NYU STERN

The Global Economy
Class Notes

International Trade

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Virtually all economists, liberal or conservative, believe that free (or "free-er") trade is a good thing: good for consumers, good for workers, good for all countries involved. Why? Because consumers are able to buy products from the cheapest vendor, which forces production to the highest productivity firms, which in turn supports the highest wages for workers.

No one else believes that. Most are convinced than one side is trade is unfair, that one country is gaining at the other's expense. The purpose of this document is to outline the logic for trade. It's mathematical logic, by which we mean it's clear and precise, if a little abstract. You can decide for yourself whether you find it persuasive.

Ricardo's theory of trade

David Ricardo was one of the most influential economists of the early nineteenth century, but he came to economics by accident. Born to a Jewish family in Amsterdam, he left the Netherlands and broke off relations with his family (and they with him) to avoid an arranged marriage — and married a Quaker instead. He set himself up in London as a government securities dealer and became, in his words, "sufficiently rich to satisfy all my desires and the reasonable desires of all those about me." Looking for something to occupy his time, he developed the modern theory of international trade.

Many people in Ricardo's day (and ours!) regarded trade as a zero-sum activity: if you gain from trade, then I must lose. His insight was that both sides typically benefit, even if it appears that one has an *absolute productivity advantage* over the other. In his words, each country has a *comparative advantage*.

We develop Ricardo's theory in a particularly simple setting: two countries produce and consume two products, and both products are produced with labor alone. In many respects this version of the theory is unrealistic, but the lack of realism is exactly what makes the analysis simple and understandable. None of the details are essential to the argument.

To be specific, let us call the countries the US (country 1) and Mexico (country 2) and the products apples and bananas. (Yes, we know neither the US nor Mexico produces many bananas, but we like the letters a and b.) We start by specifying the

	Apples	Bananas
US (country 1)	$\alpha_1 = 20$	$\beta_1 = 10$
Mexico (country 2)	$\alpha_2 = 5$	$\beta_2 = 5$

Table 1: Productivity levels in a numerical example of Ricardo's model of international trade.

productivity levels: the quantities of product (either a or b) in country i (either 1 or 2) produced with one unit of labor. The values are reported in Table 1. We also assume that the labor force is the same in the two countries: $L_1 = L_2 = 100$.

With the numbers we've been given, one unit of labor produces more in the US whether it's used to produce apples or bananas. That is, the US has an absolute advantage in producing both goods. A number of factors might play a role here: perhaps the weather is better, labor is better educated, the distribution system is more efficient, or regulations are less intrusive.

The question is: would Mexico and the US both benefit from completely free trade, relative to a position of *autarky* (no trade at all)? The answer is yes, but let's run through the argument. Suppose Mexico had high enough tariffs or other barriers to kill off trade altogether. Then Mexico would likely produce both products. How much of each? It could produce apples in quantity $a = L_2\alpha_2 = 100 \times 5 = 500$ or bananas in quantity $b = L_2\beta_2 = 100 \times 5 = 500$. It could also produce any combination in between, as shown in Figure 1 (the solid line). We call the solid line the possibility frontier for Mexico, since every point on the line represents a possible consumption combination. In this example, the line has a one-for-one tradeoff between apples and bananas, implying a relative price of $q = p_b/p_a = \alpha_2/\beta_2 = 1$.

What happens if Mexico and the US allow trade? It depends on the relative price q. Suppose Mexico can export bananas at a relative price of $q > 1$ apples for each banana. Then Mexico will produce only bananas. Why? Because it can produce each at the same cost ($1/5 = 0.2$ units of labor), but bananas sell for more on the world market. As a country, it faces strictly better possibilities if it trades rather than producing both goods itself. If it produces only bananas ($b = 500$), then trades some for apples at a rate of q apples for every banana, it does better than the one-for-one tradeoff it got from producing apples itself. (See the dashed line in 1, which is above the solid line.) [As a check on your understanding: How would this work if $q < 1$? What would Mexico produce? What would its possibility frontier look like? Would Mexico still benefit from trade?]

In short, trade benefits Mexico, even though it is less productive than the US for both products. Similar reasoning shows that the US would benefit from trade, too. [Another check: What is the possibility frontier for the US if there's no trade?]

