Lecture 13. General Equilibrium

BTM210, KAIST

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General Equilibrium Analysis

- We have studied individual markets in isolation. **(partial equilibrium analysis)**
  - We presume that activity in one market has little or no effect on other markets.
  - For instance, we assume that wheat market was largely independent of the markets for related products, such as corn and soybeans.
- But, markets are often interdependent. **(general equilibrium analysis)**
  - General equilibrium analysis determines the prices and quantities in all markets simultaneously.
  - Explicitly taking feedback effects into account, which is a price or quantity adjustment in one market caused by price and quantity adjustments in related markets.
  - For instance, oil import tax$\uparrow \Rightarrow$ oil price$\uparrow \Rightarrow$ natural gas demand$\uparrow \Rightarrow$ natural gas price$\uparrow \Rightarrow$ oil demand$\uparrow \Rightarrow$ oil price$\uparrow \Rightarrow \cdots$

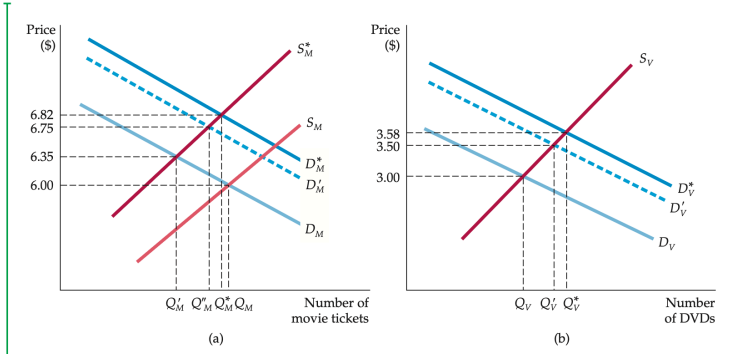


FIGURE 16.1
TWO INTERDEPENDENT MARKETS: (A) MOVIE TICKETS AND (B) DVD RENTALS

When markets are interdependent, the prices of all products must be simultaneously determined. Here a tax on movie tickets shifts the supply of movies upward from S_M to S_M^*, as shown in **(a)**. The higher price of movie tickets ($6.35 rather than $6.00) initially shifts the demand for DVDs upward (from D_V to D_V'), causing the price of DVDs to rise (from $3.00 to $3.50), as shown in **(b)**. The higher video price feeds back into the movie ticket market, causing demand to shift from D_M to D_M' and the price of movies to increase from $6.35 to $6.75. This continues until a general equilibrium is reached, as shown at the intersection of D_M^* and S_M^* in **(a)**, with a movie ticket of $6.82, and the intersection of D_V^* and S_V in **(b)**, with a DVD price of $3.58.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.1

Efficiency in Exchange

- We begin with an **exchange economy**
  - Analyzing the behavior of two consumers(or two countries) who can trade either of two goods between themselves
  - Two goods are initially allocated so that both consumers can make themselves better off by trading with each other
  - Suppose that the initial allocation of goods is economically inefficient.
- In a **Pareto efficient allocation** of goods, no one can be made better off without making someone else worse off.
  - The concept of efficiency in Exchange
  - With Pareto efficiency, we know that there is no way to improve the well-being of both individuals (if we improve one, it will be at the expense of the other)

Equity Implication of Pareto Efficiency

- Note that
  - We cannot be assured that this arrangement will maximize the joint welfare of both individuals.
  - It may be possible to reallocate the goods in a way that increases the total well-being of the two individuals, but leaves one individual worse off.
- **Question:** If we can reallocate goods so that one individual is just slightly worse off but the other individual is much, much better off, wouldn't that be a good thing to do, even though it is not Pareto efficient?

The Advantage of Trade

- In general, trade between two people or countries is mutually beneficial.
- An example
  - James and Karen have 10 units of food and 6 units of clothing between them.
  - Initially James has 7 units of food and 1 unit of clothing.
  - Karen has 3 units of food and 5 units of clothing.

