Economics 701: Macroeconomics II

Spring 2009

Lecture 5: Real Business Cycles

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7. Criticisms and Extensions

(a) Fiscal Policy in the RBC Model

- Assume that government spending is unproductive, so that the utility and production functions are as before.
- The government's budget constraint and the Ricardian Equivalence Proposition (REP)
  - Simplifications: perfect foresight $\Rightarrow$ capital and government bonds have the same returns. Not important for results.
  - The government's budget constraint is

$$ANb_{t+1}+\tau_t^k r_t k_t+\tau_t^\ell w_t \ell_t = R_t b_t+g_t+h_t. \quad \text{(GBC)}$$

7. (a) Fiscal Policy in the RBC Model

- The government's budget constraint and the REP
  - Notation:

$$
\begin{aligned}
b_t &= \text{government bonds (per effective worker),} \\
&\quad (b_t > 0 \Rightarrow \text{government is borrowing}), \\
r_t &= \text{real interest rate,} \\
\widetilde{r}_t &\equiv r_t + \delta = \text{rental price of capital,} \\
\tau_t^k &= \text{tax rate on capital income (net of depr.),} \\
\tau_t^\ell &= \text{tax rate on labor income,} \\
R_t &= \text{gross return on bonds} = 1 + \left(1 - \tau_t^k\right) r_t, \\
g_t &= \text{government spending (per effec. worker),} \\
h_t &= \text{government transfers/lump-sum taxes} \\
&\quad \text{(per effective worker).}
\end{aligned}
$$

7. (a) Fiscal Policy in the RBC Model

- The government's budget constraint and the REP
  - Recursively substituting equation (GBC), and applying a No-Ponzi-Game condition yields:

$$
\begin{aligned}
R_t b_t &= \sum_{j=0}^{\infty} q_{t+j} \left[\begin{array}{l} \tau^k_{t+j} r_{t+j} k_{t+j} + \tau^\ell_{t+j} w_{t+j} \ell_{t+j} \\ -g_{t+j} - h_{t+j} \end{array} \right], \\
q_t &\equiv 1, \\
q_{t+j} &\equiv (AN)^j \left(\prod_{k=1}^{j} R^{-1}_{t+k} \right), \qquad j \geq 1,
\end{aligned}
$$

  - The discounted sum of the government's future surpluses equals the value of its current debt.

7. (a) Fiscal Policy in the RBC Model

- The government's budget constraint and the REP
  - The household's budget constraint is

$$\begin{aligned} ANb_{t+1} + ANk_{t+1} + c_t &= R_t b_t + h_t + (1 - \delta + \widetilde{r}_t)\, k_t \\ &\quad + w_t \ell_t - \left[\tau_t^{\ell} w_t \ell_t + \tau_t^{k} r_t k_t\right], \\ AN\left[b_{t+1} + k_{t+1}\right] + c_t &= R_t \left[b_t + k_t\right] + h_t \\ &\quad + \left(1 - \tau_t^{\ell}\right) w_t \ell_t. \qquad \text{(FBC)} \end{aligned}$$

7. (a) Fiscal Policy in the RBC Model

- The government's budget constraint and the REP
  - Recursively substituting equation (FBC), and applying a No-Ponzi-Game condition yields:

$$R_t \left[b_t + k_t \right] = \sum_{j=0}^{\infty} q_{t+j} \left[\begin{array}{l} c_{t+j} - h_{t+j} \\ - \left(1 - \tau_{t+j}^{\ell} \right) w_{t+j} \ell_{t+j} \end{array} \right],$$

  - The discounted sum of the household's future "deficits" equals the value of its current assets.

7. (a) Fiscal Policy in the RBC Model

- The government's budget constraint and the REP
  - Ricardian Equivalence Proposition: any change in the sequence of transfers $\{h_t\}$ that does not violate the government's present value budget constraint will have no effect on any other equilibrium prices or quantities.
  - **Proof**: Start with an equilibrium, then switch from $\{h_t\}$ to $\{h'_t\}$. Assume that prices and tax rates do not change. With the same PVBC and after-tax prices, households and producers will choose the same quantities, and the government's choices of taxes and spending are still feasible. It is easy to show that the resource constraint still holds, so that we still have an equilibrium.

