Learning-by-playing: Economic concepts for the Ricardian Explorer game

By Alberto Isgut
Department of Economics
Wesleyan university

I- Production possibilities frontier

A producer transforms production factors, such as labor, capital, or land, into goods and services, such as cheese, wine, or haircuts. A production function tells us how many physical units of a good or service we can obtain from a given combination of production factors.

In the Ricardian model of trade, production functions take a particularly simple form: they are linear in the amount of labor used. If Q_c denotes pounds of cheese and L denotes hours of labor, the production function of cheese is obtained from the following relationship:

(1) $$L = a_{Lc} Q_c$$

The coefficient a_{Lc} is the *unit labor requirement* for the production of cheese. It tells us how many hours of labor are needed to produce one pound of cheese. If, for example, $a_{Lc} = 3$, Equation (1) tells us that we need 1,500 hours of labor to produce 500 pounds of cheese. Solving for Q_c in Equation (1) we obtain the production function of cheese

(1') $$Q_c = (1/a_{Lc})L$$

The reciprocal of the unit labor requirement, $1/a_{Lc}$, represents the productivity of labor in cheese production. Therefore, a higher unit labor requirement means that labor is less productive.

In the Ricardian theory of trade, producers produce at least two goods. Suppose that the second good is wine, whose production is characterized by the expression

(2) $$L = a_{Lw} Q_w$$

The production of wine is characterized by the unit labor requirement a_{Lw}, the number of hours of labor needed to produce a liter of wine. The production function for wine is, therefore,

(2') $$Q_w = (1/a_{Lw})L$$

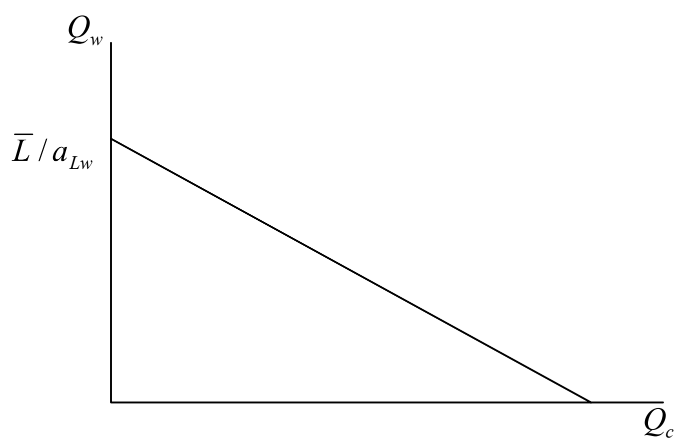
The *production possibilities frontier* tells us what are the maximal quantities of different goods that we can produce given our limited endowment of factors of production.

Suppose that a producer can choose to produce either wine or cheese, or a combination of the two, according to the production relationships (1) and (2). Suppose further that the producer has only $\overline{L}$ units of labor available. In order to use *all* this labor in the production of a combination of cheese and wine, the following restriction must be satisfied:

(3) $a_{Lc}Q_c + a_{Lw}Q_w = \overline{L}$

Solving for Q_w, we can express the production possibilities frontier as

(3') $Q_w = (\overline{L} / a_{Lw}) - (a_{Lc} / a_{Lw})Q_c$



Notice that this function will shift out in parallel if (1) the availability of labor $\overline{L}$ increases or (2) both unit labor requirements, a_{Lc} and a_{Lw} decrease proportionately.

For our purposes, the most important aspect of the production possibilities frontier is its slope, which indicates the opportunity cost of cheese in terms of wine. By increasing the production of cheese by one pound while keeping constant the hours of labor used, we necessarily have to decrease the production of wine. The required decrease in the production of wine is a_{Lc} / a_{Lw} liters.

In the example above, we assumed that we needed 3 hours of labor to produce a pound of cheese, $a_{Lc} = 3$. If we suppose in addition that we need 5 hours of labor to produce a liter of wine, $a_{Lw} = 5$, it follows that the opportunity cost of a pound of cheese is 3/5 = 0.6 liters of wine.

II- Relative prices and trading

The ultimate objective of the Ricardian Explorer game is to consume a balanced basket of goods. You can achieve that objective in two ways: You can produce the optimal mix of goods you want and then consume it, or you can produce a different basket of goods and trade some of them for others in the market. How should you decide what to do?

The key is to compare your opportunity costs with the relative prices at which goods are offered for trade in the market. Suppose, as before, that your opportunity cost of cheese in terms of wine is 0.60. And now consider that someone in the market is offering to sell 10 pounds of cheese in exchange for 5 litters of wine. If you buy those 10 pounds of cheese, you would be paying 0.5 liters of wine per pound of cheese. Because 0.5 liters per pound is less than your opportunity cost of 0.6 liters per pound, you would be better off by producing 5 liters more of wine and trading them for 10 pounds of cheese in the market.

