General Equilibrium and Economic Efficiency

EE311

Topics to be Discussed

- General Equilibrium Analysis
  - Efficiency in Exchange
    - Equity and Efficiency
    - Social welfare function
  - Efficiency in Production
  - Efficiency in Combination of Product
- The Efficiency of Competitive Markets
- Why Markets Fail

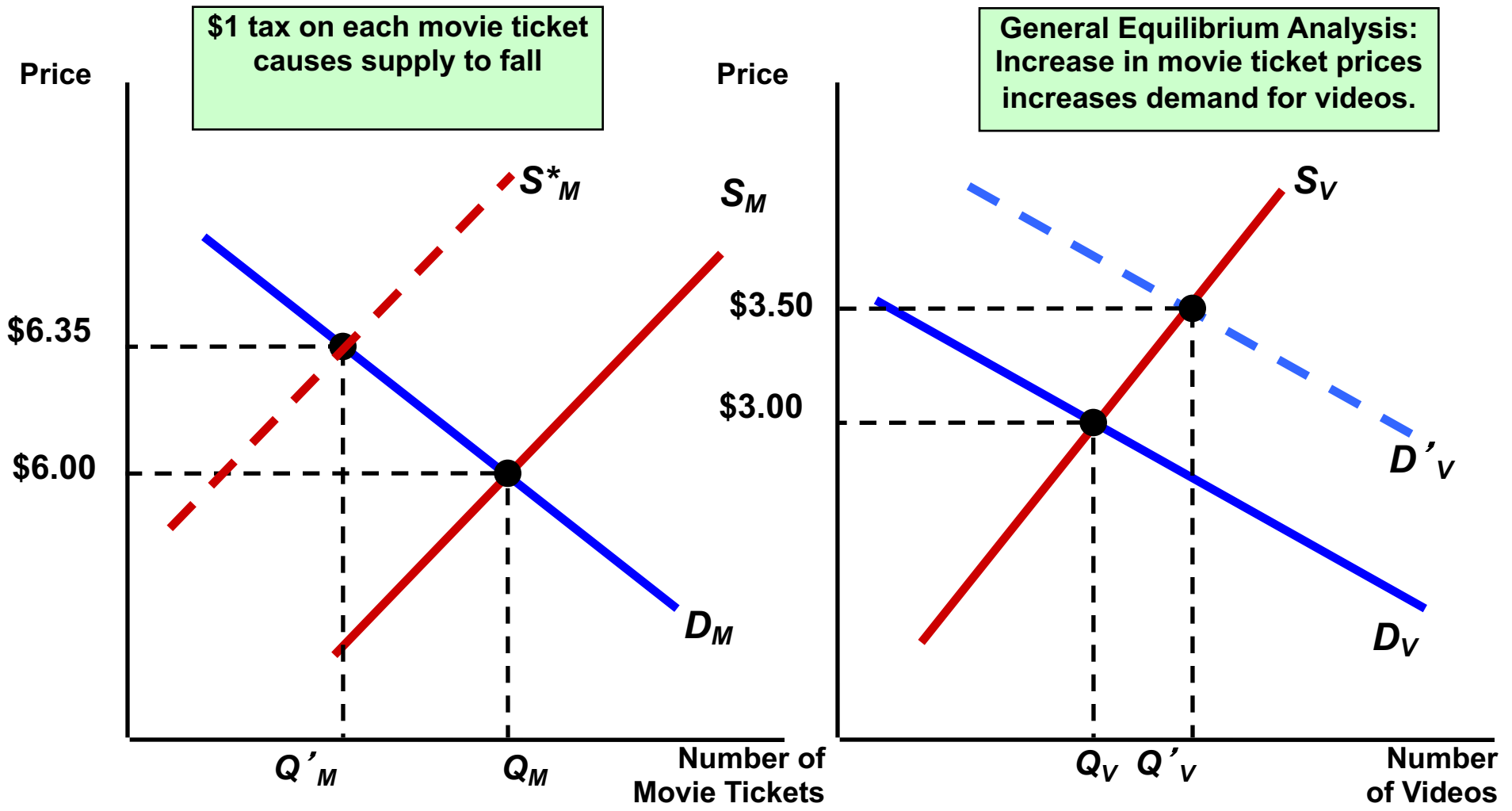
General Equilibrium Analysis

- Up to this point, we have been focused on partial equilibrium analysis
  - Activity in one market is 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

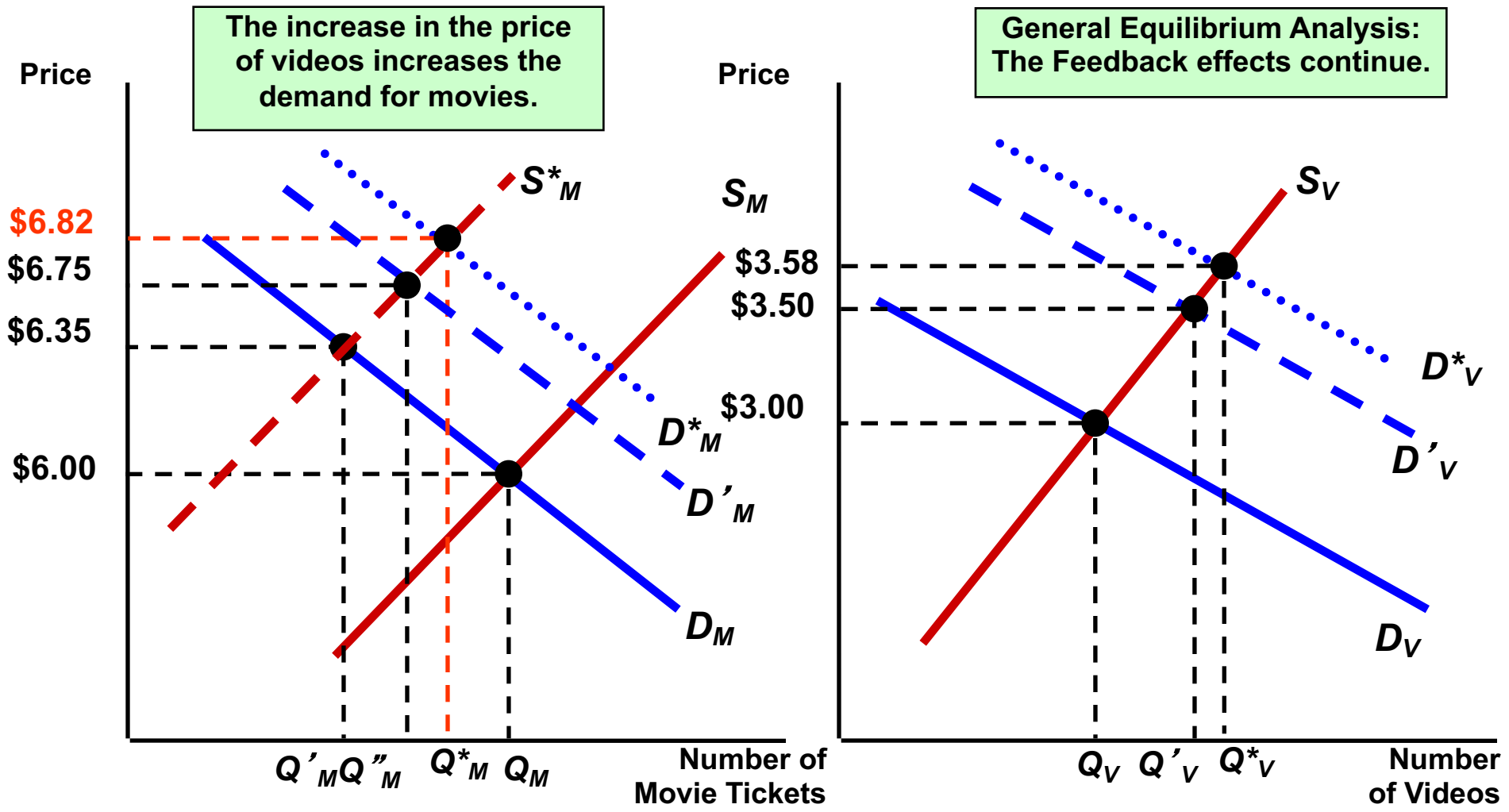
General Equilibrium Analysis

- 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

Two Interdependent Markets – Movies and DVDs



Two Interdependent Markets – Movies and DVDs



Two Interdependent Markets – Movies and DVDs

- Observation
  - Without considering the feedback effect with general equilibrium, the impact of the tax would have been *underestimated*
  - This is an important consideration for policy makers.
- You can check for yourself that in the market for complements, the tax would be overestimated

General Equilibrium Analysis

- General equilibrium in exchange
- General equilibrium in production
- General Equilibrium in Combination of Product

Efficiency concept

- The main objective of general equilibrium analysis is to find the most efficient allocation.
- Pareto improvement: an allocation of goods that at least one is made better off without making someone else worse off.
- Pareto efficiency: An efficient allocation of goods is one where no one can be made better off without making someone else worse off

I. General equilibrium in exchange

- Assumptions
  - Two consumers (countries)
  - Two goods
  - Both people know each others preferences
  - Exchanging goods involves zero transaction costs
  - James & Karen have a total of 10 units of food and 6 units of clothing.
  - Each may trade to maximize his or her utility
  - Their utilities are independent.