7. (a) The government's budget constraint and the REP
   - Combining equations (GBC) and (FBC)

$$ANk_{t+1} + c_t + g_t = (1 + r_t)\, k_t + w_t \ell_t,$$

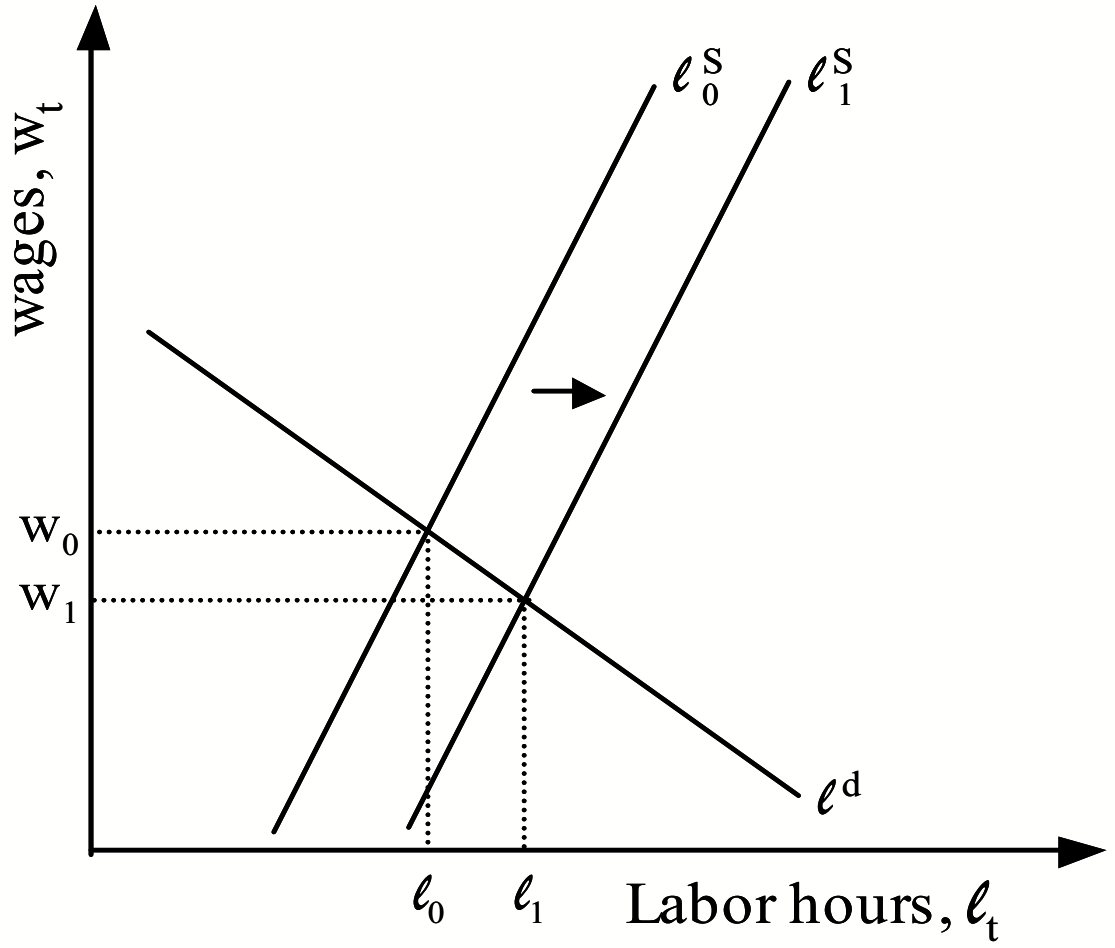
     shows that the household's resources depend only on government spending.
   - Implication: the choice between lump-sum taxation and bonds is irrelevant. Consumers care about the PV of lump-sum taxes, not their timing.
   - But government spending sets the PV of taxes, and distortionary taxes (τ_t^ℓ and τ_t^k) affect the household's incentives to save and work.
   - Fundamentally different from Keynesian analysis. Key question: Are liquidity constraints and rule-of-thumb behavior important?

7. (a) Fiscal Policy in the RBC Model

- A government spending increase financed by lump-sum taxes
  - Labor market: $g \uparrow \Rightarrow y_t^P \downarrow \Rightarrow \ell^s$ shifts out. ℓ increases, w decreases. The more persistent the spending increase, the larger the income effect.
  - Goods market: $g \uparrow \Rightarrow y_t^P \downarrow \Rightarrow c \downarrow$, but in general $g + c \uparrow$. The more permanent the spending increase, the smaller the net effect.
  - IS and FE curves both shift right. y and generally r increase.

