General Equilibrium and Efficiency

After reading this chapter, you will have learned:

- The difference between a partial and general equilibrium analysis of an economic shock, and when it's appropriate to use each type of analysis.
- How to use an Edgeworth box diagram to analyze Pareto efficiency in exchange, and the first and second theorems of welfare economics.
- How to use an Edgeworth box diagram to analyze Pareto efficiency in production, and how Pareto efficiency in production is related to the production possibilities curve.
- The mathematical conditions for general equilibrium and Pareto efficiency in a perfectly competitive economy.
- How factors such as monopoly power, selective excise taxes, and externalities prevent an economy from achieving Pareto efficiency.

Moving from Partial Equilibrium to General Equilibrium

- **Partial Equilibrium Analysis** — The impact of a change in supply or demand in one market only—the market directly impacted.
- **General Equilibrium Analysis** — The impact of a price change in one market on the equilibrium prices and quantities in all other markets.

Moving from Partial Equilibrium to General Equilibrium

The General Equilibrium Impact of an Economic Shock

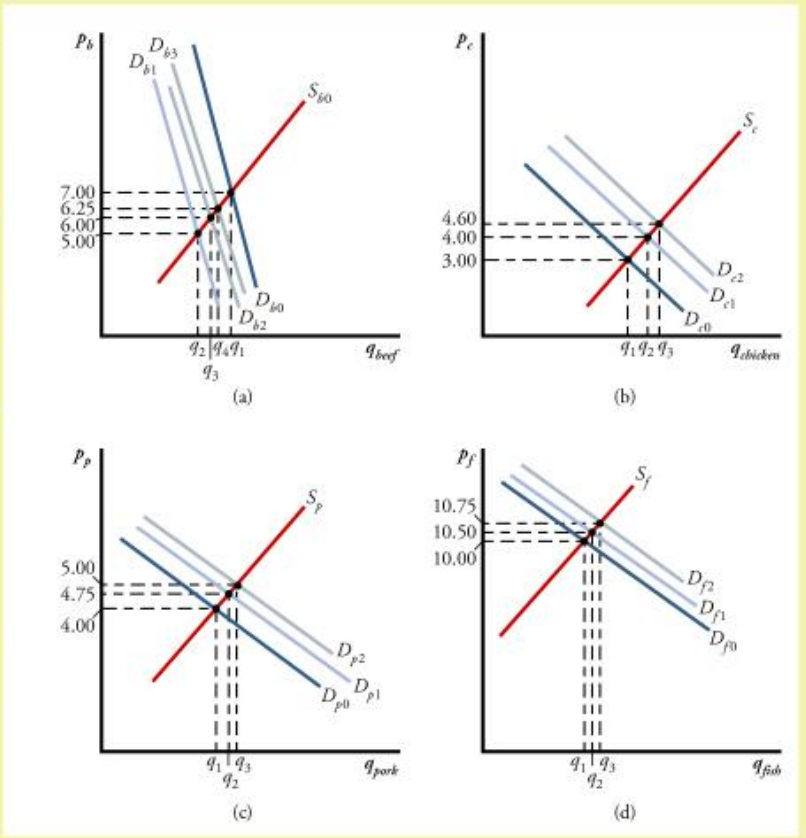


Figure 1 General Equilibrium Initially, the four markets are in general equilibrium, with p_b = \$7.00, p_c = \$3.00, p_p = \$4.00, and p_f = \$10.00. With the discovery of mad cow disease in the U.S., the demand for beef decreases to D_{b1} and p_b decreases to \$5.00. The change in tastes, away from beef, results in an increase in the demand for chicken, pork, and fish, increasing their prices to p_c = \$4.00, p_p = \$4.75, and p_f = \$10.50. As the prices of chicken, pork, and fish increase, there's a *feedback effect* on the beef market, increasing demand for beef to D_{b2} and the price of beef to \$6.00. This effect causes a further increase in the demand for chicken, pork, and fish. Eventually, a new general equilibrium is attained, with p_b = \$6.25, p_c = \$4.60, p_b = \$5.00, and p_f = \$10.75.

Moving from Partial Equilibrium to General Equilibrium

The General Equilibrium Impact of an Economic Shock

- **Spillover Effect** — A change in one market's equilibrium as a result of a change in another market's equilibrium.
- **Feedback Effect** — A change in market A's equilibrium, which results from a change in another market's equilibrium, which was caused, initially, by a change in market A.

Moving from Partial Equilibrium to General Equilibrium

The General Equilibrium Impact of an Economic Shock

Application: Low-Carb Diets and General Equilibrium

- After years of being discredited, the low-carb Atkins diet became popular and medically more acceptable.
- The market impact was dramatic and can only be correctly understood in a general equilibrium context, because it caused a huge shift in demand patterns for many types of goods.
- Not only did the demand for low-carb diet books increase, but also the demand for beef, chicken, pork, and fish. At the same time, there was a significant decrease in the demand for pasta, bagels, potatoes, and bread.

Pareto Efficiency in Exchange

Application: Pareto Efficiency and Halloween Candy

- After children return from trick-or-treating on Halloween, they often engage in the trading of candy until all mutually beneficial trades are exhausted.
- Because every trade that's made improves one child's utility without hurting another child's utility, the children succeed in reaching a Pareto-efficient distribution of candy.

Pareto Efficiency in Exchange

The Edgeworth Box Diagram

- **Edgeworth Box Diagram** — A rectangular diagram that depicts either all of the possible allocations of two goods, between two consumers, or all of the possible allocations of two inputs between two production goods.
- **Contract Curve** — The locus of all Pareto-efficient points in an Edgeworth box diagram.

