Chapter B: Comparative Advantage

(represents chapters: 3-8)

Technology

The starting point of our analysis is provided by Adam Smith. He developed the absolute cost advantage theory. However, there were many economists that criticized this theory. The most important one of these critics was David Ricardo. His contribution to the economy is called the Ricardian model. Ricardo developed the comparative cost advantage theory.

In classical and neoclassical economics we often combine the assumption of *constant returns to scale* with the assumption of *perfect competition.* If a firm wants to produce x units of a good, its costs are cx. The firm's profits, π, are total revenues minus costs. See attachment B.1 for the formula.

When the price p of a good is equal to the unit costs of production c, profits are zero independently of the level of production. When the price is lower than the unit cost, then it is most profitable not to produce at all. Profits will be made when the price exceeds the unit cost.

Absolute cost advantage theory: When a country can either import a commodity or produce it at home, it compares the cost of producing at home with the cost of procuring from abroad. If the costs of producing abroad are less than the costs at home, the country imports.

See attachment B.2 for an example of a productivity table. As is clear from the table, the EU is more efficient in the production of both goods. Based on the absolute cost advantage theory, the EU would not import from Kenya.

However, the **comparative cost advantage theory** argues that only relative costs are important for determining a nation's production advantages. A country will produce the good they produce relatively most efficiently.

Kenya is twice as inefficient as the EU in producing food but three times as inefficient as the EU in producing chemicals. Therefore, it should specialize in the production of food and export it to the EU in exchange for chemicals.

The theory of comparative costs is better than the absolute costs theory. However, the per capita welfare is based on absolute cost advantages.

To determine the maximal production for the countries we have to determine the amount of the production factors available. For instance, in the EU there are 200 laborers and in Kenya there are 120 laborers. The maximum production of food for the EU is then 200/2 = 100. We have to keep in mind that there are constant returns to scale and there is only one factor of production

In attachment B.3 one can find a table with total labor available and corresponding maximum production levels per country.

If the EU produces 100 units of food and zero units of chemicals and it now wants to produce 1 unit of chemicals, 8 laborers have to be transferred from food to chemicals. The food production will drop with 8/2=4 units. This change is *equiproportional*, such that the Ricardian production possibility frontiers (PPF's) are straight lines.

Production Possibility Frontier (PPF): All possible combinations of efficient production points of final goods, given the available factors of production and the state of technology.

Consumers in both countries choose the optimal consumption point along the PPF, while entrepreneurs adjust their production levels to satisfy the consumers. The PFF is a straight line. The PPFs for Kenya and the EU can be found in attachment B.4.

We assume that both countries want to consume at least some units of both goods.

1. If the price of chemicals in the EU is more than 4 units of food, entrepreneurs want to produce only chemicals and no food.
2. If the price of chemicals in the EU is less than 4 units of food, entrepreneurs want to produce only food and no chemicals.
3. The first two options cannot be an equilibrium price and therefore, the price of chemicals is 4 units of food in autarky in the EU. So that entrepreneurs want to produce both food and chemicals.

The price of chemicals in terms of food in is a_C^{EU} / a_F^{EU} = 8/2 = 4 in the EU and a_C^K / a_F^K = 24/4 = 6 in Kenya.
As for the gains from trade, we can distinguish three different cases:

- If trade is between four and six units of food, both countries will gain.
  Kenya will produce only food and will import the necessary chemicals from the EU at a price of 4.8. Similarly, the EU will only produce chemicals and will import the necessary food from Kenya. Consumers are able to choose a consumption point above the old optimum, because the budget line has shifted outwards.
- If trade is four units of food, only Kenya will gain and the welfare in the EU will remain unchanged. In this case the EU will completely specialize on the production of chemicals and food production will drop. Production levels in the EU are much higher than in Kenya, the terms of trade will be the same as before opening up to trade. The equilibrium price in the EU will remain the same, this implies that the budget line of the EU has not changed and therefore the welfare does not change. Kenya specializes completely on food and can trade this with the EU. As a result of the trade with the EU, the welfare of Kenya will rise.
- If trade is 6 units of food, only the EU will gain and the welfare of Kenya will remain the same. In this case changes similar to what is described in point 2 will happen.