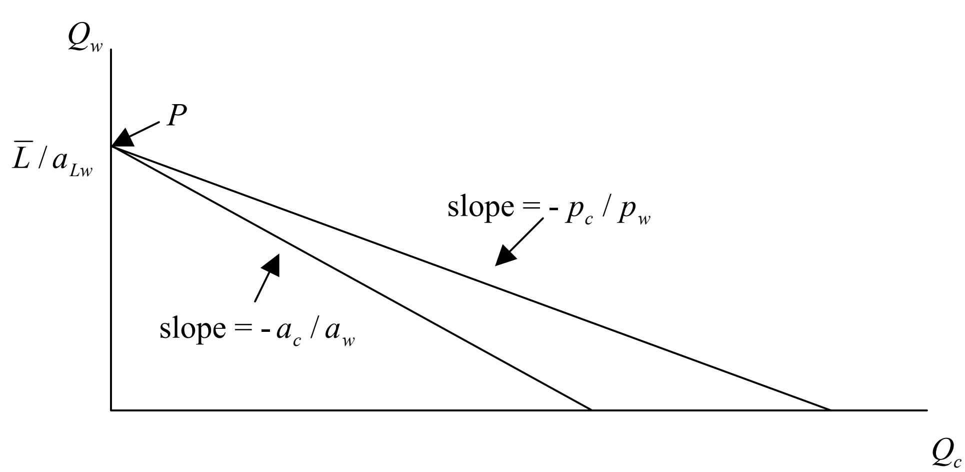
As a general rule, in deciding whether to trade or not, you need to compare your opportunity cost

$$a_c / a_w = \text{liters of wine you have to forgo to produce an extra pound of cheese}$$

with the relative price

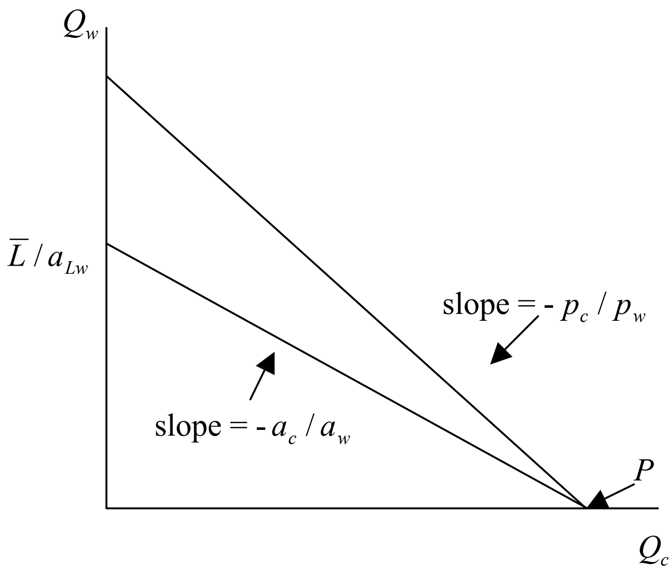
$$p_c / p_w = \text{liters of wine you have to pay per pound of cheese.}$$

If you find that $p_c / p_w < a_c / a_w$, as in the example above, it means that it is convenient for you to buy cheese in the market and produce more wine. If in the extreme you were to fully specialize in the production of wine, at the point *P* in the graph, you would be able to consume along the outer straight line, with slope $-p_c / p_w$. The difference between this and the production possibilities frontier line represents gains from trade.



Now let's consider other offer. What if someone in the market is offering to sell 10 pounds of cheese in exchange for 8 litters of wine? Would you take it? No. In this case the relative price of cheese would be p_c / p_w = 0.8 liters of wine, which exceeds your opportunity cost of only 0.6 liters of wine. You are better off making and consuming your own cheese.

Moreover, you might as well consider selling cheese in the market yourself. Suppose that in the extreme you fully specialize in producing cheese. In that case you would gain by trade if you can sell cheese at more than your opportunity cost, as the graph shows:



So as a general rule, for any two goods *x* and *y* that you can either produce or trade, if $p_x / p_y < a_x / a_y$, you might want to buy *x* in the market and produce more *y*. On the other hand, if $p_x / p_y > a_x / a_y$, you might want to produce more *x* and sell it in the market in exchange for *y*.

III- Utility: deciding how much to consume

The previous discussion is informative about the decision of whether to produce for your own consumption or trade. But as the ultimate objective of the game is to consume a balanced basket of goods, you also need to know how to decide what to consume.

The Ricardian Explorer game follows the usual assumption in economic models: that consumption decisions are guided by the desire to maximize a *utility function*. For the purposes of this handout, we are going to leave out the details about the utility function. Suffice it to say that (1) consuming more of any good while leaving the consumption of other goods constant increases utility, and (2) a balanced combination of goods gives more utility than an unbalanced combination.

This suggests two things to avoid during the game. (1) Don't waste resources: try to use all your labor and consume all the goods that you have produced or bought in the market. (2) Try to consume similar amounts of the different goods.