Black Swans and the Many Shades of Uncertainty

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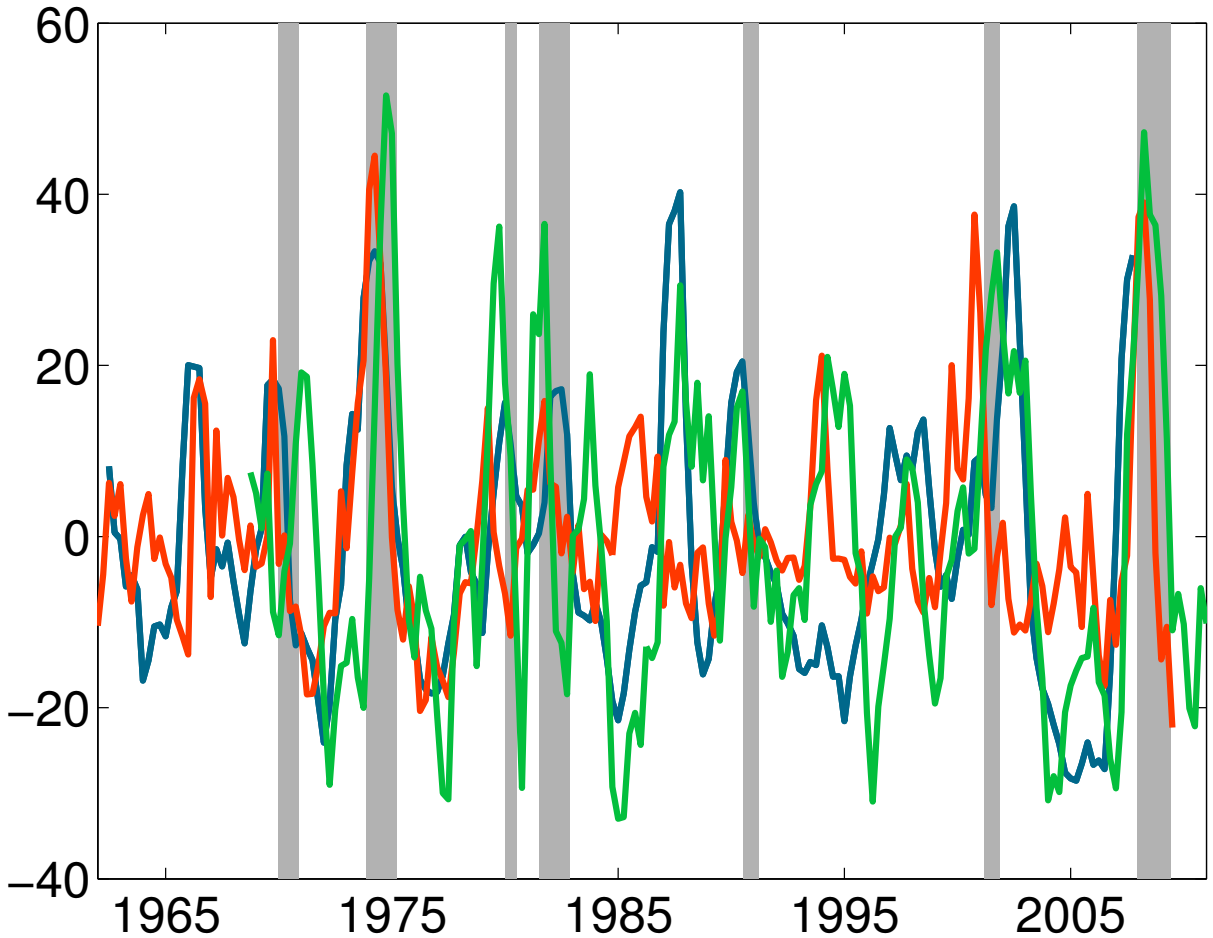
[1] Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect the position of the Board of Governors of the Federal Reserve or the Federal Reserve System.

Types of Uncertainty



VIX: expected future variance of S&P 500

Micro uncertainty: IQR of firm sales growth (MicroU)

