

## National Income Where It Comes From

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

### The Plan for the Week

- ▶ A static, model economy. . .
- ▶ Supply Side
  - A production function
  - How factor markets operate (supply, demand, price)
  - Determination of output/income and the distribution of income.
- ▶ (Next Week) Demand Side
  - Demand for consumption
  - Demand for investment
- ▶ Please read Chapter 3 (Mankiw).

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

### Factors of Production

- ▶  $K$  = Capital.  
Tools, machines, and structures used in production
- ▶  $L$  = Labor.  
The physical and mental efforts of workers
- ▶ Today, the supplies of capital and labor are fixed (i.e. not changing or exogenous):

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

- Future classes,  $K$  and  $L$  will evolve over time.

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

### Production Function

- ▶ Idea: Describe how much output or GDP ( $Y$ ) the economy can produce from  $K$  units of capital and  $L$  units of labor.
- ▶ Reflects the economy's level of technology.
- ▶ Mathematical version:

$$Y = F(K, L)$$

- $Y$  = output (GDP)
- $K$  = capital,  $L$  = labor

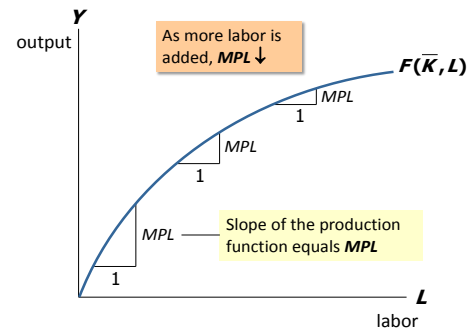
National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Production Function Properties

- ▶ More inputs lead to more output
  - Positive marginal products of capital and labor
- ▶ Diminishing marginal products
  - If we double **only one input**, this leads to a **less than** double additional output.
- ▶ Constant returns to scale
  - If we double **both inputs**, this **doubles** output.

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Diminishing Marginal Product to Labor



National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## How Are Factor Demands Determined?

- ▶ Think of a typical firm in the economy which is competitive.
  - What does competitive mean here?

- ▶ The goal of the firm is to maximize profits:

$$\text{Profit} = \max_{K,L} \{ P \times F(K, L) - W \times L - R \times K \}$$

- ▶ where

- $P$  = product price
- $W$  = wage rate,  $R$  = rental rate of capital.

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## The Marginal Product of Labor #1

- ▶ Marginal Product of Labor = extra amount of output ( $Y$ ) the firm gets from using one extra unit of labor.

- ▶ Mathematically:

$$MPL(L+1) = F(\bar{K}, L+1) - F(\bar{K}, L)$$

- ▶ What shape does the MPL have given what we assumed about the production function?

- ▶ Mathematics note: Formally, this is the partial derivative of production function. If our production function is Cobb-Douglas, what is the marginal product of labor?

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## The Marginal Product of Labor #2

- ▶ Basic Idea: Profit maximization dictates the firm hires labor up to the point the change in revenue from adding one more worker is just offset by its cost. Why?
- ▶ Mathematically:

$$\begin{aligned}\Delta \text{Profit} &= \Delta \text{Revenue} - \Delta \text{Cost}, \\ &= P \times \text{MPL} - W\end{aligned}$$

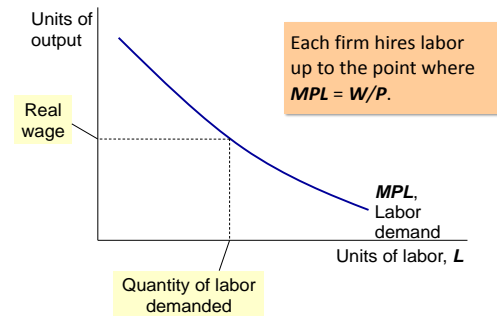
Profit maximization implies:

$$P \times \text{MPL} = W \quad \text{or} \quad \text{MPL} = \frac{W}{P}$$

- ▶ **Key:** Real wage ( $W/P$ ) reflects the marginal product of labor.

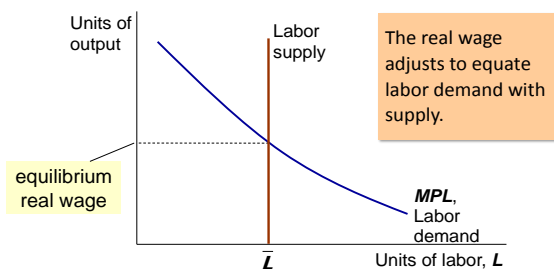
National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Labor Demand



National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Labor Market Equilibrium



National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Wages and Labor productivity, US Data

- ▶ Theory predicts real wages ( $W/P$ ) depend on labor productivity ( $Y/L$ ).

period	productivity growth	real wage growth
1960–2010	2.2%	1.9%
1960–1973	2.9%	2.8%
1973–1995	1.4%	1.2%
1995–2010	2.7%	2.2%