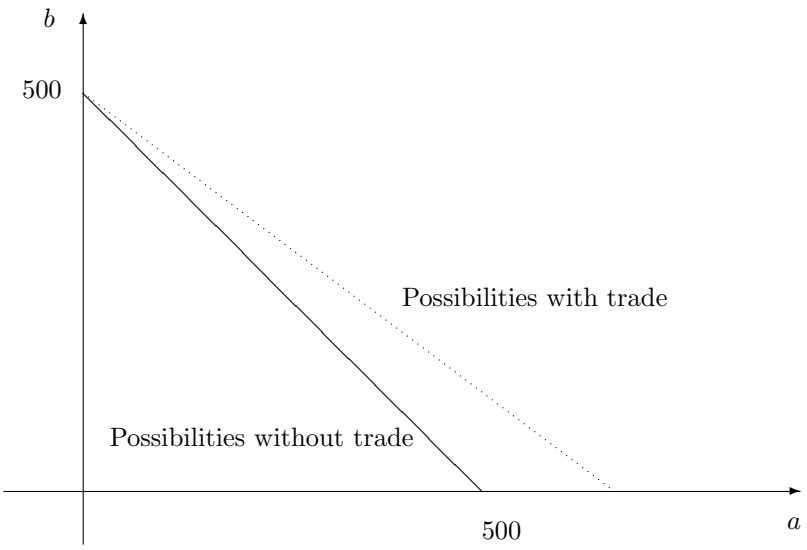

Figure 1: Gains from Trade in Mexico.

Ricardo had a rationale for these gains from trade: even though Mexico is less productive absolutely ($\alpha_1 > \alpha_2$ and $\beta_1 > \beta_2$), it is comparatively more productive in bananas than the US ($\beta_2/\alpha_2 > \beta_1/\alpha_1$). Conversely, the US is comparatively more productive in apples ($\alpha_1/\beta_1 > \alpha_2/\beta_2$). If each country produces the good for which it is comparatively most productive, then world productivity rises and both countries benefit. Ricardo referred to this as the theory of comparative advantage.

Digging a little deeper (optional)

Moving to free trade is similar to an increase in productivity: when you shift production to high productivity products, aggregate productivity rises. The impact is similar to our discussion of capital markets. Countries with good capital markets allocate capital more effectively to high-return projects and increase aggregate productivity as a result. This is a natural feature of trade models, but it takes some effort to work out the details, even in a setting as simple as our example. If you're averse to math, you might skip to the next section the first time through.

Our goal is to compare production and consumption in two cases: one with no trade, and one with completely free trade (no tariffs or transportation costs). The comparison is somewhat extreme, but the hope is that it will give us the flavor of less extreme moves toward freer trade. In each case, we need to find the competitive equilibrium. Competitive means that consumers and producers take prices as given. (No monopolies allowed here!) Formally, a competitive equilibrium is a set of prices and quantities that satisfy three conditions:

1. Consumers are on their demand curves: they buy what they want at the given prices.
2. Producers make zero profits (the effect of competition).
3. Total production equals total consumption for each product.

Finding an equilibrium can be difficult, particularly if you have a low thresh-hold for algebra, but we can readily verify a proposed equilibrium by checking the three conditions.

Consumers. The citizens of each country consume apples and bananas. They also work for the firms, getting a wage w for each unit of labor. Each consumer (we can index them by i) earns an income $y_i = wl_i$ (for simplicity, we assume that l_i is given). Obviously, $L = \sum_i l_i$. How do consumers spend their income? Like any of us, they receive satisfaction (or *utility*) from consuming both apples and bananas. Let us say that their utility from consumption is given by the following function:

$$U(a, b) \;=\; a^s b^{1-s}.$$

Given her income and prices for apples and bananas, each consumer will make spending decisions that maximize her utility. Simple calculations show that a consumer will spend a fraction s of her income on apples, and the complementary fraction $1 - s$ on bananas. Summing across all consumers, we find that a fraction s of national income Y ($Y = \sum_i y_i = w \sum_i l_i = wL$) is spent on apples, and the remainder is spent on bananas:

$$\begin{aligned} p_a a &= sY \\ p_b b &= (1-s)Y. \end{aligned}$$

These are (effectively) the demand functions for the two products. We'll assume below that $s = 0.75$ in both countries.

