Lecture 14. Final Exam Review

The Final Exam

- Online. June 1 (Mon). 9:30 am – 11:00 am. Do not be late.
- **Open-book**.
- Please bring your **student ID**.
- Joint a Zoom meeting via Canvas.
    - Turn on your camera and **turn off your mic**.
    - There are two sessions. Choose one based on your family name.
    - Change your Zoom account name to your **Official Name**, e.g., “LEE, Byoungchan.”

Arrangements

- A Dry Run: Please try the pre-exam check-up quiz, which can be found in Quizzes tab. The final exam will be in a similar format.

- In terms of time, the exam duration will be very *tight*.
- So, focus on your own exam and use your time wisely.

What we have studied so far…

- Lecture 8 / Blanchard, Chapter 7: The Labor Market
- Lecture 9 / Blanchard, Chapter 8: The Phillips Curve
- Lecture 10 / Blanchard, Chapter 9: The IS-LM-PC Model

- Lecture 11 / Blanchard, Chapter 10: The Facts of Growth
- Lecture 12 / Blanchard, Chapter 11: The Solow Model
- Lecture 13 : Technological Progress

Markets and curves

- Goods (and services) Market + Financial Markets + Labor Market

	Keynesian cross	Money market	PS and WS
	↓	↓	↓
• (Y, i or r)	IS	LM	↓
• (u, π)			PC
			↓
• (Y, π)			PC (relation)

- We introduce price, wage, (un)employment, and production to our framework.

Business Cycles in The Short and Medium Run

The Natural Rate of Unemployment

- The equilibrium (or natural) rate of unemployment u when $P^e = P$.

- The Wage-Setting Relation:

$$W = \mathcal{A}P^e F(u, z) \quad \Rightarrow \quad \frac{W}{P} = \mathcal{A}F(u, z)$$

- +

- The Price-Setting Relation:

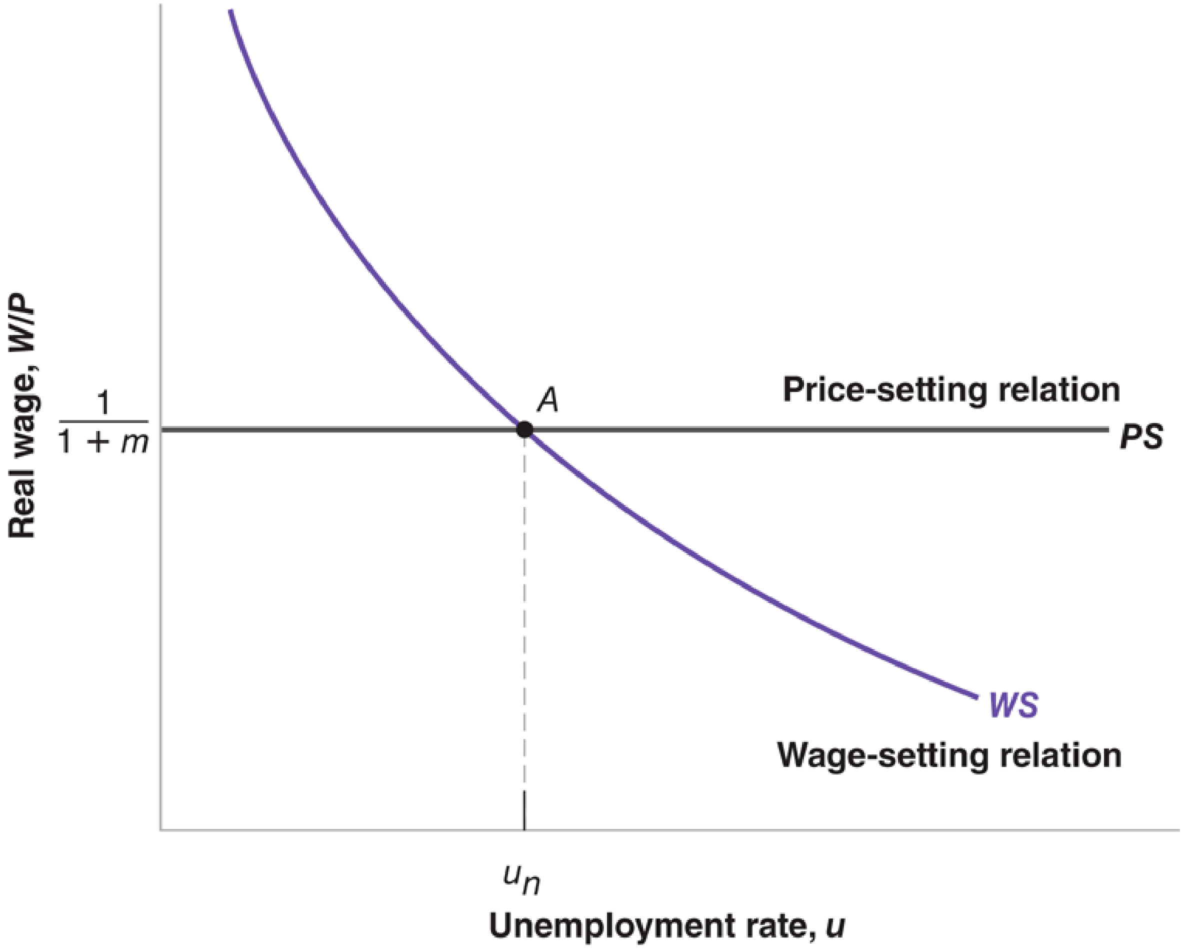
$$P = (1+m)\frac{W}{\mathcal{A}} \quad \Rightarrow \quad \frac{W}{P} = \frac{\mathcal{A}}{1+m}$$

