

## Introduction to Comparative Advantage

It has been said that “everything’s relative.” That is surely not true, but it definitely *is* true of comparative advantage. This fundamental concept in explaining why countries engage in international trade and why they gain from trade can only be understood in terms of *relative* prices, *relative costs*, or *relative* productivities. And what matters are these comparisons of prices, costs, or productivities in two senses simultaneously, both across goods and across countries.

There are many ways of illustrating comparative advantage. Later, in the optional appendix to this introduction, I will define it more carefully and in several of these ways. But mostly I will just provide a couple of numerical examples.

### Autarky and Trade with Absolute Advantage

Suppose the world has only two countries, US and UK, able to produce only two goods, food and cloth, using only one factor of production, labor. Each country is endowed with 10 units of labor (in other words, each has 10 workers). We will look at what these countries might produce and consume in “autarky” – which is the situation of no international trade – and also with free trade.

The answer depends greatly on how productive the two countries are in producing the two goods. This can be measured in either of two ways, by “labor productivity” defined as output per unit of labor, or by “unit labor requirements” defined as units of labor per unit of output. One is just the reciprocal of the other. The textbook speaks of productivity, but I find it more helpful to work with unit labor requirements because, as we will see, they more directly reflect prices. You should be able to understand it either way.

Suppose that productivity depends on only one thing: the technologies available in each country, and that the resulting unit labor requirements are as follows:

Unit labor requirements	US	UK
Food (hr/lb)	0.01	0.02
Cloth (hr/yd)	0.02	0.01

That is, in the US, it requires 0.01 hours of labor to produce a pound of food, while in the UK it requires twice that much. The corresponding labor productivities are 100 pounds of food per hour of labor in the US, and 50 pounds per hour in the UK. In the cloth industry, on the other hand, the numbers say that production of a yard of cloth requires 0.02 hours of labor in the US and only 0.01 hours of labor in the UK – so that productivities are 50 yards of cloth per hour in the US and 100 yards of cloth per hour in the UK. Any way you look at these numbers, US labor is more productive in producing food than is UK labor, while UK labor is more productive in producing cloth. In this case, we say that the US has an “absolute advantage” in producing food and that the UK has an absolute advantage in producing cloth.

With its endowment of 10 workers, then, the US could produce at most 1000 pounds of food per hour ( $=10/0.01$ ), or 500 yards of cloth per hour ( $=10/0.02$ ), or some combination of the two. Likewise, the UK could produce at most 500 pounds of food per hour, 1000 yards of cloth per hour, or again some combination of the two. Your textbook works with graphs of these production possibilities, but here I will just provide a numerical example of one such possibility.

Suppose that in autarky, when the countries must each consume only what they produce because they do not trade, each country chooses to put 4 workers into producing the good where it has the higher productivity and 6 into producing the other. The countries' production *and* consumption would then be:

Production and consumption in autarky	US	UK
Food (lb/hr)	400	300
Cloth (yd/hr)	300	400

For example, with 4 US workers producing food, and each worker producing 100 lb of food per hour, they produce  $4/0.01 = 400$  lb/hr. The remaining 6 workers, each producing 50 yards of cloth per hour, produce  $6/0.02 = 300$  yd/hr of cloth. The situation in the UK is just the opposite.

But now suppose instead that the two countries can trade. It makes sense that each might completely specialize in the good where it is more productive, so let's see what can happen if they do. If the US puts all 10 workers into producing food, it will produce 1000 lb/hr of food (and no cloth at all). If the UK puts all 10 workers into producing cloth, it will produce 1000 yd/hr of cloth, and no food. Neither country could survive if it did that without trade, since people in the US would freeze, and those in the UK would starve. But with trade, each can export part of what it produces, in exchange for imports of some of what the other produces. As just an example, suppose that each country exports half of its output to the other. Then their *consumption* (which now does not equal their production) will be 500 units of each good per hour. That is:

Consumption in free trade	US	UK
Food (lb/hr)	500	500
Cloth (yd/hr)	500	500

One point of all this can now be seen by comparing these last two tables. By specializing and trading, both countries have been able to increase their consumption of *both* goods, from either 300 to 500, or 400 to 500! Since they are consuming more, we say that they have gained from trade.

However, in this example, this result may not be surprising. After all, each country's workers were absolutely better at doing one thing than the other country's workers, and we've gained from having them do more of what they are better at doing. What if one

country's workers do not have such an absolute advantage in doing anything? The next example shows that this would not interfere with the gains from trade.

