

Principles of Economics

Chapter 18:

The Markets for the Factors of Production



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Factor Markets

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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?

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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.”

▶ 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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Do you "Agree" or "Disagree"?

“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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Do you think Economists Agree or Disagree?
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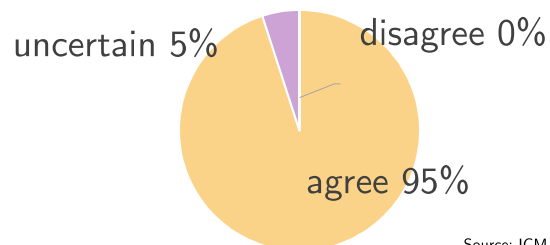
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Ask The Experts

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.”

What do economists say?



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.

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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

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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.

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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

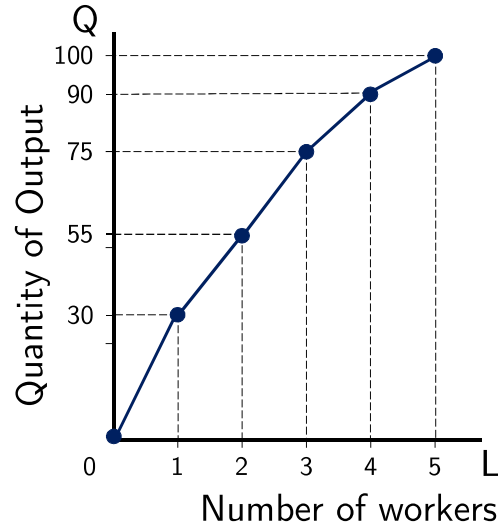
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Example 1B: Xavier's Popcorn Production Function

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



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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
 - ΔQ = change in output
 - ΔL = change in labor

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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

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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 $P = \$5$ 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 $W = \$90/\text{day}$. How many workers should Xavier hire?

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Active Learning 1: Answers, A

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

L workers	Q buckets	MPL = $\Delta Q / \Delta L$	VMPL = $P \times \text{MPL}$
0	0		
1	30	30	150
2	55	25	125
3	75	20	100
4	90	15	75
5	100	10	50

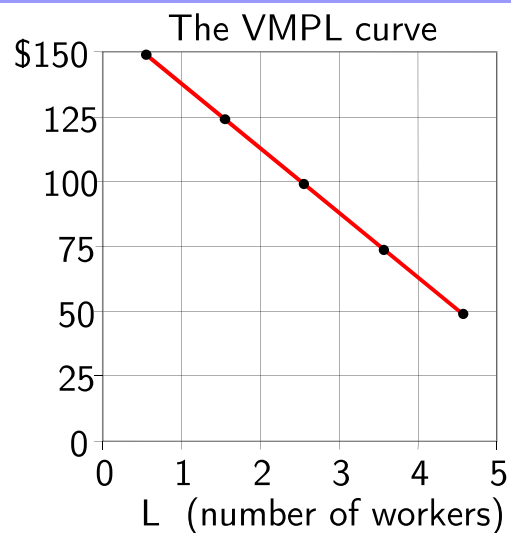
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Active Learning 1: Answers, B

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



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Suppose wage $W = \$90/\text{day}$.
How many workers should Xavier hire?

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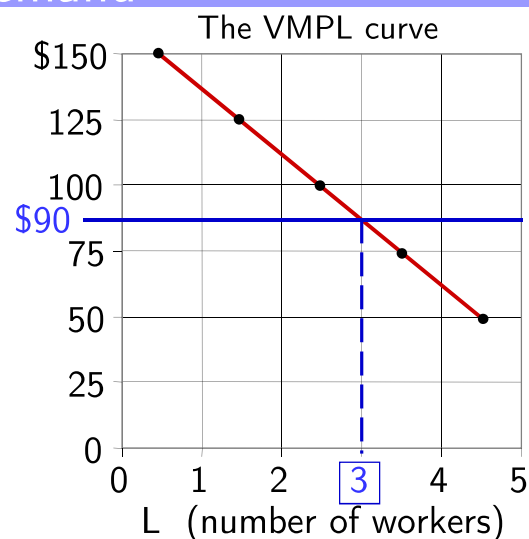
Example 1C: Xavier's Labor Demand

Suppose wage $W = \$90/\text{day}$.

How many workers should Xavier hire?