TABLE 16.1 THE ADVANTAGE OF TRADE

INDIVIDUAL	INITIAL ALLOCATION	TRADE	FINAL ALLOCATION
James	7F, 1C	−1F, +1C	6F, 2C
Karen	3F, 5C	+1F, −1C	4F, 4C

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Table 16.1

- Karen's marginal rate of substitution of food for clothing: $MRS_{FC} = 3$
  - She has a lot of clothing and little food. To get 1 unit of food, she will give up 3 units of clothing.
- James's marginal rate of substitution of food for clothing: $MRS_{FC} = 1/2$
  - He has a lot of food. He will give up only $1/2$ a unit of clothing to get 1 unit of food.
- Mutually advantageous trade is available because James values clothing more highly than Karen does, whereas Karen values food more highly than James does.
  - The actual terms of the trade depend on the bargaining process.
  - Among the possible outcomes are a trade of 1 unit of food by James for anywhere between $1/2$ and 3 units of clothing from Karen.
  - Table 16.1 shows an example that Karen offers James 1 unit of clothing for 1 unit of food and James agrees. Both will be better off.

- Note that
  - Whenever two consumers' MRSs are different, there is room for mutually beneficial trade
  - Since the allocation of resources is inefficient, trading will make both consumers better off.
  - Conversely, to achieve economic efficiency, the two consumers' MRSs must be equal.
- In general,
  - An allocation of goods is **efficient only if** the goods are distributed so that the marginal rate of substitution between any pair of goods is the same for all consumers.

$$MRS_1 \neq MRS_2 \quad \Rightarrow \quad \text{Not efficient}$$

$$MRS_1 = MRS_2 \quad \Leftarrow \quad \text{Efficient} \quad \text{(Contraposition)}$$

The Edgeworth Box Diagram

- **Edgeworth box** is a diagram showing all possible allocations of two goods between two people.
- An example
  - The horizontal axis describes the number of units of food and the vertical axis the units of clothing.
  - The length of the box is 10 units of food, the total quantity of food available.
  - Its height is 6 units of clothing, the total quantity of clothing available.
  - Each point describes the market baskets of both consumers.
  - James's holdings are read from the origin at O_J and Karen's holdings in the reverse direction from the origin at O_K.

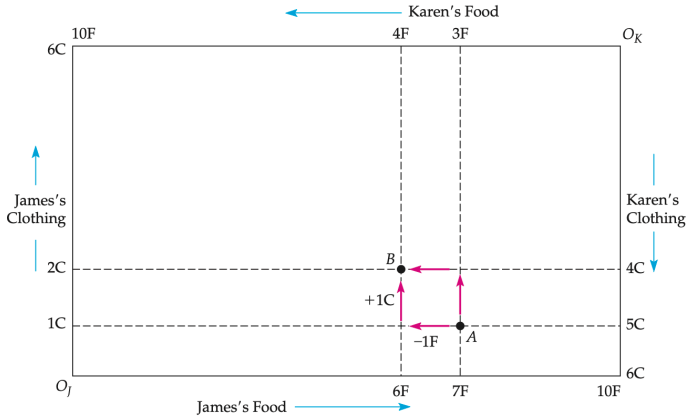


FIGURE 16.4
EXCHANGE IN AN EDGEWORTH BOX

Each point in the Edgeworth box simultaneously represents James's and Karen's market baskets of food and clothing. At *A*, for example, James has 7 units of food and 1 unit of clothing, and Karen 3 units of food and 5 units of clothing.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.4

Efficient Allocations

- A trade from A to B makes both Karen and James better off.
- Then, is B an efficient allocation?
- The answer depends on whether James's and Karen's MRSs are the same at B, which depends in turn on the shape of their indifference curves.
- At A,
  - The curves labeled U_J^1 and U_K^1 pass through the initial allocation at A.
  - The shaded area between these two indifference curves represents all possible allocations of food and clothing that would make both James and Karen better off.
  - In other words, it describes all possible mutually beneficial trades.
- A and B are inefficient, but C and D are efficient. Why?

