Principles of Economics

# Chapter 18:

# The Markets for the Factors of Production



## In This Chapter

- What determines a competitive firm's demand for labor?
- How does labor supply depend on the wage? What other factors affect labor supply?
- How do various events affect the equilibrium wage and employment of labor?
- How are the equilibrium prices and quantities of other inputs determined?

# Ask The Experts
## Immigration

- "The average U.S. citizen would be better off if a larger number of highly educated foreign workers were legally allowed to immigrate to the U.S. each year."

- Do you Agree or Disagree?
- Do you think Economists Agree or Disagree?

Source: IGM Economic Experts Panel, February 12, 2013, December 10, 2013.



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"The average U.S. citizen would be better off if a larger number of highly educated foreign workers were legally allowed to immigrate to the U.S. each year."

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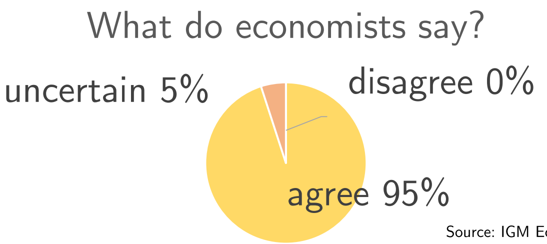
# Ask The Experts
## Immigration

- "The average U.S. citizen would be better off if a larger number of highly educated foreign workers were legally allowed to immigrate to the U.S. each year."
- Preferential treatment to international students with a STEM degree




Source: IGM Economic Experts Panel, February 12, 2013, December 10, 2013.



## Factors of Production

- Factors of production:
  - Inputs used to produce goods and services
  - (Traditionally): Labor, Land, Capital
  - Prices and quantities are determined by supply and demand in factor markets.
- Derived demand for a factor of production
  - A firm's demand for a factor of production is derived from its decision to supply a good in another market.

## Two Assumptions

1. All markets are competitive
   - The typical firm is a price taker
     - In the market for the product it produces
     - In the labor market (factors of production)
2. Firms care only about maximizing profits
   - Each firm's supply of output and demand for inputs are derived from this goal



## Example 1A: Xavier's Popcorn Truck

- Xavier sells popcorn in a perfectly competitive market.
- He hires workers in a perfectly competitive labor market.
- When deciding how many workers to hire, Xavier maximizes profits by thinking at the margin:
  - If the benefit from hiring another worker exceeds the cost, Xavier will hire that worker.

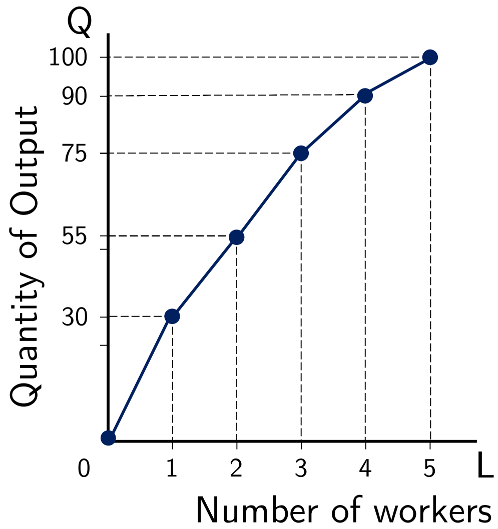
## Costs and Benefits of One More Worker

- Cost of hiring another worker:
  - The wage = the price of labor
- Benefit of hiring another worker:
  - Produce and sell more output, increasing revenue.
  - The size of this benefit depends on the production function:
    - the relationship between the quantity of inputs used to make a good and the quantity of output of that good



## Example 1B: Xavier's Popcorn Production Function

| L workers | Q buckets |
|---|---|
| 0 | 0 |
| 1 | 30 |
| 2 | 55 |
| 3 | 75 |
| 4 | 90 |
| 5 | 100 |



## Marginal Product of Labor ($MPL$)

- Marginal product of labor,

$$MPL = \Delta Q \;/\; \Delta L$$

  - The increase in the amount of output from an additional unit of labor
  - Where
    $\Delta Q$ = change in output
    $\Delta L$ = change in labor



## The Value of the Marginal Product

- Problem:
  - Cost of hiring another worker (wage) is measured in dollars
  - Benefit of hiring another worker ($MPL$) is measured in units of output
- Solution: Convert $MPL$ to dollars
- Value of the Marginal Product, $VMPL = P \times MPL$
  - The marginal product of an input times the price of the output

## Active Learning 1: Xavier's Truck MPL and VMPL

- Use the table given in Example 1B, which shows Xavier's popcorn truck input and output.

