Corporate Defaults and Large Macroeconomic Shocks

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Corporate Defaults and Large Macroeconomic Shocks

- Do non-linearities matter for credit risk?
  - Is the impact proportional to the shock size?
  - Is the impact symmetric in the sing of the shock?
  - Is the impact independent of initial conditions?
- Does estimation uncertainty matter for credit risk?
  - In some settings upper confidence intervals might matter
- Why is this interesting?
  - Stress testing → forecast of severe but plausible shock
  - Capital setting
  - Pricing

Why Should Non-linearities Matter?

- Potential Problem:
  Standard models are estimated in (log-) linear form

- If unknown data generating process (DGP) is truly linear
  → no problem

- If unknown DGP is not linear and interest lies in forecasting small perturbations around the equilibrium
  → no problem

  But: Stress testing looks at large shocks and we don't know whether DGP is truly linear → problem?

Estimation of the Non-linear VAR

- Standard VAR
  - First order Taylor series approximation
  - Impulse response functions – iterate one period model forward
- We follow Jorda (2005)
  - Estimate first, second and third order approximations (assume cross products = 0)
  - Piece-wise regressions for each horizon by OLS
  - Error bands based on covariance matrix of parameter estimates at each horizon
- Data for macroeconomic VAR
  - GDP growth, inflation (PPI), nominal interest rate
  - Quarterly data from 1992Q4 - 2004Q3

Macroeconomic Risks and Aggregate Defaults

- Aggregate liquidation rates (LQR)
  - Use logit transformed → already non-linear!
  - Include lagged liquidation rates and squares and cubes of macro variables
  - Simulate error bands based on covariance matrix of parameters and residual variance

- Related literature
  - BoE work on liquidation rates eg. Benito, et al (2001)
  - Hoggarth, Sorensen and Zicchino (2005)

Impulse response functions

- 1 and 3 std. positive/negative shocks to GDP and interest rates
- Shocks based on Cholesky decomposition
- Base case: variables are held at sample average
- Impulse responses are plotted relative to base case
- Plot confidence intervals for cubic model

Impulse Response Functions for LQR

Small shocks (+)

Large shocks (+)

GDP

Int. rate

- Impact is not proportionally to shock size
- Considerable estimation uncertainty

Impulse Response Functions for LQR (II)

Positive shocks (3std)

Negative shocks (3std)

GDP

Int. rate

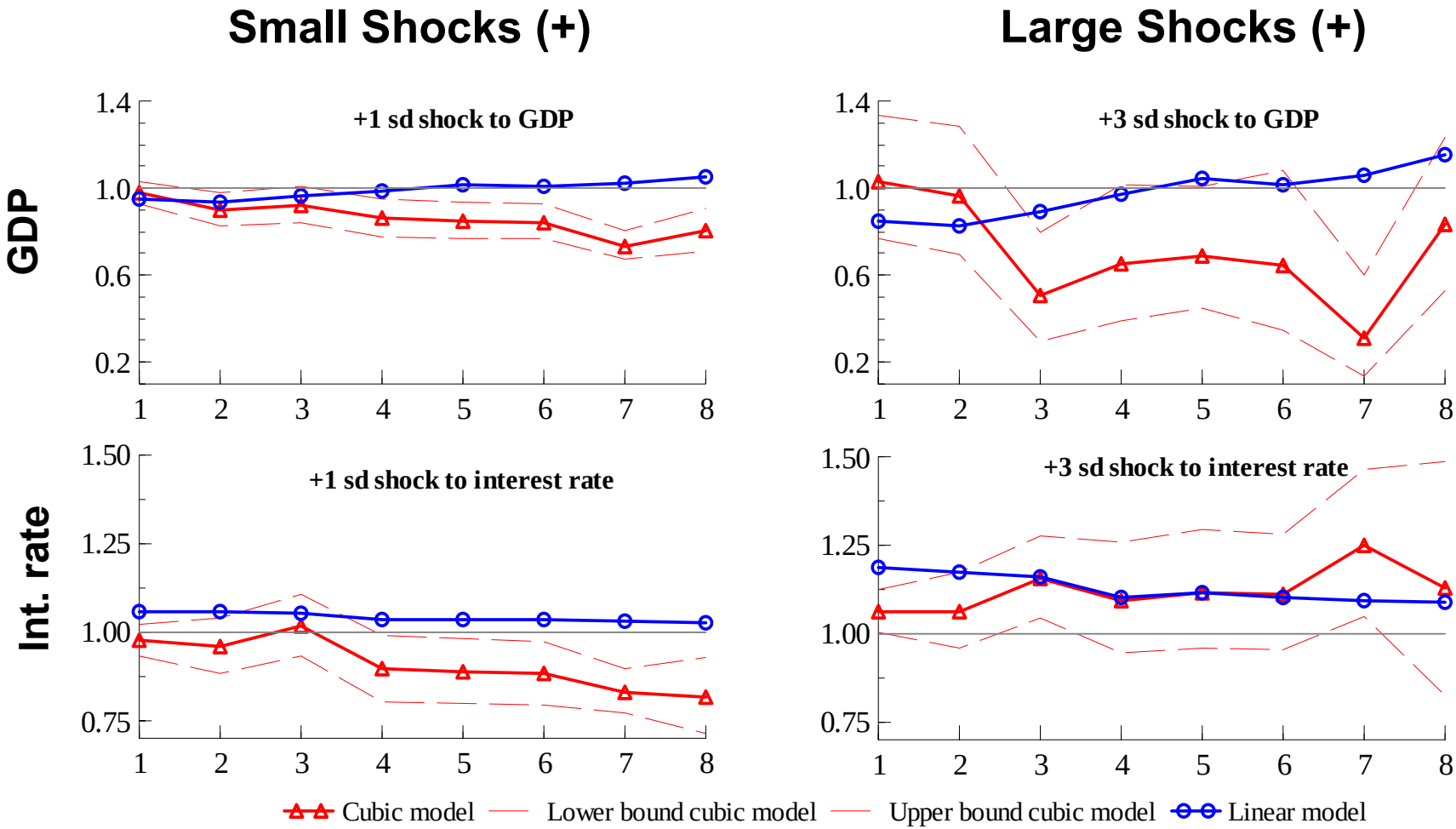
- Impact not symmetric across sign of shock
- Interest rates key risk driver

