Imperfect Competition: Monopoly and Oligopoly: Chapter 11

Imperfect competition arises for essentially three reasons:

1. Large degree of scale economies (IRS) so market can't support a large number of producers. We might think of this as a "natural" barrier to entry. Opening to trade => larger market => scale (size) effects, pro-competition effects. Different kinds of GFT.
2. Small degree of scale economies but consumers prefer particular varieties that firms specialize in. So there is a mix of IRS and product differentiation, but with free entry. Again, trade will generate new kinds of GFT, including "variety" gains.
3. Artificial entry barriers (typically due to government restrictions on entry; examples are state monopolies, licensing requirements, intellectual property rights, etc.). State monopolies are common in developing countries; we often find protected local monopolies in cities and states. Note these monopolies can be supported by trade barriers; we expect that reducing those barriers should reduce the monopoly power.

Two-good general equilibrium monopoly model

Again, let's start with partial equilibrium in good X. Suppose X is monopolized but has CRS (so some government policy supports it). Assume CRS to focus only on competition effects.

Revenue: $R_x = p_x(X) * X \qquad p_x' < 0$

$$dR_x = p_x(X)dX + Xdp_x(X)$$

$$MR_x = \frac{dR_x}{dX} = p_x(X) + \frac{Xdp_x(X)}{dX} = p_x(1 + \frac{X}{p_x} * \frac{dp_x(X)}{dX})$$

So $MR_x = p_x(1 - \frac{1}{\eta})$ where η > 0 is the elasticity of demand for X.

Recall that a monopolist will sell in a region of the demand curve where demand is elastic: η > 1. The reason is that if demand were inelastic a cut in sales would reduce costs *and* raise revenue, which cannot be profit-maximizing.

This means $MR_x < p_x$. Now profit maximization requires $MR_x = MC_x$ and so $p_x > MC_x$

And $MC_x = p_x(1 - \frac{1}{\eta})$ This generates the "markup equation": $\frac{p_x}{MC_x} = \frac{1}{(1-\frac{1}{\eta})}$

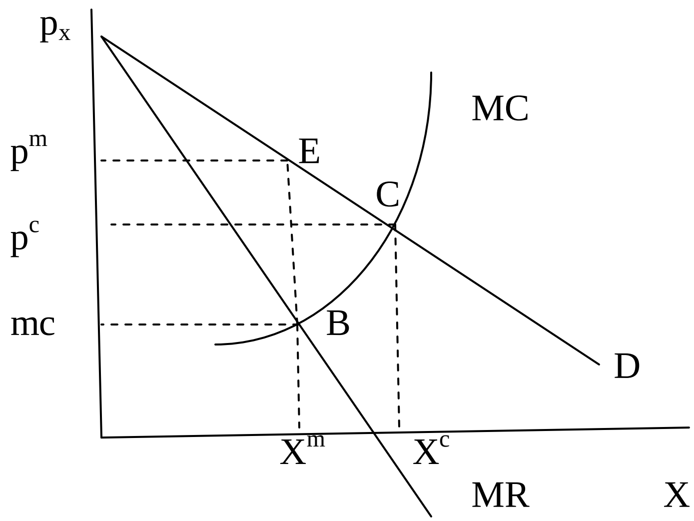
This expression approaches 1 as η approaches infinity and approaches infinity as η approaches 1. (Note this means that as η goes to 1 the markup becomes extremely large; again see why we can't have an equilibrium with η<1).

Examples: if η = 2 then $\frac{p_x}{MC_x} = 2$.

if η = 5 then $\frac{p_x}{MC_x} = 5/4$.

In the diagram below the effect of the monopoly is to set MC = MR, which means cutting output and raising price compared to the competitive equilibrium at point C. The price the monopolist gets (and consumers pay) is $q = p^m$, which is above MC. The surplus value of the lost output is area p^cmcBC and the loss in consumer surplus is $p^m p^c$CE. Monopoly profits ("rents") are the box p^mmcBE. So there is a net social deadweight loss of the monopoly of the area BCE.

Basic monopoly diagram:

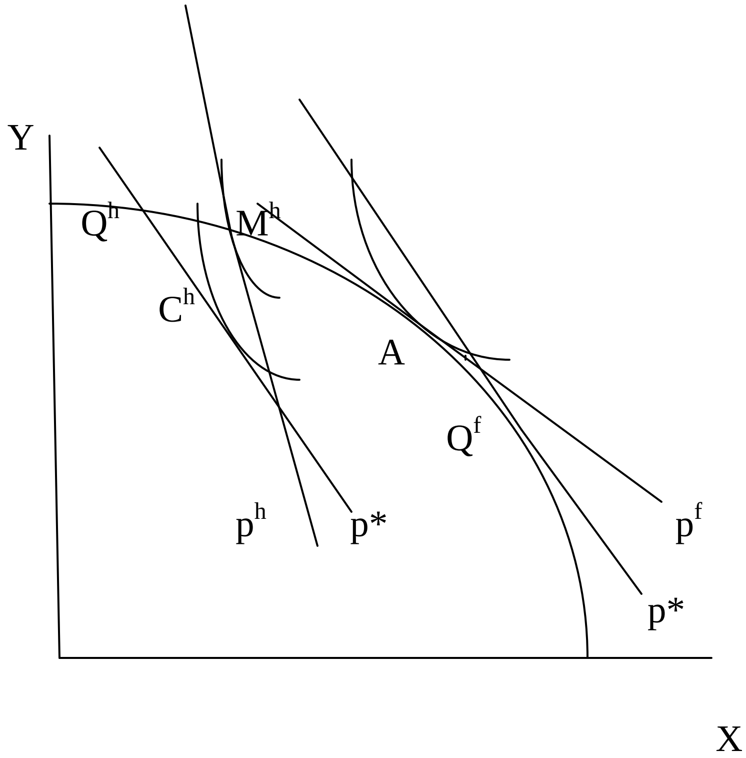


The optimal policy here to restore competitive equilibrium is to permit entry. (There are *lots* of complications to this story. Here's one: what if this just represented the static loss of a monopolist protected by a patent? You'd want to remove the patent. But if the monopoly rents are used to pay for more innovation then there could be a dynamic gain from issuing patents in terms of invention of new goods over time.)

Now let's put the simple story into general equilibrium.

Let X be monopolized but Y is CRS, perfectly competitive, so $p_y = MC_y$.

Then slope of PPF = MRT = $MC_x/MC_y = \frac{p_x\left(1-\frac{1}{\eta}\right)}{p_y} < p = q.$ The diagram follows.



Consider country h having a monopoly in X. Then instead of being undistorted at A in autarky it is at M^h with relative price p^h. The movement from A to M^h is the autarky loss from the monopoly.

Now suppose country f is identical but has no monopoly so it is in autarky at A, with price p^f. Although there is no *true* comparative advantage (h and f are identical) we still have $p^h > p^f$. So the monopoly makes X expensive in h and creates an *apparent* comparative advantage in Y for h and in X for f.

We would imagine that h could gain from trade with f if doing so reduced the monopoly distortion and got h to produce more X. But the standard analysis would say just the opposite:

Let η be constant so there is a fixed markup p_x/mc_x in h.

With trade, h would import X, export Y, implying a lower price of X in h and causing it to produce *less* X and more Y, just the opposite of what would be efficient. As price of X falls, so does mc of X and we move along PPF toward more Y, less X. Equilibrium production would be established at a point like Q^h where the lower producer price is tangent to PPF. But consumers now get to trade with country f at their price ratio. In f the relative price of X would rise to p* as they export it, so they move along PPF to a point like Q^h and produce more X, less Y. Note that f is better off. As for h, it consumes along the line p* through the production point, reaching consumption at a point like C^h. Note that trade has to be balanced with h exporting Y and importing X and f doing the opposite.

Whether h gains or loses from trade depends on how much the production point shifts in the inefficient direction ("loss from specialization" due to worsened output distortion) compared to the gain consumers get from consuming at p* ("gain from exchange").

Result is that monopoly causes trade that could be harmful.

But this is an odd result: how could opening to more competition make the monopoly distortion worse? Trade seems to support the monopoly power.

The problem here is the assumption of a fixed elasticity of demand. We would anticipate demand becoming more elastic as h monopoly has to compete with f perfectly competitive producers.

A more realistic view is that trade would destroy the monopoly power and expands h output of X, generating GFT.

Go back to partial equilibrium monopoly diagram. You can see that if price exceeds marginal cost the economy gains from expanding output. We can state this *production-expansion condition* as:

$$If\ (p_x - MC_x) * (X^c - X^m) > 0\ then\ economy\ gains\ from\ expanding\ output\ of\ X.$$

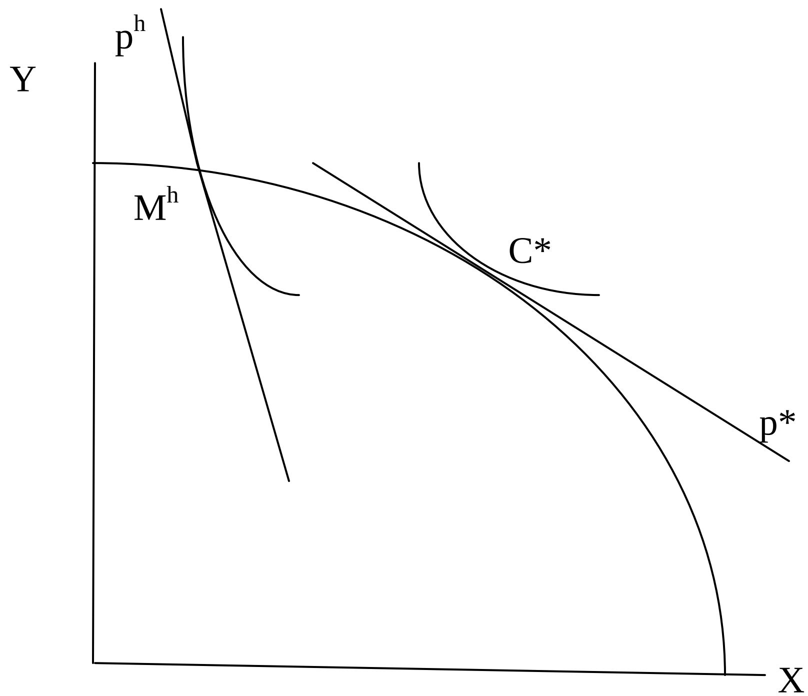
But this is true with a monopoly in place. So if we can push output of X toward the competitive equilibrium we gain welfare. This is called a "pro-competitive" gain from trade.

