Macroeconomics:
Emphasizing Constructs that Work

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Macroeconomics: What works?

- Macroeconomic concepts – challenges
  - Some frameworks hold up to recent events
    - No framework appears consistent with all events
- Today, we'll concentrate on central concepts
  - Several distinct models linked by the "target"
    - Macroeconomic concepts; macroeconomic explanations
- Explaining Short-term Fluctuations (first)
- Addressing the concept of long-run Growth

Money, Banking and Financial System

- Reserve requirement and the banking system
  - Reserve requirements
    - Regulatory requirements imposed on banks.
      - “Within limits specified by law, the Board of Governors has sole authority over changes in reserve requirements.”
        - http://www.federalreserve.gov/monetarypolicy/reservereq.htm
        - Details are “complicated” but the concepts are standard
    - Determine the maximum amount of demand deposits the bank can maintain for a given amount of bank reserves
    - RR = .10 for transactions account exceeding $58.8 Million.
      - Effective 12/30/2010

Reserve Requirements and the money multiplier

- Simple deposit multiplier:
  - $\Delta D = \Delta R \ \{1/(r_d\ )$

    where D = deposits ,

    R = reserves, and

    r_d = required reserve ratio.

    - The maximum change in checkable deposits as a result of a change in reserves = the simple deposit multiplier.

Inaccurate Assumptions of the Simple Deposit Multiplier

- All excess reserves are loaned out (especially important now).
  - Banks are holding HUGE excess reserves right now

- The Fed acts to set the monetary base – B = C + R
  - B is monetary base, C is currency, and R is bank reserves.
  - Behavior of nonbank public and banks also influences money supply.
    - E.g., banks can borrow at the discount window,

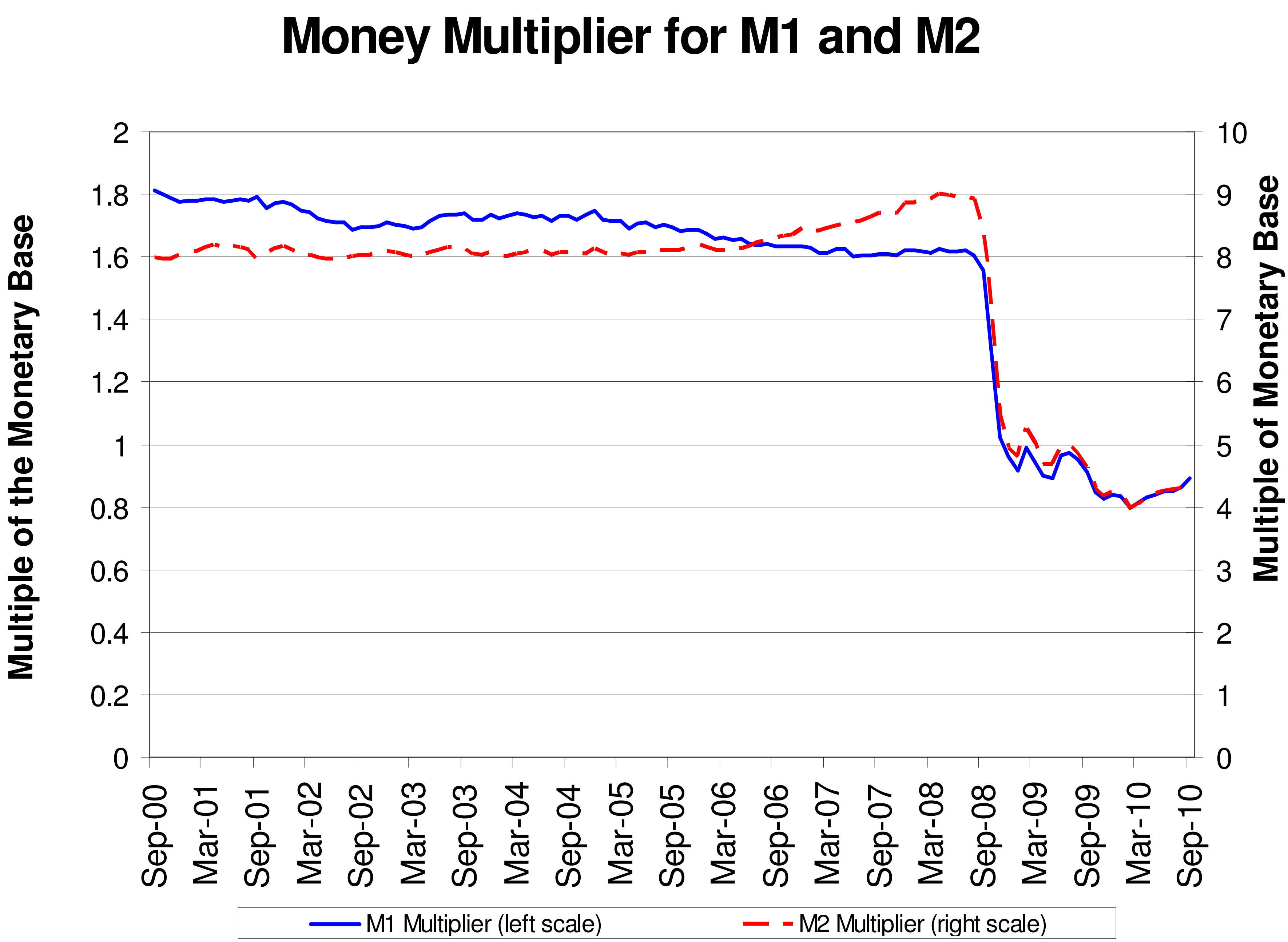
- The proportion of cash to checkable deposits (the **currency-deposit ratio**, (*C/D*)).
  - Changes in *C/D* by nonbank public will change the money supply.
  - Deposit multiplier assumes that individuals and businesses hold all their money as checkable deposits

Brief outline of the money multiplier

- The money multiplier
  - How the monetary base generates M1 = C + D
    - The narrow monetary aggregate
  - M1 = mB, where m is the money multiplier
- More explicit description of the multiplier
  - $M1 = [(1 + (C/D)) / (C/D + r_d + (ER/D))](B)$
    - Where ER refers to excess reserves
    - r_d is the required reserve ratio
    - Huge excess reserves have reduced the multiplier today

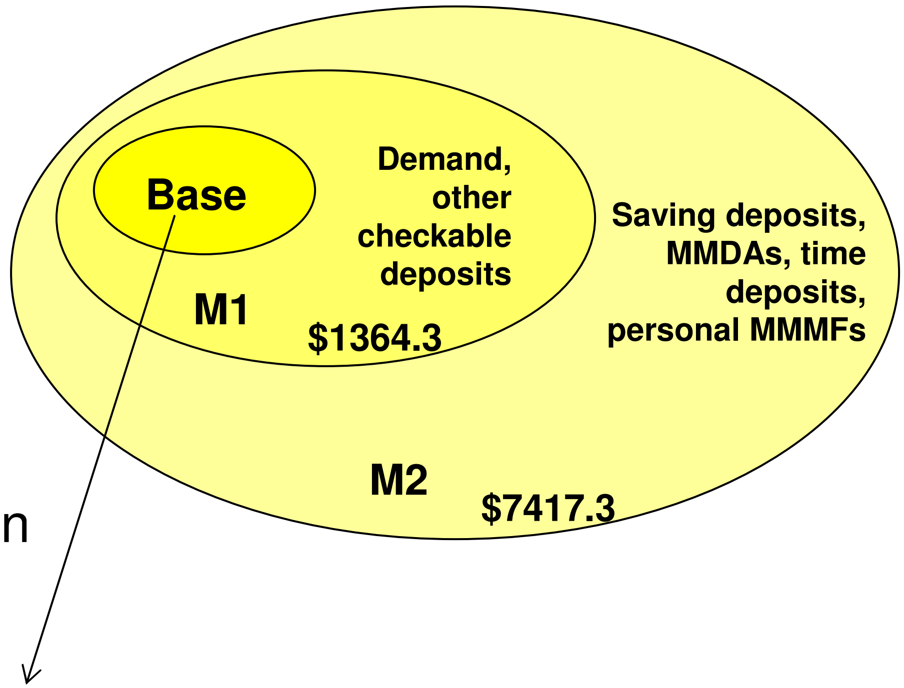
M1 as defined by the Federal Reserve

- (1) currency outside the U.S. Treasury, Federal Reserve Banks, and the vaults of depository institutions;
- (2) traveler's checks of nonbank issuers;
- (3) demand deposits at commercial banks (excluding those amounts held by depository institutions, the U.S. government, and foreign banks and official institutions)
- (4) other checkable deposits (OCDs).



Money Multiplier for M1 and M2
Multiple of the Monetary Base
Multiple of Monetary Base
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
10
9
8
7
6
5
4
3
2
1
0
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
M1 Multiplier (left scale)
M2 Multiplier (right scale)

The U.S. monetary aggregates –
The "normal" figures from Dec 2007

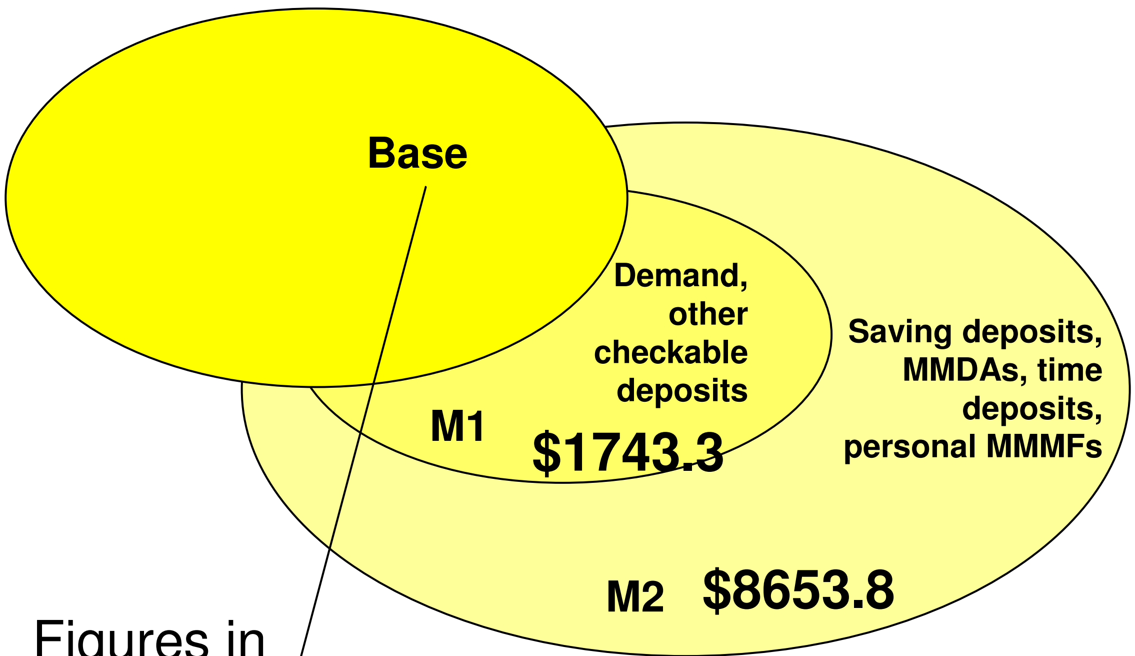


Figures in billions

Monetary base = currency in circulation + banks' reserves

$847.5 billion

The U.S. monetary aggregates – Numbers after crisis – October 2010



Figures in billions

Monetary base = currency in circulation + banks' reserves

$1987.25 billion

Monetary base exceeds M1 !!!