Producers. Consider producers in a specific country. Let's say that labor sells for w per unit, with w potentially differing across countries. A producer of apples (say) will hire labor at cost w per unit and sell apples, getting a profit of

$$\text{Profit} \;=\; a(p_a - w/\alpha),$$

where α is apple productivity in the country we're examining. If $p_a < w/\alpha$, the price is too low and no apples will be produced. If $p_a > w/\alpha$, competition among apple producers will drive the price down until $p_a = w/\alpha$. In short, if apples are produced, the price is $p_a = w/\alpha$. Similarly, if bananas are produced, their price will be $p_b = w/\beta$. If both apples and bananas are produced (and they need not be), their relative price will be $q = p_b/p_a = \alpha/\beta$.

Equilibrium without trade. If there's no trade, then each country will produce both products. Let us say that the wage rate is $w = 1$ in both countries (but not comparable, because they may be measured in different units). Since the total labor input is 100 in either country, national income is $Y = wL = 1 \times 100 = 100$ in both Mexico and the US (again, the units are not comparable). In the US, prices will be

$$\begin{aligned} p_a &= w/\alpha = 1/20 = 0.05 \\ p_b &= w/\beta = 1/10 = 0.10 \\ q &= p_b/p_a = 2. \end{aligned}$$

At these prices, the demands for apples and bananas are, respectively,

$$\begin{aligned} a &= sY/p_a = 0.75 \times 100/0.05 = 1500 \\ b &= (1-s)Y/p_b = 0.25 \times 100/0.1 = 250. \end{aligned}$$

Total utility is therefore $U = a^{0.75}b^{0.25} = 958$.

What about Mexico? Using similar methods, we find that prices are

$$\begin{aligned} p_a &= w/\alpha = 1/5 = 0.20 \\ p_b &= w/\beta = 1/5 = 0.20 \\ q &= p_b/p_a = 1. \end{aligned}$$

Demands are $a = 375$, $b = 125$. Utility is $U = 285$. The numbers are summarized in Table 2 for future reference.

Equilibrium with trade. The complete solution is reported in Table 2, but let's see where it comes from. It's moderately complicated, so skip directly to the next section unless you're incredibly curious. The objective is to find prices and wages that equate supply and demand for apples, bananas, and labor in both countries. We'll focus on bananas; if the banana market clears, so do the others.

Let's guess (we made up the example, so our guesses are pretty good) that the US produces only apples and Mexico produces only bananas. In this way the two countries specialize in the production of the good in which they have a comparative advantage. We'll verify this guess later. Let's think about how the banana market works. Supply is whatever Mexico produces given its available labor L_2 and productivity β_2:

$$\text{Supply of Bananas} = L_2\beta_2.$$

What about demand? This is more complicated. Since each country spends a fraction $1 - s$ on bananas, total demand is

$$\text{Demand for Bananas} = (1-s)Y_1/p_b + (1-s)Y_2/p_b,$$

	Free Trade	No Trade
	US	
Price of apples p_a	0.05	0.05
Price of bananas p_b	0.0667	0.10
Wage w	1	1 (dollar)
Consumption of apples a	1,500	1,500
Consumption of bananas b	375	250
Utility	1,061	958
	Mexico	
Price of apples p_a	0.05	0.2
Price of bananas p_b	0.0667	0.2
Wage w	0.3333	1 (peso)
Consumption of apples a	500	375
Consumption of bananas b	125	125
Utility	354	285

Table 2: Prices and quantities with and without trade. Note that in the no trade case, the wages are normalizations: they're in different units and are not comparable across countries.

where Y_1 and Y_2 are incomes in the US and Mexico, respectively. Competition in labor and output markets will equate income paid to workers to the value of output they produce:

$$\begin{aligned} Y_1 &= L_1\alpha_1 p_a \\ Y_2 &= L_2\beta_2 p_b. \end{aligned}$$

Why? Because competition drives profits to zero. That gives us

$$\text{Demand for Bananas} = (1-s)L_1\alpha_1 p_a/p_b + (1-s)L_2\beta_2.$$

Equating supply and demand and doing some algebra gives us

$$p_b/p_a = \frac{(1-s)L_1\alpha_1}{sL_2\beta_2}. \tag{1}$$

Plugging in numbers, we find $p_b/p_a = 4/3$. If you're unusually curious, you can show (using the same approach) that supply and demand are equal for apples at the same price.

