N. GREGORY MANKIW NINTH EDITION

PRINCIPLES OF

ECONOMICS

CHAPTER 18

The Markets for the Factors of Production

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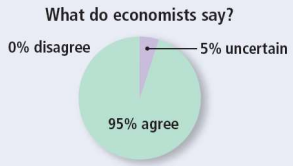
IN THIS CHAPTER

- 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?

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."



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

Factors of Production

- Factors of production:
  - Inputs used to produce goods and services: 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:

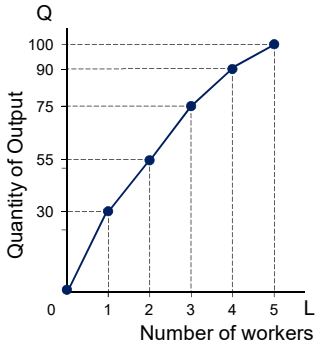
- If the benefit from hiring another worker exceeds the cost, Xavier will hire that worker.

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*** = ***ΔQ*** / ***ΔL***
  - The increase in the amount of output from an additional unit of labor
  - Where
    - ***ΔQ*** = change in output
    - ***ΔL*** = 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*** × ***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*** = \$5 per bucket of popcorn.

A. Calculate ***MPL*** and ***VMPL***, fill them in the blank spaces of the table.

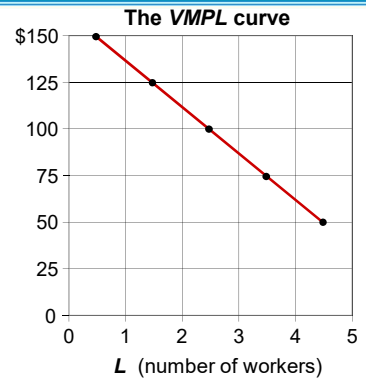
B. Then graph a curve with ***VMPL*** on the vertical axis, ***L*** on horizontal axis.

Active Learning 1: Answers, A

L workers	Q buckets	MPL = ΔQ / ΔL	VMPL = P×MPL
0	0		
1	30	30	150
2	55	25	125
3	75	20	100
4	90	15	75
5	100	10	50

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

Active Learning 1: Answers, B



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

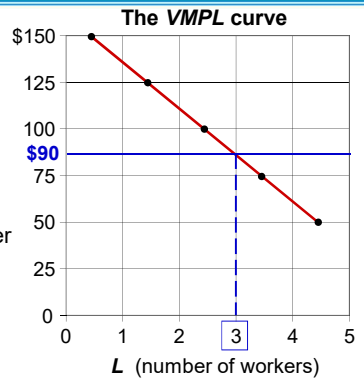
Example 1C: Xavier's Labor Demand

Suppose wage ***W*** = $90/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.

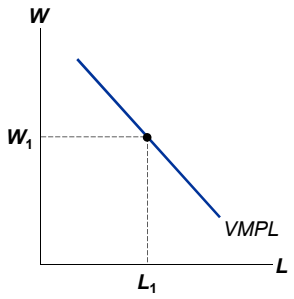


VMPL and Labor Demand

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?

- Changes in the output price, ***P***
  - An increase in P increases ***VMPL*** (= ***P*** × ***MPL***) which is the ***D*** curve
- Advances in technology (affects ***MPL***)
  - Increases the ***MPL***, increasing the demand for labor and shifting the labor-demand curve to the right
- The supply of other factors of production (affects ***MPL***)

FIY: Input Demand & Output Supply

- Marginal Cost (***MC***): cost of producing an additional unit of output

  MC = Δ***TC***/Δ***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

FIY: Input Demand & Output Supply

- The competitive firm's rule for demanding labor: ***P*** × ***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.

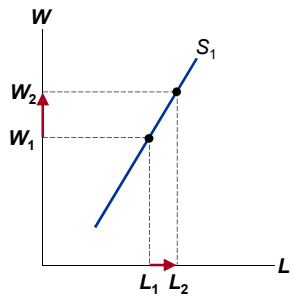
The Supply of Labor

- 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.



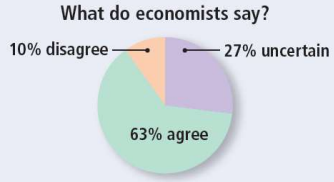
What Causes the Labor-Supply Curve to Shift?

- The labor-supply curve shifts
  - Whenever people change the amount they want to work at a given wage
  - Changes in tastes/attitudes toward work
  - Changes in alternative opportunities
  - 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."



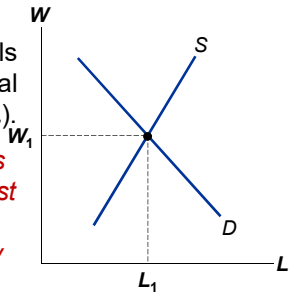
Source: IGM Economic Experts Panel, February 12, 2013, December 10, 2013.

Equilibrium in the labor market

Wage: adjusts to balance ***S*** and ***D*** for labor.

The wage 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 high-tech industry retire.