- WS Relation: $W/P = \mathcal{A}F(u, z)$
- PS Relation: $W/P = \mathcal{A}/(1+m)$

- The natural rate of unemployment u_n satisfies the following condition:

$$F(u_n, z) = \frac{1}{1+m}$$

- It depends on z and m.
- What happens when $m\uparrow$?



The Phillips curve

- $\pi_t = \pi_t^e + (m + z) - \alpha u_t = \pi_t^e - \alpha(u_t - u_n)$, where $u_n = \frac{m+z}{\alpha}$.

- Interpretation
- u_t: As $u_t \uparrow$, the bargaining power of workers decreases.
  - $\rightarrow$ $W_t \downarrow$ (WS Relation)
  - $\rightarrow$ marginal costs of production $\downarrow$
  - $\rightarrow$ $P_t \downarrow$ (PS Relation)
  - $\rightarrow$ Given P_{t-1}, $P_t \downarrow$ implies $\pi_t \downarrow$.

The Phillips curve relation

- The Phillips curve: $\pi_t - \pi_t^e = -\alpha(u_t - u_n)$

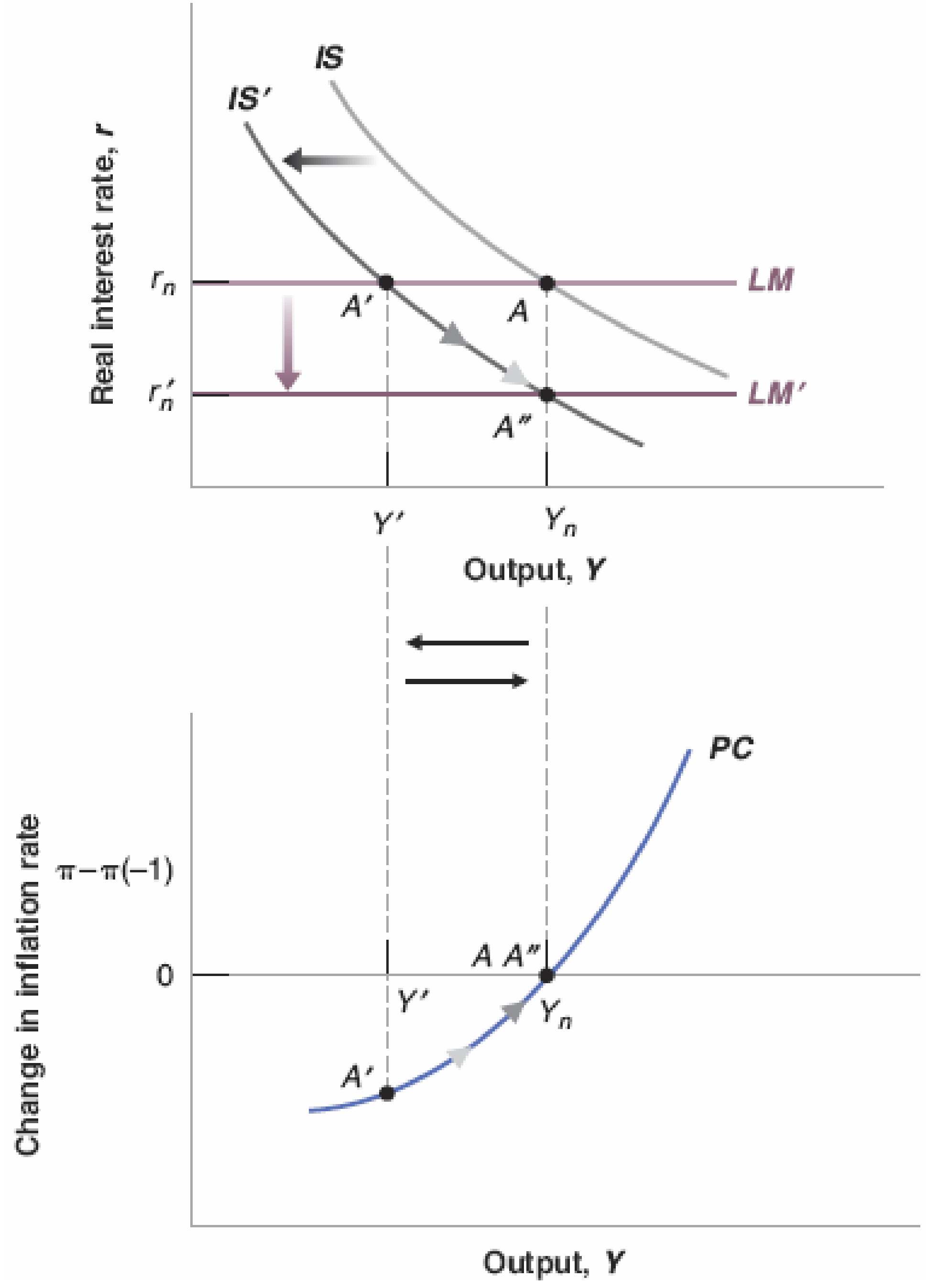
- $\underbrace{u_t - u_n}_{\text{unemployment gap}} = \left(1 - \frac{1}{\mathcal{A}}\frac{}{L}\right) - \left(1 - \frac{1}{\mathcal{A}}\frac{}{L}\right) = -\frac{1}{\mathcal{A}L}\underbrace{(Y_t - Y_n)}_{\text{output gap}}$

- The PC Relation: $\pi_t - \pi_t^e = \frac{\alpha}{\mathcal{A}L}(Y_t - Y_n)$

A Fiscal Consolidation

- SUPPOSE THAT $\pi_t^e = \bar{\pi}$.
- Assume that $Y = Y_n$ initially (Point A)
- What happens if the government increases T to reduce its debt?

- In the short run, the IS curve ←. Point A' becomes the short-run equilibrium.
- Overtime, the CB observes that π is low. So, it lowers i (and r).
- This process continues until the LM curve shifts to the LM'.
- The medium-run equilibrium is represented by point A''.