Pareto Efficiency in Exchange

The Edgeworth Box Diagram

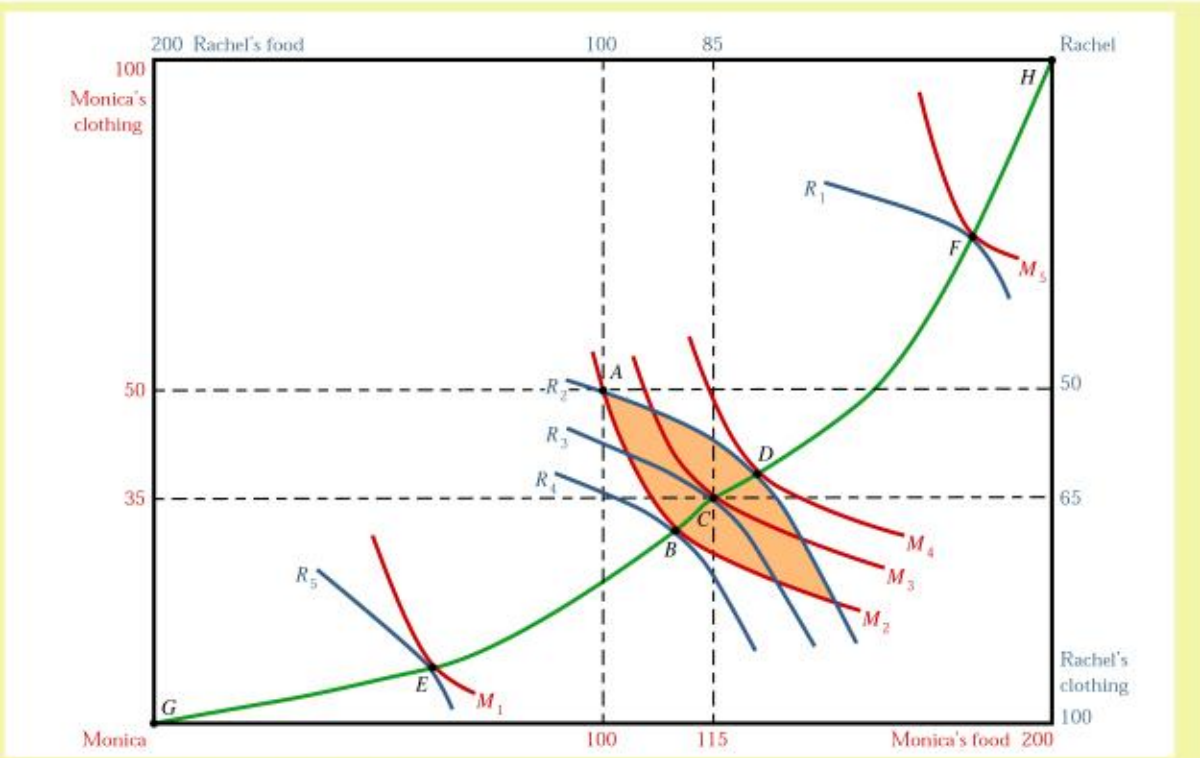


Figure 2 An Edgeworth Box and Efficiency in Exchange

If the goods were initially divided equally between Monica and Rachel, the women would consume at point *A*. By completing a Pareto-efficient trade that moves them into the orange shaded area, both Monica and Rachel increase their utility, and are better off. The only Pareto-efficient points are the points of tangency between Monica's and Rachel's indifference curves. These points make up the green contract curve.