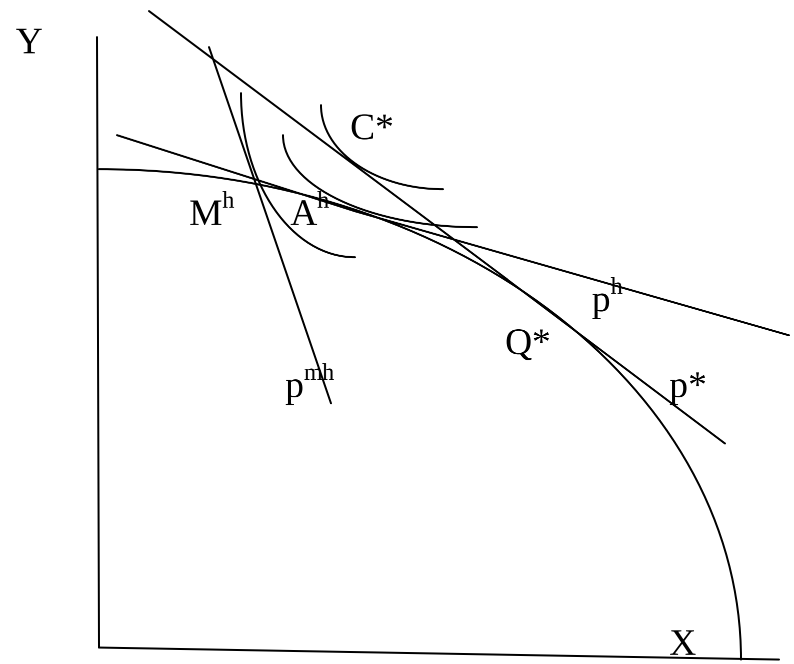
What could raise X? Imports are competition, tending to raise demand elasticity η. And this reduces the markup as output expands.

So the key question is what happens to η as trade expands? Consider two extreme cases.

First Case: Economy h is an SOE importing X at fixed relative price p*. With trade, η goes to infinity, destroying the monopoly.

Here is a depiction of a pure pro-competitive (PC) gain from trade. Let h have a PPF that without the monopoly would generate competitive price equal to p*. But the monopoly in autarky establishes a high price of X.





In this case (left-hand diagram) the mere act of entering trade at p* destroys the monopoly and h moves to C*. There is no actual trade but the economy is better off. This is a pure PC gain from trade.

We can make this a bit more interesting by looking at the right-hand diagram. Suppose the monopoly in autarky is as before (p^{mh}) but this country h actually has a *true* comparative advantage in X in the sense that at the undistorted autarky point A^h we have $p^h < p^*$. Then opening to trade will move output to Q* and consumption to C*. We have:

1. The PC gain from trade is from M^h to A^h.
2. The standard GFT is from A^h to C*.

(You might find it good practice to draw this case where h has a true comparative disadvantage in X and show the same kinds of GFT.)

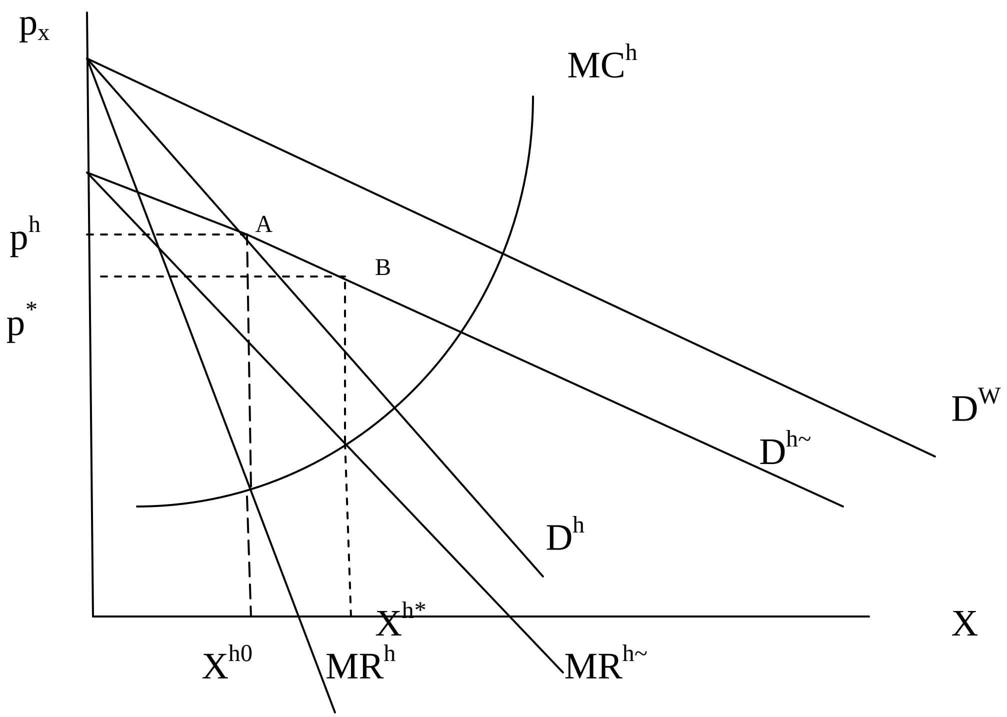
Second Case: Duopoly in Free Trade

It may be more natural to imagine that there are 2 identical countries, h and f, and each has an identical monopoly in good X. Then free trade will establish a duopoly in the *integrated* market.

