VaR for fixed income portfolios

*interest rate risk and credit risk*

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IGIDR

Bombay
Our goal

- There are portfolios of bonds which contain interest rate risk and credit risk.
- We will pretend there are no loans - everything is a security.
- How do we get to some VaR-type notions?
Basle 2 seeks to move away from simplistic linear thumb-rules.

It wants banks to build sophisticated models which generate VaR estimates.

In the future, we hope that equity capital requirements will be computed out of these internal models.
Fixed income
Fixed income VaR

- The yield curve fluctuates - this generates price risk for every fixed income portfolio.
- We seek statements like “VaR for the portfolio at a 99% level on a one-day horizon”.
- This is the rupee loss which will be exceeded tomorrow with a 1% probability.
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Fixed income VaR

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- So we get 10,000 outcomes for the profit/loss on the portfolio on a one-day horizon. Read off the 100th worst loss after sorting these 10,000 numbers. This is easy.
Problems in modelling

- Interest rates in India gradually became market determined from 1993 onwards.
- New work on zero coupon yield curve (Thomas & Saple, 2000; Darbha, Roy, Pawaskar, 2002).
- The zero coupon yield curve database is only from 1/1/1997 onwards.
- Extremely little research on the subject - less than five papers currently exist.
- Engineering applications can happen after the science is ready.
Difficulties in testing

- VaR methodologies must be backed by testing.
- Banking applications require VaR over long horizons.
- Here the tests of VaR are particularly weak.
- Data in India is weak.
- We should be careful in knowing what we do not know.
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Reprice the full portfolio at each of these draws. BIS suggests we should do profit/loss of the 99th percentile shock, not the 99th percentile of the profit/loss. This is very crude, when compared with VaR, but it's better than nothing.
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Implementation of the BIS proposal

- Existing data resources in India do support implementation of the BIS proposal.
- The 99th percentile of one-year changes in the ten-year rate in the NSE zero coupon yield curve dataset proves to be 320 bps.
- Re-express bonds as cashflows, and simulate a 320 bps shock,
- Measure the loss as percent of equity capital.
From Patnaik & Shah, 2002:

Impact upon equity capital of 320 bps shock.
Fixed income derivatives

- So far we have only talked about bonds. What about interest rate futures, interest rate options?

- Jayanth Varma’s *Risk Management Committee* has worked on models for computing VaR on a one-day horizon. See committee report on the SEBI website.

- This is fundamentally easier, since we seek only a one-day horizon, not a one-year horizon.

- Committee observes lack of scientific knowledge, but is confident about conservative approximations.

- This work will drive collateral requirements for interest rate futures and options.
With the zero coupon yield curve, we can now start thinking about interest rate risk. (Thomas & Saple, 2000; Darbha, Roy, Pawaskar, 2002). Darbha et. al. have some work on EVT-approaches to fixed income VaR.

We know a bit about VaR on a one-day horizon - can even handle interest rate futures and options. (Jayanth Varma’s report).

We know less about VaR on a one-year horizon (BIS proposals, Patnaik & Shah, 2002).
Credit risk
Credit risk requires three steps

- **What is the failure probability of a bond?**
  This is about predicting default.
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- **How much risk premium to charge? How do we put the pieces together to think about portfolio VaR?**
  This has logic like the CAPM - betas, systematic risk.

  What you can’t diversify has to be priced over and above simple risk-neutral reasoning.
## Situation in India

<table>
<thead>
<tr>
<th>Problem</th>
<th>What we know</th>
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<tbody>
<tr>
<td>Failure of a bond</td>
<td>Quite a bit</td>
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<tr>
<td>Loss given default</td>
<td>Little</td>
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<td>Portfolio credit risk</td>
<td>Very little</td>
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## Progress on modeling failure of one firm

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Further reading


MANDIRA SARMA, SUSAN THOMAS, and AJAY SHAH. “Selection of Value at Risk models.” Journal of Forecasting (forthcoming 2002)
Zero coupon yield curve


Recent work on fixed income VaR


- Jayanth Varma’s committee report on interest rate derivatives - came up on SEBI website on 19/3/2003.
Credit risk

- CMIE Prowess manuals.