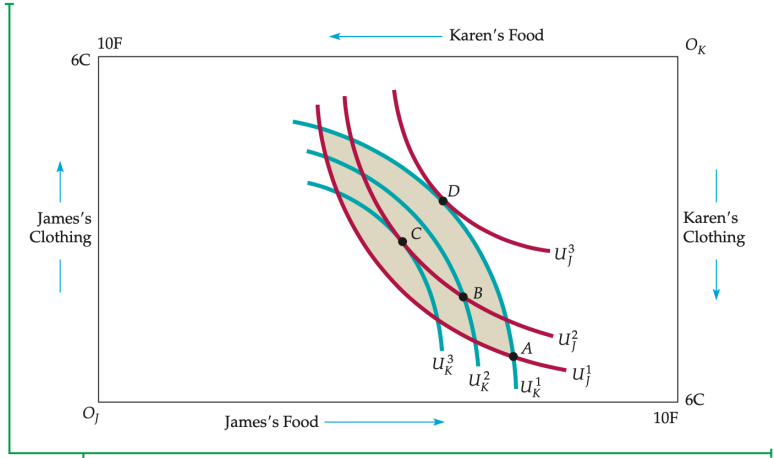


FIGURE 16.5
EFFICIENCY IN EXCHANGE

The Edgeworth box illustrates the possibilities for both consumers to increase their satisfaction by trading goods. If *A* gives the initial allocation of resources, the shaded area describes all mutually beneficial trades.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.5

The Contract Curve

- To find all possible efficient allocations of food and clothing between Karen and James, we look for all points of tangency between each of their indifference curves.
- The **contract curve** is the set of all such efficient allocations.
  - The contract curve shows all allocations from which no mutually beneficial trade can be made.
  - These allocations are efficient because there is no way to reallocate goods to make someone better off without making someone else worse off.
- In Figure 16.5,
  - E, F, and G are Pareto efficient, although each involves a different distribution of food and clothing.
  - This is because one person could not be made better off without making someone else worse off.

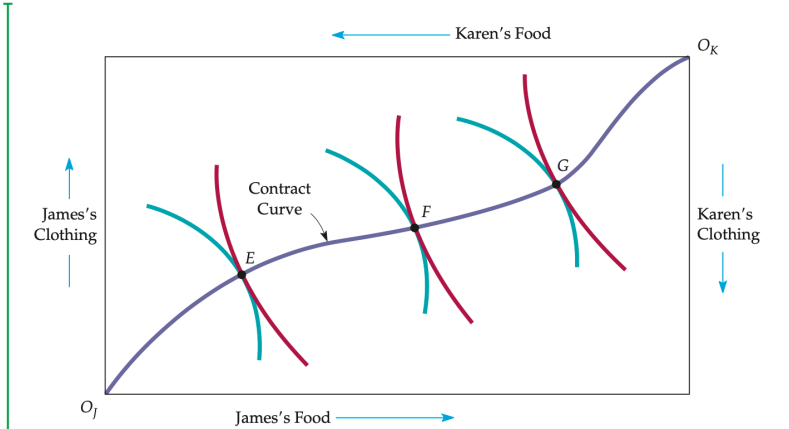


FIGURE 16.6
THE CONTRACT CURVE

The contract curve contains all allocations for which consumers' indifference curves are tangent. Every point on the curve is efficient because one person cannot be made better off without making the other person worse off.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.6

Some Remarks

- Once a point on a contract curve, such as E, has been chosen, there is no way to move to another point on the contract curve, say F, without making one person worse off (in this case, Karen).
- Without making further comparison between James's and Karen's preferences, we cannot compare allocations E and F. We simply know that both are efficient.
- Pareto efficiency is a modest goal: It says that we should make all mutually beneficial exchanges, but it does not say which exchanges are best.

Consumer Equilibrium in a Competitive Market

- Different from a two-person exchange, competitive markets have many actual or potential buyers and sellers.
- We can use the Edgeworth box to show how competitive markets lead to efficient exchange.
  - Many Jameses and many Karens
  - Each individual James and Karen is a price taker.
  - The price line PP' in the diagram, which has a slope of -1, describes all possible allocations that exchange can achieve.
  - Each James buys clothing and sells food, while each Karen buys food and sells clothing, until the allocation moves from A to C.