- The price of popcorn is $P = \$50$ per bucket of popcorn.
  A. Calculate *MPL* and *VMPL*, fill them in the blank spaces of the table.
  B. Then graph a curve with *VMPL* on the vertical axis, *L* on horizontal axis.
  C. Suppose wage W = \$900/day. How many workers should Xavier hire?



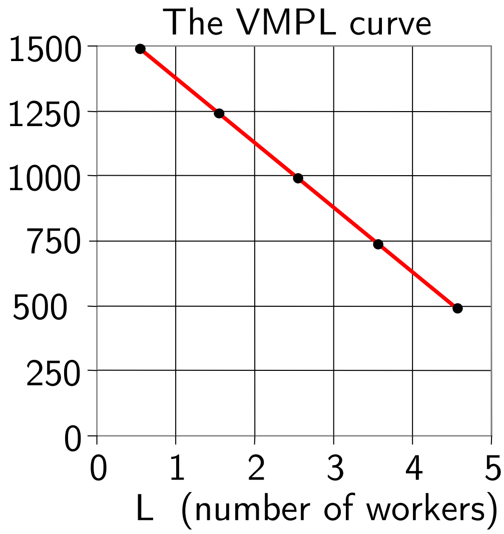
## Active Learning 1: Answers, A

- Xavier's production function exhibits diminishing marginal product: MPL falls as L increases

| L workers | Q buckets | MPL = ΔQ / ΔL | VMPL = P×MPL |
|---|---|---|---|
| 0 | 0 | | |
| | | 30 | 1500 |
| 1 | 30 | | |
| | | 25 | 1250 |
| 2 | 55 | | |
| | | 20 | 1000 |
| 3 | 75 | | |
| | | 15 | 750 |
| 4 | 90 | | |
| | | 10 | 500 |
| 5 | 100 | | |

## Active Learning 1: Answers, B

Xavier's *VMPL* curve is downward sloping due to diminishing marginal product.



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**Suppose that wage is $900/day. How many workers should Xavier hire?**

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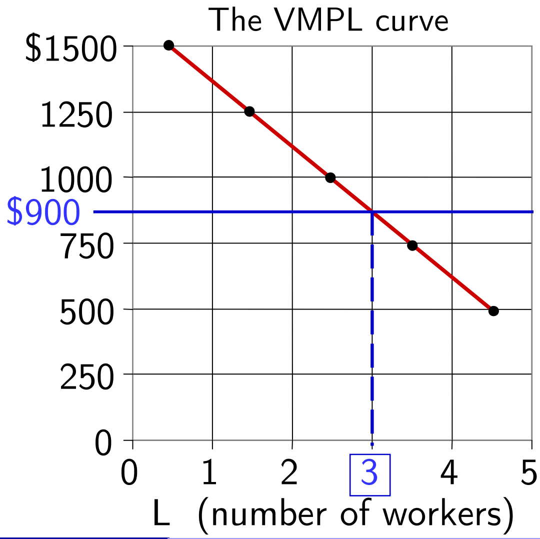
## Active Learning 1: Answers, C

Suppose wage $W = \$900$/day.

How many workers should Xavier hire?

Answer: $L = 3$

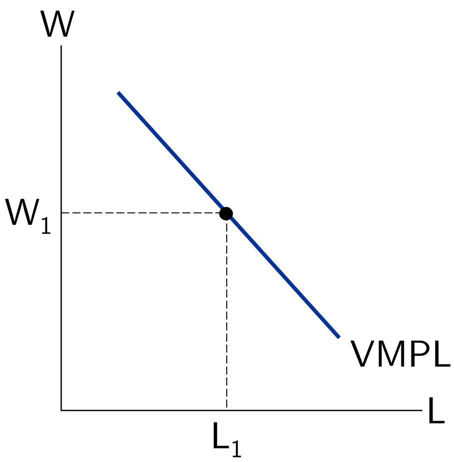
- At any smaller L: increase profit by hiring another worker
- At any larger L: increase profit by hiring one fewer worker.