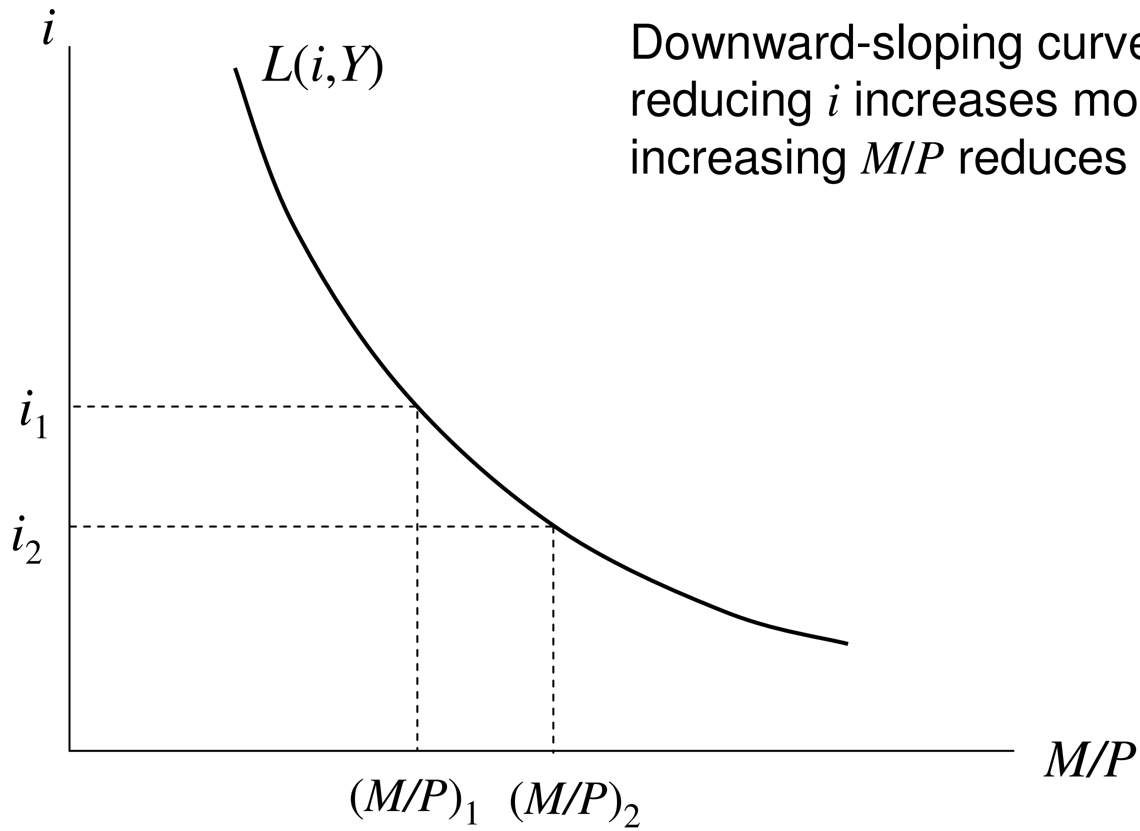
What does this mean? Currency in circulation is the common component of both M1 and monetary base.

That means that bank reserves must exceed demand and other checkable deposits.

Money demand, analytically

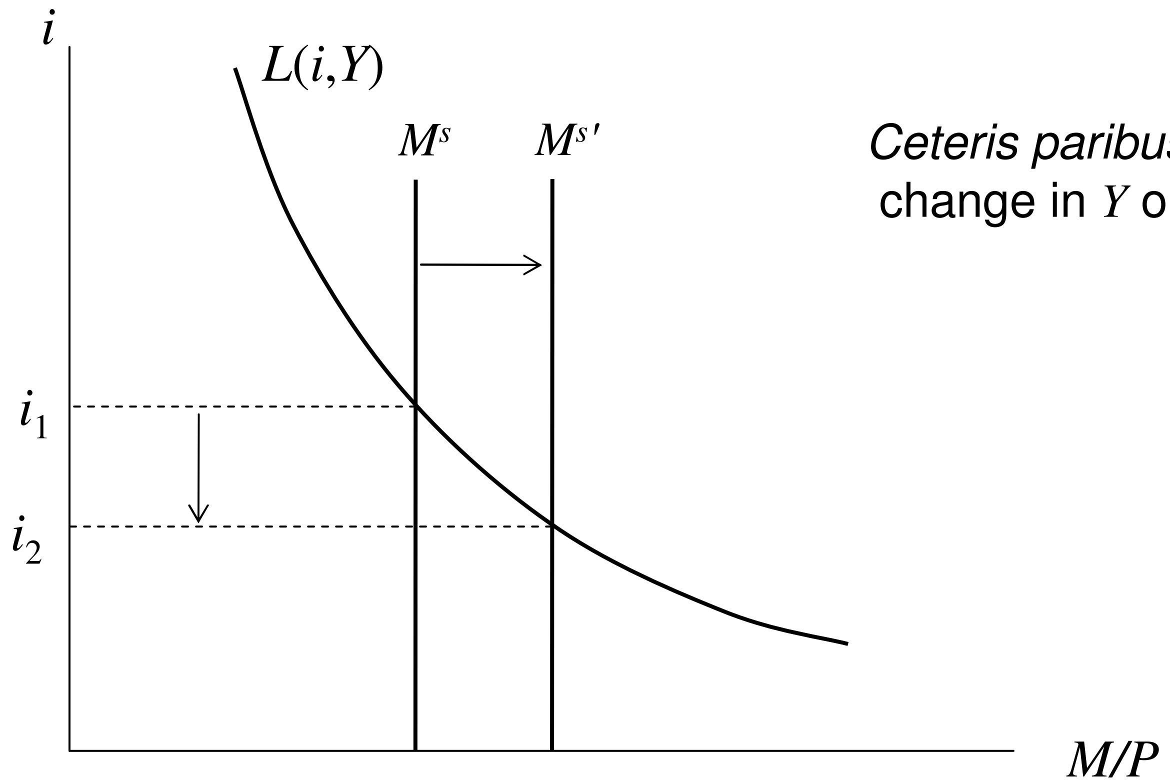
- $M^d = L(P \times Y, i - i^m)$
  - P = price level, Y = real income, i = return on "bonds," i^m = return on money
  - Assume L is "homogenous of degree 1," so that doubling P doubles M^d.
  - Also assume $i^m = 0$.
- $M^d = P \times L(Y, i\ ) = \ P \times L(Y, r + \pi^e)$
  - $Y\uparrow \Rightarrow M^d\uparrow$, and $i\uparrow \Rightarrow M^d\downarrow$

The money demand curve



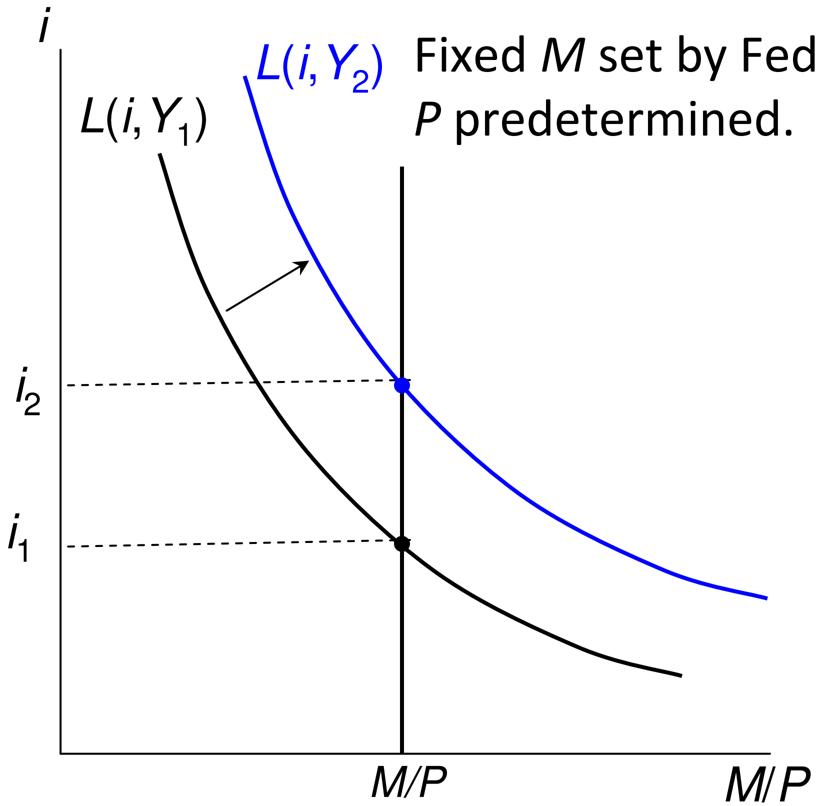
Downward-sloping curve $\Rightarrow$
reducing i increases money demand. Or:
increasing M/P reduces i.

Money demand = money supply



Ceteris paribus (i.e., no change in Y or P), $M^s \uparrow$
$\Rightarrow i \downarrow$

The basic *Liquidity Preference* Model



Fixed M set by Fed; P predetermined.

Increase in $Y \Rightarrow$ increase in money demand

With fixed M, i must rise to equilibrate money market

Money in a classical world

- Money supply & demand added to a classical model

$$M/P = L(Y, r + \pi^e)$$

Set by the central bank

Determined by NS=ND, $Y = F(K,N)$

Determined by $S = I$

A function of (expected) M growth

- What does monetary policy do?
- Given Y, r, and π^e, the central bank's choice of *M* determines the price level P.

Does Federal Reserve Action affect the natural rate of unemployment?

- Short answer – no.
- Longer answer – no, and here is why….
- The “natural rate of unemployment”
  - Arises from fundamentals of the economy
    - Structural unemployment – mismatch of labor force skills with job skill needs
    - Frictional unemployment – individuals between jobs
- Fed policy affects nominal quantities
  - “Non-neutralities” (effects on Y) arise temporarily

The concept of potential real output

- Potential real output as comparable to the "natural rate of unemployment"
  - This is the level of output that the economy can produce given technology and factor inputs
    - L as labor, K as capital, A as level of technology
- $Y^P = A\,F(K, L)$
  - To affect Y^P (or the natural rate of unemployment) there must be a change to one of the factors, technology, or the production function F.

What may affect the “natural rate”?

- The “good” – things that can lower it
  - Improved educational attainment of labor force
  - Better match of labor skills with business needs
    - For example, for new graduates entering the labor force
  - An increasingly experienced labor force
- The “bad” – things that may increase it
  - Long spells of unemployment may diminish skills
    - Especially given the recent business cycle – long spells
  - Technological advance alters match of labor to jobs

Fed Policy – when is it non-neutral?