General equilibrium in exchange

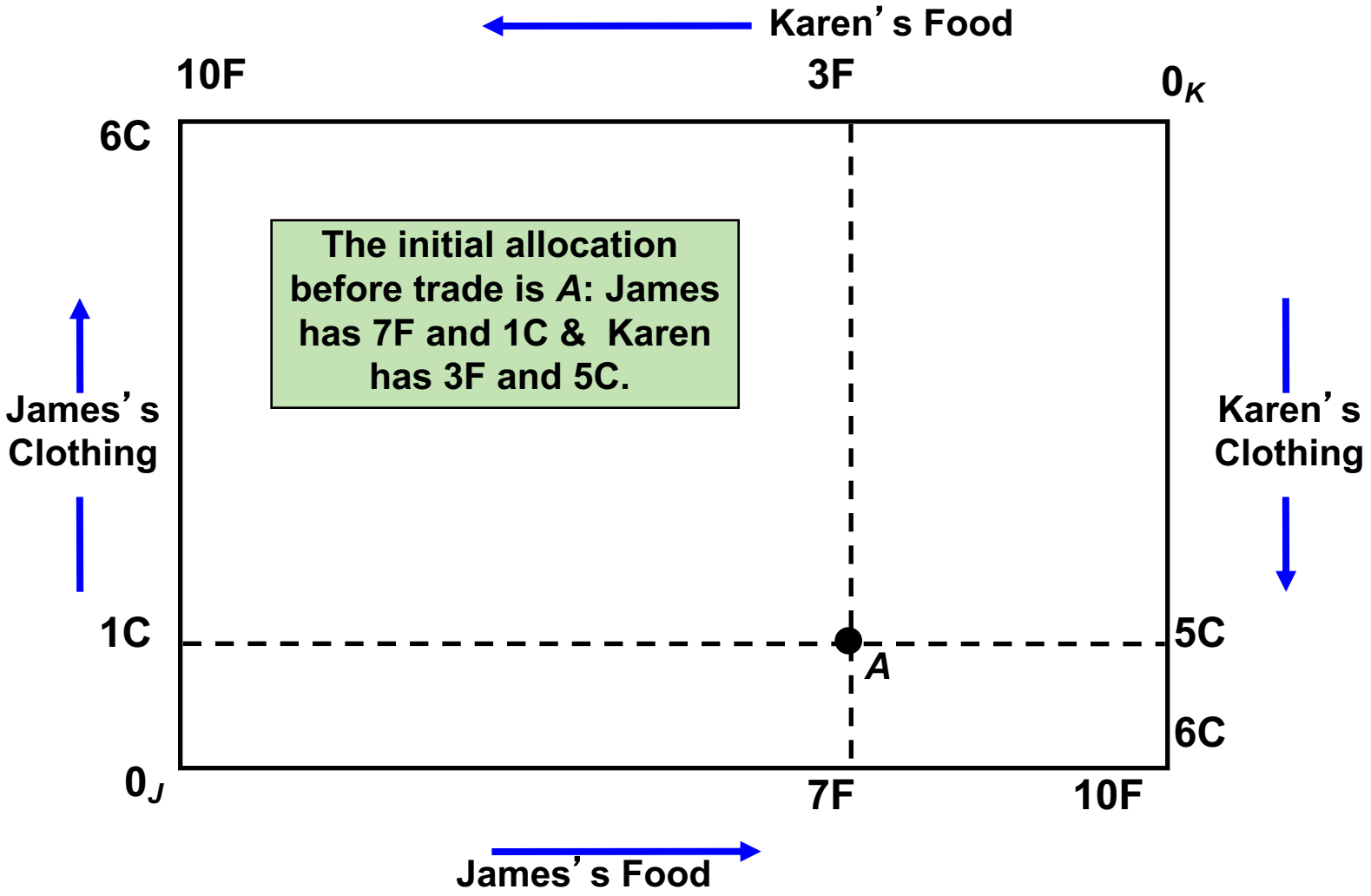
Individual	Initial Allocation	Trade	Final Allocation
James	7F, 1C	-1F, +1C	6F, 2C
Karen	3F, 5C	+1F, -1C	4F, 4C

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

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
- The Edgeworth Box diagram come from combining two indifference curves or isoquant diagrams. One is turn 180^{O} to form a box with the dimension of the total endowments.