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

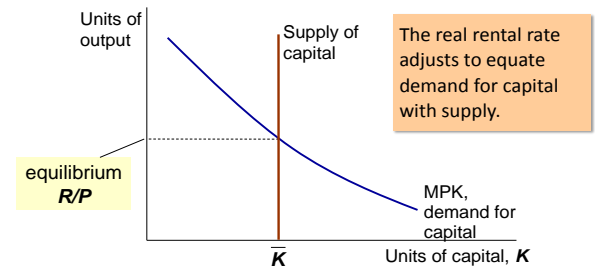
## The Marginal Product of Capital

- ▶ Previous logic also implies that the marginal product of capital (MPK) = real rental rate of capital ( $R/P$ ).
- Diminishing marginal returns to capital implies  $MPK \downarrow$  as  $K \uparrow$ .
- Profit maximization dictates the firm hires capital up to the point the change in revenue ( $P \times MPK$ ) from adding one unit of capital is just offset by its cost.
- The solution implies

$$P \times MPK = R \quad \text{or} \quad MPK = \frac{R}{P}$$

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Capital Market Equilibrium



National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Cobb-Douglas Production Function

- ▶ Cobb-Douglas production function

$$Y = F(K, L) = AK^\alpha L^{1-\alpha}$$

- where  $\alpha$  control's share of income to labor and capital.
- $A$  = total factor productivity, i.e. the level of technology.
- ▶ What type of returns to scale does this have? Does it have diminishing and positive marginal products?

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Cobb-Douglas Marginal Products

- ▶ Cobb-Douglas production function

$$Y = F(K, L) = AK^\alpha L^{1-\alpha}$$

- Marginal Product of Labor (MPL)

$$\begin{aligned} MPL = \frac{\partial F(K, L)}{\partial L} &= (1 - \alpha)AK^\alpha L^{-\alpha} \\ &= (1 - \alpha)\frac{Y}{L} \end{aligned}$$

- Marginal Product of Capital (MPK)

$$\begin{aligned} MPK = \frac{\partial F(K, L)}{\partial K} &= \alpha AK^{\alpha-1} L^{1-\alpha} \\ &= \alpha \frac{Y}{K} \end{aligned}$$

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Practice Questions...

1. Does an increase in TFP change the real rental rate of capital?
2. Labor force participation is falling in the US, is this good or bad for the owners of capital?
3. Burma is currently a closed economy and does not allow the free flow of capital (in or out).  
If Burma's current rental rate of capital is  $R^B/P > R^*/P$  (the world equilibrium rental rate of capital), how would you expect capital to flow in or out of Burma (if at all).

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## How is Income Distributed in the Economy? I

- ▶ Income inequality is a hot topic. This model can speak to some of the current issues.
- ▶ Income payments to labor and capital:
  - Labor income =  $\frac{w}{P} \bar{L} = \text{MPL} \times \bar{L}$
  - Capital income =  $\frac{R}{P} \bar{K} = \text{MPK} \times \bar{K}$
- ▶ Total (Real) GDP = payments to income, so ...

$$\bar{Y} = \text{MPL} \times \bar{L} + \text{MPK} \times \bar{K}$$

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## How is Income Distributed in the Economy? II

- ▶ Total (Real) GDP = payments to income, so ...

$$\bar{Y} = \text{MPL} \times \bar{L} + \text{MPK} \times \bar{K}$$

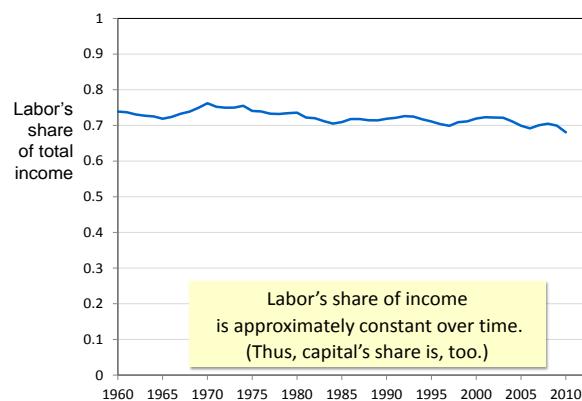
- ▶ Plugging in the marginal products, from previous slide:

$$\begin{aligned} \bar{Y} &= (1 - \alpha) \frac{\bar{Y}}{\bar{L}} \times \bar{L} + \alpha \frac{\bar{Y}}{\bar{K}} \times \bar{K} \\ &= (1 - \alpha) \bar{Y} + \alpha \bar{Y} \end{aligned}$$

- ▶ Which implies Labor's Share of income is  $(1 - \alpha)$ !

National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## Labor's Share of Income, US Data



National Income: Where It Comes From—Economics of Global Business, Revised: January 23, 2018

## A Static, Model Economy

---

### ► Supply Side

- A production function ✓
- How factor markets operate (supply, demand, price) ✓
- Determination of output/income and the distribution of income ✓