Topic 5: Welfare

Economics 1, Fall 2002
Andreas Bentz
Based Primarily on Frank Chapters 16 - 18

Review: Equilibrium

- **Topic 3, Consumer Theory:**
  - foundations of Classical Demand Theory
  - utility maximisation
    - gives us individual demand

- **Topic 4, Firms:**
  - profit maximisation (gives us factor demands)
  - cost minimisation (gives us cost curves)
    - recall: a firm’s supply curve is its marginal cost curve

- **The Equilibrium Principle:**
  - In a competitive market, price adjusts to equilibrate demand and supply: \( D(p^*) = S(p^*) \), \( p^* \) is the equilibrium price.
Partial and General Equilibrium

So far, this study has been *partial equilibrium analysis*:
- this ignores the fact that changes in the price of one good generally change the demand for other goods,
- and it ignores the fact that changes in the prices of goods that people sell change a person’s income and therefore their demand for other goods.

*General equilibrium analysis* studies the interaction between supply and demand in several markets.

General Equilibrium

When everything’s fine:
the Two Fundamental Theorems and
other Nice Results.
Exchange

Wanna trade?

General Equilibrium: Exchange

- Simplest setting:
  - two consumers: person A, person B
  - two goods: $x^1, x^2$
  - pure exchange (no production)

- In a pure exchange economy, a fixed amount of goods is exchanged.
  - Initially, every consumer is endowed with some of each good; then they may engage in trade.
  - This allows us to study how prices change in response to relative scarcity.

- How do we represent the possible allocations of the two goods between the two consumers?
  - We can represent this in an Edgeworth box.
Exchange, cont’d

- Some definitions:
  - an **allocation** $X$ of goods:
    - bundle $(x^1_A, x^2_A)$ (person A); bundle $(x^1_B, x^2_B)$ (person B)
    - This is any distribution of the two goods between the two consumers.
    - Any allocation is **feasible** if the amount of good 1 that person A holds and the amount of good 1 that person B holds add up to the total amount of good 1 in the economy, and similarly for good 2.
  - an **endowment** $W$ (or, initial allocation) of goods:
    - bundle $(\omega^1_A, \omega^2_A)$ (person A); bundle $(\omega^1_B, \omega^2_B)$ (person B)

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Feasible Allocations

- All allocations in the Edgeworth box are feasible:
Edgeworth Box

Definition: An allocation $X$ is feasible if the total amount of each good consumed is equal to the total amount available:

- $x^1_A + x^1_B = \omega^1_A + \omega^1_B$
- $x^2_A + x^2_B = \omega^2_A + \omega^2_B$

Any allocation in the Edgeworth box is feasible.

The initial endowment allocation $(\omega^1_A, \omega^2_A)$ (person A) and $(\omega^1_B, \omega^2_B)$ (person B) determines the size of the Edgeworth box.

Edgeworth Box, cont’d

Now we know how to illustrate all feasible allocations in our two-consumer economy.

How do we represent preferences?

- Each consumer has preferences over the two goods.
- Preferences are represented by indifference curves, in the way in which we have introduced them in topic 3.
Building an Edgeworth Box

At allocation W (endowment), welfare gains for both consumers are possible:

Gains from Exchange

- At allocation W (endowment), welfare gains for both consumers are possible:
Pareto Efficiency

- At X, there are no further gains from trade:
  - X is Pareto efficient.

Pareto Efficiency, cont’d

- **Definition**: Allocation X is a *Pareto improvement* over allocation Y if:
  - every agent prefers (or is indifferent between) her consumption bundle under X to her bundle under Y;
  - that is: if for every agent allocation X is on a higher (or at least the same) indifference curve.

- **Definition**: Allocation X is *Pareto efficient* if there is no other allocation that is a Pareto improvement over X.
  - The locus of all Pareto efficient allocations is the *contract curve*. 
Contract Curve

- The locus of all Pareto efficient allocations is the contract curve.
  - The contract curve joins all the tangencies between A’s and B’s indifference curves.