Assume:

X^h and X^f are homogeneous goods (perfect substitutes).
Symmetric duopoly; identical countries.
No other distortions.

Here's a simple graphical representation of the effect of trade on elasticity of demand.



The autarky equilibrium for h is the standard monopoly solution at A, with the monopoly markup over marginal cost.
Now suppose h and f agree to trade freely in an integrated market. The integration doubles the market demand curve to $D^w = D^h + D^f = 2D^h$. But now there are 2 firms and each must optimize in this duopoly. In basic game theory we consider several possibilities.

A. Cournot-Nash behavior (quantity competition). The h firm always assumes the f firm keeps its output fixed regardless of what h firm does (and vice-versa). Then the "perceived demand" for h is $D^{h\sim} = D^W - X^{f0}$ (note $X^{f0} = X^{h0}$).

Now $D^{h\sim}$ is more elastic than D^h in the neighborhood of A, so η~ (perceived elasticity) rises with introduction of trade. So $MR^{h\sim} > MC^h$ at A, causing output for h to rise to X^{h*} and price to fall to p* for h firm. Exactly the same happens for f firm by symmetry.

INTUITION: If h raises output it knows price will fall, lowering MR. But if f output is fixed, some of the price decline is forced onto f firm. Here it is ½ the loss in output. This induces h firm to raise output by *more* than it would along original demand curve. So does the f firm => there is more competition in trade. Note this is not a *cooperative* outcome (which is a good thing), for cooperative outcome would be collusion between the 2 so that both remain monopolists at A.

Next note that point B is not an equilibrium since (2 x X^{h*}) is bigger than world demand at p*. So from this point both outputs must shrink somewhat. How much is hard to see in the partial equilibrium diagram.

Let's revisit our earlier elasticity story to see how Cournot-Nash actually works. Suppose there are multiple firms i selling in country j. Then revenue for any firm is

$$R_{ij} = p_j(X_j)X_{ij} \;\; where\; X_j = \sum_i X_{ij}\ .$$

Cournot assumption is that $\frac{\partial X_j}{\partial X_{ij}} = 1$ so that no other firm will respond. Marginal revenue is

$$\frac{\partial R_{ij}}{\partial X_{ij}} = p_j + X_{ij}\frac{\partial p_j}{\partial X_j}\frac{\partial X_j}{\partial X_{ij}} = p_j + X_{ij}\frac{\partial p_j}{\partial X_j}$$ which follows from Cournot assumption.

This can be written as $\frac{\partial R_{ij}}{\partial X_{ij}} = p_j + p_j\frac{X_{ij}}{X_j}[\frac{X_j}{p_j}\frac{\partial p_j}{\partial X_j}]$. You'll recognize the bracketed term as –1/η. So we have

$\frac{\partial R_{ij}}{\partial X_{ij}} = p_j\left(1 - \frac{X_{ij}}{X_j}\frac{1}{\eta_j}\right) = p_j(1 - \frac{s_{ij}}{\eta_j})$. This looks like the earlier marginal revenue equation except for the s_{ij} term, which is simply the share of firm i's sales in market j (for a monopoly this share is one). Setting MR = MC the new markup equation is

$$\frac{p_j}{mc_i} = 1 \Big/ (1 - \frac{s_{ij}}{\eta_j}) .$$

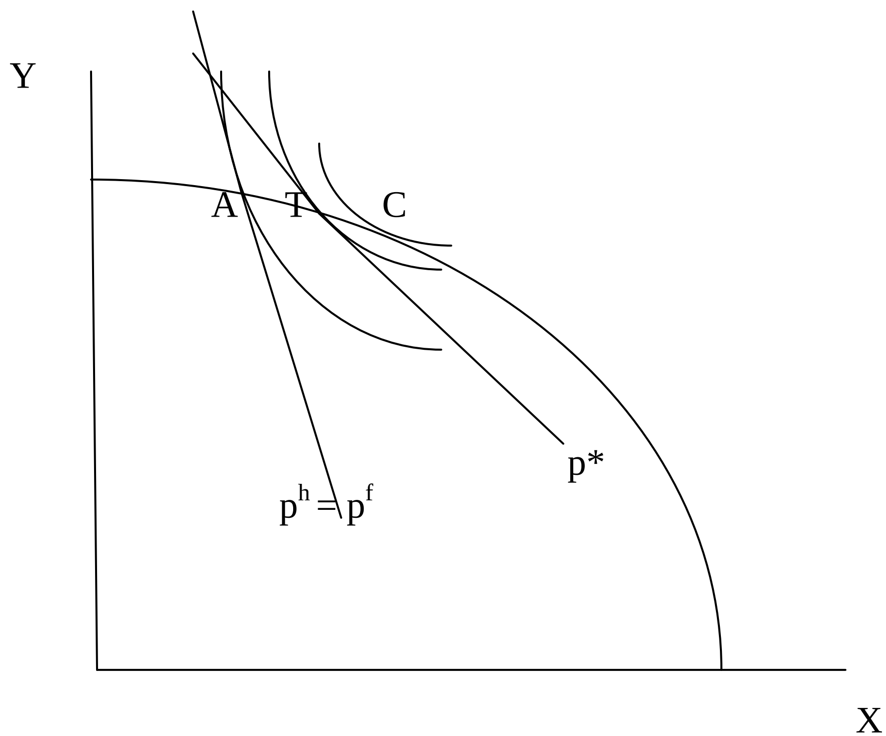
In words, the higher is a firm's share the higher its markup. The higher the demand elasticity the lower any firm's markup is. In a symmetric situation (all firms the same) each firm would have the same markup. For example with 2 firms (s = ½) and elasticity = 2 the markup per firm would be p/mc = 1/(3/4) = 4/3.