In the short run (A vs. A')

- Y decreases.
- r does not change.
- How about the following variables?
  - C
  - I
  - G
  - $G-T$
  - u
  - W/P
  - π
  - i

In the medium run (A vs. A'')

- Y does not change.
- r decreases.
- How about the following variables?
  - C
  - I
  - G
  - $G - T$
  - u
  - W/P
  - π
  - i

Economic Growth in The Long Run

The aggregate production function

- $Y = F(K, N)$
- Constant returns to scale $\Rightarrow y = \frac{Y}{N} = F\left(\frac{K}{N}, 1\right) = f(k)$
- An example: $Y = \mathcal{A}K^{\alpha}N^{1-\alpha}$, where $0 < \alpha < 1$.

Divide both hand sides by N.

$$\Rightarrow \quad y = \frac{Y}{N} = \mathcal{A}K^{\alpha}\frac{N^{1-\alpha}}{N} = \mathcal{A}K^{\alpha}N^{-\alpha} = \mathcal{A}\left(\frac{K}{N}\right)^{\alpha} = \mathcal{A}k^{\alpha}.$$

- To make y grow, we need to make either k or $\mathcal{A}$ grow.

output per worker capital per worker or productivity

The evolution of the capital stock

- The evolution of K_t:

$$K_{t+1} = (1-\delta)K_t + I_t,$$

where capital depreciates at rate δ.

- Given that N is constant and $I_t = sY_t$,

$$\frac{K_{t+1}}{N} = (1-\delta)\frac{K_t}{N} + \frac{I_t}{N} = (1-\delta)\frac{K_t}{N} + s\frac{Y_t}{N}$$

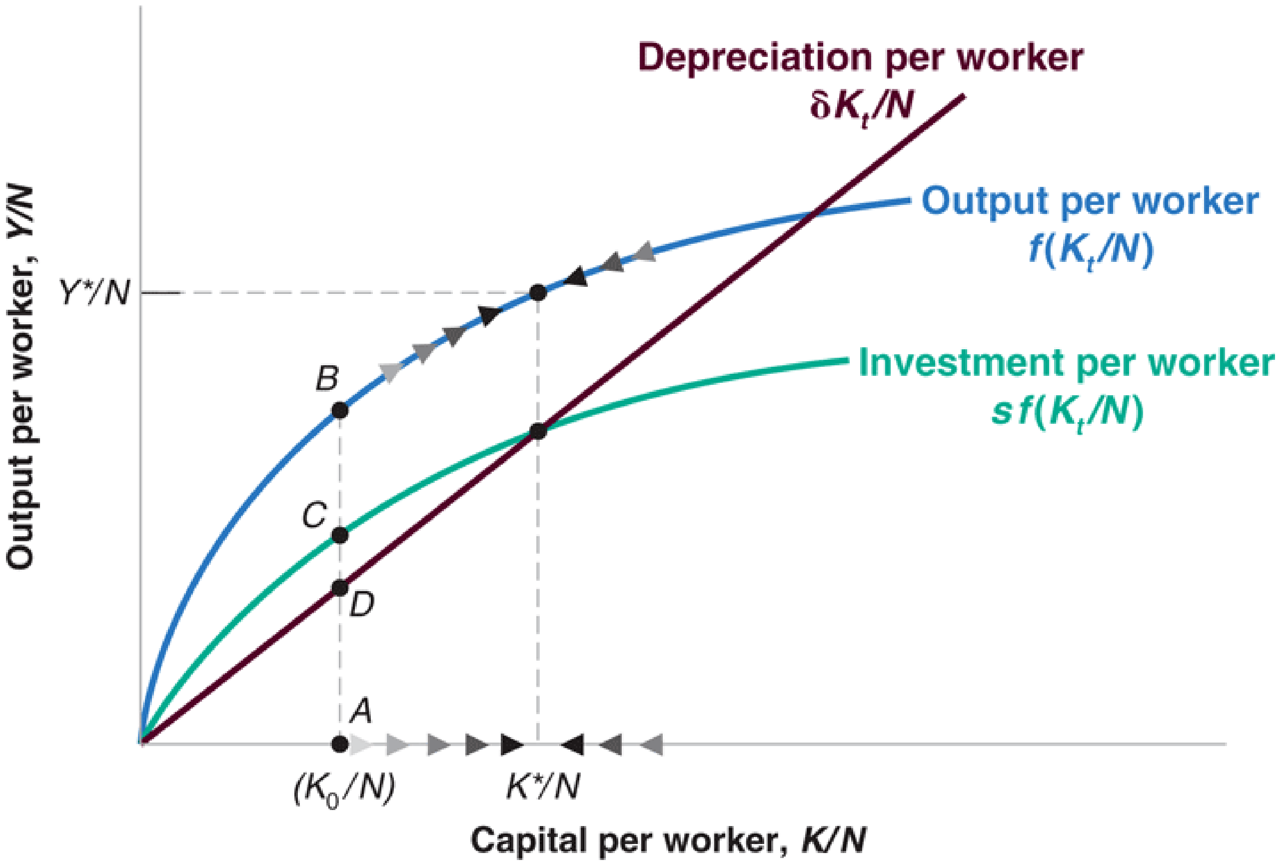
$$\begin{aligned} \Rightarrow \quad k_{t+1} &= (1-\delta)k_t + sy_t \\ &= (1-\delta)k_t + sf(k_t) \\ \Rightarrow \quad \Delta k_{t+1} &= sf(k_t) - \delta k_t \end{aligned}$$