Pareto Efficiency, cont’d

- The definitions are in terms of preferences.
  - We want a criterion that tells us whether an allocation is “good” in some sense.

- **Definition**: According to the Pareto welfare criterion, an allocation X is (socially) better than Y if X is a Pareto improvement over Y.
  - What is attractive about this definition:
    » requires only a weak value judgement, and is powerful and uncontentious;
    » most other welfare criteria are contentious.
Pareto Efficiency, cont’d

- But: The Pareto criterion ranks allocations only incompletely.
  - Example 1: If some agents “prefer allocation X to Y”, and some agents “prefer Y to X”, the Pareto criterion cannot tell us which is better.
  - Example 2: Two Pareto efficient allocations cannot be compared by the Pareto criterion.

- And: A Pareto efficient allocation may not have any other nice properties.
  - Example: Distribution: typically, an allocation where one individual has everything and everyone else has nothing is Pareto efficient.

Market Trade

- Given endowment W, what is the outcome of trade in a competitive market?
  - Can prices $p_1$, $p_2$ be equilibrium prices?
  - At prices $p_1$, $p_2$, there is excess supply of good 1 and excess demand for good 2 ($p_1$ is “too high” and $p_2$ is “too low”).
  - Lower $p_1$ and raise $p_2$ (recall slope of the budget line is $-p_1/p_2$).
Market Trade, cont’d

- At the competitive market equilibrium (or, Walrasian equilibrium), there is no excess demand or excess supply. Prices equilibrate supply and demand.
- And this equilibrium has nice properties: it is Pareto efficient.
- This is a general property of competitive market (Walrasian) equilibria. We thus have the following:

The First Theorem

- **Theorem**: All competitive market equilibria (or, Walrasian equilibria) are Pareto efficient.
  - *The First Fundamental Theorem of Welfare Economics* (Adam Smith’s “invisible hand”):
  - “[Every individual] generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. ... he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention.”
Alexander Pope, Essay on Man

On their own axis as the planets run,
Yet make at once their circle round the sun;
So two consistent motions act the soul;
And one regards itself and one the whole.
Thus God and Nature link’d the gen’ral frame,
And bade self-love and social be the same.

Epistle III, An Essay on Man (1733)

First Theorem: Discussion

- Informational economy: agents only need to know the prices they face. Then, the outcome of market trade will be efficient.
- In a two-agent world, this is not an exciting result. But it holds for large numbers of agents:
  - a strong case for the market as an allocation mechanism.
The Second Theorem

- **Theorem**: If preferences are convex, every Pareto efficient allocation can be achieved as the equilibrium outcome of competitive market trade.
  - “The Second Fundamental Theorem of Welfare Economics”
  - Or: Given convexity of preferences, we can always find a set of prices that supports any Pareto efficient allocation as a market equilibrium for an appropriately chosen endowment allocation.

Second Theorem: Illustration
The second theorem is a theorem about the separation of efficiency (a property of the allocation), and distribution.

Redistribution need not be concerned with efficiency:
- We can pick any (Pareto efficient) allocation, and redistribute to an appropriate (not necessarily Pareto efficient) allocation. The market will then achieve efficiency autonomously.

Redistribution: all we need to do is:
- choose the allocation X we like (by some welfare criterion),
- calculate the corresponding equilibrium prices,
- redistribute endowments to anywhere along the (constructed) budget line,
- then, market trade will automatically achieve efficiency (by the first theorem).
Production

… more opportunities …

General Equilibrium: Production

- In the pure exchange model, the amounts of good 1 and good 2 in the economy were given.
- We now study general equilibrium in production: how do producers decide how much (and using which input mix) to produce?
  - The quantities of the inputs capital (k) and labor (l) are given: how do firms produce output?
- The Edgeworth (production) box contains all feasible input combinations.
Production

- How much (and how) do firms produce?
  - Input allocation $R$ is not productively efficient: production of both goods can be increased.

Recall from Topic 4 that profit-maximizing firms always employ inputs such that the ratio of marginal products (the slope of the isoquant) is equal to the ratio of input prices.