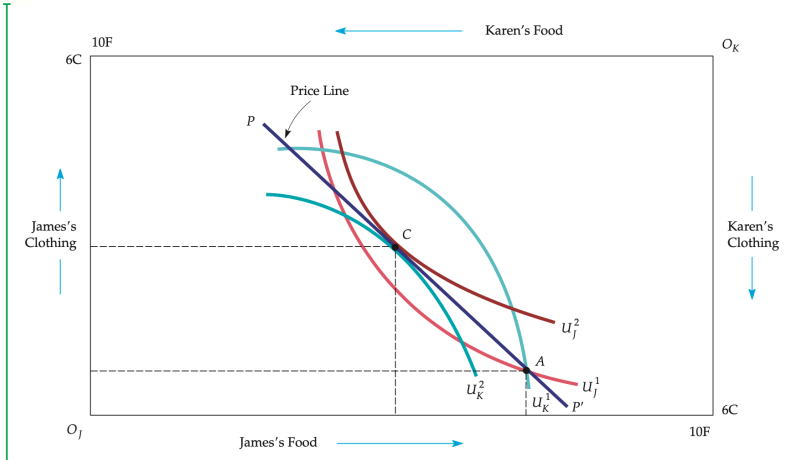


FIGURE 16.7
COMPETITIVE EQUILIBRIUM

In a competitive market the prices of the two goods determine the terms of exchange among consumers. If *A* is the initial allocation of goods and the price line *PP'* represents the ratio of prices, the competitive market will lead to an equilibrium at *C*, the point of tangency of both indifference curves. As a result, the competitive equilibrium is efficient.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.7

- At C, the market for food and clothing are in equilibrium.
  - Given the price, the quantity of food demanded by each Karen is equal to the quantity of food that each James wishes to sell.
  - Likewise, the quantity of clothing demanded by each James is equal to the quantity of clothing that each Karen wishes to sell.
- An equilibrium is a set of prices at which the quantity demanded equals the quantity supplied in every market. This is also a competitive equilibrium because all suppliers and demanders are price takers.
- Note that not all prices are consistent with equilibrium.
  - If the price of food is 1 and the price of clothing is 3, the market is in disequilibrium because there is excess demand for food.
  - Each James does not want to sell food, while each Karen wants to buy food.

The Economic Efficiency of Competitive Markets

- The allocation in a competitive equilibrium is Pareto efficient.
  - The equilibrium point C in the Edgeworth box must occur at the tangency of two indifference curves.
  - If it does not, one of the Jameses or one of the Karens will not be achieving maximum satisfaction.
  - If it does not, he or she will be willing to trade to achieve a higher level of utility.
  - It is the most direct way of illustrating the workings of Adam Smith' s famous invisible hand.
  - It tells us that the economy will automatically allocate resources in a Pareto efficient manner without the need for regulatory control.

The First Theorem of Welfare Economics

Theorem

If everyone trades in the competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will be Pareto efficient.

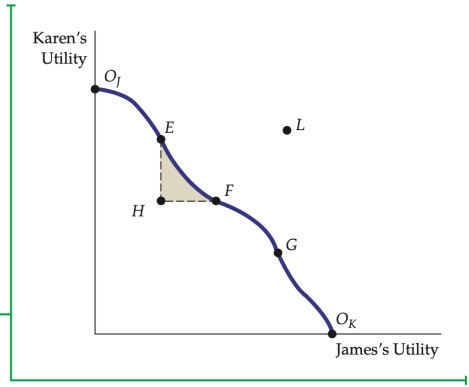
- Simply, the first welfare theorem says that every competitive allocation is Pareto efficient.
- Note that
  - Because the indifference curves are tangent, all marginal rates of substitution between consumers are equal.
  - Because each indifference curve is tangent to the price line, each person's MRS of clothing for food is equal to the ratio of the prices of the two goods.

