Chapter 13

General Equilibrium

Topics to be Discussed

- General Equilibrium Analysis
- Efficiency in Exchange
- Equity and Efficiency
- Efficiency in Production

Topics to be Discussed

- The Gains from Free Trade
- An Overview: The Efficiency of Competitive Markets
- Why Markets Fail

General Equilibrium Analysis

- Up to this point, we have been focused on partial equilibrium analysis
  - Activity in one market has little or no effect on other markets
- Market interrelationships can be important
  - Complements and substitutes
  - Increase in firms' input demand can cause market price of the input and product to rise

General Equilibrium Analysis

- To study how markets interrelate, we can use **general equilibrium analysis**
  - Simultaneous determination of the prices and quantities in all relevant markets, taking into account feedback effects
- The **feedback effect** is the price or quantity adjustment in one market caused by price and quantity adjustments in related markets

Efficiency in Exchange

- We showed before that competitive markets are efficient because consumer and producer surpluses are maximized
- We can study this in more detail by examining an exchange economy
  - Market in which two or more consumers trade two goods among themselves
  - Same for two countries

Efficiency in Exchange

- An efficient allocation of goods is one where no one can be made better off without making someone else worse off
  - Pareto efficiency
- Voluntary trade between two parties is mutually beneficial and increases economic efficiency

Gain from Trade

- Assumptions
  - Two consumers (countries)
  - Two goods
  - Both people know each other's preferences
  - Exchanging goods involves zero transaction costs
  - James and Karen have a total of 10 units of food and 6 units of clothing

Gain from Trade

Individual	Initial Endowment	Trade	Final Allocation
James	7F, 1C	-1F, +1C	6F, 2C
Karen	3F, 5C	+1F, -1C	4F, 4C

- To determine if they are better off, we need to know the preferences for food and clothing

Gain from Trade

- James' MRS of food for clothing is only ½
  - He will give up ½ unit of clothing for 1 unit of food
- Karen has a lot of clothing and little food
  - MRS of food for clothing is 3
  - To get 1 unit of food, she will give up 3 units of clothing

Gain from Trade

- There is room for trade
  - James values clothing more than Karen
  - Karen values food more than James
  - Karen is willing to give up 3 units of clothing to get 1 unit of food, but James is willing to take only ½ unit of clothing for 1 unit of food
- Actual terms of trade are determined through bargaining
  - Trade for 1 unit of food will fall between ½ and 3 units of clothing

Gain from Trade

- Suppose Karen offers James 1 unit of clothing for 1 unit of food
  - James will have more clothing, which he values more than food
  - Karen will have more food, which she values more
- Whenever two consumers' MRSs are different, there is room for mutually beneficial trade
  - Allocation of resources is inefficient

Gain from Trade

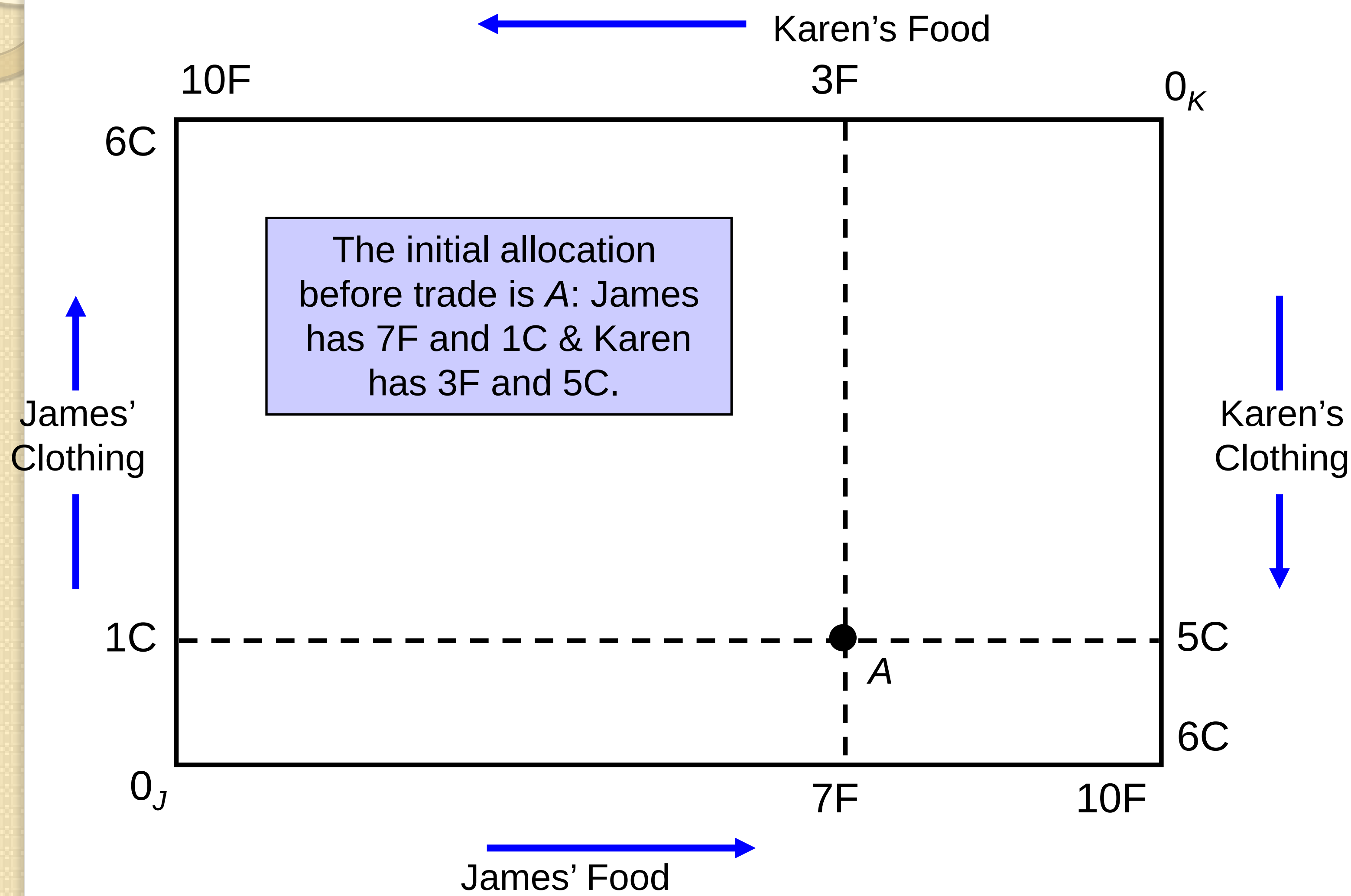
- From this analysis we obtain an important result:

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

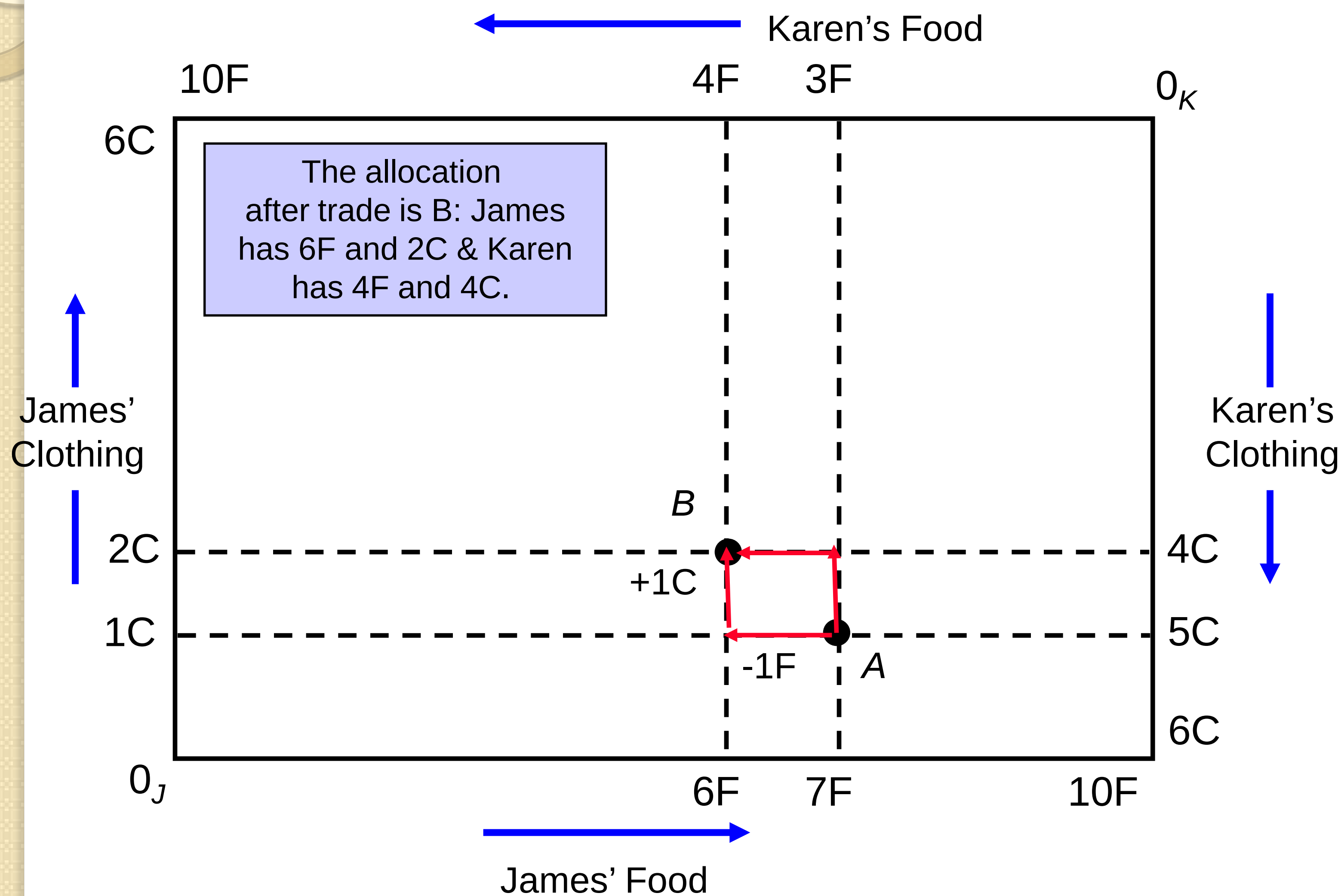
The Edgeworth Box Diagram

- A diagram showing all possible allocations of either two goods between two people or of two inputs between two production processes is called an **Edgeworth Box**
- Let's consider an exchange economy

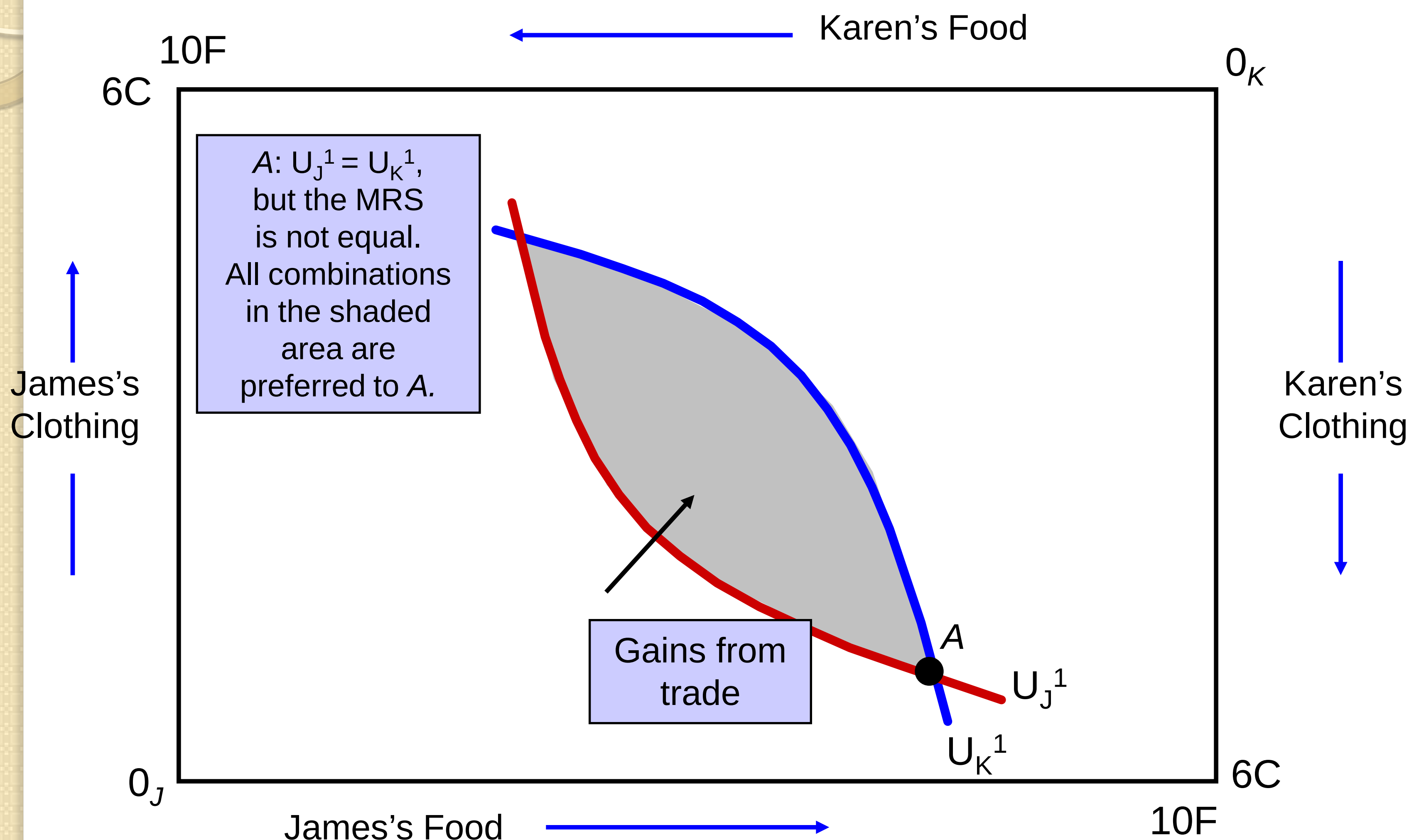
The Edgeworth Box



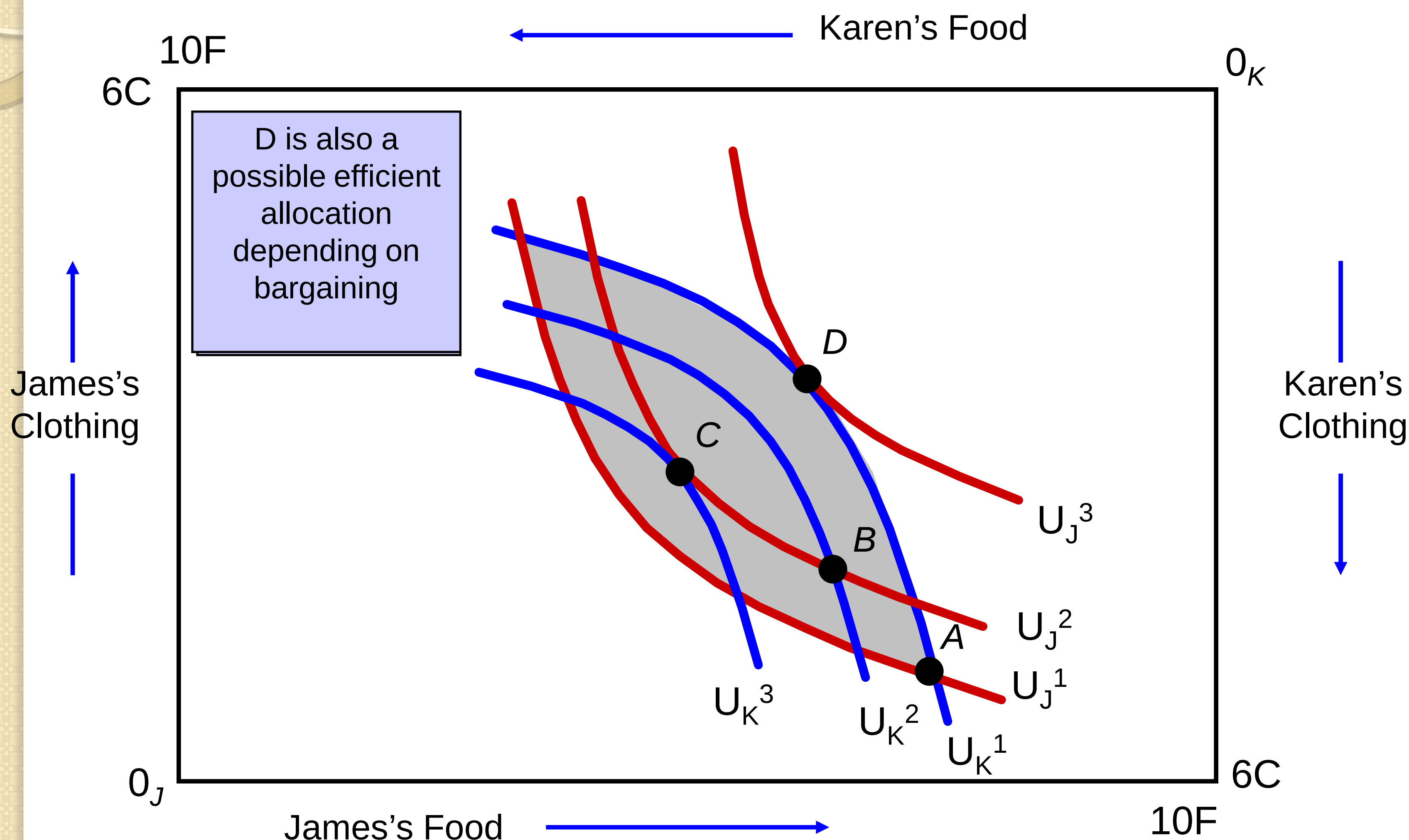
Exchange in an Edgeworth Box



Gains from Trade



Efficiency in Exchange

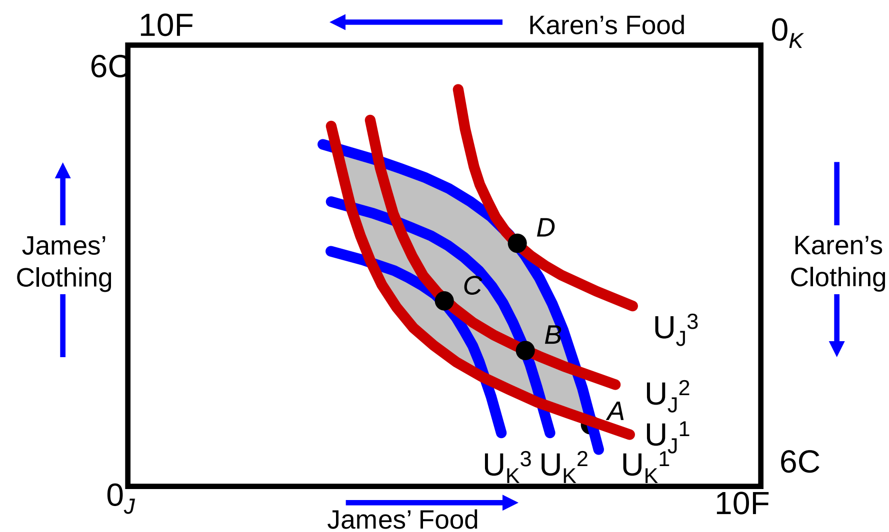


Efficient Allocations

- How do these parties reach an efficient allocation?
  - When there is no more room for trade
  - When their MRSs are equal
  - They will keep trading, reaching higher indifference curves, until they can no longer do so and still make each better off
  - This is when indifference curves are tangent – they have the same slope and same MRS

Efficiency in Exchange

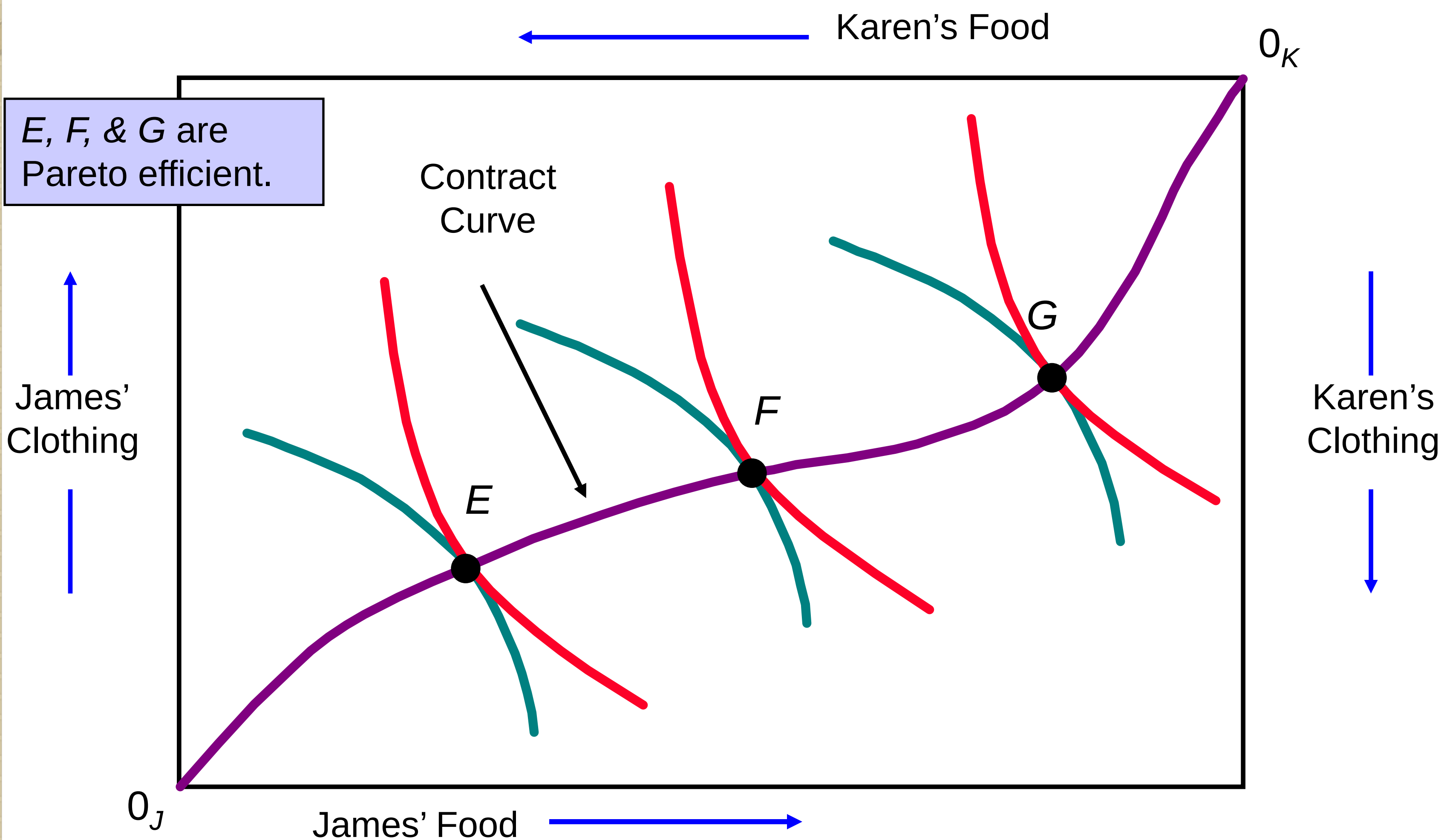
- Any move outside the shaded area will make one person worse off (closer to their origin)
- B is a mutually beneficial trade--higher indifference curve for each person
- Trade may be beneficial but not efficient
- MRS is equal when indifference curves are tangent and the allocation is efficient



The Contract Curve

- To find all possible efficient allocations of food and clothing between Karen and James, we would look for all points of tangency between each of their indifference curves
- The **contract curve** shows all the efficient allocations of goods between two consumers, or of two inputs between two production functions

The Contract Curve



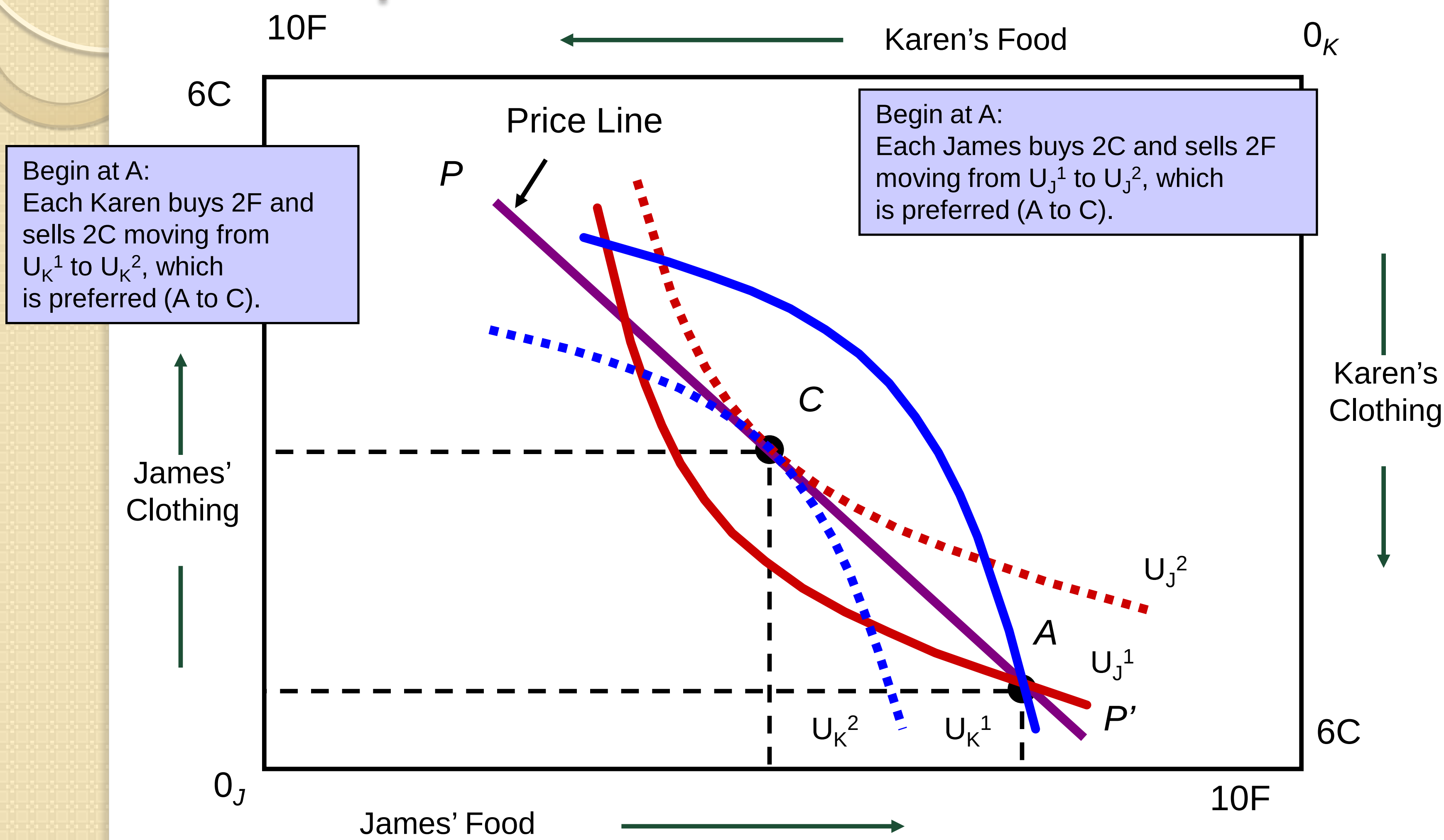
Contract Curve

- All points of tangency between the indifference curves are efficient
  - MRS of individuals is the same
  - No more room for trade
- The contract curve shows all allocations that are Pareto efficient
  - Pareto efficient allocation occurs when further trade will make someone worse off
  - *Pareto set itself does not depend on the initial endowment*

