Productivity, Output, and Employment

Overview of this class

- How much does an economy produce?
  - Productivity
- How much labor is demanded for production?
- Equilibrium in the labor market
  - Wage and employment determination
- Does technology help or hurt workers?

Production Function

- Mathematical relationship between factors of production and output
- Factors of production
  - labor
  - capital
  - technology
  - other

Production Function (cont.)

- $Y = A * f(K , N)$
  - A is total factor productivity (TFP)
  - K is capital
  - N is labor

Total Factor Productivity

- With the same amount of capital and labor, more output is produced
- Also called supply shocks
- Examples
  - technology
  - education
  - management techniques
  - weather
  - oil prices

Cobb-Douglas production function

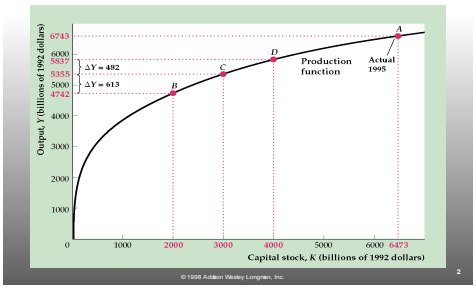
- Usually written as a Cobb-Douglas production function
  - $Y = A * K^{.3} N^{.7}$
- Constant returns to scale
  - Double the amount of capital and labor leads to double the amount of output
- Superscript determines the share of income going to that factor of production

Draw production function

- Graph relationship between output and one factor
- Two properties
  - Upward slope (positive marginal product)
  - Slope becomes flatter as amount of input rises (diminishing marginal product)
- Cobb-Douglas production function has these properties

The Production Function (graph)

Figure 3.1 The production function relating output and capital

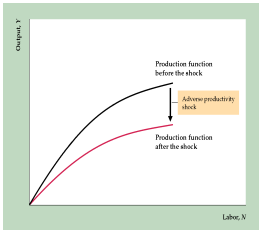


Graphing the production function

- Marginal product of capital (MPK) can be written as $\Delta Y/\Delta K$
- Marginal product of labor (MPN) can be written as $\Delta Y/\Delta N$

Shifting the production function

- Decreases in A
  - shift the production function down
  - decrease output at every level of N
  - decrease the MPN at every level of N



Shifting the production function

- Production function of Y versus N
  - Increase in A shifts the line up
  - Increase in K shifts the line up
  - Increase in N is a movement along the line
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Demand for Labor

- Four assumptions
  - Hold capital stock fixed (short-run analysis)
  - Workers are all alike
  - Labor market is competitive
  - Firms maximize profits
- Compare marginal benefit to marginal cost of an additional worker

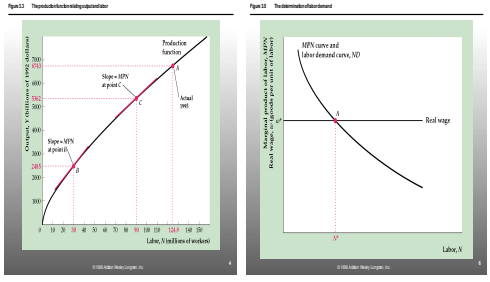
Marginal Benefit and Marginal Cost

- Marginal Benefit
  - Marginal product of labor (output from one additional worker) - MPN
  - Price at which output is sold - P
  - Marginal benefit = MPN*P = marginal revenue product of labor (MRPN)
- Marginal Cost
  - Wage

Hiring Decision

- If MPN*P > W, hire one more worker
  - Usually written as MPN>W/P, where W/P is called the real wage
- If MPN<W/P, reduce the number of workers
- Firms maximize profits when MPN = W/P

Hiring Decision (graphically)



Shifting the labor demand curve

- Increase in A
  - At every level of N, MPN rises -> labor demand shifts right
- Decrease in K
  - At every level of N, MPN falls -> labor demand shifts left