- For firm 1:
  \[ \frac{MP^I_1}{MP^k_1} = \frac{w}{r} \]

- And for firm 2:
  \[ \frac{MP^I_2}{MP^k_2} = \frac{w}{r} \]

- Since both pay the same input prices, \( \frac{MP^I_1}{MP^k_1} = \frac{MP^I_2}{MP^k_2} \)
  - so the isoquants are parallel.
Product Mix

Are you being served?

Production Possibilities Frontier

- What are the combinations of outputs this economy could (at best) produce (with given amounts of inputs)?
  - For every quantity of good 2, what is the largest quantity of good 1 that can be produced (when factors are employed optimally)?
- This gives us a schedule of an economy’s production possibilities: the different output combinations the economy can maximally produce.
  - This is the *Production Possibilities Frontier (PPF)*.
The contract curve in the Edgeworth (production) box tells us where it is not possible to increase production of one good without reducing production of the other.

It has all the information we need for the PPF:
- Given any quantity of good 2, what is the maximum that can be produced of good 1?

As we move down the PPF, we gain more of good 1, but have to give up some of good 2.
- The absolute value of this ratio (the slope of the PPF) is the *marginal rate of transformation* (MRT).
What is MRT?
- As we gain one more unit of good 1, we need resources (k and l) costing MC₁.
- How much of good 2 do we need to give up to “free up” enough to buy inputs worth MC₁ (to produce this one unit of good 1)?
  - If we produce one unit of good 2 less, we free up MC₂.
  - If we produce 1 / MC₂ units of good 2 less, we free up $1.
  - If we produce MC₁ / MC₂ units of good 2 less, we free up MC₁.
- So MRT = MC₁ / MC₂. In a competitive market, this is equal to \( p₁ / p₂ \).

The economy is productively efficient (it produces on, not inside the PPF):
- which point on the PPF is chosen (the product mix) determines the size of the Edgeworth (exchange) box.
Efficiency

Efficiency in production:
- economy produces on PPF

Efficiency in exchange:
- consumers consume on contract curve

And: efficient product mix:
- \( MRT = \frac{p_1}{p_2} = MRS \)

- MRT = MRS is efficient:
  - Suppose MRT < MRS: we could have one more unit of good 1 for less of good 2 than how consumers are willing to substitute 1 for 2: we could make consumers better off.

Taxes

- Suppose good 2 is taxed (at rate t). Then, if prices are \( p_1 \) and \( p_2 \), producers get \( p_1 \) and \( (1 - t) p_2 \).
  - MRT > MRS
- This is inefficient:
  - in production we can substitute a lot of good 2 for one unit of good 1;
  - and consumers would be equally well off if, in return for losing one unit of good 1 they were compensated with only a little of goods 2.
- Too little of good 2 is being produced.
  - This is intuitive: a tax on good 2 reduces production of good 2.
Externalities

When things can go wrong.

Externalities: Production

- **Definition:** When an agent’s production possibilities depend on another agent’s consumption or production decisions, we have a *production externality*.
  - **Example:** The noise coming into my office from Tabard puts me off work. (Negative externality)
  - **Example:** Professor Scott talking to me makes me more productive. (Positive externality)
Externalities: Consumption

- **Definition**: When an agent has preferences over another agent’s consumption or production decisions, we say that there is a consumption externality.
  - **Example**: I dislike your consumption of cigarettes in my office. (Negative externality)
  - **Example**: I enjoy teaching an interested class that asks lots of questions. (Positive externality)

Externalities, cont’d

- In each case, there is a cost (for negative externalities) or a benefit (for positive externalities) imposed on someone other than the decision-maker.
  - Since the decision-maker does not bear this cost (benefit) herself, she does not take it into account in her decision.
- There will be “too much” of a negative externality and “too little” of a positive externality (relative to what is socially optimal).
Example: Noise

- Social and private cost diverge: the externality imposes an external cost on “society” (agents other than the decision-maker).
- Decision rule:
  - marginal cost = marginal benefit.
- Implication: privately and socially optimal quantities differ.

What’s the Problem?