B. Bertrand behavior (price competition). Here h believes f will keep its price the same no matter what price h chooses. So if h raises its output (which would lower its price) it assumes no price reaction => it raises output by even more. So does the f firm. So we would get an even larger rise in joint output than in Cournot case, implying lower price and lower profits. A highly competitive outcome.

C. Stackelberg market leader behavior. The idea here is that one firm has considerable share of the market and so sets the price along some residual demand curve. The "followers" sell all they want at that price. Since we will focus only on symmetric cases we'll not use this assumption.

There are other assumptions, including static versus dynamic games. Virtually all conclude that unless there is collusion open trade will expand the market, raise perceived elasticity of demand, raise outputs and reduce prices and profits. These are pro-competitive gains from trade. We'll mainly stick with Cournot-Nash since it's fairly straightforward and generates insights.

Let's do the analysis above in general equilibrium. Again assume h and f are identical, with identical monopolies in X. This means $p^h = \frac{p_x^h}{p_y^h} = \frac{p_x^f}{p_y^f} = p^f \quad further\ q^h = q^f.\ But\ p^h > MRT^h\ and\ same\ for\ f.$ This means that consumer prices equal producer prices; in both countries these are steeper than slope of PPF; and the autarky situations are identical in h and f.



Here, point A is autarky for both countries with the high relative price of X as shown. Both are suffering a domestic welfare loss in comparison with the competitive equilibrium at C. Since they are identical (PPFs, preferences) there is no true comparative advantage. And since the monopolies are identical there is no apparent CA either.

Now let them trade with each other. Each X firm recognizes there is a larger (double) market into which it can sell. In the Cournot assumption each will see a higher perceived demand elasticity and will expand output. This will generate higher X output by each firm and more sold in each country. The free-trade eq is at a point like T, where we have a duopoly equilibrium at the lower relative price p*. We do not go all the way to the competitive case since there remain only 2 firms.

Some interesting results:

1. Trade reduces the market power of each monopolist and output of X expands in both countries. Output of Y contracts in both countries.
2. There is no actual trade at point T. What happens is that each X firm represents a competitive threat to the other so by opening to trade each must drop its price and expand output. You can think of this as just a threat of entry driving down price.
3. The movement from A to T is a pure PC gain from trade. The duopoly is more competitive than each monopoly.
4. The production-expansion condition holds for both h and f in this case. Both are better off.

So we get a clear GFT even if no trade happens. This isn't magic; it's competition.

Is this kind of thing actually important in the world? PC gains happen when countries choose to break up regional marketing boards, national monopolies, state-owned enterprises, and so on. Opening up to import competition can achieve this outcome. Of course these monopolies will resist it.

Increasing Returns to Scale

The analysis above assumed CRS, which is not very likely when we think about firms with market power. And modern trade theory is largely about trade in the presence of firm-level IRS.

To focus closely on the effects of IRS it pays to use a simple model of IRS, with one factor of production, L. (We can do this with 2 factors but then we have to sort out factor intensity effects from IRS effects and it's messy.)

First, an overview of the new kinds of GFT that can happen with internal (inside the firm) IRS:

1. Pro-competitive gains (reduce market power).
2. Average costs decline as output expands (higher productivity; lower costs).
3. Exit of redundant (typically higher-cost) firms.
4. Increase in product variety (both of outputs and intermediate inputs).

This is all in addition to standard comparative advantage GFT in terms of consumer prices and resource reallocation if there is also a reason for CA (eg, different relative factor endowments).

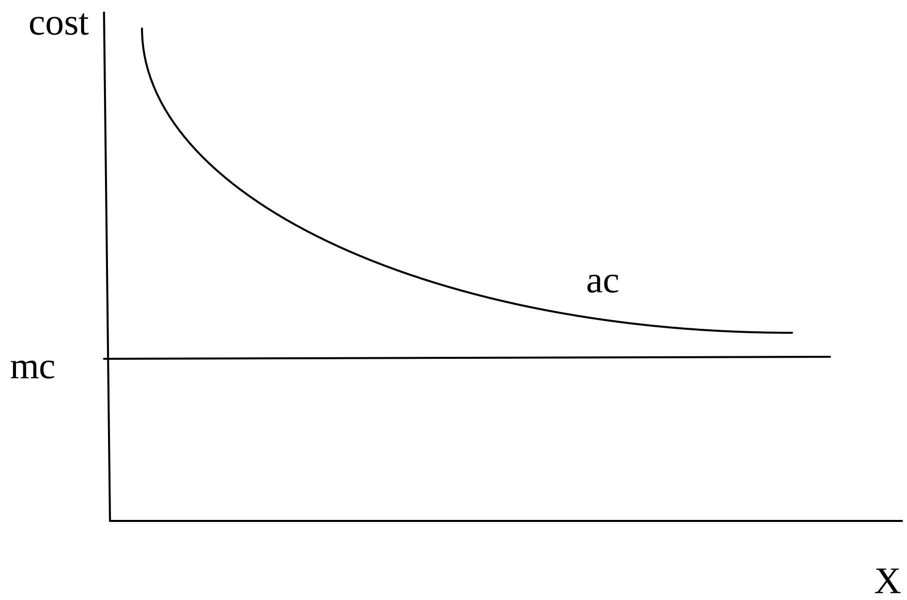
We can develop a simple model to handle these 4 cases.

