A Cost of Capital Approach to Credit and Liquidity Spreads

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Introduction

- Apply cost of capital concepts to credit risk issues
- Key Application: better understanding of how credit spreads should, or should not, apply to valuing long life insurance liabilities
- Process:
  - Start with a best estimate (it's wrong)
  - Hold Capital for risk model is wrong in short run
  - Hold Capital for risk best estimate is wrong
  - Risk Margins calculated as PV Cost of Capital
  - Cost of Capital rate itself allowed to be stochastic

Introduction – Motivating Questions

- Should credit spreads, of any kind, be applied to compute fair value of life insurance contracts?
  - Issue has been debated for 20+ years
  - Solvency II answer: take credit for “liquidity component” of observed credit spread
- Does “traditional” actuarial model give you the right answer?
- E.g. Gross Credit Spread – expected default costs
- – cost of regulatory capital = free money
- How do we handle “Flight to quality” issues?

Key Risk Management Conclusions

- Model decomposes forward default rates into sum of

1. Best Estimate default cost
2. Spread for contagion (short term) risk
3. Spread for assumption change risk (liquidity)
4. Stochastic Spread

Paper argues items (1,3,4) should apply to life insurance liabilities

Introduction – Paper's Structure

- Introduction
- Two state model – develops main ideas and conclusions
- Multi-State Model – does enough work to show that concepts don't change (the numbers do !)

- Out of Scope (space and time limitations)
  - Calibrating the model to real data
  - Detailed comparison with Solvency II approach to liquidity spreads for insurance liabilities

Two State Model (1)

- Context: Market Value Accounting Model
- Risk Free forward discount rate(s) r

- Bond is either alive or in default (dead)
- Best Estimate Default rate $\mu_0 = 50\ bp$
  - Recovery rate $R = 50\%$
  - Net Default Cost = $(1 - R)\ \mu_0 = 25\ bp$

  - Best Estimate Value of Bond

    = PV Cash Flow using $[r + (1 - R)\ \mu_0]$

Two State Model (2)

- Contagion (short term risk or credit crunch)
  - Hold capital for scenario where $n = 4$ years worth of expected default costs happen overnight.

$$\text{Capital} = n(1 - R)\ \mu_0 \times \text{Value of Bond}$$

  - If cost of capital rate is $\pi = 10\%$ then risk adjusted net default rate is

$$\mu = (1 - R)\ \mu_0(1 + n\pi) = 35\ bp$$

  - An example of a *static* risk loading

Two State Model (3)

- Parameter risk: What if new information arrives that suggests $\mu_0 \rightarrow \mu_0 + \Delta\mu$
- Should hold economic capital for change in fair value

$$Capital = V - \hat{V}$$

- Poses some technical conundrums (circularity)
- Solution is to use idea of a dynamic margin

Two State Model (4)

- Solution is to use the idea of a dynamic margin
- A financial engineering concept
- Margin variable β that is zero in the real world
- Risk loaded default rate for fair value V

