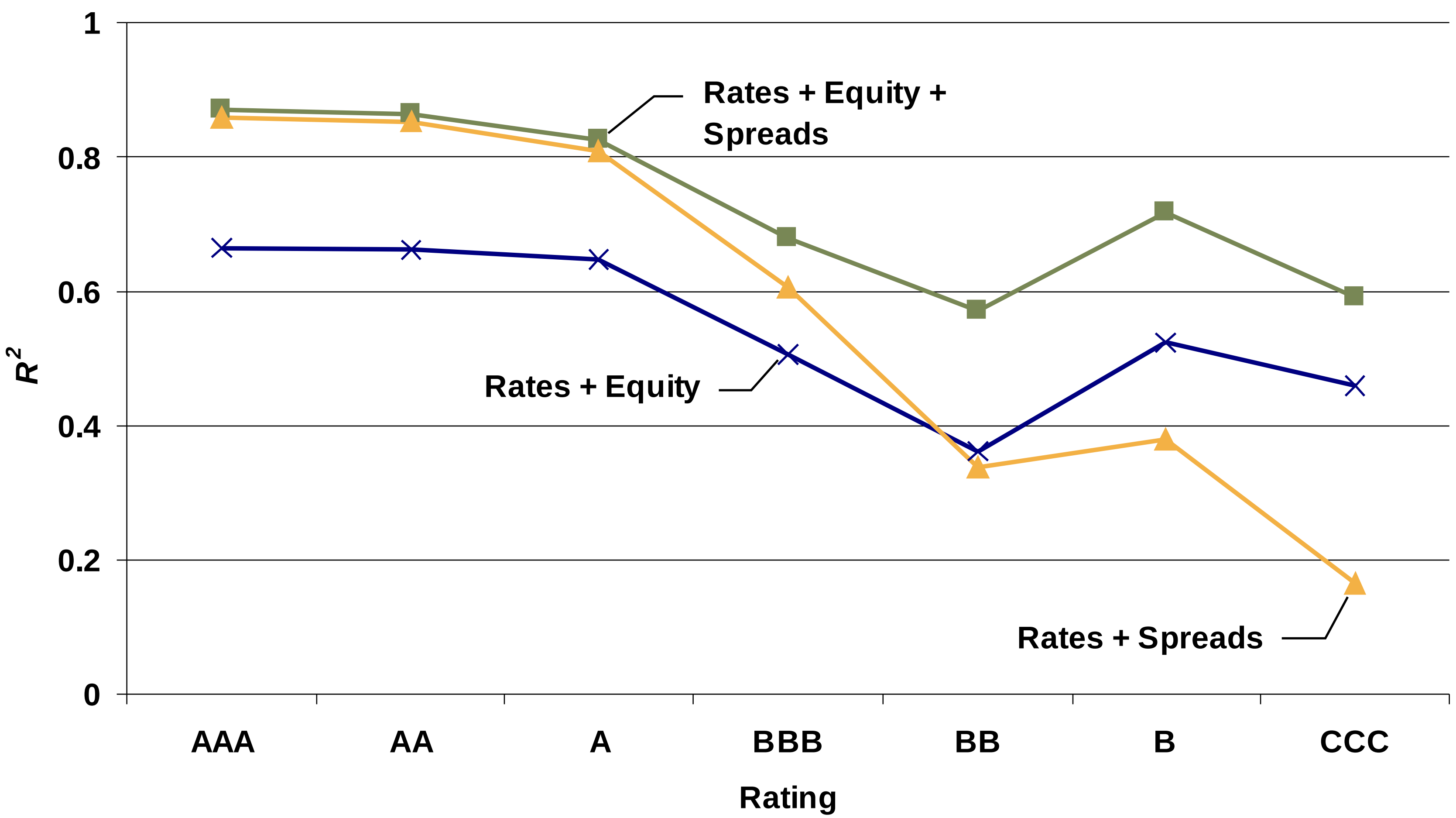
sector/rating spread change

$$r^t_{Bond} = \beta_{IR} r^t_{GovBond} + \beta_E r^t_{Equity} + (-D^{spd}_B)\Delta s^t_{Factor} + \eta^t_{Bond}$$

spread duration

remaining residual

R^2 with Equity Linkage
(US, 1/2000 – 10/2002)



