NU Econ 101 Lecture 10: Efficiency

Lecturer: Shane Auerbach

Wednesday 22/06/16

Where are we now?

General equilibrium versus partial equilibrium analysis

General equilibrium analysis requires us to consider the markets for all goods simultaneously.

- A positive demand shock to one good may affect prices of other goods which may have secondary effects on the demand for the first good.

Partial equilibrium analysis focuses on the market for one good, assuming other markets remain unchanged (*ceteris paribus*).

- Analyzing all markets at once is hard. Easier to just focus on one market. This is what we did for smoked salmon.
- *ceteris paribus* = all else equal (in Latin).

Exchange economies

In an **exchange economy with production**, we model production and consumption together.

In a **pure exchange economy**, we take production as exogenous to focus on consumption.

- Instead of production, agents just enter the market with endowments of each good.
- We will focus on these for the next two sections.

Bundles and allocations

Suppose there are two goods in the world, guns and lollipops.

A **bundle** for agent i, z_i, is a quantity of each of the two goods.

- An example: $z_i = (9.2 \text{ guns}, 1.7 \text{ lollipops})$
- We would say $z_{i,1} = 9.2$ and $z_{i,2} = 1.7$.

An **allocation** is a bundle for each of the N agents:

- $z = \left((z_{1,1}, z_{1,2}), (z_{2,1}, z_{2,2}), \ldots, (z_{N,1}, z_{N,2}) \right)$

Feasibility

In a pure exchange economy, each agent i has an **endowment** e_i:

- In a two-good world, $e_i = (e_{i,1}, e_{i,2})$.

Suppose there are K goods.

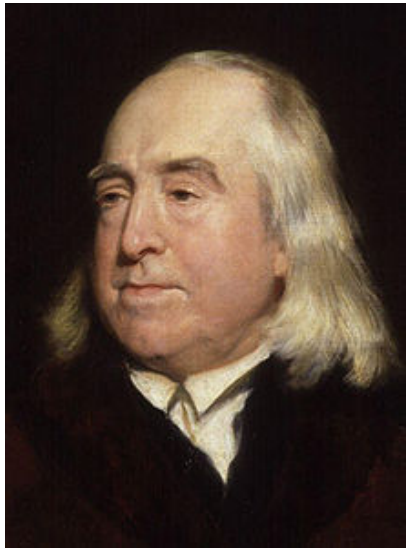
An allocation z is **feasible** if, for $k = 1, \ldots, K$:

$$\sum_{i=1,\ldots,N} z_{i,k} \leq \sum_{i=1,\ldots,N} e_{i,k}$$

- That is, an allocation is feasible if the total quantities of each good in the allocation do not exceed the total quantity of that good's endowment.

Where are we now?

Jeremy Bentham



Jeremy Bentham

Bentham was...

- a British philosopher, jurist, and social reformer.
- the founder of modern utilitarianism
- a real person, before becoming an auto-icon.

Fundamental axiom of utilitarianism:

- *It is the greatest happiness of the greatest number that is the measure of right and wrong.*

Utilitarianism (1)

We're trying to maximize happiness? Let's maximize utility:

$$z^* = \arg\max_z \sum_i u_i(z_i)$$

$$\text{subject to } \sum_{i=1,\ldots,N} z_{i,k} \leq \sum_{i=1,\ldots,N} e_{i,k}$$

That is, we could say that an allocation is efficient if it maximizes the sum of all of the agents' utilities (and is feasible).

Utilitarianism (2)

We call the thing utilitarians try to maximize a **social welfare function (SWF)**. There are a couple key variants:

- Benthamite SWF: $\sum_i u_i(z_i)$
  - Treat all equally, but willing to take something from a poor person and give it a wealthy one if the wealthy derives more utility from it.
- Max-Min/Rawlsian SWF: $\min_i u_i(z_i)$
  - Our social welfare is how much utility the society offers to the least favored member.

