Introduction to General Equilibrium Models

Introduction to General Equilibrium Models

We are interested in understanding how changes in economic conditions affect the wellbeing of real people. What would happen to the economy if taxes were cut or if trade with China were banned? In another field, a scientist might run an experiment. How do bald mice respond to the latest baldness cure? Unfortunately, we cannot run such experiments in a large complicated economy. Instead, economists will create imaginary worlds called economic models.

In a world in which.....

In International Trade, we use general equilibrium models to analyze how international trade affects the economy.

General Equilibrium Models capture the interaction between the key, economy-wide variables of interest. These models contain a common set of ingredients. These ingredients specify how resources are turned into goods and how markets determine how these resources are in fact used.

1. **Technology**: How are factors (raw inputs, such as labor, capital, and land) turned into the goods that people consume?
2. **Endowments**: Are the stock of factors are available to the economy for production. Example: the U.S. labor force is roughly 180 million.
4. **Preferences (Tastes)**: What do consumers value? How many units of one good are they willing to give up to get one unit of another good?

Technology and Endowments determine a country’s resource constraint, which is also known as the economy’s production possibility frontier (PPF).
In the absence of international trade, a country’s PPF when combined with the assumptions over market structure and consumers’ preferences determine how much of each good that will be produced.

**The Simplest General Equilibrium Model**

Imagine a world with one factor called labor (L) that can be used to make two goods, X and Y.

**Supply**

**How the PPF is derived.**

Technology is captured by production functions. For instance,

\[ Q_Y = 5L_Y, \quad Q_X = 2L_X, \]

where \( Q_X \) and \( Q_Y \) are the output of X and Y and \( L_Y \) and \( L_X \) are the amounts of labor used in the production of X and Y. In this example, the marginal product of labor in Y is given by 5 and the marginal product of labor in X is 2.

The country’s endowment of X is assumed to be 100, or \( L_E = 100 \).

Assuming that all labor is used, then the resource constraint is

\[ L_E = L_X + L_Y. \]

Note that we assume that labor moves freely between the two uses.

Solving for \( L_Y = Q_Y/5 \) and \( L_X = Q_X/2 \), and substituting into the resource constraint gives us the country’s production possibility frontier:

\[ Q_Y = 500 - (5/2)Q_X, \]
which we can graph easily. The slope of this equation gives us some important information about the imaginary economy: the opportunity cost of good X in terms of good Y. Increasing output of X by one unit requires us to move labor out of producing Y. Given the technology of the economy, production of Y will have to fall by 5/2 in order to expand production of X by one unit.

**Question:** What happens to the PPF if there is technological advance: MPL\textsubscript{Y} increases to 6?

**Where on the PPF will the economy produce?**

To answer this question, we have to make assumptions about market structure. We assume the market structure in the markets for both goods and in the labor market is perfect competition.

Let

- P\textsubscript{X} be the dollar price of a unit of good X,
- P\textsubscript{Y} be the dollar price of a unit of good Y,
- and W be the dollar price of a unit of labor.

With perfect competition, P\textsubscript{X}, P\textsubscript{Y}, and W are taken as given by all firms.

**Implications of perfect competition**

Notice that the perfect competition assumption has the following implications

- The wage rate is the same in both industries.
- P\textsubscript{X} MPL\textsubscript{X} \leq W and P\textsubscript{Y} MPL\textsubscript{Y} \leq W.
- If both goods are to be produced, then P\textsubscript{X} MPL\textsubscript{X} = W = P\textsubscript{Y} MPL\textsubscript{Y}, so P\textsubscript{X}/P\textsubscript{Y} = MPL\textsubscript{Y}/MPL\textsubscript{X} = 5/2.
This ratio, $P_X/P_Y$, is the relative price of good X in terms of good Y. It is NOT in terms of dollars. This relative price tells us the opportunity cost of good X in terms of good Y facing consumers.

A key point made by Adam Smith over 200 years ago: when there is perfect competition in all markets, firms charge prices that reflect the exact resource costs facing the country.

**Question:** What would happen to output if $P_X/P_Y < 5/2$?

**Demand**

**A Review of Consumer Theory**

**The Budget Constraint**

Let I be the dollar income of a worker, and let $P_X$ and $P_Y$ continue to be the prices of goods X and Y. Let $D_X$ be the amount demanded of good X and $D_Y$ be the amount demanded of good Y. If a consumer spends all of her income on goods X and Y, we have

$$I = P_X*D_X + P_Y*D_Y.$$  

After only a little bit of algebra, we have

$$D_Y = (I/P_Y) - (P_X/P_Y)*D_X,$$

which can be easily graphed. Here again we see the role of relative prices – they indicate the opportunity cost of good X in terms of good Y facing a consumer.

Now connect the budget constraint to the problem at hand.

Workers collective income is $W*L_E$ (The country’s GDP) and $P_Y = W/5$ and $P_X = W/2$. Hence, we have

$$D_Y = 500 - (5/2)*D_X,$$
which turns out to be exactly the same equation as the PPF for this country!

**Market Clearing**

In equilibrium, it markets must clear so $D_X = Q_X$ and $D_Y = Q_Y$.

**Which bundle on the PPF/Budget Constraint do workers choose to Consume?**

To answer this, we need the last part of the general equilibrium model: preferences or tastes. We capture these using the concept of indifference curves.

![Indifference Curves](image)

Assumptions behind the way that indifference curves are drawn:

1. consumers want more of all goods, and
2. ceteris paribus consumers get diminishing returns out of consuming more of the same good.
From these assumptions it follows that indifference curves are convex (as shown) and higher indifference curves imply greater utility. Changes in income and relative prices change a consumer’s budget constraint but have no impact on the consumer’s tastes. That is, the map of indifference curves never changes, just which curve we can reach. The tastes of the entire country are represented using a single set of indifference curves that tell us which bundle on their budget constraint consumers choose and how well off they are.

**Indifference curve don’ts:** NEVER, EVER, EVER, EVER draw a diagram so that the indifference curves appear to cross.

**Autarky Equilibrium**

Autarky means NO trade, so an autarky equilibrium is a No-trade equilibrium.

In equilibrium,

- Firms choose employment and output to maximize their profits taking as given prices of goods and the wage,
- Consumers choose consumption to maximize their utility subject to their budget constraint,
- Markets clear (all the output produced by firms is demanded by consumers).

Note: don’t necessarily need to provide specific numbers for consumption levels, but to be able to draw the relevant diagram.

**Comparative static** (change one variable and see how the equilibrium changes): consider productivity growth in good X, show how people are better off because they get to a higher indifference curve.

- Emphasize the indifference curve don’t.