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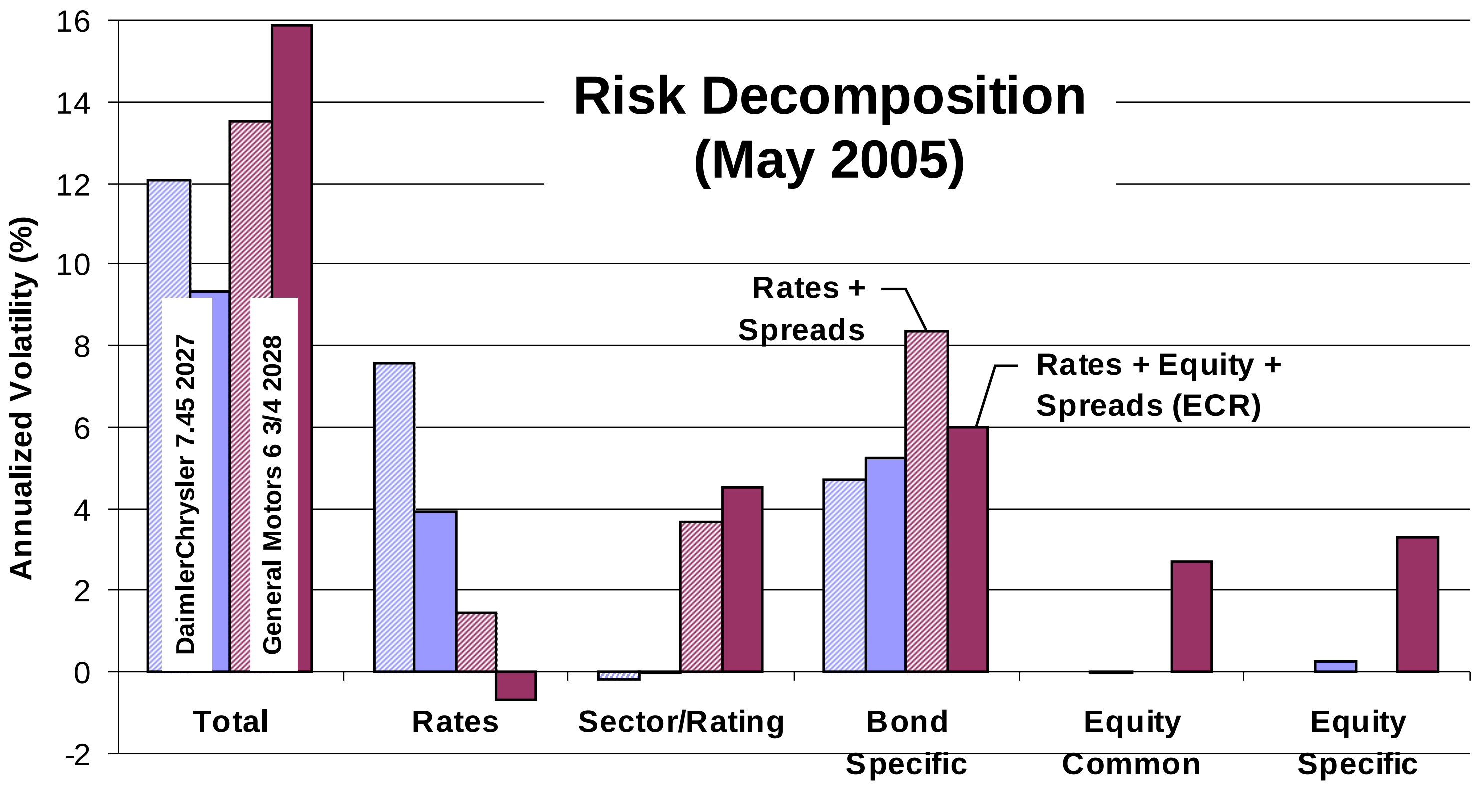
Applications

