

AAE635: Applied Microeconomic Theory

Discussion Section 12

Professor: Paul Dower

TA: Erick F Molina

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Dept. of Agricultural & Applied Economics
Taylor Hall 306, 427 Lorch St, Madison, WI 53706

molinaperez@wisc.edu

Today's goal

- Build intuition for Pareto efficiency using the Edgeworth box.
- Develop confidence in analyzing efficiency, rationality, and the core.

Pareto Efficiency

- Economics studies the allocations of scarce resources. The decision (optimization) problems focus on how people respond to incentives.
- Now, let's think about allocations (benevolent planner's problem) directly without worrying about individual's decision problems.
- Later, we learn the welfare theorems showing how individual decisions and planner's allocation coincide.

An allocation is **Pareto efficient** if:

1. it is feasible.
2. there is no other feasible allocation that can make one person better off without making any other worse off.

Key:

- Pareto efficiency $\Leftrightarrow$ no Pareto improvement.
- Pareto frontier: the set of Pareto efficient allocations.
- Not take into account fairness/equality.

Example

Suppose the utility function between you and me from consuming oranges and apples are $u(x_1, x_2) = x_1 x_2$

- When I have two apples (x_1) and you have three oranges (x_2), this allocation may not be Pareto efficient since we can trade our apples and oranges and improve utilities of both of us.
- When you have two apples and three oranges and I have nothing, this allocation is Pareto efficient since any other allocation decreases your utility.

The Edgeworth Box

Figure 1: The Edgeworth box

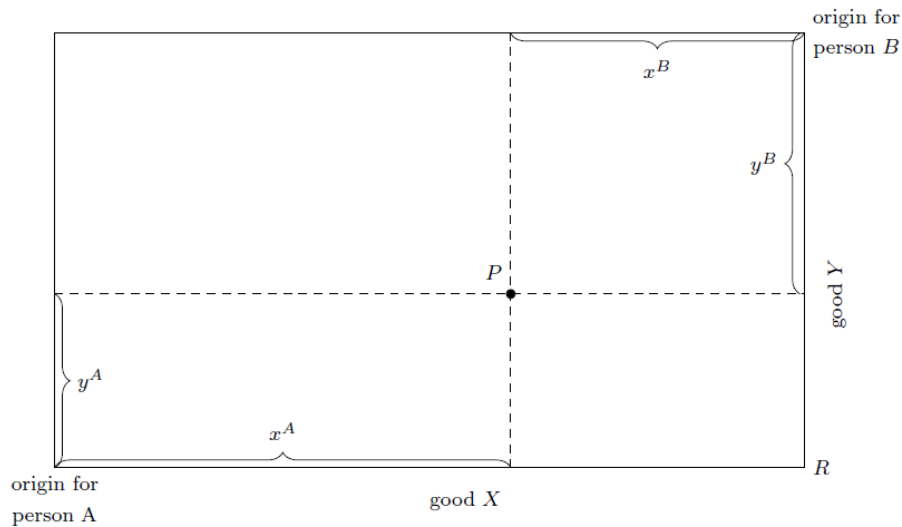


Figure 1: The Edgeworth box

Figure 1 shows how to read an Edgeworth Box. In particular,

- In this economy, the total endowment of the good X is $(x^A + x^B)$ and the total endowment of the good Y is $(y^A + y^B)$
- At the allocation P, a person A has (x^A, y^A) and a person B has (x^B, y^B) .

Figure 2: Indifference curves in the Edgeworth box

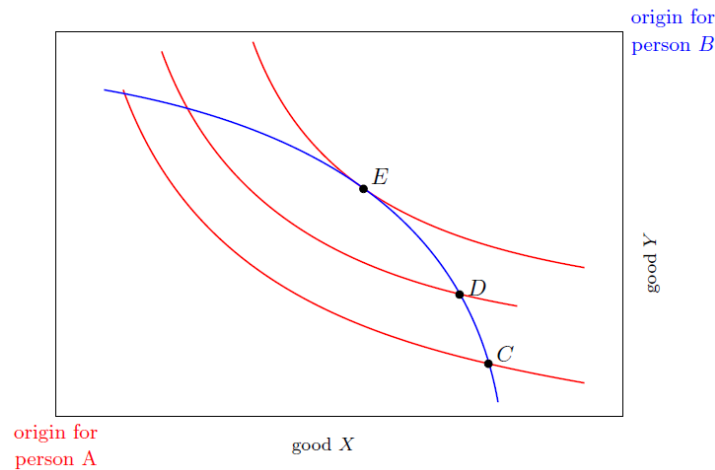


Figure 2: The Edgeworth box (inefficient allocations (C and D) and an efficient allocation (E))