B. Foreign business preferences shift toward MIC instead of MIT.

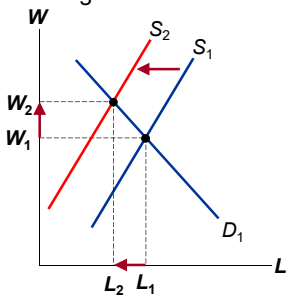
C. Technological progress boosts productivity in the high-tech manufacturing industry.

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

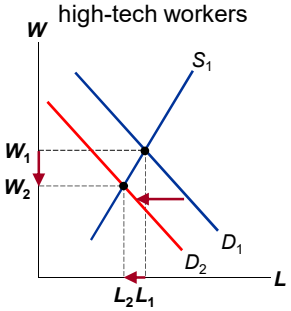


Active Learning 2: Answers, B

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

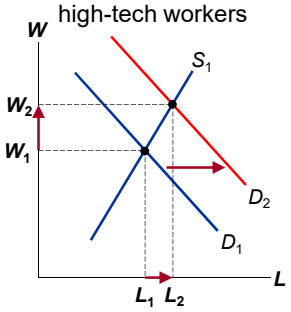


Active Learning 2: Answers, C

At each ***L***, ***MPL*** rises due to tech. progress.

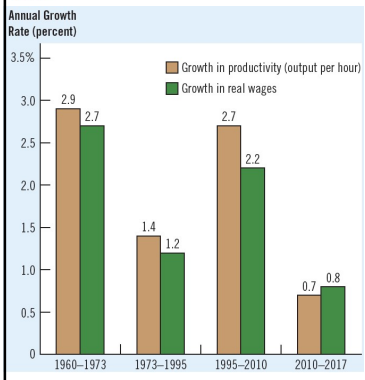
- ***VMPL*** rises
- Labor demand curve shifts right.
- ***W*** and ***L*** increase.

The market for high-tech workers



CASE STUDY

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.

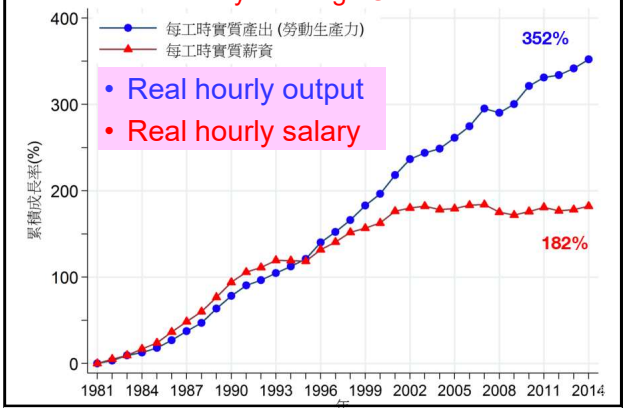
CASE STUDY

Productivity and Wage Growth in Taiwan

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

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

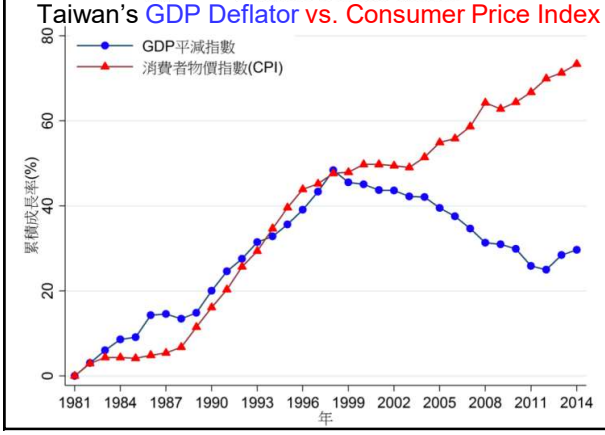
Labor Productivity vs. Wage Growth in Taiwan



- Real hourly output
- Real hourly salary

(a) GDP 平減指數與消費者物價指數

Taiwan's GDP Deflator vs. Consumer Price Index



CASE STUDY

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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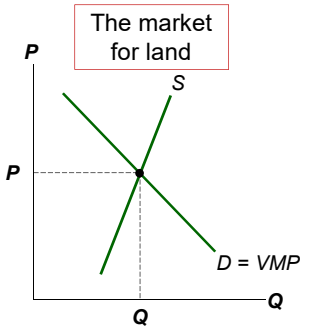
How the Rental Price of Land is Determined

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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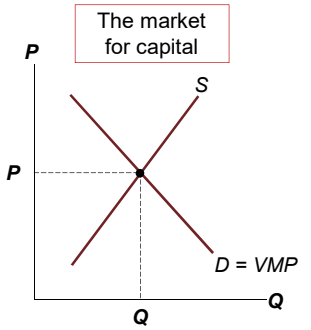
How the Rental Price of Capital is Determined

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.

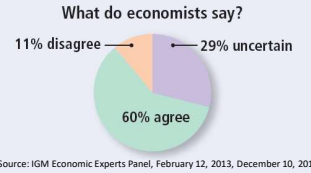
Linkages Among the Factors of Production

- 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

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."



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

THINK-PAIR-SHARE

You are watching a debate about immigration on public television 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. Maybe a better arbitrator could help these groups find a position on immigration that would satisfy both groups."

THINK-PAIR-SHARE

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?

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