Consider a basic one-factor model (L). This is essentially a Ricardian model but with IRS in X.
Assume Y is CRS and the production function is $Y = L_y$ (marginal productivity = 1).
Also let Y be the *numeraire* good so that $p_y = 1$ and the relative price we consider is just p_x.
Immediately we see that because $MPL_y = 1 \Rightarrow w/p_y = 1 \Rightarrow w = 1$. (Labor's real wage is fixed at one unit of Y; it could change in terms of X. L and Y are basically the same units in this model.)

Let X have IRS in the form $L_x = F + mc * X$ F is fixed cost of output in L units (or Y units); mc is the constant marginal cost. (In Ricardian terms if there were no fixed costs then
$mc = \frac{L_x}{X}$ *so mc would be the inverse Ricardian productivity coefficient.*

Then $tc = wL_x = mc * X + F$; $ac = \frac{tc}{X} = mc + \frac{F}{x}$.

This kind of cost curve has the following simple shape:



Note that since ac > mc we cannot have p = mc; there must be some kind of market power with p > mc even if there is free entry so that firms cover their fixed costs.

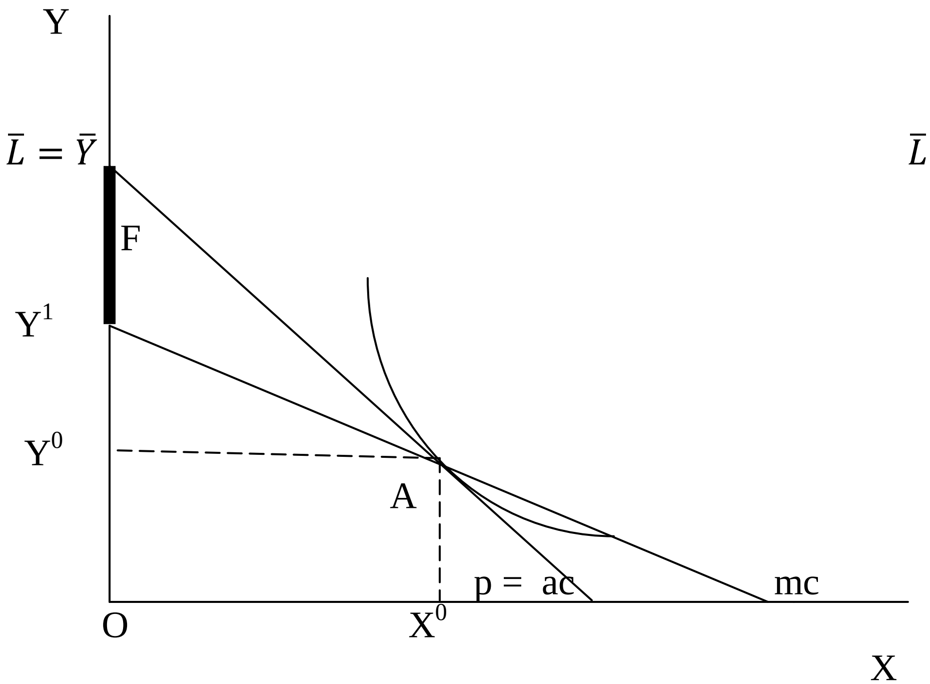
Let's develop the PPF (see also Chapter 2 and Figure 11.2).

$$\bar{L} = L_x + L_y \; then \; \bar{L} = F + mc * X + Y \; so \; that \; Y = (\bar{L} - F) - mc * X$$