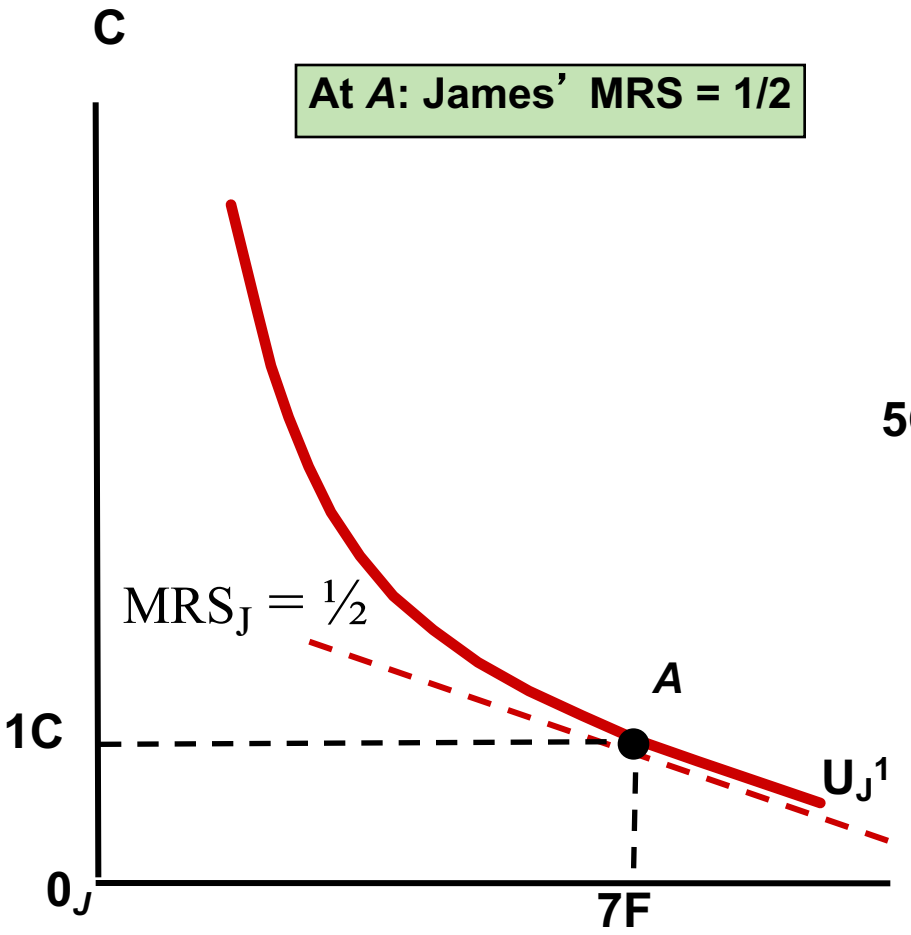
Exchange in an Edgeworth Box

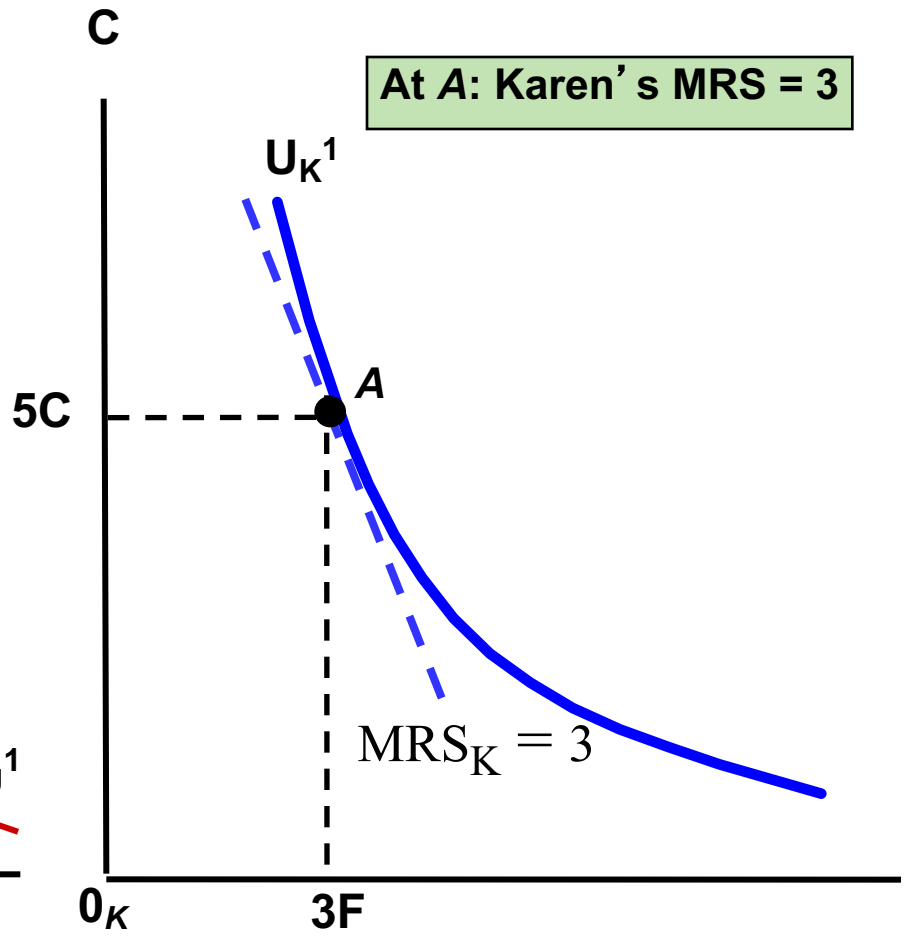


General equilibrium in exchange

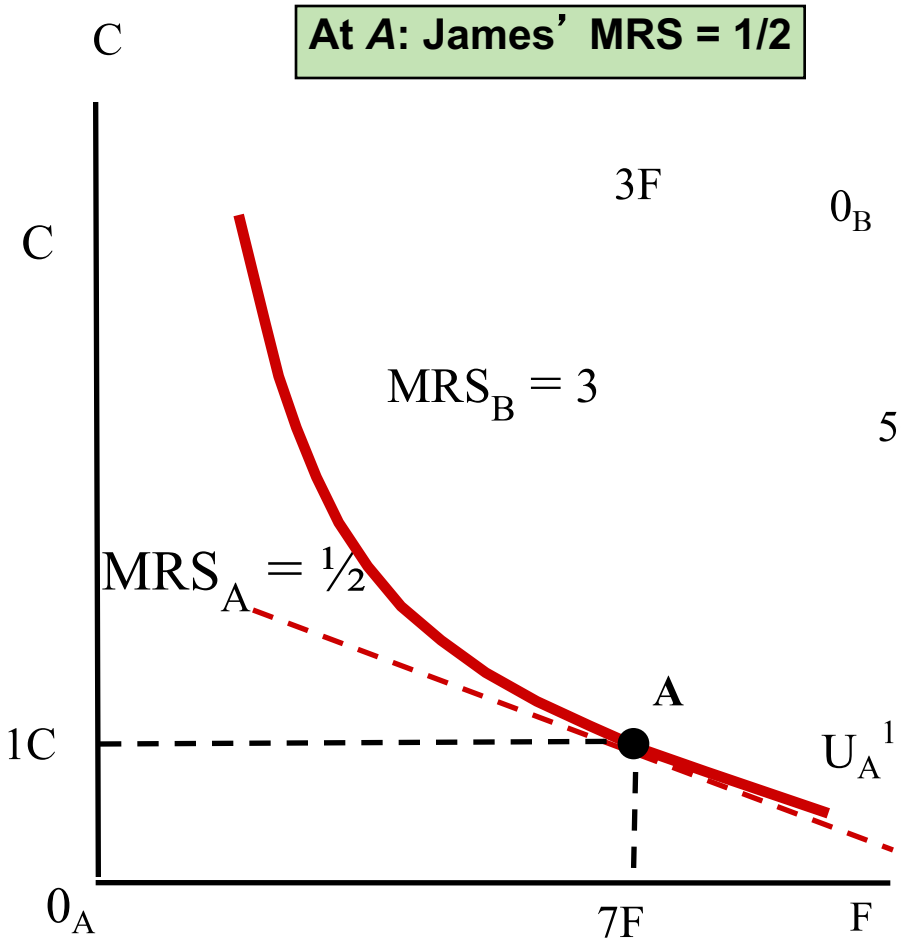
- Karen has a lot of clothing and little food.
  - Suppose MRS of food for clothing is 3
  - To get 1 unit of food, she will give up 3 units of clothing ->she likes food more
- Suppose James' MRS of food for clothing is only ½
  - He will give up ½ unit if clothing for 1 unit of food ->he likes clothing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

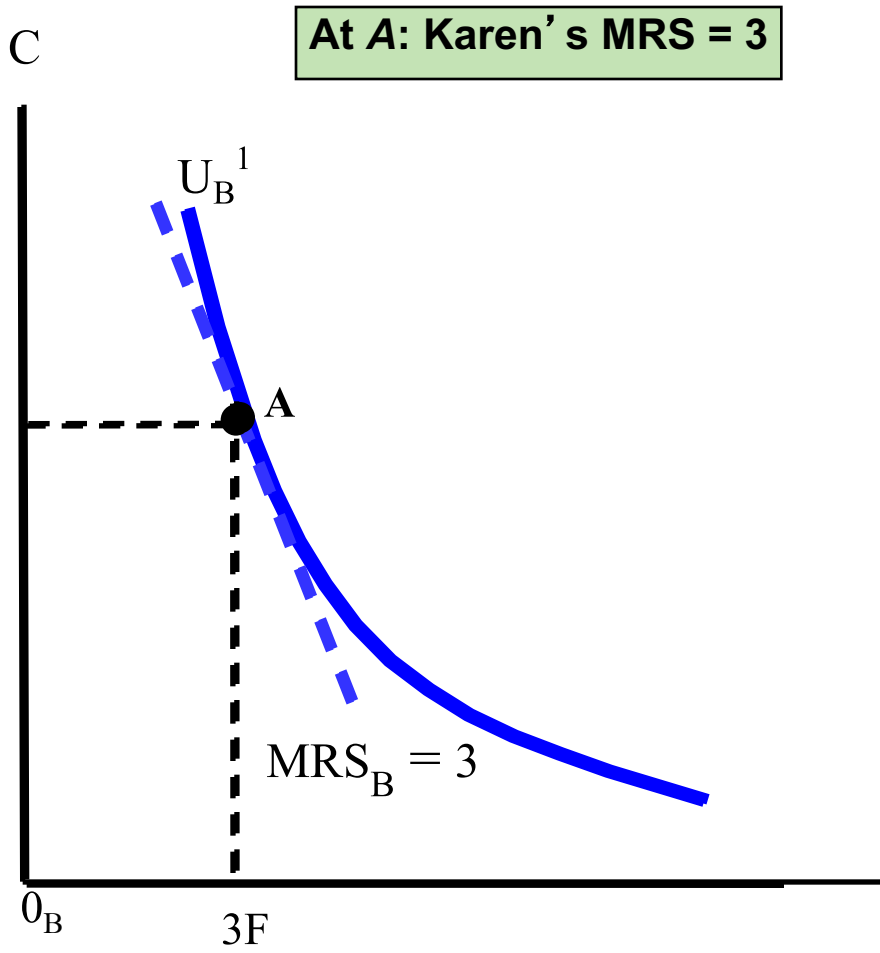
Comparing preferences





Comparing preferences

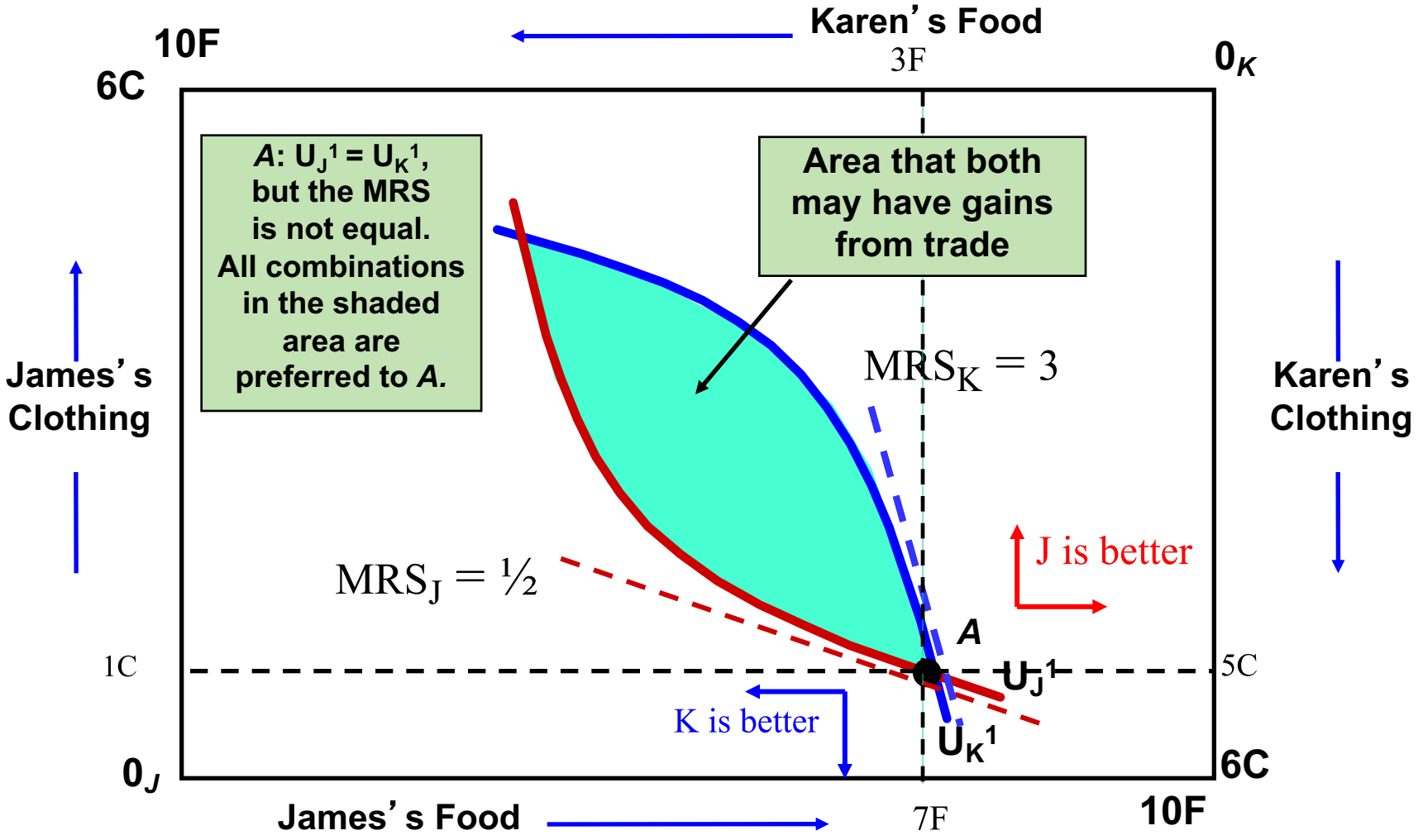




General equilibrium in exchange

- The initial allocation A is not efficient
- There is room for trade
  - James values clothing more than Karen
  - Karen values food more than James
  - Karen 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