- Risk Analysis
- Hedging
- Scenario Analysis

Applications: Bond Risk Decomposition



Exposures	GM		Daimler	
	R+S	ECR	R+S	ECR
Int. Rate	8.99	3.82	10.53	7.71
Equity	0	0.23	0	0.09

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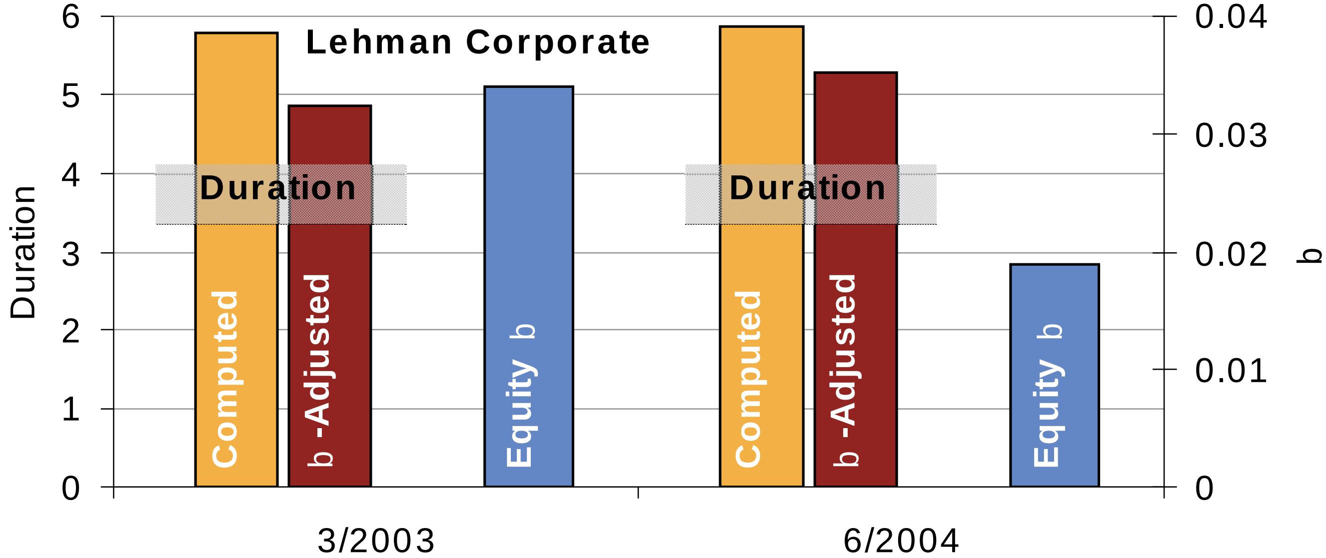
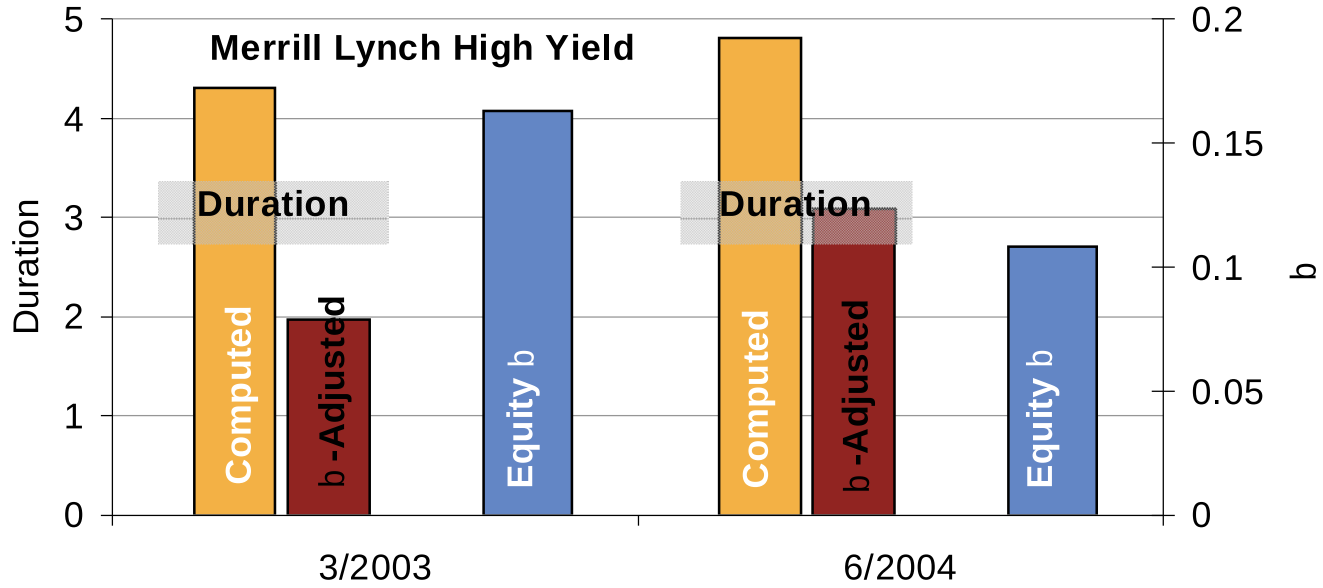
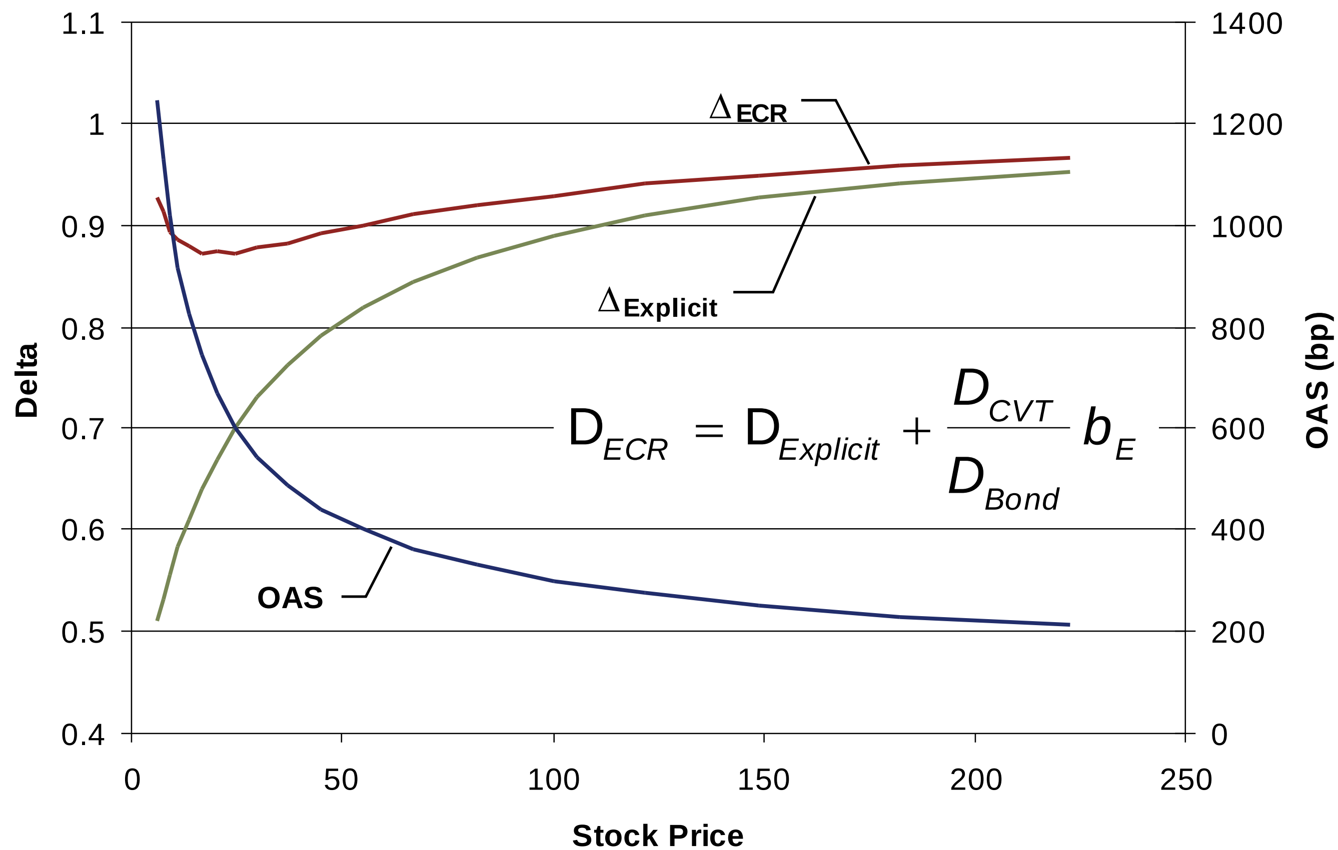
Applications: Portfolio Exposures