In the example of Kenya and the EU there are only two countries and two goods. However, we can also have situations with many countries and many final goods. The method used before to determine comparative advantage is more difficult in this situation.

To solve this problem we need a measure to determine the strong sectors of an economy. The most frequently used measure for this is the Balassa index.

Balassa Index (BI_j^A): Indicates whether a country has a strong position in a certain sector. The formula to calculate the Balassa index can be found in attachment B.5.

If we use the term goods, we refer both to goods and services, although there is a difference between these two. If countries become wealthier, their services sectors become more important and the agriculture sectors become less important.

Production structure

To understand the principles behind international trade and capital flows it is important to study the foundations of neoclassical economics. This theory focuses on differences in relative factor endowments as a cause for international trade and is based on the following 4 propositions:

- The **factor price equalization proposition**: International free trade of goods leads to an equalization of factor prices.

- The **Stolper-Samuelson proposition**: An increase in the price of a final good will increase the reward of the intensively used production factor and reduce the reward of the other production factor.

- The **Rybczynski proposition**: An increase in the supply in a production factor results in an increase in the output of the final good that uses this factor intensively and a reduction in the output of the other final good.

- The **Heckscher-Ohlin proposition:** A country will export the good that intensively uses the relatively abundant factor of production.

The HOS model: Model that is based on the findings and thoughts of Heckscher, Ohlin and Samuelson. This model has the following structure:

1. There are two countries, two final goods and two factors of production(labor and capital)
2. There are **constant returns to scale**: If both factors of production are increased by the same multiplicative factor κ, the output also increases by that factor κ.
3. Identical technology; no technology differences between the countries.
4. Labor and capital are mobile between different sectors but not between countries.
5. There is perfect competition in all markets.
6. The demand structure of the two countries is the same.
7. The available amounts of labor and capital may differ between the two countries.

The Cobb-Douglas production functions for the manufacturing sector (M) and the food sector (F) can be found in attachment B.6. The parameter α (α_m, α_f) measures the intensity of the production factor. At least one of the factors is needed to produce any output.

Isoquant: Line of all possible efficient combinations of capital and labor able to produce a certain level of output. An example of an isoquant with M=1 is found in attachment B.7.

The goal of the entrepreneurs is to achieve profit maximization. If entrepreneurs do not strive for this goal they will be driven out of business. The entrepreneur can divide the production decision into two steps:

- *Cost minimization*. The entrepreneur determines the level of costs associated with a certain level of input. The entrepreneur can choose between two different inputs, capital and labour. With wage rate ω and rental rate r, then
  Costs = ω L + r K

  This equation gives different combinations of labor and capital at a specific cost level which leads to straight lines, called isocost lines. These isocost lines have a slope of –ω/r.

- *Output determination*. To determine what the profit maximizing point is it is necessary to determine the level of output you want to achieve. The profit maximizing point is the point where the isoquant touches the isocost line. This point is marked as point A in the graph. The maximizing profit point leads to inputs of capital, K, of labour, L. See attachment B.8.

Capital-labor ratio: the optimal relative input combination of labor and capital. See attachment B.9 for the formula. This ratio depends on two factors:

1. The ratio is higher if the parameter α rises.
2. The ratio is higher if ω/r rises.

If there is an equiproportional change in the wage rate and the rental rate, the slope of the isocost line will be unchanged. If the wage rate rises, the demand for capital will rise. If rental rates rise, the demand for labor will rise.

We assume that the production of manufacturers is more capital intensive than the production of food for all wage-rental ratios. This means that $\alpha_m > \alpha_f$.

Assuming that there are constant returns to scale in the production process gives us two important simplifications for:

- The structure of the isoquants. If we know one isoquant and we know that there are constant returns to scale, we can determine all isoquants. All the isoquants are radial blow-ups of one another.
- The cost minimization. The slope of the isoquant is the same in all the intersect points of the isoquant and the isocost line. The line from the origin through all these intersect points is called the **expansion path.**

Factor prices

Factor price equalization proposition (FPE): In a neoclassical framework with two final goods and two production factors, there is a one-to-one correspondence between the prices of the final goods and the prices of the production factors, provided both goods are produced. It states that if factor rewards (ω,r) are known, the price p can be derived and when the prices are known, factor rewards can be derived.