$$(1-R)[\ \mu_0 + n\pi\mu_0 + \beta\Delta\mu]$$

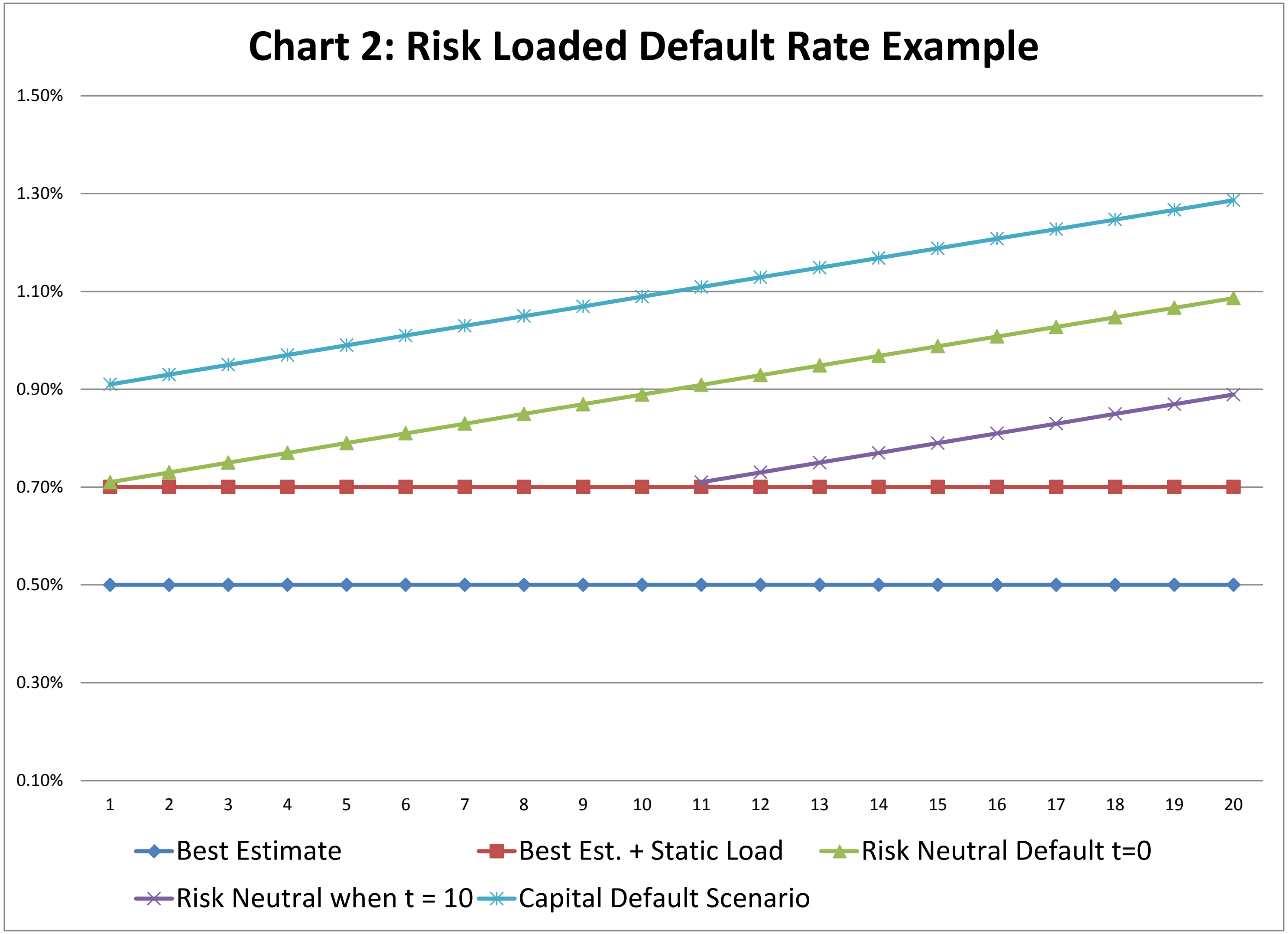
- For shocked value $\hat{V}$ use

$$(1-R)[\ \mu_0 + \Delta\mu + n\pi\mu_0 + \beta\Delta\mu]$$

- Margin variable dynamic $d\beta = [\pi - \beta\Delta\mu(1-R)]dt$

- For technical details see the paper

Two State Model (5)



Two State Model (6)

