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# National Income: Where It Comes From and Where It Goes

## MACROECONOMICS

# Outline of model

A closed economy, market-clearing model

- Supply side
  - factor markets (supply, demand, price)
  - determination of output/income
- Demand side
  - determinants of ***C***, ***I***, and ***G***
- Equilibrium
  - goods market
  - loanable funds market

# The production function: Y = F(K,L)

- shows how much output (***Y***)
  the economy can produce from
  ***K*** units of capital and ***L*** units of labor
- reflects the economy's level of technology

# Returns to scale:

Initially $Y_1 = F(K_1, L_1)$

Scale all inputs by the same factor $z$:

$K_2 = zK_1$ and $L_2 = zL_1$

(*e.g.*, if $z$ = 1.2, then all inputs are increased by 20%)

What happens to output, $Y_2 = F(K_2, L_2)$?

- If **constant returns to scale**, $Y_2 = zY_1$
- If **increasing returns to scale**, $Y_2 > zY_1$
- If **decreasing returns to scale**, $Y_2 < zY_1$

# Assumptions

1. Technology is fixed.
2. The economy's supplies of capital and labor are fixed at

$$K = \overline{K} \quad \text{and} \quad L = \overline{L}$$

(bar over a variable indicates a particular number. For example, in 2014 an estimate of the US capital stock was $51.2 trillion, that would be an example of $\overline{K}$, while the labor force is about 160 million people, an $\overline{L}$

# The distribution of national income

- determined by **factor prices**,
  the prices per unit firms pay for the factors of production
  - wage = price of ***L***
  - **rental rate** = price of ***K***

# Notation

$W$ = nominal wage

$R$ = nominal rental rate

$P$ = price of output

$W/P$ = real wage
(measured in units of output)

$R/P$ = real rental rate

# Diminishing marginal returns

- As an input is increased,
  its marginal product falls (other things equal).
- Intuition:
  Suppose $\uparrow$***L*** while holding ***K*** fixed
  $\Rightarrow$ fewer machines per worker
  $\Rightarrow$ if a worker is added, their productivity will be lower than previously added workers since they are less well equipped with the tools they need.

# The Neoclassical Theory of Distribution

- states that each factor input is paid its marginal product
- a good starting point for thinking about income distribution

# How income is distributed to *L* and *K*

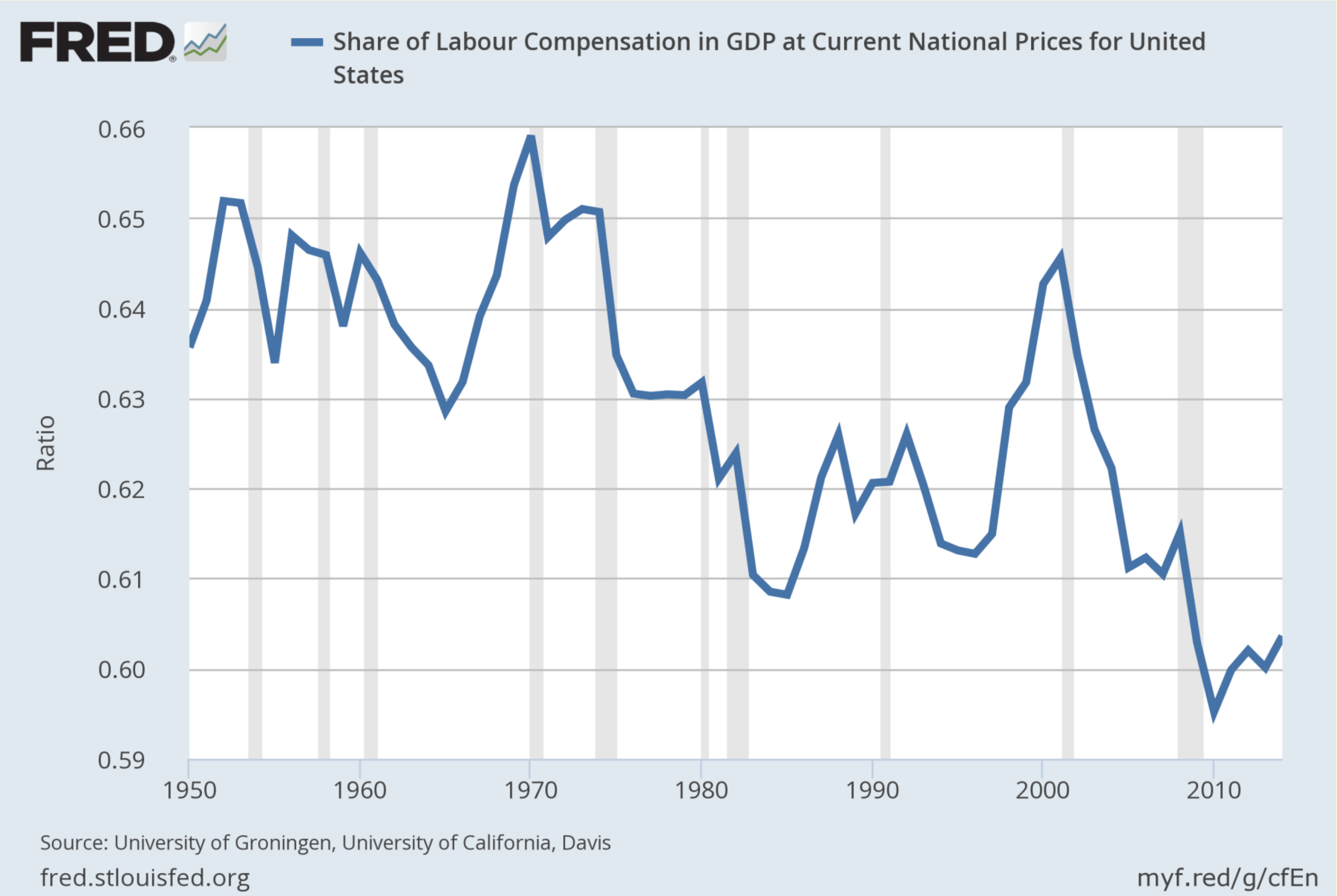
$$\text{total labor income} = \frac{W}{P}\bar{L} = MPL \times \bar{L}$$