The FPE proposition has been extended by the statement of corollary, which states that prices of goods in two nations will be equalized by international trade. The same holds for rewards of production factors in two countries. We have to assume that the state of technology in the two nations is the same.

Lerner diagram: A diagram with the unit value isocost line and the unit value isoquant. So that:

- $\omega L + r K = 1$ (unit isocost line)
- $p_m LM = 1$ and $p_f F = 1$ (unit isoquants of manufacturers and food)

An example of a Lerner diagram can be found in attachment B.10. This graph shows the connection between costs and revenues. The equilibrium production point is found where the unit isocost line is tangent to the unit value isoquant. For manufacturers this point is point A and for food this is point B.

If a good is produced under perfect competition then the price of the good is equal to the costs of producing the good. So there are no profits. If the price of manufactures rises, the unit value isoquant of manufactures will shift inward because fewer goods are needed to achieve one unit of value.

Stolper-Samuelson proposition: An increase in the price of a final good increases the reward to the factor used intensively in the production of that good and reduces the reward to the other factor of production.

Assuming that the relative capital intensity for manufactures is higher than for food, this leads to the conclusion that if the price of manufactures rises, the rental rate will rise and the wage rate will fall. The same applies for a rise in food prices rise, then the wage rate will rise and the rental rate will fall.

On the occasion of the Stolper-Samuelson result, a debate has started. The base of this debate is about different empirical observations in Europe and America, namely two different types of labor; high-skilled labor and low-skilled labor. OECD countries are relatively abundant in high skilled labor, while low-wage countries are relatively abundant in low-skilled labor.

Several conclusions can be made:

- If trade of OECD countries with low-wage countries rises, the price of high-skilled intensive goods will increase.
- The OECD countries will then begin to produce more high-skilled intensive goods and less low-skilled intensive goods. The fall in low-skilled intensive goods is seen as a de-industrialization in the OECD countries.
- An increase in the price of high-skill-intensive goods relative to low-skill-intensive goods raises the wage rate for white-collar workers and reduces the wage rate for blue-collar workers.

Using the assumption made before that the production of manufactures is relatively capital intensive, we can conclude the following:

- If the available amount of labor rises, the output of the relatively labor intensive good, food, will rise.
- If the available amount of capital rises, the output of the relatively capital intensive good, manufactures, will rise.

Production volume

Edgeworth Box: A tool used to analyze the relation between amount of output and amount of available production factors. The isoquants for both food and manufactures are used in this tool. The origin and axes of one of the isoquants rotates 180 degrees. See attachment B.11 for an example of an Edgeworth box.

The isoquant lines of manufactures have intersects with the isoquant lines of food. These intersects are the points were the combination of inputs is efficient. Such efficient input combinations are denoted by point B and C. The curve that connects all these points and crosses two origins is called the **contract curve.** Point A is not an efficient input combination.

In economic equilibrium all available inputs must be used so that the labor and capital market are both in equilibrium; $K(m) + K(f) = K$ and $L(m) + L(f) = L$

The basic reasoning of Rybczynski consists of three main steps:

- If we know the prices p_f and p_m, we can determine the wage rate and the rental rate.
- If we know the wage rate and rental rate, we can derive the capital-labor ratios for both goods.
- From these two points above we can derive the equilibrium allocation of labor and capital in the two sectors.

If the available amount of labor rises, the isoquant for food will shift down. However, the wage-rental ratio will not change. The intersect of the expansion paths of food and manufactures is now

closer to the origin then before. the output level for food has increased and the output level for manufacturers has fallen.

We can conclude this theory in a formula, where λ_m is the share of labor force in manufactures. See attachment B.12.

In increase in the total capital-labor ratio means that there is relatively more capital available. This must lead to a diversion of labor to the capital intensive sector.

The results of Rybczynski were used to understand the immigration of Russians into Israel in the 1990s. The enormous migration of Russians to Israel was a result of the changing skill composition in the labor force. The Russian immigrants had a high education level that was higher than the education level of the people in Israel.

Even though many high-skilled Russians were leaving the country, the wage of the high-skilled workers in Russia increased. In Israel the production in high-skilled intensive sectors increased.