Efficiency in Exchange



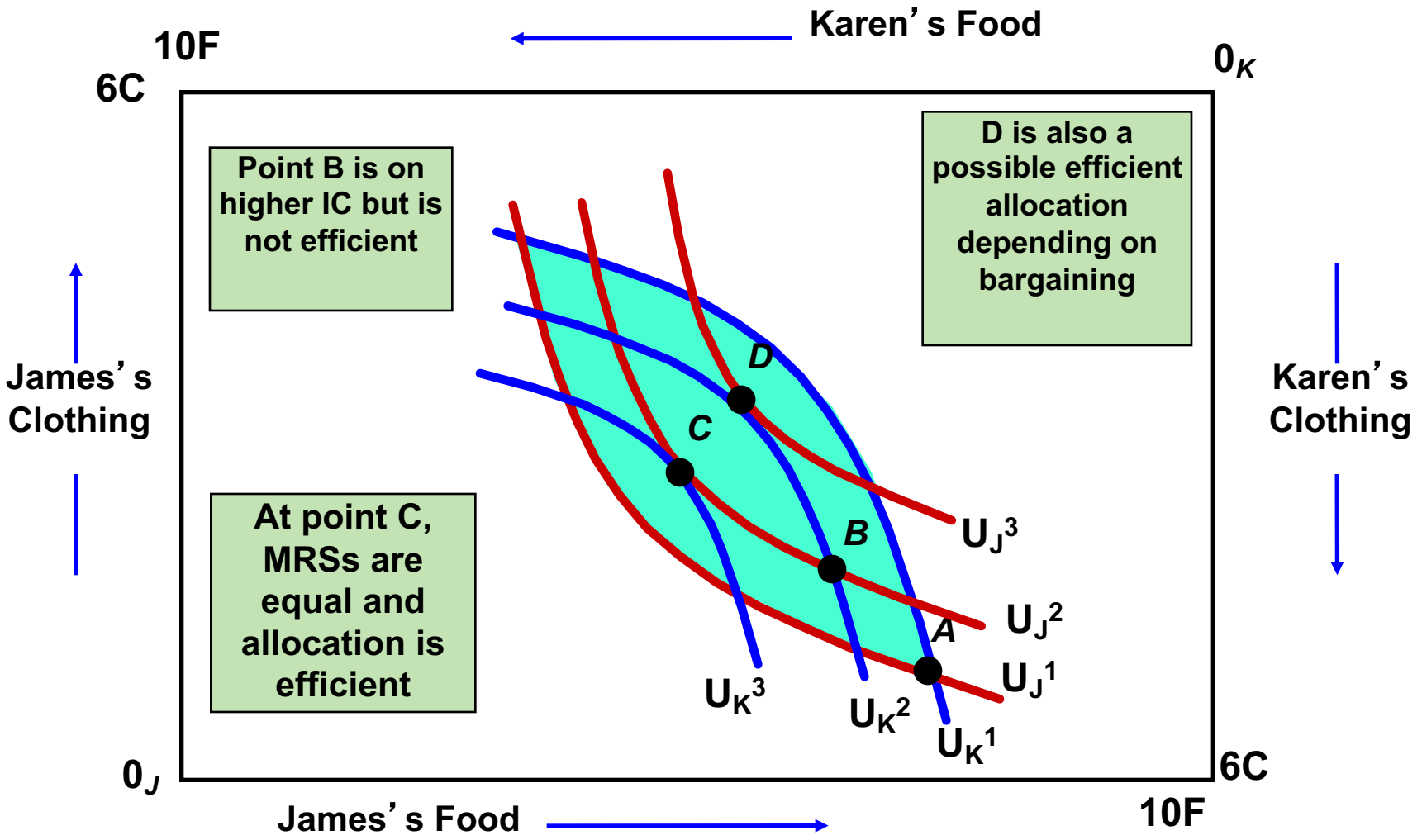
Exchange that mutually increase welfare

- Welfare for both will be improved when:
- Both sides want to exchange to achieve highest utilities
- Indifference curves have the normal properties; e.g., negative slope, convex to the origin, never cross
- More is preferred to less
- Independent preferences: welfare of each individual is independent form others

Efficient Allocations

- The shaded area between these two indifference curves represents all the possible allocations of food and clothing that would make both James and Karen better off than A
  - Describes all mutually beneficial trades
  - or all Pareto improvement from A
- The allocation of resources will be optimal when MRS of every one is the same

Efficiency in Exchange



Efficient Allocations

- We can see both parties are better off at point B since they both end up on a higher indifference curve
  - Not efficient since MRSs different – indifference curve have different slopes
- Although a trade might make both parties **better off**, the new allocation is not necessarily efficient

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

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.

Consumer Equilibrium in a Competitive Market

- Assumptions
- There are many James*es* and Karen*s*.
- They are price takers
- Assuming that the relative price of food and clothing = 1
  - Trade depends on relative prices, not absolute prices

Economic Efficiency of Competitive Markets

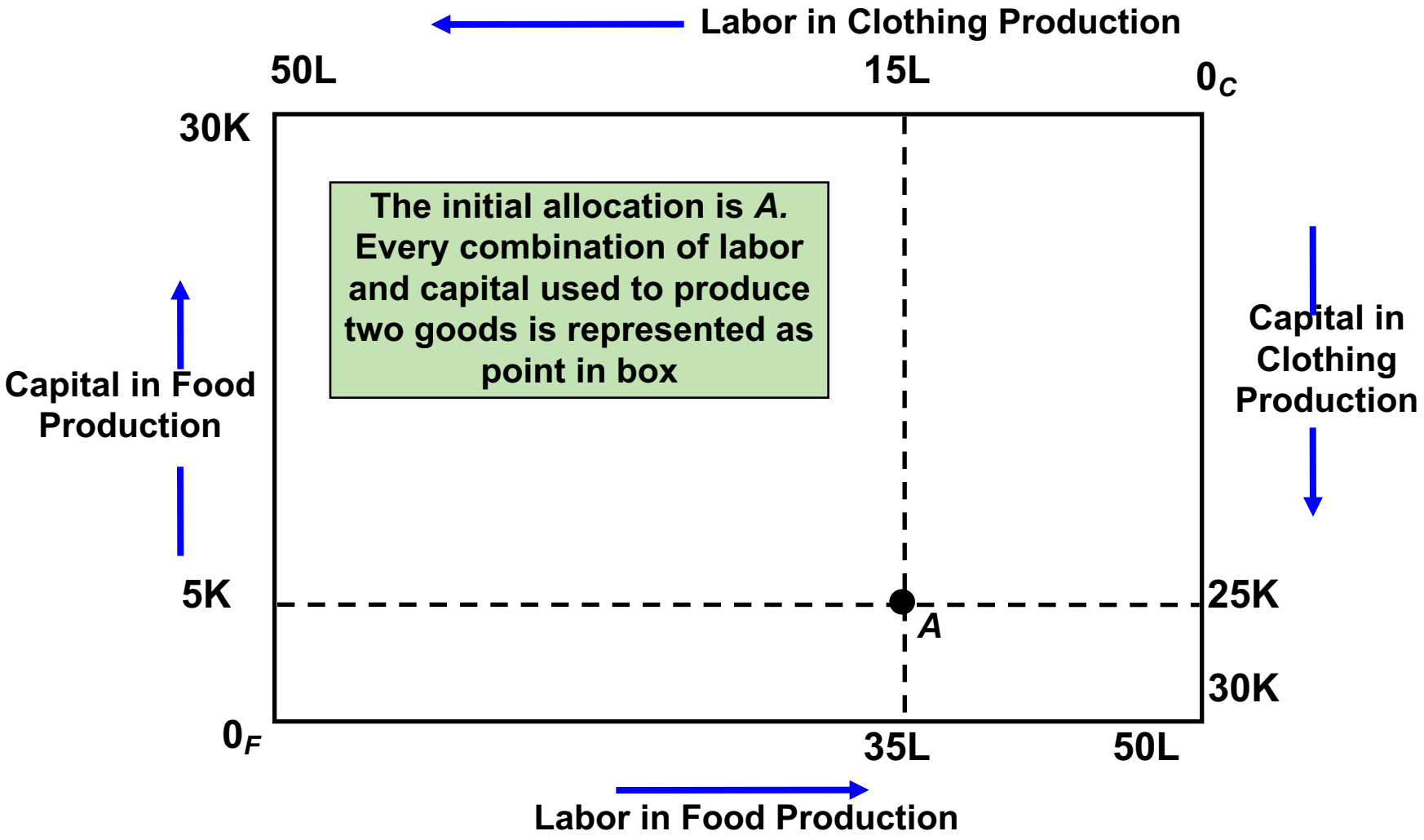
- As shown before, we can see that the allocation in a competitive equilibrium is economically efficient
  - The efficient point must occur where the two indifference curves are tangent
  - If not, one of the consumers can increase their utility and be better off