Market Trade

- What would happen if the two persons are in a competitive market?
- Both are price-takers
- Suppose we have a third party who acts as an "auctioneer" for the two agents
- At any prices announced by the auctioneer, if there is excess demand or supply, then she will change the prices such that demand equals demand for any good

Consumer Equilibrium in a Competitive Market



Walrasian Equilibrium

- A market **equilibrium** or Walrasian **equilibrium** is a set of prices at which the quantity demanded equals the quantity supplied in every market
  - Also called **competitive equilibrium**
- In the market equilibrium, all consumers are facing the same price, so all consumers will have the same marginal rate of substitution between any two goods

Walrasian Equilibrium

- At the equilibrium prices p*, we should have $X_A^i(p_1^*, p_2^*) + X_B^i(p_1^*, p_2^*) = W_A^i + W_B^i \ (i = 1,2)$
- This means that $(X_A^i * - W_A^i) + (X_B^i * - W_B^i) = 0$
- Let us denote the excess demand for good i by agent j by $e_j^i = X_j^i(p_1, p_2) - W_j^i \ (j = A, B)$
- Then, we get $z_i\,(p_1, p_2) = e_A^i(p_1, p_2) + e_B^i(p_1, p_2)$
- Z (p1,p2) represents the aggregate excess demand for good i

Walrasian Equilibrium

- The prices (p_1^*, p_2^*) are equilibrium prices if

  $$z_1(p_1^*, p_2^*) = 0,\ z_2(p_1^*, p_2^*) = 0$$

- The equilibrium prices will clear all markets simultaneously

- In order to understand the nature of these conditions, we need to know Walras' Law

The Walras' Law

$$p_1 z_1(p_1, p_2) + p_2 z_2(p_1, p_2) = 0$$

$$\textit{At the optimal bundles } (X_A^1(p^*), X_A^2(p^*))$$

$$p_1 X_A^1(p^*) + p_2 X_A^2(p^*) = p_1 W_A^1 + p_2 W_A^2 \Rightarrow p_1 e_A^1 + p_2 e_A^2 = 0$$

$$p_1 X_B^1(p^*) + p_2 X_B^2(p^*) = p_1 W_B^1 + p_2 W_B^2 \Rightarrow p_1 e_B^1 + p_2 e_B^2 = 0$$

$$\Rightarrow p_1(e_A^1 + e_B^1) + p_2(e_A^2 + e_B^2) = 0$$

$$\Rightarrow p_1 z_1(p_1, p_2) + p_2 z_2(p_1, p_2) = 0$$

$$\textit{More generally, } \sum_{k=1}^{K} p_k z_k(p) = 0$$

Implications

- If (K-1) markets clear, then the last market will also clear
- There are only (K-1) independent prices
- Note that p^* and tp^* are both equilibrium prices, and by setting $t=1/p_1$, then there are only (K-1) relative prices
- In general we call good 1 as *numenaire* good

Equilibrium and Efficiency

- As shown before, we can see that the allocation in a competitive equilibrium is economically efficient
  - The efficient point must occur where the two indifference curves are tangent
  - If not, one of the consumers can increase their utility and be better off

A Proof of Efficiency in Market Equilibrium

- This can be proven by way of counter argument
- Suppose a market equilibrium is NOT efficient, then it implies that there is another feasible allocation (y_A, y_B)

such that

$$y_A^i + y_B^i = W_A^i + W_B^i \quad (i = 1{,}2)\ and$$

$$(y_A^1, y_A^2) \succ_A (X_A^1, X_A^2)$$

$$(y_B^1, y_B^2) \succ_B (X_B^1, X_B^2)$$

A Proof of Efficiency in Market Equilibrium

- If (y_A) is better than the bundle (x_A) A is choosing, then it must cost more than A can afford, similarly for B
- That is, $p_1 y_j^1 + p_2 y_j^2 > p_1 W_j^1 + p_2 W_j^2 \quad (j = A, B)$
- Adding these two equations, we get

$$p_1(y_A^1 + y_B^1) + p_2(y_A^2 + y_B^2) > p_1(W_A^1 + W_B^1) + p_2(W_A^2 + W_B^2)$$

- This contradicts with the feasibility condition with equality

First Theorem of Welfare Economics

- *Market equilibria are Pareto efficient*
- If everyone trades in a competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will be economically efficient
  - Welfare economics involves the normative evaluation of markets and economic policy

Equilibrium and Efficiency

- The first welfare theorem is the best illustration of Adam Smith's ***invisible hand***
  - Economy will automatically allocate all resources efficiently without need for regulatory control
    - Supports argument for less government intervention and more highly competitive markets
- Markets use ***minimum*** information to function well (compare this with the centralized planning)

Underlying Assumptions

- For the first theorem to hold, there are several implicit assumptions:
  - No externality or public goods
  - No monopoly power in setting prices
  - No asymmetric information: markets can be missing due to the asymmetric information

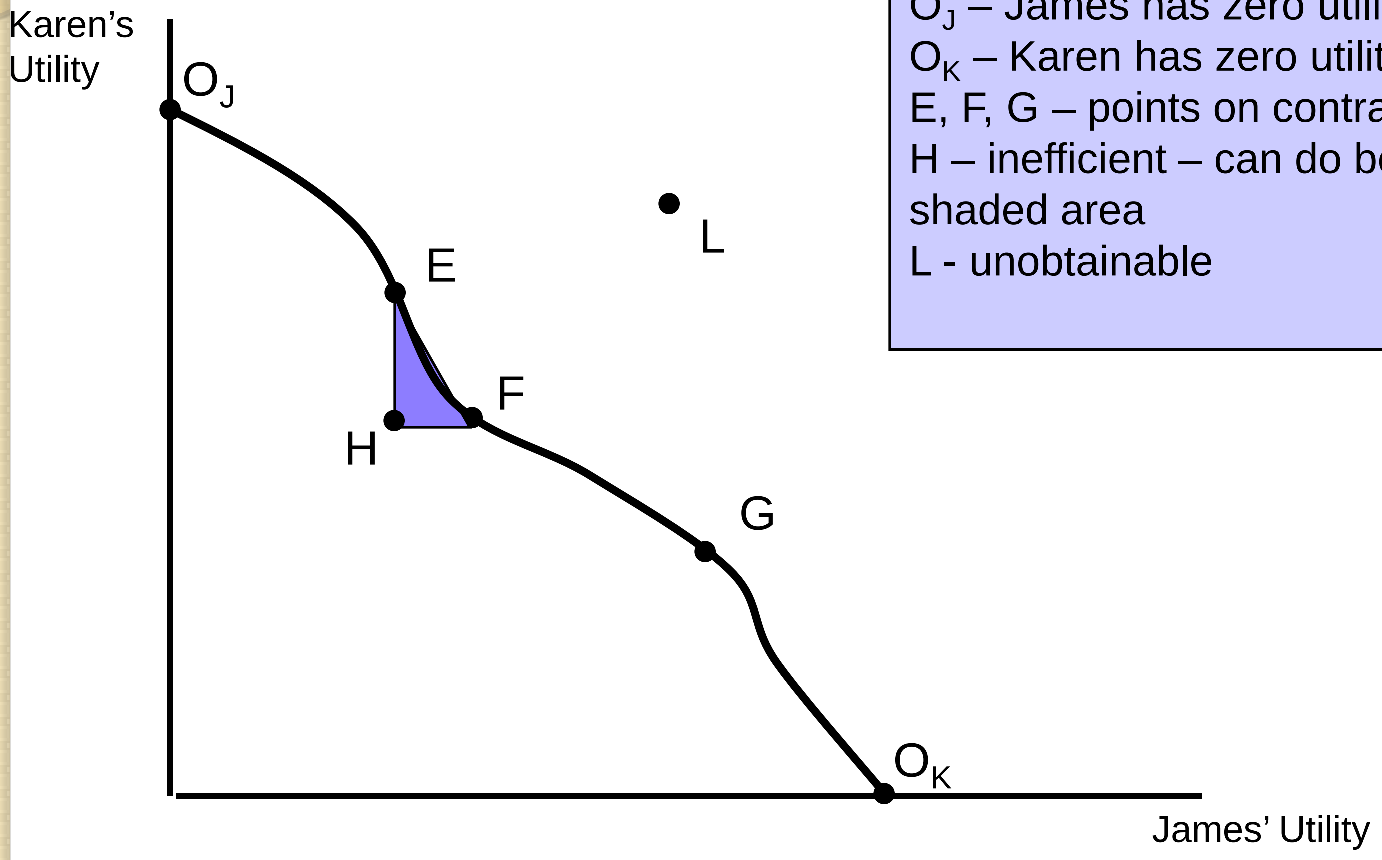
Equity and Efficiency

- Although there are many efficient allocations, some may be more fair than others
- The difficult question is, what is the most equitable allocation?
- We can show that there is no reason to believe that efficient allocation from competitive markets will give an equitable allocation

The Utility Possibilities Frontier

- From the Edgeworth Box, we showed a two person exchange
- The **utility possibilities frontier** represents all allocations that are efficient in terms of the utility levels of the two individuals
  - Shows the levels of satisfaction that are achieved when the two individuals have reached the contract curve

The Utility Possibilities Frontier



O_J – James has zero utility
O_K – Karen has zero utility
E, F, G – points on contract curve
H – inefficient – can do better in shaded area
L - unobtainable

The Utility Possibilities Frontier

- From previous example, one can see that an inefficient allocation might be more equitable than an efficient one
- But how do we define an equitable allocation?
  - It depends on what we believe equity to entail
  - Requires interpersonal comparisons of utility

Social Welfare Functions

- Weights are often applied to individual's utility to determine what is socially desirable
  - How these weights are applied comes from the social welfare functions
- The **utilitarian function** weights everyone's utility to maximize utility for the whole society

Social Welfare Functions

- Each social welfare function is associated with a particular view of equity
- Some views of equity do not assign weights and cannot be represented by a welfare function
  - Competitive market process is equitable because it rewards those who are most able and work hardest
  - Believes competitive equilibrium would be most equitable

Social Welfare Functions

- The Rawlsian view is that individuals don't know what their endowment will be
- Rawls argues that if you don't know your own fate, you will opt for the system in which the least well-off person is treated reasonably well
- *The most equitable allocation maximizes the utility of the least well-off person in society*

Social Welfare Functions

- An egalitarian view believes that goods should be equally shared by all individuals in society
- Could have situation where more productive people are rewarded, thereby producing more goods and then having more to reallocate to all of society

Four Views of Equity

Egalitarian	All members of society receive equal amount of goods
Rawlsian	Maximize the utility of the least-well-off person
Utilitarian	Maximize the total utility of all members of society
Market - Oriented	The market outcome is the most equitable

Equity and Perfect Competition

- A competitive equilibrium can occur at any point on the contract curve depending on the initial allocation
- Since not all competitive equilibria are equitable, we rely on the government to help reach equity by redistributing income
  - Taxes
  - Public services

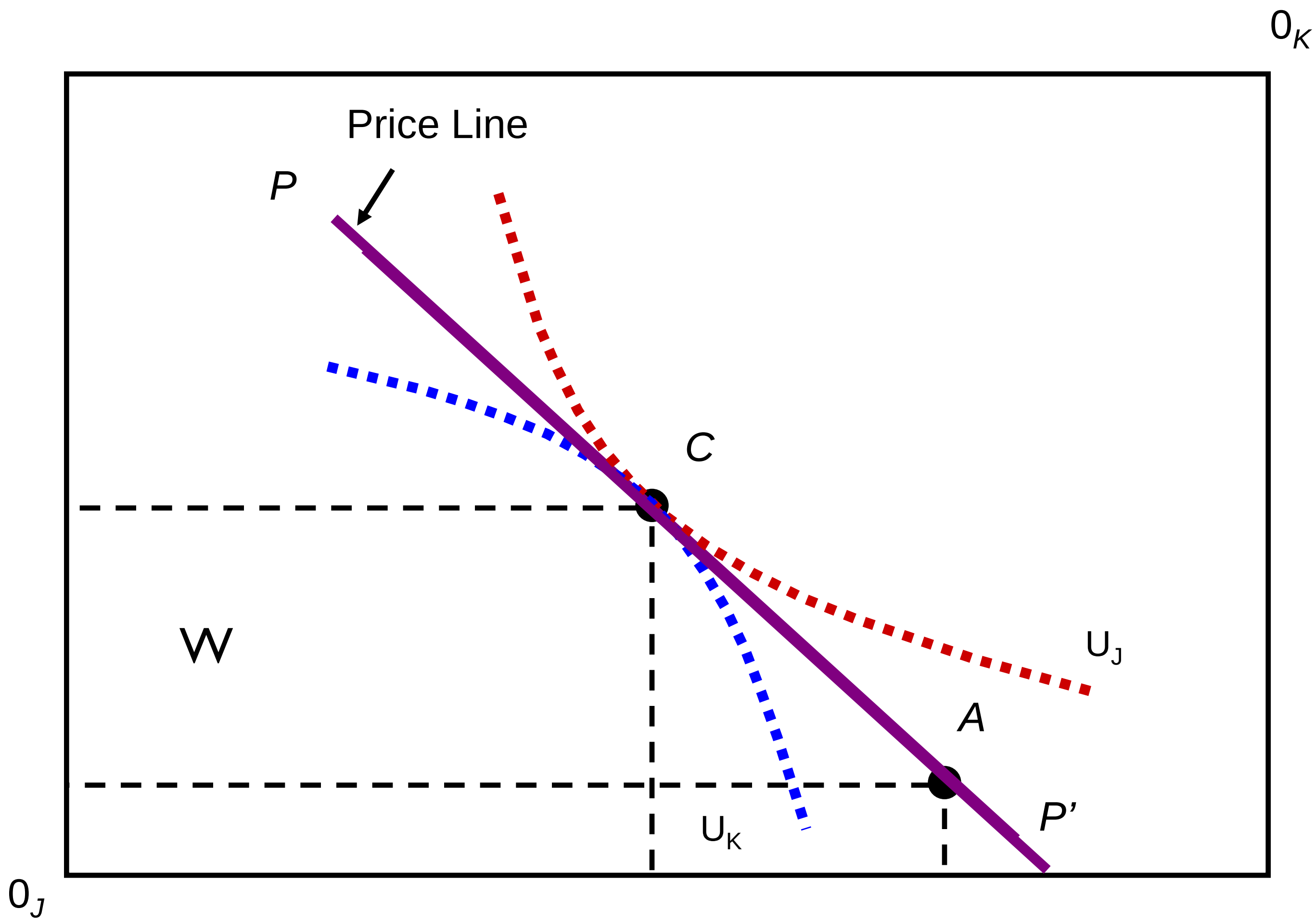
Efficiency and Equilibrium

- Must a society that wants to be more equitable necessarily operate in an inefficient world?

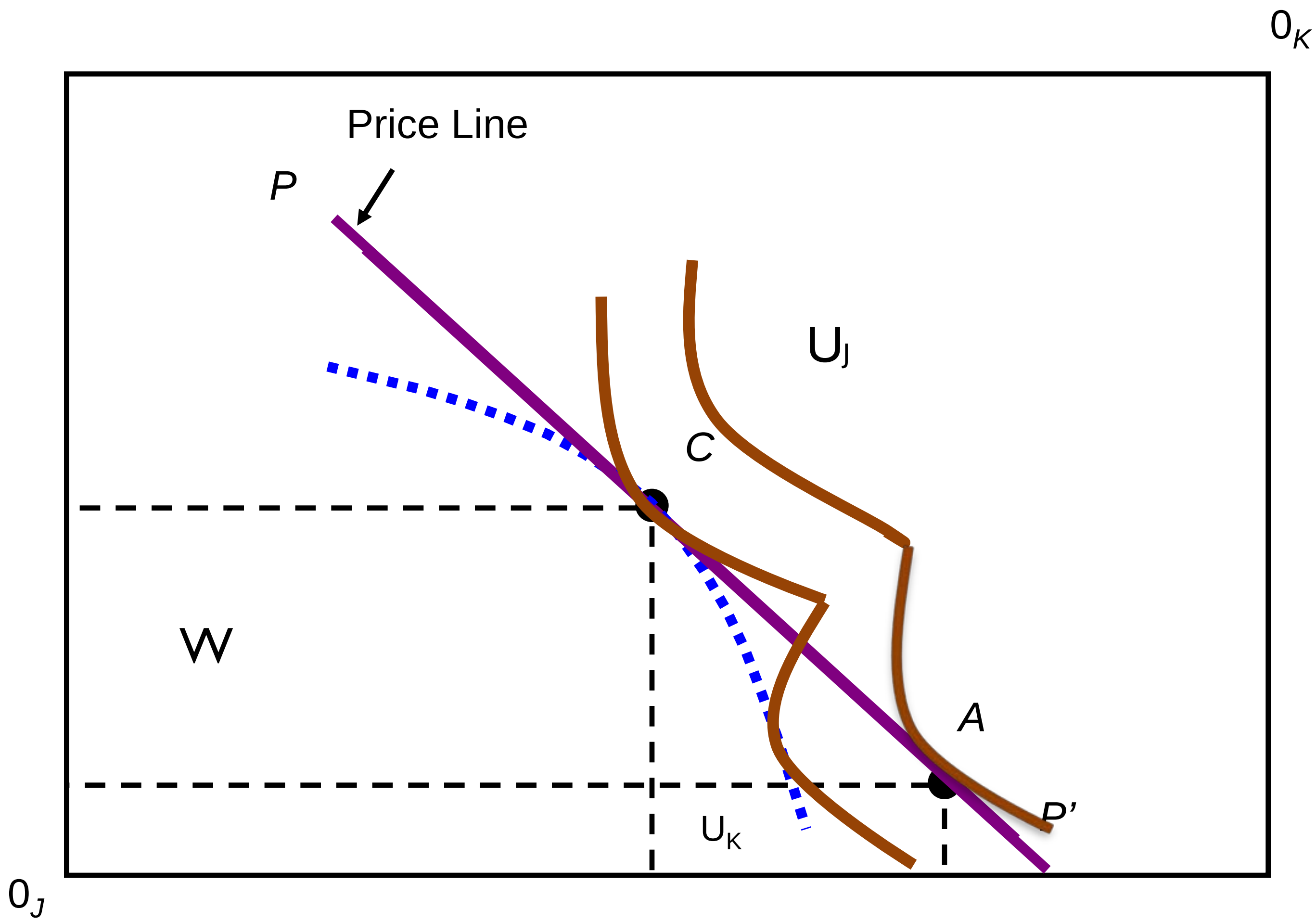
Second Theorem of Welfare Economics

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

Efficiency and Equilibrium



Why Are Convex Preferences?



Implications of the Second Theorem

- The problem of distribution and efficiency can be separated
- Prices play two roles in the market system: *allocative vs. distributive*
- The allocative role of prices is to reflect relative scarcity while the distributive role is to determine the values of the endowments
- Let prices allocate resources and government redistribute wealth or income using (lump-sum) subsidy or taxes
- Don't mix up these two roles

Berkeley Program

- ***Berkeley Economics Semester Abroad Program*** (BESAP)
- A select group of international students take a semester, upper level courses in Berkeley
- Fall 2013 and Spring 2014,
- 12 units
- *Deadline: Jan 15 and April 15, 2013*
- You must apply before **Jan 10, 2013**
- Requirement: TOEFL(iBT) 88, 雅思 7.0
- Tuition $ 8250 (covered by Guanghua) and students pay living expenses

Announcement

- No office hours on Dec 23 and 30
- Office hours: 1:00-5pm, Jan 2, Rm. 405

- **Final Exam**
  - **Time: 7-9pm, Jan 7**
  - **Place: Rm.102、202、112、115**

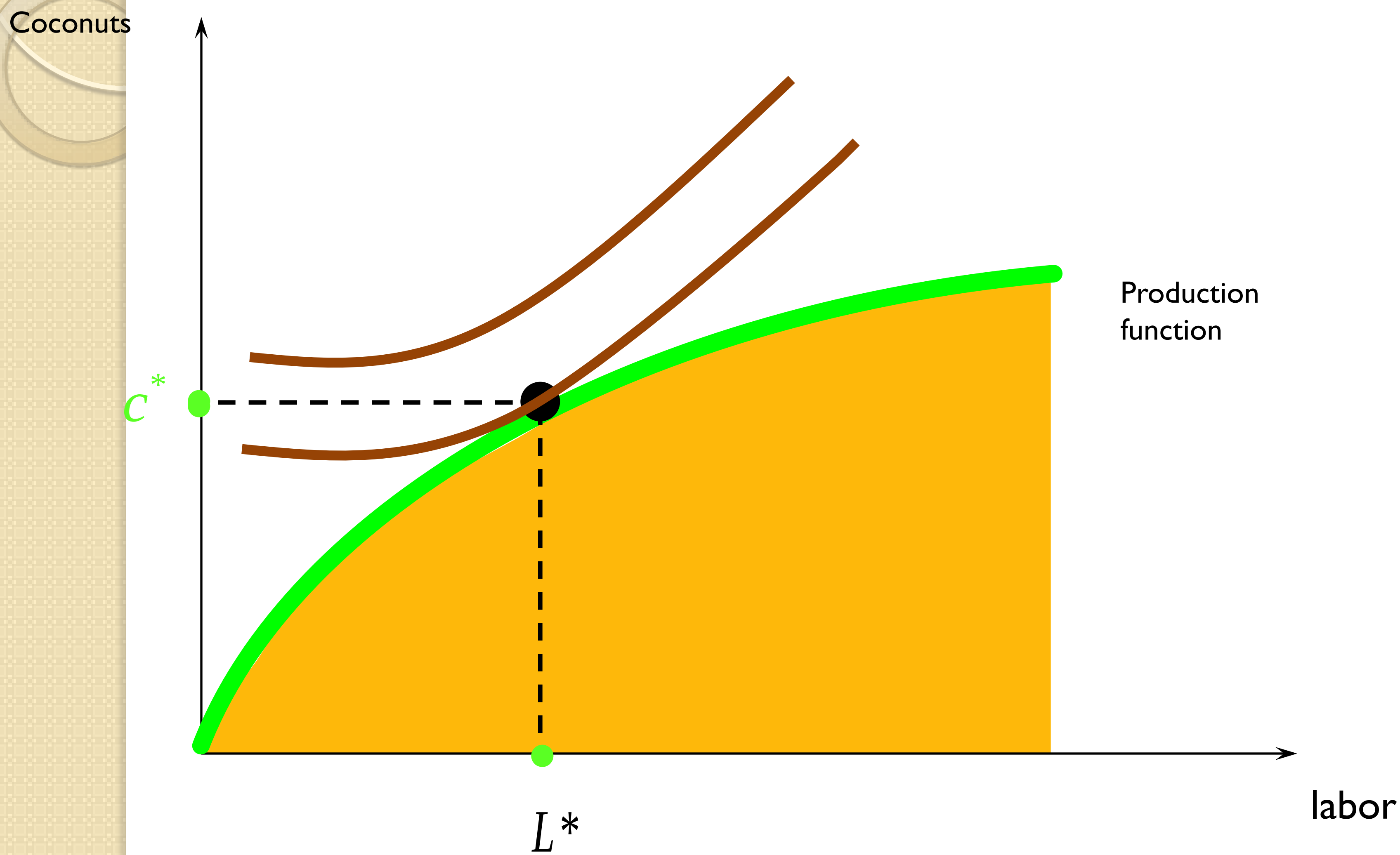
Chapter 14

General Equilibrium with Production

The Robinson Crusoe Economy

- This economy is characterized by one consumer, one firm, and two goods
- Robinson Crusoe plays a dual role: consumer plus producer
- He can spend time loafing on the beach by consuming leisure or gathering coconuts
- How to allocate time on consumption and production?