Suppose everybody else reports their utility function as $u_j(x, y) = \sqrt{x \cdot y}$, how should you report your utility?

Utility monsters! (Nozick 1974)

Suppose there is just one good, cookies (x), there are ten million cookies and ten million people, and everybody else reports utility function $u(x) = \sqrt{x}$. What about cookie monster (CM)?

A Utility Monster

If the social welfare function is **Benthamite**:

- CM reports $u_{CM}(x) = 2x$,
  - gets all of the cookies!

If the social welfare function is **Rawlsian**:

- CM reports $u_{CM}(x) = \sqrt{x} - 10\,000\,000$,
  - gets all of the cookies!

There is no way to aggregate utilities to remain immune to a utility monster!

Interpersonal comparisons of utility (1)

By aggregating individual utilities into a social welfare function, we implicitly assume **interpersonal comparisons of utility**.

- We are taking **cardinal utility** very seriously!

Social choice theory, which includes utilitarianism, requires these comparisons.

Interpersonal comparisons of utility (2)

Defenders of social choice theory say we can *partially* compare utilities interpersonally.

Was it efficient for Nero to burn down Rome? (Sen 1970)

- Most of us would agree that it wasn't.
- This judgment entails an interpersonal comparison – we're valuing the losses of most Romans over Nero's pleasure.

Still, maybe we don't want interpersonal comparisons of utility involved in our notion of efficiency . . .

Where are we now?

Vilfredo Pareto

Vilfredo Pareto

Vilfredo Pareto was...

- an Italian engineer, sociologist, economist, political scientist, and philosopher.
- a critical contributor to the development of microeconomics as a positive science.
- a fascist (?).

Pareto improvements and Pareto efficiency

Pareto improvement

A change from one feasible allocation to another feasible one that makes at least one individual better off without making any other individual worse off.

Pareto efficiency (or Pareto optimality)

A state of allocation in which it is impossible to make any one individual better off without making at least one individual worse off. **OR:** An allocation for which no Pareto improvement exists.

Examples

Suppose $u_1(x, y) = x$, $u_2(x, y) = y$, and $e_{i,k} = 1$ for all i, k.

Are these allocations Pareto efficient?

1. $z' = ((0, 0), (0, 0))$
   - $z' = ((1, 0), (0, 0)$ is a Pareto improvement.
2. $z'' = e = ((1, 1), (1, 1))$
   - $z' = ((1.5, 0.5), (0.5, 1.5)$ is a Pareto improvement.
3. $z''' = ((2, 0), (0, 2))$
   - Pareto efficient.

Pareto efficiency and fairness

Note that Pareto efficiency is a totally separate idea from fairness. Suppose $u_1(x, y) = u_2(x, y) = x + y$ and there are ten units of each good to be allocated.

- $((10, 10), (0, 0))$ is Pareto efficient.
- $((0, 0), (10, 10))$ is Pareto efficient.
- Any allocation that uses all of both goods is Pareto efficient.

Pareto efficiency and MRS (1)

It might seem that Pareto efficiency is a weak notion of efficiency.

Yet, for standard utility functions (i.e. Log, C-D), Pareto efficiency requires that the allocation is such that all agents have the same marginal rate of substitution.

The idea:

- The marginal rate of substitution is the rate at which a consumer can substitute one good for another and maintain the same utility.
- If $MRS_{XY}(z)$ is greater for one agent than for another, the former could trade some y to the second for some x and both would benefit (i.e. a Pareto improvement).

Pareto efficiency and MRS (2)

An example: Suppose for agents A and B and allocation z:

$$MRS^A_{XY}(z) = \frac{2}{1} > \frac{1}{2} = MRS^B_{XY}(z)$$

Then consider z' where A has given one unit of Y to B and B has given one unit of X to A.

Both parties benefit:

- A lost one unit of Y, losing one util, but gained one unit of X, gaining two utils.
- B lost one unit of X, losing one util, but gained one unit of Y, gaining two utils.

z' is a Pareto improvement, so z is not Pareto efficient.