7. (a) Fiscal Policy in the RBC Model

- A government spending increase financed by lump-sum taxes



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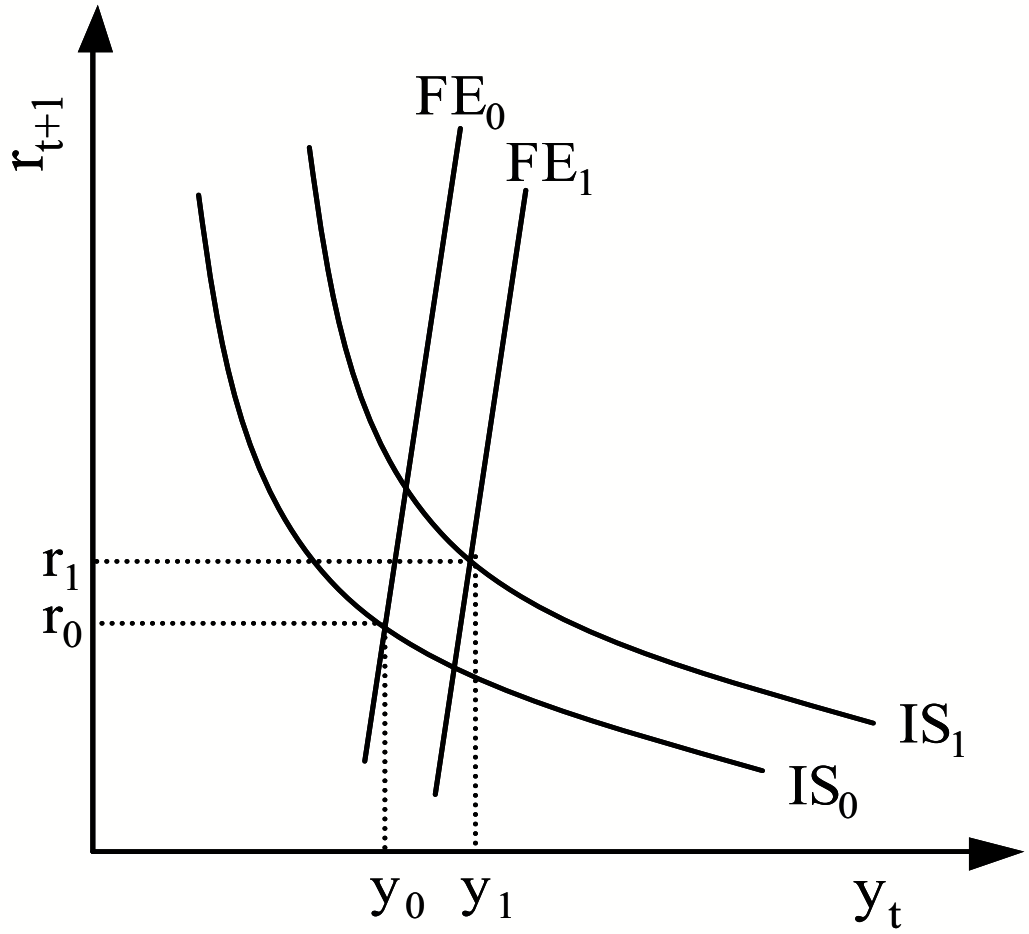
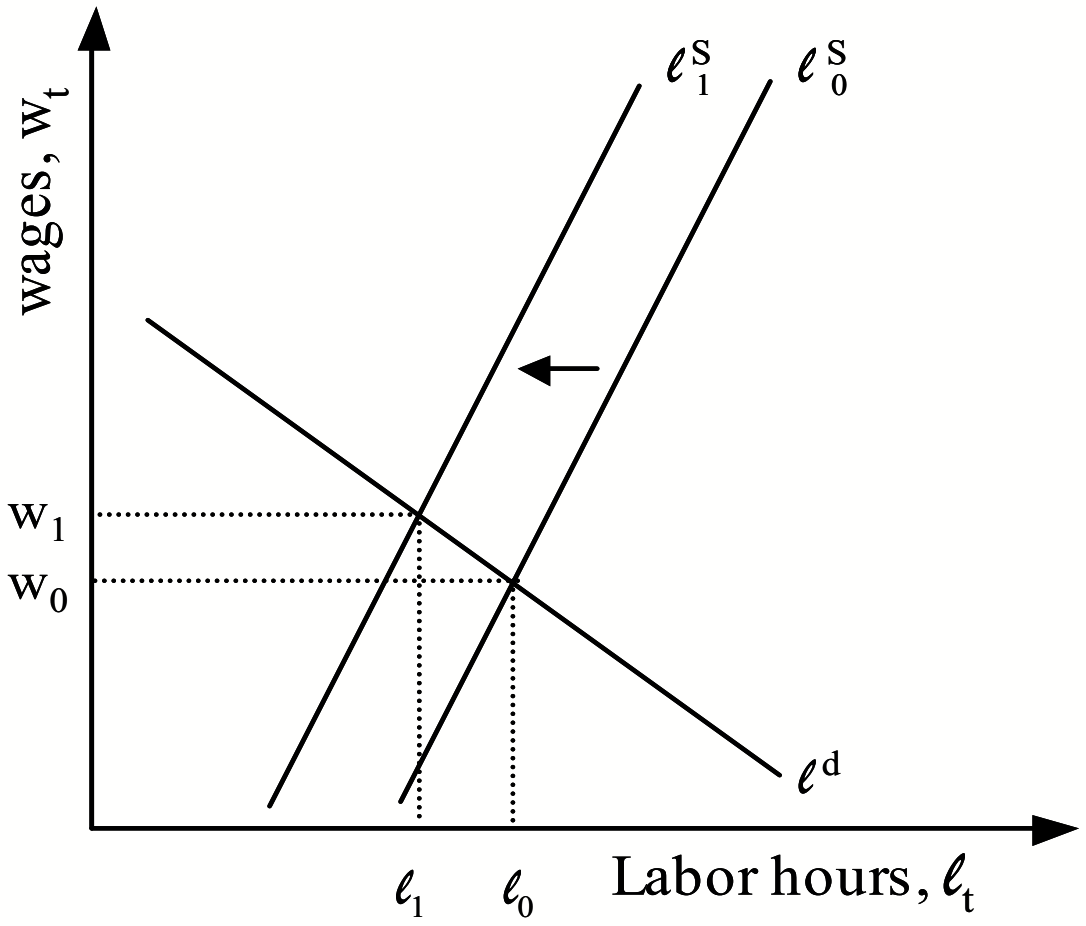