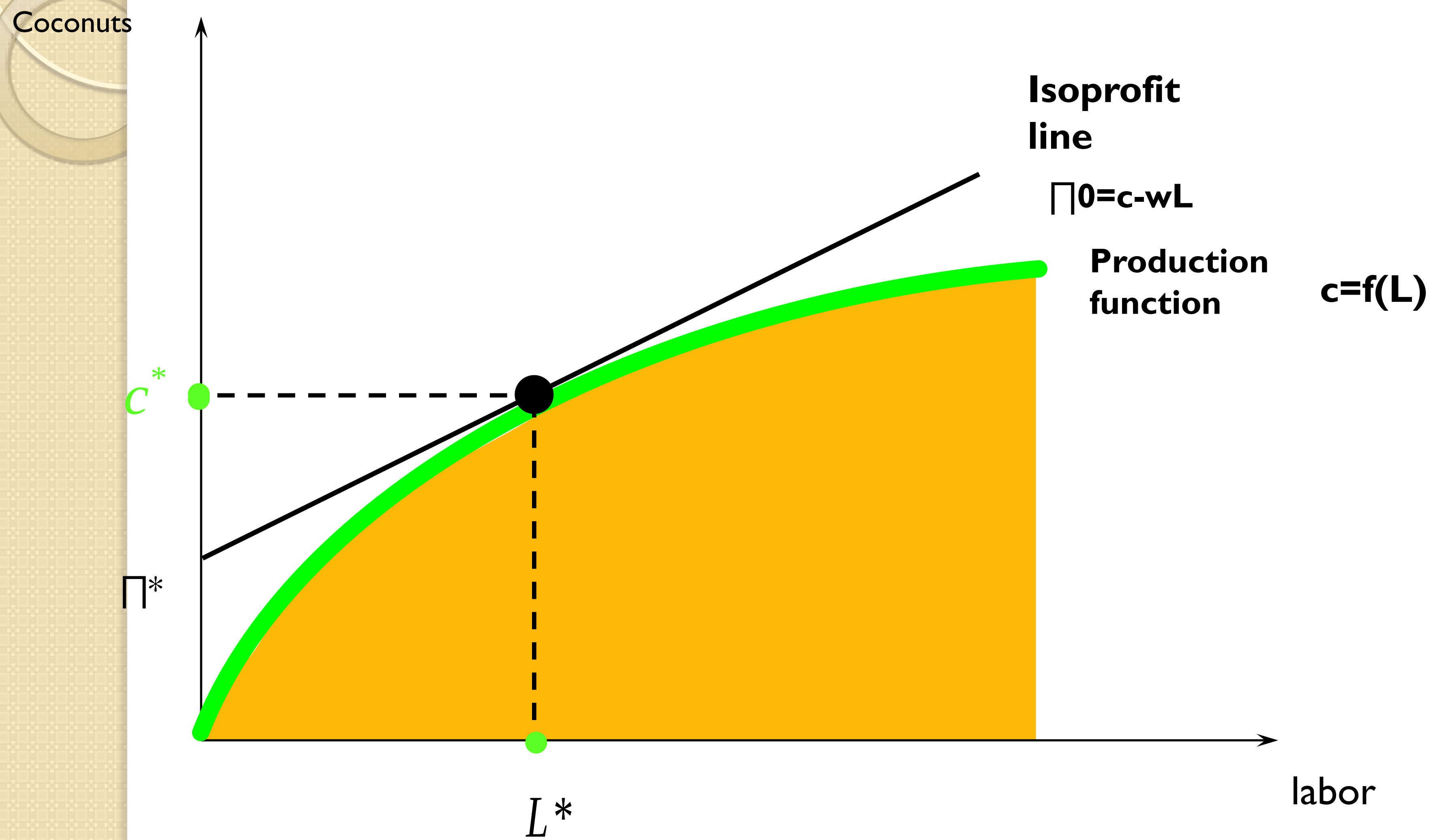
Leisure vs. Production



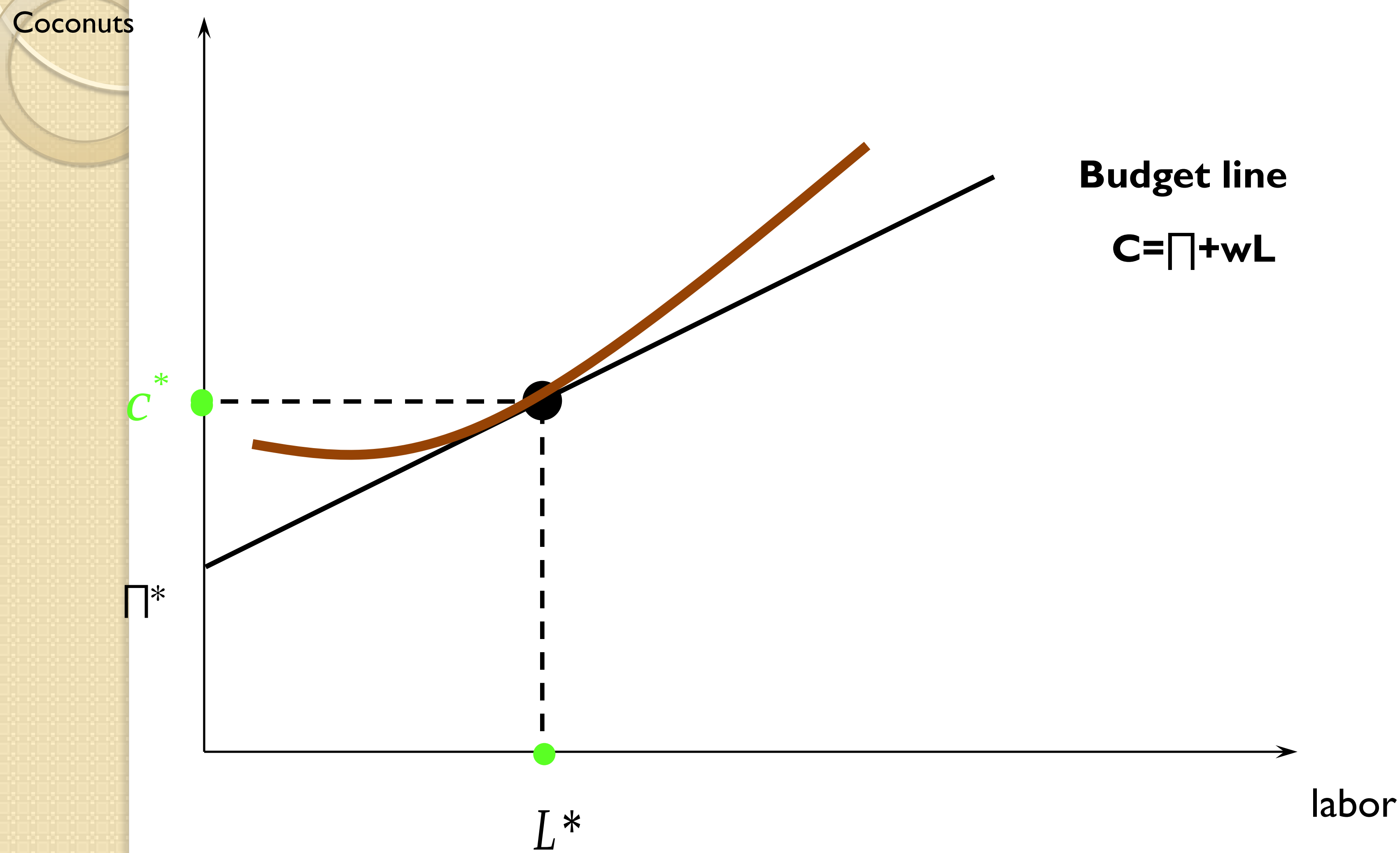
Extended Robinson Crusoe Economy

- Consider two markets—a labor market and a coconut market at the same time
- Crusoe has multiple roles:
  - ***Shareholder*** of the firm who collects profits
  - ***Consumer*** who decides how much to consume
  - ***Worker*** who decides how much labor to supply
  - ***Producer*** who decides the employment and production

The Firm: Profit-max



Consumer's Problem

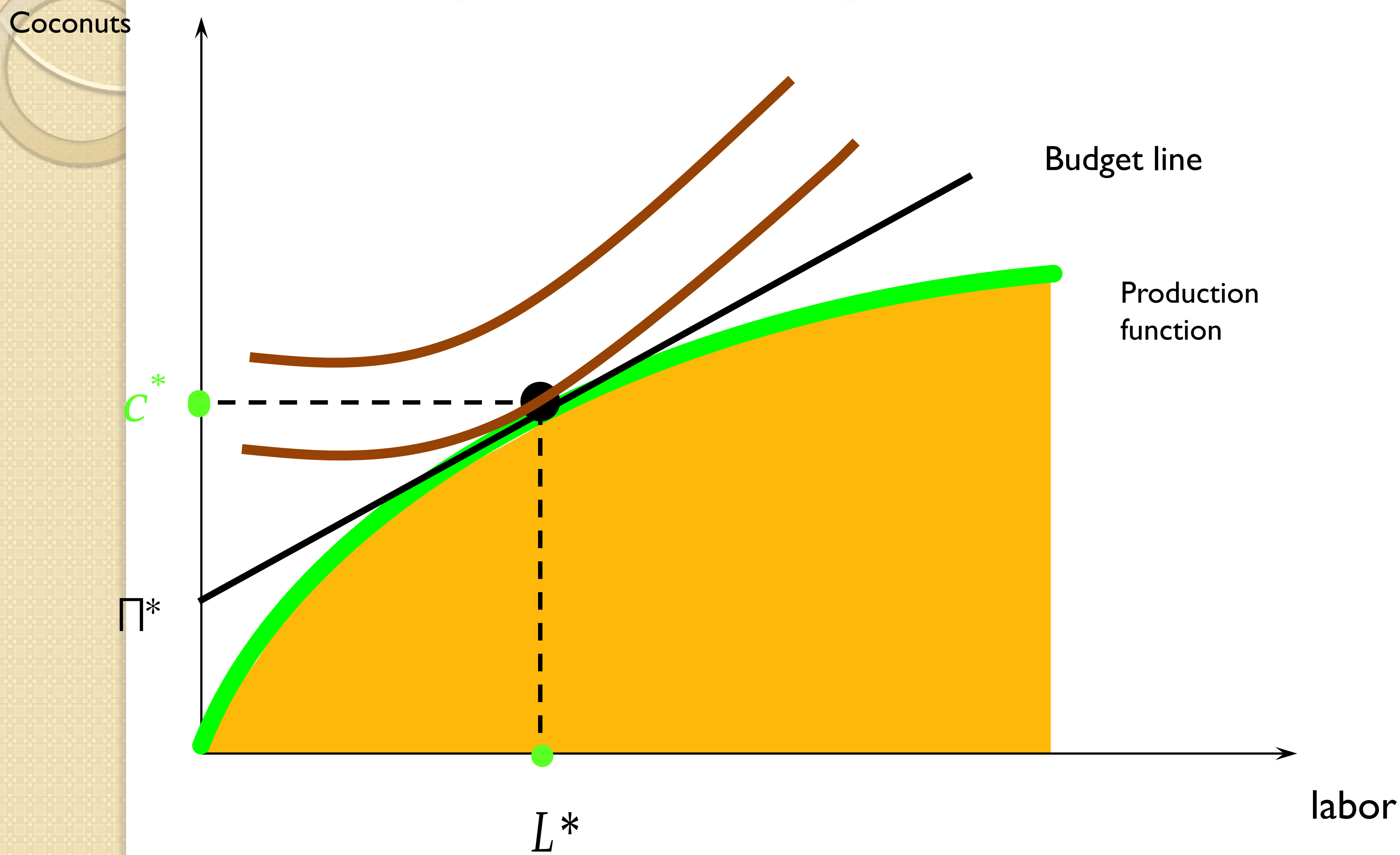


Consumer's Problem

$$Max\, u(c, \bar{L} - L)$$

$$s.t.\ pc + w(\bar{L} - L) = \pi^* + w\bar{L} \Rightarrow pc = \pi^* + wL$$

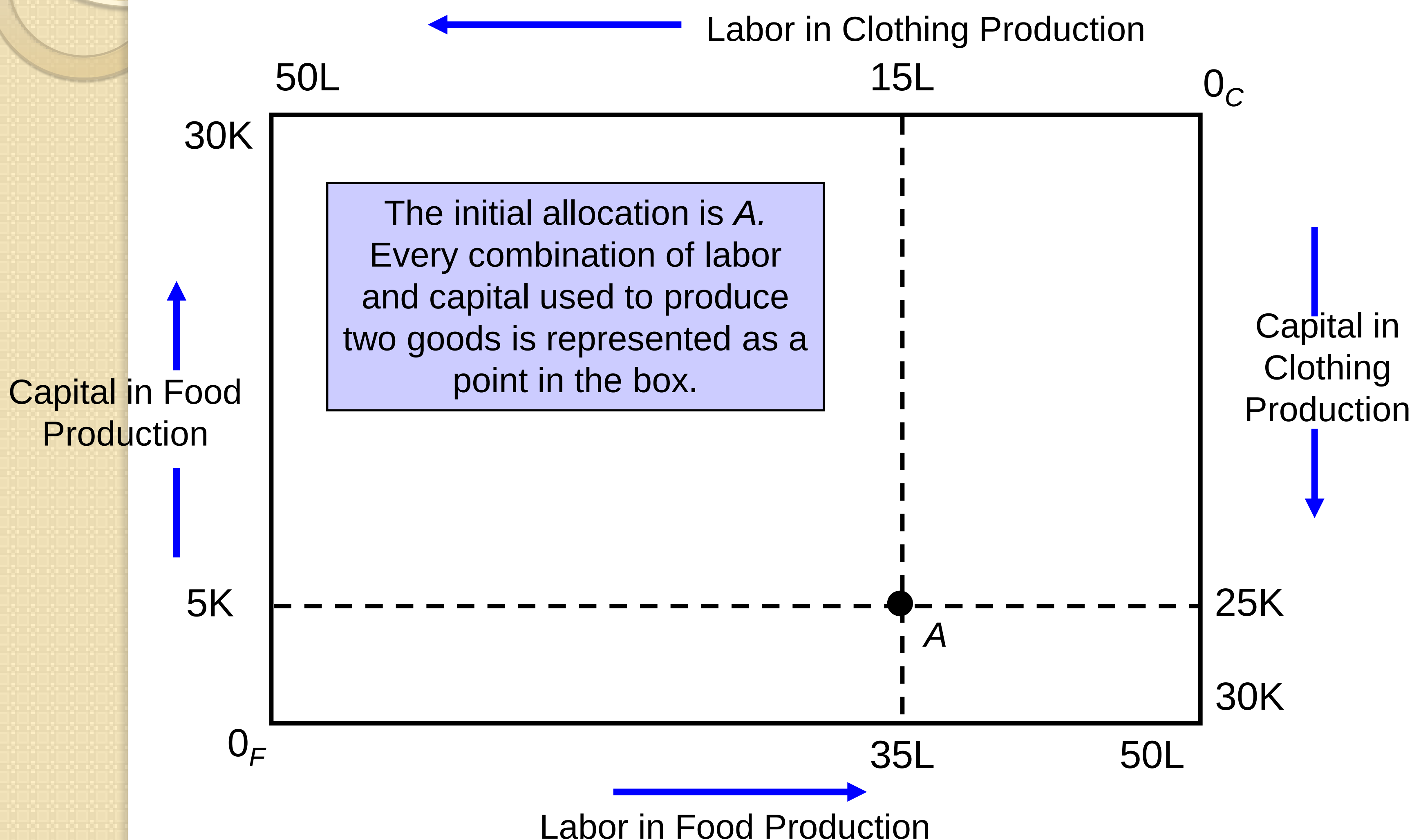
Putting Them Together



Efficiency in Production

- Using the Edgeworth Box diagram, we can show efficient use of inputs in production
  - Labor on horizontal axis
  - Capital on vertical axis
  - 50 hours of labor and 30 hours of capital available
  - Each origin is an output

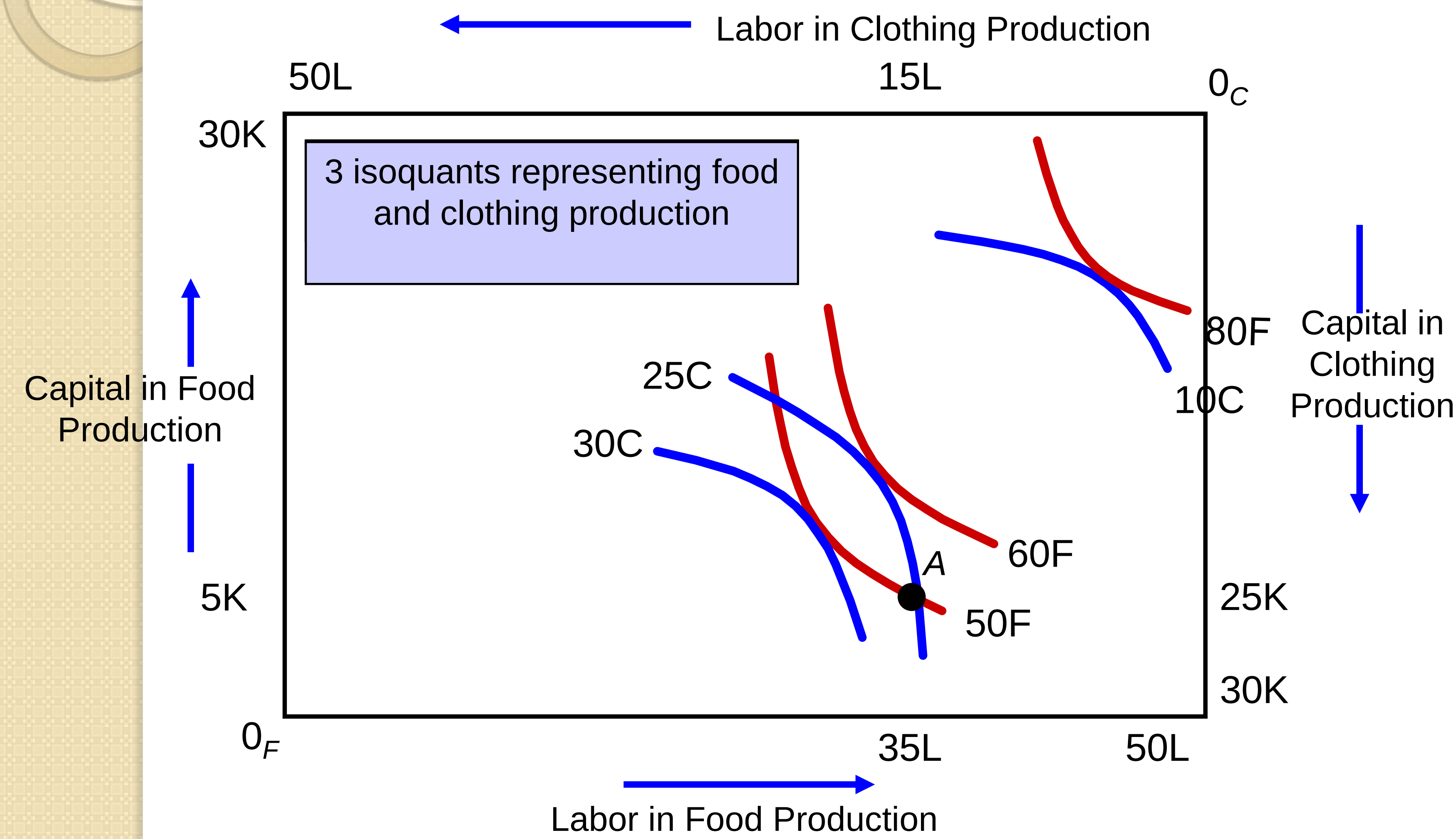
Production in an Edgeworth Box



Production in an Edgeworth Box

- Each point in the box represents the labor and capital inputs in the production of food and clothing
- Can use production isoquants to show levels of output produced with each combination of inputs
  - 3 isoquants representing 50, 60 and 80 units of food
  - 3 isoquants representing 10, 25 and 30 units of clothing

Production in an Edgeworth Box



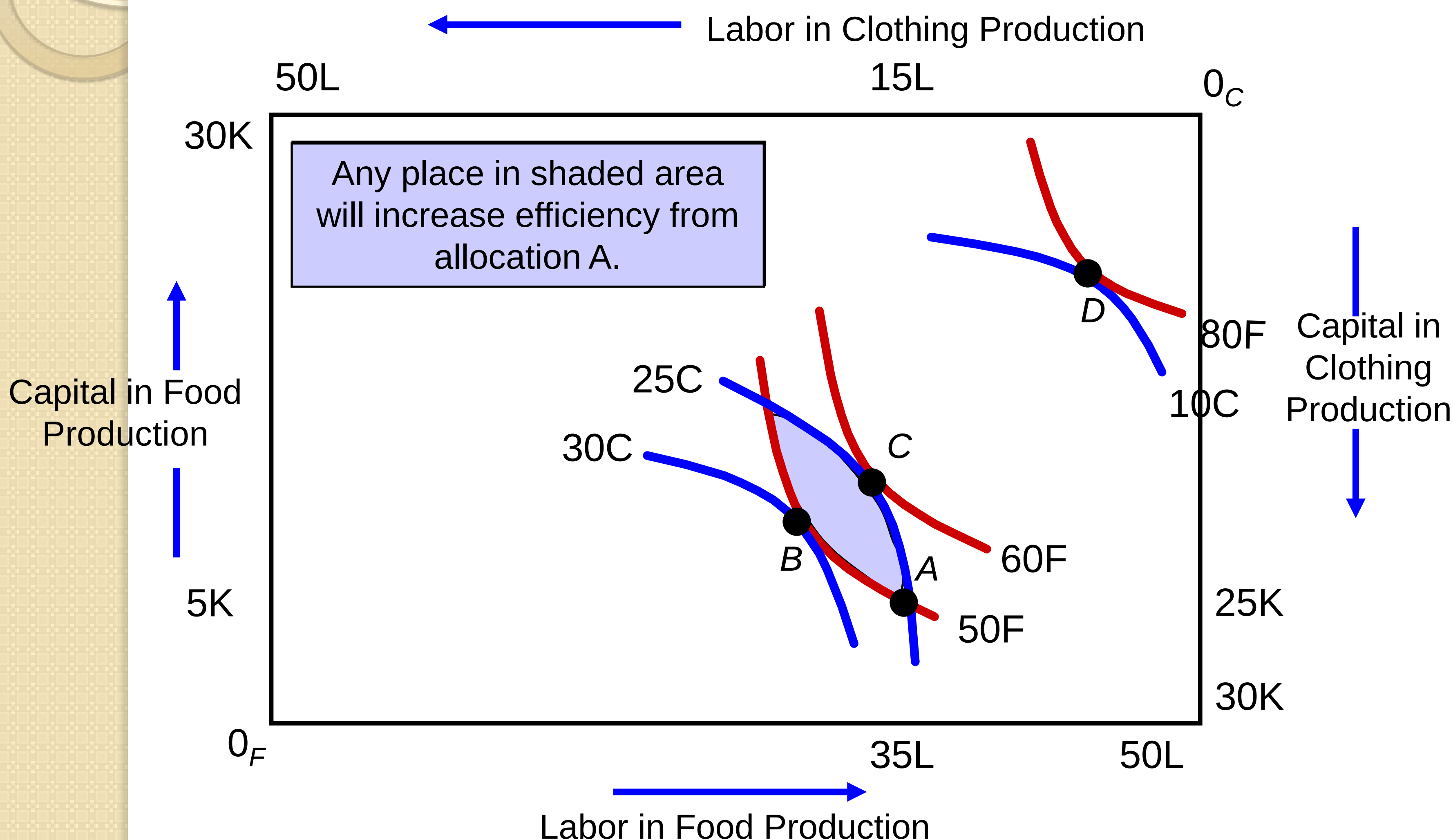
Production in an Edgeworth Box

- To find efficient production, must find different combinations of inputs used to produce the two outputs
- An allocation of inputs is **technically efficient** if the output of one good cannot be increased without decreasing the output of another good

Production in an Edgeworth Box

- Production at point A is inefficient since we can increase production of both goods
  - Shaded area indicates increases in production of both goods if begin at A
  - Allocation A could exist if a labor union market has enforced inefficient work rules

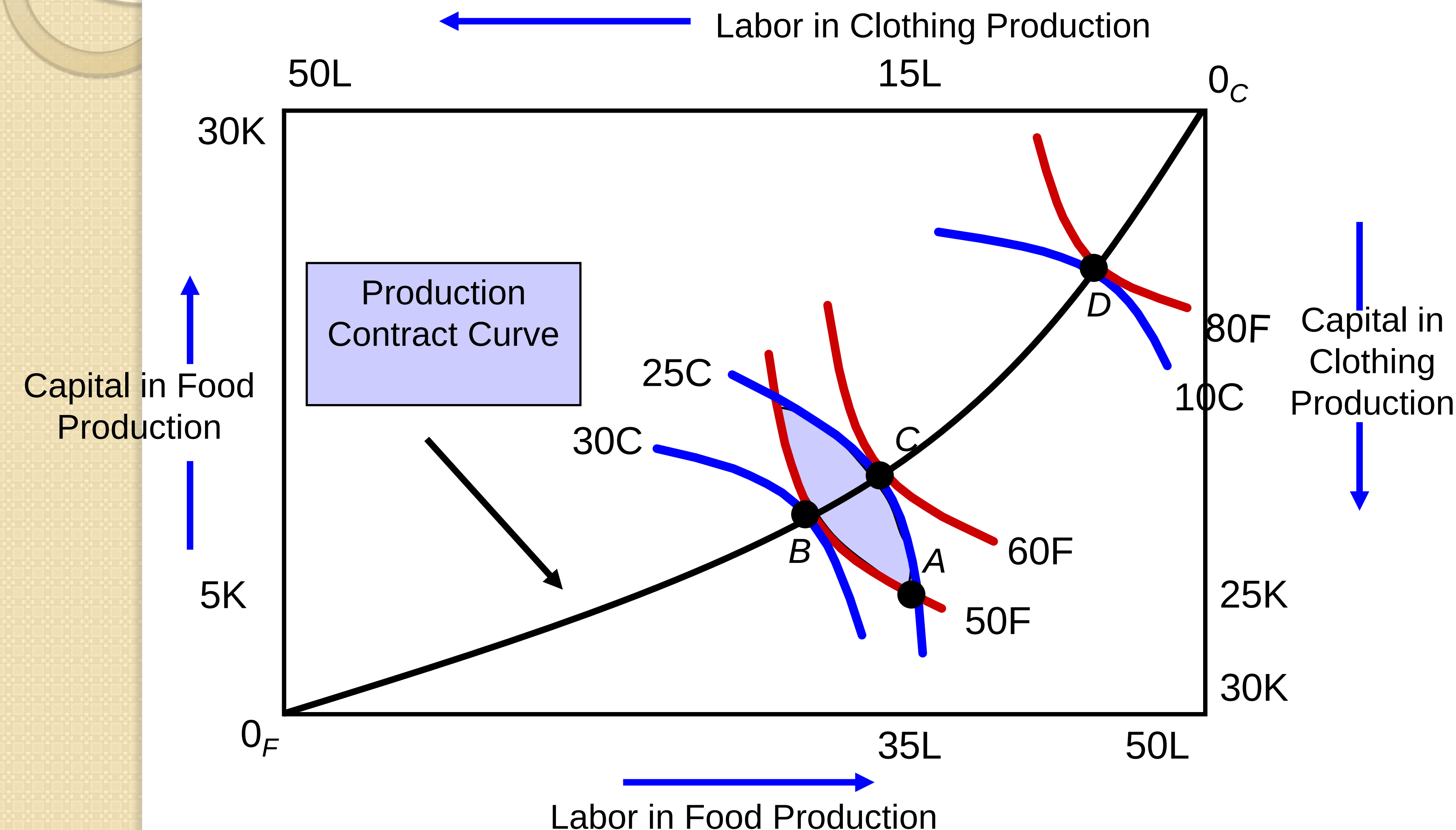
Production in an Edgeworth Box



Production in an Edgeworth Box

- Points B and C are efficient allocations and therefore lie on the **production contract curve**
  - Curve showing all technically efficient combinations of inputs
  - Curve connects the origins O_F and O_C
  - All points on curve are tangencies between two isoquants