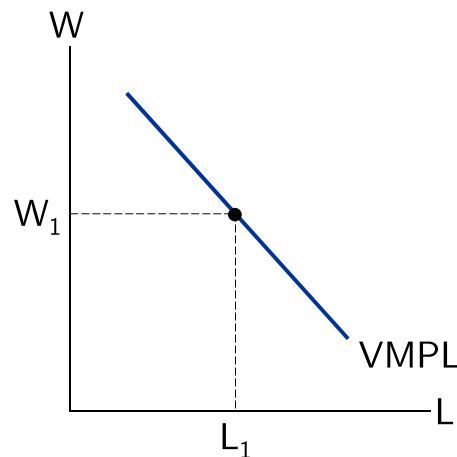
Answer: $L = 3$

- ▶ 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.



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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)

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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: $MC = W / MPL$
 - ▶ 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!

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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.

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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

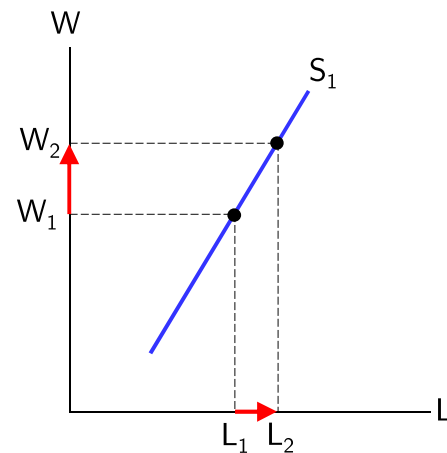
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The Labor Supply Curve

- ▶ An increase in W is an increase in the opportunity cost of leisure.
- ▶ People respond by taking less leisure and by working more.



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What Causes the Labor-Supply Curve to Shift?

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

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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.”
 - ▶ 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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Do you Agree or Disagree?

“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.”

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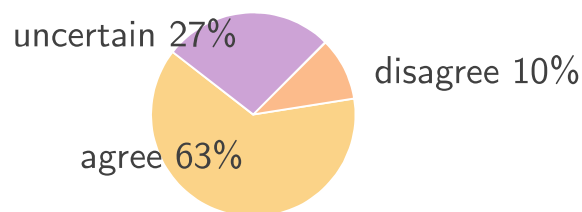
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Ask The Experts

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.

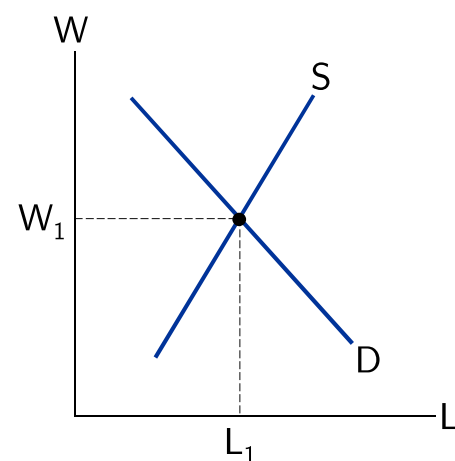
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Equilibrium in the Labor Market

- ▶ 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.



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Active Learning 2: Changes in Labor-Market Equilibrium

- ▶ In each of the following scenarios, use a diagram of the market for (domestic) high-tech workers to find the effects on their wage and employment.
- A. Baby boomers who worked in the high-tech industry retire.
 - B. Foreign business preferences shift toward MIC instead of MIT.
 - C. Technological progress boosts productivity in the high-tech manufacturing industry.

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Scenario 1: Baby boomers who worked in the high-tech industry retire.

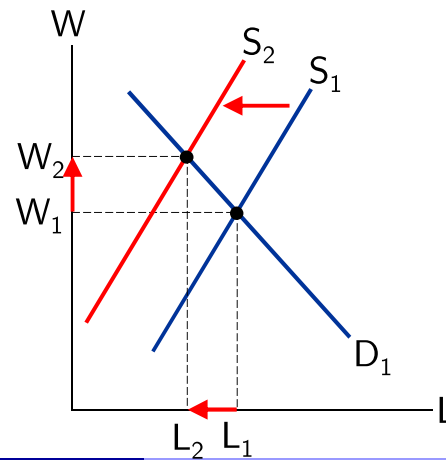
Use a diagram of the market for (domestic) high-tech workers to find the effects on their wage and employment.

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Active Learning 2: Answers, A

- ▶ The retirement of baby boomer high-tech workers shifts supply leftward.
- ▶ W rises, L falls.