Factor abundance

The Heckscher-Ohlin proposition leads to the following conclusions:

- A country that is relatively capital abundant will export the capital intensive good, manufactures, and will import the labor intensive good, food.
- A country that is relatively labor abundant will export the labor intensive good, food, and will import the capital intensive good, manufactures.

To understand everything about international trade flows we have to look both at the supply and the demand. Exports to a country can be seen as an excess of supply of this country. Exports can be calculated by subtracting consumption from production.

The supply curve determines the production level of goods and services and the demand curve determines the consumption level of goods and services. The assumption that has to be made is that all consumers in the countries have identical homothetic preferences. On the occasion of this assumption we derive a utility function for all consumers.

All consumers want to buy as many goods and services as they can, but they have to consider the prices of the goods and their income level. If we let C be the consumption level, I the income level and δ(m) the share of income spent on manufactures we find the **budget constraint** and the **Utility function.** See attachment B.13 and B.14 respectively.

Iso-utility curve: A curve that shows all consumption combinations to the same level of utility.

The maximizing points are found where the iso-utility curve, U, and the budget constraint, I, intersect. All these points together form the **income expansion path,** starting from the origin.

The slope of the income expansion path depends on the price ratio (p_m /p_f). An increase in the income level leads to an equiproportional increase in the consumption of goods.

The maximizing consumption combinations are found at point A, B and C. The line through these three points is the income expansion path.

Marginal Rate of Substitution (MRS): The absolute value of the slope of an iso-utility curve. Measures how a consumer can substitute one good for another good remaining the same utility level.
Utility maximization when MRS= p_m /p_f
So the iso-utility curve is in this case tangent to the income line.

Marginal Rate of Transformation (MRT): The absolute slope of the production possibility frontier (PPF).
Profit maximization when MRT= p_m /p_f
The PPF is in this case tangent to the income line.

In the Ricardian model the PPF is a straight line, but in the neoclassic model the PPF is a curve. The PFF curve in the neoclassic model is responsive to changes in the capital input and in the labor input.

An example of a PPF in the neoclassic model can be found in attachment B.15.
If the capital stock rises, the PPF will shift outwards. This outward shift is more in the direction of the manufactures because the production of manufactures is capital intensive.

Similarly for a rise in labor input, then the PPF curve will also shift outwards but now more in the direction of food because the production of food is labor intensive.

If the markets of production factors are perfectly competitive, and MC are the marginal costs, then:
MRT= MC_m / MC_f

There are five types of economics agents involved in the international trade flows in equilibrium:

- Laborers
- Capital owners
- Consumers
- Producers of manufactures
- Producers of food

A person can be two types at the same time. For instance, if a laborer buys something he/she is also a consumer. In trade we also distinguish between two trade flows, namely, flows of goods and services and money flows. These flows are always moving in opposite direction.

An economy is in equilibrium if six conditions are satisfied:

1. Consumers maximize utility

2. Producers maximize profits
3. All laborers are employed
4. All capital is used
5. Supply of manufactures equals demand for manufactures
6. Supply of food equals demand for food

In the economy we distinguish between two different equilibria:

- **The autarky equilibrium;** satisfies conditions at national level.
  Utility maximizing and profit maximizing result in the following condition:
  MRT= p_m /p_f = MRS
  The domestic demand equals domestic supply in this equilibrium.

- **The international trade equilibrium;** satisfies conditions at global level for final goods markets and at the national level for production factors.
  In the international trade equilibrium we have the same condition as in the autarky equilibrium, namely;
  MRT= p_m /p_f = MRS

  If the international trade equilibrium price for food is higher than the price in the autarky equilibrium, then production of food increases and the production of manufactures decreases. So that world demand equals world supply. The trade leads to trade gains and higher welfare for both countries.

If a country is capital abundant, its PPF is more in the direction of manufactures. In autarky this country will specialize on manufactures.

Similarly, if a country is labor abundant, its PPF is more in the direction of food and in autarky it will specialize on food. In autarky the price ratio (p_m /p_f) is higher in the country that is relatively labor abundant.