Production in an Edgeworth Box



Producer Equilibrium – Competitive Input Markets

- If input markets are competitive, an efficient point will be achieved
- In competitive input markets
  - Wage rate, *w*, will be equal in all industries
  - Rental rate of capital, *r*, will be equal in all industries

Producer Equilibrium – Competitive Input Markets

- We saw before that if producers minimize costs, they will choose inputs to the point where the ratio of the marginal products of the two inputs is equal to the ratio of input prices:

$$\boxed{\frac{MP_L}{MP_K} = \frac{w}{r}}$$

Producer Equilibrium – Competitive Input Markets

- Ratio of marginal products is the same as the marginal rate of technical substitution of labor for capital:

$$\boxed{\frac{MP_L}{MP_K} = \frac{w}{r} = MRTS_{LK}}$$

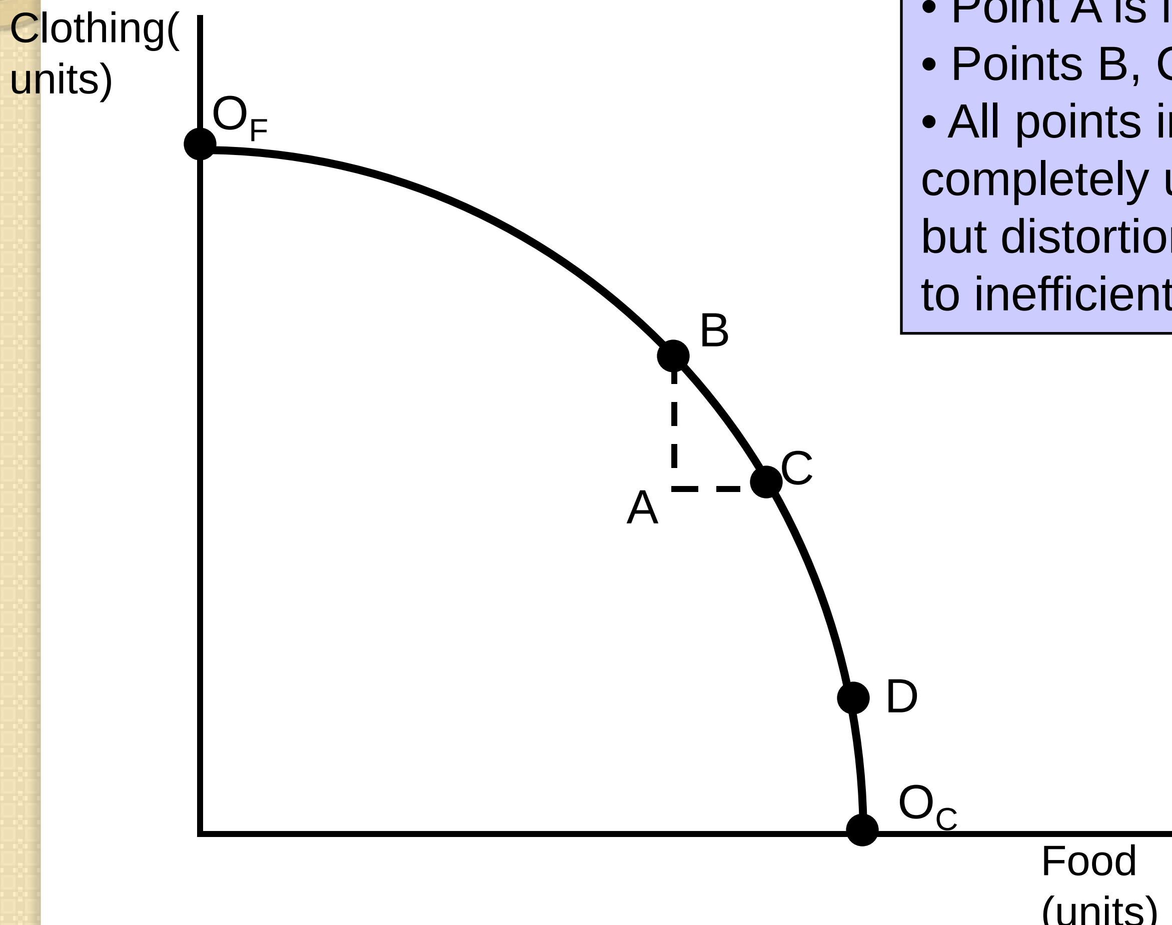
Producer Equilibrium – Competitive Input Markets

- The MRTS is the slope of the isoquant, so competitive equilibrium exists only if:
  - Slopes of the isoquants are equal to one another
  - These also equal the ratio of the prices of two inputs
- *Competitive equilibrium lies on the production contract curve, and the competitive equilibrium is efficient in production*

Production Possibilities Frontier

- PPF shows the various combinations of two goods that can be produced with fixed quantities of inputs
- Frontier is derived from the production contract curve
- Points on PPF show efficiently produced levels of both goods

Production Possibilities Frontier



- Point A is inefficient
- Points B, C and D are efficient
- All points in triangle ABC completely utilize capital and labor, but distortion in labor market leads to inefficient use

Production Possibilities Frontier

- PPF is downward sloping
  - In order to produce more of one good, must give up producing some of the other good
- PPF is concave
  - Slope is the MRTS which increases as the level of production of food increases

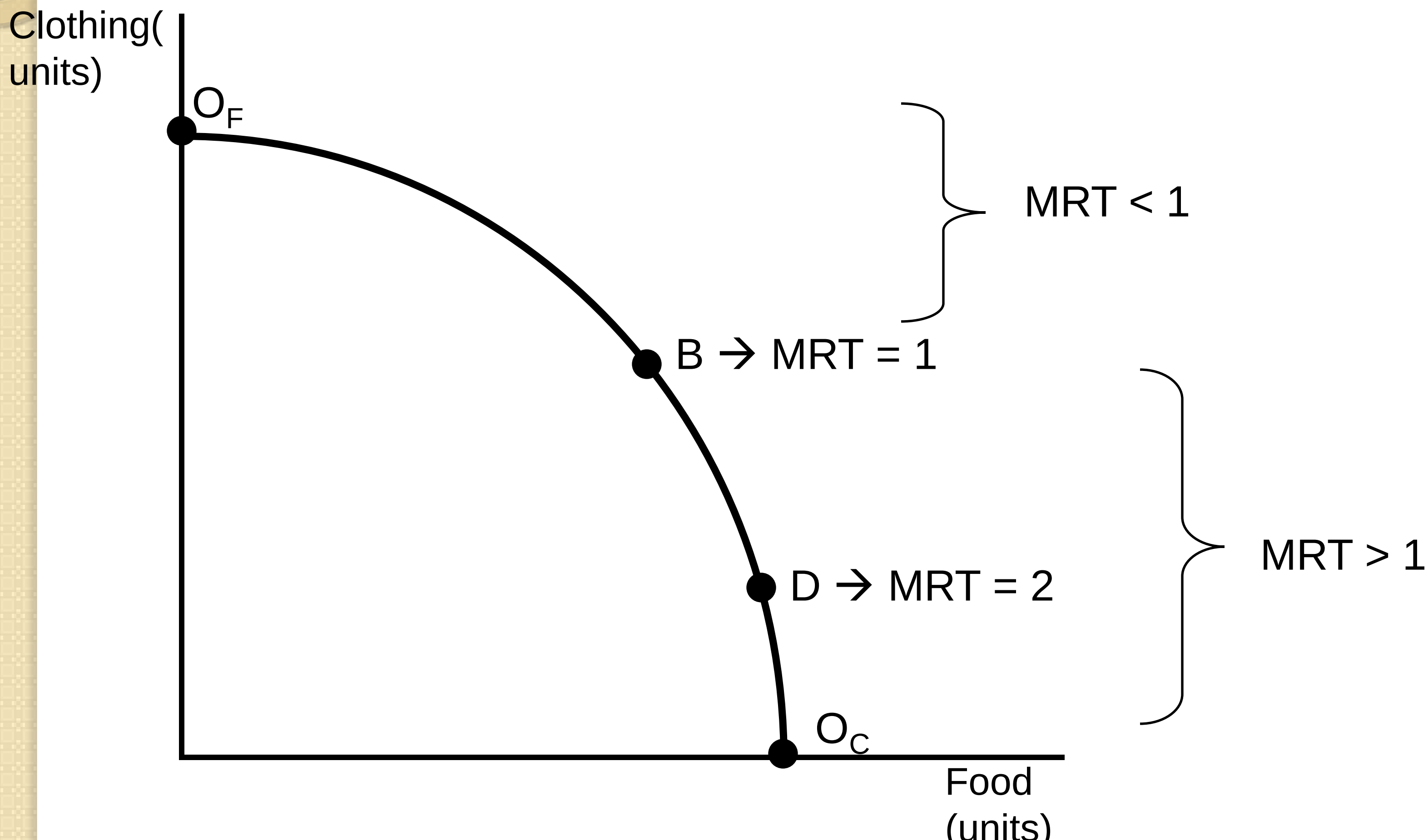
Production Possibilities Frontier

- Marginal rate of transformation (MRT) of food for clothing is the magnitude of the slope of the frontier at each point
  - Amount of one good that must be given up to produce one additional unit of a second good
  - How much clothing must be given up to produce one additional unit of food
  - As we increase the production of food by moving along the PPF, the MRT increases

Marginal Rate of Transformation

- The productivity of labor and capital differs depending on whether the inputs are used to produce more food or clothing
  - Starting where only clothing is produced, MP of labor and capital are relatively low
  - Transferring some to food production where MP is relatively high
  - As we do this, MP in food decreases and MP in clothing increases

Production Possibilities Frontier



Marginal Rate of Transformation

- Can also describe in terms of costs
  - When producing at O_F, the MC of food is very low and the MC of clothing is very high
  - When MRT is low, so is the ratio of the MC of producing food to clothing
  - Slope of PPF measures the MC of producing one good relative to the MC of producing the other

$$\boxed{MRT = \frac{MC_F}{MC_C}}$$

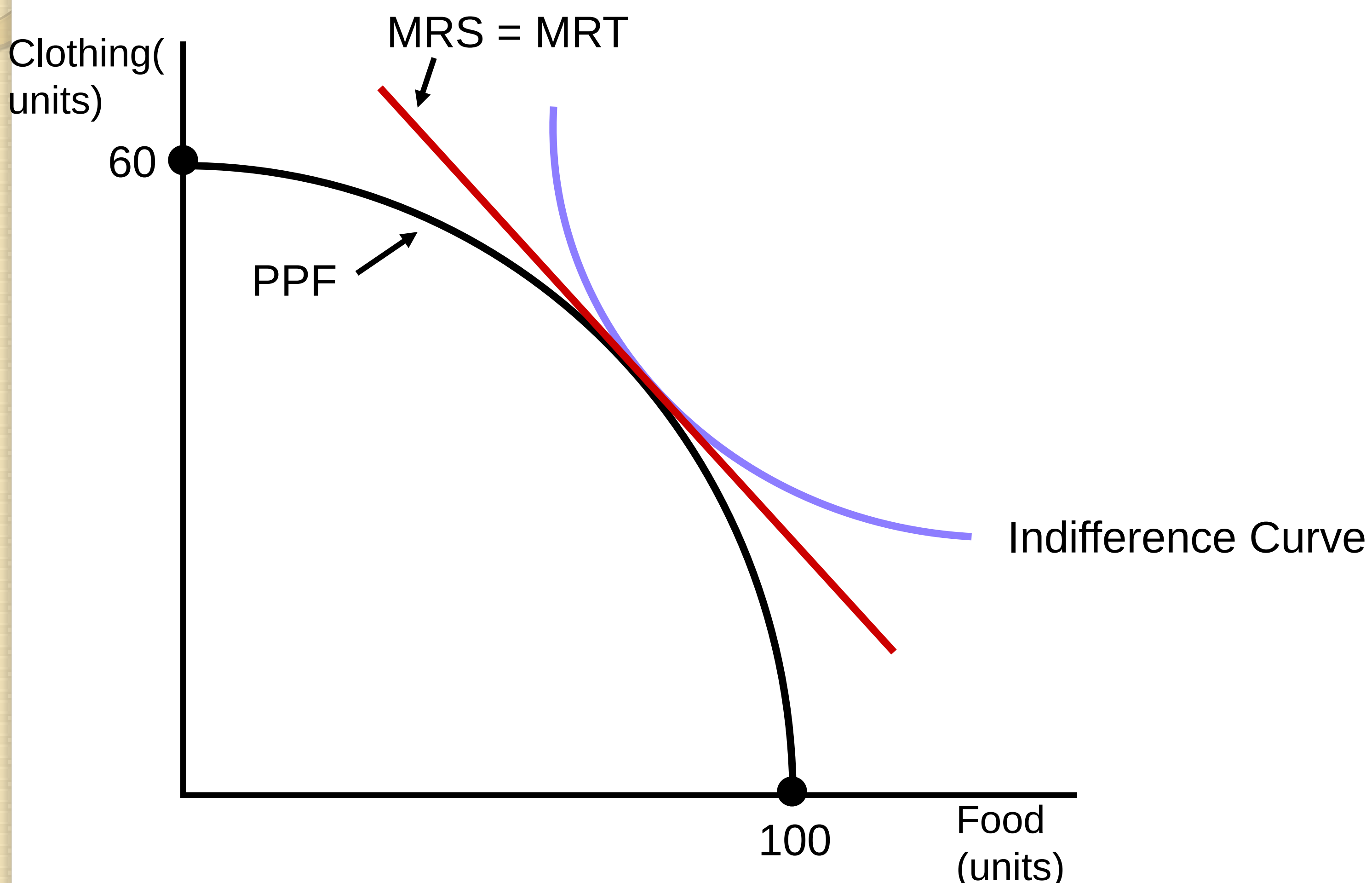
Output Efficiency

- For efficiency,
  - Good produced at minimum cost
  - Must be produced in combinations that match people's willingness to pay
  - MRS = consumer's WTP for additional food by consuming less clothing
  - MRT = cost of additional unit of food in terms of producing less clothing
- Efficiency means MRS = MRT

Output Efficiency

- What if MRT $\neq$ MRS?
  - Suppose MRT = 1 and MRS = 2
  - Consumer willing to give up 2 units of clothing to get 1 unit of food
  - Cost of getting additional food is only 1 unit of lost clothing
  - Too little food is being produced
  - Food production must increase, MRS falls and MRT increases until two are equal again

Output Efficiency



Efficiency in Output Markets

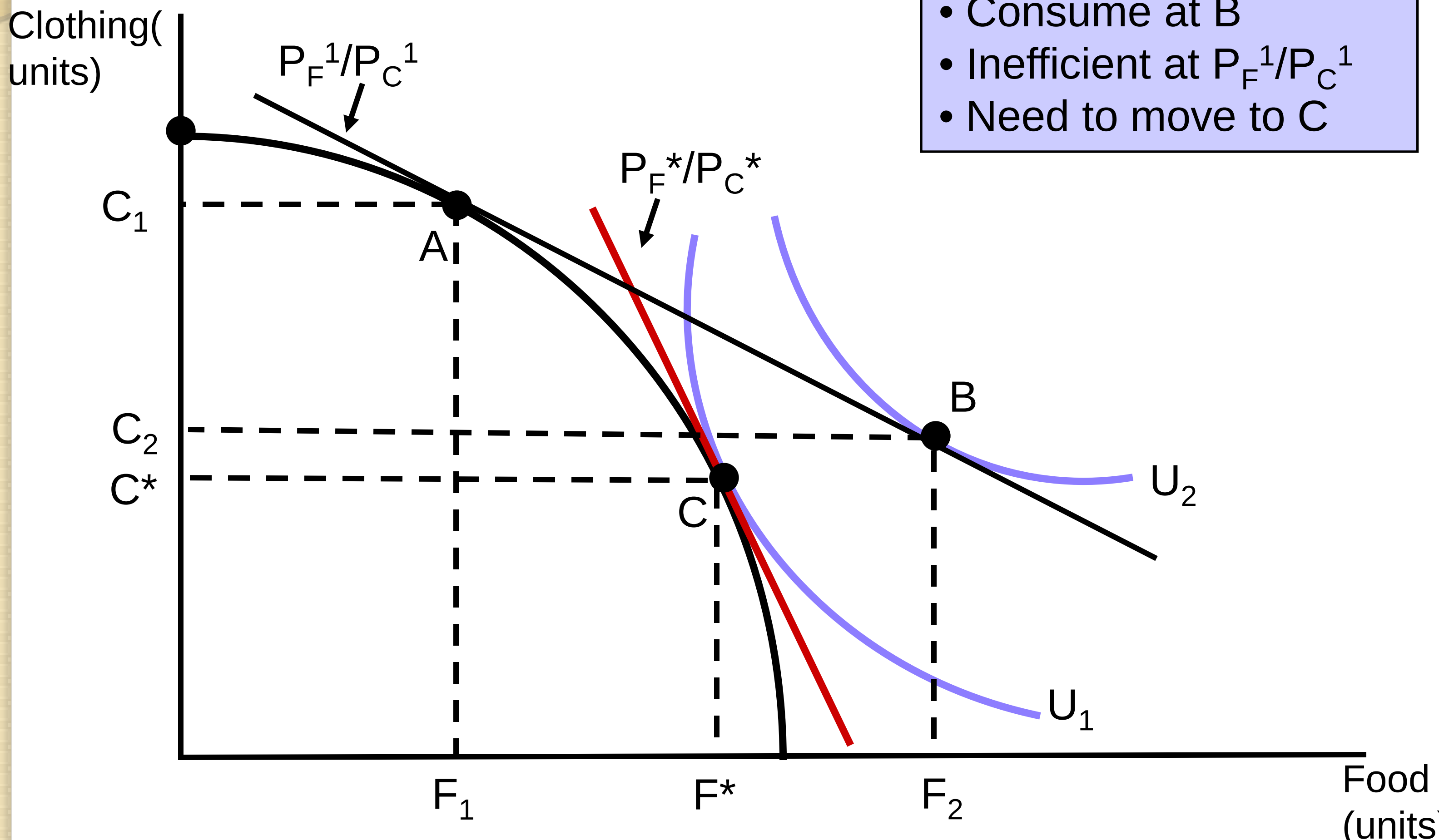
- For perfectly competitive markets, all consumers allocate their budgets so their MRS between two goods are equal to the ratio of prices
- Profit maximizing firms produce output to the point where price is equal to MC
- MRT is equal to the MRS

$$\boldsymbol{MRT = \frac{MC_F}{MC_C} = \frac{P_F}{P_C} = MRS}$$

Efficiency in Output Markets

- Efficiency in competitive markets is achieved when there is separate production and consumption
- Market price ratio of P^1_F/P^1_C
- Food and clothing are produced at A where price ratio equals MRT
- This price causes consumer to maximize utility and consume at B

Efficiency in Output Markets



- Produce at A
- Consume at B
- Inefficient at P_F^1/P_C^1
- Need to move to C

Overview – Efficiency of Competitive Markets

1. Efficiency in Exchange
   - $MRS^J_{FC} = MRS^K_{FC}$
   - $MRS^J_{FC} = P_F/P_C = MRS^K_{FC}$
2. Efficiency in the use of inputs in production
   - $MRTS^F_{LK} = MRTS^C_{LK}$
   - $MRTS^F_{LK} = w/r = MRTS^C_{LK}$

Overview – Efficiency of Competitive Markets

3. Efficiency in the output market
   - $MRT_{FC} = MRS_{FC}$ (for all consumers)
   - $P_F = MC_F$, $P_C = MC_C$ resulting in
   - $MRT_{FC} = MC_F/MC_C = P_F/P_C$; therefore
   - $MRS_{FC} = MRT_{FC}$

Why Markets Fail

- Market Power
  - Those with market power choose the price and quantity
  - Less output is sold than in competitive markets
  - Inefficiency
  - Can have market power as producers or as inputs

Why Markets Fail

- Incomplete Information
  - Consumers must have accurate information about market prices or production quality for markets to operate efficiently
  - Lack of information can change supply
    - Buy products with no value
    - Don't buy enough of products with value
  - Some markets may never develop
  - May be impossible to get insurance because suppliers of insurance lack information

Why Markets Fail

- Externalities
  - Market prices do not always reflect the activities of either producers or consumers
  - Consumption or production has indirect effect on other consumption or production not reflected in market prices

Why Markets Fail

- Public Goods
  - Nonexclusive, nonrival goods that can be made available cheaply but which, once available, are difficult to prevent others from consuming
  - Company thinking about researching a new technology if can't get patent
    - Once it's made pubic, others can duplicate it

Chapter 15

Externality and Public Goods

Externalities

- An externality is a cost or a benefit imposed upon a consumer or a firm by actions taken by others. The cost or benefit is thus generated externally to the consumer or the firm
- An externally imposed benefit is a positive externality
- An externally imposed cost is a negative externality

Examples of Negative Externalities

- Air pollution.
- Water pollution.
- Loud parties next door.
- Traffic congestion.
- Second-hand cigarette smoke suffered by a non-smoker.
- Increased health insurance premium due to alcohol or tobacco consumption.

Examples of Positive Externalities

- A well-maintained property next door that raises the market value of your own property
- A pleasant cologne or scent worn by the person seated next to you
- Improved driving habits that reduce accident risks
- A scientific advance

Externalities and Efficiency

- Externalities occur when one's action or decision directly enters other people's payoff function (utility or profits)
- The crucial feature of an externality is that there are goods people care about that are not sold on markets
- It is this lack of markets for externalities that causes problems

Externalities and Efficiency

- Externalities cause Pareto inefficiency; typically
  - too much scarce resource is allocated to an activity which causes a negative externality
  - too little resource is allocated to an activity which causes a positive externality.