The Utility Possibilities Frontier

- Every point on the contract curve shows the levels of utility that James and Karen can achieve.
- We can put the information from the Edgeworth box in a different form.
- The **utility possibilities frontier** shows all efficient allocations of resources (on the contract curve) measured in terms of the utility levels of two individuals.
- It shows the levels of satisfaction that are achieved when the two indi- viduals have reached the contract curve.
- James's utility is measured on the horizontal axis and Karen's on the vertical axis.
- Every movement to the right in Figure 16.8 represents an increase in James's utility, and every upward movement an increase in Karen's.

FIGURE 16.8
UTILITY POSSIBILITIES FRONTIER

The utility possibilities frontier shows the levels of satisfaction that each of two people achieve when they have traded to an efficient outcome on the contract curve. Points *E*, *F*, and *G* correspond to points on the contract curve and are efficient. Point *H* is inefficient because any trade within the shaded area will make one or both people better off.



Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 16.8

Social Welfare Functions

- In economics, we often use a **social welfare function** to describe the well-being of society as a whole in terms of utilities of individual members.
- Social welfare functions differ in terms of the weights they place on individual utilities.
- The four views of equity in Table 16.2 move roughly from most to least egalitarian.

TABLE 16.2	FOUR VIEWS OF EQUITY
1. Egalitarian—all members of society receive equal amounts of goods	
2. Rawlsian—maximize the utility of the least-well-off person	
3. Utilitarian—maximize the total utility of all members of society	
4. Market-oriented—the market outcome is the most equitable	

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Table 16.2

The Second Theorem of Welfare Economics

Theorem

If individual preferences are convex, then every Pareto efficient allocation (*every point on the contract curve*) *is a competitive equilibrium for some initial allocation of goods.*

- Is there a trade-off between equity and efficiency?
- In other words, must a society that wishes to achieve a more equitable allocation of resources necessarily operate in a manner that is Pareto efficient?
- The second welfare theorem tells us that redistribution need not conflict with economic efficiency.
- Any equilibrium deemed to be equitable can be achieved by a suitable distribution of resources among individuals in a competitive market.

Why Markets Fail

- Competitive markets fail for four basic reasons: market power, incomplete information, externalities, and public goods.
  - Market power: fewer outputs, higher prices
  - Incomplete information: inaccurate market prices or product quality
  - Externality: market prices do not convey information.
  - Public goods: very difficult to prevent others from consuming it.

Market Power

- When a firm (or group of firms) can influence prices due to lack of competition, leading to inefficiently low output and higher prices.
- Example
  - Microsoft in the 1990s: Held dominant power in PC operating systems, which allowed it to restrict competitors and charge monopoly prices.
  - Electric utility monopolies: In many regions, a single company controls electricity distribution and can charge higher prices than in competitive markets.
- In general, market power gives rise to less output and higher prices than socially optimal.

Incomplete Information

- When buyers or sellers lack full knowledge about price, quality, or safety, leading to poor market decisions.
- Example
  - Used car market ("The Market for Lemons"): Buyers can' t tell if a used car is a good one or a lemon, so they offer low prices, driving out high-quality sellers.
  - Health insurance: Insurers don' t know individuals' true health risks, which can lead to adverse selection or moral hazard.
- In general, with incomplete information prices don't reflect true value or risk, and thus results in misallocation of resources.

Externality

- An externality is a cost or benefit that affects others who did not choose to incur that cost or benefit.
- The word externality is used because the effects on others (whether benefits or costs) are external to the market.
- Example
  - Air pollution from a coal plant harms nearby residents who don't buy or sell electricity.
  - A homeowner plants a beautiful garden that passersby enjoy.
- In general, negative externality results in too much of the good (e.g., pollution).

Public Goods

- Goods that are non-rivalrous (one person's use doesn't reduce availability to others) and non-excludable (can't easily prevent non-payers from using).
- Example
  - National defense: Everyone in a country benefits, and no one can be excluded.
  - Lighthouses: Ships benefit from the signal, but can' t be charged easily.
  - Clean air: Everyone breathes it, regardless of payment.
  - Research: Once the invention is made public, others can duplicate it.
- In general, private markets underprovide public goods $\rightarrow$ free rider problem.

The End.