Pareto Efficiency in Exchange

A Mathematical Approach to Pareto Efficiency

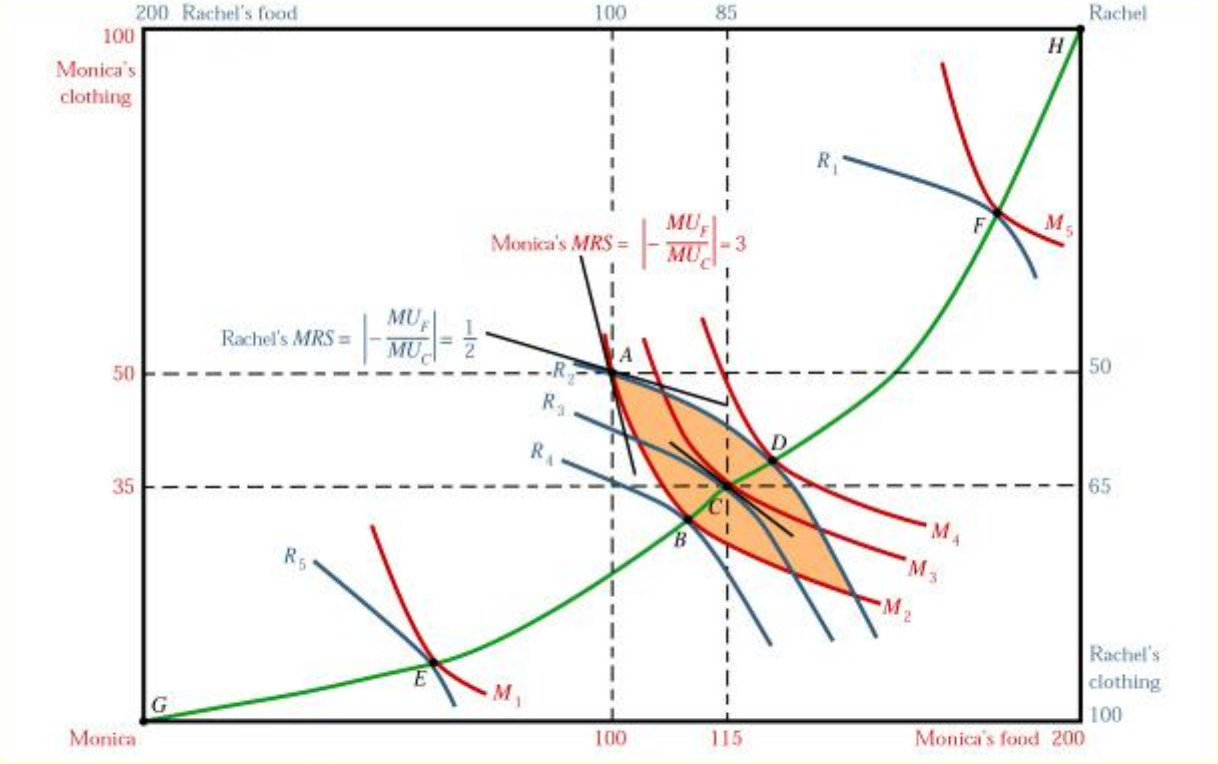


Figure 3 Disequilibrium in the Edgeworth Box

At point *A*, Monica's *MRS* is 3 and Rachel's *MRS* is 1/2. Because their marginal rates of substitution aren't equal, point *A* isn't Pareto-efficient. They both have the same *MRS* anywhere along the green contract curve where their indifference curves are tangent. This is the mathematical condition for Pareto efficiency.

Pareto Efficiency in Exchange

Consumer Equilibrium: Adding Prices to the Model

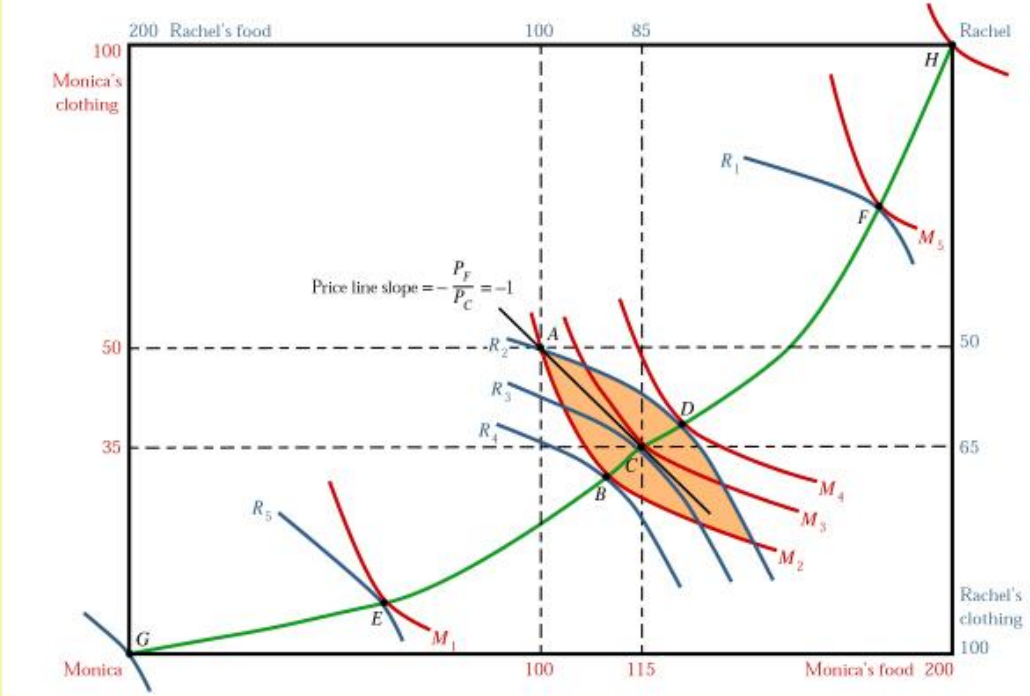


Figure 4 Prices and Efficiency in Exchange

If Monica and Rachel are initially at point A and the price ratio is $P_F/P_C = 1$, Monica can sell 15 units of clothing and use the income to buy 15 units of food, while Rachel can sell 15 units of food and use the income to buy 15 units of clothing. The new equilibrium would be Pareto-efficient at point C.

