Revised October 20, 2025

14.03/003 Micro Theory & Public Policy, Fall 2025

Lecture slides 12. General equilibrium in a pure exchange economy

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Motivation for general equilibrium

- So far we talked about one market at a time: fast-food workers, real estate brokers, rice
- In reality, all markets interact through substitution effects, income effects, and complementarities
  - **Substitution effects**—If the price of Ramen rises, I might buy more peanut butter, jelly, and bread
  - **Income effects**—If my rent rises, I might eat out less often and cut down on cold brew
  - **Complementarity**—If the price of peanut butter falls, I might buy both more peanut butter *and* more jelly
  - Similar processes operate on the **supply side** of the market: If *everyone* buys more jelly when the price of peanut butter falls, then the price of jelly will rise

Motivation for general equilibrium

- All changes in quantities or prices ultimately feed back into the demand and/or supply for other goods through several channels.
- We need a model that can accommodate the interactions of all markets simultaneously and allows us to determine the properties of the grand equilibrium.
- This is the goal of the General Equilibrium (GE) model.

The Edgeworth box

- To make the general equilibrium problem tractable, we want to reduce the dimensionality of the "all markets" problem to something manageable
- The Edgeworth Box provides the tool we need
- Focus here on two goods and two people
- Edgeworth box depicts the gains in welfare that may accrue from pure exchange of goods
- Intuitively demonstrates two fundamental results in economics: the First and Second Welfare Theorems

From (1) Consumer Choice to (2) Partial Eq'm to (3) General Eq'm

	Consumer's Problem	**Partial Equilibrium**	**General Equilibrium**
Preferences	Exogenous	Exogenous	Exogenous
Budget set	Exogenous	Exogenous	**Endogenous**
Prices	Exogenous	**Endogenous**	**Endogenous**
Consumption	**Endogenous**	**Endogenous**	**Endogenous**

Edgeworth notation

- There are two goods: call them food F and shelter S. There are two agents: call them A and B. The initial endowment is:

$$\begin{aligned} E_A &= (E_A^F, E_A^S) \\ E_B &= (E_B^F, E_B^S) \end{aligned}$$

- The consumption of A and B are denoted as:

$$\begin{aligned} X_A &= (X_A^F, X_A^S) \\ X_B &= (X_B^F, X_B^S) \end{aligned}$$

- *Without trade* between agents A and B, their consumption bundles will equal their endowments:

$$\begin{aligned} X_A &= E_A \\ X_B &= E_B \end{aligned}$$

- *With trade*, many exchanges between A and B become feasible, but the following equalities must always hold:

$$\begin{aligned} X_A^F + X_B^F &= E_A^F + E_B^F \\ X_A^S + X_B^S &= E_A^S + E_B^S \end{aligned}$$

- This is a model of *exchange without production*, but that's merely for simplicity. Adding production does not change the problem (though it adds to the fun)

The Edgeworth box: Endowments and preferences

A Graphical Example

Market conditions for trading

We will assume that trade between A and B satisfies these four conditions

1. No transaction costs
2. No market power
3. No externalities
4. Full information

What constraints must general equilibrium satisfy?

1. Preferences respected—freedom of choice

   No one prefers initial endowment to market equilibrium

2. All gains from trade exhausted

   No Pareto-improving trades remain (allocative efficiency)

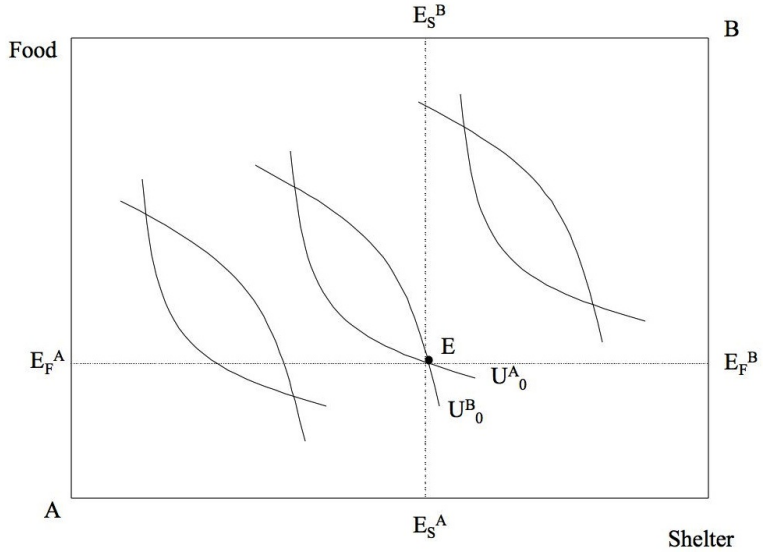
3. All markets clear

   No excess demand or supply of any good

– Note that although we are discussing markets *clearing*, there are no prices in this model (yet). *Prices are endogenous*

