Lecture 18
The Real Business Cycle Model
Part 5: Application and Matching Data

Hui-Jun Chen

National Tsing Hua University

October 29, 2025

Overview

- Recall that in Lecture 13, there is no production in dynamic model.
- The following 5 lectures is for **Real Business Cycle** (RBC) model:
  - Lecture 14: consumer
  - Lecture 15: firm
  - Lecture 16: competitive equilibrium
  - Lecture 17: formal example
  - Lecture 18: application to bring RBC to data

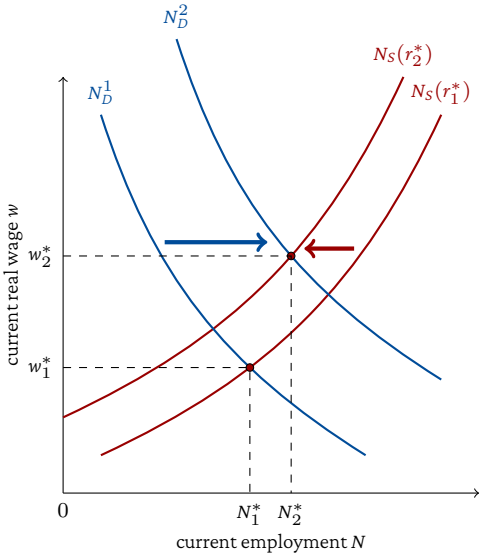
Outline

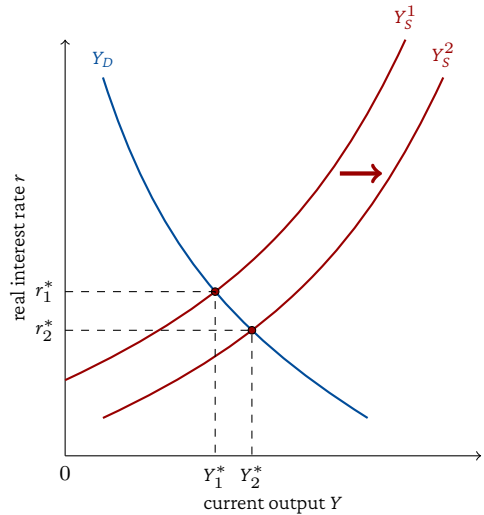
Analysis on $z \uparrow$

Suppose current TFP increases from z_1 to z_2, $z_2 > z_1$

- labor demand (firm): $z \uparrow \Rightarrow MPN \uparrow$, and thus $N_{D,2} > N_{D,1}, \forall w$
- labor supply (consumer): no direct effect, but $r^* \downarrow$ leads to $N_S(r)$ shifts in
- labor market clearing: demand $\uparrow$, $w \uparrow$, and $N^*(r) \uparrow$, hold r fixed
- output supply: shifts out $\because$ labor market, $Y_{S,2}(r) > Y_{S,1}(r), \forall r$
- output demand: no effect, only move along the curve, because
  - firm: current TFP is not changing optimal investment schedule
  - consumer: no direct effect
  - government: no direct effect

Equilibrium Effects of $z \uparrow$





Taking Stock: $z \uparrow$

Output supply curve shifts out, while output demand remain the same

- output $\uparrow$, $Y_2 > Y_1$
- real interest rate $\downarrow$, $r_2 < r_1$
- decreases in r make labor supply shifts in
  - saving S become less desirable, so no need to work that much
- wage increase because of the shifts in demand and supply
- effect on N^* is theoretically ambiguous, yet data shows that the effect of intertemporal substitution of leisure ($N_S \downarrow$) is small

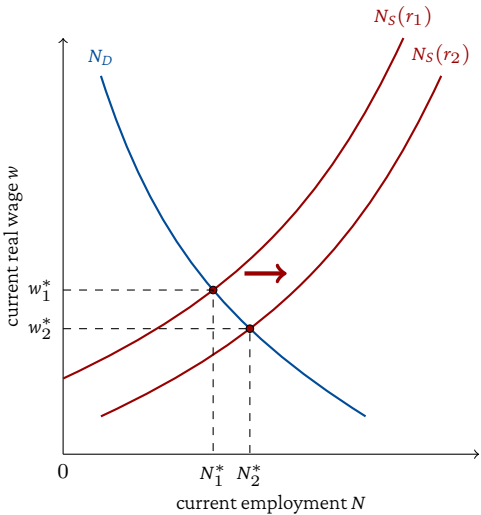
Recall **business cycle facts**: procyclical labor, real wage, and average labor productivity.
All consistent with model prediction!