The market for high-tech workers



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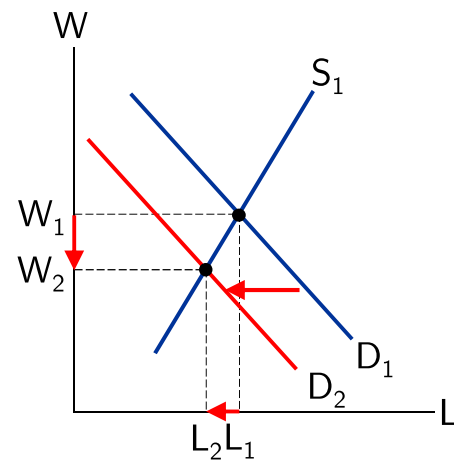
Scenario 2: Foreign business preferences shift toward MIC instead of MIT.
Use a diagram of the market for (domestic) high-tech workers to find the effects on their wage and employment.

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Active Learning 2: Answers, B

- ▶ A fall in the demand for Made-In-Taiwan 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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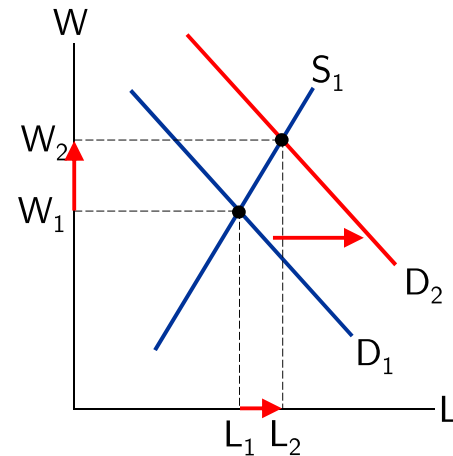
Scenario 3: Technological progress boosts productivity in the high-tech manufacturing industry. Use a diagram of the market for (domestic) high-tech workers to find the effects on their wage and employment.

① Start presenting to display the poll results on this slide.

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



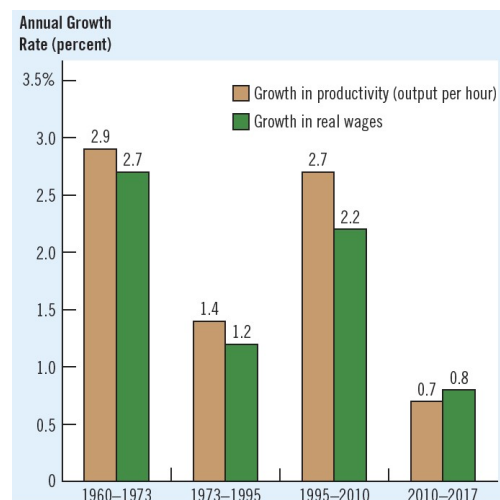
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Productivity and Wage Growth in the U.S.

- ▶ 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.



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Productivity and Wage Growth in Taiwan

- ▶ Real wages pretty flat in the past 20+ years
- ▶ What about productivity?



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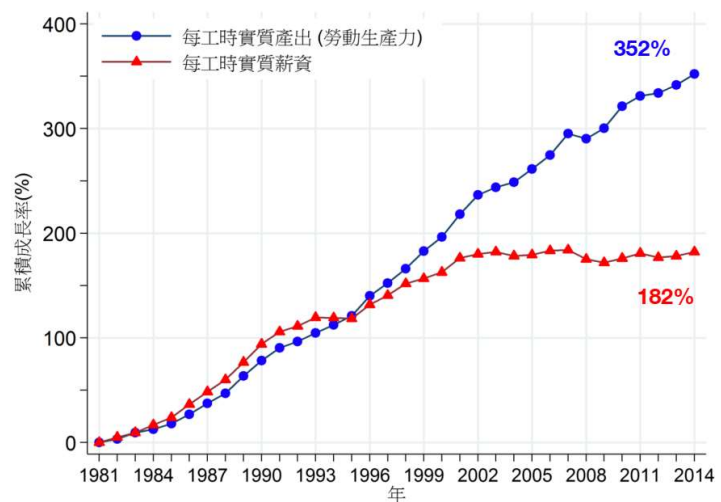
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Labor Productivity vs. Wage Growth in Taiwan