Inefficiency & Negative Externalities

- Consider an example of two roommates, A and B, and two commodities, money and smoke.
- Both smoke and money are goods for Agent A.
- Money is a good and smoke is a bad for Agent B.
- Smoke is a purely public commodity which is nonrivalry and nonexcludable

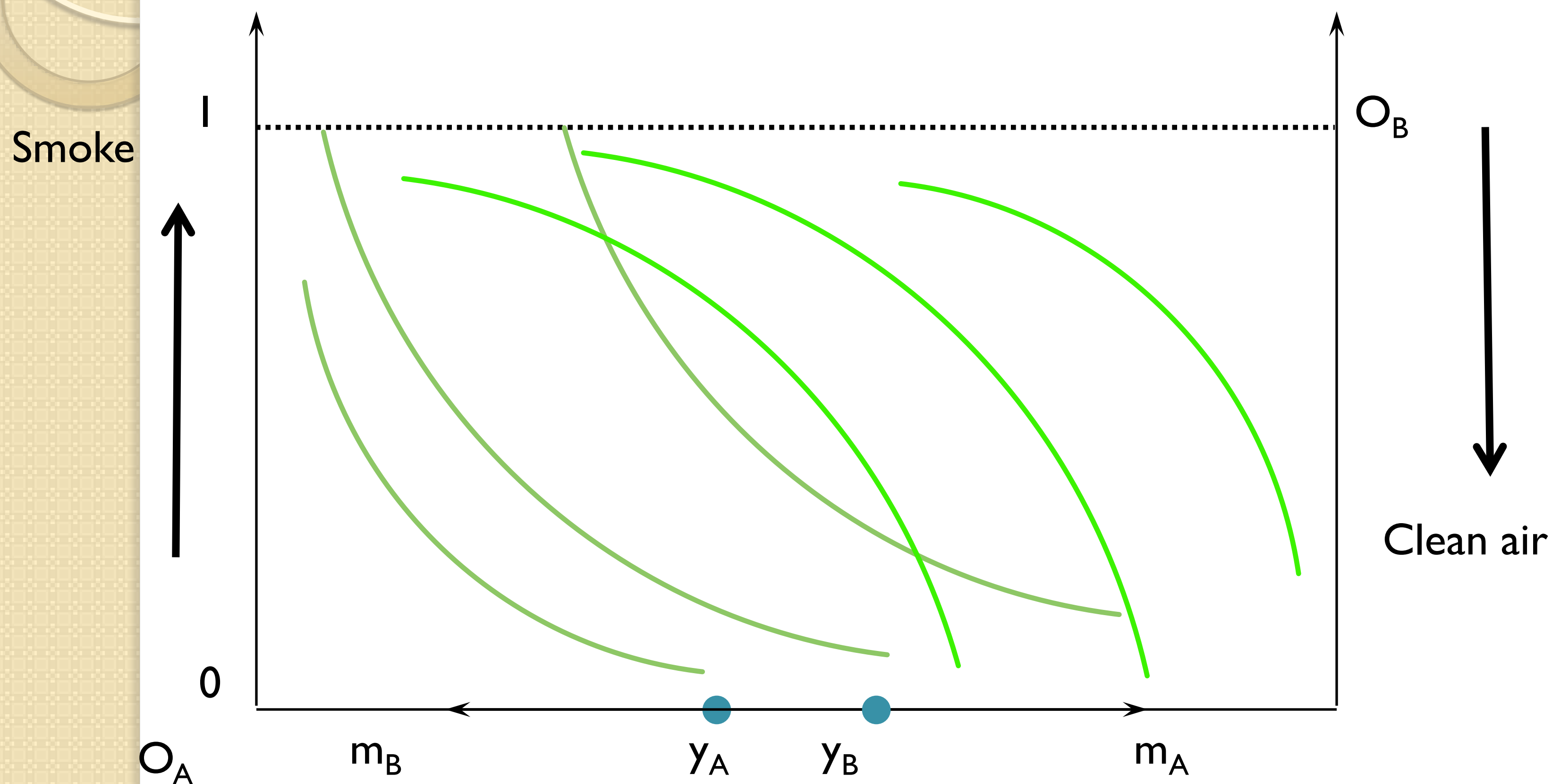
Inefficiency & Negative Externalities

- Agent A is endowed with $\$y_{A=100}$
- Agent B is endowed with $\$y_{B=100}$
- Smoke intensity is measured on a scale from 0 (no smoke) to 1 (maximum concentration)
- Hence there is only one amount of smoke that they must both consume

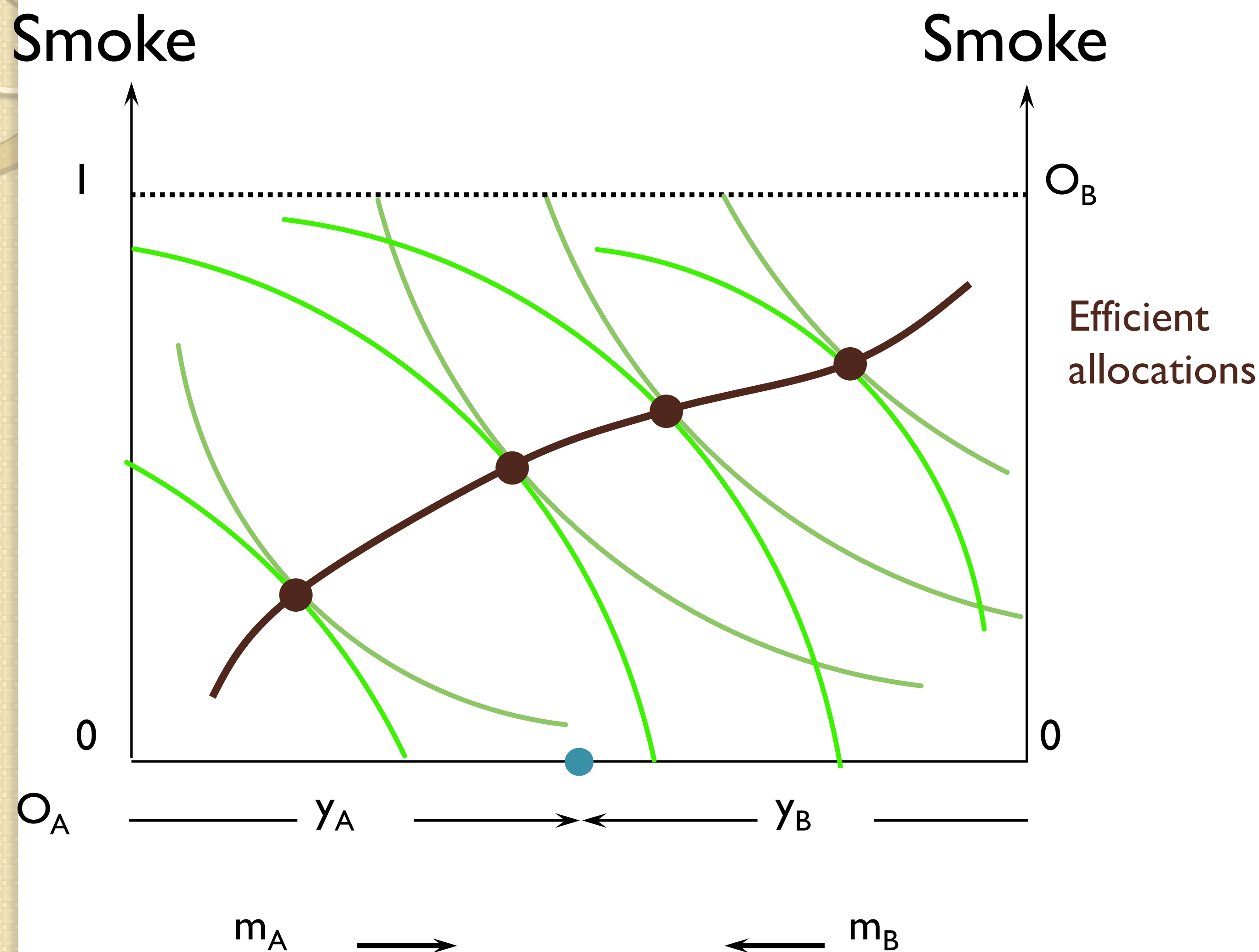
Inefficiency & Negative Externalities

- What are the efficient allocations of smoke and money?

Inefficiency & Negative Externalities



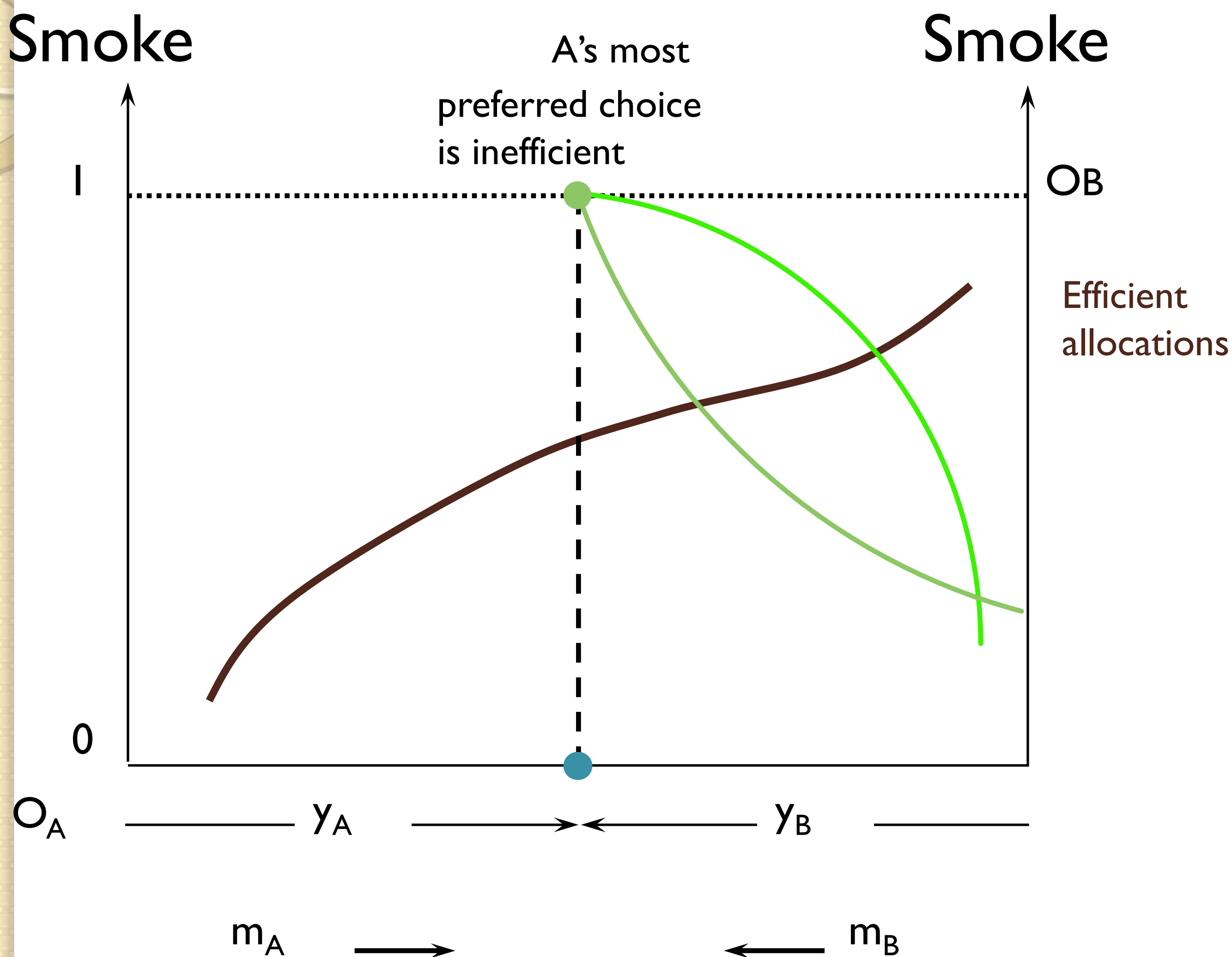
Inefficiency & Negative Externalities



Inefficiency & Negative Externalities

- Suppose there is no mechanism by which money can be exchanged for changes in smoke level.
- What then is Agent A's most preferred allocation?
- Is this allocation efficient?

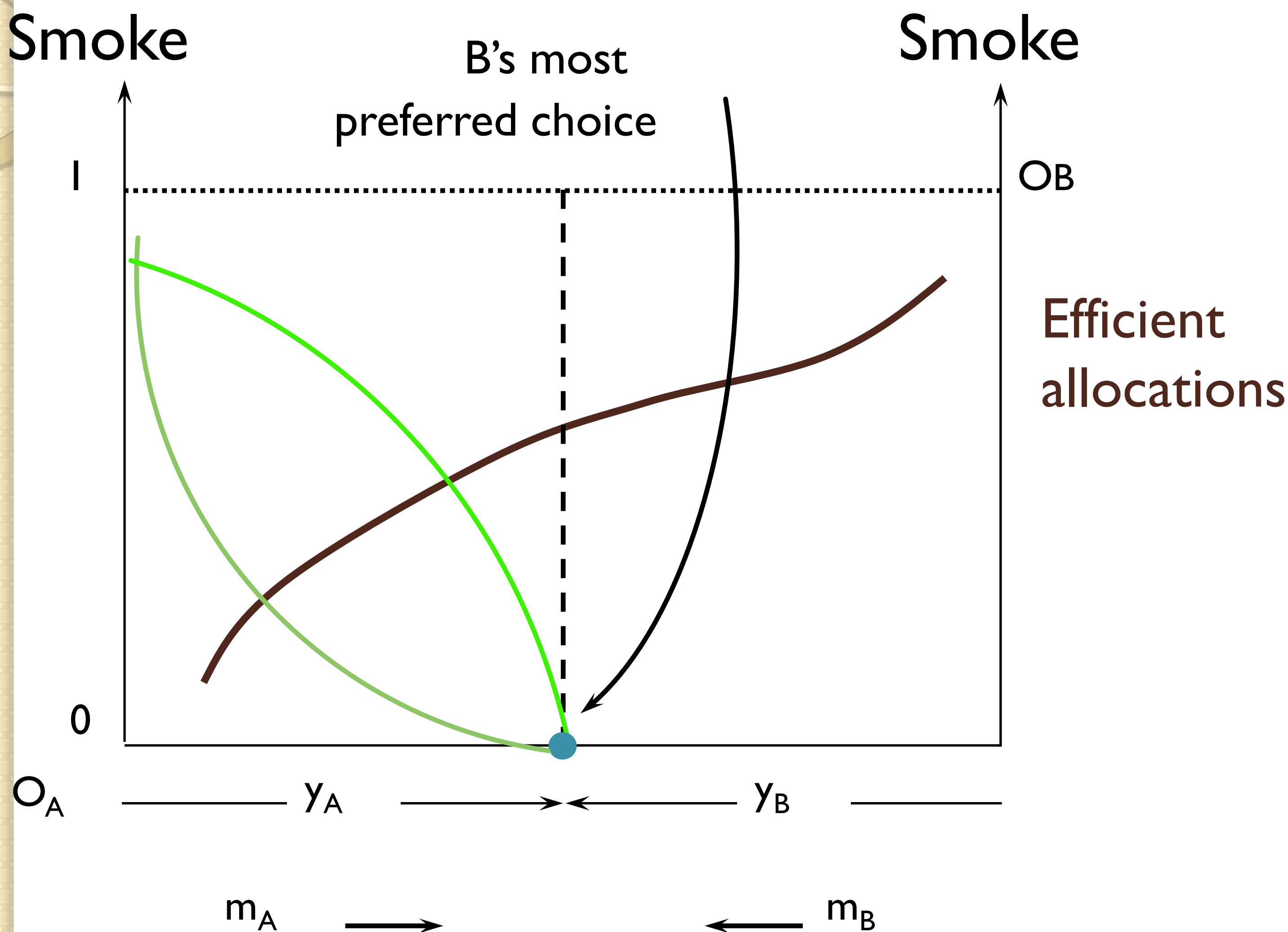
Inefficiency & Negative Externalities



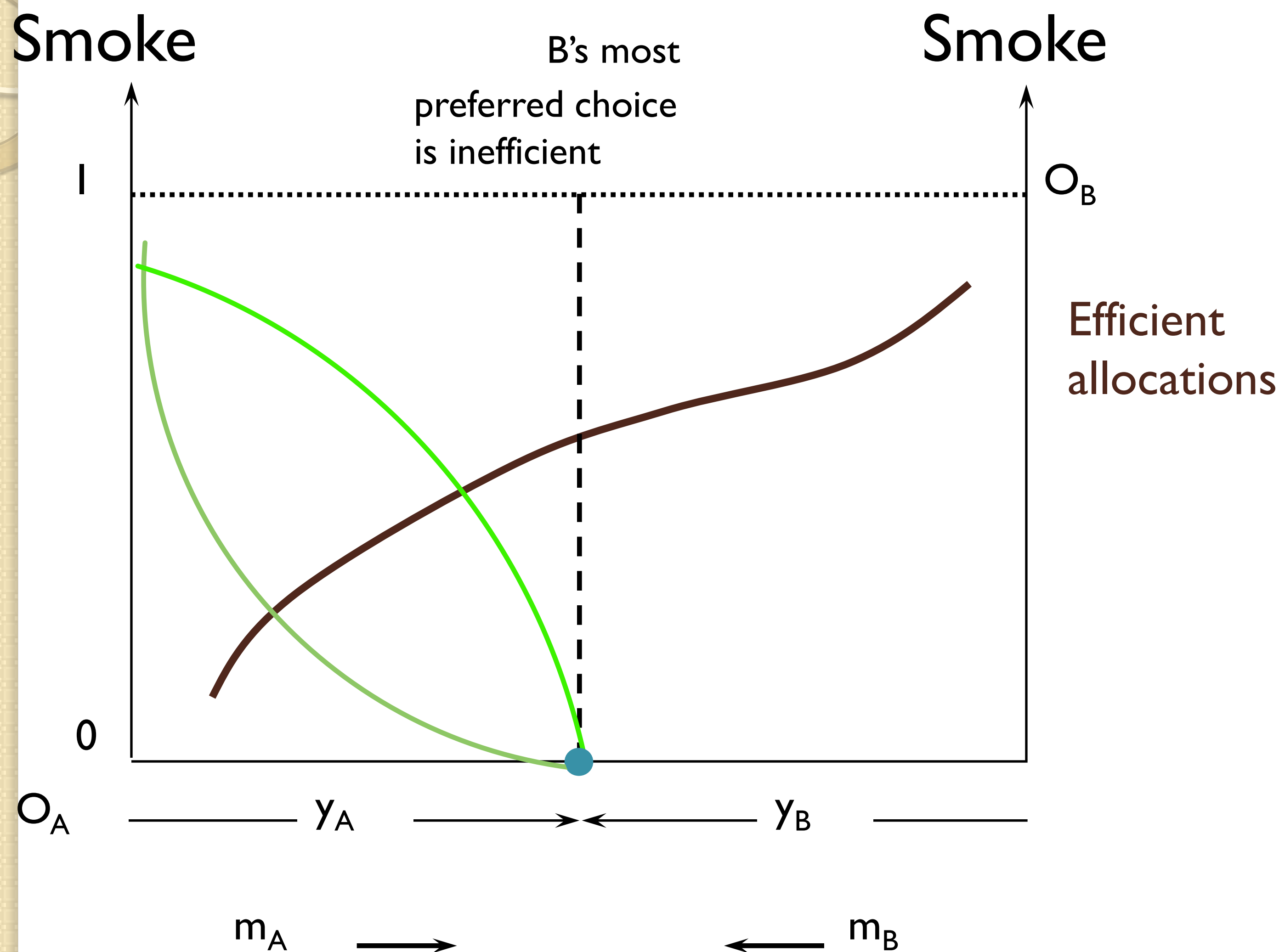
Inefficiency & Negative Externalities

- Continue to suppose there is no mechanism by which money can be exchanged for changes in smoke level.
- What is Agent B's most preferred allocation?
- Is this allocation efficient?

Inefficiency & Negative Externalities



Inefficiency & Negative Externalities



Inefficiency & Negative Externalities

- So if neither A nor B can trade money for changes in smoke intensity, then the outcome is inefficient.
- ***The only problem arises when the property rights are not well defined***
- ***No payment will be to compensate the loss in this case***
- Either there is too much smoke (A's most preferred choice) or there is too little smoke (B's choice).

Externalities and Property Rights

- Ronald Coase's insight is that most externality problems are due to an inadequate specification of property rights and, consequently, an absence of markets in which trade can be used to internalize external costs or benefits.

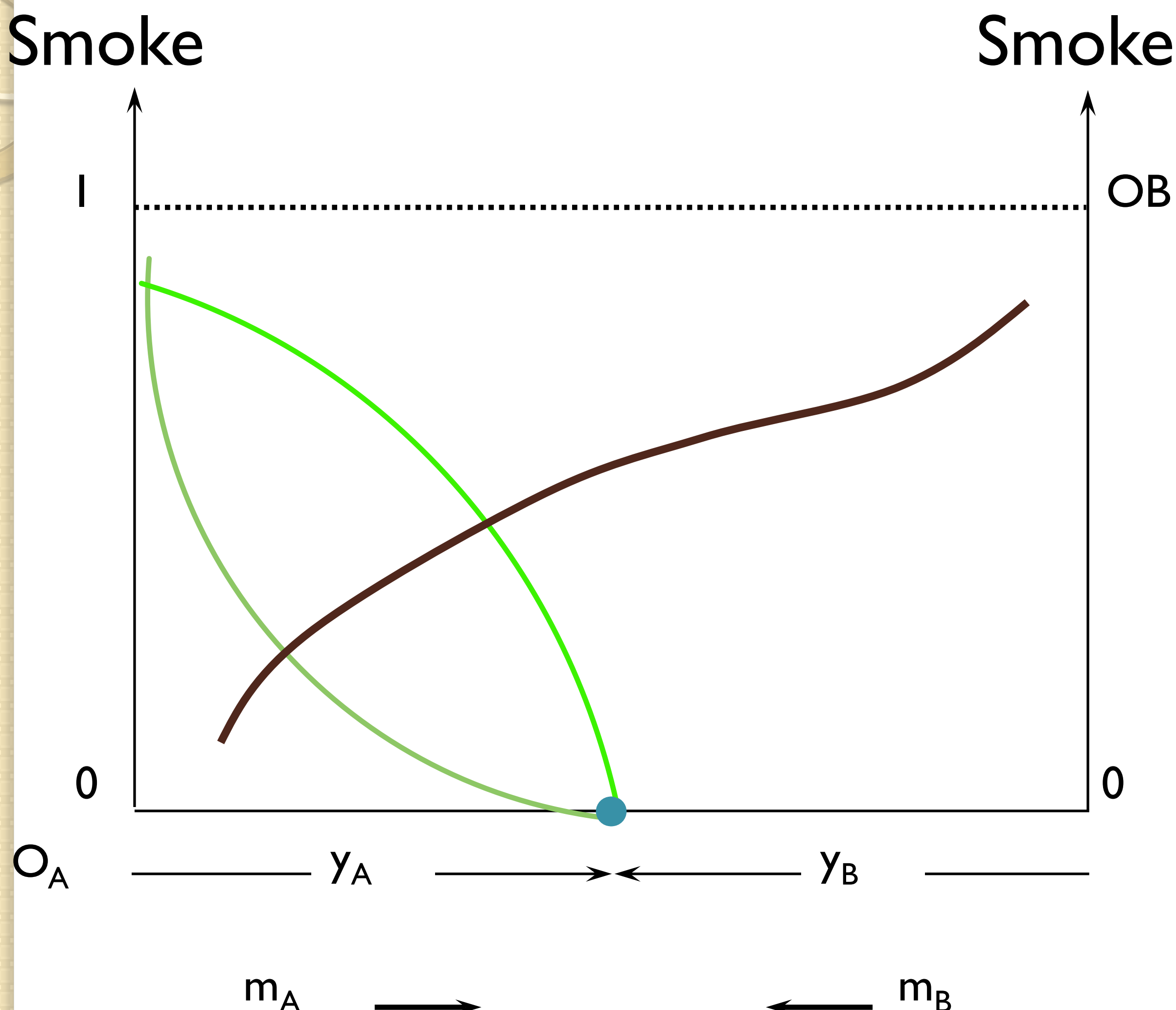
Externalities and Property Rights

- Suppose that Agent B is assigned ownership of the clean air in the room.
- Agent B can now sell "rights to smoke".
- Will there be any smoking?
- If so, how much smoking with there be and what will be the equilibrium price for this amount of smoke?

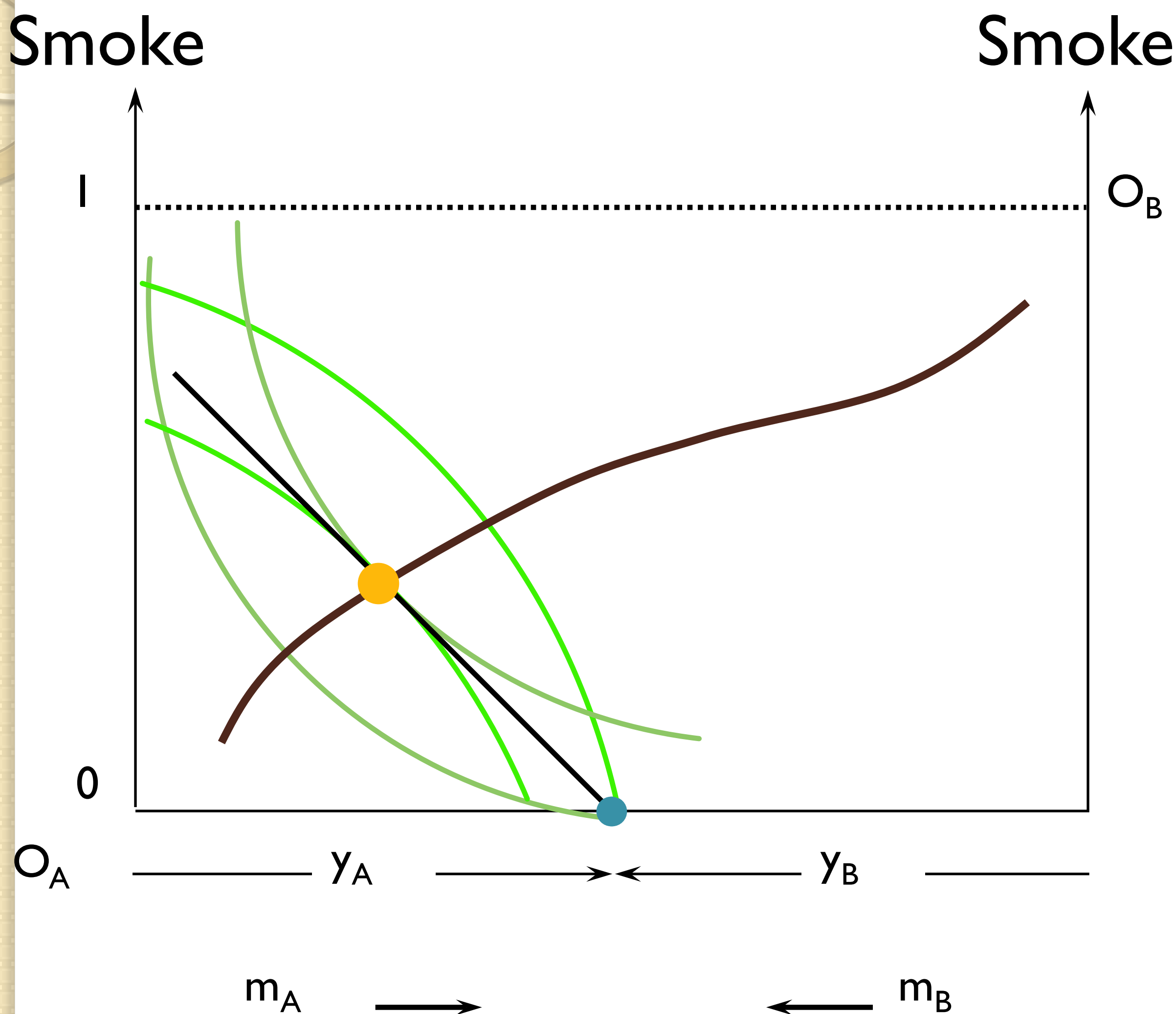
Externalities and Property Rights

- Let $p(s_A)$ be the price paid by Agent A to Agent B in order to create a smoke intensity of s_A.