7. (a) Fiscal Policy in the RBC Model

- A government spending increase financed by labor income taxes (Baxter and King: AER, 1993)
  - Labor market: substitution effects dominate income effects $\Rightarrow \ell^s$ shifts in. ℓ decreases, w increases. The more persistent the spending/tax increase, the larger the income effect, and the smaller the overall effect.
  - Goods market: same as before.
  - IS curve shifts right, FE curve shifts left. y decreases and r increases.

7. (a) Fiscal Policy in the RBC Model

- A government spending increase financed by labor income taxes



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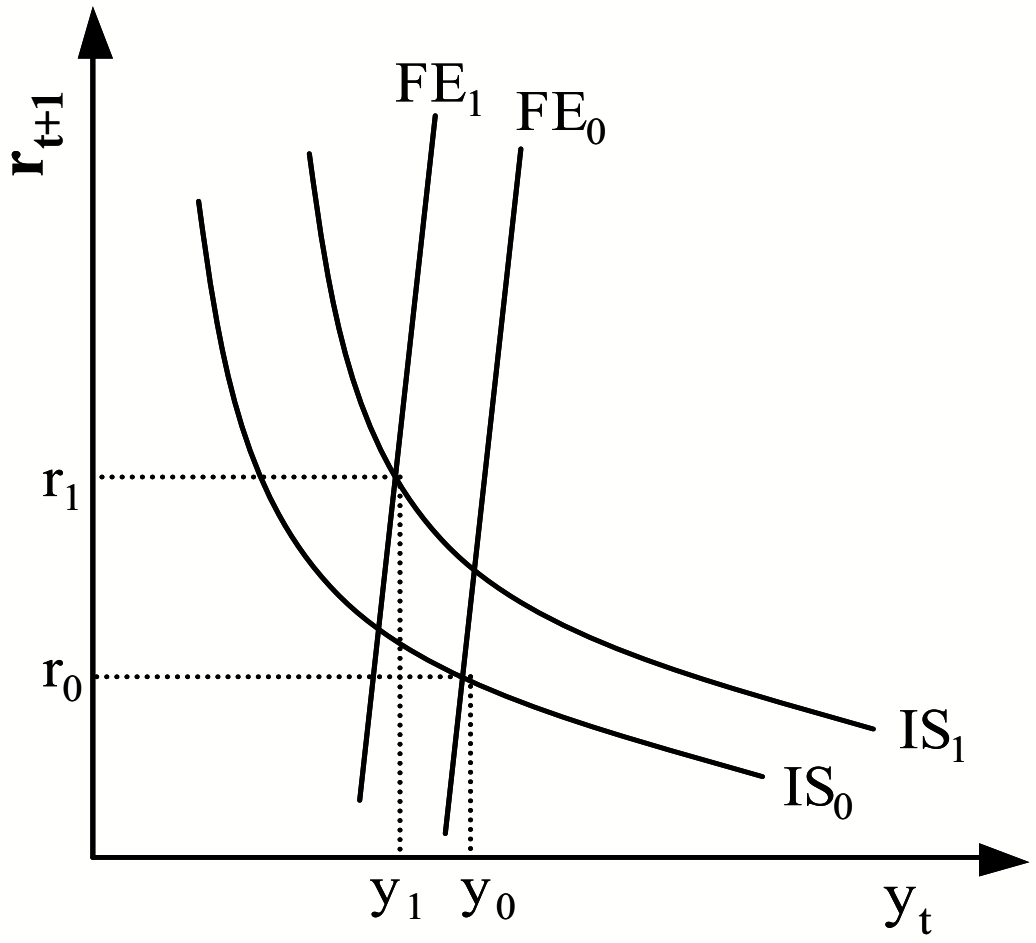