$$\left|MRS_{FC}^{A}\right| = \left|MRS_{FC}^{B}\right| = \frac{P_F}{P_C}$$

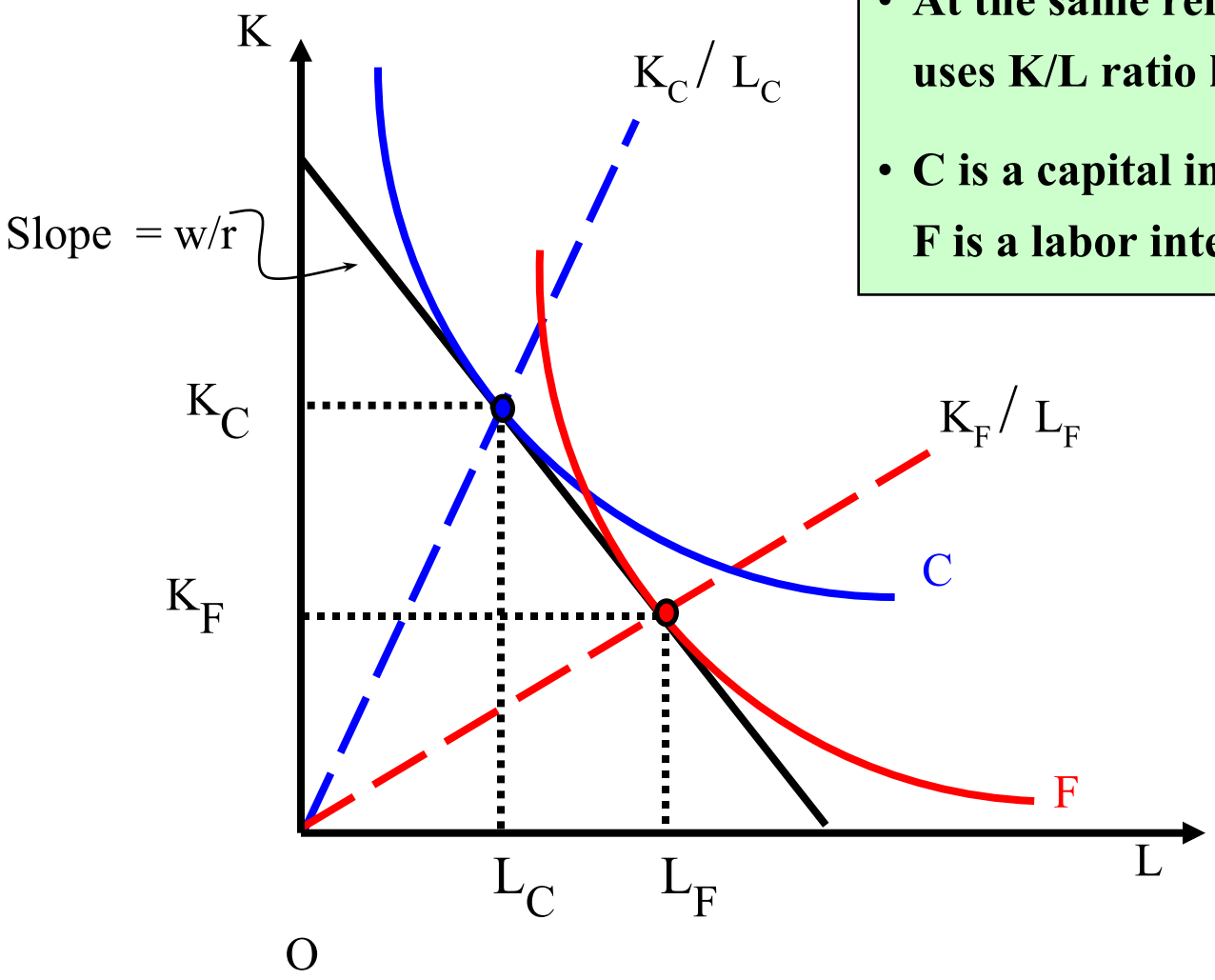
II. General equilibrium in in Production

- Using the Edgeworth box diagram, we can show efficient use of inputs in production
  - Two fixed inputs: capital and labor
  - Produce same two goods: food and clothing
  - Labor on horizontal axis
  - Capital on vertical axis
  - 50 hours of labour and 30 hours of capital available
  - Each origin is an output

Production in an Edgeworth Box

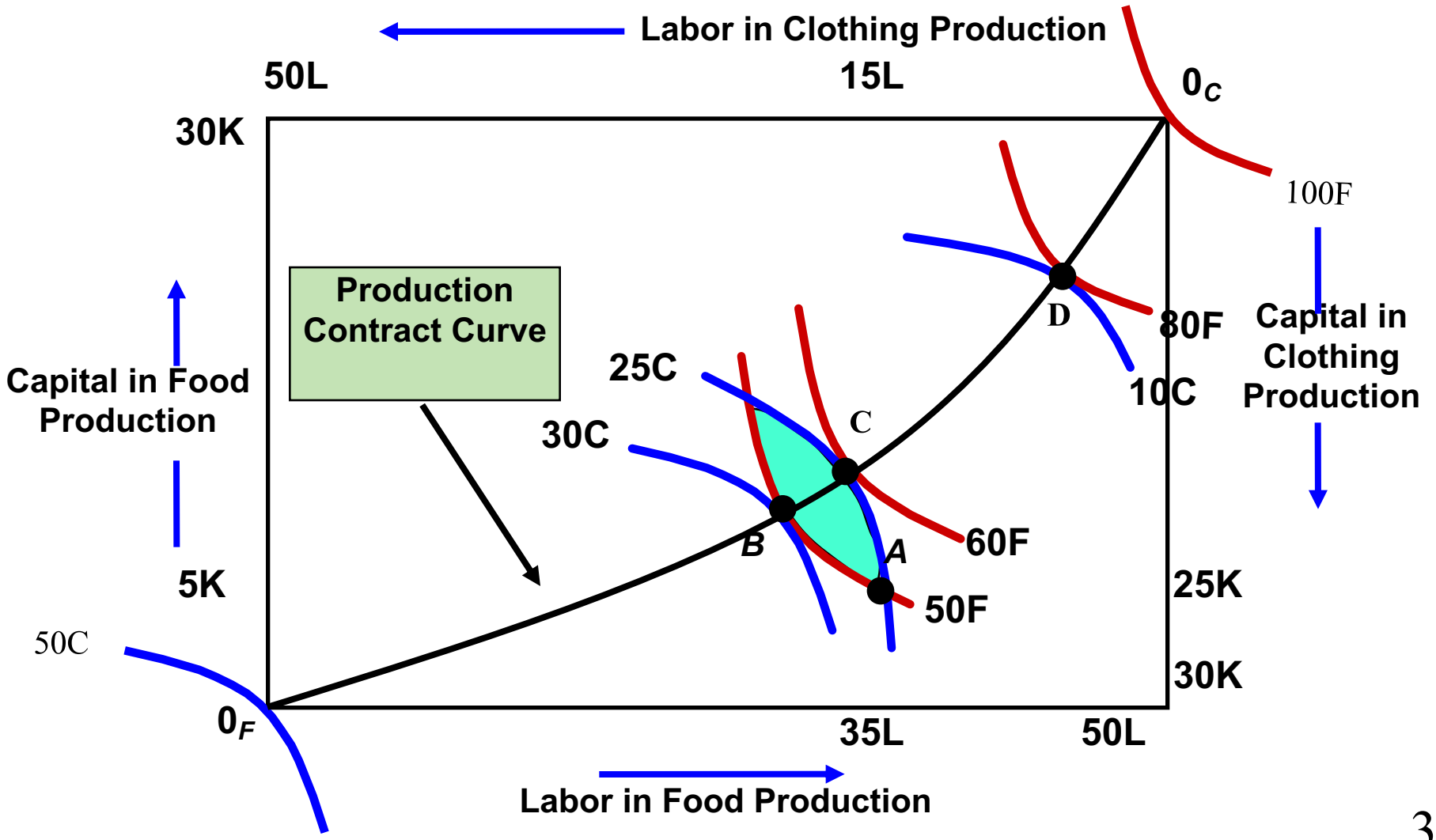


Edgeworth Box for Production



- **At the same relative factor price, C uses K/L ratio higher than F**
- **C is a capital intensive good; while F is a labor intensive good**