$$\Delta k_{t+1} = sf(k_t) - \delta k_t$$

- $k_t < k^* \Rightarrow \Delta k_{t+1} > 0$, i.e., $k \uparrow$
- $k_t > k^* \Rightarrow \Delta k_{t+1} < 0$, i.e., $k \downarrow$

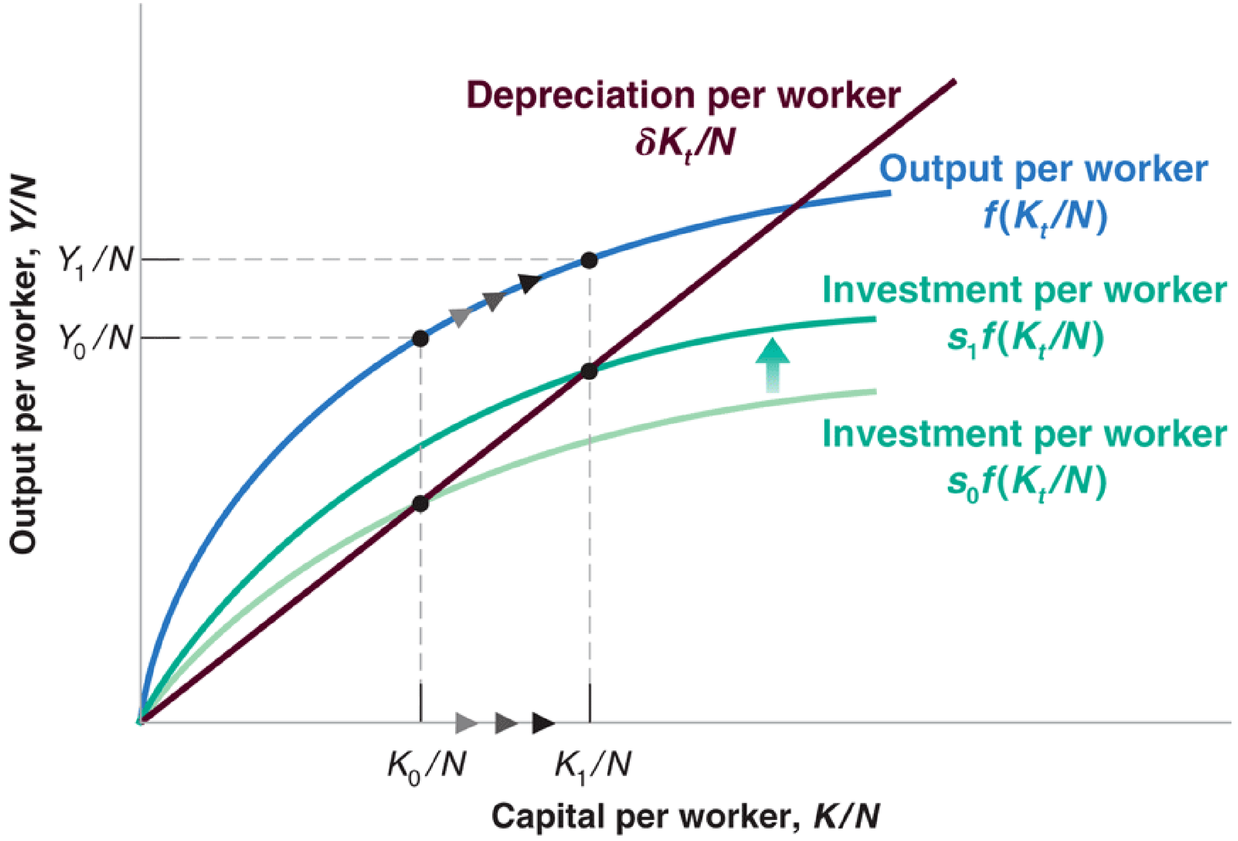
- The steady state of the economy:
$$k_t = k^* \Rightarrow k_{t+1} = k_{t+2} = \cdots = k^*$$
$$\Rightarrow y_t = y_{t+1} = \cdots = f(k^*)$$