Macroeconomic Risks and Firm Specific Defaults

- Firm specific PDs
  - Estimate firm specific quarterly probit model → already non-linear!
  - Derive quarterly series from annual accounts data (over 30,000 UK companies) and liquidation rates from 1991-2004
  - Include firm specific variables
    (the interest cover, the current ratio, the debt to asset ratio, the number of employees, the profit margin and industry dummies)
  - Include squares and cubes of macro variables
  - Simulate error bands based on covariance matrix of parameters

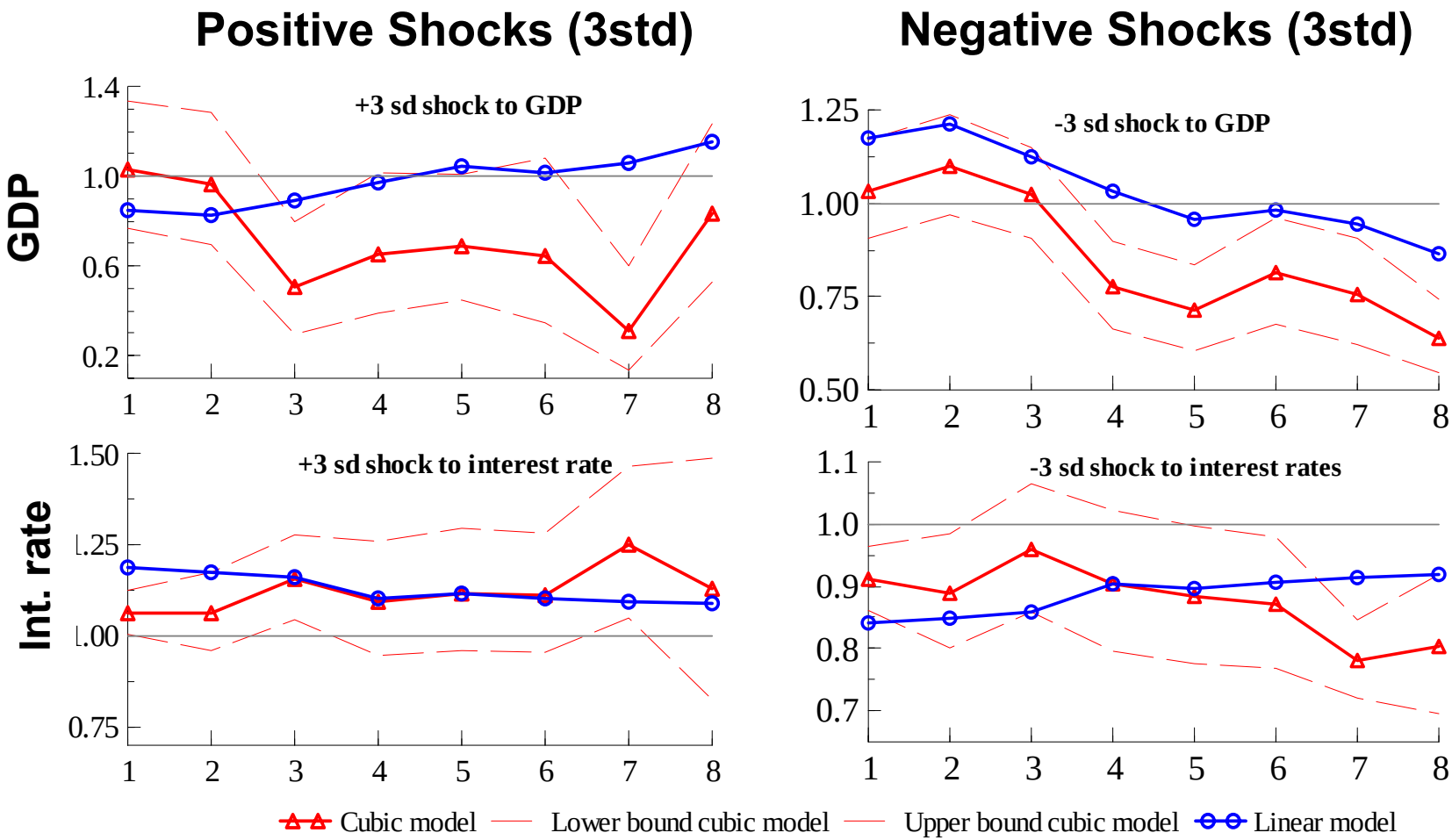
- Related literature
  - Bunn and Redwood (2003)
  - Beaver (1966), Altman (1968), Wilson (1997a,b),
  - Shumway (2001), Duffie et al (2005), Campell et al (2005)