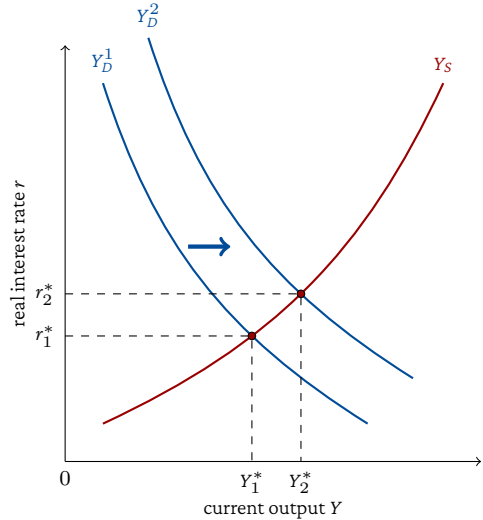
Outline

Analysis on $z' \uparrow$

- labor demand: no direct effect
- labor supply: no direct effect, yet $r \uparrow$ cause supply to shift to the right
- output supply: no direct effect
- output demand: higher $z' \Rightarrow$ higher $MPK' \Rightarrow$ firm's investment demand is higher $\Rightarrow$ demand shifts to the right
  - no direct effect from consumer and government

Equilibrium Effect of $z' \uparrow$





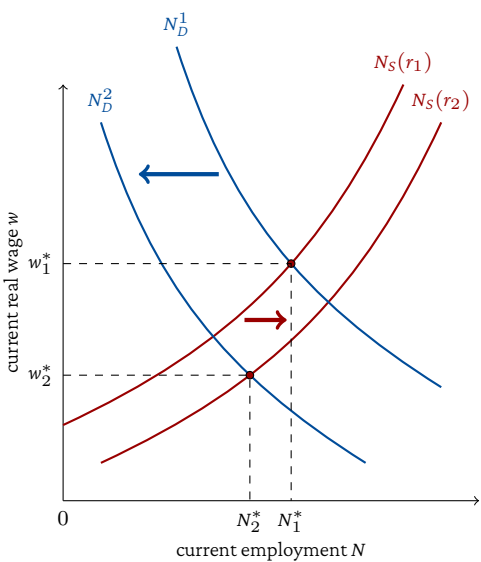
Outline

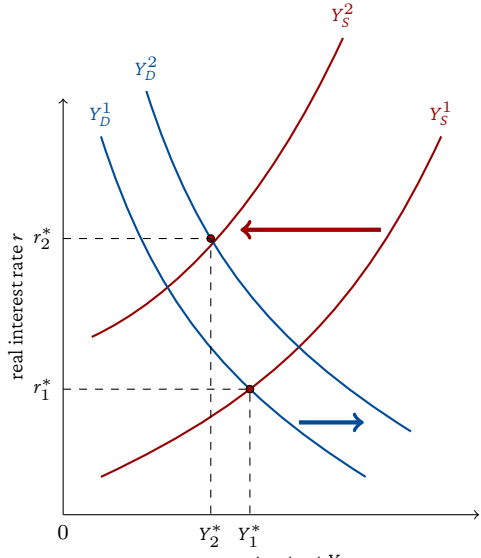
Analysis on Destruction of Initial Capital $K \downarrow$

Suppose a natural disaster destroys some initial capital: $K_1 \to K_2$, where $K_2 < K_1$.

- labor demand: $K \downarrow \Rightarrow MPN \downarrow \Rightarrow N_D^2(w) < N_D^1(w), \forall w$
- labor supply: no direct effect, but $r^* \uparrow \Rightarrow N_S(r) \downarrow$
- labor market clearing: lower wage and quantity of labor, hold r fixed
- output supply: shifts in, $\because$ labor market effects, $Y_S^2(r) < Y_S^1(r), \forall r$
- output demand: shifts out, because
  - firm: $K \downarrow$, so must $I_D \uparrow$ to meet same amount of K'
    - remember capital accumulation process $K' = I_D + (1 - \delta)K$
  - consumer and government have no direct effects

Equilibrium Effect of $K \downarrow$





Outline

Analysis on Government Spending Increase $G \uparrow$

Suppose $G \uparrow$, holding G' fixed. This is more complicated...

- example: wartime spending (WWII), Stimulus in recession (COVID check)

Need to trace individual decisions and market clearing conditions to find **overall equilibrium effect**.

- simplification: assume *MPC* is constant
- interpretation: slope < 1 in output demand curve
- example: $U(C, C') = \ln C + \beta \ln C' \Rightarrow C' = \beta(1+r)C$, which implies

$$C = \frac{1}{1+\beta}\left(Y - T + \frac{Y' - T'}{1+r}\right) \Rightarrow \frac{dC}{dY} = \frac{1}{1+\beta}$$

Impact on Output Demand

$G \uparrow$ causes a Δ amount of shift in the output demand curve. How big is Δ, and where do the change comes from?