Pareto Efficiency in Exchange

Consumer Equilibrium: Adding Prices to the Model

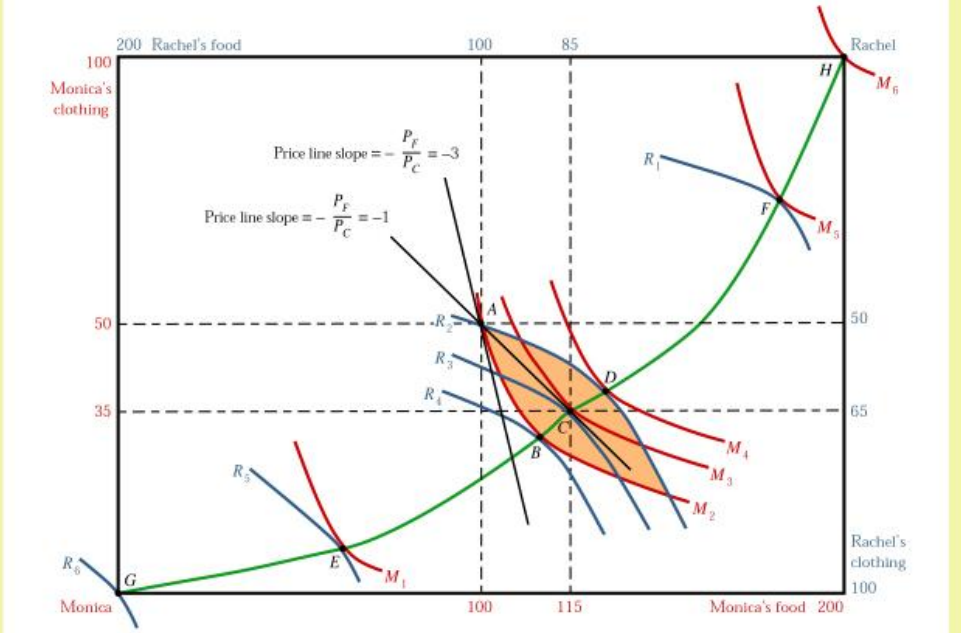


Figure 5 The Edgeworth Box, and Excess Supply and Excess Demand
If Monica and Rachel are initially at point A and the price ratio is $P_F/P_C = 3$, Monica will be in equilibrium and won't be willing to trade. Rachel, however, would want to sell food and buy clothing, at that price ratio. At a price ratio of 3, there would be an excess supply of food and an excess demand for clothing. As a result of the excess supply and demand, the price of food decreases and the price of clothing increases. If the price of food decreases and the price of clothing increases, so that the new price ratio is $P_F/P_C = 1$, Monica and Rachel would reach Pareto efficiency at point C.

Pareto Efficiency in Exchange

The First Theorem of Welfare Economics

- **First Theorem of Welfare Economics** — A theorem stating that, in a competitive exchange economy, all Pareto-improving moves will be made, ensuring that the economy will be Pareto-efficient in its final equilibrium.

Pareto Efficiency in Exchange

What about Equity?

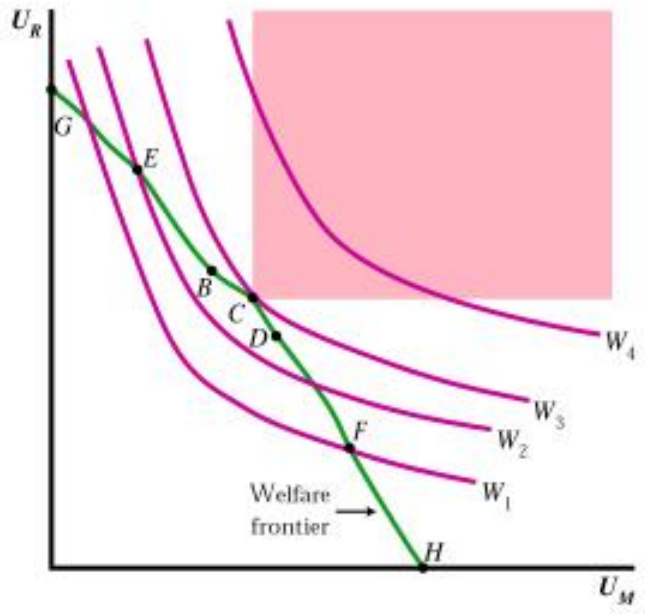
- **Utility Possibilities Curve (Welfare Frontier)** — A curve identifying all possible Pareto-efficient combinations of utility for consumers in an exchange economy; that is, the possible utility combinations for points on the contract curve in an Edgeworth box diagram.
- **Social Welfare Function** — An expression of society's well-being as a function of the utilities of its individual members.

Pareto Efficiency in Exchange

What about Equity?

Figure 6 The Welfare Frontier

The utility possibilities curve, or welfare frontier, identifies all of the Pareto-efficient utility combinations for society. It's derived from the locus of points on the contract curve in Figures 2 through 5. Any points to the north, east, or northeast of a point on the welfare function, such as any point in the light-red shaded area in relation to point *C*, are impossible to reach, because *both* Monica and Rachel would be better off in the red area, compared to point *C*. If the social welfare function is $W = W(U_M, U_R)$, depicted by the purple indifference curves, society's welfare is maximized at point *C*.



Pareto Efficiency in Exchange

What about Equity?

Common Error: Failing to Understand There's No Connection between Pareto Efficiency and Equity

It's often difficult to understand that Pareto efficiency has nothing to do with equity or fairness in the distribution of income.

A distribution of income between two individuals that gives all goods to one individual is Pareto-efficient, because it's impossible to make one person better off (the person with nothing) without making another person worse off (the person with everything).

Pareto Efficiency in Exchange

The Second Theorem of Welfare Economics

- **Second Theorem of Welfare Economics** — A theorem stating that, given convex indifference curves, every point on the contract curve is a competitive equilibrium for some initial allocation of goods; implies that, by selecting a suitable price ratio, any point on the contract curve can be reached.