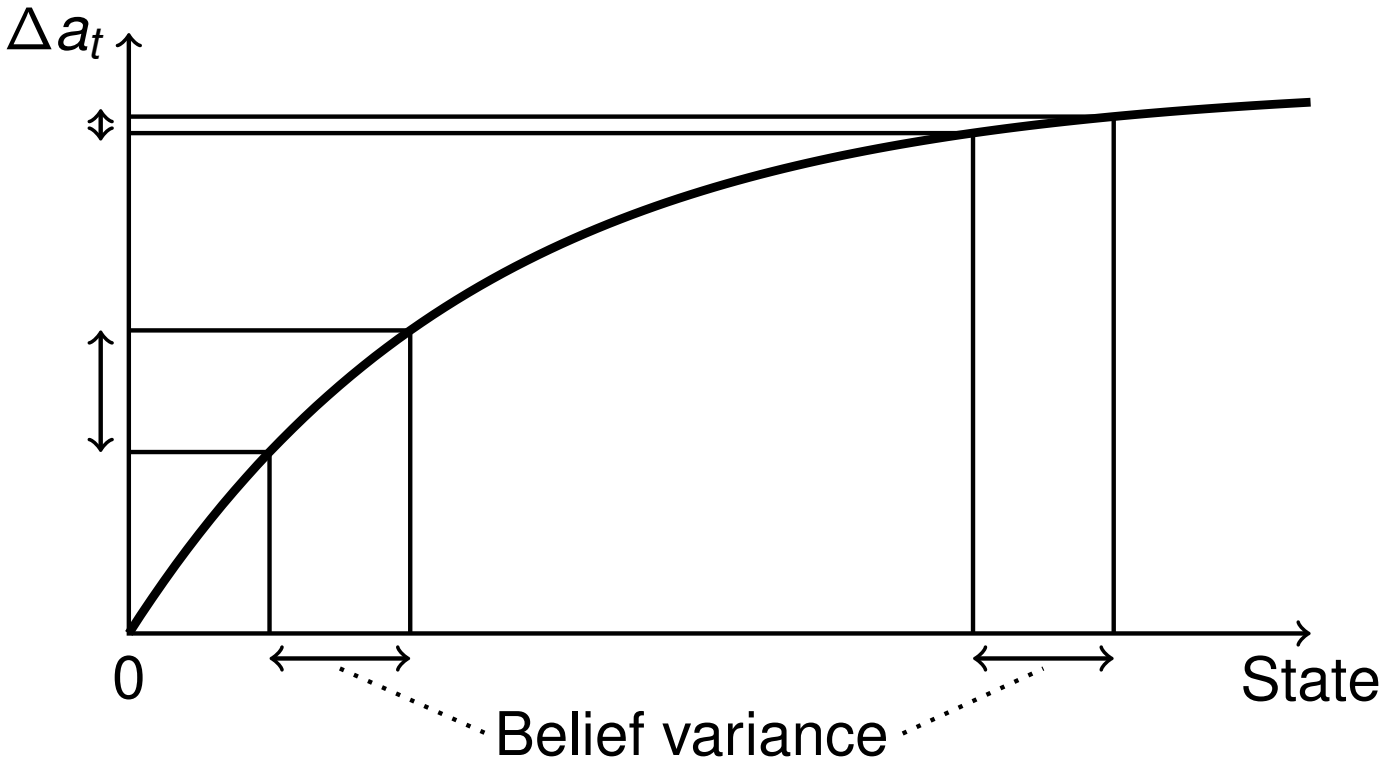
Higher-order uncertainty: std. of GDP growth forecasts (HiOrderU)

Introduction

- Approaches to modeling uncertainty
  - MacroU: heteroskedastic aggregate shock
  - MicroU: heteroskedastic firm-specific shock
  - HiOrderU: changes in dispersion of private information

  Provides no connection between different types of uncertainty
- In the paper: the different types of uncertainty are highly correlated—even after controlling for the business cycle
- Why? What's the connection between the various uncertainty shocks?