- k^* satisfies
$$sf(k^*) = \delta k^*.$$

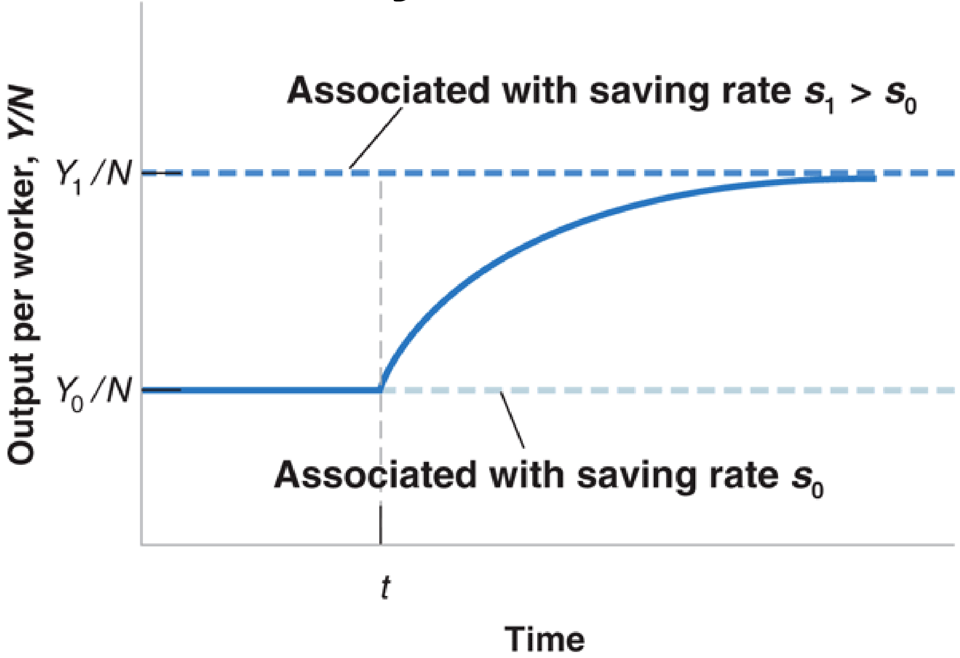


The saving rate, s, increases from s_0 to s_1

- k starts to grow from $k_0(=$



y and g_y

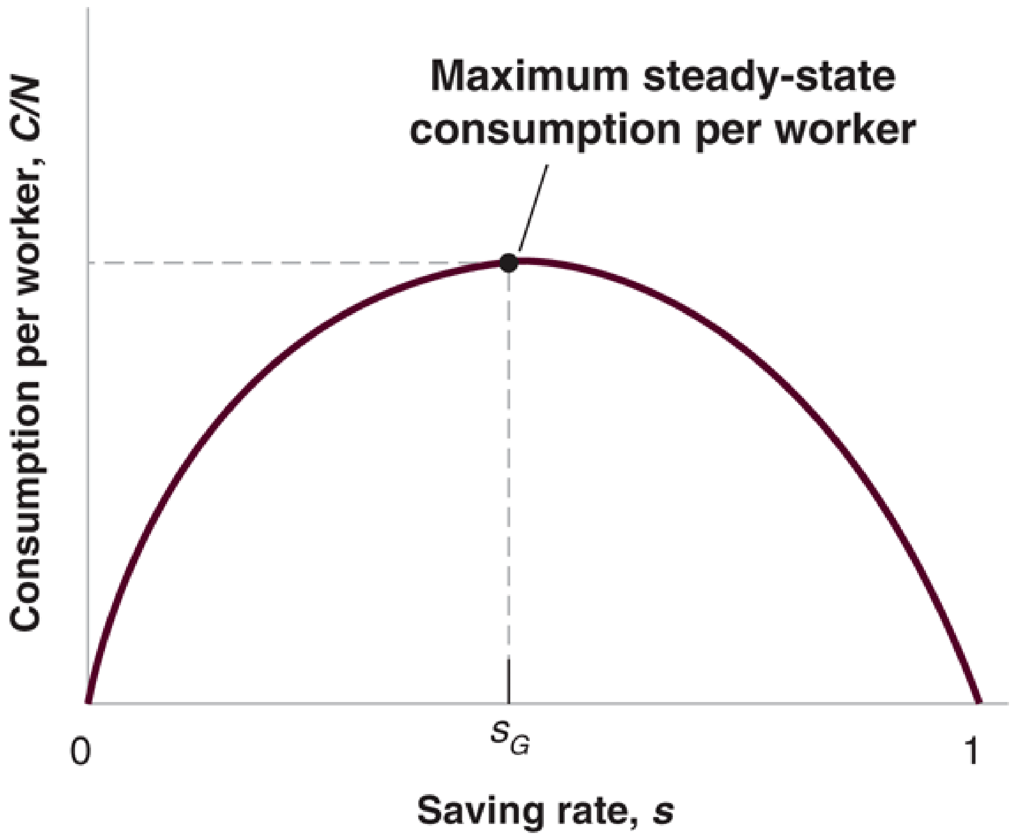


- The saving rate has no effect on the long-run growth rate of output per worker, which is equal to zero.
- Nonetheless, the saving rate determines the level of output per worker in the long run.
- An increase in the saving rate will lead to higher growth of output per worker for some time, but not forever.

$$c^* = (1 - s)f(k^*)$$

- As $s \uparrow$, $(1 - s) \downarrow$ and $f(k^*) \uparrow$.
- There exists the *golden-rule* rate of saving, s_G, that maximizes c^*. The corresponding value of k^* is the golden-rule level of capital (per worker).

- $s < s_G \quad \Rightarrow \quad s \uparrow$ increases c^*
- $s > s_G \quad \Rightarrow \quad s \uparrow$ decreases c^*



Growth in the steady state

- When N grows at the rate of $g_N \neq 0$ and $\mathcal{A}$ at $g_{\mathcal{A}} \neq 0$, we can still use the Solow model (if you're interested, read Chapter 12).

- In steady state, $\frac{K_t}{N_t}$ and $\frac{Y_t}{N_t}$ grow at the rate of $g_{\mathcal{A}}$.
- Similarly, K_t and Y_t grow at the rate of $g_{\mathcal{A}} + g_N$.

- Once an economy is close enough to its steady state, technology/productivity $\mathcal{A}$ becomes the key driver of a sustained economic growth!