7. (a) Fiscal Policy in the RBC Model

- Utility-enhancing government spending
  - If government spending enhances utility by

$$u\left(c_t, \ell_t, g_t\right) = v\left(c_t, \ell_t\right) + w\left(g_t\right),$$

    the wealth effects of government spending are the same as before.
  - If government spending affects utility by

$$u\left(c_t, \ell_t, g_t\right) = v\left(c_t + \alpha g_t, \ell_t\right), \quad \alpha \in (0, 1),$$

    the wealth effects of government spending (on labor supply) are reduced.

7. (a) Fiscal Policy in the RBC Model

- Production-enhancing-spending (Baxter and King: AER, 1993)
  - Suppose production were given by

$$y_t = e^{(1-\alpha)z_t} k_t^{\alpha} \ell_t^{1-\alpha} g_t^{\theta}, \quad \theta > 0.$$

  - For reasonable values of θ, the productivity effects of increased government spending—especially the effects on capital and labor inputs—dominate the wealth effects.

7. Criticisms and Extensions

(b) Labor markets

- Problem 1
  - $APL = Y/L$ fluctuates too much relative to employment. $\sigma_\ell/\sigma_{y/\ell}$ is too low relative to data.
  - Reason: if IES_L has a value consistent with micro studies ($IES_L < 1$) labor supply curve is steep $\Rightarrow$ productivity-induced shifts in ℓ^d cause small shifts in ℓ and larger shifts in y (and thus y/ℓ).

7. Criticisms and Extensions

(b) Labor markets

- Problem 2
  - APL is too highly correlated with output and hours.
  - Baseline RBC model suggests that $corr\,(y, y/\ell)$, $corr\,(\ell, y/\ell) > 0.9$ (for HP-filtered data).
  - Data suggest that $corr\,(y, y/\ell) \approx 0.5$, $corr\,(\ell, y/\ell) \approx 0$.
  - Reason: single-shock model.

7. (b) Labor markets

- Indivisible labor: Hansen (1985)
  - Large number of identical workers, number normalized to 1.
  - Everybody that works, works $\bar{\ell}$ hours—reflects fixed costs of working.
  - Lotteries: At period t, each person works with probability $\eta_t \Rightarrow$ aggregate labor supply is

$$\ell_t = \eta_t \bar{\ell}.$$

  - Employment insurance: workers and producers agree to η_t and w_t before lottery; each worker receives $w_t \eta_t \bar{\ell}$ whether she works or not.