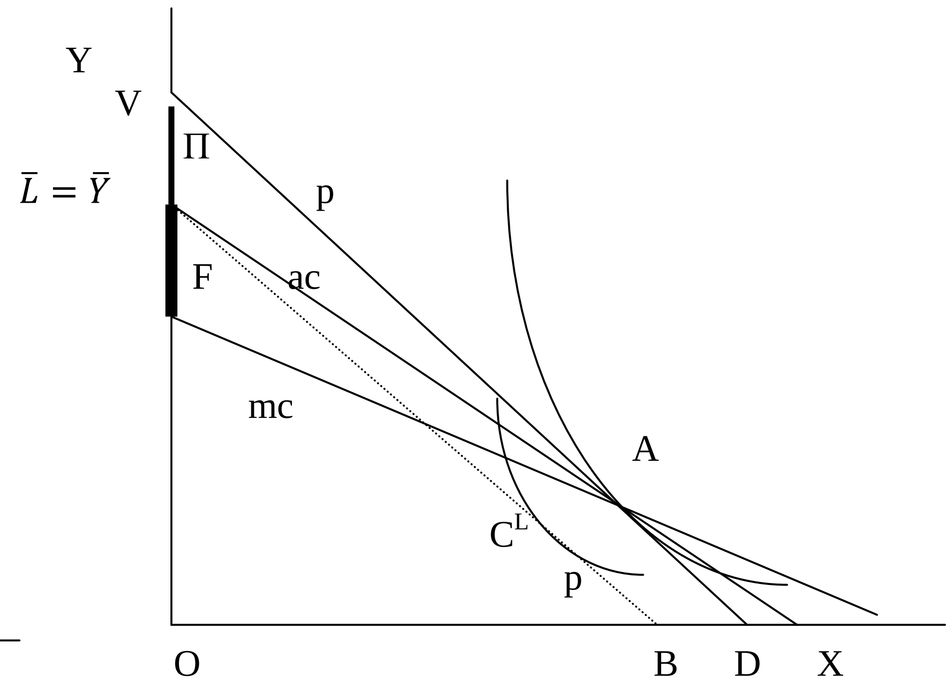
Note that $ac = \frac{L_x}{X} = \frac{\bar{L}-L_y}{X} = \frac{\bar{L}-Y}{X}$ So as X rises, Y falls and ac in X falls.

Profits: $\Pi_x = p_x X - total\ costs = p_x X - mc * X - F = (p_x - mc)X - F$

There are 2 diagrams below. The one on the left has free entry (average cost = price) and the one on the right has some kind of restricted entry so ac > p and profits are made in autarky.



Free entry



Restricted entry

Point $\bar{Y}$ is the max Y output. After investing F units of Y (labor) in X, then X output expands along mc (and Y output declines). As noted above, at autarky point A the average cost of x is $ac = \frac{\bar{Y}-Y^0}{X^0}$. So ac is the (absolute value of) the slope of the line between $\bar{Y}$ and the point of production.

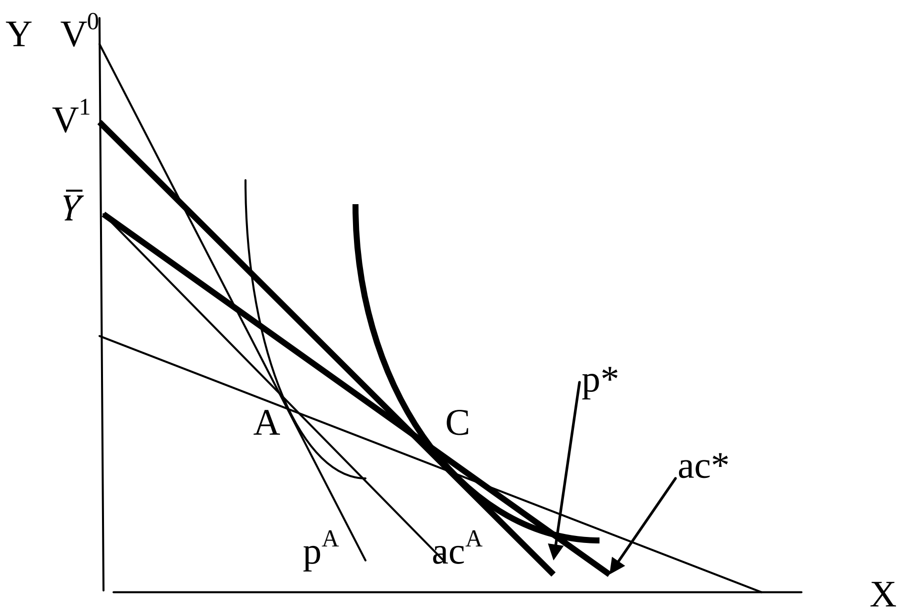
With free entry there are no profits and p = ac for good X. Autarky equilibrium is at A and all income earned goes to labor.

With restricted entry there are profits made and p > ac. The indifference curve is tangent to p but steeper than ac. Profits Π are represented by the thick line segment on Y axis above $\bar{Y}$ to V. Here national income is made up of income to Labor and profits. How do we know this? If equilibrium is at A at price p, recall that real national income (measured in Y units) is the distance OV. But labor income is $w\bar{L} = \bar{Y}$. So the rest of the national income goes to profits. Note this means workers in total consume at C^L, the rest of consumption goes to the profit owners.

Put differently, $Real\ GNP = \bar{L} + \Pi$; $Labor\ budget\ constraint = \bar{L}B$; $National\ budget\ constraint = VAD$.

Effects of Trade

Let's start with the case where there are profits in each of 2 identical countries in autarky. So suppose there is one X producer in h and one in f. The right-hand diagram above will work for either (symmetric) country.



Autarky is at A with $p^A > ac^A$ and profits are made by the X firm in both countries. Now let the countries trade; again both X firms perceive a doubling of the market size and an increase in perceived demand elasticity, so they expand output to point C (again, no actual trade is necessary). In turn this reduces price to something like p*. That generates a PC gain as discussed earlier. Note that profit falls from $\bar{Y}V^0$ to $\bar{Y}V^1$. Again, the production-expansion condition above holds: price exceeds marginal cost and output expands in trade.

But now there is something more: because output expands the average cost of producing X falls to ac*. This implies a more efficient production structure and a more productive economy. That is, the X sector now gets a greater degree of economies of scale (IRS), making the economy more efficient. True of both h and f.