Trade policy

In international trade a commission can impose restrictions to protect a certain country or sector. A commission that can do this is the European Commission (EC). Some options for the EC are:

- *Specific tariff:* An specific amount to be paid per unit imported
- *Ad valorem tariff:* A percentage to be paid per unit imported
- *Quota:* Restrict the number of units imported
- Subsidize European production
- Subsidize the export of Europe
- Require a minimum content before the good may be labeled European
- Prohibit sale or import of a good

Over the years, the number of trade restrictions has fallen. This is the result of the work of the General Agreement on Tariffs and Trade (GATT) that now is transformed in the **World Trade Organization (WTO).** The decrease in the number of trade restrictions led to an increase in international trade and capital flows.

If a country is not involved in international trade the equilibrium is where domestic supply equals domestic demand, with price p2 and quantity q2.

Suppose the world price is lower than the domestic price, then the price will be at p0. In this situation there is an excess demand. Therefore the amount q4-q0 has to be imported to satisfy the demand.

The home country can decide to impose an ad valorem tariff t. The world price p0 will be unchanged but the domestic price will rise to p0 (1+t).

Because of the fall in demand and the increase in the supply, the excess demand is reduced. This means that the amount they have to import decreases, the amount imported is then q3-q1. So the tariff leads to a reduction in the trade volume. See attachment B.16.

1. The welfare for domestic producers, the producer surplus, has increased. This gain is shown by the area a.
2. The welfare for the government, the government revenue, has increased too. The government revenue equals imports x tariff. This gain is shown by the two c areas.
3. The welfare for consumers, the consumer surplus, has decreased. This loss is shown by the areas a, b and c.
4. The areas b form the net welfare loss, these areas are called the Harberger triangles.

So producers and the government gain from the tariff while consumers lose. However, the loss of consumers is spread over many consumers so that the loss per consumer is small. The benefits are spread over a limited of producers and the government so that the benefits per producer are large.

The conclusions above apply to a small home market. If we look at a large home market there are some changes. When there is a reduction of imports this results in a lower world price p1 instead of a higher world price. In this case the producer surplus, the consumer surplus and the government revenue will be the same as in a small market. However, the net welfare loss decreases. The shaded area is the government revenue paid by foreigners.

The new net welfare loss will be the shaded area minus the Harberger triangles. So the net welfare loss will only be positive if the government revenue paid by foreigners exceeds the Harberger triangles.

When a country imposes an ad valorem tariff, t, on the imports of manufactures, the domestic price will be higher than the world price of manufactures. See attachment B.17.

The tariff imposes a double distortion on the economy:

1. Producers change production. The domestic price differs from the world market price so the production is not at its optimal point. This results in an income loss and a lower welfare level. This is called the *production effect.*
2. Also consumption suffers under the price differences. The utility will fall and therefore the consumption is not at its optimal point. This is called the *consumption effect.*

The **offer curve:** Connects export offers in exchange for imports for all prices. It summarizes all optimal production and consumption decisions in the economy.

It is possible to derive trade indifference curves from the offer curve. The trade indifference curve is tangent to trade balance lines at optimal points.

Combining the offer curve of two countries helps us to determine the trading equilibrium and the exports and imports. If we put both offer curves in one figure we can see where the trading equilibrium lies.

In attachment B.18 one can see the offer curves of two countries, A and B, combined in one figure. There is a trade equilibrium at the point where the two curves intersect, point E.

The line through the origin and the trade equilibrium point is the trade balance line. The slope of this line gives us the free trade equilibrium price.

When imposing a tariff there will be a welfare loss and a reduction in the trade volume. A reduction of the trade volume means that the trade equilibrium is lower and so the offer curve will shift inwards.

Given that B now has a restriction then the offer A curve will shift inward to offer A'. A imposes an optimal tariff to reach point 1. Same holds for a restriction on A, then the offer curve of B will shift inwards to the curve offer B'. B imposes an optimal tariff to reach point 2.
The intersect of the offer A' curve and the offer B' curve give us the new equilibrium point E'.
At this new equilibrium point the welfare for both country A and B has decreased.
When imposing a tariff there is always a loss of welfare in a small country. A large country might benefit from an optimal tariff but these benefits disappear under a system of retaliation leading to tariff wars. Hence there is need for international rules and policy coordination by the WTO.
For some countries that are very important for the economy, the average tariff rates have reached historical low levels in the last few years. An example of such a country is the USA.