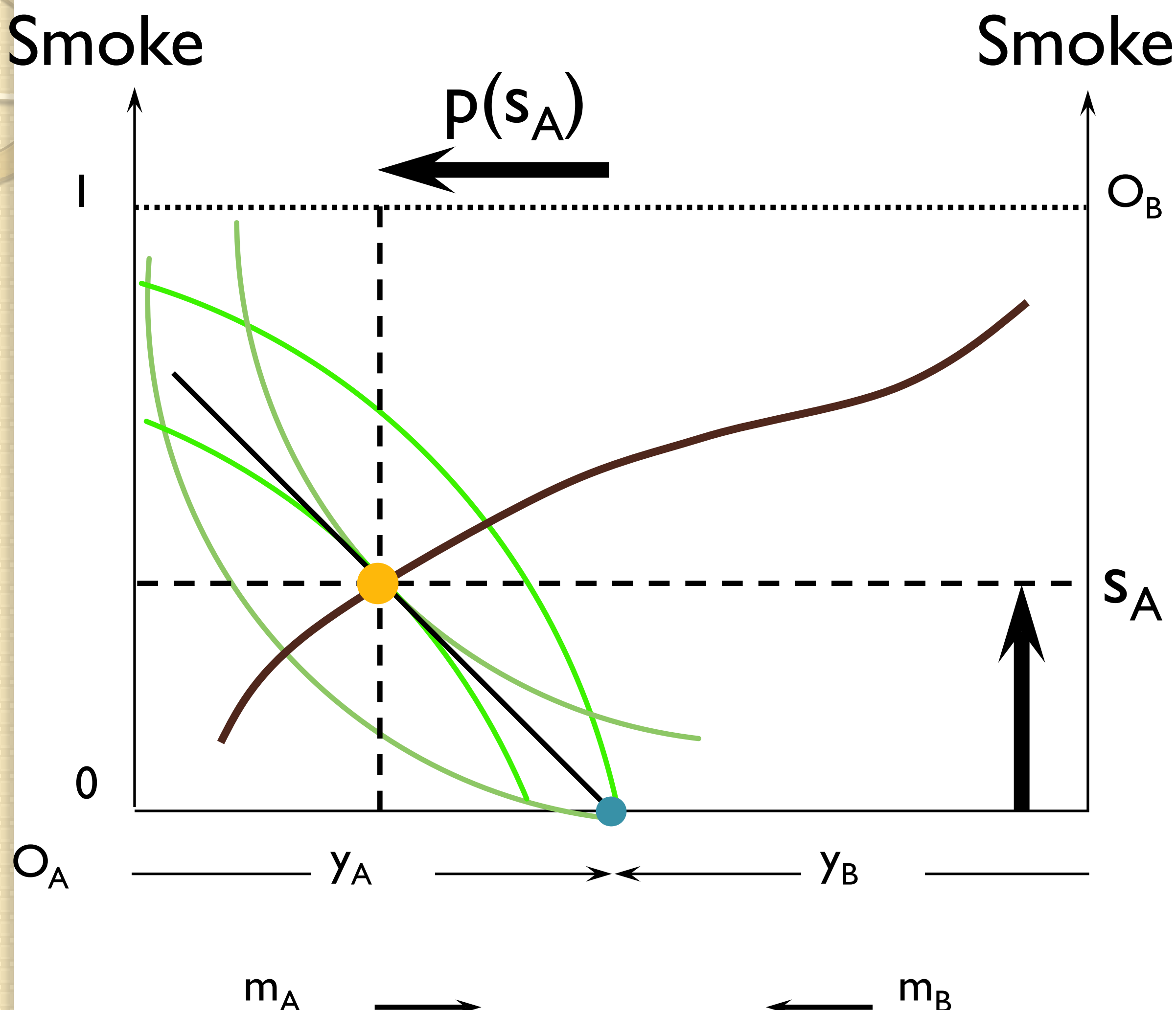
Externalities and Property Rights



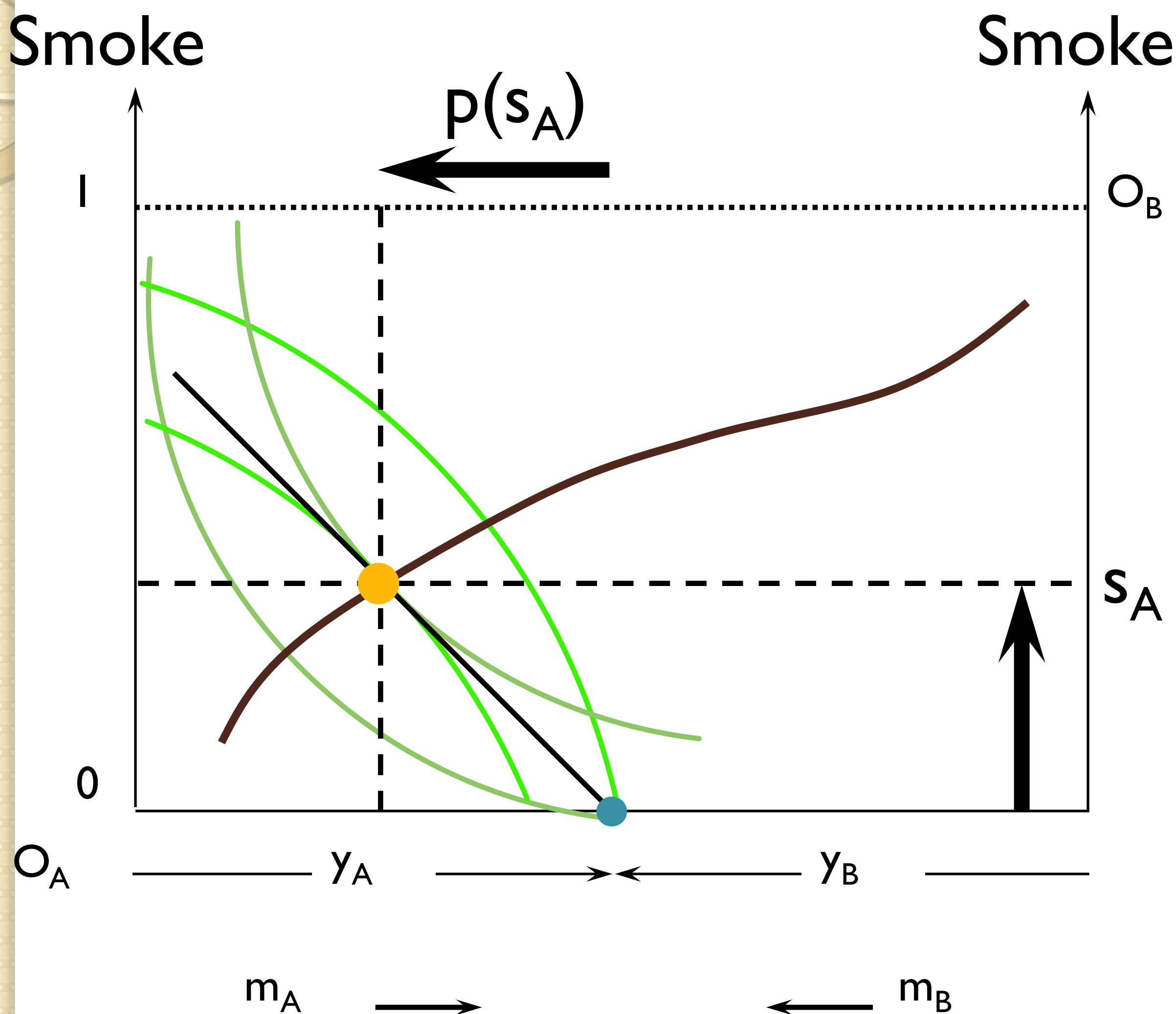
Externalities and Property Rights



Externalities and Property Rights

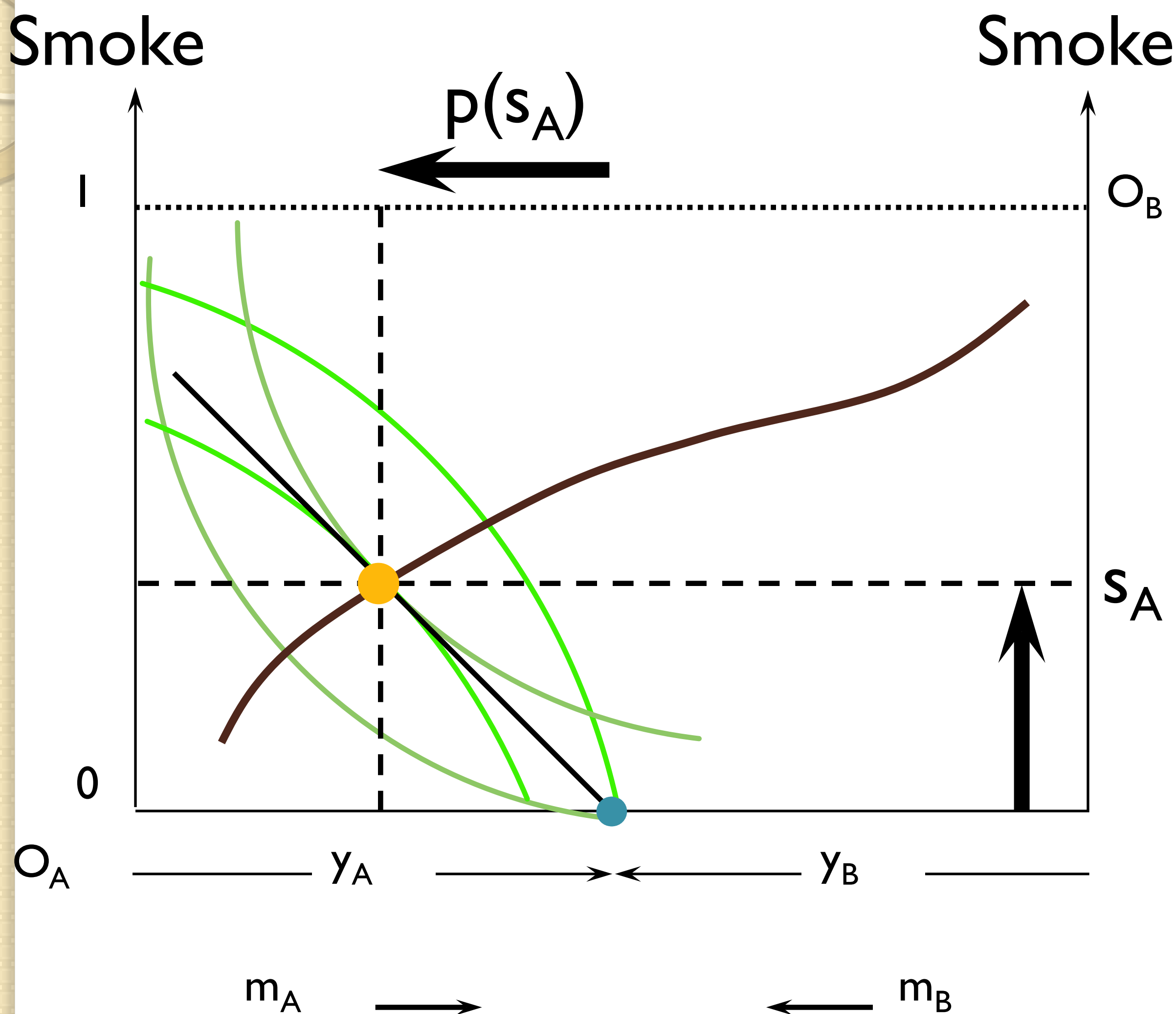


Externalities and Property Rights



Both agents gain and there is a positive amount of smoking.

Externalities and Property Rights

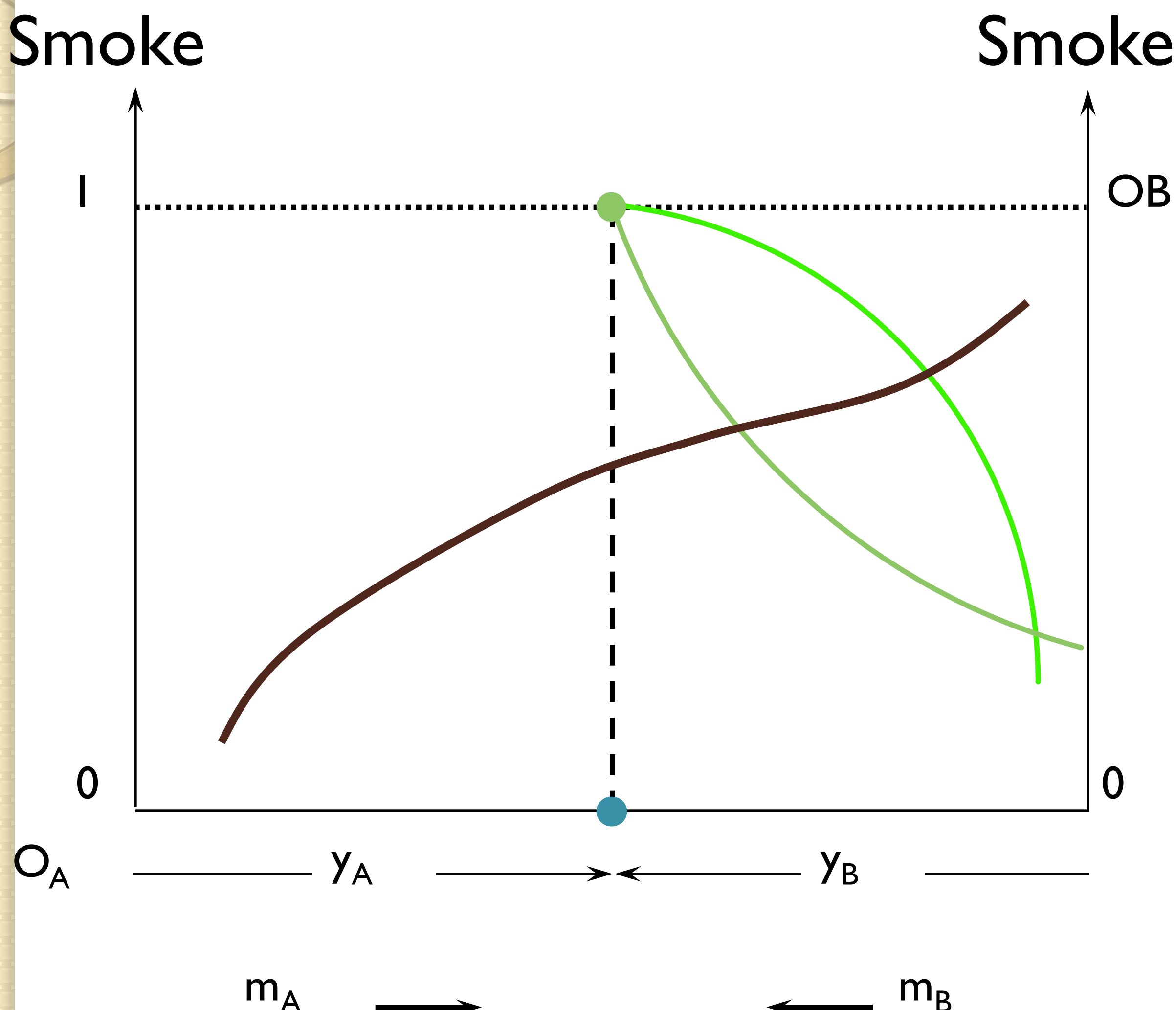


Establishing a market for trading rights to smoke causes an efficient allocation to be achieved.

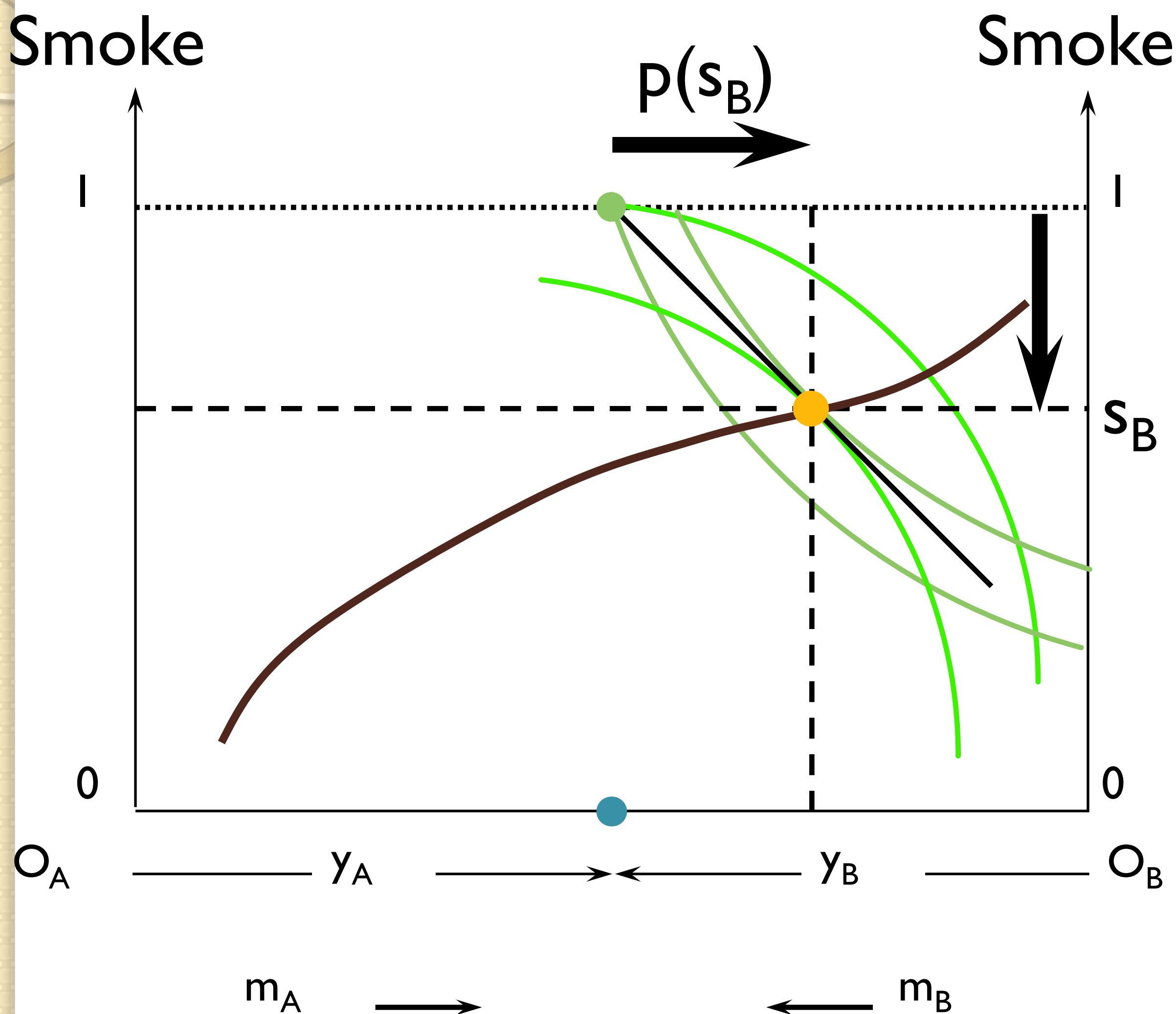
Externalities and Property Rights

- Suppose instead that Agent A is assigned the ownership of the air in the room.
- Agent B can now pay Agent A to reduce the smoke intensity.
- How much smoking will there be?
- How much money will Agent B pay to Agent A?

Externalities and Property Rights



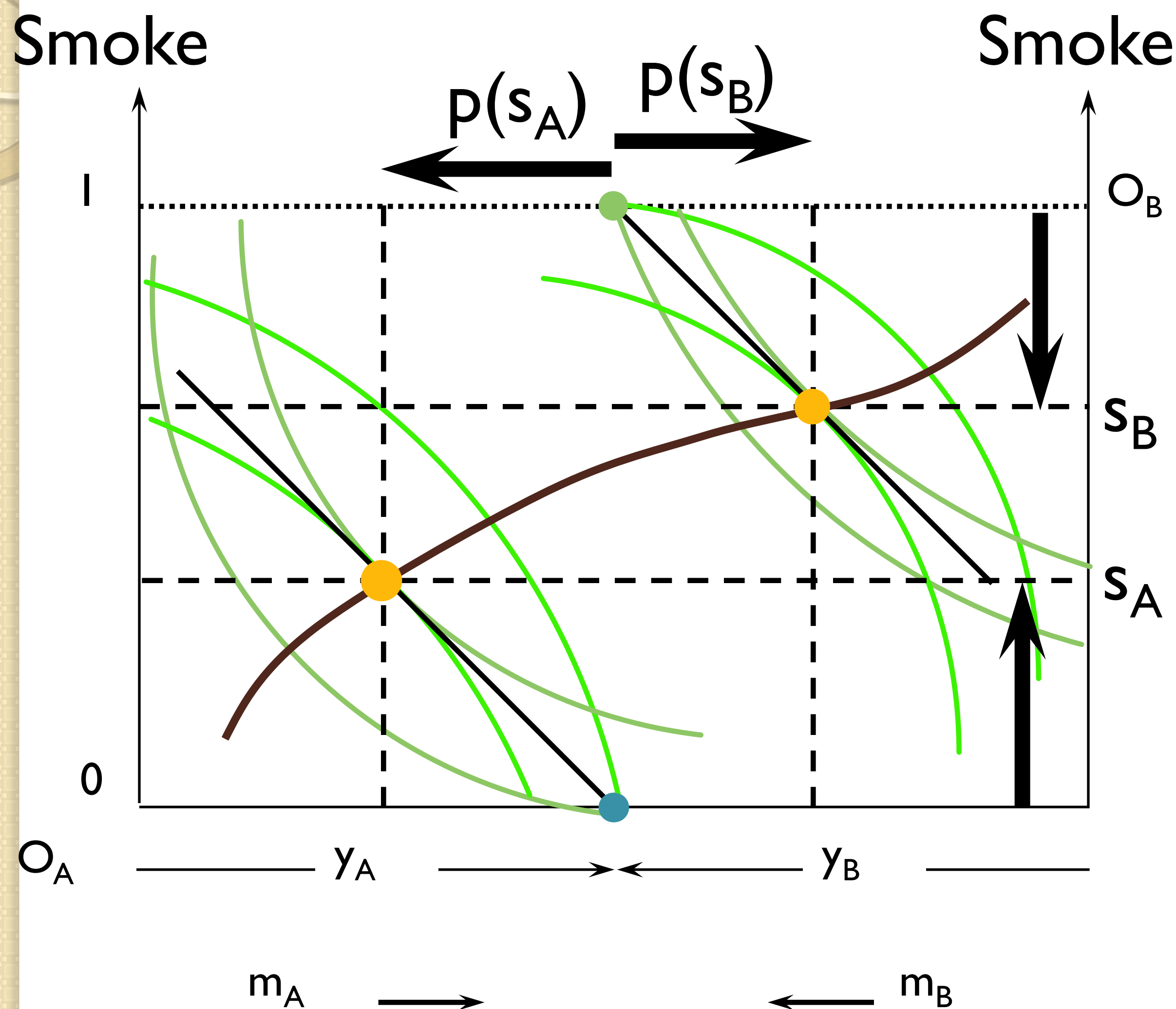
Externalities and Property Rights



Externalities and Property Rights

- Notice that the agent given the property right (asset) is better off than at his/her own most preferred allocation in the absence of the property right.
- Notice also that the amount of smoking that occurs in equilibrium typically depends upon which agent is assigned the property right.

Externalities and Property Rights

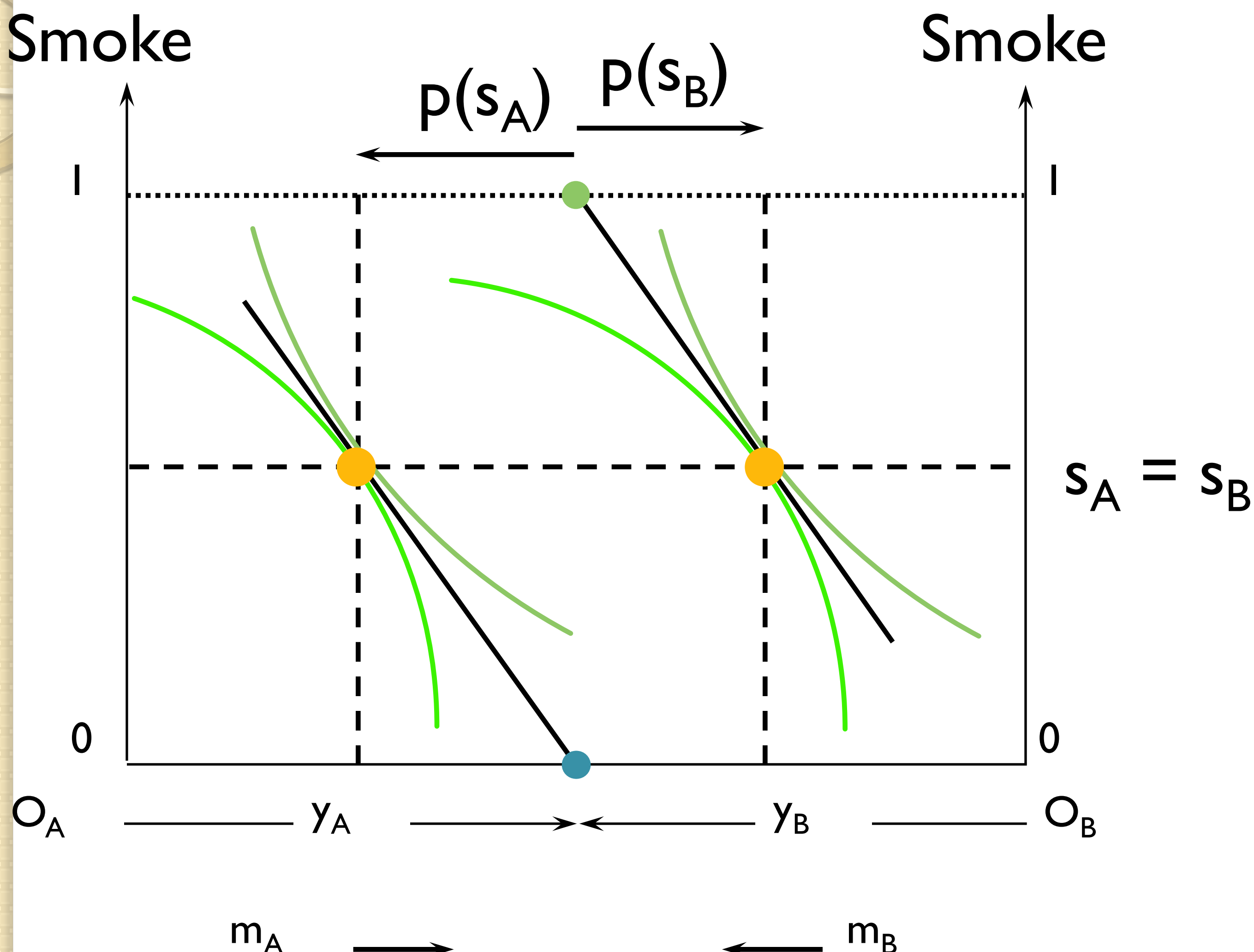


$s_A \neq s_B$

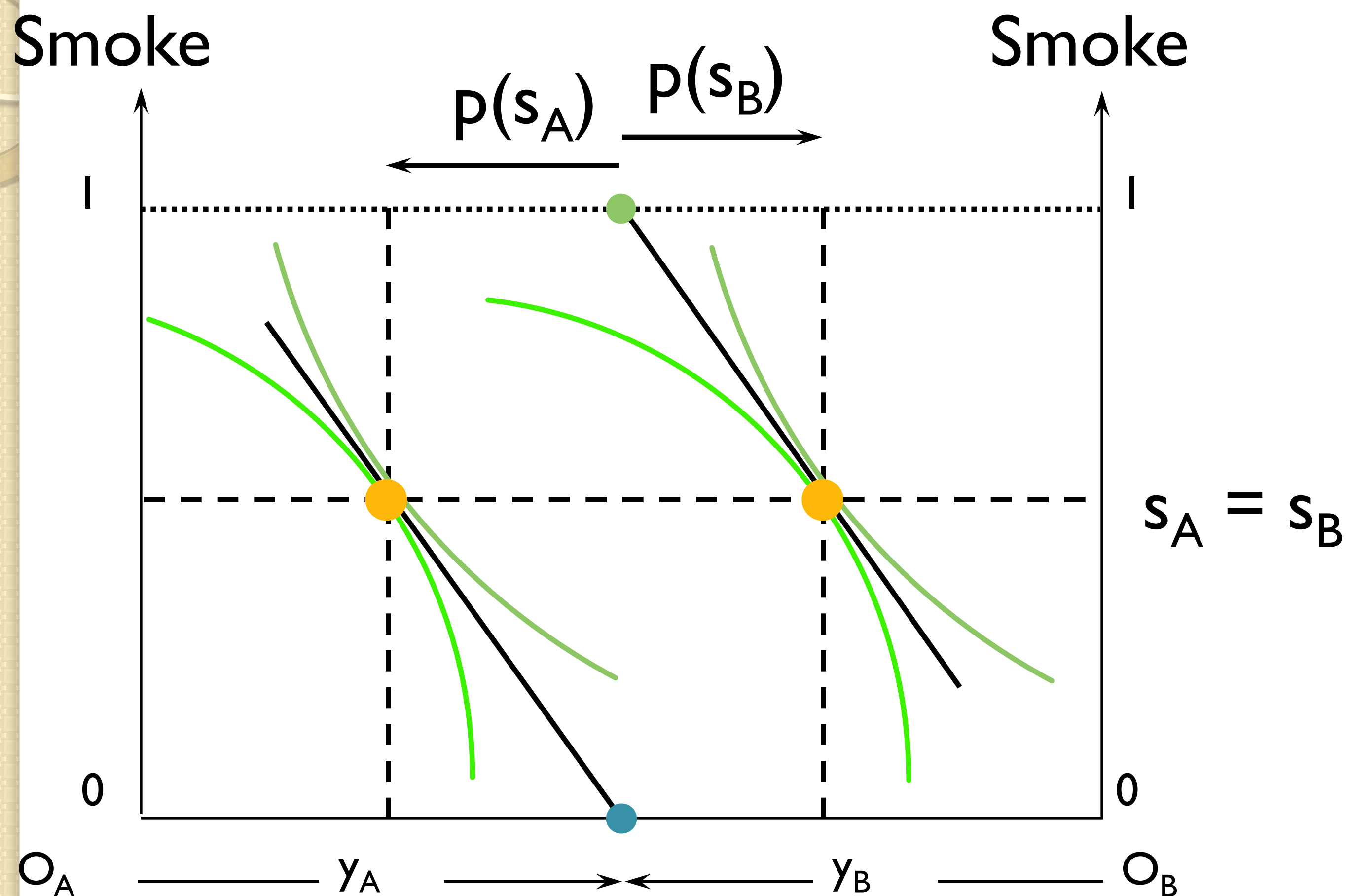
Externalities and Property Rights

- Is there a case in which the same amount of smoking occurs in equilibrium no matter which of the agents is assigned ownership of the air in the room?

