1 News about the future and fluctuations

- old idea: expectations drive business cycle

- uncertainty about the economy’s fundamentals, which will determine the long run equilibrium

- partial equilibrium ideas:
  - consumption: permanent income hypothesis future income expectations matter for consumption decisions
  - investment: high expected returns

- problem: how to fit these ideas in general equilibrium setup
1.1 Evidence

- basic fundamental for long-run growth: TFP
- can expectations about long-run TFP drive cycle?
- how to measure expectations?
- Beaudry and Portier (2006): use the stock-market
\[
\begin{bmatrix}
\Delta TFP_t \\
\Delta S_t
\end{bmatrix} =
\begin{bmatrix}
a_{11}(L) & a_{12}(L) \\
a_{21}(L) & a_{22}(L)
\end{bmatrix}
\begin{bmatrix}
\varepsilon_{1t} \\
\varepsilon_{2t}
\end{bmatrix}
\]

Two identification approaches:

1. Short run:
   \[a_{12,0} = 0.\]

2. Long run:
   \[a_{12}(1) = 0.\]
Impulse responses to shocks $e_2$ and $\widetilde{e}_1$ in the (TFP, SP) VAR

The figure displays the response of consumption, investment, output (measured as C + I) and hours to a unit $\epsilon_2$ shock (the shock that does not have instantaneous impact on TFP in the short run identification). The unit of the vertical axis is percentage deviation from the situation without shock. (See the main text for more details)
Impulse responses to $\varepsilon_2$ and $\tilde{\varepsilon}_1$ in the (TFP, SP, H) VAR, without (upper panels) or with (lower panels) Adjusting TFP for capacity utilization.

Share of the forecast error variance of consumption (C), Investment I, Output (C+I) and hours (H) attribute to $\varepsilon_2$ (left panel) and $\tilde{\varepsilon}_1$ (right panel) in 4-variables VARs, with non adjusted TFP (top panels) or adjusted TFP (bottom panels).

Main conclusions:

- both identifications give similar shocks

- response of C and Y builds up, then permanent

- response of H has hump then dies out slowly
1.2 Neoclassical growth model

Preferences

\[ E \sum_{t=0}^{\infty} \beta^t U (C_t, N_t) \]

Technology

\[ C_t + K_t - (1 - \delta) K_{t-1} \leq A_t F (K_{t-1}, N_t) \]

- what happens when agents receive news about future \( A_{t+s} \)?

- what type of cycles does this generate?
Basic parametrization

\[ U(C_t, N_t) = \log C_t - \frac{1}{1 + \eta} N_t^{1 + \eta} \]

\[ A_t F(K_{t-1}, N_t) = A_t K_{t-1}^\alpha N_t^{1-\alpha} \]

\[ A_t = e^{a_t} \]

\[ a_t = \rho a_{t-1} + \epsilon_t \]

\[ \beta = 0.99 \]
\[ \eta = 1 \]
\[ \alpha = 0.36 \]
\[ \rho = 0.95 \]
\[ \delta = 0.025 \]
Shock to current productivity
Now introduce news about the future

Simplest way: agents observe shock realization $T$ periods in advance

$$a_t = \rho a_{t-1} + \epsilon_{t-T}$$

What happens at the time of the announcement?

Consumption increases, investment and hours fall!

1.2.1 Mechanism

Basic mechanism driven by intra-temporal optimality condition

$$(1 - \alpha) \frac{1}{C_t} A_t K_{t-1}^{\alpha} N_t^{-\alpha} = N_t^\eta$$

or (in terms of real wages)

$$\frac{1}{C_t} W_t = N_t^\eta$$

together with the resource constraint

$$I_t + C_t = A_t K_{t-1}^{\alpha - 1} N_t^{1 - \alpha}$$
• If $A_t$ unchanged cannot have $I_t \uparrow, C_t \uparrow$

• Changing intertemporal elasticity and elasticity of labor supply can change response of $C_t$ and $I_t$, but cannot give right combination

• Adjustment costs in $K_t$ can give $I_t \uparrow$ but then $C_t \downarrow$
• No hope for neoclassical model with news about the future?

• Several attempts

• Jaimovich and Rebelo (2006): three ingredients
  – adjustment costs in *investment*
  – variable capacity utilization
  – preferences with “weak wealth effects on labor supply”
Preferences

\[ \sum \beta^t \left( C_t - N_t^\theta X_t \right)^{1-\sigma} - 1 \]

- \( X_t \) is a geometric discounted average of past consumption levels
  \[ X_t = C_t^\gamma X_t^{1-\gamma} \]

- The parameter \( \gamma \in [0, 1] \): speed at which the wealth effect kicks in

- Suppose \( X_t \equiv 1 \) then quasi-linear (GHH)
  \[ W_t = \theta N_t^{\theta - 1} \]
no income effect here. Inconsistent with LR growth