- If money supply growth reduces the real wage

- This happens when
  - Nominal wages are sticky,
  - Prices are sticky, or
  - Inflation expectations are sluggish

- Short Run Phillips Curve reflects the dynamics

Short run Phillips Curve

- Short Run Phillips Curve – "expectations-based"
- $\pi = \pi^e - \omega\,(U - U^N) + \rho$
  - Where: π is the inflation rate
    - π^e is the expected rate of inflation
    - U is the unemployment rate
    - U^N is the "natural rate" of unemployment
    - ρ is a "shocks" parameter
    - ω is a coefficient parameter
- Or, $\pi - \pi^e = -\,\omega\,(U - U^N) + \rho$
  - This formulation – deviations of inflation from expected inflation are (negatively) associated with deviations of unemployment from the natural rate

Okun's Rule of Thumb

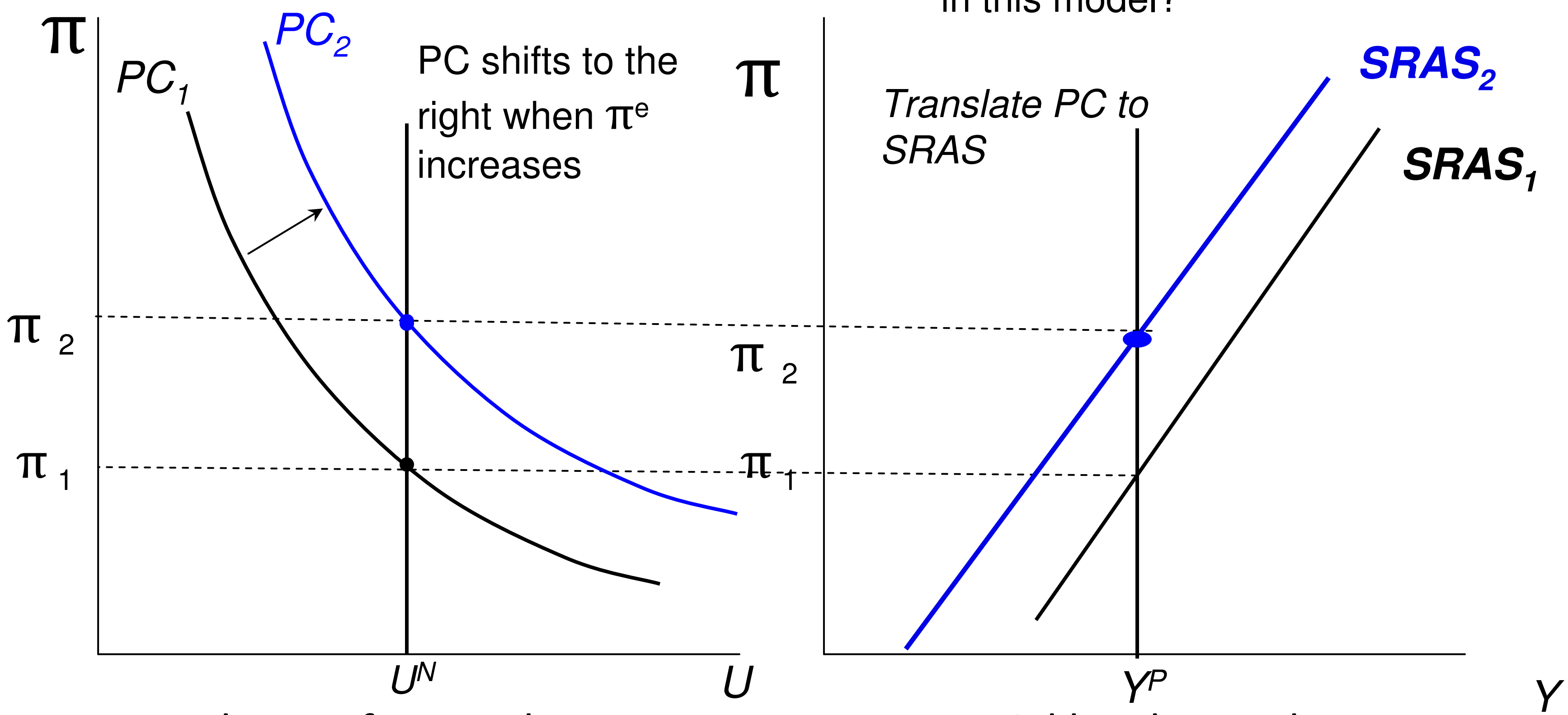
- Relates potential output to the natural rate of unemployment
- $(Y - Y^P) = -\,0.5\,(U - U^N)$
- Where: Y is the actual level of real output
  - Y^P is the potential level of real output
  - U is the unemployment rate
  - U^N is the "natural rate" of unemployment
- Here, deviations of real output from potential output are (negatively, and one half the size) associated with deviations of unemployment from the natural rate

- Substitute into the Phillips Curve, and get:
- $\pi - \pi^e = 0.5{*}\omega\,(Y - Y^P) + \rho$

The *Phillips* Curve, graphically

Note: Think about where $\pi^e = \pi$

Where is equilibrium in this model?



Natural rate of unemployment

Potential level or real output

Long Run Aggregate Supply

- Equilibrium for Short run Phillips Curve
  - When $U = U^N$ and $\pi = \pi^e$, on the natural rate curve
    - U is at the natural rate of unemployment
    - π is equal to inflation expectations (no surprises)
- Long run aggregate supply curve – same idea
  - When $Y = Y^P$ and $\pi = \pi^e$
    - Y is at its potential real output level
    - π is equal to inflation expectations (no surprises)

Investment spending and capital formation

- Profit maximization:
- MPK = “real cost of capital.”
  - Firms should add to their capital stock up to the point where the (declining) MPK is just equal to its marginal cost.

What does it cost to own capital?

- Suppose a piece of capital equipment costs $100 to purchase.
- What does that *really* cost you, on an annual basis?

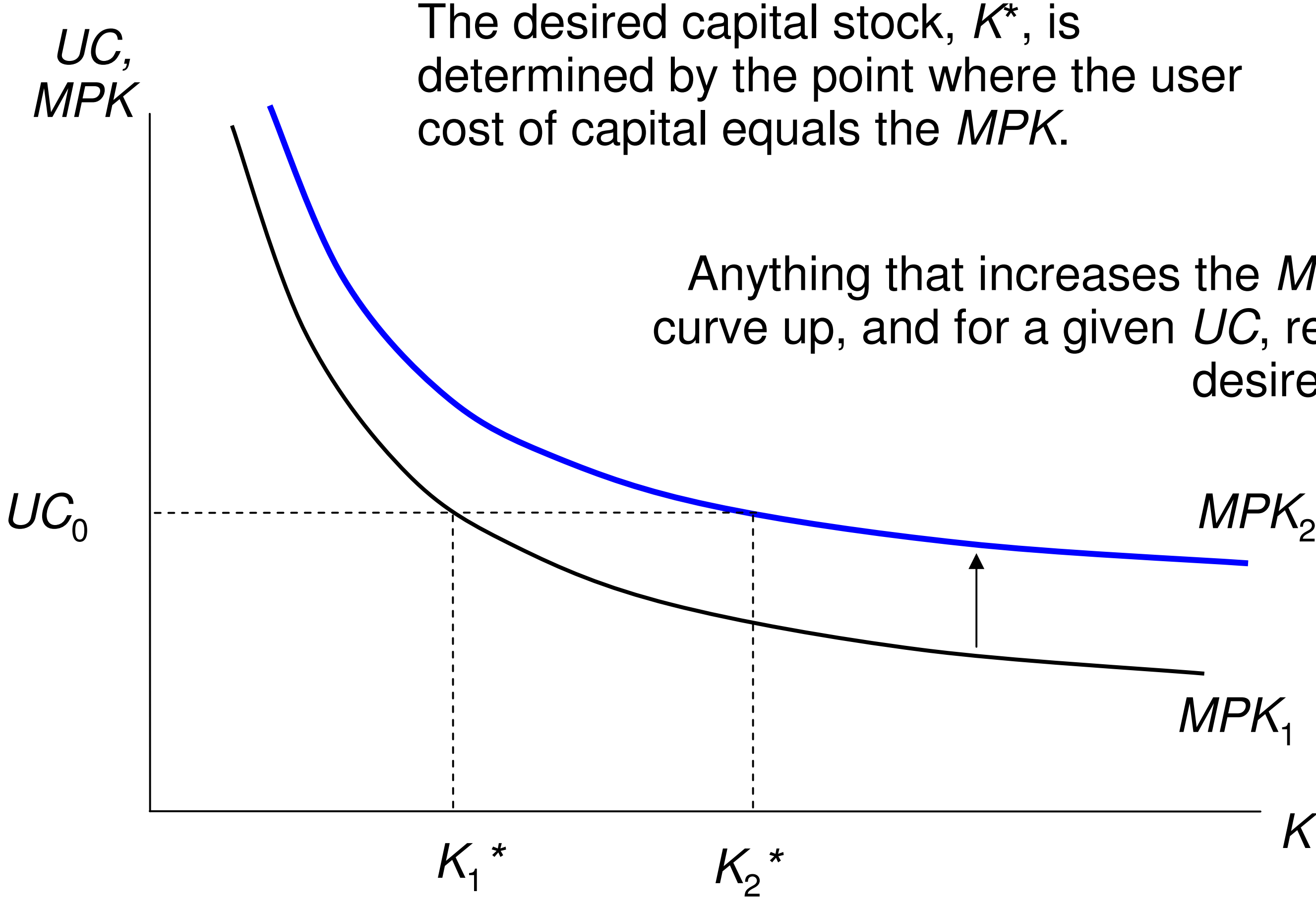
What does it cost to own capital?

- Suppose a piece of capital equipment costs \$100 to purchase.
- Cost of ownership for 1 year includes:
  - Opportunity cost = $r \times$ \$100.
  - Physical depreciation = $d \times$ \$100.
  - Maybe also tax angles, expected change in resale value. (Ignore for now.)
- "User cost" (UC) = ($r + d$) $\times$\$100.

The desired capital stock

The desired capital stock, K^*, is determined by the point where the user cost of capital equals the *MPK*.