## VMPL and Labor Demand

- For any competitive, profit-maximizing firm:
  - To maximize profits, hire workers up to the point where $VMPL = W$.
- The $VMPL$ curve is the labor demand curve.



## What Causes the Labor-Demand Curve to Shift?

1. Changes in the output price, $P$
   - An increase in $P$ increases $VMPL$ ($= P \times MPL$) which is the $D$ curve
2. Advances in technology (affects $MPL$)
   - Increases the $MPL$, increasing the demand for labor and shifting the labor-demand curve to the right
3. The supply of other factors of production (affects $MPL$)
   - The 4$^{\text{th}}$ person would be more productive with an additional pencil or tape



## FIY: Input Demand and Output Supply

- The competitive firm's rule for demanding labor:

$$P \times MPL = W$$

- Divide both sides by $MPL$: $P = W \,/\, MPL$
- Substitute $MC$ = W / MPL from previous slide:

$$P = MC$$

  - This is the competitive firm's rule for supplying output.
- Hence: Input demand and output supply are two sides of the same coin.

## FIY: Input Demand and Output Supply

- Marginal Cost ($MC$): Cost of producing an additional unit of output $MC = \Delta TC/\Delta Q$, where $TC =$ total cost
- In general: (P=)$MC = W \ / \ MPL$
  - To produce additional output
    - Hire more labor. As $L$ rises, $MPL$ falls…
      - Causing $W \ / \ MPL$ to rise…
        - Causing $MC$ to rise.
- Diminishing marginal product and increasing marginal cost are two sides of the same coin!

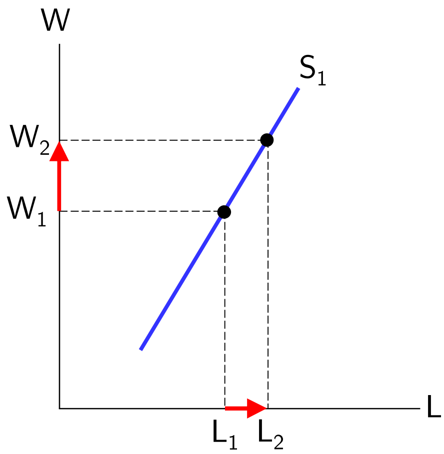


## The Supply of Labor

- Trade-off between work and leisure:
  - The more time you spend working, the less time you have for leisure.
- Wage
  - Is the opportunity cost of leisure
  - When wage increases, the opportunity cost of enjoying leisure goes up

## The Labor Supply Curve

- An increase in *W* is an increase in the opportunity cost of leisure.
- People respond by taking less leisure and by working more.
- What if W is extremely high?
  - Labor supply may be *backward bending*






## What Causes the Labor-Supply Curve to Shift?

- The labor-supply curve shifts whenever people change the hours they want to work at a given wage
  1. Changes in tastes/attitudes toward work
  2. Changes in alternative opportunities
  3. Immigration
     - Movement of workers from region to region, or country to country

## Ask The Experts
### Immigration

- "The average U.S. citizen would be better off if a larger number of low-skilled foreign workers were legally allowed to enter the U.S. each year."

- Do you Agree or Disagree?

- Do you think Economists Agree or Disagree?

Source: IGM Economic Experts Panel, February 12, 2013, December 10, 2013.



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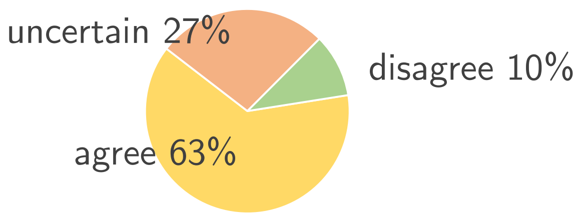
## Ask The Experts
### Immigration

- "The average U.S. citizen would be better off if a larger number of low-skilled foreign workers were legally allowed to enter the U.S. each year."