- Here income effect that phases in slowly

- In the long run

\[ W_t = \theta N_t^{\theta-1} C_t \]
Simplistic interpretation:

1. quasi-linear in short run: no income effect

2. log in the long run: income and substitution cancel

but 1 is wrong!
Decomposition: income effect

\[ \sum \beta^t \frac{(C_t - N_t^\theta X_t)^{1-\sigma} - 1}{1 - \sigma} \]

\[ \sum R^{-t} (C_t - W N_t) = B_0 \]

- Suppose real wage constant at $W$, interest rate constant at $R = 1/\beta$
- effects of an increase in $B_0$
Response of Hours - Income Effect

% Deviations from Steady State

Periods

GHH $\gamma = 0.01$ $\gamma = 0.05$
$\gamma = 0.1$ $\gamma = 0.2$
$\gamma = 0.3$ $\gamma = 0.4$
$\gamma = 0.5$ $\gamma = 0.6$
$\gamma = 0.7$ $\gamma = 0.8$
$\gamma = 0.9$ $\gamma = KPR$

Image by MIT OpenCourseWare.
Mechanism

first order condition for labor supply in the following form

$$\xi_t W_t = \theta X_t N_t^{\theta - 1},$$

and

$$\xi_t = \frac{\left( C_t - N_t^{\theta} X_t \right)^{-\sigma} - \mu_t \gamma C_t^{\gamma - 1} X_t^{1 - \gamma}}{\left( C_t - N_t^{\theta} X_t \right)^{-\sigma}}.$$ 

where $\mu_t$ is a complicated forward looking object.

Agents forecast that work will be painful in the future, so they work more today
1.2.2 Habits and labor supply

Christiano, Ilut, Motto and Rostagno

\[ E \sum_{t=0}^{\infty} \beta^t \left( \log (C_t - bC_{t-1}) - \frac{1}{1 + \eta} N_t^{1+\eta} \right) \]  (habit)

\[ K_t = (1 - \delta) K_{t-1} + \left( 1 - \frac{a}{2} \left( \frac{I_t}{I_{t-1}} \right)^2 \right) I_t \]  (CEE Adj. Costs)

\[ Y_t = A_t K_t^\alpha N_t^{1-\alpha} = I_t + C_t \]

\[ A_t = e^{a_t} \]

\[ a_t = \rho a_{t-1} + \epsilon_{t-T} \]
Real business cycle model with habit and CEE investment adjustment costs baseline - tech shock not realized, perturbation - tech shock realized in period 5

Image by MIT OpenCourseWare. Adapted from Figure 3 on p. 78 in Christiano, Lawrence, Cosmin Ilut, Roberto Motto, and Massimo Rostagno. "Monetary Policy and Stock Market Boom-Bust Cycles." European Central Bank Working Paper No. 955, October 2008.
Real Business Cycle Model without Habit and with CEE Investment Adjustment Costs
Technology Shock not Realized in Period 5

Output

Investment

Consumption

Hours worked

Riskfree rate with payoff in t+1 (annual)

\( P_k \)

\[ \text{Percent} \]

\[ 0.05, 0.1, 0.15, 0.2, 0.25, 0.3 \]

\[ 0.05, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5 \]

\[ 0 \] to \[ 1000 \] basis points

\[ -0.2, -0.3, -0.4, -0.5, -0.6, -0.7, -0.8 \]

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Image by MIT OpenCourseWare. Adapted from Figure 4 on p. 79 in Christiano, Lawrence, Cosmin Ilut, Roberto Motto, and Massimo Rostagno. "Monetary Policy and Stock Market Boom-Bust Cycles." European Central Bank Working Paper No. 955, October 2008.
Real Business Cycle Model with Habit and Without Investment Adjustment Costs Technology
Shock not Realized in Period 5

Image by MIT OpenCourseWare. Adapted from Figure 5 on p. 80 in Christiano, Lawrence, Cosmin Ilut, Roberto Motto, and Massimo Rostagno. "Monetary Policy and Stock Market Boom-Bust Cycles." European Central Bank Working Paper No. 955, October 2008.
Conclusions:

- model with both habits and CEE adjustment costs produces right comovement of quantities

- but not of prices: interest rate and asset prices

- looking for real interest rate that responds less→models with nominal rigidities
Importance of habit formation

\[ \lambda_t W_t = N_t^\eta \]

\[ \lambda_t = \frac{1}{C_t - bC_{t-1}} - \beta bE_t \left[ \frac{1}{C_{t+1} - bC_t} \right] \]

- high consumption in the future increases incentive to work today.