7. (b) Labor markets

- Indivisible labor: Hansen (1985)
  - Negotiations based on expected utility for agent i:

$$\begin{aligned}
E_t\left(u\left(c_t^i, \ell_t^i\right)\right) &= \ln\left(c_t\right) + E_t\left(\chi \ln\left(1-\ell_t^i\right)\right), \\
&= \ln\left(c_t\right) + \eta_t \chi \ln\left(1-\overline{\ell}\right) \\
&\quad + \left(1-\eta_t\right)\chi \ln\left(1-0\right) \\
&= \ln\left(c_t\right) + \eta_t \chi \ln\left(1-\overline{\ell}\right) \\
&= \ln\left(c_t\right) + \frac{\ell_t}{\overline{\ell}} \chi \ln\left(1-\overline{\ell}\right) \\
&= \ln\left(c_t\right) + \psi \ell_t, \\
\overline{\ell} \in (0,1) &\Rightarrow \psi < 0.
\end{aligned}$$

7. (b) Indivisible labor: Hansen (1985)

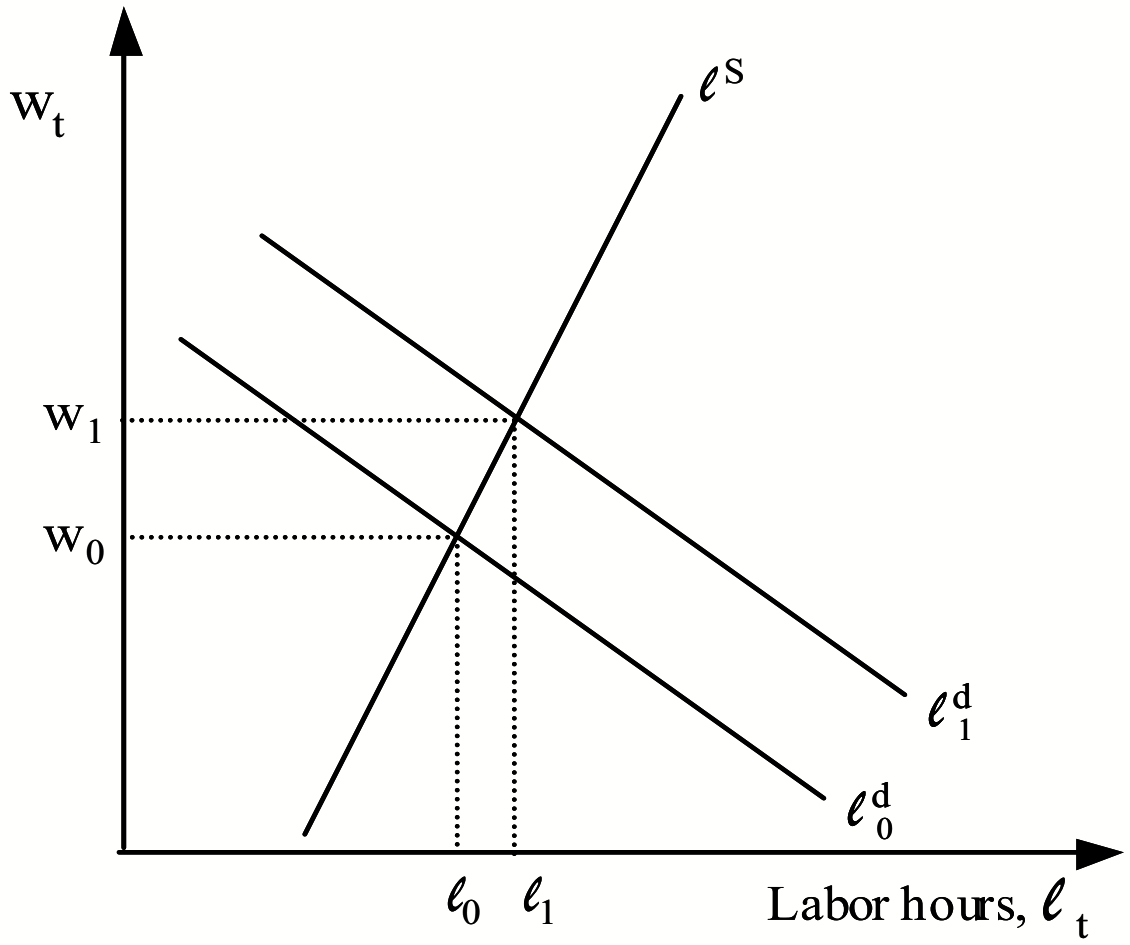
- Expected utility is linear in aggregate labor! More labor supplied $\leftrightarrow$ each worker increases ex-ante probability of being employed.
- Effective $IES_L = \infty$. ℓ^{sf} is horizontal, but income effects make ℓ^s slope up.
- Significantly increases $\sigma_\ell / \sigma_{y/\ell}$, as well as σ_y.
- Data show that 2/3 of variance in labor hours is due to movements along extensive margin (employed vs. unemployed), while 1/3 of variance is due to movements along intensive margin (hours per employed worker).
- Full insurance assumption very unrealistic, especially in U.S. Under full insurance, unemployed workers have higher utility!