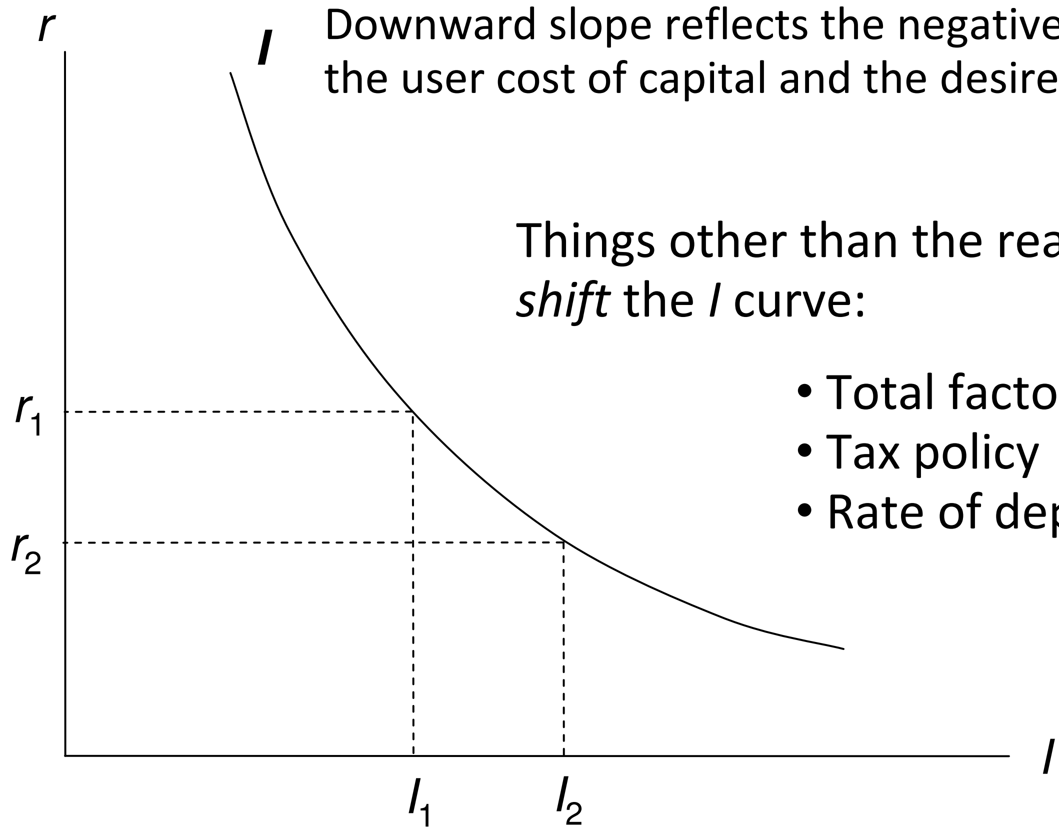
Anything that increases the *MPK* will shift the curve up, and for a given *UC*, result in a higher desired capital stock.



What about investment?

- $MPK = UC \longrightarrow$ the desired *stock* of capital.
- Investment is a *flow*, representing the (gross) increment to the capital stock.
  - $K_{t+1} = K_t + I_t - dK_t$
- Assume investment closes the gap between desired & actual K:
  - $I_t = [K^* - (1 - d)K_t]$
- Bottom line: higher $K^* \Rightarrow$ more I.

The investment demand curve



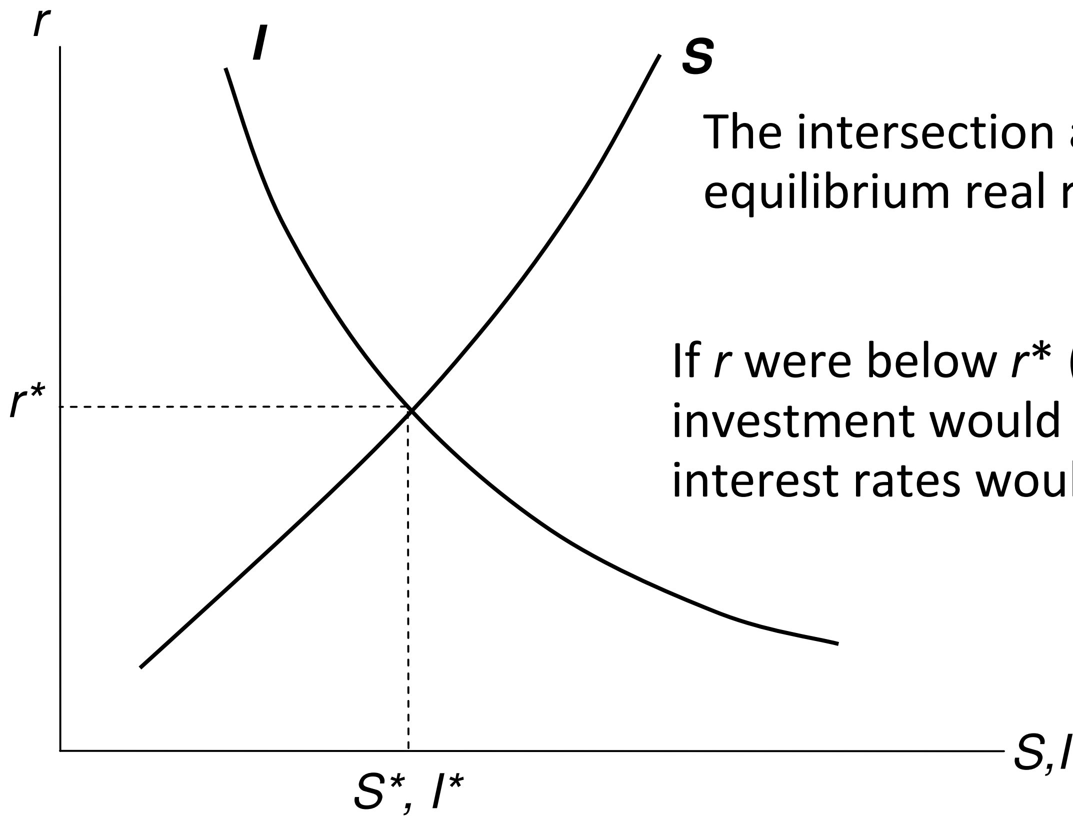
Downward slope reflects the negative relationship between the user cost of capital and the desired capital stock.

Things other than the real rate will *shift* the *I* curve:

- Total factor productivity
- Tax policy
- Rate of depreciation

Putting it together

Saving = investment at the intersection of the two curves.



The intersection also determines the equilibrium real rate of interest.

If *r* were below *r** (for example), then investment would exceed saving, and interest rates would get bit up!

The Market for Loanable Funds

- Start with the accounting identity

  $Y = C + I + G$ (closed economy)

  $Y - C - G = I$

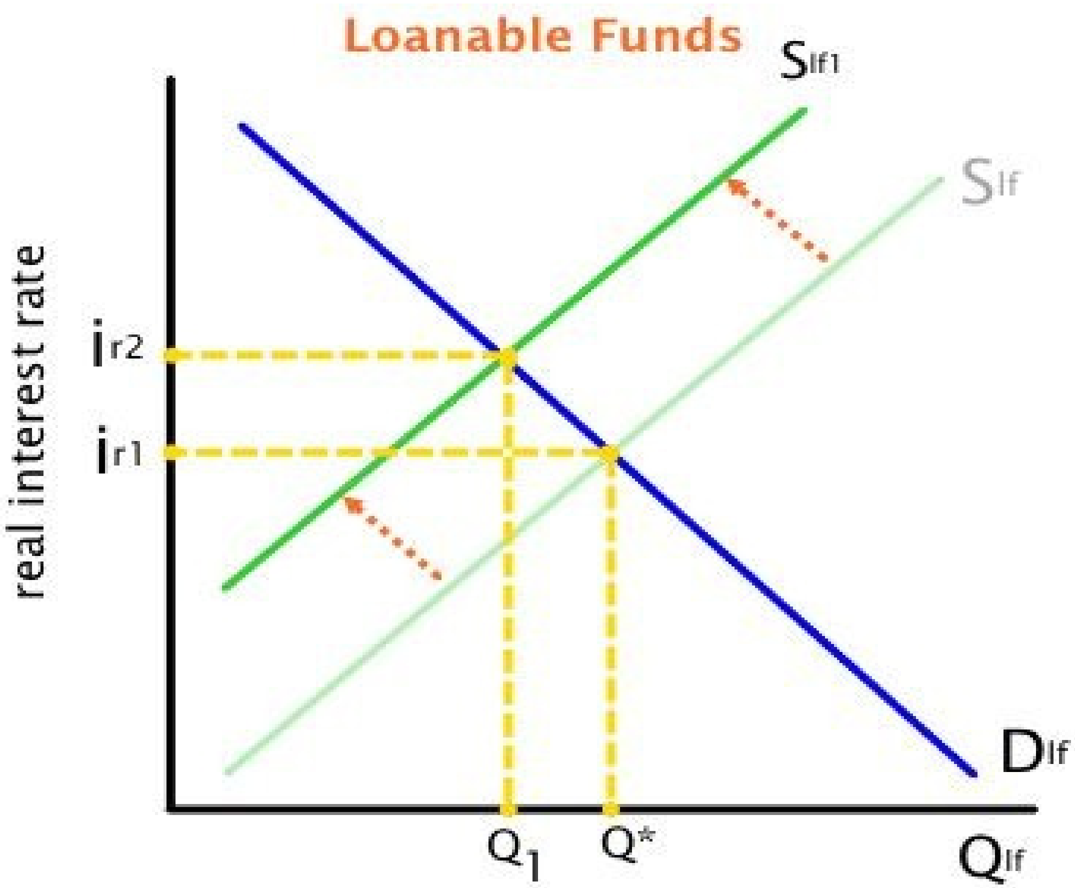
  $Y - C - G$ is just ***national savings***
- $S = (Y - T - C) + (T - G) = I$

  where the first term is “private savings” and

  the second term is “government or public savings”
- We can take S as given, let I decline as r rises