Production in an Edgeworth Box



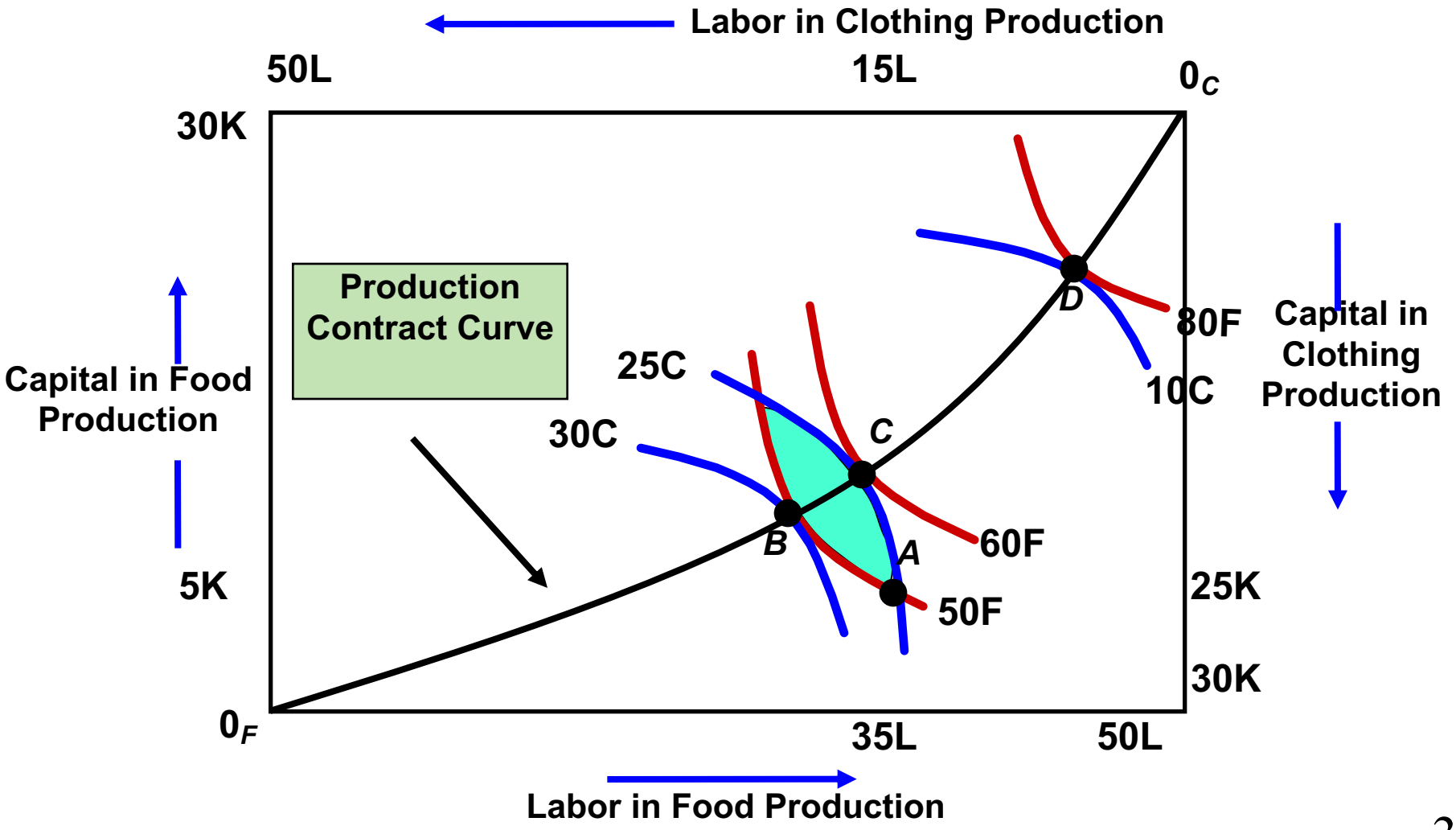
Production in an Edgeworth Box

- 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 goods
- 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

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

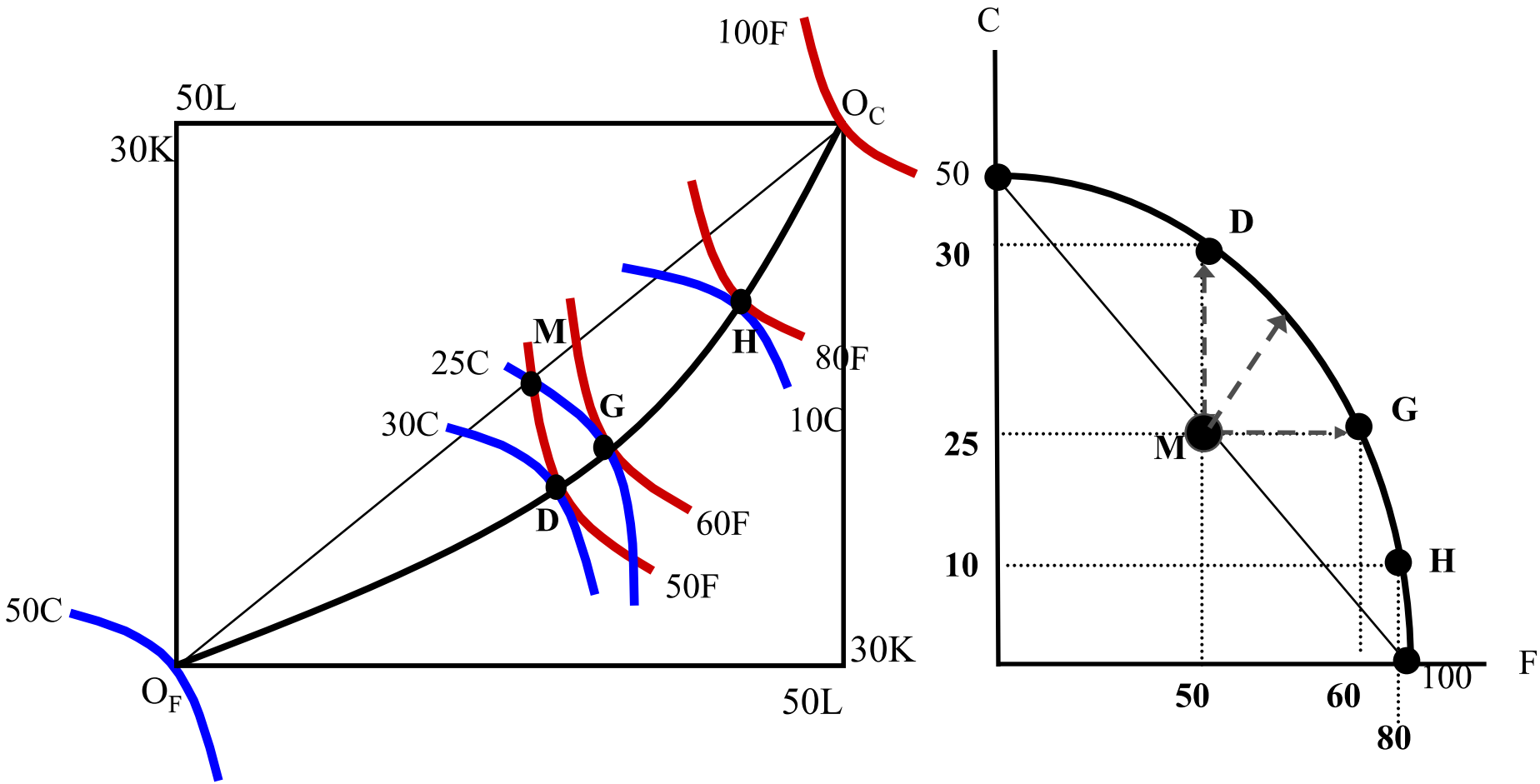
- If input markets are competitive, an efficient point will be achieved
- In competitive input markets
  - Wage rate, *w*, will be equal in all industries
  - Rental rate of capital, *r*, will be equal in all industries
- To minimize cost, each firm will mix inputs until

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

Production Possibilities Curve (PPC)

- PPC shows the various combinations of two goods that can be produced with fixed quantities of inputs.
- PPC is derived from the production contract curve
- Points on PPC show efficiently produced levels of both goods
- Points underneath the PPC show inefficient combination of inputs or under utilisation of resources

Production Possibilities Curve



Production Possibilities Curve

- PPC is downward sloping
  - In order to produce more of one good, must give up producing some of the other good
- PPC is concave
  - Slope is the MRT which increases as the level of production of food increases
  - The inputs release from one good do not fit the input intensity of the other good
  - Capital-intensive C releases more K and less L than what Labor-intensive F needs

Marginal Rate of Transformation

- Marginal rate of transformation (MRT) of food for clothing is the magnitude of the slope of the frontier at each point
  - How much clothing must be given up to produce one additional unit of food
  - As we increase the production of food my moving along the PPC, the MRT increases
  - It is possible to prove that MRT is the ratio of MCs

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

Marginal Rate of Transformation

$$\text{MRT} = \frac{\Delta Y}{\Delta X} = \frac{\Delta Y / \Delta L_X}{\Delta X / \Delta L_X} = -\frac{\Delta Y / \Delta L_Y}{\Delta X / \Delta L_X}$$