Impulse Response Functions for PDs



- Impulse responses more precisely estimated
- Linear model may overestimate corporate credit risk

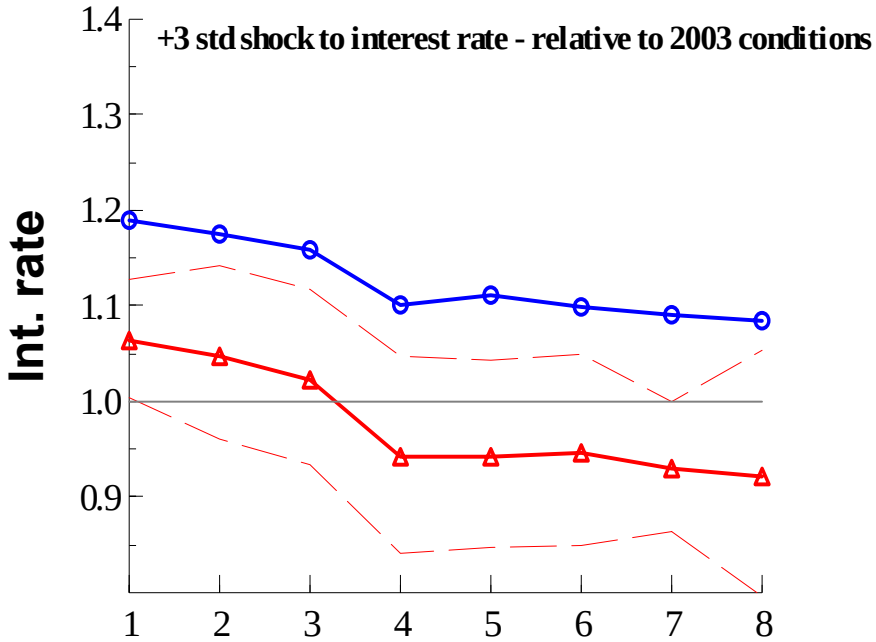
Impulse Response Functions for PDs (II)



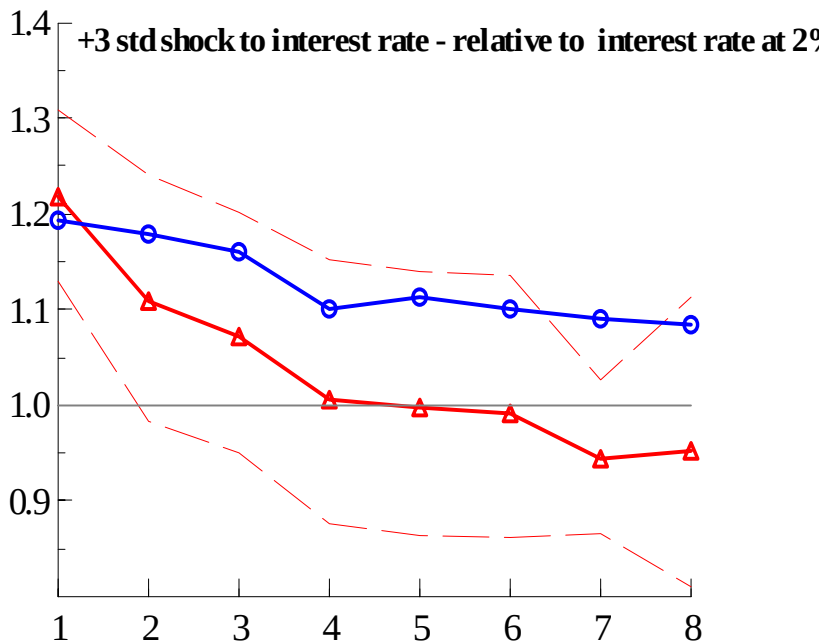
- Impact is not symmetric

Impulse Responses and Initial Values

2003 conditions (+3std)