We can now get a sense where the relative price of bananas comes from: supply and demand! On the supply side: higher productivity for bananas (higher β_2) drives the price down. This is the usual shift out of the supply curve. Similarly, higher apple

productivity (higher α_1) makes apples relatively less expensive. On the demand side: lower s indicates lower desire for apples, higher desire for bananas, and drives the price of bananas up. This is essentially a rightward shift of the demand curve.

Finally, we verify that the US produces only apples, Mexico only bananas. How do we show this? At these prices and wages, US banana producers lose money: so they don't produce any. Ditto Mexican apple producers: the wage rate supported by banana production is too high for apple producers to break even, so they won't produce either. This is really a good thing for Mexican workers: producing bananas supports a higher standard of living.

Wages and productivity

In the US you sometimes hear: "US workers can't compete with Mexican workers, because their wages are so low." In Mexico, you sometimes hear: "Mexican workers can't compete with US workers, because their productivity is so much higher." Who is right? The answer, of course, is neither. In our model, wages reflect productivity. Mexican wages are lower, because Mexican workers are less productive. Their wage is low enough to (just) make up for their lower productivity. Ditto American workers: firms hire them despite their higher wage, because their productivity is higher. The value of labor to a firm is a balance between the two forces: price and productivity.

We can be more specific about the connection between productivity and wages. As a rule, the wage ratio will be somewhere between the productivity ratios for the two products. In this case, the ratio of the US to the Mexican wage will be between 2 (= 10/5, the ratio of banana productivities) and 4 (= 20/5, the ratio of apple productivities):

$$2 = \beta_1/\beta_2 < w_1/w_2 < \alpha_1/\alpha_2 = 4.$$

If we were to (somehow) force up the Mexican wage above the upper bound, we would simply make Mexican bananas more expensive to Americans than producing them locally. Demand for Mexican labor would dry up. Similarly, if we were to force down the Mexican wage below the lower bound, Mexico would find it profitable to produce both goods. However, demand for Mexican labor would exceed supply, which you'd expect to increase its price.

Overall, wages are connected to productivities. Between the two bounds, demand plays a role, as we've seen. If people have a stronger desire for bananas, that tends to benefit the Mexican workers who produce them, by increasing the price of bananas, as we see in equation (1).

Bottom line

Let's think about the calculations summarized in Table 2 from a nontechnical perspective. The numbers make several points that extend to more general settings:

- Trade makes consumers (=workers) better off. In the US, consumption of apples stays the same and consumption of bananas increases. As a result, utility rises from 958 to 1061. In Mexico, consumption of bananas does not change, but consumption of apples is larger. Therefore, utility rises from 285 to 354. In more realistic models, the impact of trade is typically small, but both countries gain, as they do here. It's a byproduct of Adam Smith's invisible hand (aka the first theorem of welfare economics), which you might recall from Firms and Markets.

- Trade changes production. In this case, Mexico shifted out of apples into bananas, and the US did the reverse. In other models, the change in production may not be so extreme, but it's generally true that they predict that every country will stop producing some products, and import them instead. The result is a more efficient system of production, as each country produces those goods for which its relative productivity is the highest.

- Both effects show up in macroeconomic data as increases in productivity. If we were NIPA people, we might compute GDP like this: sum production of apples and bananas, valued at a consistent set of prices. In this case we'll use the free trade prices, which is similar to PPP adjustment (apply the same prices in every country). GDP at world prices is

	Free Trade	No Trade
US	100.0	91.7
Mexico	33.3	27.1

  Once trade shows up in GDP, it shows up in aggregate productivity, too. We don't have capital in this model, so the production function is $Y = AL$. Since L is unchanged across trade regimes, the change in Y reflects an increase in TFP.