7. (b) Labor markets

- Labor supply shocks
  - Address APL correlation issues.
  - Technology shocks shift ℓ^d curve. y, ℓ, and y/ℓ move in same direction. Generates counterfactually high $corr\,(y, y/\ell)\,,\ corr\,(\ell, y/\ell)$.
  - Labor supply shocks cause y and ℓ to move in same direction, but due to diminishing MPL, y/ℓ moves in the opposite direction.
  - Combining technology and labor supply shocks yields more reasonable values of $corr\,(y, y/\ell)$ and $corr\,(\ell, y/\ell)$.

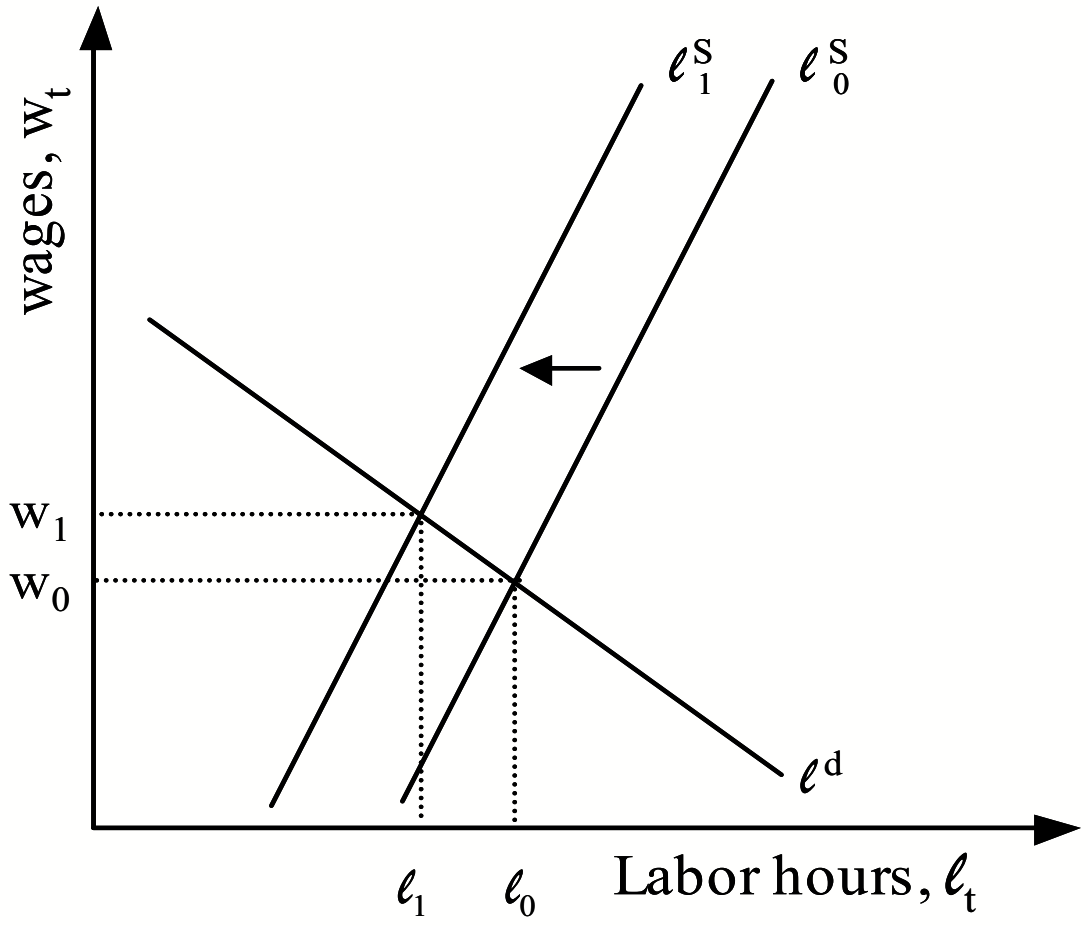
7. (b)

- Technology (labor demand) shocks cause y, ℓ, and y/ℓ to move in same direction.



- Note: Cobb-Douglas $\Rightarrow$ wage = $(1-\alpha)$APL.