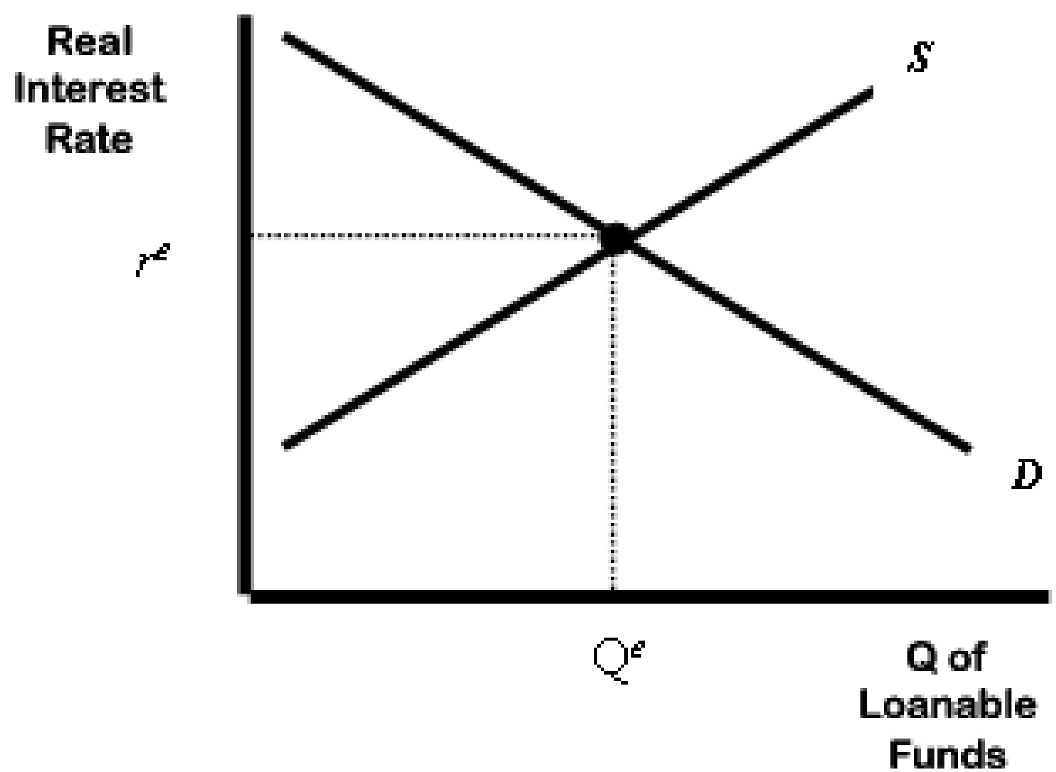
Some examples…

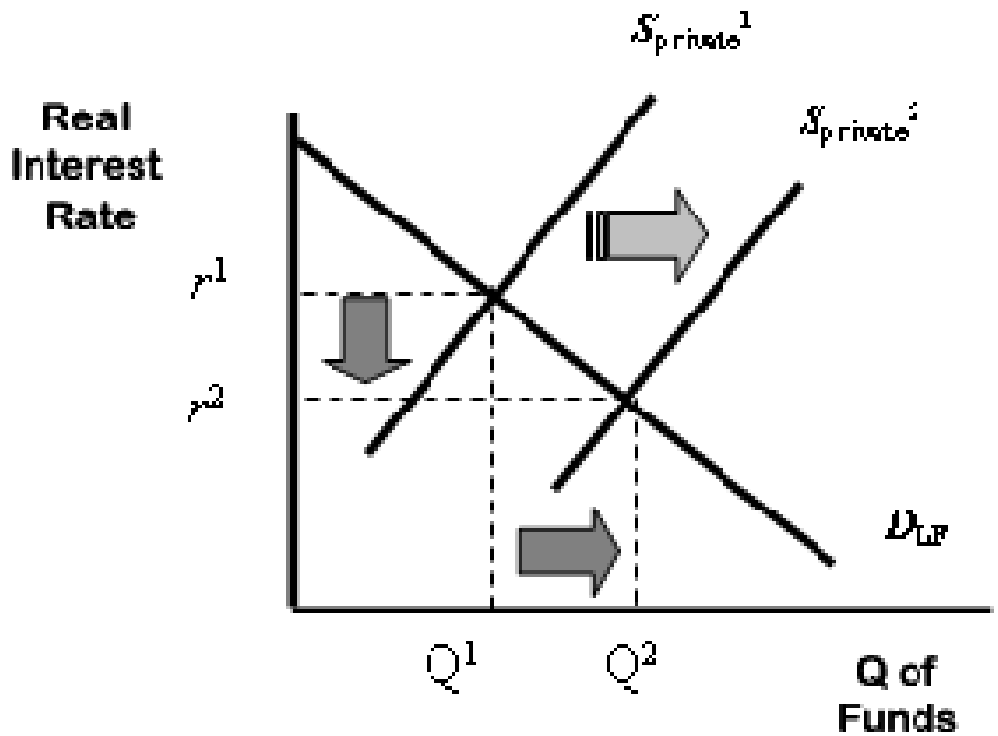
- How would saving, investment, and the real interest rate change under the following scenarios?
  - An increase in government budget deficits.
  - An investment tax credit.
  - A reduction in the tax rate on savings.



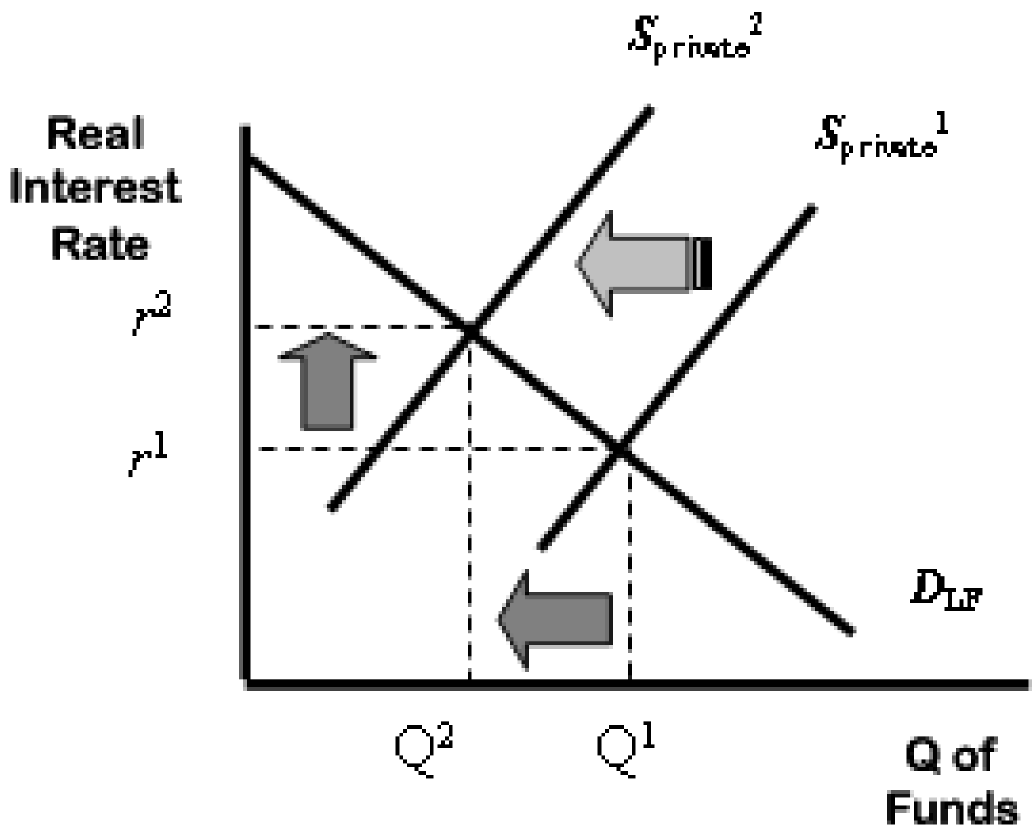
Gov't deficit spending shifts the supply of loanable funds available to the private sector in. Higher interest rates in the bond market mean investors will take money out of banks and buy bonds instead, reducing supply of loanable funds. Fewer funds available for private lending drives up the real interest rate and the quantity of funds demanded by firms and households down to Q_1

Loanable funds – real interest rate

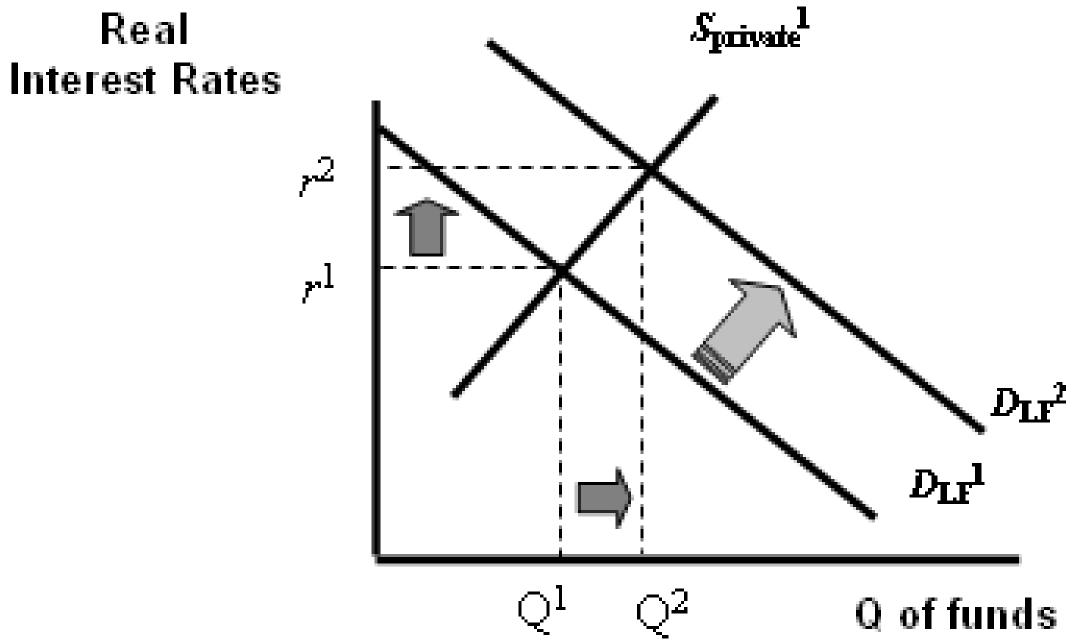




Reduce tax rate on interest income, stimulate savings.



Government spending increases, financed by bond issues to the public.



An investment tax credit for new equipment

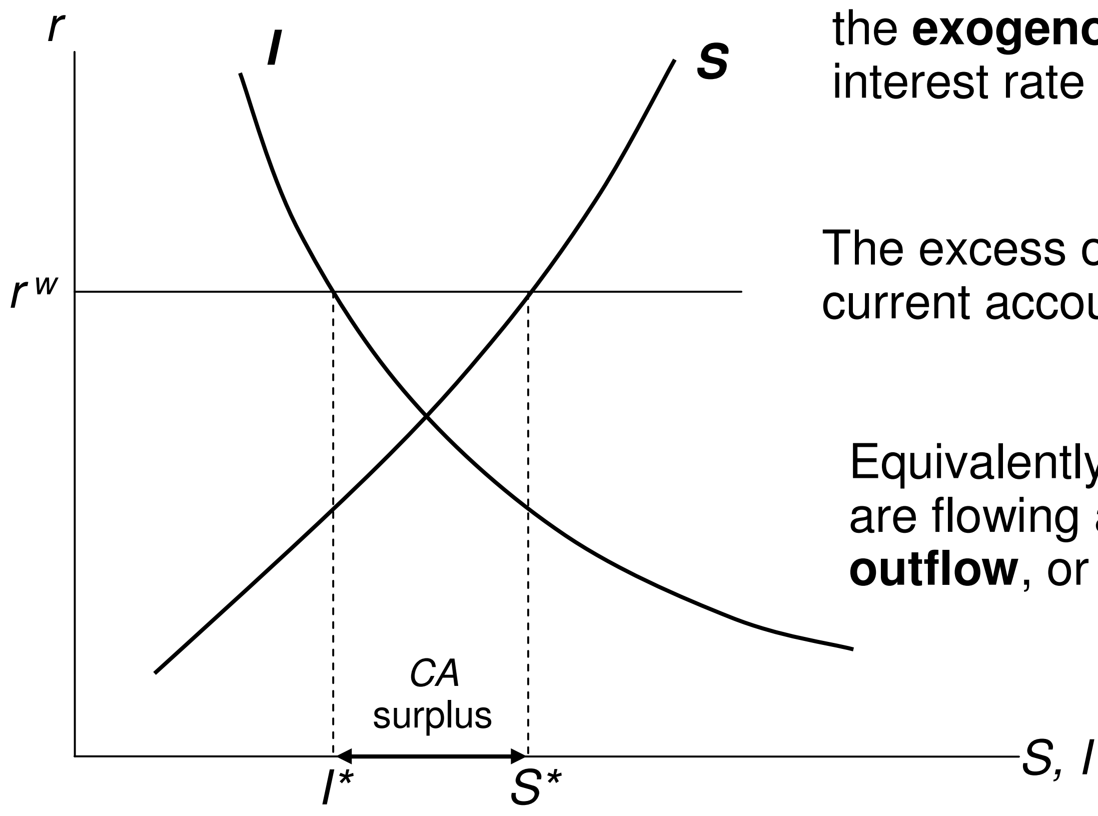
Summing up

- We’ve looked:
  - the determination of saving & investment.
- Key “price” here: the real interest rate.
- Important limitations:
  - Long-run, full-employment analysis
  - Static
  - Closed economy (no foreign saving).

