II.A. Welfare economics

In the equilibrium/disequilrium approach, we have looked at optimization from individual viewpoints, whether it is that of consumer, producer or the authority. In a sense, one does not have to care about others' decisions. The invisible hand of the market or the visible hand of the government would achieve "equilibrium" with some efficiency improvements outside self-interested private "equilibrium".

The problem is that an economy consists of multiple agents with different objectives. Private optimization would not automatically bring general stability. Local optimality/efficiency might mean global sub-optimality/inefficiency. In a nutshell, equilibrium, optimality and efficiency may not co-exist, unlike in the section "The Equilibrium Approach".

Economic agents interact with each others. That is the crux of welfare economics.

Welfare economics is concerned with **the evaluation of the social/extra-individual desirability of alternative economic states** – in particular **arrangements/states** of economic activities, each of which is associated with
- a different allocation of resources (output/spending); and
- a different distribution of rewards (income).

Almost every alternative **arrangement/state** will have **favourable** effects on some people and **unfavourable** effects on others – due to the **INTERDEPENDENCE of welfare** among economic agents. So an economist has two choices:

(1) He refuses to deal with cases in which a proposed social change improves the lot of some and depresses the lot of others and content herself with analyzing situations in which only unambiguous welfare improvement are possible;

(2) He decides to make **interpersonal comparisons of utility/welfare** and

analyse a broader class of situations. She will have to say that it is justified to increase the welfare of A at the expense of B, whose welfare will be reduced.

In (1), the economist is primarily concerned with efficient allocation of resources and output.

In (2), he must make explicit **value judgment** that benefits some but harm others, but based on what criteria? Morality? Social consensus? Religion? However, is she competent in such an assessment?

Pareto-optimality: provides a definition of economic efficiency of allocation of commodities for consumers and resources for producers. It serves **the basis for an analysis of (1)**. It however stops short of distributional considerations and interpersonal consideration of utility – with no explicit value judgment.

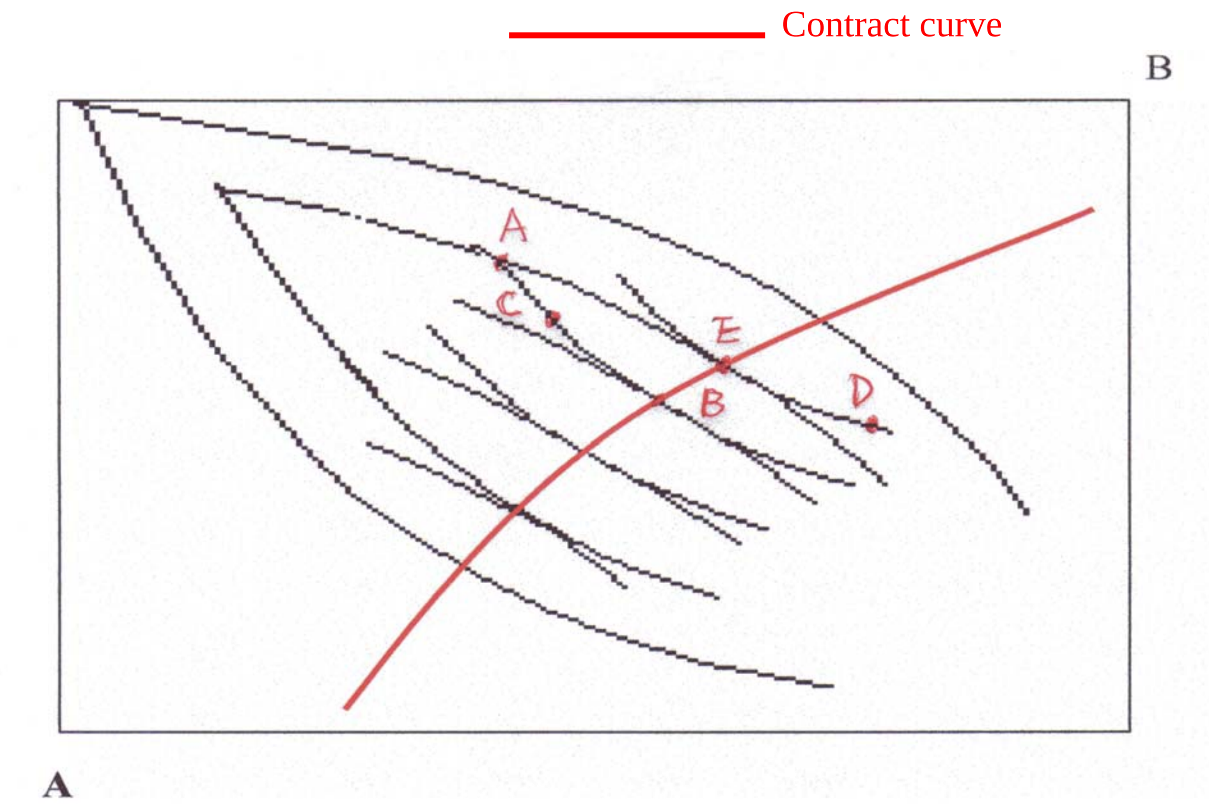
An allocation is **"Pareto-optimal" or "Pareto-efficient" (e.g. E)** if production/consumption cannot be rearranged to increase the utility of one or more individuals without reducing the utility of others (**e.g. no E ~~to~~ B!**).

An allocation is **Pareto-suboptimal (e.g. A)** if someone's utility can be increased without harming anyone else, by effecting another arrangement **(e.g. A → E)**.

An allocation is said to be Pareto-superior to another if the utility of at least one individual is higher and the utility of none is lower, even though the allocation itself may not be Pareto-optimal, i.e **"Pareto improvements"** are still possible **(e.g. A → C) (E ~~to~~ B is NOT!)**.