Applications: Convertible Bond Hedge



Assumptions:

- 50% equity vol
- 10 year maturity
- 10:1 conversion
- Convert any time

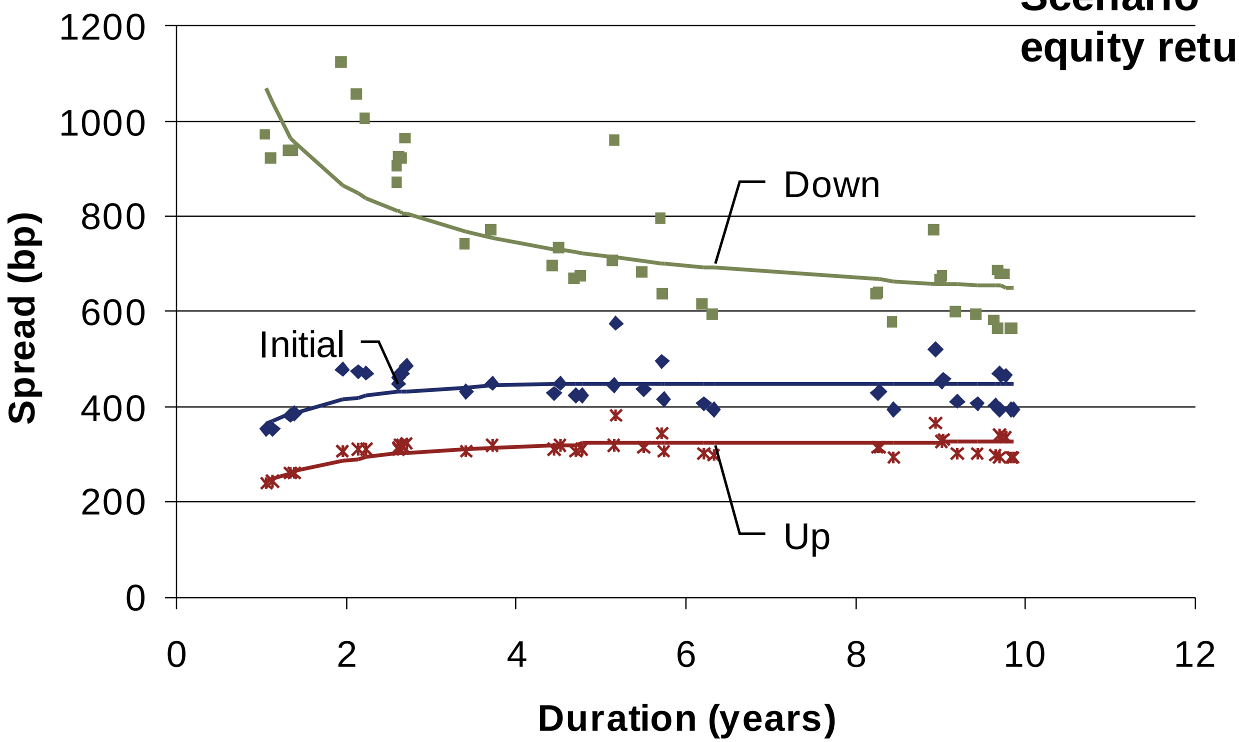
Applications: Scenario Analysis

- Equity Risk Implied Spread (ERIS): $r_E^* = -D \int_{s_i}^{s^*} \frac{ds}{b_E(s)}$

Scenario spread

Initial spread

Scenario equity return



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