- No jobs were lost — or found. In our example, every unit of labor was used whether trade was possible or not. This is only a little extreme: no trade models suggest that trade will have much impact on employment. Any effect there might be comes from the impact on labor supply of an increase in the wage. So when you read the newspaper, especially in an election year, remember: trade has an impact on what the jobs are, not on how many there are.

Winners and losers

From what we've seen, trade is a wonderful thing. Who could be against it? In fact, lots of people seem to have a passionately held view that trade and globalization are a plague on the world. What could they be thinking? What follows is a short list of arguments one might use. In practice, our experience is that most arguments against trade are simply self-interest in disguise.

Externalities. This is a classic "failure" of markets, the (unpriced) impact of one person's decision on another's utility. For example, a polluting producer may inflict bad air on you and reduce your welfare. When talking about trade, people often refer to positive external effects on productivity. Are there advantages to having a local industry beyond the profit and loss? Could it help others to increase their efficiency? This is a legitimate argument, but probably not a good one in most cases. Moreover, it's typically used by firms and industries looking for special deals from their governments. It was used, for example, by European car makers when seeking government protection from Japanese and Korean imports. Their argument was that the domestic producers generated technology spillovers that benefitted related industries.

Differences among residents of a country. We rushed over it, but built into our example was that all citizens of a country have the same tastes and the same productivity in the workplace. In practice, this is not true and trade will affect each person differently. One example: in the example summarized in Figure 1, all Mexican consumers are better off. Now suppose Mexicans differ in how much they like apples and bananas (ie, the parameter s is not the same across individuals). In this case, the ones who like apples less and bananas more may be worse off, since the relative price of bananas has gone up with free trade. In short, there can be losers. What the theory says, however, is that the winners win a lot more than the losers lose — Mexicans gain on average. In principle, you might want to take some of the winners' gains and give them to the losers, but in practice this isn't that easy to do. Another example shows up regularly in the press: people who lose their jobs when production adjusts to trade. In this case, suppose you worked for an apple producer and lost your job. The long-term answer is: get a job working for a banana producer, since their productivity is higher. But in the short run, there's no question you suffer a loss from losing your job. Also, if working for a banana producer requires skills that you do not have, you might have to retrain yourself. Again, the winners should be able to compensate the losers and still be better off, but in practice it rarely happens. More importantly, people lose jobs all the time for lots of reasons, and trade is unlikely to be a major factor in most cases.

Executive summary

1. International trade allows consumers to buy products more cheaply and workers to take jobs where their productivity is highest.

2. There can be both winners and losers from trade, but in theory the gains outweigh the losses in every country.

Review questions

1. Changing demand. In the example, show that an increase in s to 0.5 is good for US workers and bad for Mexican workers. Why might that be?

   Answer. This increases the price of the product produced by US workers, which improves their situation. The opposite for Mexican workers. We say the "terms of trade" (relative price of their export good) has moved against them. Think of an oil-exporting country: an increase in the price of oil is good for them, bad for importers. [Duh!]

2. Could there be losers? If trade eliminates apple-producing jobs in Mexico, could apple producers and workers be worse off?

   Answer. Yes! But the gains for others are typically larger than these losses, so we should be able to compensate the losers and leave everyone better off. This is trickier than it sounds, though.

3. Food prices and trade. When food prices rose sharply in 2008, India restricted food exports to keep prices down. Who would you expect to benefit from this policy? Lose? Is the overall impact on the Indian economy likely to be positive or negative?

   Answer. You might expect this to keep prices down in the short run because we've reduced the demand for locally produced food. (You could also express this as an increase in supply to the domestic market, but it's cleaner this way.) Who gains: domestic food buyers, foreign producers. Who loses: domestic sellers/producers, foreign buyers. Generally, any market intervention like this is a net loss. You could show this formally using a supply and demand diagram.

If you're looking for more

The personal information about Ricardo comes from the New School's History of Economic Thought web site, which includes profiles of many leading economists. Doug Irwin's "History of trade policy" is a short overview of two centuries of policy arguments.