What do economists say?

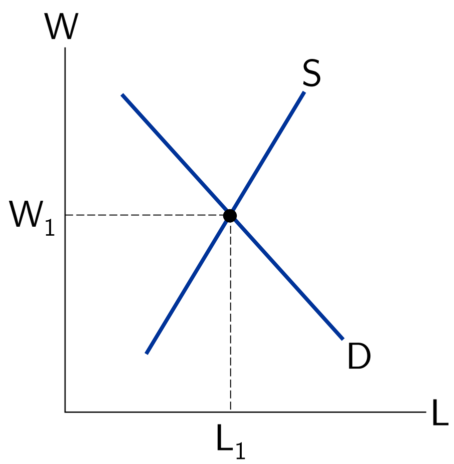



Source: IGM Economic Experts Panel, February 12, 2013, December 10, 2013.



### Equilibrium in the Labor Market

- Wage: adjusts to balance *S* and *D* for labor.
  - Always equals the value of the marginal product of labor (*VMPL*).
- Any event that changes the S or D for labor must change the equilibrium wage and the VMPL by the same amount.



## Active Learning 2: Changes in Labor-Market Equilibrium

- In each of the following scenarios, use a diagram of the market for (domestic) auto workers to find the effects on their wage and employment.

A. Baby boomers who worked in the auto industry retire.

B. Car buyers' preferences shirt toward imported cars.

C. Technological progress boosts productivity in the auto manufacturing industry.



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**Scenario: Baby boomers who worked in the auto industry retire. What would happen to the labor demand and supply?**

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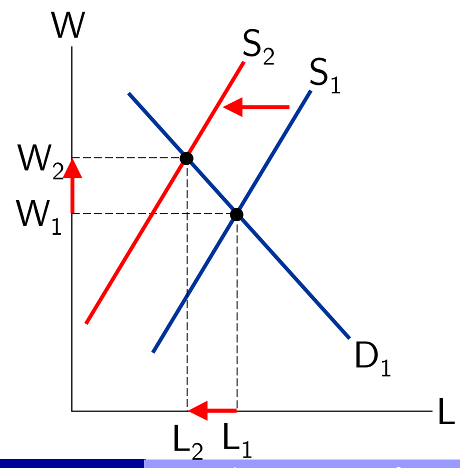
## Active Learning 2: Answers, A

- The retirement of baby boomer workers shifts supply leftward.

- *W* rises, *L* falls.

The market for high-tech workers



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**Scenario: Car buyers' preferences shift toward imported autos. What would happen to the labor demand and supply?**

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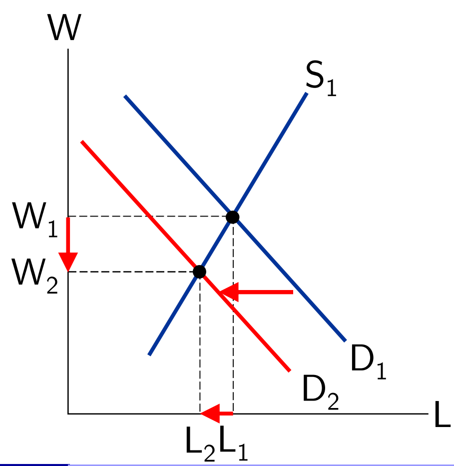
## Active Learning 2: Answers, B

- A fall in the demand for domestic cars reduces ***P***.
- At each *L*, *VMPL* falls.
- Labor demand curve shifts left.
- *W* and *L* both fall.

The market for high-tech workers



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**Scenario: Technological progress boosts productivity in the auto manufacturing industry.**
**What would happen to the labor demand and supply?**

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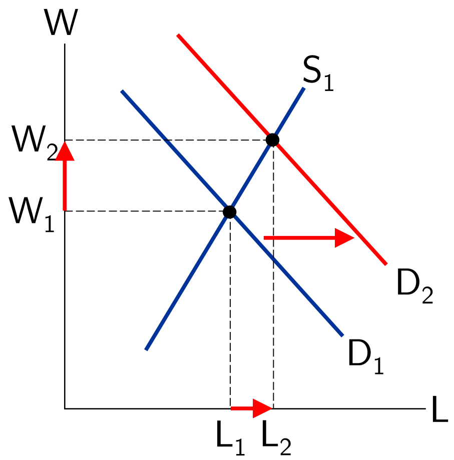
## Active Learning 2: Answers, C

- At each $L$, $MPL$ rises due to technological progress.
- *VMPL* rises
- Labor demand curve shifts right.
- $W$ and $L$ increase.