What happens when A and B trade

Pareto improvements

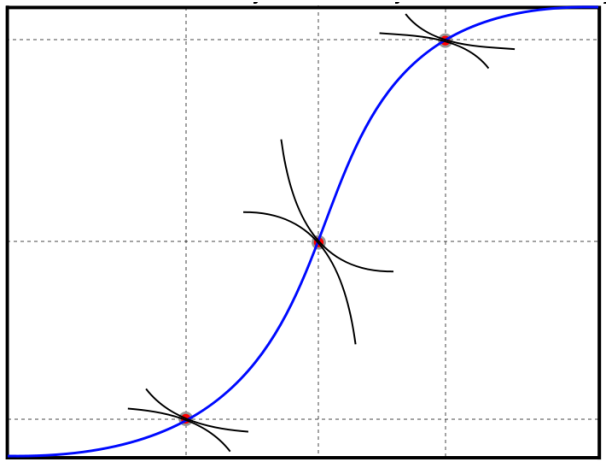


Pareto efficient allocations

The contract curve

Pareto efficient allocations

The contract curve



How to get from E to a point on the contract curve?

Walrasian auctioneer

1. In the initial endowment: *Market clears (that is, all goods consumed) but the allocation is not Pareto efficient*
2. An auctioneer could announce new prices, then both parties could trade what they have for what they preferred at these prices
3. Problem: *Choices would then be Pareto efficient but would not necessarily clear the market*
4. It's possible there would be extra F and not enough S or vice versa
5. So, must re-auction at new prices...

Walrasian auctioneer

Prices with infeasible consumption plans

Walrasian equilibrium

- What should auctioneer do? Raise P_F/P_S (=decrease P_S/P_F)
- When the auctioneer gets the price ratio correct, the *market clears*
  - This is a market equilibrium or competitive equilibrium or Walrasian equilibrium.
- In equilibrium
  1. Each consumer chooses his most preferred bundle given prices and his initial endowment
  2. All choices are compatible so that demand equals supply
  3. Pareto efficient consumption ('Allocative Efficiency') $\left(\frac{\partial U/\partial S}{\partial U/\partial F}\right)_A = \left(\frac{\partial U/\partial S}{\partial U/\partial F}\right)_B$

Walrasian equilibrium

Pareto efficiency

- How do we know **Pareto Efficiency** will be satisfied?
  - Because both A, B face the same prices
  - Each person's optimal choice will therefore be the highest indifference curve that is tangent to her budget set given by the line with the slope P_S/P_F that intersects E
  - These choice sets (for A, B) are separated by the price ratio, so we know they will be tangent but not intersect

How do we reach the equilibrium?

- Leon Walras loosely proved that the market can reach this equilibrium without assistance from a central planner
- This result—*the existence of general equilibrium as a self-organizing outcome of the market*—is fundamental
- The description that Walras used was that the economy would reach equilibrium through a process of *Tattonment* (trial and error).

First welfare theorem: A free market, in equilibrium, is Pareto efficient

All gains from trade exhausted

1. There is no excess demand or supply for any good—no wasted resources
2. No consumer wishes to sell a good at the market price but cannot find a buyer
3. No consumer wishes to buy a good at the market price but cannot find a seller
4. Every consumer is weakly better off than at their initial endowment
5. The equilibrium is **Pareto efficient**

Reminder: Result rests on the following conditions

1. No externalities
2. Perfect competition
3. No transaction costs
4. Full information
5. And we are continuing to invoke Axioms A1–A5 of consumer theory

It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our necessities but of their advantages.

– Adam Smith, *The Wealth of Nations*, 1776

Every individual necessarily labors to render the annual revenue of the society as great as he can.... 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...

– Adam Smith, *The Wealth of Nations*, 1776

First welfare theorem: Another perspective

Can think of General Equilibrium as an optimal resource allocation problem subject to three constraints

(C1) No actor is worse off in the market equilibrium than in the initial allocation

(C2) At the eq'm, no party can be made better off without making another party worse off

(C3) No more goods can be demanded/consumed than the economy is endowed with

First welfare theorem: Another perspective

- The *First Welfare Theorem* says that the free market equilibrium is the *decentralized, self-solving* solution to this problem
- Simply by allowing trade among small market actors, the market solution—that is, the price vector and resulting equilibrium choices—will satisfy the three constraints above
- An important result: implies that the decentralized market continually "solves" a complex problem that would be difficult for any individual (or large government agency) to solve by itself

Second welfare theorem

Does the 1st Welfare Thm guarantee that market eq'm will be *fair* or *equitable*?

- No – not at all
- There are many alternative Pareto efficient allocations of resources differing in allocations among parties
- Some Pareto efficient allocations are pretty unattractive — e.g., give *everything* to one person

Second welfare theorem

- **Is there a trade-off between between efficiency and equity in equilibrium?**
  - Second Welfare Theorem says the answer is **no**
- **Restated:** Given a Pareto efficient allocation of resources, **must there exist** prices and an initial endowment so that this allocation is supported as a competitive equilibrium?
  - The Second Welfare Theorem says that the answer is **yes**
- In other words, there is **no trade-off** between equity and efficiency
  - But this is **true only if** lump-sum transfers are feasible

Second welfare theorem

- Providing that preferences are convex and conditions C1-C4 are satisfied, any Pareto efficient allocation can be supported as a market equilibrium

- **Question:** If we don't like the distribution of wealth in the market equilibrium, how do we change it?