### Autarky and Trade with Comparative Advantage

Suppose that the second country is not the United Kingdom, UK, but the United Catastrophe, UC, a country where people are not very productive at all but are otherwise very similar to people in the UK. That is, suppose that workers in the UC are only 1/10 as productive as workers in the UK, or – equivalently – that their unit labor requirements are ten times larger:

Unit labor requirements	US	UC
Food (hr/lb)	0.01	0.20
Cloth (hr/yd)	0.02	0.10

If they had the same number of workers, UC would be able to produce a lot less than UK, but to keep our examples simple, let's suppose that UC also has ten times as many workers. That is, while the labor endowment of the US remains 10 workers, that of the UC is 100 workers. This exactly makes up for their lower productivity, and permits them to produce exactly the same amounts as the UK did above. In particular, by putting 40 of their 100 workers into producing cloth in autarky, UC can produce 400 yd/hr of cloth and 300 lb/hr of food:

Production and consumption in autarky	US	UC
Food (lb/hr)	400	300
Cloth (yd/hr)	300	400

Then, with trade, if they put all 100 workers into producing cloth, they will again get 1000 yd/hr of it, and by trading half of that with the US, be able to consume 500 units/hr of each:

Consumption in free trade	US	UC
Food (lb/hr)	500	500
Cloth (yd/hr)	500	500

Thus it really did not matter that the UK had an absolute advantage in producing either good in order to gain from trade. For the UC has an absolute *disadvantage* in both industries, but nonetheless, it can gain from trade by specializing in the industries where its disadvantage is, in some sense, smaller. That is the industry in which we say that it has a ***comparative advantage***.

Note the unit labor requirements for the UC compared to the US above. They are lower in both industries in the US than in the UC, which confirms that the US has absolute advantage in both industries. But while they are 1/20 of UC unit labor requirements in food, they are only 1/5 of UC unit labor requirements in cloth. Thus the US advantage is comparatively smaller in cloth, indicating that the UC has the comparative advantage there. Alternatively,

one could say that the US productivity in food is 20 times that in UC (100 lb/hr vs. 5 lb/hr) but only 5 times that in UC in cloth (50 yd/hr vs. 10 yd/hr), which tells us the same thing.

### Wages and Prices

These examples show that countries can gain from trade if they produce and export the goods in which they have comparative advantage. But what will induce them to do that? The answer is prices. And these are in turn determined, in this simple context where labor is the only factor of production, by wages.

Consider again the US and the UK. Suppose they share the same currency, and that the wage in both countries is \$10/hr in autarky. Then we can get the prices of the two goods in each country by just multiplying this wage by the unit labor requirements:

Wages and prices in autarky	US	UK
Labor (\$/hr)	\$10	\$10
Food (\$/lb)	\$0.10	\$0.20
Cloth (\$/yd)	\$0.20	\$0.10

That is, at these wages, the price of food is 10 cents/lb in the US and 20 cents/lb in the UK, which is exactly the sort of price difference that would cause food to be exported from the US to the UK, if trade were permitted. Similarly, cloth is cheaper in the UK, and will be exported from there.

But now consider the US and the UC instead, and suppose also that both wages are \$10/hr in autarky. Then we have a problem:

Wages and prices in autarky	US	UC
Labor (\$/hr)	\$10	\$10
Food (\$/lb)	\$0.10	\$2.00
Cloth (\$/yd)	\$0.20	\$1.00

Now both goods are cheaper in the US than in the UC, suggesting that both should be exported by the US to the UC.

But will that happen? No. Because the people in UC would have no way of paying for goods from the US, at least not for long, because if everybody tries to buy only the cheaper goods from the US, soon the people in the UC will have no income to buy anything at all. What will happen instead is that wages in the UC and US will have to adjust, either rising in the US or falling in the UC, until there is something that workers in the UC can produce competitively. (In practice, different countries have different currencies, and most of this adjustment take place by changes in exchange rates.)

Suppose that we do this adjustment by only lowering the wage in UC. How far will it have to fall in order for something produced in the UC to be as cheap as the same good produced in the US? A wage of \$2.00/hr will do it, since this will reduce the price of UC cloth to the

same twenty cents/yd as cloth produced in the US. The wage could also fall even further in UC, but not below \$0.50/hr, since that would push the price of UC food also below that in the US, and create the opposite disequilibrium. We cannot know what the equilibrium wage must be without more information, but let's make one up. Suppose the wage in UC were \$1.50/hr. Then autarky prices would be

Wages and prices in autarky	US	UC
Labor (\$/hr)	\$10	\$1.50
Food (\$/lb)	\$0.10	\$0.30
Cloth (\$/yd)	\$0.20	\$0.15

Notice that with these wages, cloth is now cheaper in UC and food is cheaper in US, so that the incentives to trade are exactly what we need to get food exported by US and cloth exported by UC.

What will the prices of goods be with free trade? If both countries produce only one good, as above, and if the wages in US and UC are indeed \$10 and \$1.50 respectively, then the prices of the goods will be \$0.10/lb of food and \$0.15/yd of cloth, since these will be their costs of production in the (only) country where they are produced.