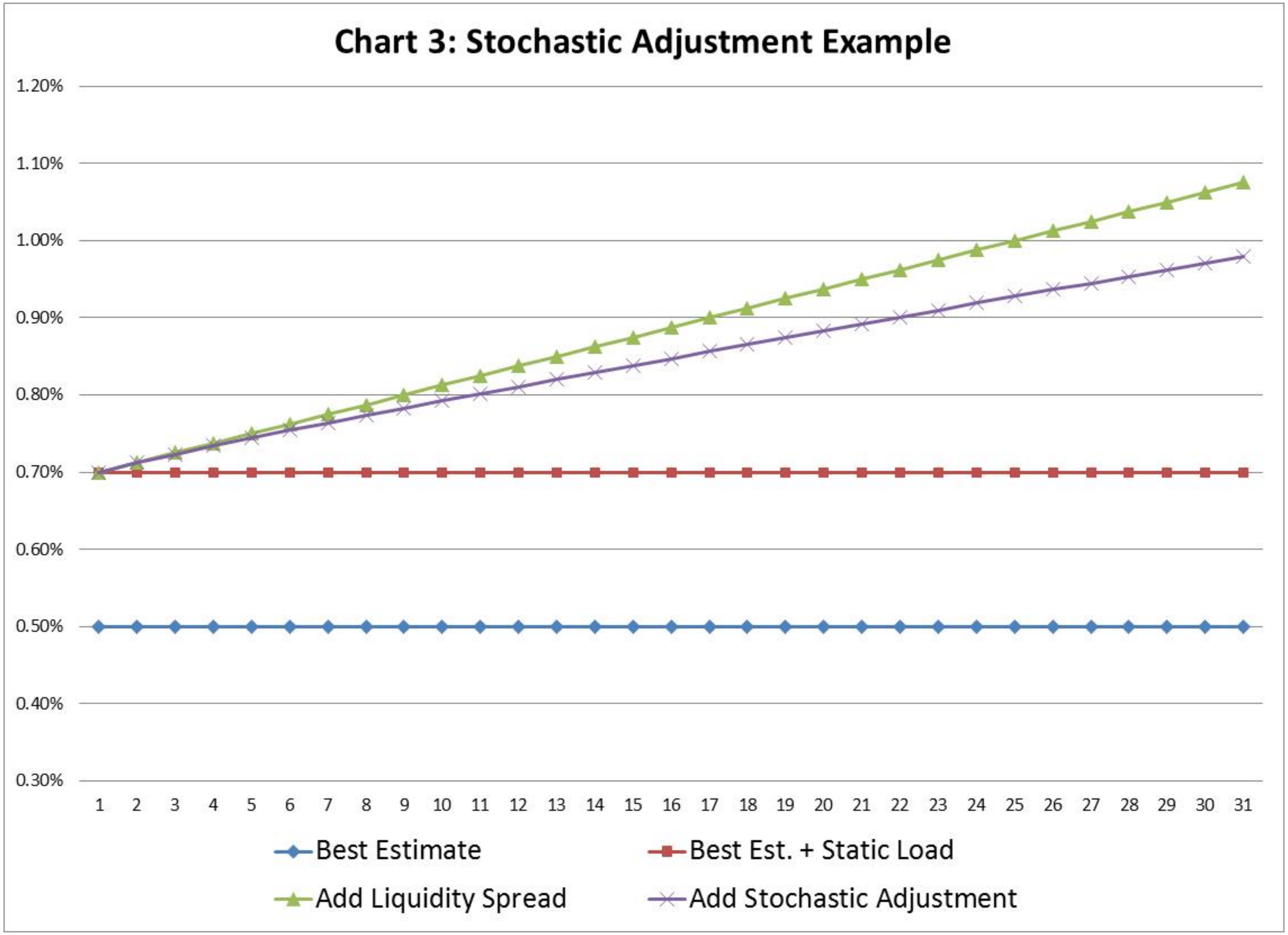
- Key subjective idea:
- Size of the parameter shock $\Delta\mu$ can capture "liquidity" issues
- Two bonds with the same best estimate and contagion default assumptions can have different values because they have different $\Delta\mu$

- Very liquid bonds have small $\Delta\mu$
- Illiquid bonds have large $\Delta\mu$
- In some models Treasury bonds could have $\Delta\mu < 0$