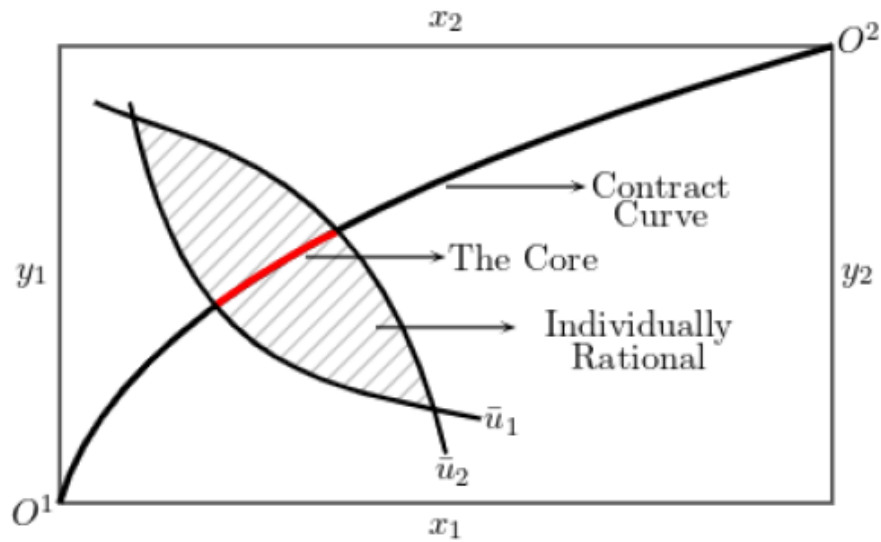
Figure 2 shows indifference curves of two persons and their allocations. Red curves are indifference curves of a person A, and curves located at more north-east indicate higher utilities. The blue curve is an indifference curve of a person B.

- The allocation C is not Pareto efficient since by moving from C to D , without decreasing B 's utility, we can improve A 's utility.
- Similarly, the allocation D is not Pareto efficient since by moving from D to E , without decreasing B 's utility, we can improve A 's utility.
- The allocation E is Pareto efficient since, if we try to improve A 's utility, we need to decrease B 's utility.

Given agents' endowments, what properties are desirable for the final allocations?

- Feasible
- Individually rational
- Pareto efficient

Figure 3: Contract curve and core

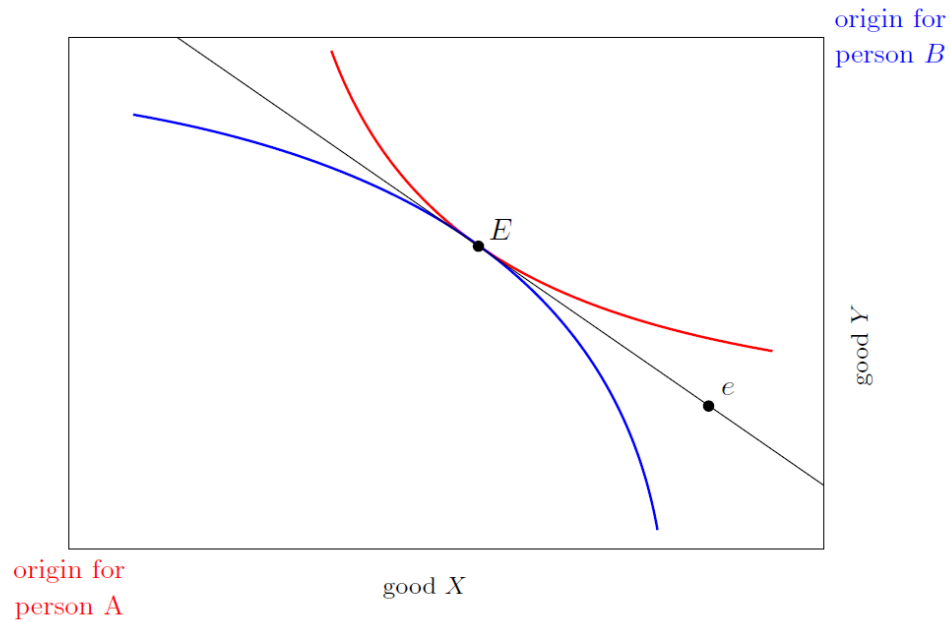


Some definitions:

1. **Contract curve:** all Pareto efficient allocations
2. **Core:** all allocations that are Pareto efficient and individually rational

One important implication is that, at Pareto efficient allocations, two indifference curves are tangent. This means that the marginal rates of substitutions of two persons are identical at Pareto efficient allocations (if they are not corner solutions).

Figure 4: Pareto Efficiency and Initial Endowments



- Competitive equilibrium in an exchange economy. The slope of the line is the equilibrium price, $-\frac{p_x}{p_y}$.
- The allocation E is the equilibrium allocation. The point e indicates initial endowments.

Practice Questions

1. Consider an exchange economy with two goods (x and y) and two agents (A and B). Suppose that the total endowments of x and y in this economy are 2 and 1, respectively. Find the set of Pareto efficient allocations in the following cases. More specifically, specify the relationship between x^A and y^A under Pareto efficient allocations.

- $u_A(x, y) = x^\alpha y, \alpha > 0; u_B(x, y) = xy$

2. Consider an exchange economy with two goods (x and y) and two agents (A and B). Suppose that A has 3 units of x and 2 units of y , while B has 2 units of x and 2 units of y . Suppose that the utility function of A and B are $u_A(x, y) = 2xy, u_B(x, y) = 2xy$, respectively.

- (a) Draw the Edgeworth box that corresponds to this situation with consumer A in the lower left, and where the horizontal distance from the lower left origin represents A 's allocation of c_1 . Label the endowment in this box.
- (b) Sketch the contract curve in this box.
- (c) Find the individually rational area or Pareto improvement area, and label it in your Edgeworth box.
- (d) Label the core in your Edgeworth box.