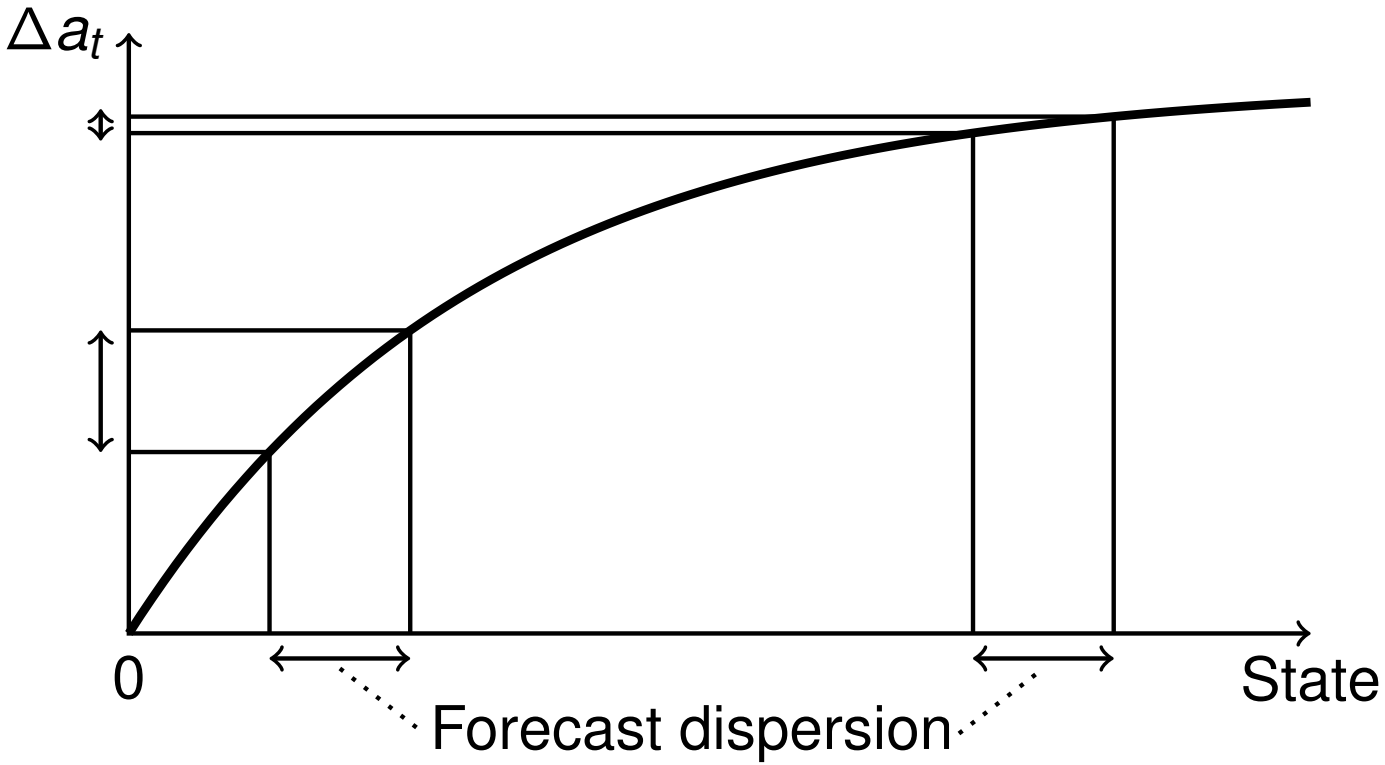
Skewness amplifies uncertainty in bad times



