Noisy Business Cycles

George-Marios Angeletos and Jennifer La'O

January 25, 2010

Motivation

- Question: How does *heterogeneous information* affect the business cycle?
- Main findings:
  - Noise shocks formalize demand shocks in a real setting
  - Employment may fall with TFP
  - Noise can drive bulk of fluctuations even with minimal uncertainty about fundamentals
- *Key*: strategic complementarities

Model

Model: Geography

- Continuum of islands $i \in I = [0, 1]$
- Continuum of firms on each island, $(i, j) \in I \times J$
- Continuum of households on mainland, $h \in H = [0, 1]$
- Different islands have different info about TFP $\rightarrow$ dispersed info affects production and labor supply decisions

Model: Households

- Preferences:

$$\mathrm{u}_h = \sum_{t=0}^{\infty} \beta^t \left[U(C_{h,t}) - \int_I V(n_{h,i}) di \right]$$

$$C_{h,t} = \left[\int_I c_{hi,t}^{\frac{\rho-1}{\rho}} di \right]^{\frac{\rho}{\rho-1}}$$

$$c_{hi,t} = \left[\int_J c_{hij,t}^{\frac{\eta-1}{\eta}} dj \right]^{\frac{\eta}{\eta-1}}$$

- Budget constraint:

$$\int_{I\times J} p_{ij,t} c_{hij,t} d(i,j) + B_{h,t+1} \leq \int_{I\times J} \pi_{ij,t} d(i,j) + \int w_{i,t} n_{hi,t} di + R_t B_{h,t}$$

Model: Households

- Preferences:

$$u_h = \sum_{t=0}^{\infty} \beta^t \left[U(C_{h,t}) - \int_I V(n_{h,i}) di \right]$$

$$C_{h,t} = \left[\int_I c_{hi,t}^{\frac{\rho-1}{\rho}} di \right]^{\frac{\rho}{\rho-1}}$$

$$c_{hi,t} = \left[\int_J c_{hij,t}^{\frac{\eta-1}{\eta}} dj \right]^{\frac{\eta}{\eta-1}}$$

- Budget constraint:

$$\int_{I \times J} p_{ij,t} c_{hij,t} d(i,j) + B_{h,t+1} \leq \int_{I \times J} \pi_{ij,t} d(i,j) + \int w_{i,t} n_{hi,t} di + R_t B_{h,t}$$

Model: Firms

- Output:

$$q_{ij,t} = A_{i,t} n_{ij,t}^{\theta}$$

- Profits:

$$\pi_{ij,t} = p_{ij,t} q_{ij,t} - w_{i,t} n_{ij,t}$$

- Objective:

$$max \mathbb{E}_{ij,t} \left[U'(C_t) \pi_{ij,t} \right]$$

Model: Shocks and Information

- Fundamentals

$$a_{it} := logA_{it} = \bar{a}_t + \xi_{it}$$

$$\bar{a}_t = \rho \bar{a}_{t-1} + \nu_t$$

- Signals:
  - Island-specific:

$$x_{it} = \bar{a}_t + \varsigma_{it}$$

  - Public:

$$z_t = \bar{a}_t + \varepsilon_t$$

Model: Shocks and Information

- Fundamentals

$$a_{it} := logA_{it} = \bar{a}_t + \xi_{it}$$

$$\bar{a}_t = \rho \bar{a}_{t-1} + \nu_t$$

- Signals:
  - Island-specific:

$$x_{it} = \bar{a}_t + \varsigma_{it}$$

  - Public:

$$z_t = \bar{a}_t + \varepsilon_t$$

Model: Timing

1. Stage 1: employment and production with dispersed info
   - Each household sends a worker to each island
   - Aggregate and idiosyncratic shocks are realized
   - Information in each island is revealed
   - Local labor markets operate and production choice takes place
2. Stage 2: consumption and saving with common info
   - Workers return home
   - Aggregate state becomes commonly known
   - Consumption and saving choices take place in centralized markets

Equilibrium

Key equilibrium condition (with $\eta \to \infty$, i.e. no monopoly power within an island):

$$V'(n_{it}) = \mathbb{E}_{it}\left[U'(Q_t)\left(\frac{q_{it}}{Q_t}\right)^{-\frac{1}{\rho}}\left(\theta A_{it} n_{it}^{\theta-1}\right)\right]$$