Pareto efficiency and markets

Remember we said in consumer theory that a consumer optimally sets her marginal rate of substitution equal to the price ratio?

- Equivalently, equating the slope of the indifference curve to the slope of the budget constraint.
- This was embedded in the golden rule.

This ensures that a market equilibrium is Pareto efficient.

- Since each consumer's MRS matches the price ratio, they all match eachother, hence Pareto efficient!

Pareto and Nero

Was it efficient for Nero to burn down Rome? (Sen 1970)

- Utilitarians say no.
- Pareto says sure . . . .
    - The alternative, in which he doesn't burn down Rome, is not a Pareto improvement because Nero is worse off.

A note: This doesn't mean Nero *should have* burned down Rome.

- NOT burning down Rome is also Pareto efficient.

Where are we now?

Productive efficiency

So far we have focused on exchange economies.

- We could talk about efficiency in terms of just consumption.

We also want production to be efficient!

- Suppose we can produce one unit of output with one unit of capital and one unit of labor.
- OR we can produce one unit of output with two of each.
- First option is more efficient.

Absolute advantage

Suppose we have two employees, Ann and Bob. We produce two types of output: legal (l) and medical (m) advice.

- Per hour, Anne can produce 4 units of l or 3 of m.
- Per hour, Bob can produce 2 units of l or 1 of m.

Anne has the absolute advantage in both goods, because she can produce more of each per hour than Bob.

Comparative advantage (1)

Who has the comparative advantage in each good?

Legal advice (l):

- To produce one unit of l, Anne foregos $3/4$ of a unit of m.
- To produce one unit of l, Bob foregos $1/2$ of a unit of m.

Bob has the comparative advantage in l.

Medical advice (m):

- To produce one unit of m, Anne foregos $4/3$ of a unit of l.
- To produce one unit of m, Bob foregos 2 units of l.

Anne has the comparative advantage in m.

Comparative advantage (2)

Does this mean that Anne should spend all her time on m and Bob should spend all of his on l?

- No – maybe we don't want to produce that ratio of l to m.

What does it mean?

- Anne should only produce l if Bob has maxed out his time on l and the firm still wants more l.
- Bob should only produce m if Anne has maxed out his time on m and the firm still wants more m.

Comparative advantage (3)

We can see the benefit of having people work at their comparative advantage by comparing it to what happens if Anne and Bob were used identically.