What changes in the open economy?

- The *S* and *I* curves themselves don't change…
- But equilibrium is not (necessarily) where the two intersect.
  - Exogenous r^w is represented by a fixed horizontal line.
  - Saving & investment are determined where the r^w line intersects the two curves.
  - Difference between S^* and I^* = *CA* balance.

“Small” open-economy *S*/*I* analysis



Intersection of *S* and *I* curves with the **exogenously given** world real interest rate (***r*** ^{w}) determines *S**, *I**.

The excess of *S** over *I** is the current account **surplus**.

Equivalently: *S** > *I** ⇔ savings are flowing abroad ⇔ capital **outflow**, or *KFA* **deficit**.

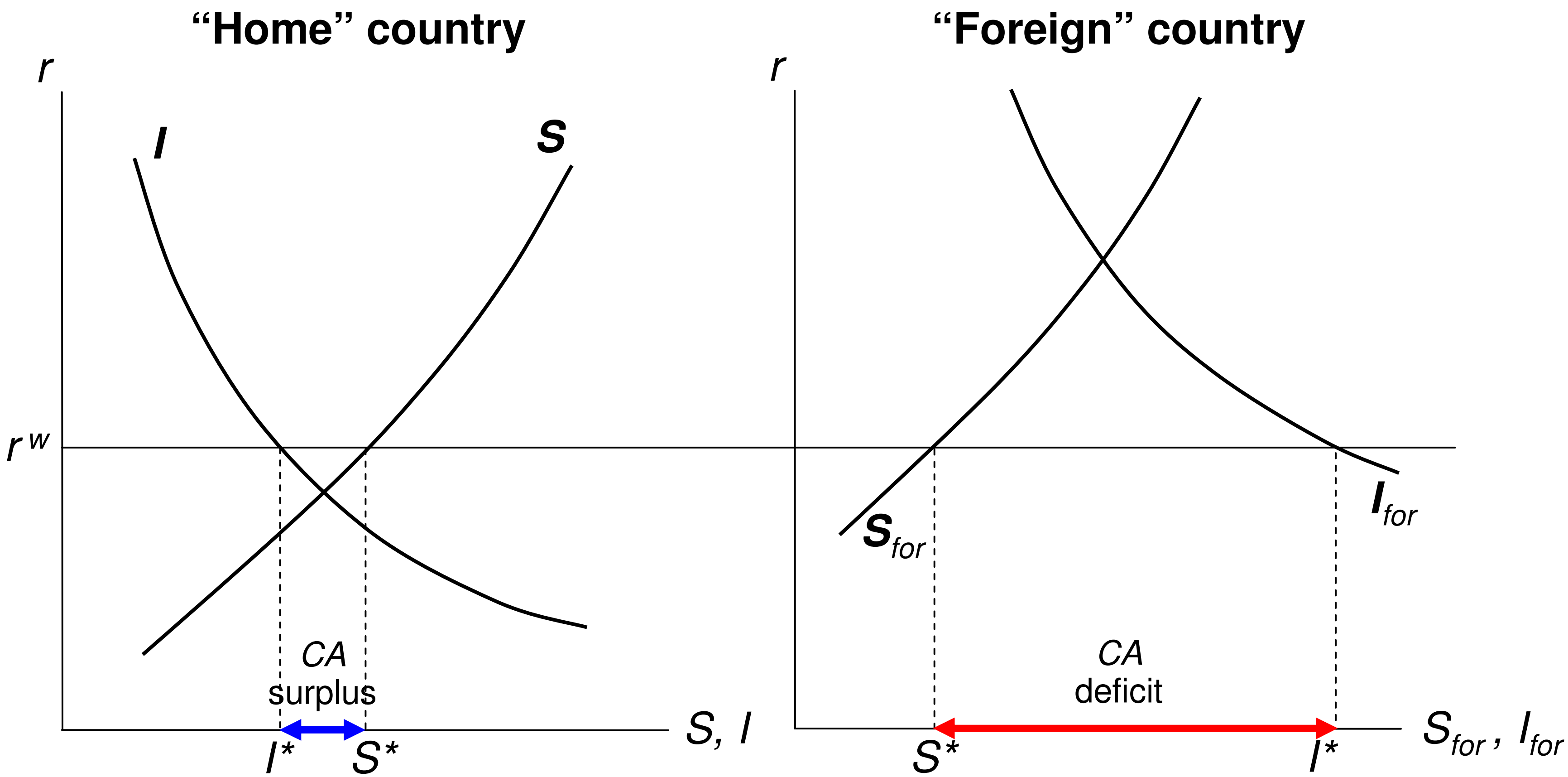
Examples…

- How would this work in practice?
  - A decrease in government saving, i.e., an increase in *G* or a decrease in *T* not fully offset by an increase in private saving…
  - An investment boom caused by an investment tax credit.

What changes in a "large" economy?

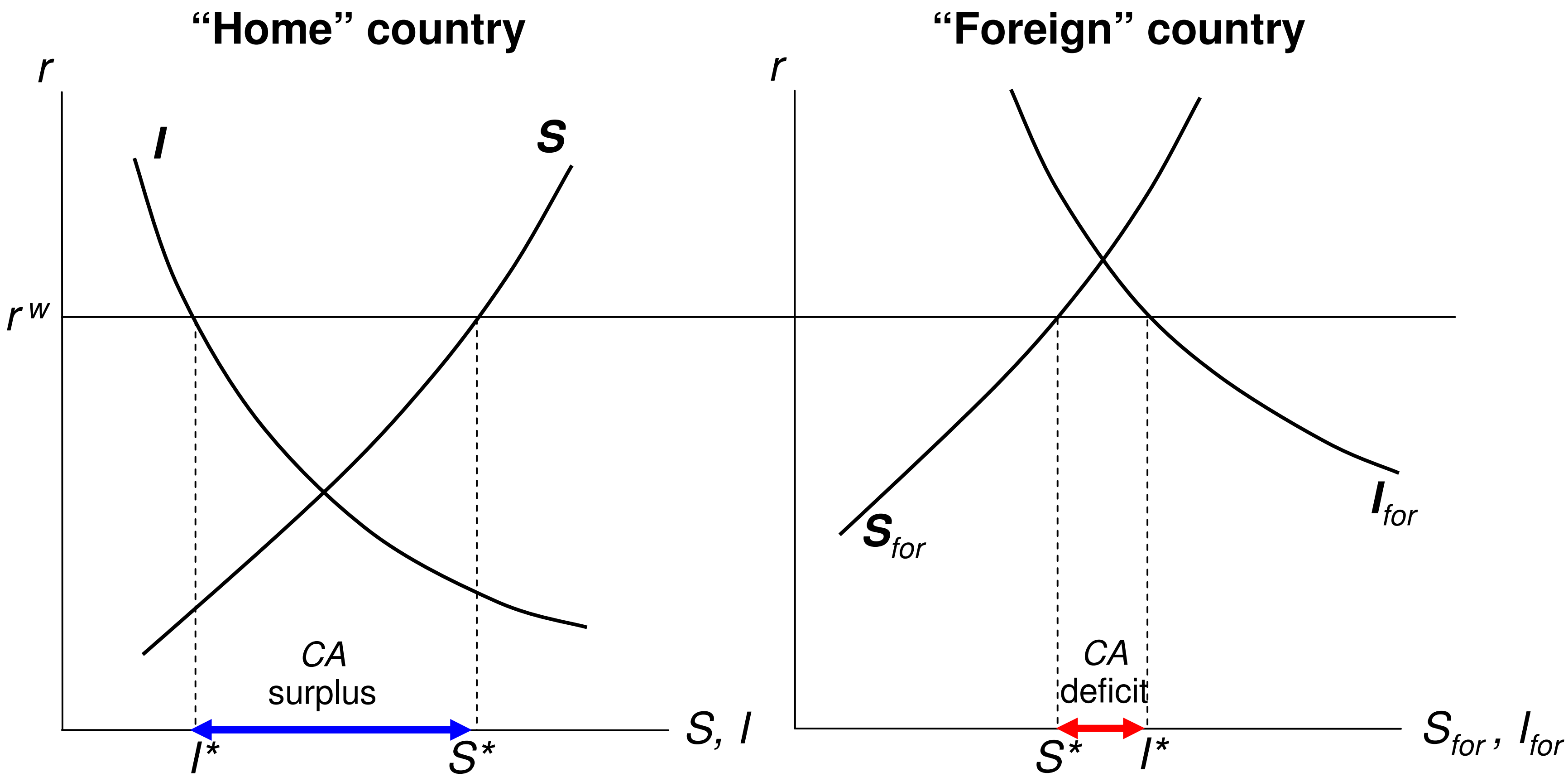
- Equilibrium still occurs where the horizontal r^w line intersects the *S* and *I* curves…
  - But now r^w is no longer *exogenous*.
  - Interest rate adjusts so that the sum of all capital flows = 0.
  - One country's *CA* deficit = other's *CA* surplus.
  - r^w too high $\Rightarrow$ global excess saving; r^w too low $\Rightarrow$ global excess investment.

“Large” open-economy *S*/*I* analysis



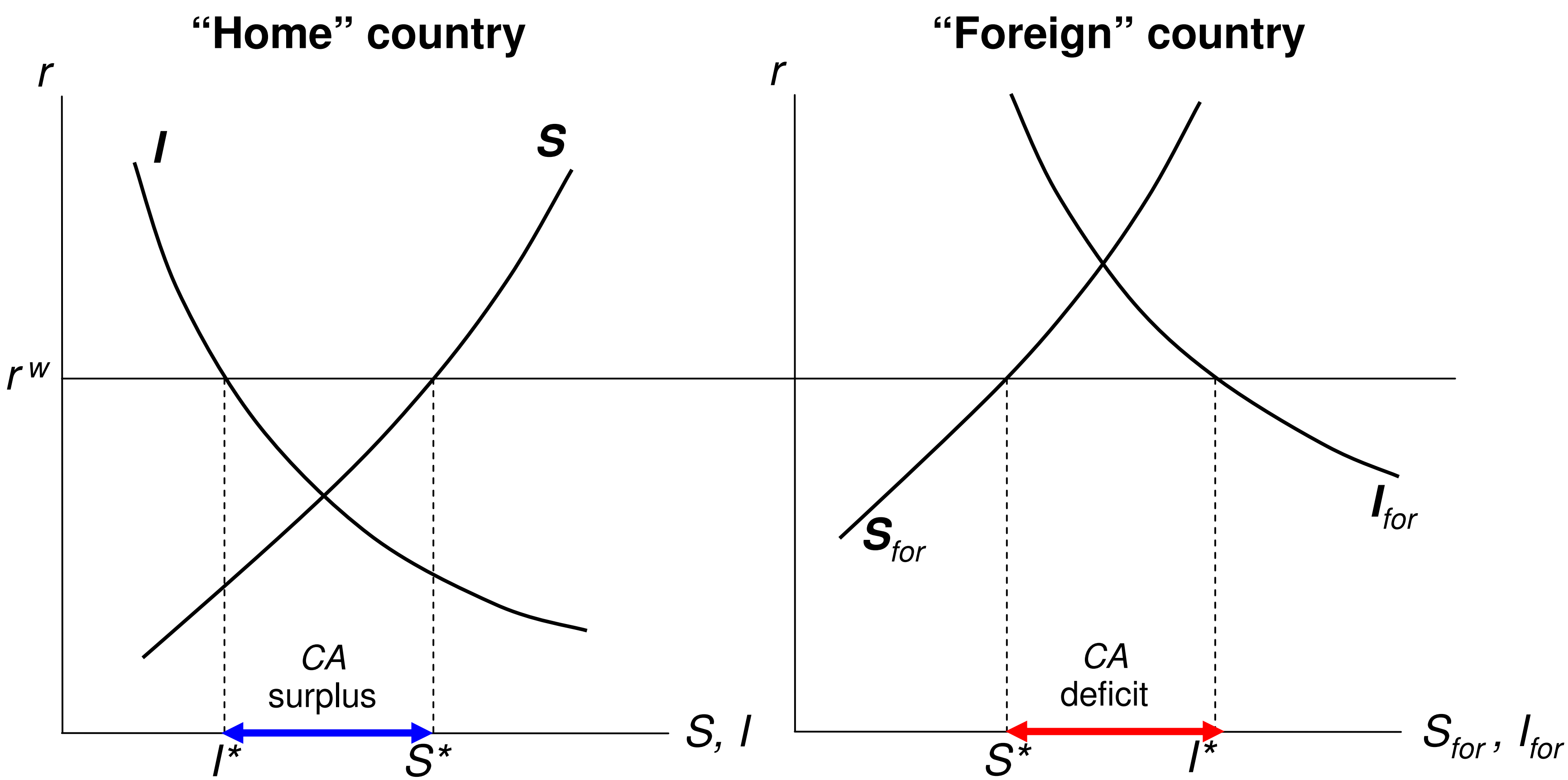
“This *r^w* is *too low*!”