Externalities and Property Rights

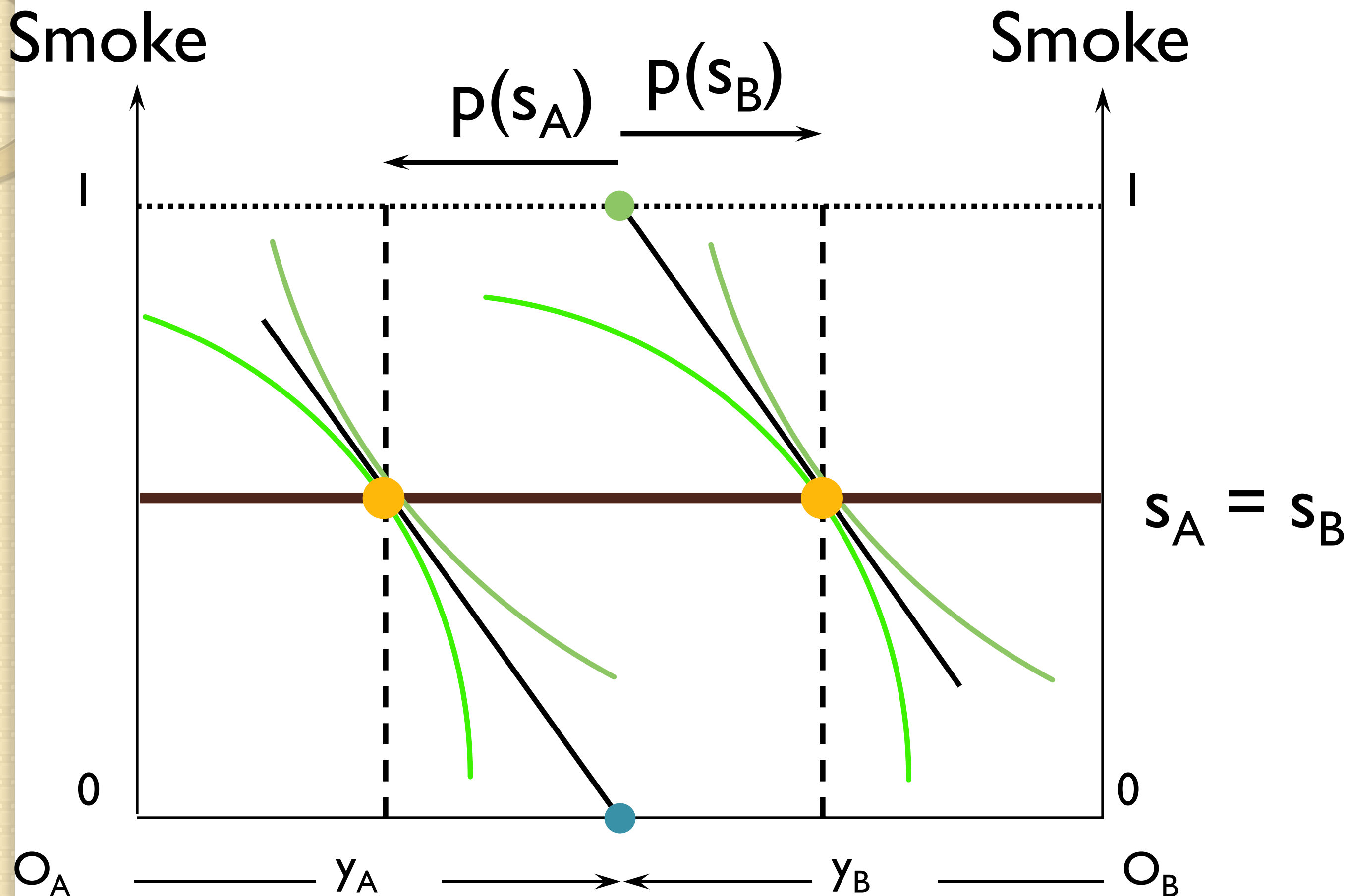


Externalities and Property Rights



For both agents, the MRS is constant as money changes, for given smoke intensity

Externalities and Property Rights



So, for both agents, preferences must be quasilinear in money; U(m,s) = m + f(s).

Digression: Quasilinear Preferences

$$\max U(x, y) = v(x) + y$$

$$s.t.\ p_x x + p_y y = m$$

$$\Rightarrow v'(x) = p_x / p_y$$

$$\Rightarrow x = x^*(p_x / p_y)$$

No income effect

Coase's Theorem

- ***Coase's Theorem***: *If the property rights are well defined and transaction costs are zero, then the allocation will be efficient no mater how the property rights are assigned*

- What's more, if all agents' preferences are quasilinear in money, then the efficient level of the externality generating commodity is produced no matter to which agent its property right is assigned

Production Externalities

- Consider a steel mill which produces jointly steel and pollution and a fishery which produces fish
- The pollution adversely affects a nearby fishery.
- Both firms are price-takers.
- p_S is the market price of steel.
- p_F is the market price of fish.

Production Externalities

- $c_S(s,x)$ is the steel firm's cost of producing s units of steel jointly with x units of pollution.
- Fishery's cost function $c_f(f,x)$
- Assume that $$\frac{\partial c_s(s,x)}{\partial x} \le 0, \frac{\partial c_f(f,x)}{\partial x} > 0$$

Production Externalities

$$\text{The Steel firm}:$$

$$\max_{s,x} \Pi_s(s,x) = p_s s - c_s(s,x)$$

$$F.O.C.,\ p_s = \frac{\partial c_s(s,x)}{\partial s}, \quad \frac{\partial c_s(s,x)}{\partial x} = 0$$

$$\text{The Fishery}:$$

$$\max_{f} \Pi_f(f,x) = p_f f - c_f(f,x)$$

$$F.O.C.,\ p_f = \frac{\partial c_f(f,x)}{\partial f}$$

Production Externalities

$$-\frac{\partial c_s(s,x)}{\partial x}$$ is the marginal benefit to the firm of increasing pollution emission.

What is the marginal cost to the steel firm from increasing pollution?

Zero, since the firm does not face its external cost.

Hence the steel firm chooses the pollution level for which $-\frac{\partial c_s(s,x)}{\partial x} = 0.$

Production Externalities

The first-order profit-maximization condition is

$$p_F = \frac{\partial c_F(f;x)}{\partial f}.$$

Higher pollution raises the fishery's marginal production cost and lowers both its output level and its profit. This is the external cost of the pollution.

Merger and Internalization

- Are these choices by the two firms efficient?
- Suppose the two firms merge to become one. What is the highest profit this new firm can achieve?

Merger

$$Max\ p_s s + p_f f - c_s(s,x) - c_f(f,x)$$

$$F.O.C.:\ p_s = \frac{\partial c_s}{\partial s}(s^*, x^*),\ p_f = \frac{\partial c_f}{\partial f}(f^*, x^*)$$

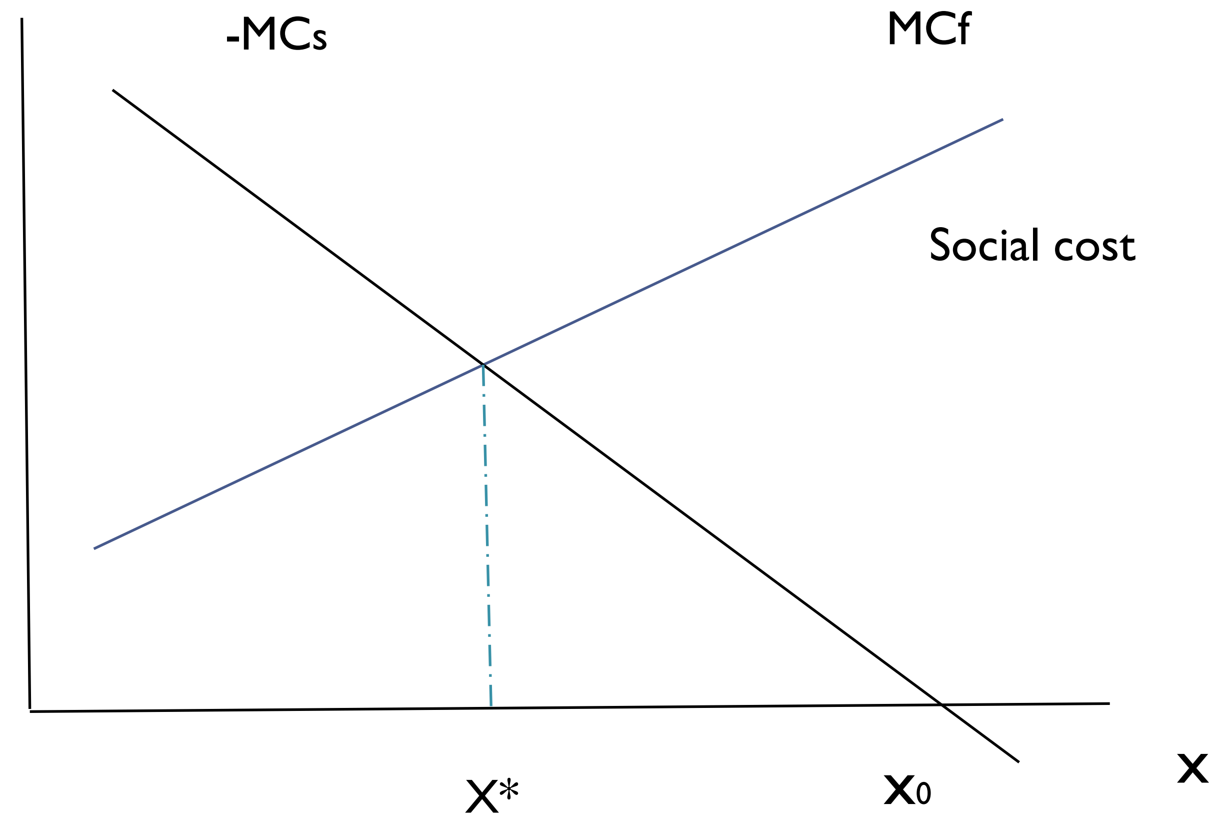
$$\frac{\partial c_s}{\partial x}(s^*, x^*) + \frac{\partial c_f}{\partial x}(f^*, x^*) = 0$$

$$Note\ that\ in\ the\ previous\ case, -\frac{\partial c_s}{\partial x}(s_0, x_0) = 0$$

$$Since\ \frac{\partial c_f}{\partial x} > 0,\ -\frac{\partial c_s}{\partial x}(s^*, x^*) = \frac{\partial c_f}{\partial x}(f^*, x^*) > 0$$

$$\Rightarrow -\frac{\partial c_s}{\partial x}(s^*, x^*) > -\frac{\partial c_s}{\partial x}(s_0, x_0),\ x_0 > x^*$$

Pareto Efficient Outcome



Merger and Internalization

- Merger has improved efficiency.
- On its own, the steel firm produced x_0 units of pollution.
- Within the merged firm, pollution production is only x^* units.
- So merger has caused both an improvement in efficiency and less pollution production. Why? ***Internalization of externality!***

Merger and Internalization

- The merged firm's marginal pollution cost is larger because it faces the full cost of its own pollution through increased costs of production in the fishery, so less pollution is produced by the merged firm

Merger and Internalization

- Merger therefore internalizes an externality and induces economic efficiency.
- How else might internalization be caused so that efficiency can be achieved?

Solutions to Externality Problem

- There are two major interpretations why externality causes problems
  - The steel firm faces the **wrong price** for pollution
  - There is a **missing market** for pollutants

Pigouvian Tax

- The production of pollution costs it nothing and therefore it is necessary to correct it by letting the firm face the social cost of its actions
- Place a tax on the pollution generated by the firm

$$Max \; p_s s - c_s(s, x) - tx$$

$$F.O.C. \; p_s = \frac{\partial c_s}{\partial s}$$

$$\frac{\partial c_f}{\partial x}(f^*, x^*) = t = -\frac{\partial c_s}{\partial x}(s^*, x^*)$$

Coase's View

- The externality problem arises because the polluter faces a **zero** price for an output good that it produces
- People would be willing to pay money to have that output level reduced
- From a social point of view, the output of pollution should have a **negative** price (i.e., it should be compensated for a lower level)

Coase Theorem

- Suppose that the fishery had the right to clean water, but could sell the right to allow pollution
- Let q be the price per unit of pollution
- Let x be the amount of pollution that the steel mill produces

Coase Theorem

$$The\ steel\ \ firm's\ \ problem:$$

$$Max\ \ p_s s - qx - c_s(s, x)$$

$$\mathrm{p_s} = \frac{\partial c_s}{\partial s}, \quad q = -\frac{\partial c_s}{\partial x}$$

$$The\ \ fishery's\ \ problem:$$

$$Max\ \ p_f\, f + qx - c_f(f, x)$$

$$\mathrm{p_f} = \frac{\partial c_s}{\partial f}, \quad q = \frac{\partial c_f}{\partial x}$$

$$\Rightarrow q = -\frac{\partial c_s}{\partial x} = \frac{\partial c_f}{\partial x} \Rightarrow Pareto\ efficiency$$

Coase Theorem

- Suppose that the steel firm had the right to pollute the water
- The fishery would have to pay to induce the steel firm to pollute less
- Suppose that the steel firm has the right to pollute up to some amount $\bar{x}$

Coase Theorem

$$The\ steel\ \ firm's\ problem:$$

$$Max\ p_s s + q(\bar{x} - x) - c_s(s, x)$$

$$\mathrm{p_s} = \frac{\partial c_s}{\partial s}, \quad q = -\frac{\partial c_s}{\partial x}$$

$$The\ \ fishery's\ problem:$$

$$Max\ p_f f - q(\bar{x} - x) - c_f(f, x)$$

$$\mathrm{p_f} = \frac{\partial c_s}{\partial f}, \quad q = \frac{\partial c_f}{\partial x}$$

$$\Rightarrow q = -\frac{\partial c_s}{\partial x} = \frac{\partial c_f}{\partial x} \Rightarrow Pareto\ efficiency$$

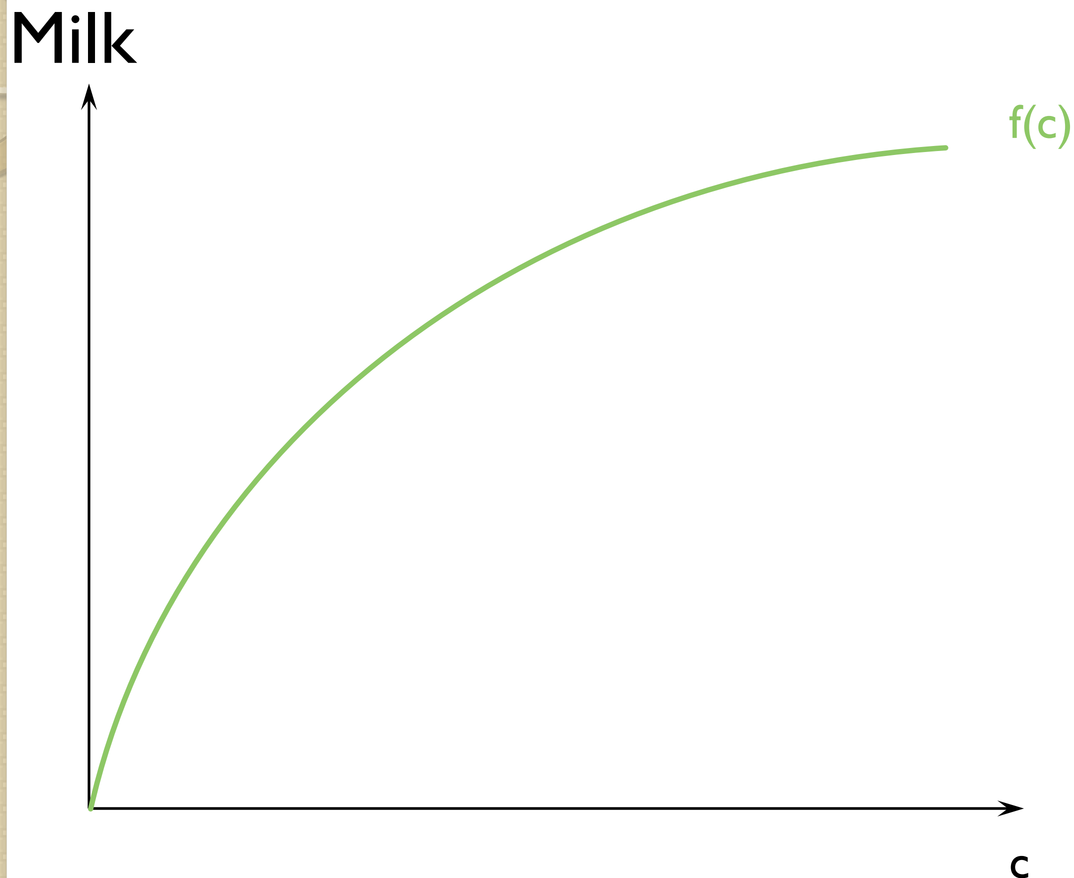
Applications of Coase Theorem

- Trading of pollution permits while the total number of permits is fixed
- Inter-county trade for pollution quotas
- The redline for 1.8 billion arable land: the current system fixes the land quota for each county
- Can we trade for arable land quotas across regions?
- The market for Di Piao in Chengdu and Chongqing

The Tragedy of the Commons

- Consider a grazing area owned "in common" by all members of a village.
- Villagers graze cows on the common.
- When c cows are grazed, total milk production is $f(c)$, where $f'>0$ and $f''<0$.
- How should the villagers graze their cows so as to maximize their overall income?

The Tragedy of the Commons



The Tragedy of the Commons

- Normalize the price of a unit of milk to \$1 and let the relative cost of grazing a cow be \$$p_c$.
- If the commons are run like a private firm, then the profit function for the entire village is

$$\Pi(c) = f(c) - p_c c$$

- The village's problem is to

$$\max_{c \geq 0} \Pi(c) = f(c) - p_c c.$$

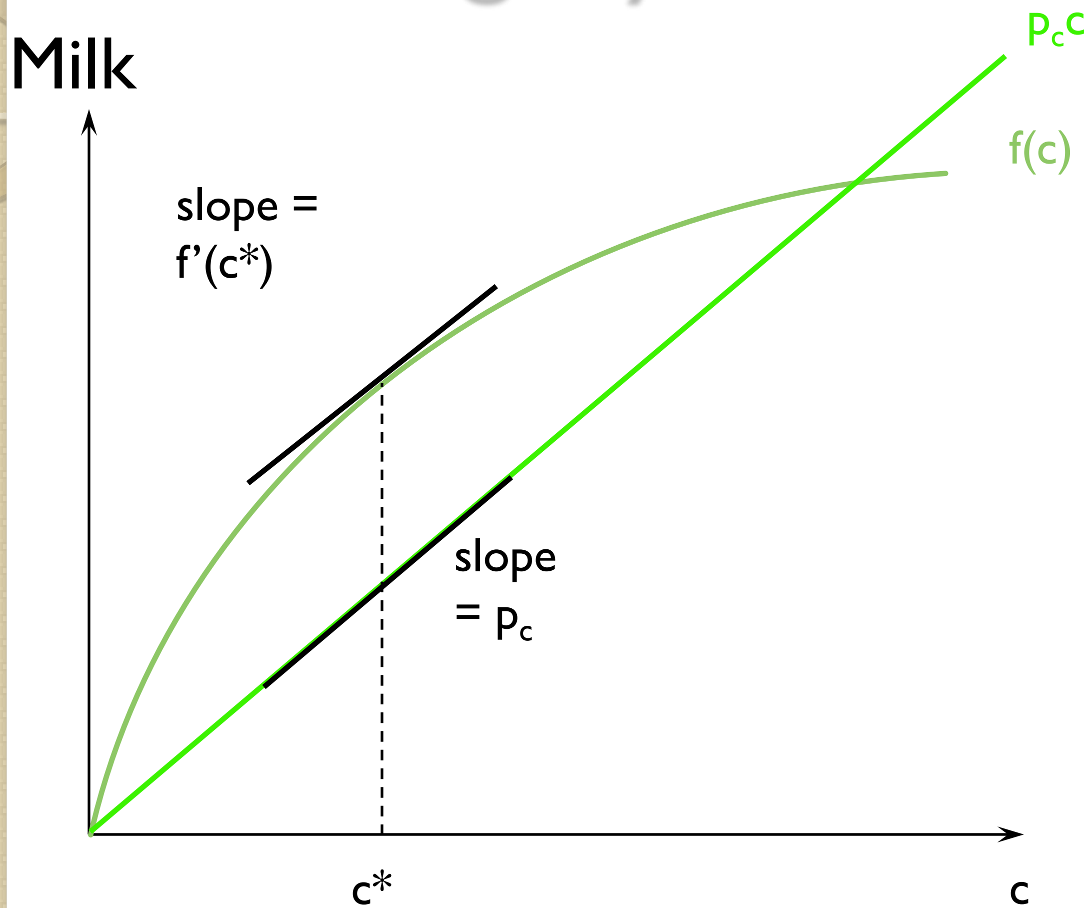
The Tragedy of the Commons

The income-maximizing number of cows to graze, c*, satisfies

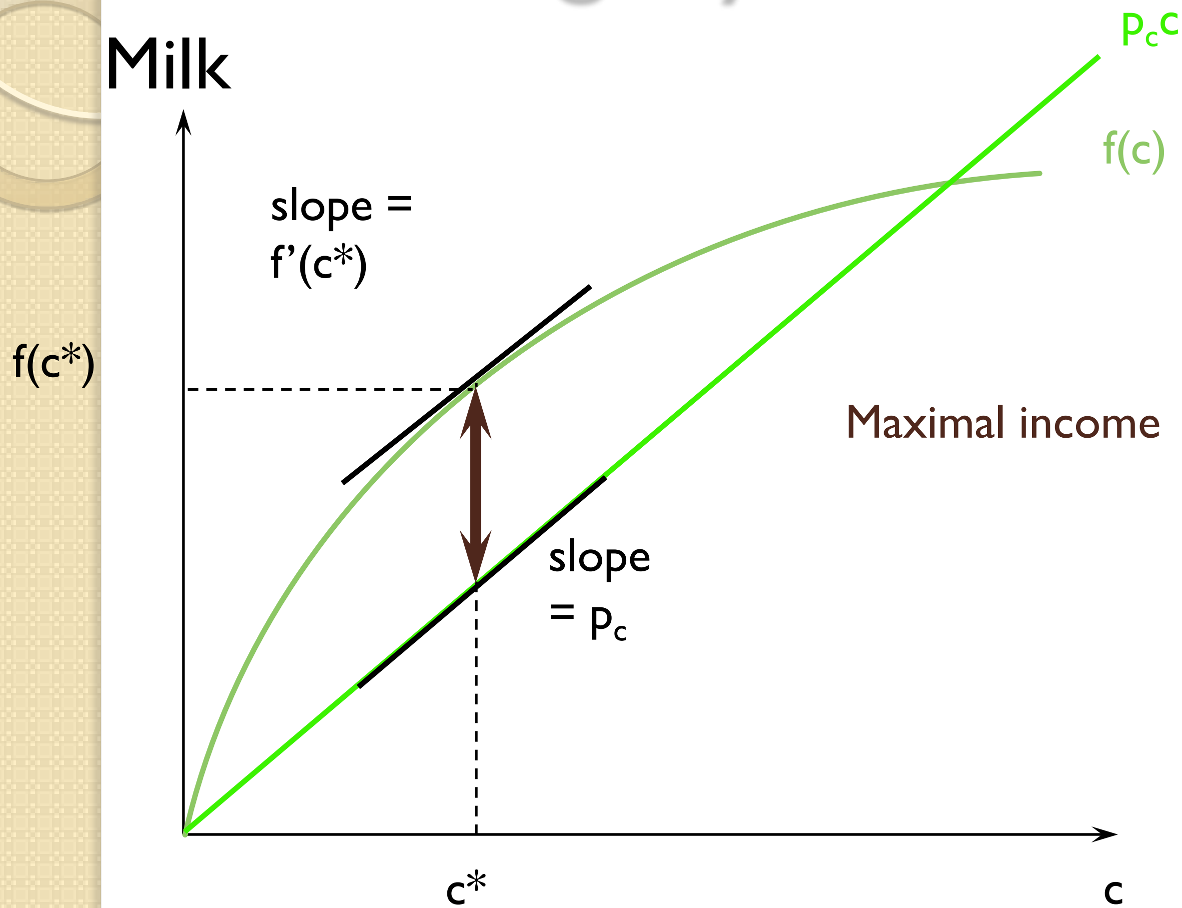
$$f'(c) = p_c$$

i.e. the *marginal* income gain from the last cow grazed must equal the *marginal* cost of grazing it.