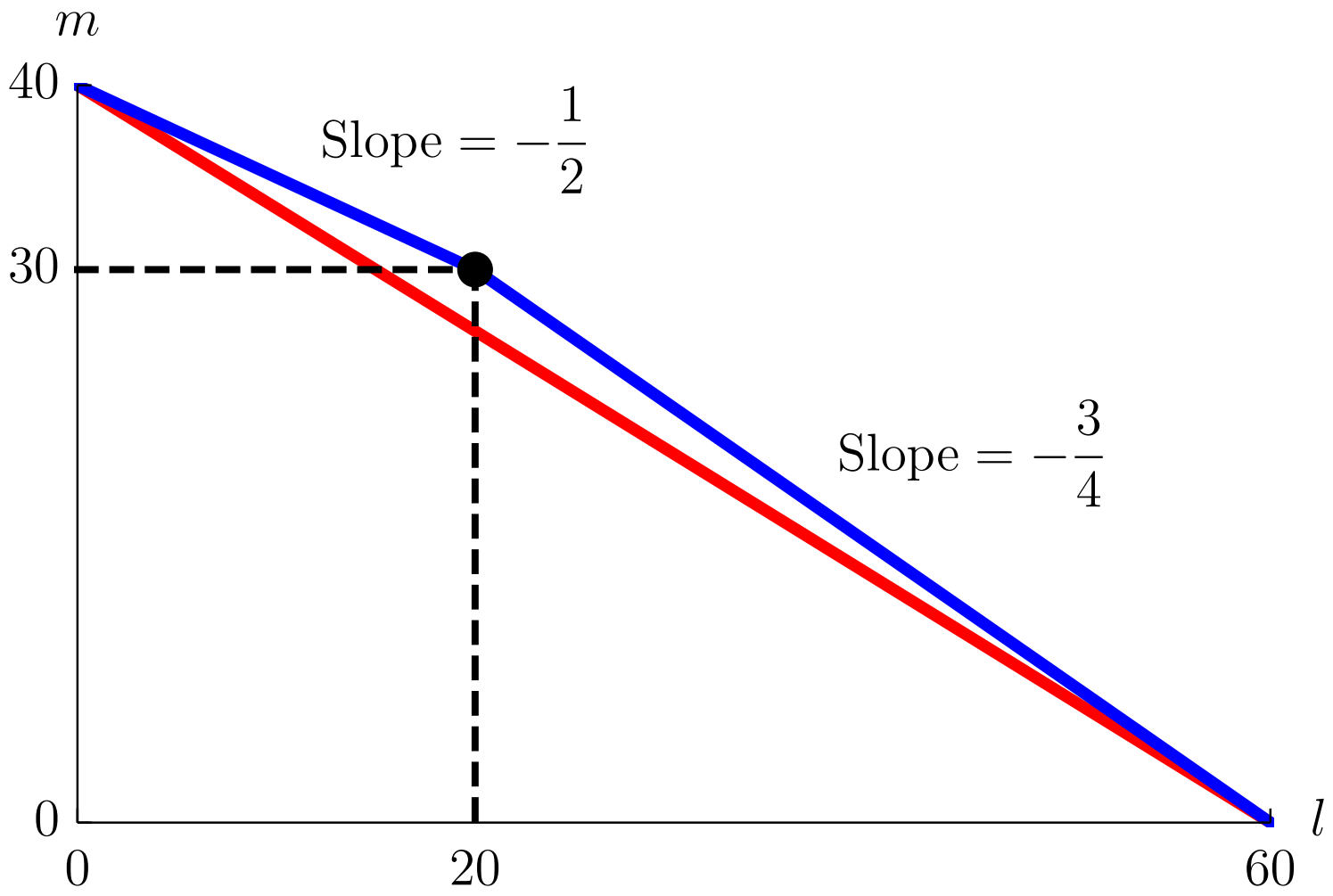
Production possibility frontier (PPF)

A graphical representation of possible combinations of two goods with constant resources and technology.

- We'll do one PPF where they're used optimally.
- We'll compare it to another where they're used identically.

We'll suppose each works a ten-hour day.

Production possibility frontiers



Blue is the PPF. Red is if we (stupidly) use the workers identically.

Productive efficiency and markets

Productive efficiency requires that firms produce on their PPF.

- More broadly: societal production is on a societal PPF.

Profit maximization and cost minimization imply that firms produce on their PPF.

- In our model of markets, productive efficiency is guaranteed.

Where are we now?

Allocative efficiency (1)

It's great for firms to produce on their PPFs, and for a society to produce on its societal PPF, but we also want to produce goods at the optimal ratio.

- Perhaps people demand more m than l.
- This will dictate where on each PPF we should produce.

What is optimal production for a society?

- We want to produce a good if the marginal social benefit of producing that good is higher than the marginal social cost.

Allocative efficiency (2)

The supply curve *is* the marginal cost.

- And marginal cost is the marginal social cost – only the firm producing the good sustains costs.