The last term is true because $L = L_X + L_Y$. Thus,

$$\Delta L = \Delta L_X + \Delta L_Y = 0$$

$$\Delta L_X = -\Delta L_Y$$

$$\frac{\Delta Y}{\Delta X} = -\frac{\Delta Y / \Delta L_Y}{\Delta X / \Delta L_X} = -\frac{\Delta Y / \Delta wL_Y}{\Delta X / \Delta wL_X}$$

$$= -\frac{\Delta Y / \Delta TVC_Y}{\Delta X / \Delta TVC_X} = -\frac{1/MC_Y}{1/MC_X} = -\frac{MC_X}{MC_Y}$$

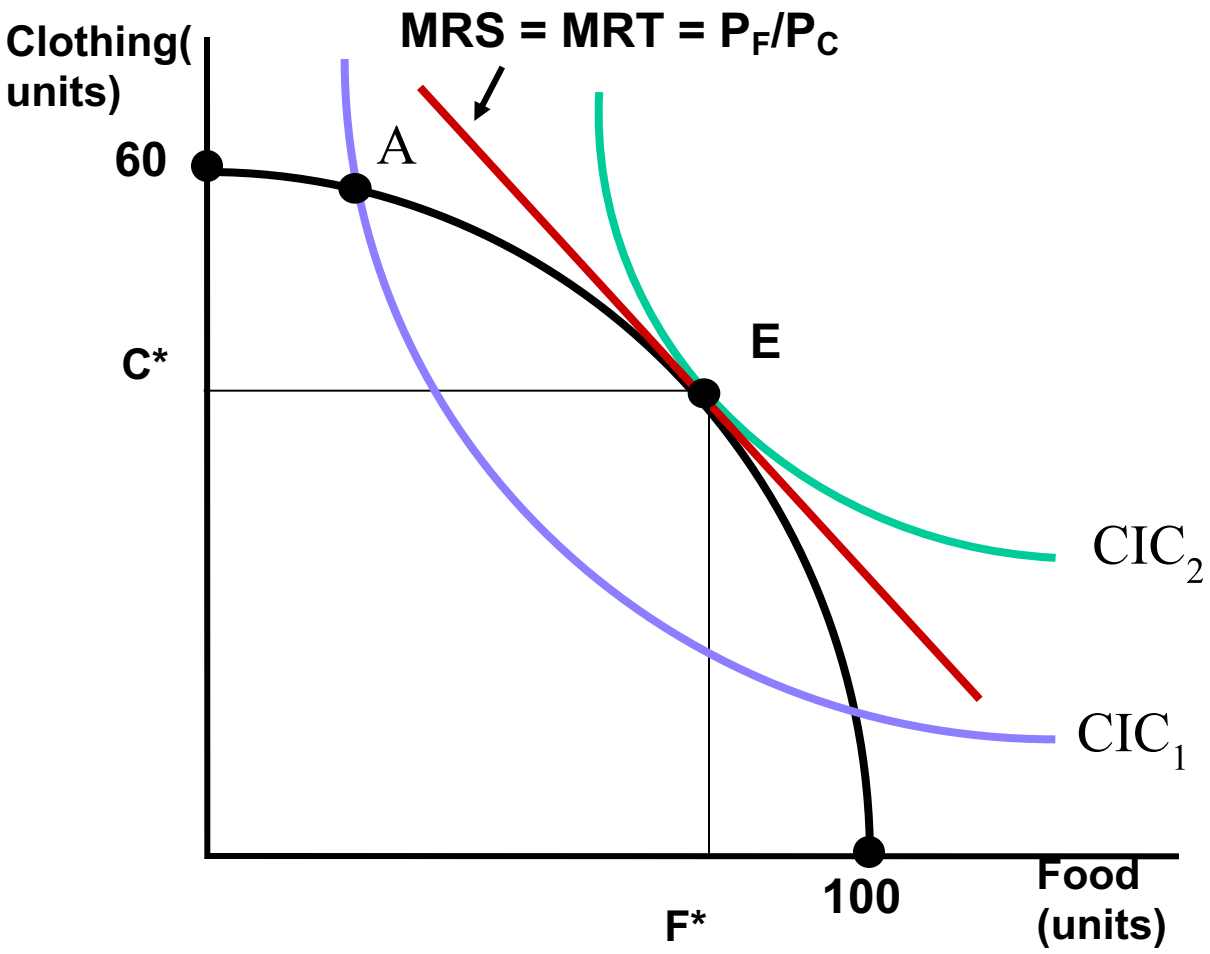
III. General equilibrium in Combination of Product

- 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

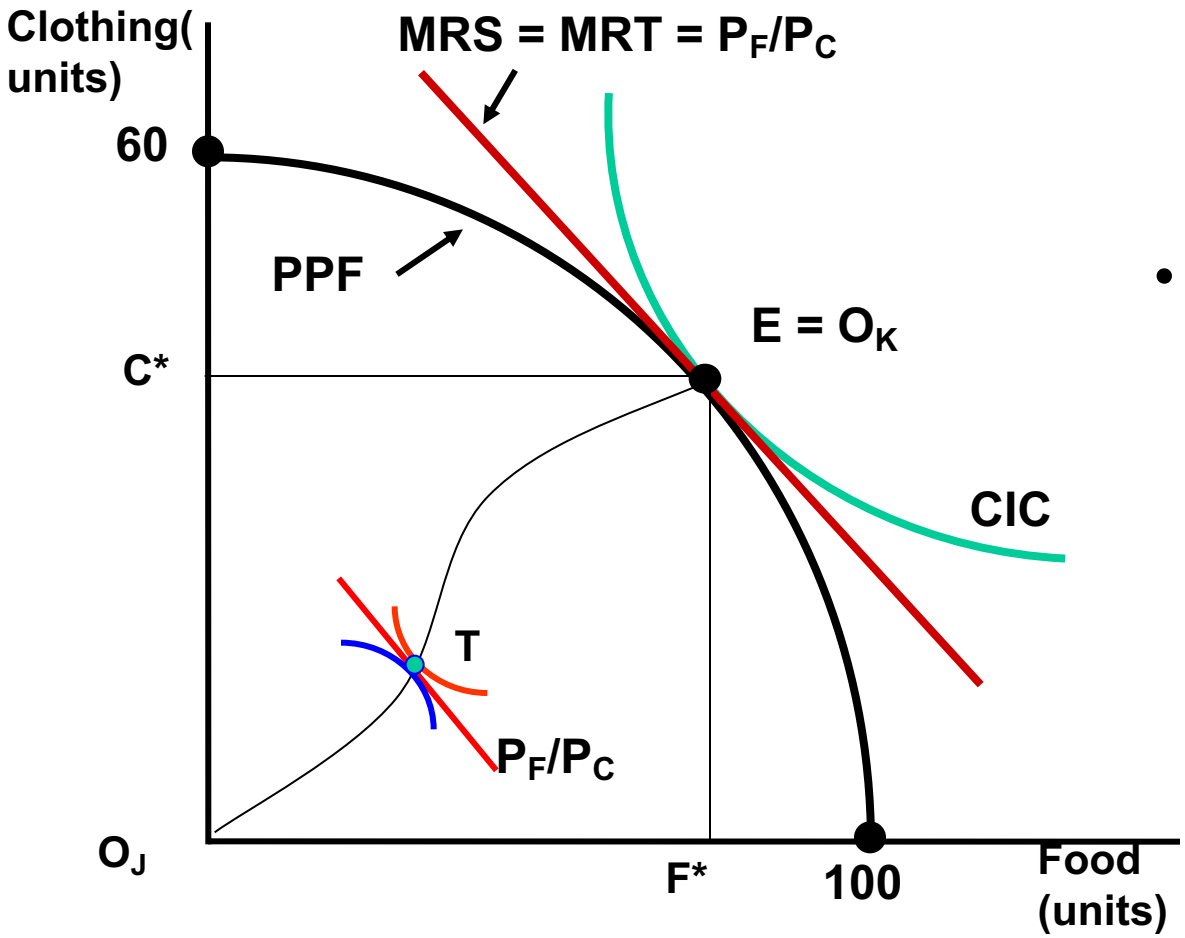
Combination of Product Efficiency

- What if MRT < or > 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 increase until two are equal again

Combination of Product Efficiency



Combination of Product Efficiency



- From the equilibrium point E, construct an Edgeworth Box for exchange from F^*, C^*
- There must be at least one allocation such as at point T that is Pareto efficient and has the same price ratio as point E

Combination of Product Efficiency

- In the competitive markets, all consumers allocate his or her budget between the two goods such that MRS = P_F/P_C
- Firms maximize profits at the point where P = MC, which cause MRT = $MC_F/MC_C = P_F/P_C$

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

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 combination of output
   - $MRT_{FC} = MRS_{FC}$ (for all consumers)
   - $P_F = MC_F$, $P_C = MC_C$ resulting in
   - $MRT_{FC} = MC_F/MC_C = P_F/P_C$; therefore
   - $MRS_{FC} = MRT_{FC}$