MacroU: average st. dev. of beliefs about TFP growth

Skewness amplifies MacroU in bad times

Skewness amplifies uncertainty in bad times

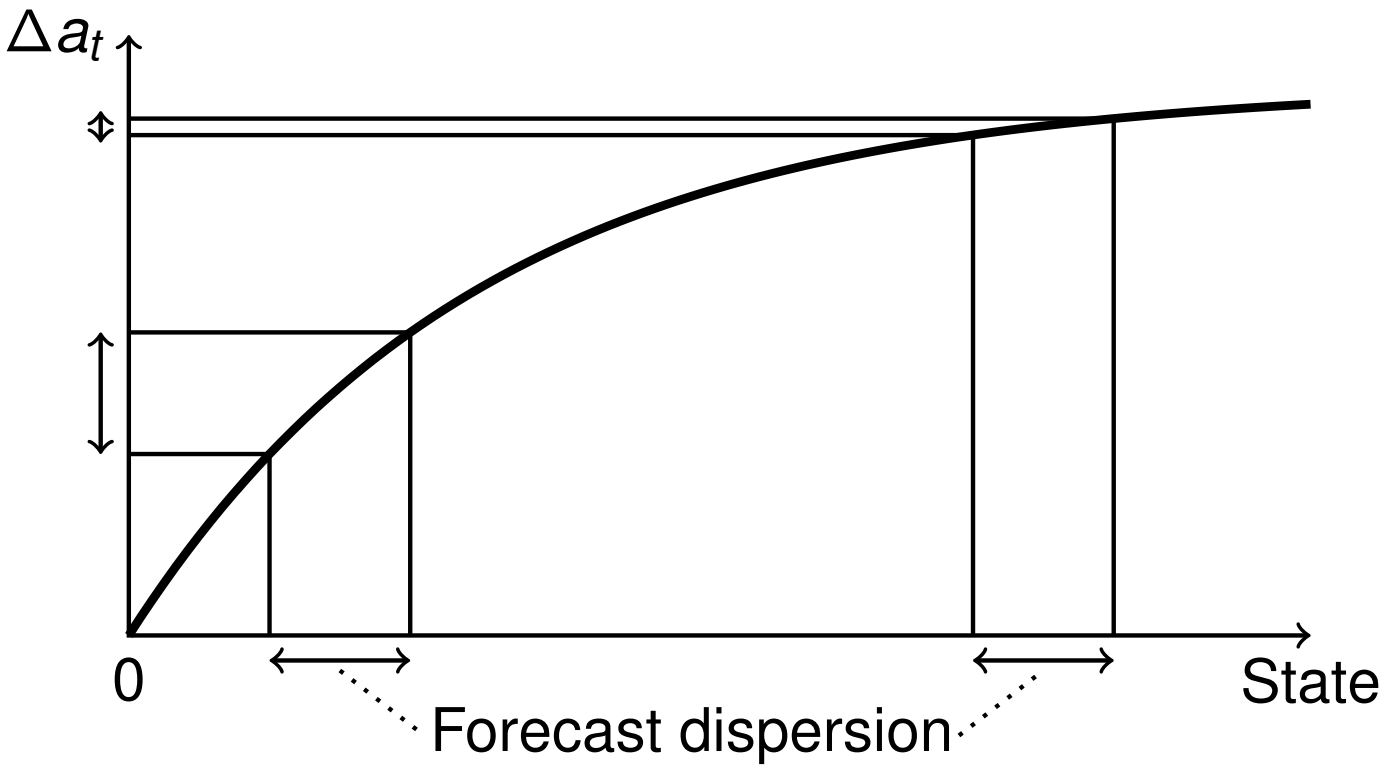


Same force amplifies disagreement when uncertainty is high

$\rightarrow$ Firms choose different inputs $\rightarrow$ growth dispersion (MicroU)

& Firms make different GDP growth forecasts (HiOrderU)

Skewness amplifies uncertainty in bad times



Key: With skewness, good times are more similar than bad times

Model

- Islands model with unit mass of islands/firms
- *Decision:* choose labor supply to maximize utility

$$U_{it} = Q_{it} - L_{it}^{\gamma},$$
$$Q_{it} = A_t L_{it}$$

- TFP process:

$$\Delta a_t \equiv \Delta \log A_t = c + b \exp X_t$$

X_t : GARCH(1,1), parameters unknown

- Firms forecast X_t at end of $t-1$ to choose labor
  - Prior for t: estimate GARCH model on data to $t-1$.
  - Posterior: prior + idiosyncratic signal by Bayes' law.

$$z_{i,t-1} = \Delta X_t + \eta_{t-1} + \psi_{i,t-1},$$
$$\eta_{t-1} \sim N(0, \sigma_\eta^2), \quad \psi_{i,t-1} \sim N(0, \sigma_\psi^2).$$

Model cont.

- Key ingredients of model
  1. Negatively skewed TFP growth: calibration $\rightarrow b < 0$
  2. Variation in prior precision of beliefs about X_t
  3. Private information
- Role of ingredients 2 and 3:

  More uncertainty about aggregate state (more MacroU)

  $\rightarrow$ more weight on private information

  $\rightarrow$ more dispersed actions (MicroU) and forecasts (HiOrderU)
- Investigate role of skewness by comparing results to model with $\Delta a_t = X_t$

Quantitative exercise

- Calibration
  - Period: 1962Q3–2011Q4
  - TFP growth (5 params.) calibrated to moments of GDP growth
  - Signal noises calibrated to moments of GDP growth forecasts
- Uncertainty measures
  - MacroU: Av. std. of beliefs about TFP growth
  - HiOrderU: Cross-sectional st. dev. of GDP growth forecasts
  - MicroU: Cross-sectional IQR of firm level sales growth
- We want to explain
  1. Size of HiOrderU and MicroU shocks
  2. Correlation of HiOrderU and MicroU
  3. Correlation of HiOrderU and MicroU with GDP growth

Results

	Model	Data
(a) Micro Uncertainty		
Std.	14.7	11.6
Corr. with GDP growth	−0.07	−0.52
Corr. with HiOrderU	0.21	0.43
(b) HiOrder Uncertainty		
Std.	23.6	31.1
Corr. with GDP growth	−0.17	−0.28

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Uncertainty countercyclical

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Uncertainty countercyclical

MicroU very countercyclical in the data

Separating the Mechanisms

	No skewness	Full Model
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Skewness generates countercycle uncertainty

Conclusion

Recent research uses different kinds of uncertainty shocks

- This paper: What's the connection between them?

We use some exogenous MacroU & explain MicroU and HiOrderU

- MacroU shocks $\rightarrow$ agents vary their reliance on private info
  $\rightarrow$ MicroU and HiOrderU shocks
- Negative skewness in aggregate outcomes
  $\rightarrow$ good times are more similar than bad times
  $\rightarrow$ MacroU, MicroU and HiOrderU amplified in bad times