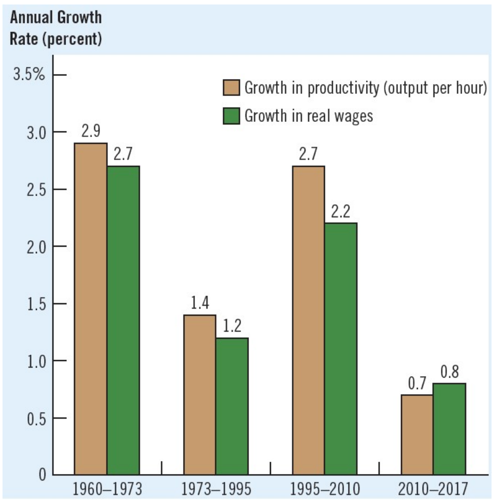
The market for high-tech workers






## Productivity and Wage Growth in the U.S.

- Recall one of the Ten Principles: "A country's standard of living depends on its ability to produce goods and services."
- Our theory implies wages tied to labor productivity ($W = VMPL$)
- We see this in the data.



## FYI: Monopsony

- Monopsony:
  - A market with one buyer
  - A monopsony employer can use its market power to increase its profits by paying lower wages
  - As with monopoly, economic activity under monopsony is below the socially optimal level, causing a deadweight loss
- Monopsonies are rare in the real world
  - Small rural villages built around a big manufacturing plant



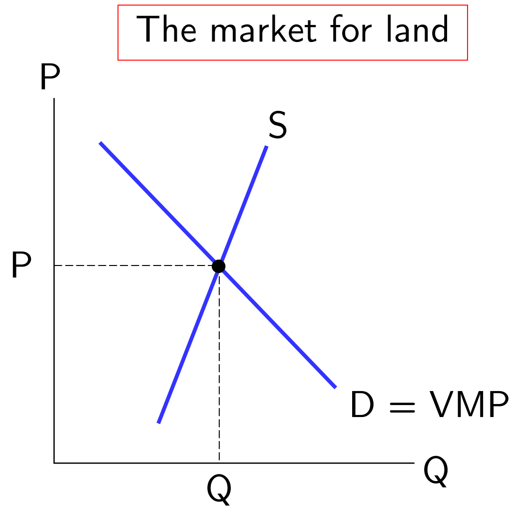
## Land and Capital

- With land and capital, must distinguish between:
  - Purchase price: the price a person pays to own that factor indefinitely
  - Rental price: the price a person pays to use that factor for a limited period of time
    - The wage is the rental price of labor
- The determination of the rental prices
  - Analogous to the determination of wages

## How the Rental Price of Land is Determined

Firms increase the quantity of land to rent until the value of the marginal product (*VMP*) of land equals the land's rental price.

The rental price of land adjusts to balance supply and demand for land.

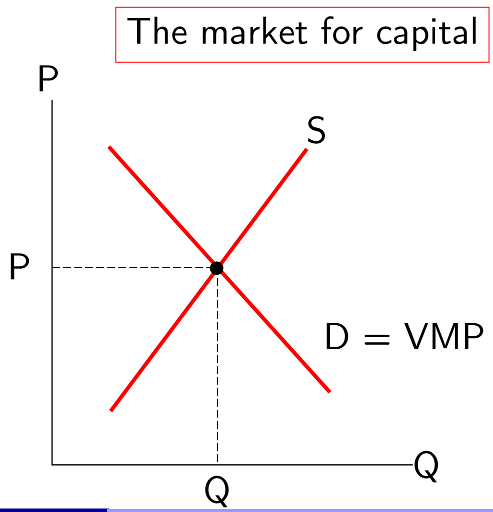





## How the Rental Price of Capital is Determined

Firms increase the quantity of capital to rent until the value of the marginal product (***VMP***) of capital equals the capital's rental price.

