Wages ↑ → Income effect → employment ↓
→ Substitution effect → employment ↑.
↑
Prod. shock

RBC fits co-movements of output, employment, productivity, consumption, and investment.

However, this generates implausible labor supply elasticities.
- certain shocks do not generate effects in the model but seem to in the real world.

$$\frac{dN}{N} = -\frac{dL}{L}\frac{L}{N} = -\frac{dL}{L}\frac{1-N}{N} = \frac{1-N}{N}\frac{dw}{w} \Rightarrow \frac{dN}{dw}\frac{w}{N} = \frac{1-N}{N}$$

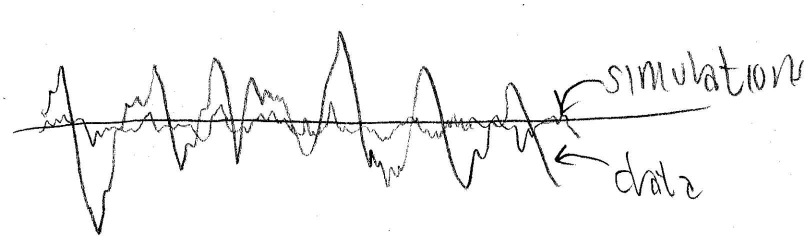
King-Rebelo assumes $\bar{N} = 0.2$ (20% of our time is spent working.)

$$\Rightarrow \frac{dN}{dw}\frac{w}{N} \equiv \eta = \frac{0.8}{0.2} = 4$$

- labor supply elasticity.

If $\bar{N} = 0.5$, then $\eta = 1$. (more realistic if we don't consider sleep as leisure)

Empirical estimates show $\hat{\eta} < 1$. However, even if we assume $\eta = 1$, we don't get nice movements in the simulations.



Deeper criticisms

$\underbrace{\text{Intensive margin}}_{\text{do I work 7 or 8 hours?}}$ vs. $\underbrace{\text{extensive margin}}_{\text{do I work at all?}}$

- cannot separate out the two effects in RBC model w/ homogeneous agents.

Complication 1: If work 8 hours or not work is the only decision, wealth will differ, so consumption will differ, and hence reservation wage will differ.
- This will give us a sloped labor supply curve.

Complication 2: This is still a theory of voluntary unemployment.
- What about job search?
- Implications for "wage setting relation" will be covered in 14.454.
- This is a totally unsolved issue.

Technological shocks

- Evidence of low frequency movements
  - TFP$_{\text{growth}}\downarrow$ from 1973 – 1990, TFP$_{\text{growth}}\uparrow$ since
  - will argue that high frequency movements are primarily measurement error.
- Productivity slumps associated with slumps in output.
- Diffusion of technological progress is smooth
  - Takes a while for innovations to spread

Solow Residual

- $Y = F(K, N, A)$. Want F_A
- $$\frac{dY}{Y} = \frac{F_K K}{Y}\frac{dK}{K} + \frac{F_N N}{Y}\frac{dN}{N} + \frac{F_A A}{Y}\frac{dA}{A}$$
  $$= \frac{F_K dK + F_N dN + F_A dA}{Y}$$

Let $P = MC = W/F_N = R/F_K \Rightarrow F_K = \frac{R}{P},\ F_N = \frac{W}{P}$

$$\Rightarrow \frac{dY}{Y} = \underbrace{\frac{\overbrace{RK}^{\equiv \alpha_K}}{PY}}_{\text{share of capital in value-added}}\frac{dK}{K} + \underbrace{\frac{\overbrace{WN}^{\equiv \alpha_N}}{PY}}_{\text{share of labor in value added}}\frac{dN}{N} + \frac{F_A A}{Y}\frac{dA}{A}$$

Let $\frac{dX}{X} = \alpha_K \frac{dK}{K} + \alpha_N \frac{dN}{N}$

$$\Rightarrow S = \frac{dY}{Y} - \frac{dX}{X}$$

If you regress: $\frac{dY}{Y} = 1.16\,S + 0.36\,S(-1) + \varepsilon$, get $\bar{R}^2 = 0.82$

Don't need many assumptions to get this, but you <u>do</u> need assumptions:

- No costs of adjustment: understates cost of labor/capital.
- Markets might not be competitive

- Quarter-to-quarter, there are likely movements in N or K that are not measured. (ie effort, capacity utilization)

Suppose markup pricing:

Let $P = (1+\mu) MC$

Then $P = (1+\mu) \frac{W}{F_N} \Rightarrow F_N = (1+\mu)\frac{W}{P}$

$$F_K = (1+\mu)\frac{R}{P}$$

$$\Rightarrow S = \frac{dY}{Y} - (1+\mu)\frac{dX}{X}$$

$$= \underbrace{\frac{dY}{Y} - \frac{dX}{X}}_{\substack{\hat{S} \\ \text{measured Solow residual}}} - \mu\frac{dX}{X} = \hat{S} - \mu\frac{dX}{X}$$

- If $\mu = 0$, no problem.
- In a boom, $\frac{dX}{X} > 0 \Rightarrow \hat{S} \uparrow$, but $S \uparrow$ by less.
    - S may be less procyclical
- If assume $\mu = 0.1$ or $\mu = 0.2$, less procyclicality. If $\mu = 0.5$, eliminate procyclicality

Unobserved input

$N = \underbrace{B}_{\#\text{workers}} \underbrace{H}_{\text{hours}} \underbrace{E}_{\text{effort}}$ observe only B, H

$$S = \frac{dY}{Y} - \left[\alpha_K \frac{dK}{K} + \alpha_N\left(\frac{dB}{B} + \frac{dH}{H} + \frac{dE}{E}\right)\right]$$

$$= \underbrace{\frac{dY}{Y} - \alpha_K \frac{dK}{K} - \alpha_N \frac{dB}{B} - \alpha_N \frac{dH}{H}}_{=\hat{S}} - \alpha_N \frac{dE}{E}$$

$$= \hat{S} - \alpha_N \frac{dE}{E}$$

- How can we measure effort?
- BLS: effort ↑ ⇒ accidents ↑

- same issue here.

$$S = \frac{dY}{Y} - \underbrace{(1+\mu)\frac{dX}{X}}_{\text{markup pricing}} - \underbrace{(1+\mu)\alpha_N \frac{dE}{E}}_{\text{unobserved effort}}$$

$$\Rightarrow \underbrace{\frac{dY}{Y}}_{\text{observable}} = \underbrace{(1+\mu)\frac{dX}{X}}_{\text{observable}} + \underbrace{(1+\mu)\alpha_N \frac{dE}{E} + S}_{\text{error term}}$$

- likely to have correlation between $\frac{dX}{X}$ and error term.

Suppose $\frac{dH}{H} \simeq \frac{dE}{E}$. Then can "observe" $\frac{dE}{E}$

- Still have correlation b/t $\frac{dX}{X}$ and S

- Need instruments: gov't spending, oil price, federal funds changes.
  - Weak instruments.
- Find $\mu \approx 1$. This and the correction in $\frac{dE}{E}$ leads to acyclicality of Solow residual.

- Point estimate of initial impact of productivity shock is negative: countercyclical Solow residual?
- Man hours seems to decrease in response to positive productivity shocks.
  - very different than RBC model.

SVAR approach

- Don't look at Solow residual
- Claim: shocks which have LR effect on level of productivity are technological shocks.
- Bivariate VAR in $\Delta \log(Y/N)$ and $\Delta \log(N)$