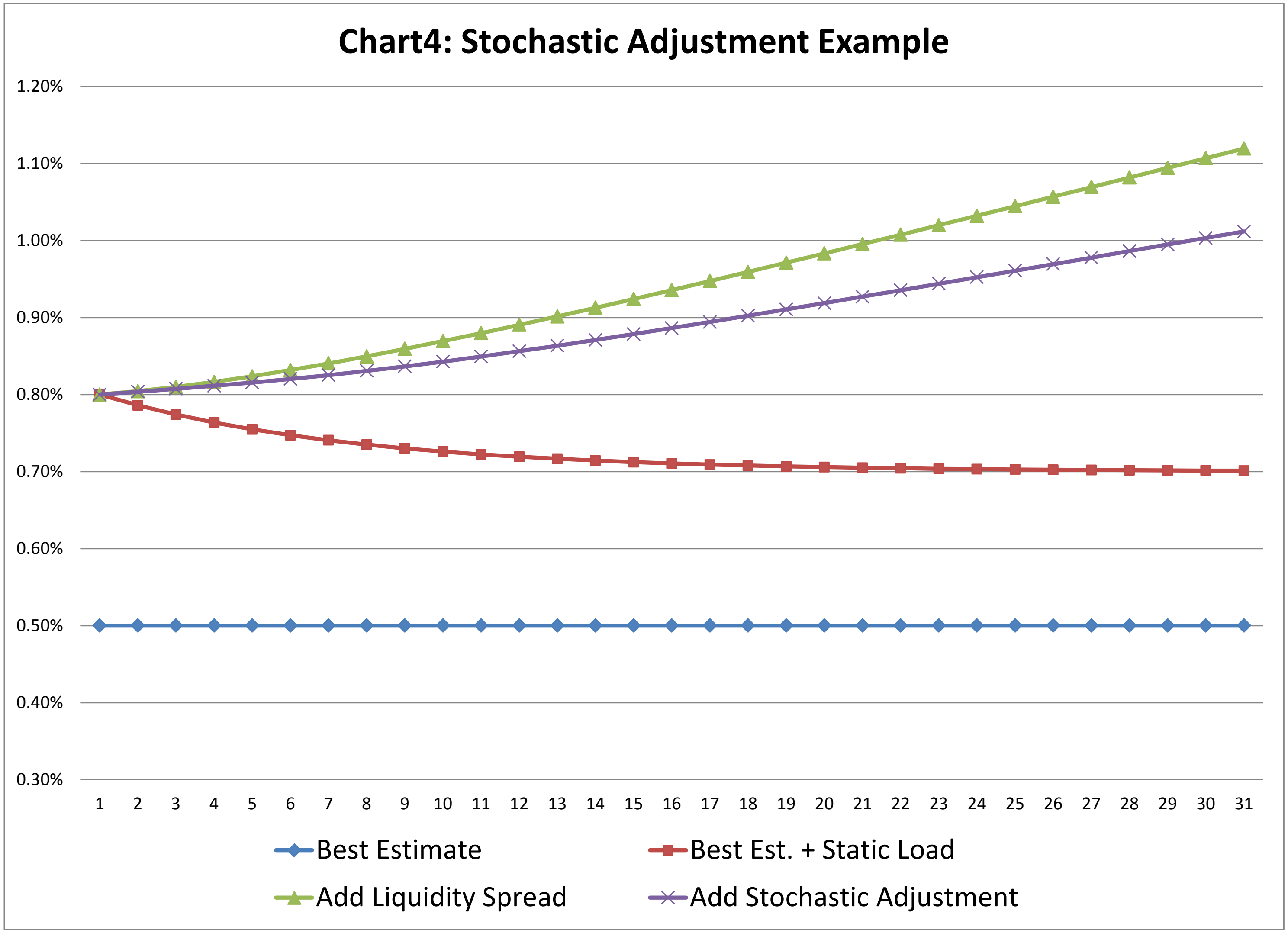
Two State Model (7)

- Who said $\pi = 10\%$ was the right answer?
- Can capture "flight to quality" issues by allowing cost of capital rate itself to be stochastic
- Many models within the "affine jump diffusion" family
- Paper develops example where π follows a Cox, Ingersoll & Ross process

Two State Model (8)



Two State Model



Multi-State Model(s)

- Simple two state model can be generalized in many different ways
- Paper shows we can go to a full multi-state model and still stay within the affine jump diffusion family
- Details omitted from this presentation

Key Risk Management Conclusions - 1

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Key Risk Management Conclusions - 2

- Once you accept the previous conclusions
  - It is possible to hedge issues like changing market sentiment by matching a long liability's capital duration to the corresponding sensitivity on the asset side of the balance sheet
  - Major remaining un-hedged risks are
    - Credit risk contagion
    - Mismatch (in a larger sense)

- End up closer to the "traditional" actuarial model than I thought possible