The Tragedy of the Commons



The Tragedy of the Commons



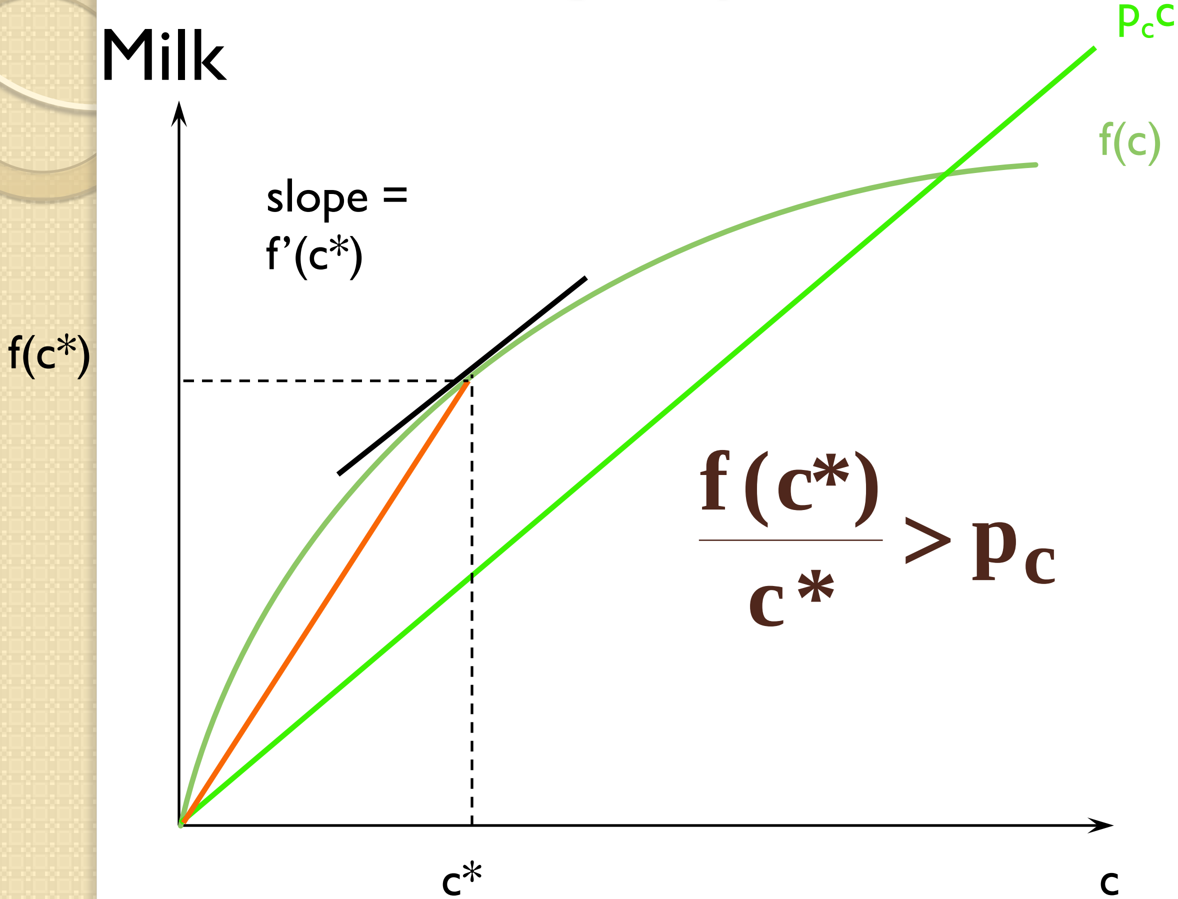
The Tragedy of the Commons

- For c = c*, the average gain per cow grazed is

$$\frac{\Pi(c^*)}{c^*} = \frac{f(c^*) - p_c c^*}{c^*} = \frac{f(c^*)}{c^*} - p_c > 0$$

because f’ > 0 and f’’ < 0.

The Tragedy of the Commons



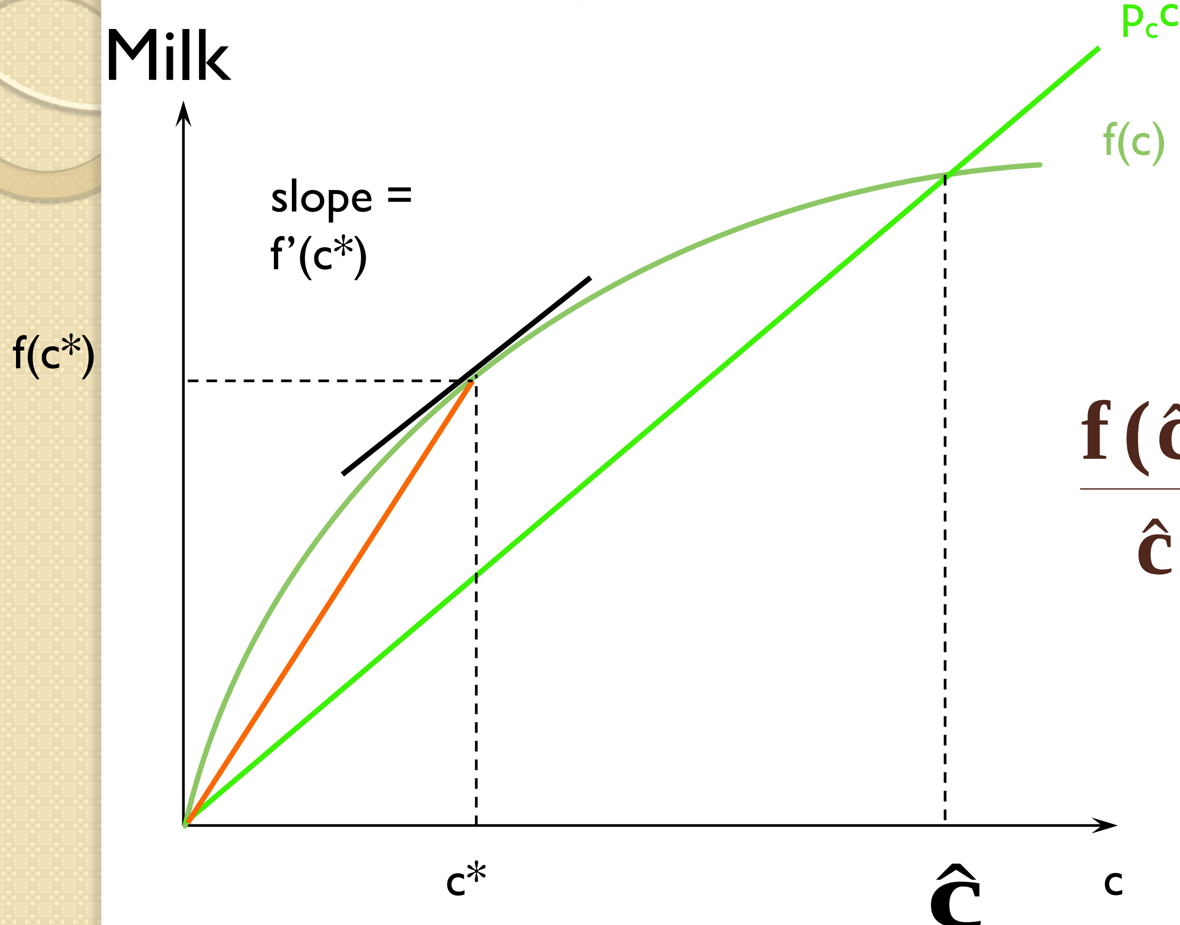
$$\frac{f(c^*)}{c^*} > p_c$$

The Tragedy of the Commons

- If the commons are collectively owned, then nobody owns the commons, and entry is not restricted
- Entry continues until the economic profit of grazing another cow is zero; that is, until

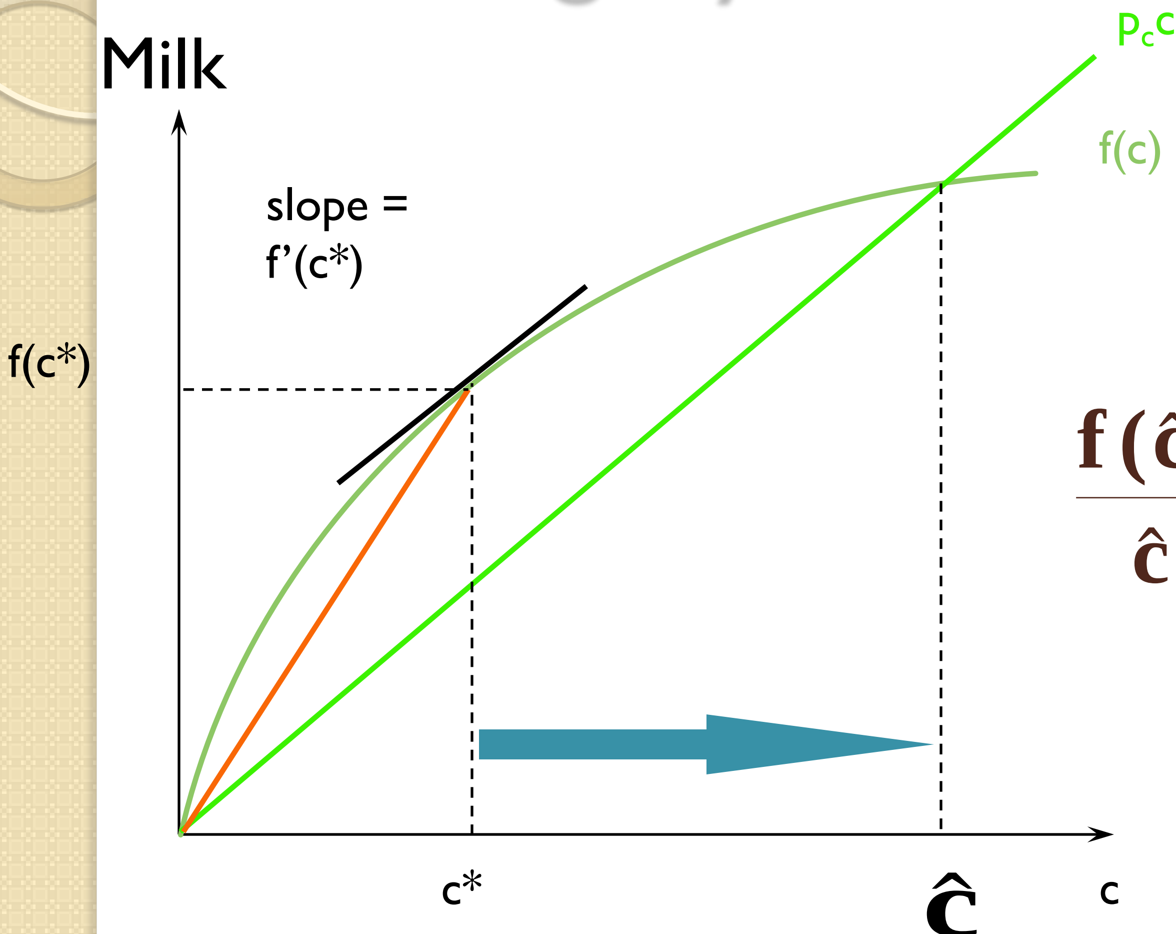
$$\frac{\Pi(c)}{c} = \frac{f(c) - p_c c}{c} = \frac{f(c)}{c} - p_c = 0.$$

The Tragedy of the Commons



$$\frac{f(\hat{c})}{\hat{c}} = p_c$$

The Tragedy of the Commons



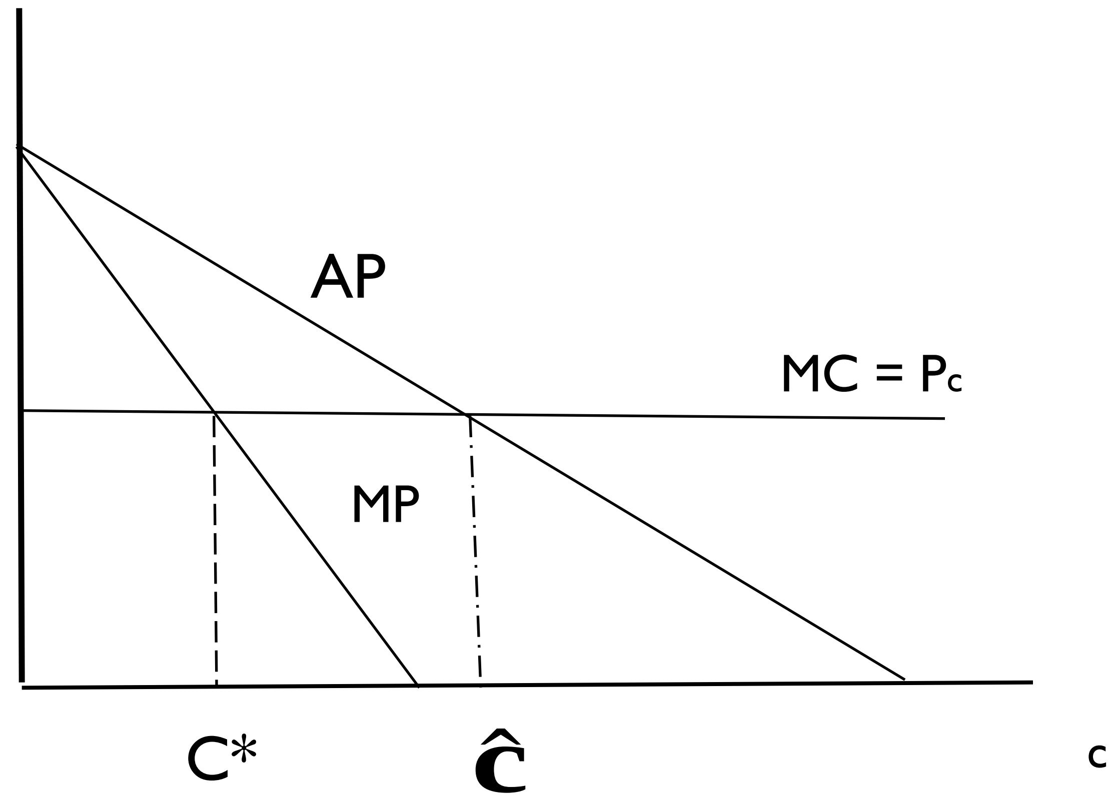
$$\frac{f(\hat{c})}{\hat{c}} = p_c$$

The commons are over-grazed, tragically.

The Tragedy of the Commons

- The reason for the tragedy is that when a villager introduces one more cow, that villager's income increases (by $f(c)/c - p_c$) but every other villager's income falls.
- *The villager who introduces the extra cow takes no account of the negative externality inflicted upon the rest of the village*
- Note that **f'(c) in the private ownership is net added value of an additional cow, taking into account of externality**

The Tragedy of the Commons



The Tragedy of the Commons

- Modern-day "tragedies of the commons" include
  - over-fishing the high seas
  - over-logging forests on public lands
  - urban traffic congestion
  - AA-system in eating out plan
  - Excessive birth rates in developing countries
  - Moving bandits vs. stationary bandits
  - Too many checkpoints on the freeway

More on Coase Theorem and Externality

- Coase theorem is valid under the assumption of zero transaction costs
- When transaction costs are non-zero, then the assignment of property rights is critical
- Coase theorem lays the foundation for economics of property rights
- Externality includes positive externality (innovation and good peers) and negative externality
- In any case, externality may lead to Pareto inefficiency due to the divergence of private costs and social costs

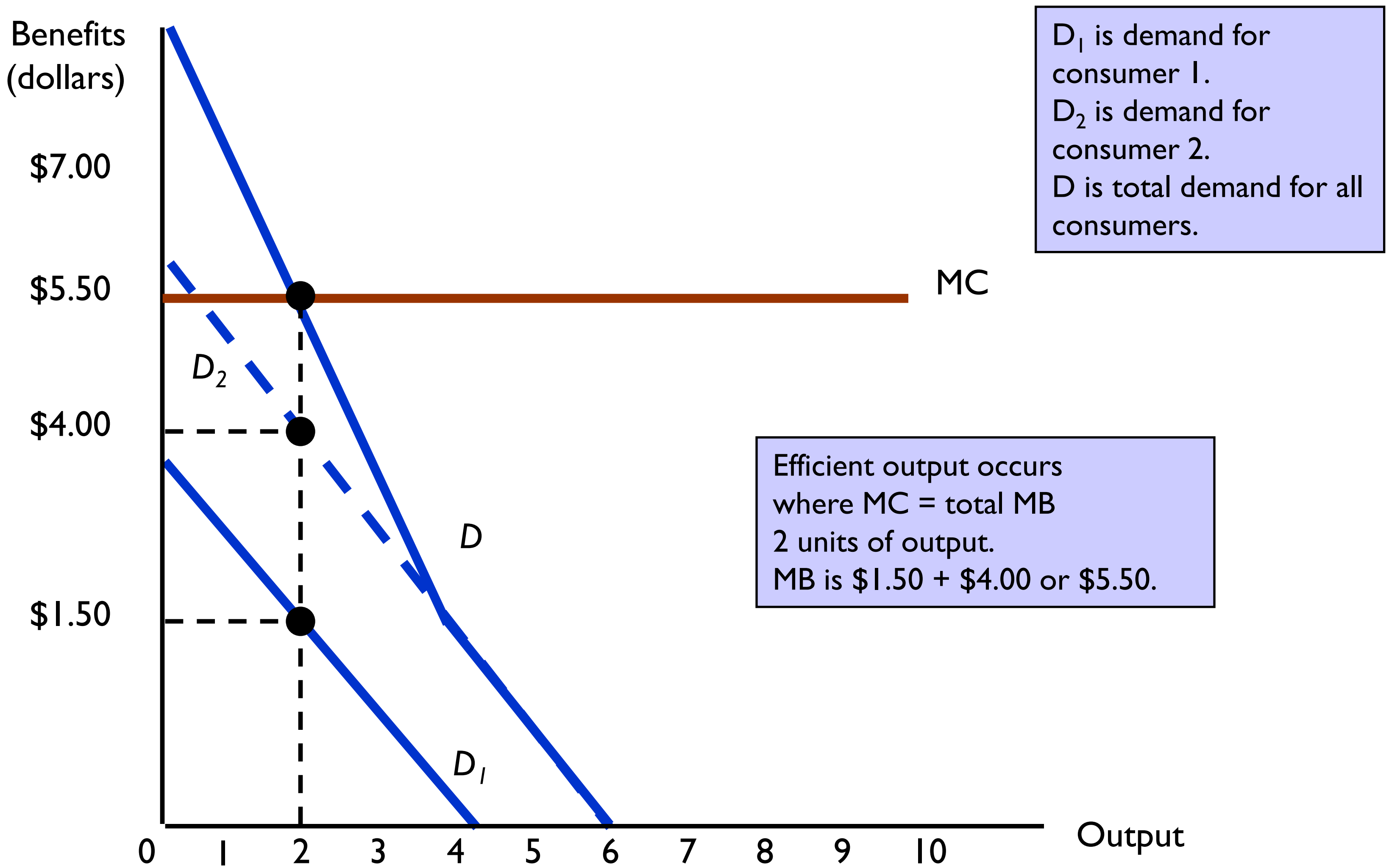
Public Goods

- Non-rivalry in consumption: marginal cost of additional consumption of the same unit of public goods is zero
- Nonexclusive
  - Goods that people cannot be excluded from consuming, so that it is difficult or impossible to charge for their use
  - Example: fireworks, national defense

Efficiency and Public Goods

- Efficient level of private good is where marginal benefit equals marginal cost
- For a public good, the value of **each person** must be considered
  - Can add demand of all those who value good
  - Vertical aggregation of demand curves
- Must equate the sum of these marginal benefits to the marginal cost of production

Efficient Public Good Provision



Public Goods and Market Failure

- Free Riders
  - Households do not have the incentive to pay what the item is worth to them
  - Free riders understate the value of a good or service so that they can enjoy its benefit without paying for it

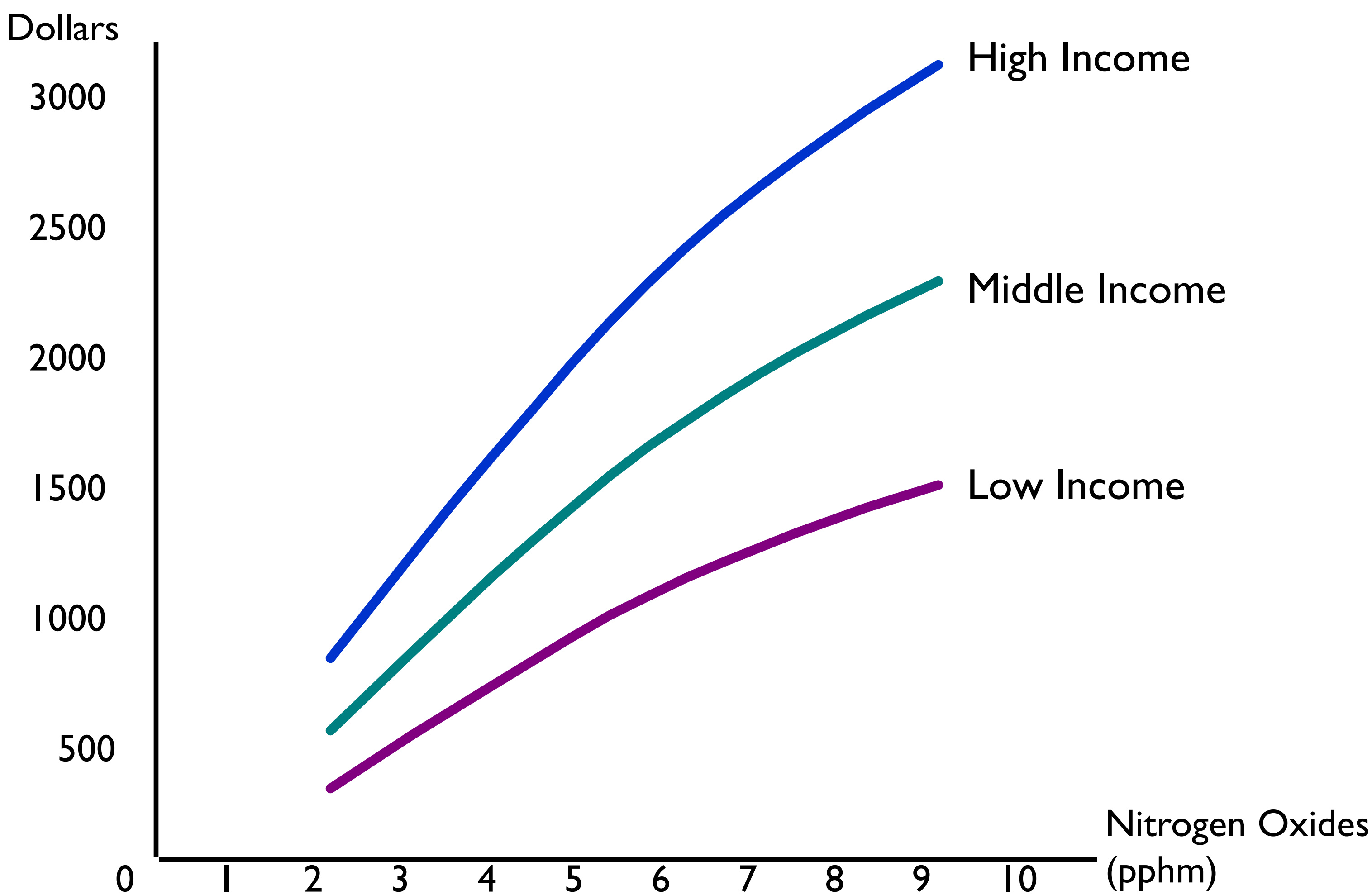
The Demand for Clean Air

- Clean Air is a public good
  - Nonexclusive and nonrival
  - No market and no observable price at which people are willing to trade clean air for other goods

The Demand for Clean Air

- Choosing where to live
  - Some study correlates housing prices in Boston with the quality of air and other characteristics of the houses and their neighborhoods

The Demand for Clean Air



The Demand for Clean Air

- Findings
  - The amount of people who are willing to pay for clean air increases substantially as pollution increases
  - Higher income earners are willing to pay more (the gap between the demand curves widen)
  - National Academy of Sciences found that a 10% reduction in auto emissions yielded a benefit of $2 billion---somewhat greater than the cost

Private Preferences for Public Goods

- Government production of a public good is advantageous because the government can assess taxes or fees to pay for it
- Determining how much of a public good to provide when free riders exist is difficult

Private Preferences for Public Goods

- Can represent different citizens' willingness to pay for education minus any required tax payments
- In general, benefit from increased spending on education increases as spending increases
- Tax payments to provide more education increase as well

期末考试

- 1月7日晚上7点－9点
- 试卷为中文；考试范围为所有课堂内容
- 题型：分析计算题，与平时作业相同
- 答题写下关键性步骤
- 第五次作业7日考试时提交