### **Gains from Trade**

Are there still gains from trade? The fall in the wage in UC, from \$10 to \$1.50/hr, seems to suggest that workers in UC have been made worse off by trade. But they have not. In autarky, UC workers were paid \$10/hr but faced prices of \$2.00/lb for food and \$1.00/yd for cloth. An hour of work therefore earned them enough to buy either 5 lb of food or 10 yd of cloth. Now, with free trade, they are paid only \$1.50/hr, but they face prices of \$0.10/lb for food and \$0.15/yd for cloth, so an hour of work allows them now to buy 15 lb of food ( $\$1.50/0.10$ ) and, again, 10 yd of cloth. Thus their real wage – what their wage will buy – has gone up in terms of food and has not fallen in terms of cloth. Indeed, exactly like the country as a whole that we depicted earlier, each worker can, if they previously consumed both goods, now consume more of both if they want to.

UK workers also gain from trade here. Their unchanged \$10 wage still buys the same amount of food as before, but its value in terms of cloth has risen from 50 yd to 67 yd ( $=10/0.15$ ). Of course, it is also true that UK workers are much better off, both in autarky and in free trade, than UC workers. But this is the natural result of the fact that the UC workers are so much less productive.

**Appendix (Optional): Comparative Advantage More Generally Defined**

**Definition:** Comparative Advantage is the relative cheapness of a good or service in a country that enables that country to export it. More precisely, a country has a comparative advantage in the good whose price in the absence of trade (autarky), *relative* to other goods in the same country, is lower than the relative price of that same good on world markets.

Formally, let  $\tilde{p}_g^c$  be the autarky price of good  $g$  in country  $c$  (the “~” here indicates autarky), and  $\tilde{p}_g^W$  be the price of the same good on the world market (which could be simply the other country, if there are only two). Then country  $c$  has a comparative advantage in good  $g_1$  if

$$\frac{\tilde{p}_{g_1}^c}{\tilde{p}_{g'}^c} < \frac{\tilde{p}_{g_1}^W}{\tilde{p}_{g'}^W} \quad \text{for all } g' \neq g_1$$

Notice that the comparison involves four individual prices of goods, two in one country and two in the other. The left-hand side is the relative price of good  $g_1$  compared to another good in country  $c$ , while the right-hand side is the same relative price abroad.

**The Ricardian Model:** In the Ricardian model, it is assumed that unit labor requirements for production are constant (do not vary with output). Let  $a_g^c$  be the unit labor requirement for producing good  $g$  in country  $c$ . If the autarky wage of labor (the only factor) in country  $c$  is  $\tilde{w}^c$ , then with competitive markets price equals cost:  $\tilde{p}_g^c = \tilde{w}^c a_g^c$ . Substituting this into the definition of comparative advantage above, the wages cancel out of each fraction and it becomes:

$$\frac{a_{g_1}^c}{a_{g'}^c} < \frac{a_{g_1}^W}{a_{g'}^W} \quad \text{for all } g' \neq g_1$$

This gives us an equivalent definition of comparative advantage, for the Ricardian model:

- In the Ricardian Model, a country has a comparative advantage in the good whose labor cost, *relative* to other goods in the same country, is lower than the relative labor cost of that good abroad.

For the special case of only two countries (A and B) and two goods (1 and 2), country A has a comparative advantage in good 1 if

$$\frac{a_1^A}{a_2^A} < \frac{a_1^B}{a_2^B}$$

If this inequality is reversed, then country A has a comparative advantage in good 2. Except in the coincidental case of the two ratios being equal – in which case neither country has a comparative advantage or disadvantage in anything – it must be true that one or the other holds, and therefore that each country has a comparative advantage in something.

**An alternative definition:** Notice that, while this puts the relative prices of goods within a country on each side of the inequality, one could just as easily compare the relative prices of goods across countries. Multiplying both sides of the inequality by  $a_2^A$  and dividing both sides by  $a_1^B$  (which, since both are positive, does not reverse the inequality), we get the equivalent condition:

$$\frac{a_1^A}{a_1^B} < \frac{a_2^A}{a_2^B}$$

Thus a country can also be said to have a comparative advantage in a good if its labor requirement relative to the labor requirement abroad is smaller than for other goods.

**Another alternative definition:** Notice also that we could as well define comparative advantage in terms of the productivity of labor instead of unit labor requirements, as is done in the text. If  $a_g^c$  is the unit labor requirement for producing good  $g$  – that is, the quantity of labor divided by output – then  $\pi_g^c = 1/a_g^c$  is output divided by labor, or labor productivity. It is easy to transform all of the above conditions into ones comparing these  $\pi$ 's instead of the  $a$ 's. For example, country A has a comparative advantage in good 1 if

$$\frac{\pi_1^A}{\pi_2^A} > \frac{\pi_1^B}{\pi_2^B}$$

That is, a country has a comparative advantage in a good if its productivity in that good, relative to other goods, is *higher* than abroad.

### **Theoretical Implications of Comparative Advantage:**

1. If countries are permitted to trade freely (and actually, even if that trade is restricted), and if they have competitive, undistorted markets, then they will export the good or goods in which they have comparative advantage and import those in which they have comparative disadvantage.
2. Under the same conditions, all countries will gain from trade, in the sense that those individuals who gain from trade within each country will gain enough that they could potentially fully compensate those individuals who lose, within the same country, and still remain better off than in autarky.