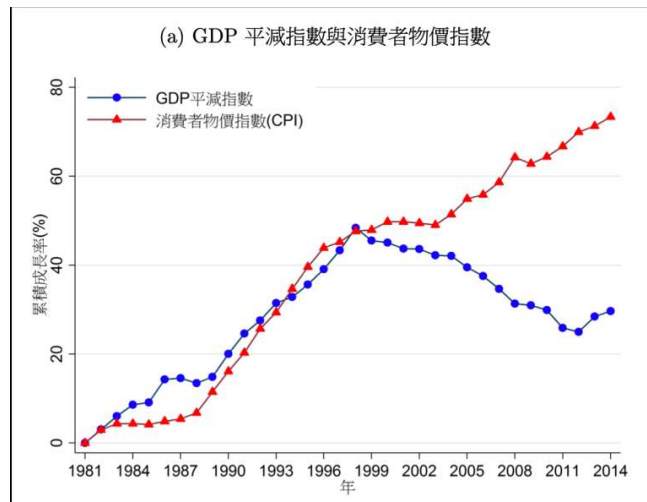
- ▶ Real hourly output
- ▶ Real hourly salary

圖 1：勞動生產力與每工時實質薪資的累積成長率（台灣工業與服務業）：1981-2014 年



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Taiwan's GDP Deflator vs. Consumer Price Index



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Shiu-Sheng Chen (TER-forthcoming)

Terms of Trade Deterioration and Exchange Rates: The Case of
Taiwan

Shiu-Sheng Chen

Department of Economics, National Taiwan University

Since 1998, Taiwan is associated with a long-run terms of trade deterioration. This study aims at exploring potential explanations for such a long-run decline. Using monthly data from 1998:M1 to 2019:M6, we find strong evidence that one of the main causes of the deteriorating terms of trade is due to persistent currency depreciation in Taiwan.

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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

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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

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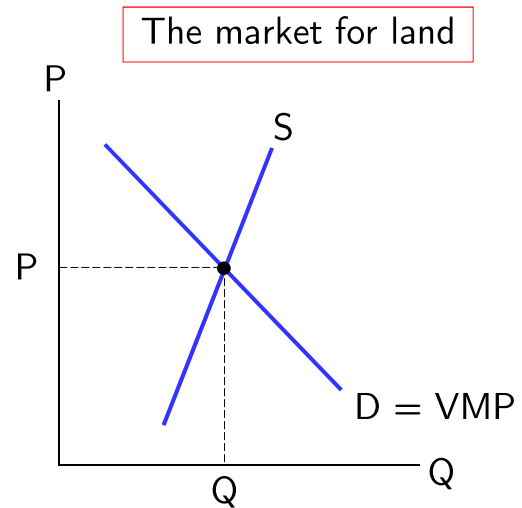
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How the Rental Price of Land is Determined

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.



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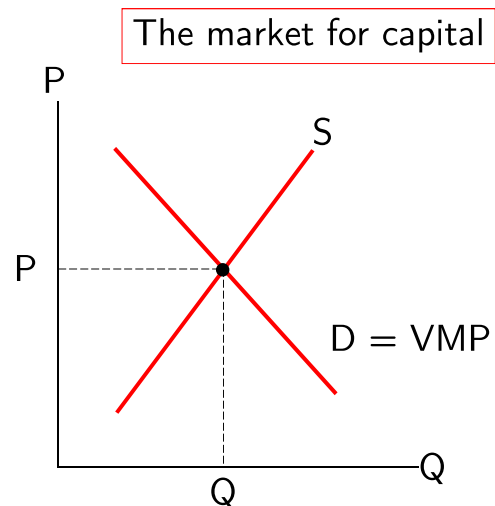
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How the Rental Price of Capital is Determined

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.



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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.

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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 fall
 - ▶ Having more capital makes workers more productive,
 - ▶ *MPL* and *W* rise

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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?

▶ Do you think Economists Agree or Disagree?

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

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Do you Agree or Disagree?

“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.”

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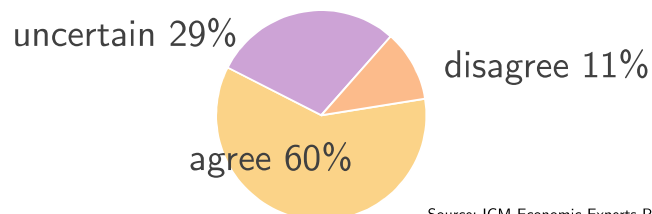
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Immigration

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What do economists say?



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

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

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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.

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

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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**.

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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.

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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

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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

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