1. direct effect: $G_2 - G_1 > 0$
2. indirect effect: increase in taxes decreases the consumption
   - $\because G_2 > G_1, T_2 + \frac{T_2'}{1+r} > T_1 + \frac{T_1'}{1+r}$, and thus consumer's income $\downarrow$ by the amount of $G_2 - G_1$.
   - effect on consumption: $MPC \times (G_2 - G_1)$
3. indirect effect: consumer perceives as Y_D changes Δ amount, and thus consumption changes.
   - translate to consumption: $MPC \times \Delta$

$$\Delta = G_2 - G_1 + MPC \times (G_2 - G_1) + MPC \times \Delta \Rightarrow \Delta = G_2 - G_1$$

note: more complicated if MPC is not constant, or varies across people!

Impact on Output Demand (Cont.)

The elasticity of output demand with respect to government spending is defined as the **demand multiplier**:

$$m_D = \frac{\Delta}{G_2 - G_1} = 1$$

- implication: rightward shift of the demand curve is exactly 1-1

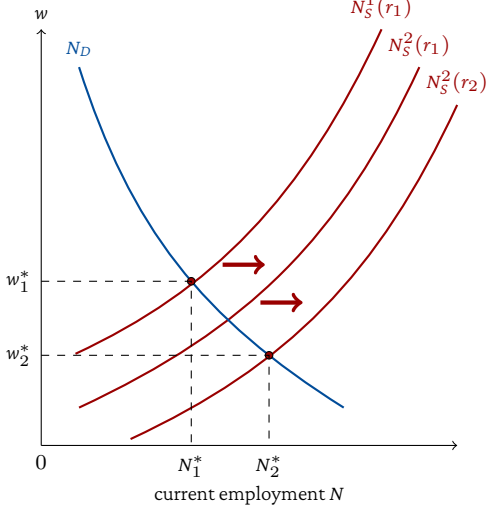
- because of 1-1 relationship, we know $Y_D^2(r) = Y_D^2(r) + \Delta$

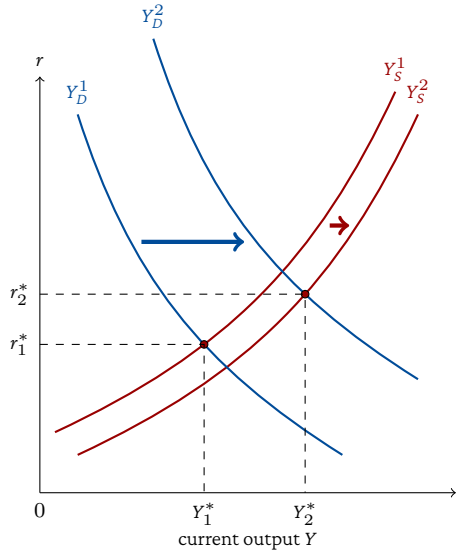
Impact on Output Supply

- labor demand: no effect
- labor supply: outward shift, $\because$ wealth effect of T, $T' \uparrow$
  - holding r fixed, $N_S^2(r_1) > N_S^1(r_1)$
  - in equilibrium of next slide, $r^* \uparrow$, and thus saving become desirable, $N_S^2(r_2) > N_S^2(r_1)$
- output supply: shifts out, given labor supply shifts

Combine effects: $Y^* \uparrow$, $N^* \uparrow$, $w^* \downarrow$, yet r^* depends on the amount of movement for both demand and supply.

Equilibrium Effect of $G \uparrow$





Taking Stock: Output

What is the total government expenditure multiplier?

- definition: the **equilibrium** (as opposed to demand or supply only) ratio of increase in output to the increase in government spending.

- result: must is less than 1 without "large" shifts in supply curve
  - shift in output demand curve is $G_2 - G_1$ for each r
  - supply curve slopes up: equilibrium effect $< G_2 - G_1$ (before shift)
  - what determines size of supply curve shift?
    - size of wealth effect on labor supply (small)
    - size of intertemporal substitution effect on labor supply (small)
  - "Keynesian" stimulus: multiplier may be positive in recessions, but need some sort of economic inefficiency for this result.

Taking Stock: Everything Else

Imagine supply curve is horizontal:

- equilibrium effect: $Y_2 - Y_1 = G_2 - G_1$, no change in r
- would have to come from no change in consumer's lifetime wealth, and so would induce no change in current consumption.

With upward slope sufficient to make $r_2 > r_1$ (empirically plausible case):

- consumption falls due to intertemporal substitution effect
- investment falls due to higher opportunity cost of investing in capital
- "crowding out:" government expenditures here also limit future production
- total: higher output, but at what cost?