7. (b) Labor supply shocks cause y/ℓ to move in the opposite direction of y and ℓ.



7. (b) Labor markets

- Labor supply shocks
  - Utility shocks (Bencivenga, 1992):

$$u\left(c_t, \ell_t\right) = \ln\left(c_t\right) + \chi_t \frac{\left(1-\ell_t\right)^{1-\gamma}}{1-\gamma},$$

    where χ_t is a taste shifter.
  - Government spending with lump-sum taxes (Christiano and Eichenbaum, 1992). Wealth effects.
  - Distortionary taxes (Braun, 1994; McGrattan, 1994).

7. (b) Labor markets

- Labor supply shocks
  - Home production: “leisure” time is spent in productive activities that are not included in formal GDP. Changes in returns to home production can change willingness to work. (Digression: does economic “growth” reflect the transfer of home production to market providers?)

7. Criticisms and Extensions

(c) Technology Shocks

- Criticism 1: no independent evidence for technology shocks.
  - Hard to identify specific shocks.
  - Negative shocks $\Rightarrow$ technological regress?
  - Oil price shocks act like technology shocks, but are best modelled separately.
- Criticism 2: the Solow residual is correlated with demand shocks.

7. Criticisms and Extensions

(c) Technology Shocks

- Labor hoarding
  - Measured labor hours don’t account for intensity of effort.
  - During recessions, reduce effort rather than hours.
  - During expansions, increase effort, rather than hours.
  - Can reflect matching and training costs, implicit insurance.

7. (c) Labor hoarding

- Suppose output is given by:

$$Y_t = K_t^{\alpha} \left(A_t L_t U_t\right)^{1-\alpha},$$

where U_t denotes utilization (effort).

- The true Solow Residual is

$$\begin{aligned} SR_t &= \Delta \ln\left(Y_t/L_t\right) - \alpha \Delta \ln\left(K_t/L_t\right) \\ &\quad - \left(1-\alpha\right) \Delta \ln\left(U_t\right). \end{aligned}$$

But the conventional Solow residual is

$$\begin{aligned} \widehat{SR}_t &= \Delta \ln\left(Y_t/L_t\right) - \alpha \Delta \ln\left(K_t/L_t\right) \\ &= SR_t + \left(1-\alpha\right) \Delta \ln\left(U_t\right). \end{aligned}$$

7. (c) Labor hoarding
   - Increases in utilization are mistaken for increases in productivity.
   - Addresses Criticism 2: Demand shocks increase utilization and thus increase utilization-unadjusted Solow residual.
   - Keynesian AD-AS model with sticky wages, demand-driven fluctuations and no labor hoarding implies that $corr\,(y, y/\ell) < 0$. Data shows $corr\,(y, y/\ell) \approx 1/2$. Adding labor hoarding can generate a positive correlation.
   - Burnside, Eichenbaum and Rebelo (1993) show that an RBC model with labor hoarding can explain the correlation between government spending and the Solow residual.

7. Criticisms and Extensions

(d) Propagation Mechanisms

- Propagation mechanisms: Economic dynamics that extend and transform the effects of an exogenous shock.
- Propagation mechanisms in the baseline RBC Model
  - Intertemporal substitution of labor: higher productivity today induces more work today.
  - Capital accumulation
  - Problem 1: Without indivisible labor, small IES_L implies small labor propagation.
  - Problem 2: Capital accumulation generates little propagation. Even with indivisible labor, the dynamics of output are the dynamics of technology.

7. Criticisms and Extensions

(d) Propagation Mechanisms

- Persistence problem (Cogley and Nason, 1995): RBC models that use measured Solow residuals cannot produce
  - A positive autocorrelation in output growth (not output).
  - (Note: Solow residuals follow AR(1) with $\rho \leq 1$.)
  - A "hump-shaped" impulse response function for transitory shocks

7. Criticisms and Extensions

(d) Propagation Mechanisms

- Generating persistence
  - Key idea: slow down the economy's response to the initial shock.
  - Labor search (Merz, 1995; Andolfatto, 1996) : Employers and workers need time to make matches.
  - Finance constraints (Carlstrom and Fuerst, 1997; Bernanke, Gertler and Gilchrist, 1999): Over time, higher productivity allows firms to borrow more.
  - Factor hoarding (Burnside, Eichenbaum and Rebelo, 1996): Firms first increase effort and capital utilization, then increase hours and capital.