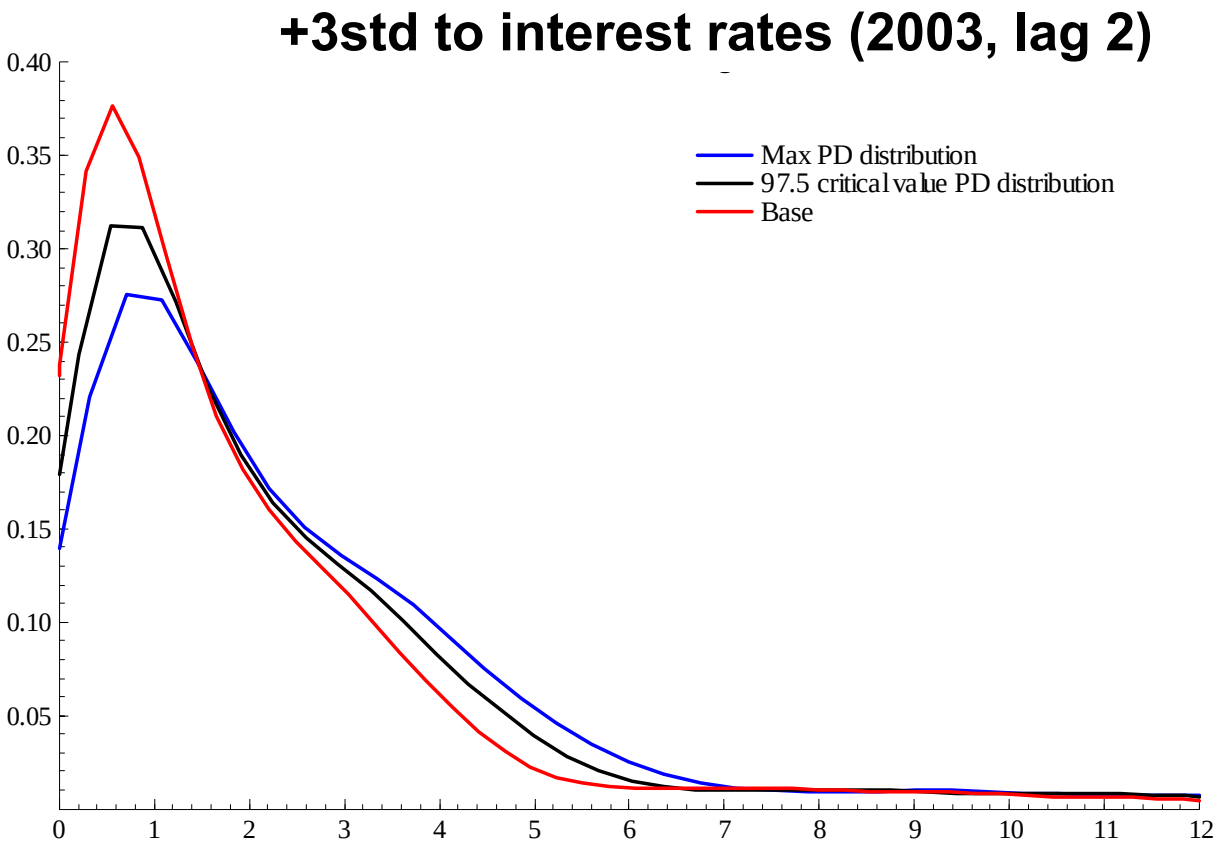


2% interest rate (+3std)



- Initial conditions matter
- Large interest rate shocks have larger impact on corporate defaults when interest rates are low

Distribution of PDs



- Estimation uncertainty matters

Next steps

- Robustness checks:
  - Dependence on sample period
  - Structural break?
- Explore the level effect
- Focus on company specific PDs
  - Check robustness of firm specific variables
  - Derive full 1 year ahead loss distributions
  - Explore pricing and capital setting implications

Conclusion

- Do non-linearities matter for credit risk?
  - Is the impact proportional to the shock size? **NO**
  - Is the impact symmetric in the sing of the shock? **NO**
  - Is the impact independent of initial conditions? **NO**
- Does estimation uncertainty matter for credit risk? **YES**

→ **stress testing / capital setting**

- Linear models may overestimate corporate credit risk

→ **Pricing**