$$\text{total capital income} = \frac{R}{P}\bar{K} = MPK \times \bar{K}$$

If production function has constant returns to scale, then

$$\underbrace{\bar{Y}}_{\text{national income}} = \underbrace{MPL \times \bar{L}}_{\text{labor income}} + \underbrace{MPK \times \bar{K}}_{\text{capital income}}$$

# Labor's share of income in the U.S., 1950-2014



# The Cobb-Douglas Production Function

- The Cobb-Douglas production function has constant factor shares:

  $\alpha$ = capital's share of total income:

  $$\text{capital income} = \boldsymbol{MPK} \times \boldsymbol{K} = \alpha \boldsymbol{Y}$$

  $$\text{labor income} = \boldsymbol{MPL} \times \boldsymbol{L} = (1 - \alpha)\boldsymbol{Y}$$

- The Cobb-Douglas production function is:

  $$\boldsymbol{Y} = \boldsymbol{A}\boldsymbol{K}^{\alpha}\boldsymbol{L}^{1-\alpha}$$

  where ***A*** represents the level of technology.

# The Cobb-Douglas Production Function

- Each factor's marginal product is proportional to its average product:
- Marginal product of input is the partial derivative of ***Y*** with respect to an input.

$$MPK = \alpha A K^{\alpha-1} L^{1-\alpha} = \frac{\alpha Y}{K}$$

$$MPL = (1-\alpha) A K^{\alpha} L^{-\alpha} = \frac{(1-\alpha) Y}{L}$$

# Demand for goods and services

Components of aggregate demand:

***C*** = consumer demand for g & s

***I*** = demand for investment goods

***G*** = government demand for g & s

(closed economy: no ***NX***)

# Consumption, *C*

- def: **Disposable income** is total income minus total taxes: $\boldsymbol{Y - T}$.
- Consumption function: $\boldsymbol{C = C\,(Y - T\,)}$
  Shows that $\uparrow(\boldsymbol{Y - T}) \Rightarrow \uparrow\boldsymbol{C}$
- def: **Marginal propensity to consume (MPC)** is the change in **C** when disposable income increases by one dollar.

# Investment, $I$

- The investment function is $I = I(r)$

  where $r$ denotes the **real interest rate**,
  the nominal interest rate corrected for inflation.

- The real interest rate is
  - the cost of borrowing
  - the opportunity cost of using one's own funds to finance investment spending

So, $\uparrow r \Rightarrow \downarrow I$

# Government spending, *G*

- ***G*** = govt spending on goods and services
- ***G*** excludes transfer payments
  (*e.g.*, Social Security benefits,
  unemployment insurance benefits)
- Assume government spending and total taxes are exogenous:

$$\boldsymbol{G = \bar{G}} \quad \text{and} \quad \boldsymbol{T = \bar{T}}$$

# The market for goods & services

- Aggregate demand: $C(\overline{Y}-\overline{T})+I(r)+\overline{G}$
- Aggregate supply: $\overline{Y}=F(\overline{K},\overline{L})$
- Equilibrium: $\overline{Y} = C(\overline{Y}-\overline{T})+I(r)+\overline{G}$

The real interest rate adjusts
to equate demand with supply.

# The loanable funds market

- A simple supply–demand model of the financial system.
- One asset: "loanable funds"
  - demand for funds: investment
  - supply of funds: saving
  - "price" of funds: real interest rate

# Demand for funds: Investment

The demand for loanable funds…

- comes from investment:
  Firms borrow to finance spending on plant & equipment, new office buildings, etc.
  Consumers borrow to buy new houses.
- depends negatively on ***r***,
  the "price" of loanable funds
  (cost of borrowing).