Labor Supply

- Determined by individuals
- Compare costs and benefits of working an additional hour
- Cost
  - One hour of leisure (non-market time)
- Benefit
  - Wage (more current and future consumption)

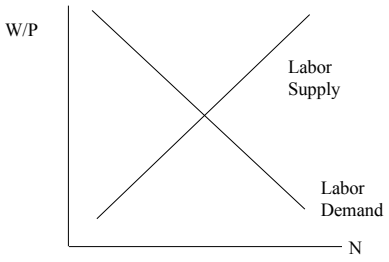
Effect of a wage increase

- Substitution effect
  - Wage (benefit) rises
  - Substitute labor for leisure
  - Hours of work increase
- Income effect
  - Income rises
  - Workers are essentially wealthier because future working hours give higher rewards
  - Hours of work decrease

Income and Substitution Effects

- Which will dominate?
  - How long will this wage increase last?
- Empirical evidence
  - For men, the income and substitution effects offset
  - For women, the substitution effect dominates
  - For temporary wage increases, the substitution effect dominates
- We assume that the substitution effect dominates
  - Upward sloping labor supply curve

Labor Market



Factors which shift the labor supply curve

- Wealth
  - Higher wealth reduces labor supply
  - Labor supply curve shifts left
- Expected future real wage
  - Higher expected future real wage reduces labor supply
  - Labor supply curve shifts left

Factors which shift labor supply curve

- Population size
  - Higher population raises labor supply
  - Labor supply curve shifts right
- Other

Labor Market Equilibrium

- When supply = demand
  - Wage is equal to $\overline{w}$
  - Level of employment is equal to $\overline{N}$
    - Also called full employment
- Classical model of the labor market
  - Wage adjusts quickly
  - No involuntary unemployment

Full employment output

- When the economy is at full employment, it produces the following level of output

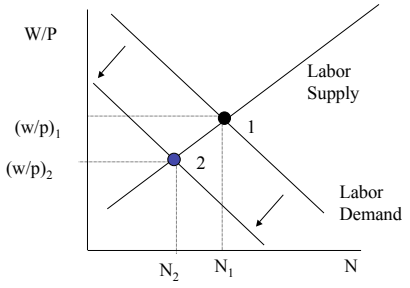
$$\overline{Y} = A * f(K, \overline{N})$$

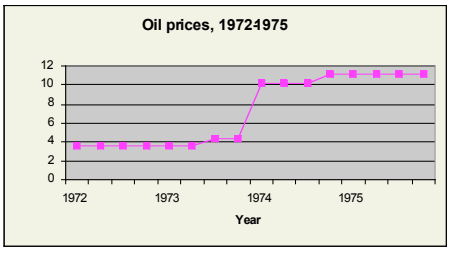
- Full employment output is affected by
  - Supply shocks
  - Changes to K
  - Changes to full employment
    - Determined in the labor market

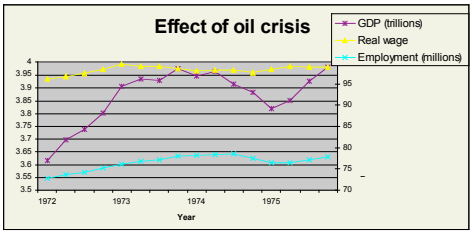
Real world application

- 1973-1974
  - Oil shock (supply shock)
  - "A" decreases
  - MPN decreases
  - Labor demand shifts left
  - Real wage and employment drop
  - Output drops

Labor Market







Is technology good for workers?

- Classical Model predicts
  - "A" increases
  - MPN increases
  - Labor demand shifts right
  - Employment and wage increases
- Video

Questions to keep in mind

- What is the effect of self-cleaning restrooms on labor hours used by the gas station?
- What are the benefits? Who gains?
- What are the costs? Who loses?
- Is technological progress inevitable?
- What steps can the government take to help those hurt by technology?