- What goes wrong in the presence of externalities is that external costs and benefits are not taken into account by the decision-maker:
  - She does not face the full price (opportunity cost) of her actions:
    - I would be willing to bribe you not to play loud music; or: I would be willing to put up with your music if you paid me.
  - There is no market in which the externality is traded (and which would result in a price).
  - Externalities are an example of market failure.
What’s the Problem, cont’d

- If all parties affected by an external cost or an external benefit could negotiate with the decision-maker at *no transaction cost*, the socially optimal solution could be obtained.
  - Costless negotiation would institute a price.
  - If negotiation is not costless, the transaction cost from negotiation may outweigh the benefit to those affected by the externality. (No negotiation will take place.)

Example: Smoke

- Setup:
  - For person A, smoke is a good, for person B, a bad; both have equal amounts of money.
  - If there is a market for smoke, everything’s fine …
    - the equilibrium depends on who has the property right to clean air
  - If there is no market for smoke, things go wrong …
Coase’s Theorem

In 1960, Ronald Coase argued precisely what we have just seen:
- If negotiation is costless, the (socially) optimal allocation can be attained without action by the state.
- How likely is negotiation to be costless?
  - The more people are affected by the externality, the higher the transaction cost.
    » Example: polluted air
- What if negotiation is too costly?

Is there a Case for Intervention?

- The first section of Topic 5 (... when everything’s fine) is about why competitive markets do the best job at efficiency if they are perfectly competitive.
- For externalities, there exists no market (the market fails).
- Only when markets fail do economists see a case for state intervention.
What can the State Do?

- Institute an artificial price for the externality:
  - introduce a (“Pigouvian”) tax.

- Example: Noise.

- Tax emission of each decibel so that the private cost rises sufficiently so that it is equal to the social cost.
  - But how do governments know what the right tax is?

Public Goods and Government

“Why national defense is run by the government” and other stories.
Public Goods

- Public goods are goods that have two characteristics:
  - non-diminishability: if I consume some of the good there isn’t any less of it there for you
  - non-excludability: it is impossible or prohibitively expensive to exclude anyone from consuming the good

- Examples:
  - public parks
  - street lighting
  - national defense

What’s the Problem?

- What can go wrong with public goods is this:
  - Once a public good is provided, everyone (by non-excludability) can consume it.
  - So I would rather have you provide the public good (and you pay for it), than to provide it myself.
  - This is a “free rider problem:” I want to free-ride on your effort.
    - There is no reason to believe that profit-maximizers provide (the efficient level of) public goods.
What’s the Problem, cont’d

- Again, there is *market failure*:
  - If there were a price for the public good (which users pay and which the provider can collect), there would be an incentive to provide the public good if benefit > cost.
- Since, by definition (non-excludability), there is no price that can be collected, the market fails.
  - There is a case for state intervention.

Willingness to Pay

- The marginal-willingness-to-pay curve for a public good tells you how much you value (would just be prepared to pay for) each additional unit of the good. (cf. Topic 3)
  - (This is just an inverse demand curve.)
Willingness to Pay, cont’d

- To derive an inverse demand curve for the public good, or aggregate (marginal-) willingness-to-pay curve, we add the individual marginal-willingness-to-pay curves vertically.
- Why?
  - A fixed amount of the public good will be provided. Suppose this amount is $q^*$. How badly do people want $q^*$? At the margin, person A would be willing to pay $p_A^*$, and person B, $p_B^*$. Together, they are willing to pay (value at) $p_A^* + p_B^*$.

Optimal Provision

- How much of the public good should be provided optimally?
  - The quantity at which aggregate marginal-willingness-to-pay = marginal cost of provision.
  - Why? Suppose $MC > AMWTP$. Then the last unit of the public good costs more to produce than it is valued by society, so there should be less of it. (etc.)
Public Provision of Public Goods

If a person’s total WTP is less than the tax imposed on her, she will vote against provision.

Taxation:
- Suppose governments can only impose “lump-sum” taxes.
- The total cost of providing the public good is the area under MC (up to $q^*$).
- Each person’s valuation of (or, total willingness to pay for) a level of public good provision of $q^*$ is the area under her marginal willingness to pay curve.