The rental price of capital adjusts to balance supply and demand for capital.



## Rental and Purchase Prices

- Buying a unit of capital or land
  - Yields a stream of rental income
- The rental income in any period
  - Equals the value of the marginal product (*VMP*)
- Hence, the equilibrium purchase price of a factor
  - Depends on both the current *VMP* and the *VMP* expected to prevail in future periods.



## Linkages Among the Factors of Production

- Factors of production are used together
  - In a way that makes each factor's productivity dependent on the quantities of the other factors
- Example: an increase in the quantity of capital
  - The marginal product and rental price of capital may fall
  - Having more capital makes workers more productive,
    - ***MPL*** and ***W*** rise
- Labor and capital may substitute each other in the short run (the industrial revolution and the *Luddites*)

## Ask The Experts
### Immigration

- "Unless they were compensated by others, many low-skilled American workers would be substantially worse off if a larger number of low-skilled foreign workers were legally allowed to enter the U.S. each year."

- Do you Agree or Disagree?

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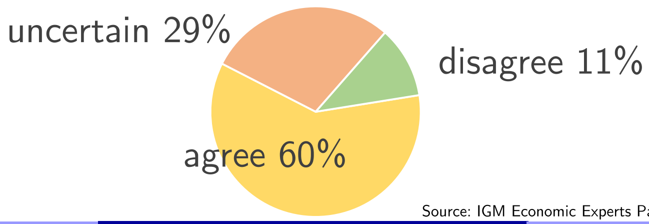


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### Conclusion: Neoclassical theory of income distribution

- Theory developed in this chapter
- Factor prices are determined by supply and demand
- Each factor is paid the value of its marginal product
- Used by most economists as a starting point for understanding the distribution of income

## Think-Pair-Share
### You are Watching a Debate About Immigration on TV

- …with a friend. The participants represent two camps—organized labor and corporate industry.
  - Organized labor argues against open immigration while U.S. industry argues in favor of more open immigration.
- Your friend says, "I can't believe that these two groups can't get together on this issue.
  - Both firms and workers join forces to produce our industrial output. I would think that their interests would be similar.



## Think-Pair-Share
### You are Watching a Debate About Immigration on TV

  - Maybe a better arbitrator could help these groups find a position on immigration that would satisfy both groups."

A. If there were open immigration, what would happen to the value of the marginal product of labor and the wage?

B. If there were open immigration, what would happen to the value of the marginal product of capital and land and their rental rates?

C. Are the positions that each group takes on immigration consistent with their interests? Explain. Is there likely to be a solution that satisfies both? Why or why not?

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## Chapter In A Nutshell

- The economy's income is distributed in the markets for the factors of production: labor, land, and capital.
- The demand for factors is a derived demand that comes from firms that use the factors to produce goods and services. Competitive, profit-maximizing firms hire each factor up to the point at which the value of the factor's marginal product equals its price.
- The supply of labor arises from individuals' tradeoff between work and leisure.

## Chapter In A Nutshell

- The price paid to each factor adjusts to balance the supply and demand for that factor.
  - Because factor demand reflects the value of the marginal product of that factor, in equilibrium each factor is compensated according to its marginal contribution to the production of goods and services.
  - Because factors of production are used together, the marginal product of any one factor depends on the quantities of all factors that are available. As a result, a change in the supply of one factor alters the equilibrium earnings of all the factors.



## Chapter 18: Factor Markets

- Labor Market: Yet "another" market
  - Derived Demand: W = P * MPL = VMPL
- Output Supply = Input Demand:
  - MC = P = W / MPL
- Labor Supply: Work vs. Leisure
- Other Factors: Land, Capital, etc.

- Homework: Mankiw, Ch.18: 4, 5, 7-9

## Chapter 18: Factor Markets

- Challenge Questions (Past Finals)
  - 2007 - Part 4
  - 2008 - Essay A
  - 2009 - Essay B
  - 2012 - Part II, B1-B5, C
  - 2013 - Part II
  - 2016 - Essay D
  - 2017 - Essay A1-A8
  - 2018 - Essay A6-7