Equilibrium

Equilibrium levels of output:

$$\log q_{it} = \text{const} + (1-\alpha) f_{it} + \alpha \mathbb{E}_{it}\left[\log Q_t\right]$$

$$\log Q_t = \text{const} + \int_I \log q_{it} di$$

where

$$f_{it} := \log\left[\theta^{\frac{\theta}{1-\theta+\epsilon+\gamma\theta}} A_{it}^{\frac{1+\epsilon}{1-\theta+\epsilon+\gamma\theta}}\right]$$

$$\alpha := \frac{\frac{1}{\rho}-\gamma}{\frac{1}{\rho}+\frac{1-\theta+\epsilon}{\theta}} < 1$$

- α measures "strategic complementarity"
- α monotonically decreasing in ρ, cross-island e. of subst.

Noisy Business Cycles

Proposition: There exist economies in which

- Agents are arbitrarily well informed about fundamentals
- TFP innovations account for nearly zero of SR variation in Q_t
- Employment falls with a positive TFP shock

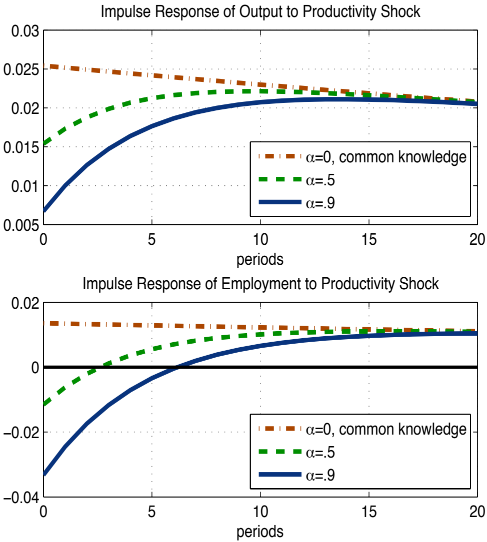
Intuition:

- With strong complementarities agents care more about average forecast than about fundamentals per se
- With sufficiently strong complementarity, agents disregard private info even if arbitrarily precise
- Key is not imperfect info, but lack of common knowledge interacting with complementarities

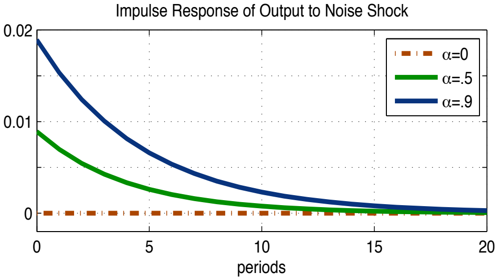
Extension with slow learning

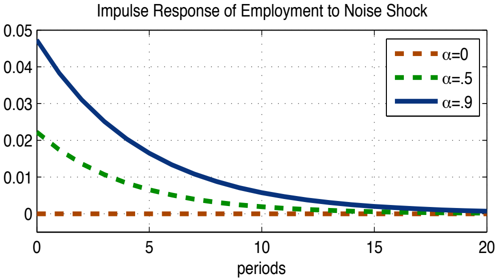
- Relax assumption that aggregate state is revealed at end of t
- Agents learn only through exogenous signals

Impulse Responses: TFP

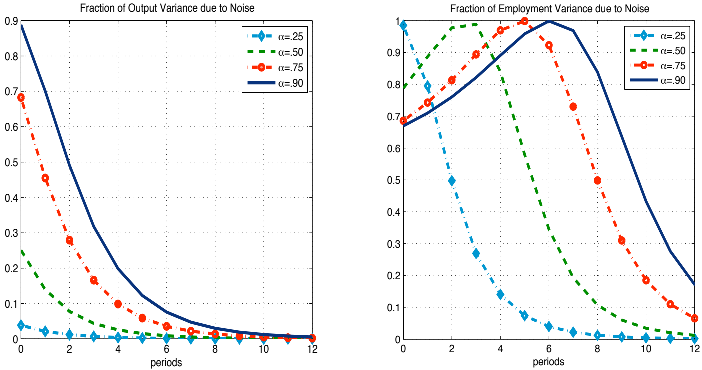


Impulse Responses: noise





Variance Decomposition



Forecast errors