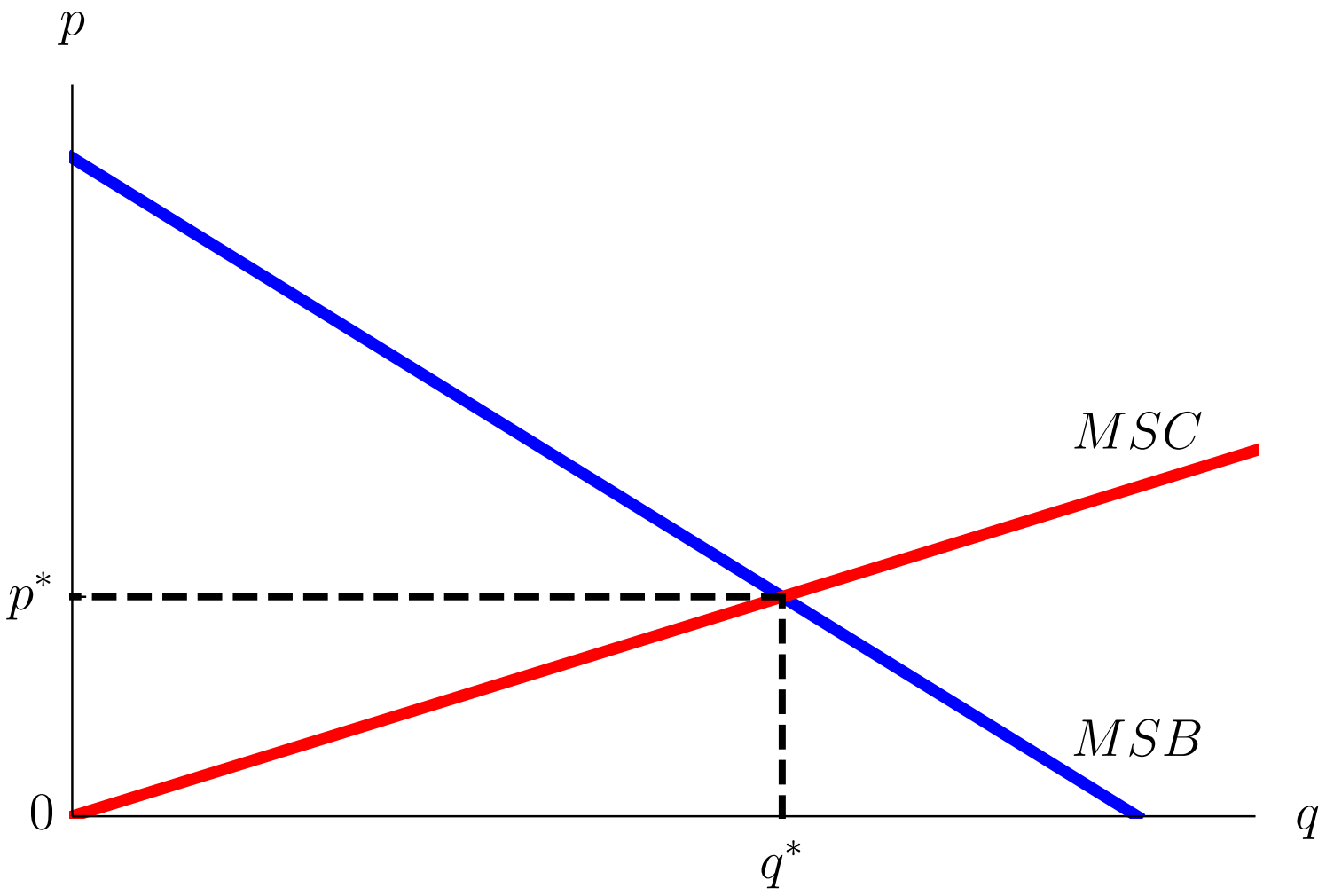
The demand curve *is* the marginal social benefit.

- At $p(q) = 10$, agents are willing to pay \$10 for the good, hence that is the marginal social benefit.

Therefore, when we equate supply and demand, we are equating marginal social cost with marginal social benefit.

- **Markets yield allocative efficiency!**

Allocative efficiency (3)



Where are we now?

Let's review the exam ...

If time remains, we'll have a look at the exam.