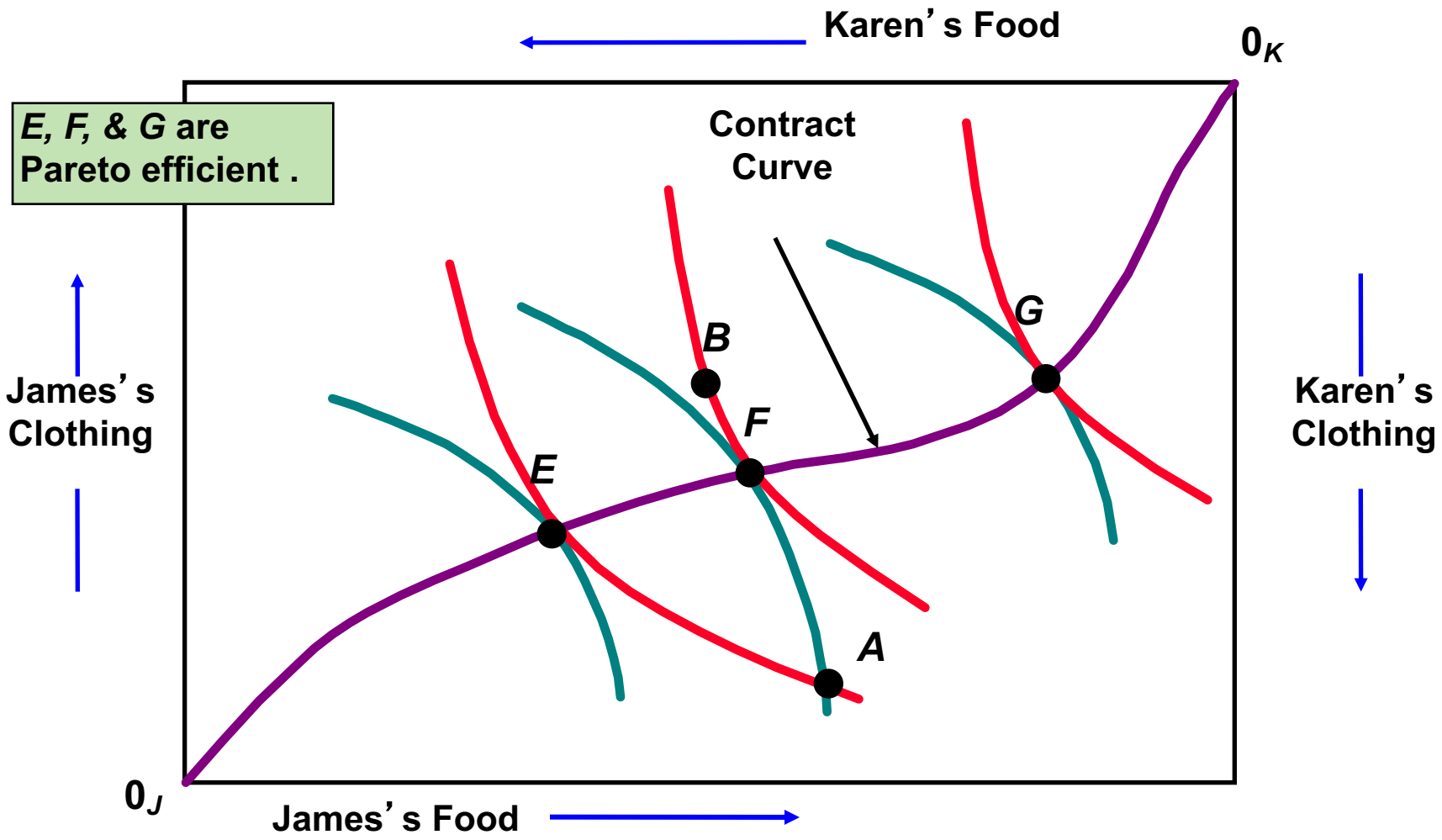
Welfare economics

- First Theorem of Welfare Economics
  - If everyone trades in a competitive market place, 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

Equity and Efficiency

- Although there are many efficient allocations, some may be fairer 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
- Example: Point B is more equitable than point E

Equity and Efficiency



Equity and Efficiency

- From previous example, we 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

Equity and Perfect Competition

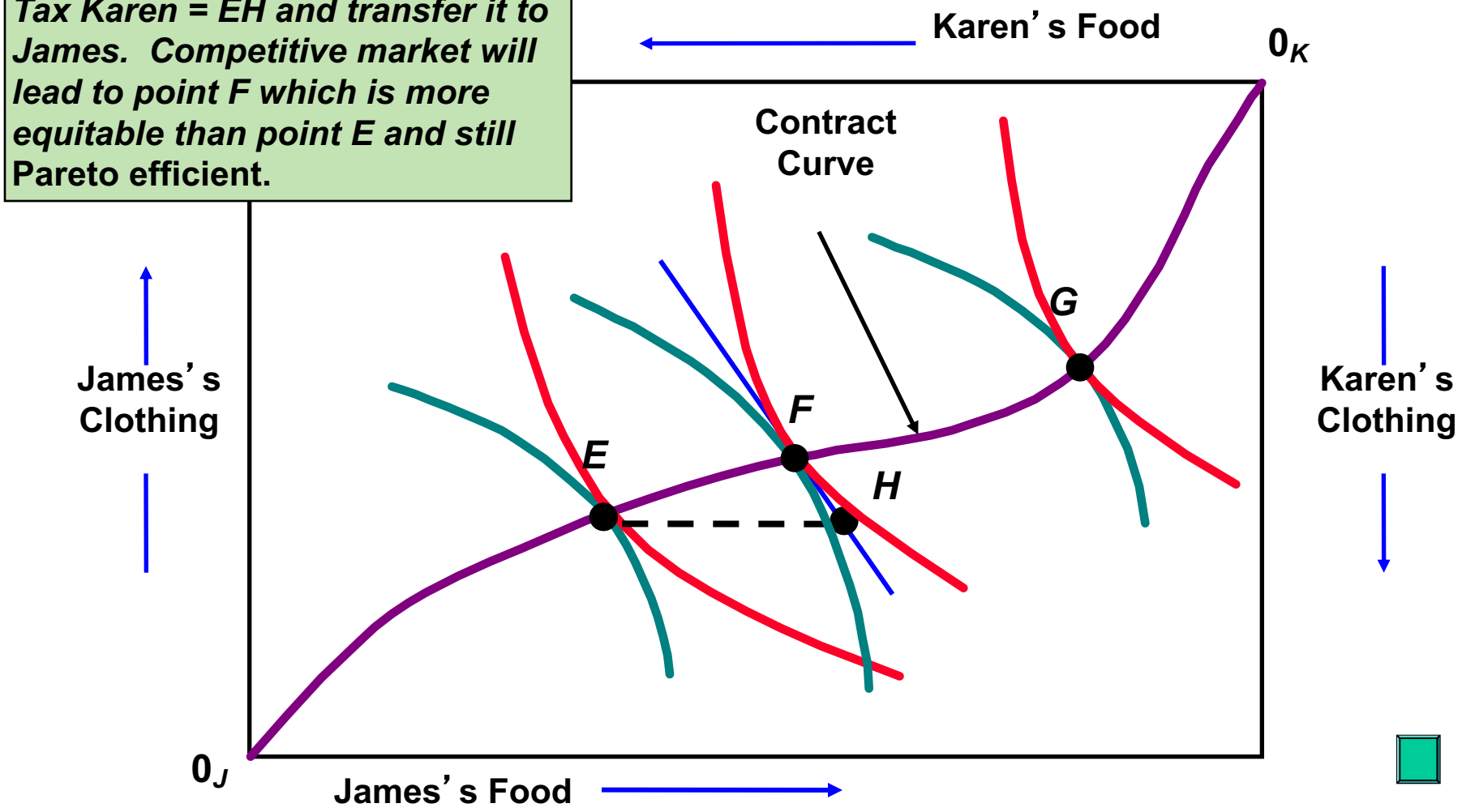
- A competitive equilibrium can occur at any point on the contract curve depending on the initial allocation.
- Since not all competitive equilibriums are equitable, we rely on the government to help reach equity by redistributing income.
  - Taxes
  - Pubic services

Equity and Perfect Competition

- 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.
  - Any equilibrium that is equitable can be achieved by redistributing resources and may be efficient.

Equity and Efficiency

Tax Karen = EH and transfer it to James. Competitive market will lead to point F which is more equitable than point E and still **Pareto efficient.**



Kaldor-Hicks efficiency

- **Kaldor–Hicks criterion**, is a measure of economic efficiency that captures the intuitive appeal of Pareto efficiency, but has less stringent criteria and is hence applicable to more circumstances.
- Kaldor–Hicks efficiency: an outcome is considered more efficient if a Pareto optimal outcome can be reached by arranging sufficient compensation from those that are made better off to those that are made worse off so that all would end up no worse off than before.

Equity and Perfect Competition

- Any equilibrium that is equitable can be achieved by redistributing resources and may be efficient
- Typical ways to redistribute goods, however, are costly
  - Taxes lead to bad incentives
    - Firms devote fewer resources to avoid taxes
    - Encourage individuals to work less

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
- $W_u = w_1u_1 + w_2u_2 + \ldots + w_nu_n$

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
  - Some economists believe that 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: 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 maximises 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 reward more productive people 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	Maximise the utility of the least-well-off person
Utilitarian	Maximise the total utility of all members of society
Market - Oriented	The market outcome is the most equitable

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 efficiency
  - Lack of information can change supply
    - Buy products with no value
    - Don’t buy enough of products with value
  - Some markets may never develop

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
  - May be impossible to get insurance because suppliers of insurance lack information

Why Markets Fail

- Public Goods
  - Nonexclusive, nonrival good that can be made available cheaply but which, once available, is 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