Pareto Efficiency in Exchange

The Second Theorem of Welfare Economics

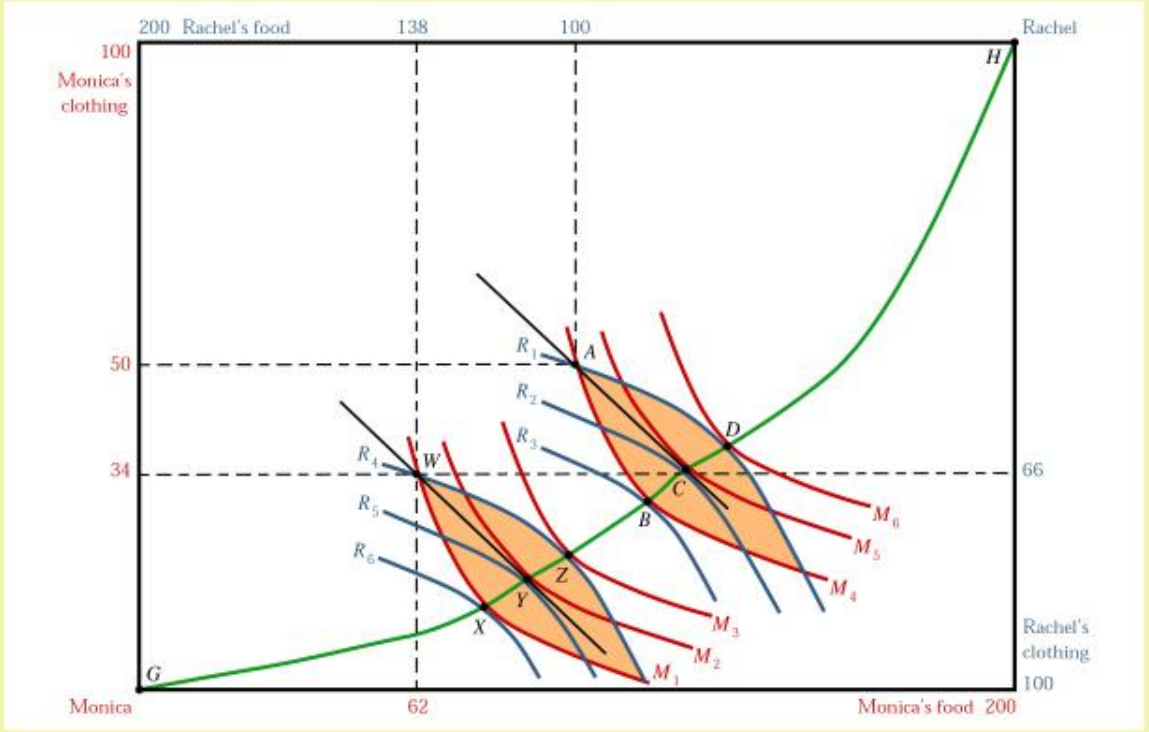


Figure 7 The Second Theorem of Welfare Economics

Suppose the economy is initially at point W and the government decides point W is unfair to Monica, so it transfers goods from Rachel to Monica such that the goods are distributed equally at point A. According to the first theorem of welfare economics, in a free market economy, the invisible hand will move Rachel and Monica from point A to a point on the contract curve like point C. Increasing equity doesn't result in a reduction in efficiency. This is the primary lesson of the *second theorem of welfare economics*.

Efficiency in Production

The Edgeworth Box and Production Efficiency

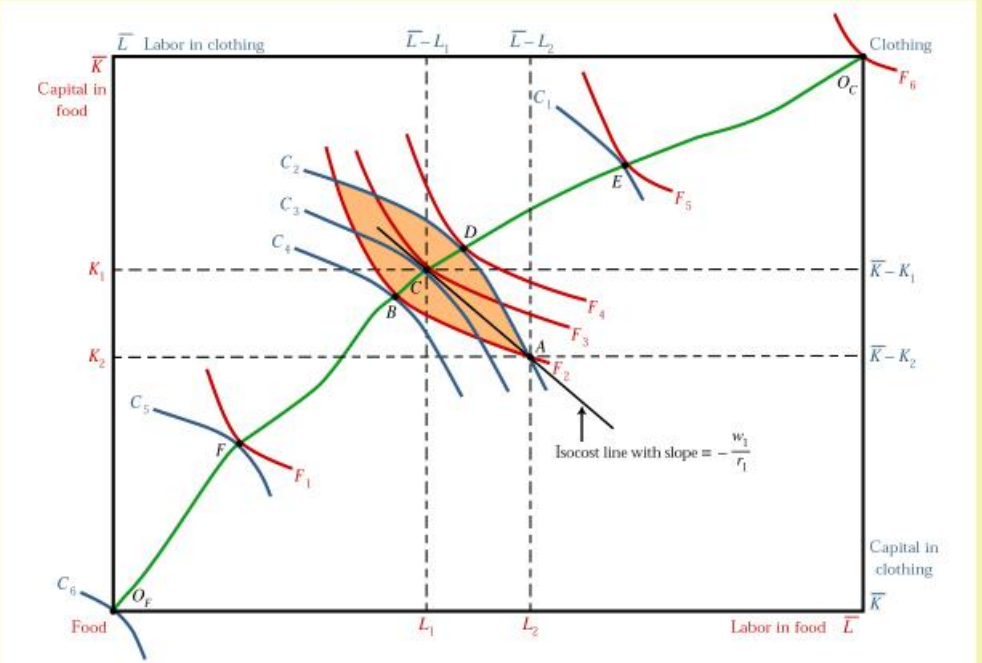


Figure 8 The Edgeworth Box and Efficiency in Production

The Edgeworth box depicts all of the possible allocations of labor and capital between food and clothing. Suppose inputs are initially divided between food and clothing at point A. By completing a Pareto-efficient trade that moves the producers into the orange shaded area, the output of both food and clothing can be increased; therefore, the economy is better off. The only Pareto-efficient points in the Edgeworth box are the points of tangency between the food and clothing isoquants. These points of tangency make up the green contract curve. Starting at point A, if the input price ratio is w_1/r_1, the food producer should fire workers and rent more capital, and the clothing manufacturer should hire more workers and rent fewer units of capital, until production reaches point C on the contract curve.