** Hence **interdependence** of economic interests is at the core of welfare economics, and decision makers are likely to consider others' possible actions before they make their own. The equilibrium approach that we have covered, however, assumes that people's utility functions are **independent (hence horizontal aggregation)**. We therefore need a tool to analyse situations of **"strategic interdependence"**. Game theory is the modern tool.

Edgeworth Box



Game Theory: PRELIMINARIES

Game theory is a technique with which we can solve the problems of strategic interdependence and conflicts of interests.

I. Decision making in economics always consists of a number of components:

1. objective: max/min/π/utility/cost etc
2. alternative courses of action (discrete or continuous)
3. outcome of each course of action
4. constraints

Usually, all 4 components are generalized into continuous functions, e.g.

Max U = XY
s.t. PxX + PyY = I
in the case of consumer theory.

In game theory, for the sake of simplicity, we usually use a "payoff matrix", which is 2-dimension table linking "strategies" to the "outcomes". Hence it is "discrete" in nature, e.g. a "game" with nature:

		States of nature	$ profit	
		Dry	Wet	Heavy rain
Farmer's crop choice	Rice	-50	50	100
	Fruit	10	60	80
	Pepper	80	50	-20

How should the farmer optimize? Which crop should he choose?

The key problem here is that of uncertainty: Will the weather turn out to be dry? Wet? Or heavy rain? Given that the farmer is not certain about which "state of nature" would prevail, how should he decide?

II. Types of uncertainty

In our first section on the "equilibrium approach", we have neglected the problems of **uncertainty**. The economic agent knows his objective and the constraints (budget and quantity) with perfect knowledge. Moreover, his actions and his results will not be affected by others' actions and results. But in reality, uncertainty abounds, and we have to distinguish between **two types of uncertainty**.

1. Lack of knowledge or "natural" uncertainty, e.g. about weather

2. Uncertainty arising from inter-personal conflicts or **"strategic interdependence"**, which can be totally independent of the lack of knowledge. Other people's action is not certain because it depends on the course of action that you choose, and vice versa.

Both types of uncertainty can be handled by game theory:

1. games against nature;
2. Games against other economic agents.

It is obvious that the second type is more difficult to analyze, hence also more interesting, e.g. there are 2 firms only:

A's payoff matrix

		B's strategies B_1	B_2
A's strategies	A_1	20	70
	A_2	60	10

Payoff: market share %
1: advertise
2: not advertise

What is the implied payoff matrix for B?

III. Types of games

1. Zero-sum games: 零和遊戲

   one's gain is another's loss: by nature non-cooperative

2. Variable-sum games: 變和遊戲

   a. cooperative 合作遊戲

   b. non-cooperative 不合作遊戲

Those games can be played
- between two players or *n* players ($n > 2$)
- in a one-off manner (static/one-period game) or in a multi-period manner (repeated/sequential/dynamic games)

The theory of games was invented by John von Neumann and further improved by mathematical economists like John F. Nash Jr. (a Nobel Laureate in economics).

IV. Some basic decision rules under uncertainty

Let us look at a simple game against nature with the following payoff matrix:

		N_1	N_2	N_3
	S_1	45	6	30
Strategies	S_2	66	-21	90
	S_3	-12	120	24

What strategy is optimal? It depends on the decision rule that one adopts. There are five popular rules:

1. MAXIMIN criterion

i. First determine the worst payoff under each strategy (MIN)
ii Then choose the strategy which gives the best of the worst payoffs (MAXI-MIN). Check that for the above payoff matrix, the MAXIMIN criterion will lead one to choose $\underline{S_1}$. This strategy is usually adopted by people who are risk-adverse or conservative.

2. MAXIMAX criterion

i. determine the best payoff under each strategy (MAX)
ii choose the strategy which gives the maximum of these best payoffs (MAXI-MAX). Check that for the above matrix, $\underline{S_3}$ is the MAXIMAX strategy. This criterion is preferred by risk-seekers.

3. Minimax Regret Criterion

"Regret" is measured by the difference between the actual payoff and the pay that one should have received if the one has known which state of nature would prevail in advance, e.g. payoff (N_1, S_1): 45 in the above matrix, but if one knows that N_1 will prevail, one should choose strategy S_2 which yields a payoff of 66. So the "regret" for (N_1, S_1) is 45-66 = -21.

Following this rule, we can construct the "regret" matrix:

N_1 N_2 N_3

S_1	-21	-114	-60
S_2	0	-141	0
S_3	-78	0	-66

From the perspective of each strategy (along the row), we determine the "maximum regret": S_1(-114), S_2(-141), S_3(-78). Then we choose the strategy which gives the minimum of these maximum regrets. Which is the strategy?
This criterion is based on the "regret theory" in psychology.

4. Maximum likelihood criterion

Assume that we can assign probabilities (subjective or objective) to different N's, e.g.

	N_1	N_2	N_3
P	0.1	0.55	0.35

We would choose the one strategy that fares the best under the "most likely" state of nature. Which one should we choose in the above matrix?

5. Expected value criterion

We can find out the expected value of each strategy by using the probabilities of each N as weights:
$E(S_1) = 0.1\ (45) + 0.55\ (6) + 0.35\ (30)$
$E(S_2) = 0.1\ (66) + 0.55\ (-21) + 0.35\ (90)$
$E(S_3) = 0.1\ (-12) + 0.55\ (120) + 0.35\ (24)$

Check that $\underline{\underline{S_3}}$ should be chosen. What is the expected value of it?
What if we do not know the probability distribution? How should calculate the expected value?