Public Provision, cont’d

How should we tax (in order to finance public goods)?
- A tax on prices is inefficient:
  » expenditure tax (VAT)
  » income tax (changes the price of leisure)
- We should tax in a lump-sum way:
  » but if everyone pays the same, we may get the inefficiency on the previous slide;
  » and: it may seem inequitable.
  » We should impose a lump-sum tax on each person’s endowment (what they have) … largely, everyone’s capacity to earn income (not actual income earned).
Public Provision, cont’d

- But how do we tax earning potential?
  - If we ask people (and they know they will be taxed on their reply), they will understate their earning potential.
  - This is an asymmetric information problem: individuals have more information about their potential than the state.
  - The theory of optimal taxation is about constructing a tax schedule that elicits the “right” labor/leisure choice from people, while imposing the “right” tax.

Private Provision of Public Goods

- Private provision of public goods:
  - donations
    - social reward/stigma
    - large private benefit may be sufficient for provision
  - sale of by-products
    - Example: TV: access to audience (advertising). But: distortion to programming?
  - exclusion of non-payers
    - Example: pay-TV: paying for programming improves programming. But: people with low (but positive) WTP are excluded (although MC of provision for them is zero)
  - private contracts
    - Example: maintenance fee in condos
Public Choice

The Economics of Politics.

Social Choices

- If social choices (about public good provision) have to be made, how do we decide?
  - Individual agents’ preferences are fundamental.
- How do we aggregate individual preferences into “social preferences”? 
  - Dictatorship: only one person’s preferences count.
  - Utilitarianism: maximize the sum of everyone’s utility (“the balance of pleasure over pain”) (Bentham, Mill)
  - “Maximin:” maximize the utility of the least well-off person in society (Rawls)
  - Democracy: majority voting
Voting and the Condorcet Paradox

- One possible way of aggregating individual preferences into “social preferences” is voting:

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<th>Rank</th>
<th>Person A</th>
<th>Person B</th>
<th>Person C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>Y</td>
<td>Z</td>
</tr>
<tr>
<td>2</td>
<td>Y</td>
<td>Z</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Z</td>
<td>X</td>
<td>Y</td>
</tr>
</tbody>
</table>

- But: Social preferences from majority voting are intransitive: $X \succ Y, Y \succ Z, Z \succ X$
  - The outcome of voting depends on the order in which votes are taken.

The Median Voter Theorem

- **Example:** Voting over taxes (i.e. the level of public good provision)
  - Individual's tastes are distributed along a line: some people prefer low taxes (and low levels of public goods), others prefer high taxes (and high levels of public goods).
The Median Voter Theorem, cont'd

- Which party will win an election?
  - The party advocating the level of taxes preferred by the *median voter*.
  - Suppose there are two parties, D and R.
  - If they do not advocate the level preferred by the median voter, either party could gain votes by moving towards the median voter.

This is the *median voter theorem*:

- Whenever outcomes can be ranked according to the closeness to each voter’s most preferred outcome, the median voter’s most preferred option will prevail under majority voting.
Costs and Benefits

- So far we have answered the question: Who prefers what?
- We have not addressed the question: Who prefers what by how much?
  - Measure: total willingness to pay (consumer surplus).
  - Obviously this is important: if the people who prefer high taxation (and high public good provision) prefer this by a lot; and those preferring low taxation, prefer this by only a little, you should think that the outcome “should” be influenced by this.

Costs and Benefits, cont’d

- What we would like to do is weigh up the costs (loss of consumer surplus from having the high taxation option rather than the low taxation option) to some people against the benefits to others.
- If we have econometric estimates of consumer surplus (willingness to pay), we can pursue cost-benefit analysis.
  - Back to the question: What do we want to (socially) maximize? Overall happiness (utilitarianism)?
Positive and Normative Economics

- We have now started to delve deep into normative questions: how should society be organized?
- Economics itself cannot answer these questions …
- … but it can help us understand what the economic consequences are of adopting any one way of organizing social decision-making: it can answer positive questions.

Sadly …

The End.