Efficiency in Production

The Production Possibilities Curve

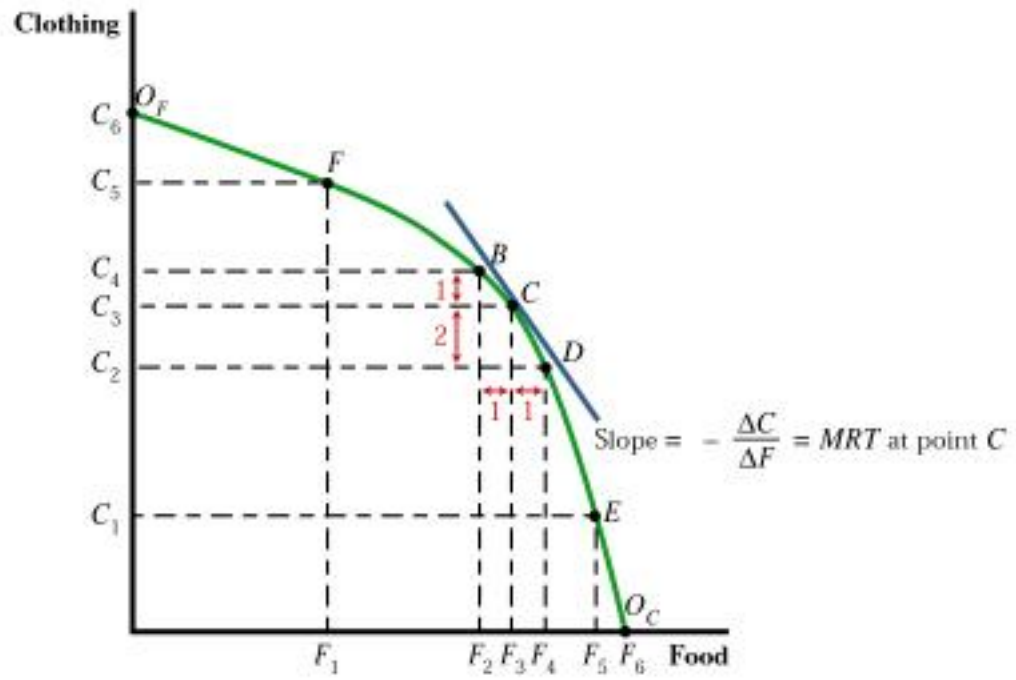
- **Production Possibilities Curve** — A curve identifying all of the possible efficient combinations of goods and services the economy is capable of producing, given current resource constraints.
- **Marginal Rate of Transformation, MRT** — The opportunity cost of producing one more unit of one good, in terms of the number of units of another good that must be sacrificed.

Efficiency in Production

The Production Possibilities Curve

Figure 9 The Production Possibilities Curve

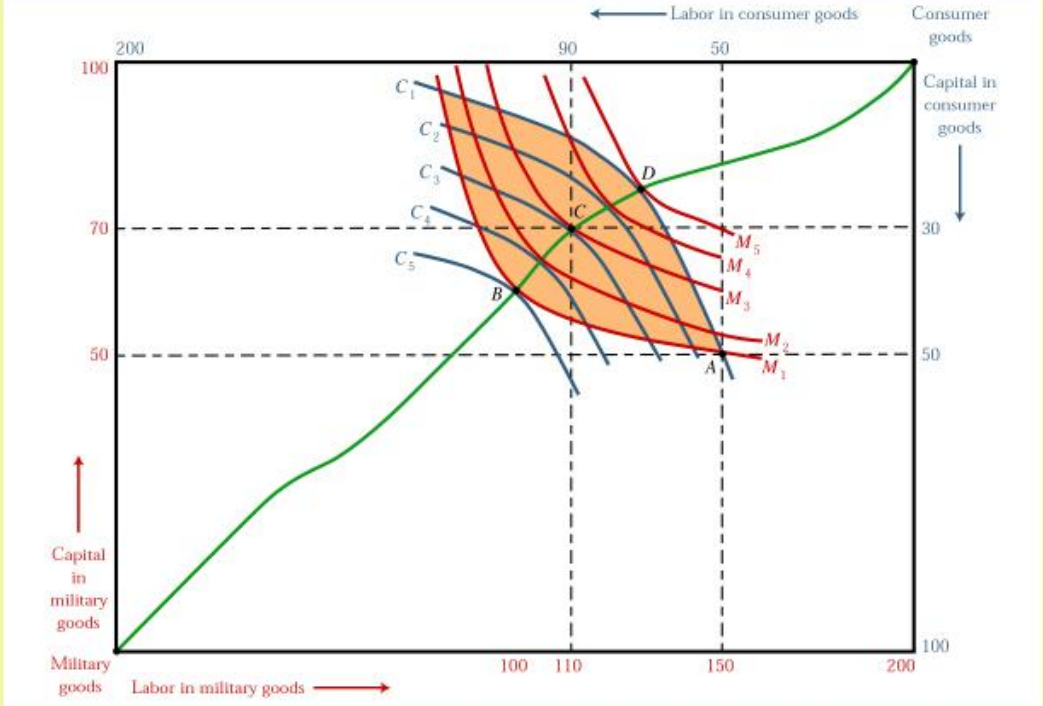
The production possibilities curve represents all of the Pareto-efficient points on the contract curve in Figure 8. Each point on the contract curve corresponds to exactly one point on the production possibilities curve. The absolute value of the slope of the production possibilities curve at a point measures the *marginal rate of transformation*, or *MRT*, which measures the opportunity cost of food in terms of clothing. As more food is produced, the opportunity cost of producing food increases; therefore, the *MRT* increases as well.