- wealth effects here? See problem set
1.3 Nominal rigidities

- two period economy
- households of consumers-producers
- monopolistic competition, price-setting
- uncertainty about productivity
• preferences

\[ \sum_{t=1}^{2} \beta^t \left( \log C_{it} - \frac{\kappa}{1 + \eta} N_{it}^{1+\eta} \right), \]

\( C_{it} \) is the CES aggregate

\[ C_{it} = \left( \int_{0}^{1} C_{ijt}^{\sigma-1} \, di \right)^{\frac{\sigma}{\sigma-1}}, \]

with \( \sigma > 1 \)

• Technology

\[ Y_{it} = A_t N_{it}. \]
- Productivity shocks $A_t$

$$A_t = e^{a_t}$$

$$a_1 = x + \epsilon_1,$$

$$a_2 = x + \epsilon_2$$

- $x$ and $\epsilon_t$ mean-zero, i.i.d., normal

- A signal about long-run productivity

$$s = x + e$$
• nominal balances with central bank at nominal rate $R$

• household set $P_{it}$ then consumers buy

• intertemporal BC

\[(P_2C_{i2} - P_{i2}Y_{i2}) + R \cdot (P_1C_{i1} - P_{i1}Y_{i1}) \leq 0,\]

• $P_t$ is the price index

\[P_t = \left(\int P_{it}^{1-\sigma} \, dt\right)^{\frac{1}{1-\sigma}}.\]
Flexible price equilibrium

- optimality for price-setting

\[(1 - \sigma) \frac{1}{P_tC_{it}} \frac{P_{it}Y_{it}}{P_{it}} + \kappa\sigma \frac{1}{A_t P_{it}} Y_{it} N_{it}^\eta = 0.\]

- symmetric equilibrium, \(Y_t = A_t N_t\), this condition gives

\[N_t = \left(\frac{\sigma - 1}{\kappa\sigma}\right)^{\frac{1}{1+\eta}} = 1\]

(choosing \(\kappa = (\sigma - 1)/\sigma\)).

- quantities

\[C_t = Y_t = A_t.\]
• what about consumers’ decisions?

• consumer Euler equation

\[ \frac{1}{C_1} = RE \left[ \frac{P_1}{P_2 C_2} \right| a_1, s \]  

• \( C_t = A_t \) log-normal

\[ r + p_1 - E [p_2|a_1, s] = E [a_2|a_1, s] - a_1 - \frac{1}{2} Var [a_2|a_1, s]. \]

• all changes in \( E [y_2] \) go to the real interest rate

• notice role of \( p_1 \): neutralizes \( r \)
Fixed prices in period 1

- price-setting before any shock observed

\[ E \left[ (1 - \sigma) \frac{1}{P_1 C_{i1}} \frac{P_{i1} Y_{i1}}{P_{i1}} + \kappa \sigma \frac{1}{A_2} N_{i1}^{\eta} \frac{Y_{i1}}{P_{i1}} \right] = 0. \]

- rearranging this gives

\[ E \left[ N_1^{1+\eta} \right] = 1 \]

- this will pin down averages but not responses to shocks
• quantities: equilibrium in period 2 identical

• in period 1 now Euler equation (set $p_2 = 0$)

\[ c_1 = E[a_2|a_1, s] - \frac{1}{2} Var[a_2|a_1, s] - r - p_1. \]

• suppose $r$ fixed, $p_1$ fixed by assumption

• now “sentiment shocks” affect consumption
RBC and Simple Monetary Model Expectation of Technology Shock in Period 13 Not Realized

Output

Investment

Consumption

Hours worked

Ex post realized real
\( R^e_{t+1}/\pi_{t+1} \) (annual)

\( P_{k'} \)

Inflation (APR)

Nominal rate of interest
\( (R^e_{t+1}, \text{annual}) \)

Real wage

Note: Subscript on nominal rate of interest indicates date of payoff. \( R^e_{t+1} \) is graphed at date \( t \), \( \pi_t \) indicates gross change in price level from \( t-1 \) to \( t \).

Image by MIT OpenCourseWare. Adapted from Figure 8 on p. 83 in Christiano, Lawrence, Cosmin Ilut, Roberto Motto, and Massimo Rostagno. "Monetary Policy and Stock Market Boom-Bust Cycles." European Central Bank Working Paper No. 955, October 2008.
pin down $p_1$

\[ E \left[ N_1^{1+\eta} \right] = E \left[ e^{(1+\eta)(y_1-a_1)} \right] = 1, \]

thanks to log-normality this equation can be solved explicitly and gives

\[-r - p_1 - \frac{1}{2} Var [a_2|a_1, s] + \frac{1}{2} (1 + \eta) (\beta + \delta - 1)^2 \sigma_x^2 + \]
\[ + \frac{1}{2} (1 + \eta) (\beta - 1)^2 \sigma_\epsilon^2 + \frac{1}{2} (1 + \eta) \delta^2 \sigma_\epsilon^2 = 0 \]

where

\[ E [a_2|a_1, s] = \beta a_1 + \delta s \]
• simple implication anticipated changes in $r$ are neutral

• if instead we follow rule, e.g.

$$r = \alpha_0 + \alpha_1 y_1$$

then economy response changes

• we’ll go back to monetary policy