“Large” open-economy *S*/*I* analysis



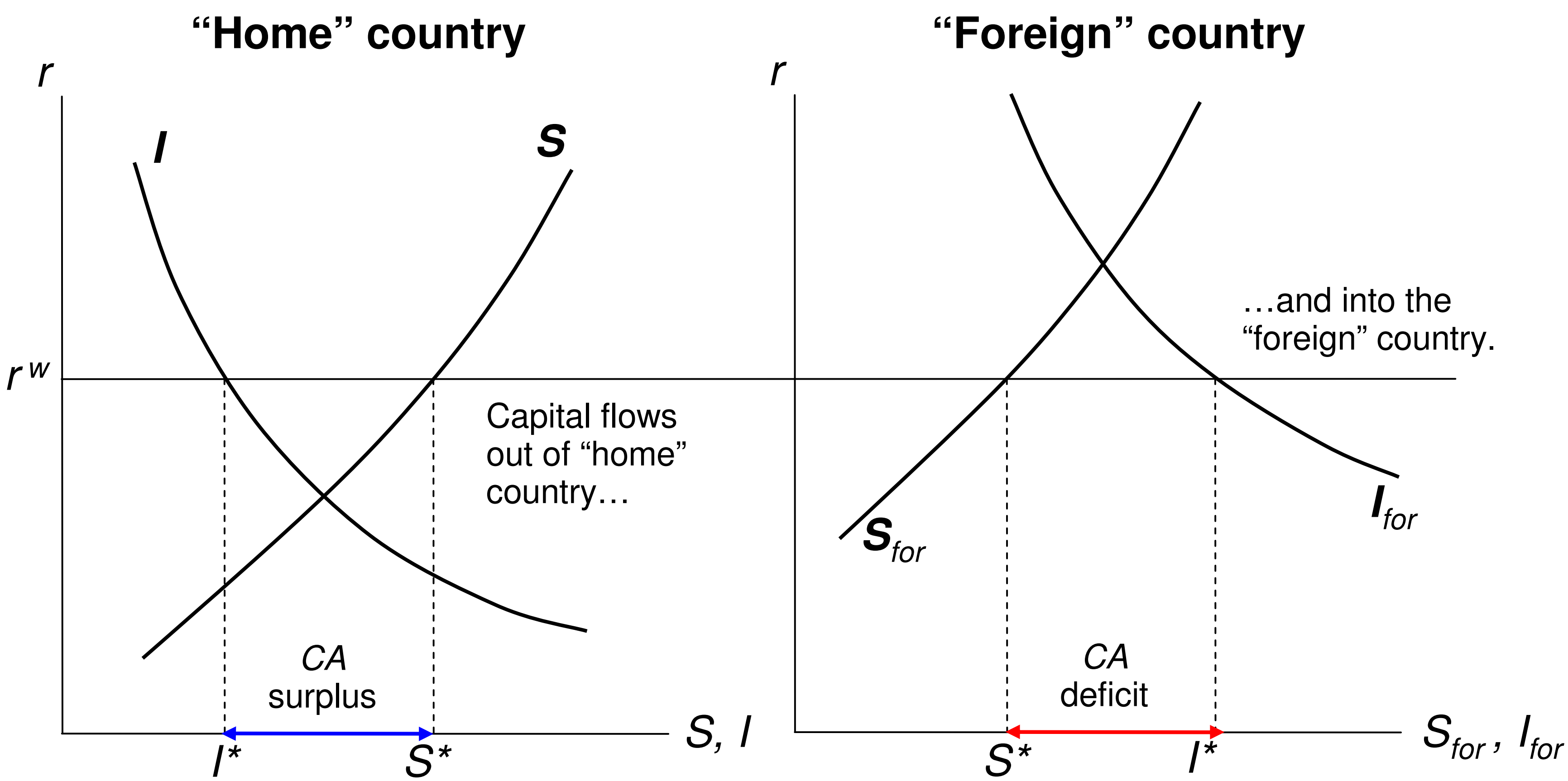
“This r^w is *too high*!”

"Large" open-economy *S*/*I* analysis



"This r^w is *just right*!"

"Large" open-economy *S/I* analysis



The intersection of S and I curves with $\boldsymbol{r^w}$ still determines S^*, I^*.
But now the *level* of $\boldsymbol{r^w}$ is determined by the condition that $\boldsymbol{CA + CA_{for} = 0}$!

Examples…

- Take the same two examples from before:
  - A decrease in government saving, and
  - An investment boom.
- What's different relative to the "small economy" case?
  - Impact on global interest rates,
  - Ultimate impact on home country current account.

Modeling economic growth

- Suppose population grows exogenously at a constant rate…
- But now allow capital accumulation to be *endogenous*.
  - How will saving and capital accumulation contribute to the growth process?
  - What ultimately determines the rate of economic growth, and the standard of living (output per person)?

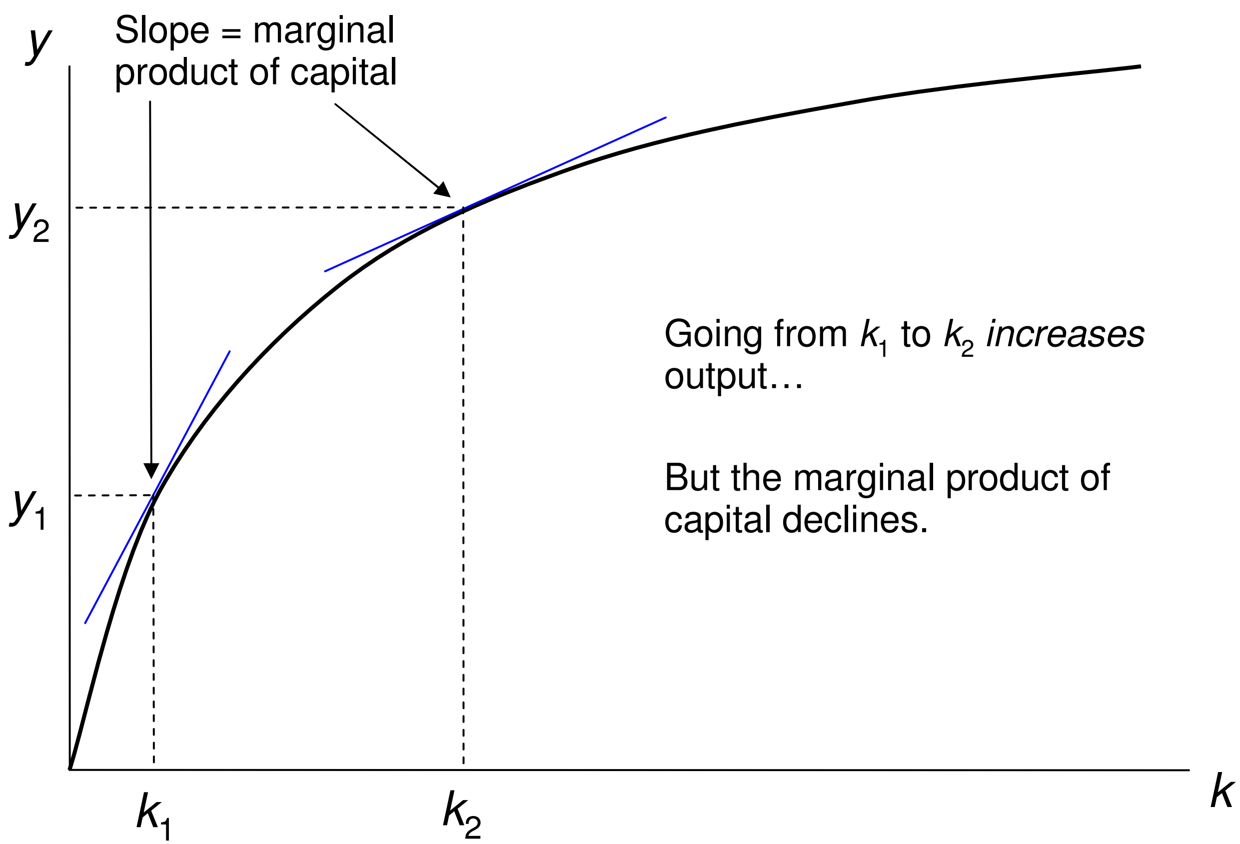
Solow's simplifying assumptions

- Population grows at rate *n*.
- Work force equals (or is proportional to) total population.
  - No labor supply decision
- TFP ("*A*") is constant.
- No government, so $Y = C + I$

Solow model: steps 1-3

- Notation: Y, C, I, N
- Put everything into "per capita" or "per worker" terms: y, c, i
- Assume a CRTS production function, $F(K,N)$
  - Also express in "per capita" terms, $f(k)$