Efficiency in Production

The Production Possibilities Curve

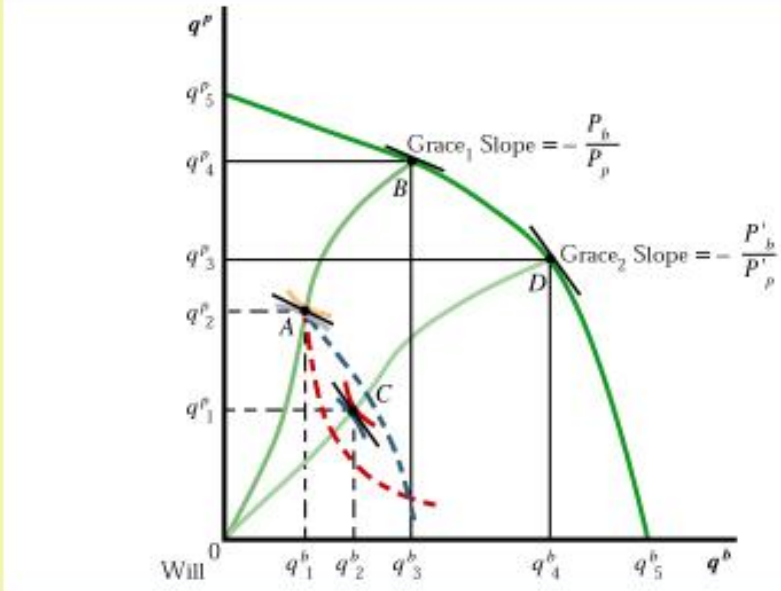
Application:
Economic Inefficiency in the Former Soviet Union



Application Figure 1 **Production Inefficiency in the Former Soviet Union**
In the former Soviet Union, central planners decided how many inputs each industry would receive. If the planners allocated resources at point *A*, with 75 percent of labor and 50 percent of capital going into military goods, the economy was producing inefficiently, because it wasn't producing on the contract curve; therefore, it wasn't producing on its production possibilities curve. With no free-market price mechanism to correct the inefficiency, there was no reason for the economy to move from point *A*, and it remained permanently mired in inefficiency.

General Equilibrium in a Perfectly Competitive Economy

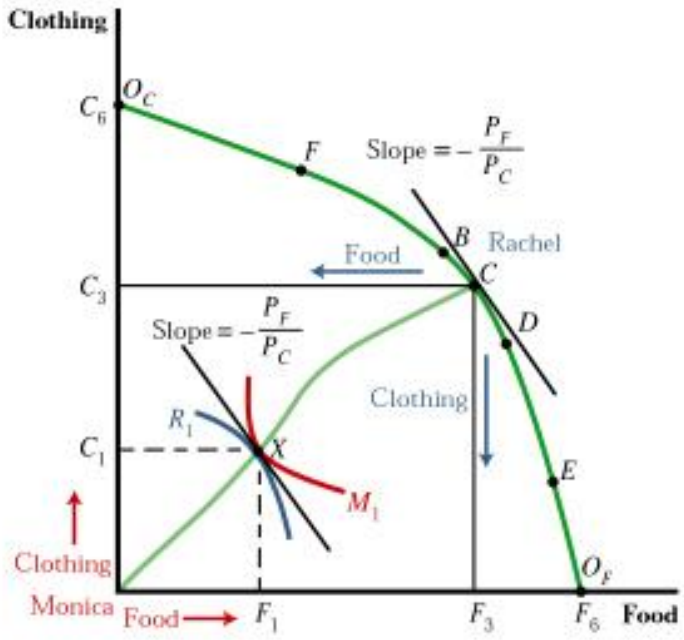
Application:
How the Economy Adjusts to a Change in Tastes



Application Figure 2
Before the low-carb diet craze, Will and Grace are in equilibrium at point *A*, where there's a tangency between Will's orange indifference curve and Grace's light-blue indifference curve. Because of the low-carb diet fad, their indifference curves become steeper and there's no longer an equilibrium at point *A*. As the price ratio, P_b/P_p, increases, Will and Grace move to a new equilibrium at point *C*, where both consume more beef. The equilibrium on the production possibilities curve moves from point *B* to point *D*, so the economy produces more beef and less pasta.