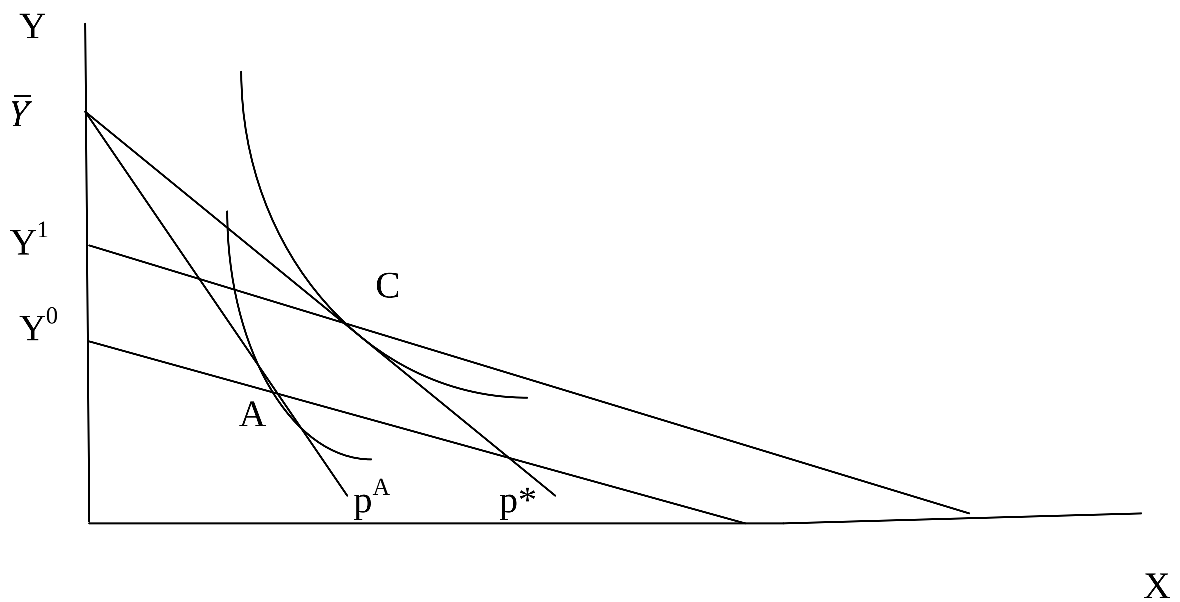
So now we have two sources of GFT with imperfect competition.

1. Pro-competitive GFT (also called "profit effect") from having two firms competing and reducing profits.
2. Declining AC effect, generating productivity gains.

It is difficult to precisely separate these 2 since they happen simultaneously. But if you want to do that you can imagine the PC gain coming from holding output fixed at A but permitting consumers to trade at p*. Then each country in principle could get a higher utility level by importing X and exporting Y. (Obviously not an equilibrium). This is something like the "gain from exchange" earlier but it comes from reducing price. Then permit each economy to expand production along its PPF to get to the final point C, which reduces average costs. (At point C there is no trade and that can be an equilibrium.) This is like the "gain from specialization" we had earlier but it's due to IRS and declining ac.

But there is another possibility, which we can analyze with the free-entry case (left-hand diagram above). With free entry and price = ac (no profits) there must be a significant number of firms in the market (so-called "monopolistic competition" as in the following chapter). But each X firm has the same fixed costs and marginal costs so if we just add up all the fixed costs of these firms we get F and the PPF and autarky equilibrium look as shown. The main point here is that the difference between price and marginal costs, times per-firm output, just covers per-firm fixed costs when there are zero profits (see above):

$(p_x - mc) * x_i = F_i$ This is the "zero-profits" or "free-entry" condition. Here I use x_i to indicate output of firm i. (If all firms are identical then this is the same per firm.)



(See also Figure 11.4 in text.) Initial equilibrium is at A and the sum of all the fixed costs in the X firms is distance $Y^0\bar{Y}$. Now let h and f enter trade with each other. Each of these X firms will (as a Cournot-Nash competitor) see a higher perceived demand elasticity and will expand output. This will bring price down to p*; average cost also falls so we get the same kind of productivity gain as before. Average firm output is higher.

But there's something new here also. With a lower price it can no longer be true that all firms can remain in the market. If they did they would stay at A but that would mean fixed costs would not be covered at p*, so some firms must exit. (Which firms? Here it is indeterminate but generally the higher-cost firms.) So in the new equilibrium at C we will have fewer firms but with each covering its fixed costs:

$$(p * -mc *)x_i^* = F_i$$

Note from this there is a lower price but the same mc (by assumption) and same fixed costs so x_i has to rise. The markup of price over mc falls.

With firms exiting there will be lower overall fixed costs by ($\sum F_i$) (or F times the number of firms that exit if F is the same per firm). This means point Y^1 is higher and there is a higher PPF due to getting rid of some redundant firms.

In this case we have two kinds of productivity gains:

1. Average cost effect (output per firm rises so average cost falls due to IRS).
2. "Rationalization gain" from the exit of redundant firms.

This rationalization gain can be quite significant as an economy liberalizes its trade restrictions and becomes more integrated with world markets.

Final note: ignore section 11.3 and 11.4. We'll return to 11.3 when we get to trade policy later.