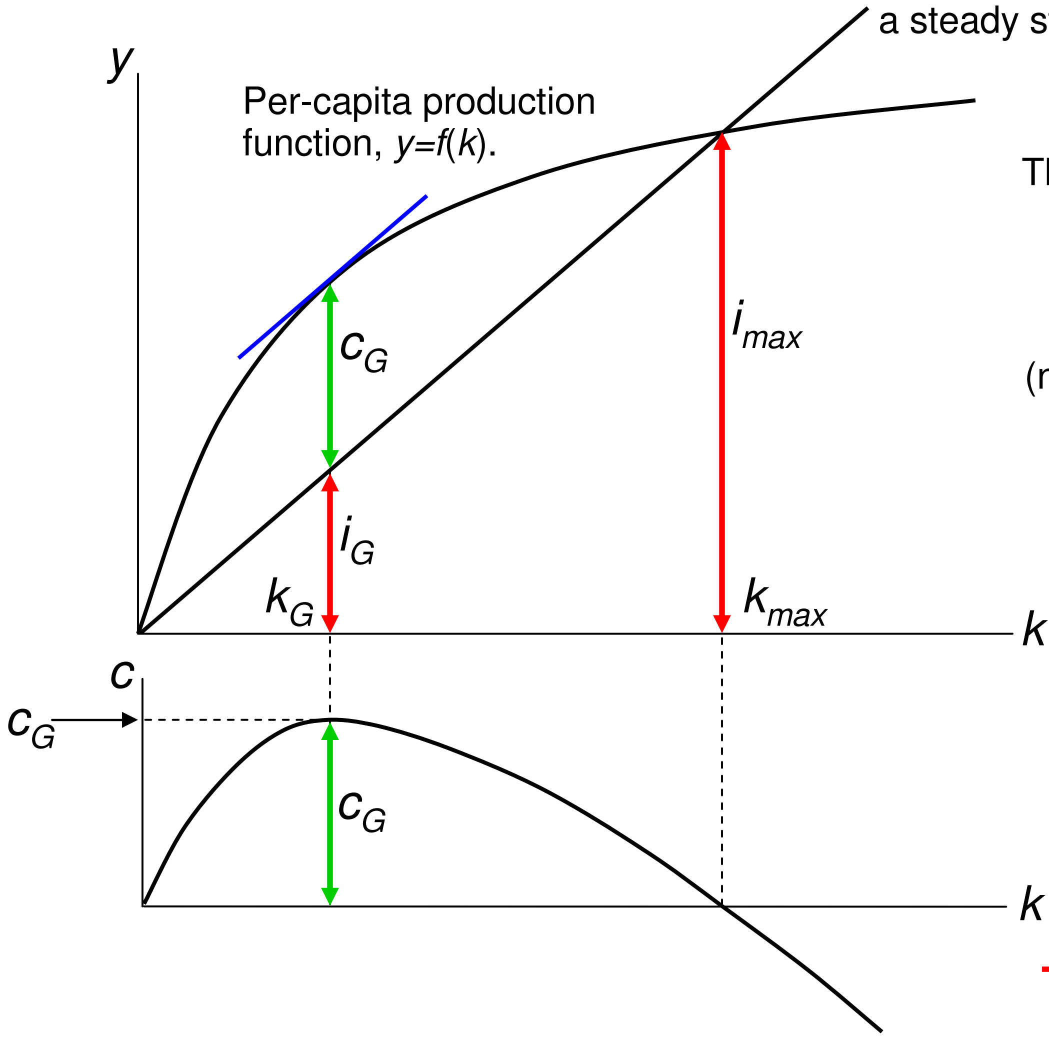
The production function, graphically



Solow model: step 4

- Define a "steady state"
- Investment required to keep k constant:
  - $(n+d)\times k$
  - $d\times k$ for the capital that's wearing out
  - $n\times k$ to supply new workers with capital

How much capital *should* we have?



The vertical distance between $y=f(k)$ curve and $(n+d)k$ represents consumption.

With *all* production going into investment (no consumption), the economy can reach k_{max}. But who would want that?

The *maximum* steady-state consumption level is attained with a much lower level of capital, the "golden rule" level k_G.

The "golden rule" is attained where the marginal product of capital equals $n+d$.

The moral: it's possible to have *too much* capital!.

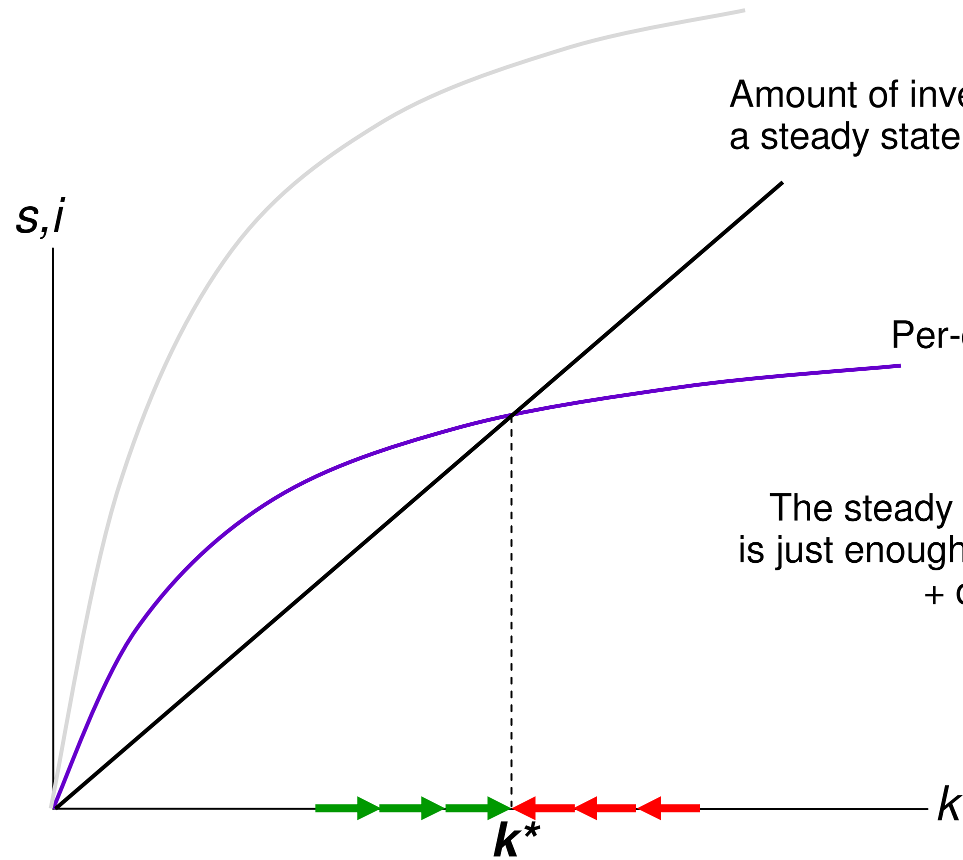
Solow model: step 5

- Assume something about saving.
  - Suppose people same some constant fraction *s* of their income.
  - Per-capita saving = $s \times y_t = s \times f(k_t)$

Solow model: step 5

- Assume something about saving.
  - Suppose people same some constant fraction s of their income.
  - Per-capita saving = $s \times y_t = s \times f(k_t)$
  - Our steady state will be where per-capita saving equals the per-capita investment that's required to keep k constant.
  - $s \times f(k_t) = (n + d)k$

How much capital *will* we have?



The steady state k^* is reached where saving is just enough to provide for population growth + depreciation, keeping k constant.

$k < k^* \Rightarrow$ saving **>** investment needed to keep k constant $\Rightarrow k\uparrow$.

$k > k^* \Rightarrow$ saving **<** investment needed to keep k constant $\Rightarrow k\downarrow$.

The economy will eventually converge to a level of capital determined by *s*, *n*, and *d*.

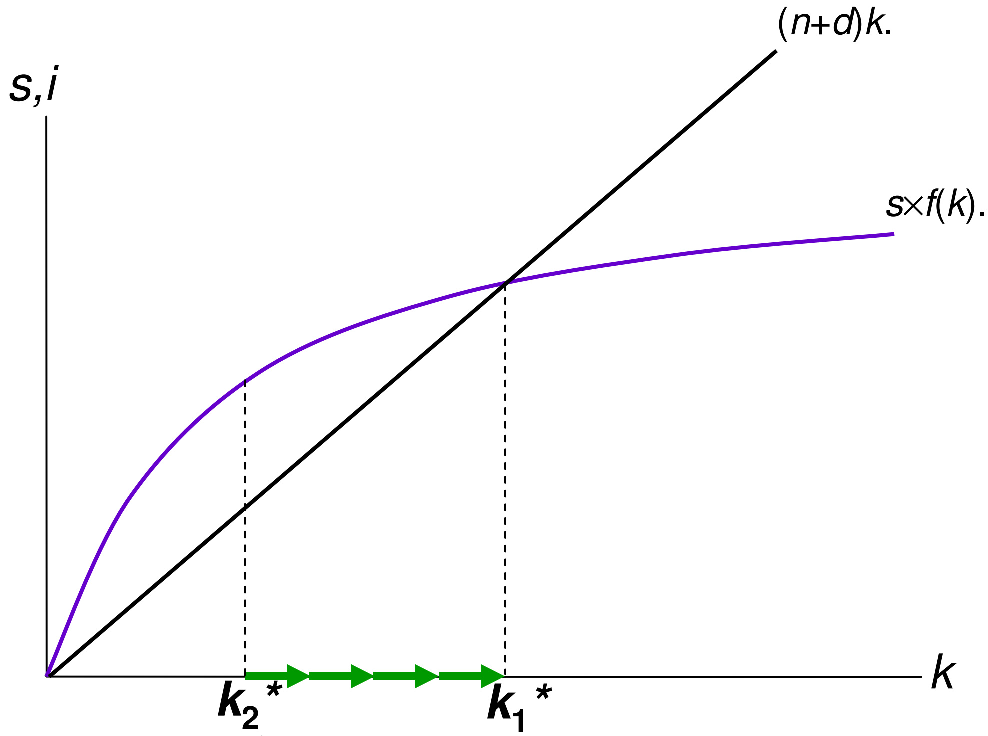
Some experiments…

- How does k^* change in response to:
  - An increase in the saving rate, s?
  - An increase in the population growth rate, n?
  - An increase in the depreciation rate, d?
  - An increase in productivity?

Why do living standards differ?

- Consider two countries: "Country 1" and "Country 2".
- Assume there are no differences in TFP (*A*), population growth rate (*n*), depreciation rate (*d*), or saving rate (*s*); both use the same production function (*f*).
- Initial level of capital stock (*k*) **may** differ.

Why do living standards differ?



Eventually, country 2 catches up to country 1, and living standards **converge**…

…assuming both countries have the same n, d, and A.

"Country 1" is in a steady-state at (or near) the golden rule. Per-capita consumption growth is driven entirely by productivity.

"Country 2" is far below steady-state; growth comes from productivity *and* capital deepening.

Can thrift affect long-run growth?

- In the Solow model, the answer is "no."
  - Because of diminishing returns, as k increases, maintaining a given level of k becomes more costly.
  - "Running faster and faster just to stay in the same place."
- Changes in s affect only the *levels* of k^*, y^*, & c^*….
- …although growth may be affected in the short run, during the transition.

"Convergence!"

- If countries differ only in their initial conditions…
  - …then "poor" countries will catch up to the "rich" ones. *Unconditional convergence*.
  - Initial conditions don't matter.
- What if countries differ in some way—n, s, d, A, or f ? *Conditional convergence*.
- What factors could prevent convergence?

Solow recap

- Overall growth rate is determined solely by population (and technology) growth.
  - Thrift (saving rate) has no effect on growth rate in the long run.
- Maximizing steady-state consumption ⇔ "golden rule" capital stock.
  - Requires a certain saving rate.
- Living standards converge, if parameters are the same.

Whirlwind tour of Macroeconomics

- Data resources on the web from Fed, BEA, BLS

- Tons of notes on the web

- Publishers provide good summary resources

- Check the blogs of “big name” economists
  - E.g., http://www.econbrowser.com/


"That's all Folks!"