General Equilibrium in a Perfectly Competitive Economy

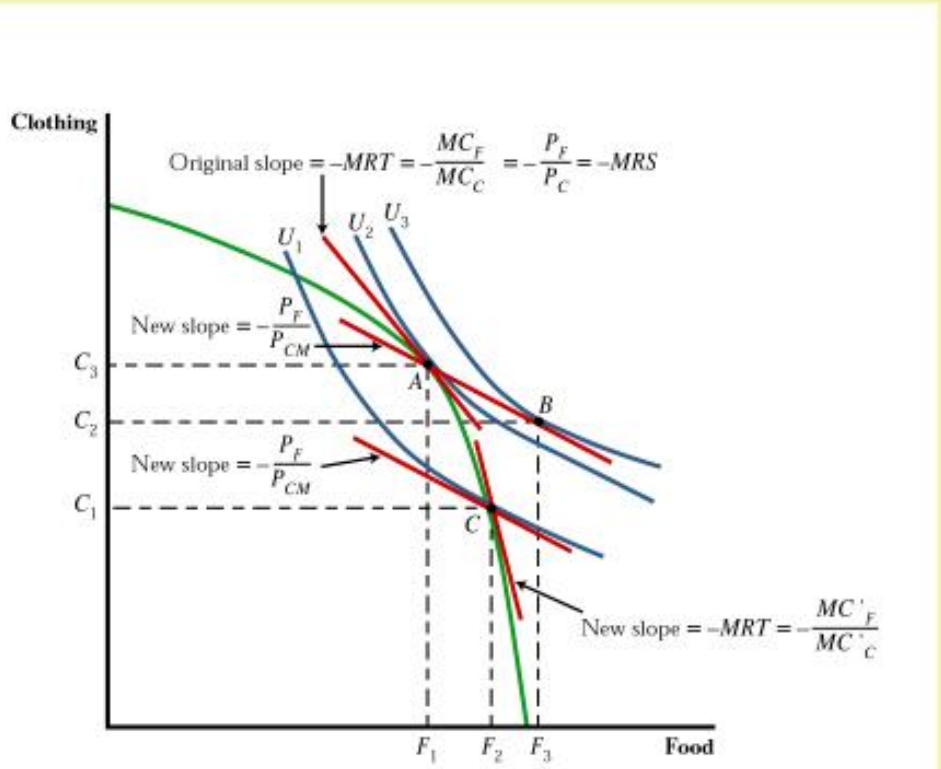
Figure 10 General Equilibrium in a Perfectly Competitive Economy
In an economy in which all markets are perfectly competitive, the production point on the production possibilities curve (here, point C) determines the size of the Edgeworth box for Monica and Rachel to allocate goods. In a Pareto-efficient general equilibrium, $MRS = MRT$, so the slope of the production possibilities curve at C must equal the slopes of the indifference curves for Monica and Rachel at point X. If MRS and MRT aren't equal, prices will adjust to cause a movement along the production possibilities curve. Eventually, the equality between MRS and MRT will be reestablished.



Failures to Achieve Pareto Efficiency

Monopoly

Figure 11 Monopoly and Inefficiency
With perfect competition, the economy reaches an efficient equilibrium at point A, where the slope of the production possibilities curve equals the slope of indifference curve U_2. If the clothing industry is monopolized, the price of clothing increases from P_C to P_{CM}. Given the new price ratio, consumers *want* to consume at point B, on indifference curve U_3, but they can't, because it's beyond the PPC. Eventually, the economy adjusts to the new prices by moving to point C, where there's less clothing and more food produced, and the *MRS* is less than the *MRT*. Consumers are worse off at point C than at point A, because indifference curve U_1 is below indifference curve U_2.



Failures to Achieve Pareto Efficiency

Excise Tax

Common Error: Believing That, because Excise Taxes Prevent an Economy from Achieving Pareto Efficiency, All Excise Taxes Are Bad

- Because excise taxes on specific goods always distort consumers' choices among goods and, therefore, prevent the attainment of Pareto efficiency, students sometimes conclude that all excise taxes are bad for an economy.
- This is incorrect thinking, because it ignores how the government uses the tax revenues it collects. For example, if the government uses the revenues to improve public education, consumers may consider themselves better off as a result of an excise tax.

Failures to Achieve Pareto Efficiency

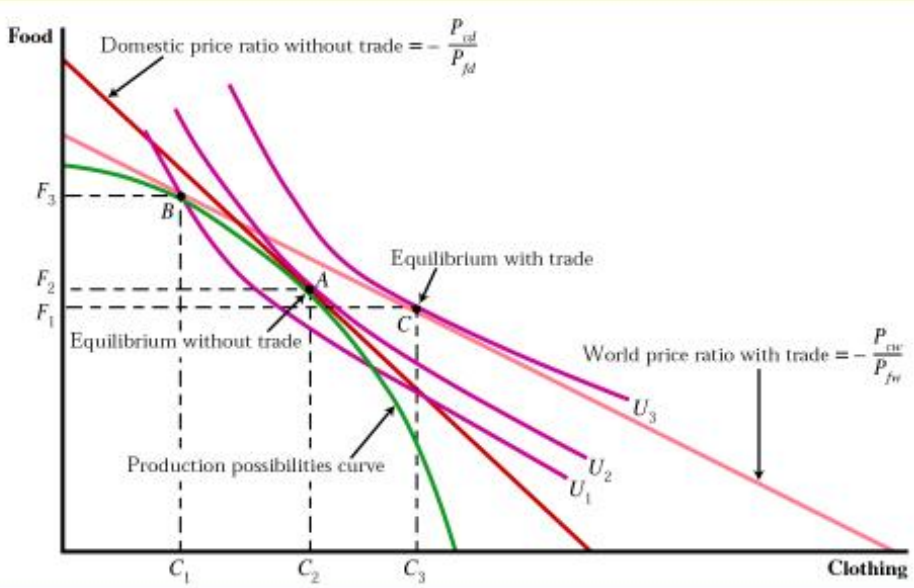
Externalities

- **Negative Externalities** — Social costs of production or consumption not considered to be costs to the producer or consumer.
- **Positive Externalities** — Social benefits of production or consumption not considered to be benefits to the producer or consumer.

Failures to Achieve Pareto Efficiency

Externalities

Application: The Gains from Trade



Application 3 The Gains from Trade in General Equilibrium

In a closed economy without trade, the efficient point on the production possibilities curve is A, where the $MRS = MRT$. MRT equals the price ratio without trade, P_{cd}/P_{fd}. If the price ratio with trade is P_{cw}/P_{fw}, the economy should produce at point B on the production possibilities curve, where the $MRT = P_{cw}/P_{fw}$ and trade along the light-red world price ratio line, at point C, where the $MRS = P_{cw}/P_{fw}$. Trade permits the economy to consume beyond its production possibilities curve, thereby increasing society's utility from U_2, at point A, to U_3, at point C.