# Supply of funds: Saving

- The supply of loanable funds comes from saving:
  - Households use their saving to make bank deposits, purchase bonds and other assets. These funds become available to firms to borrow to finance investment spending.
  - The government may also contribute to saving if it does not spend all the tax revenue it receives.

# Types of saving

**private saving** $= (Y - T) - C$

**public saving** $= T - G$

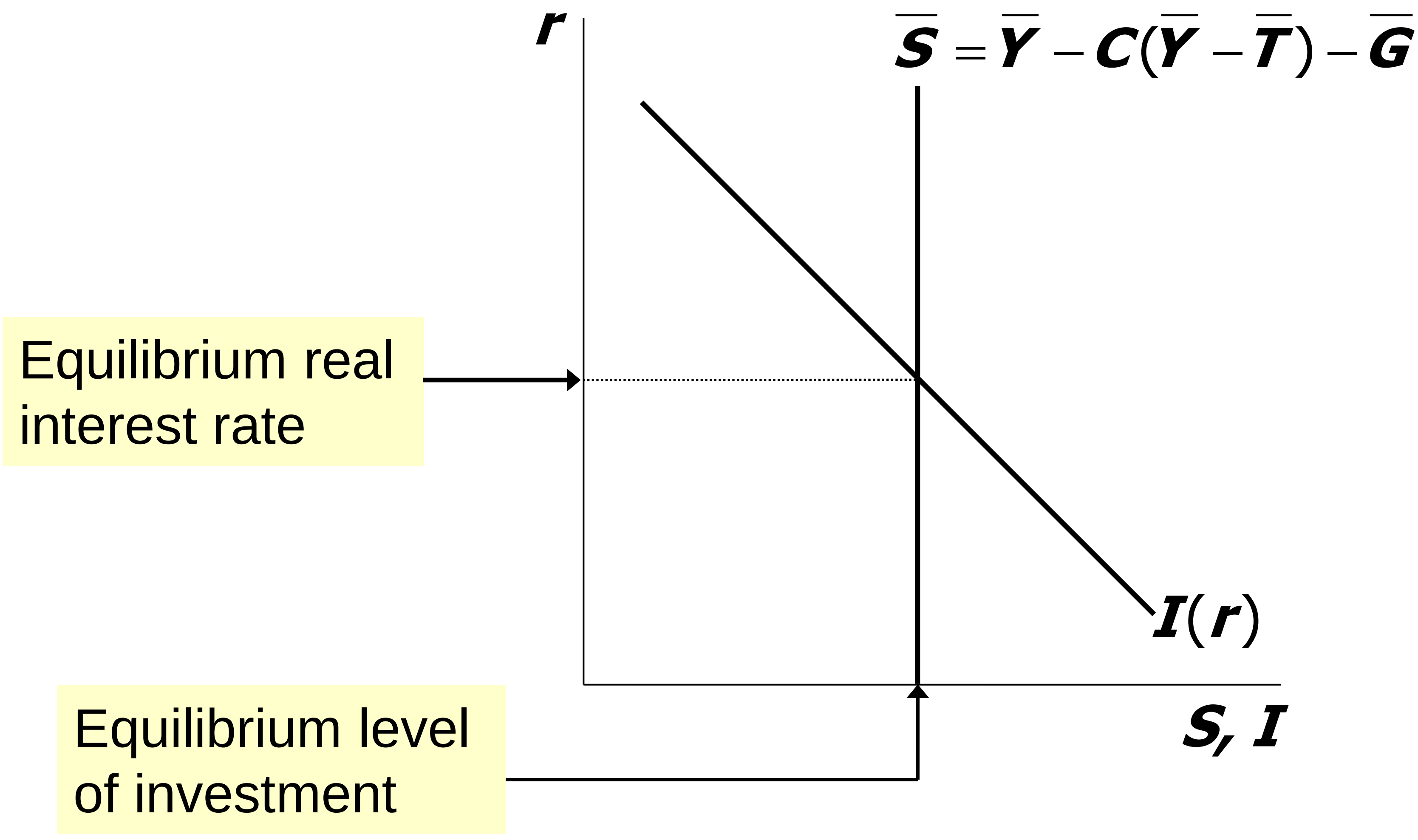
**national saving**, $S$

$= \text{private saving} + \text{public saving}$

$= (Y - T) - C + T - G$

$= Y - C - G$

# Loanable funds market equilibrium



# The special role of *r*

***r*** adjusts to equilibrate the goods market *and* the loanable funds market simultaneously:

If L.F. market in equilibrium, then

$$Y - C - G = I$$

Add $(C + G)$ to both sides to get

$$Y = C + I + G \quad \textit{(goods market eq'm)}$$

Thus,

| | | |
|---|---|---|
| Eq'm in L.F. market | $\Leftrightarrow$ | Eq'm in goods market |

# Mastering the loanable funds model

Things that shift the saving curve

- public saving
  - fiscal policy: changes in ***G*** or ***T***
- private saving
  - preferences
  - tax laws that affect saving
    - – 401(k)
    - – IRA
    - – replace income tax with consumption tax