Market Failures, Distortions, Externalities and Trade: Chapter 10

This chapter essentially makes two points:

1. Government or market "distortions" and externalities can be causes of international trade.
2. Trade caused by a distortion or externality is not necessarily beneficial.

Preliminary concepts:

Market distortions can be:

1. Government-induced. Examples include taxes, subsidies, licenses, fees, marketing restrictions, government procurement rules, market set-asides, limits to mobility, product standards, sanitation regulations, etc. If imposed in an otherwise perfectly competitive, no-distortion economy they reduce economic efficiency and welfare. But
    a. These may be imposed to offset some private market distortion or failure, such as pollution (impose tax); monopsony hiring power (permit labor unions); inability of firms to charge high enough prices to pay for innovation costs (impose intellectual property rights); etc. In such cases welfare can be improved or worsened by the policy response.
    b. These might be put in place for non-economic reasons (social and political goals). Economists find these hard to measure in terms of welfare gains and losses. What we can do is indicate how to achieve these goals at the least efficiency costs. Often there is a tradeoff between social objectives and economic efficiency.
2. Private market failures and externalities. Examples include those above in 1 along with monopoly (use anti-trust law), free-riding on contributions that generates under-provision of public goods (raise taxes), consumption externalities (impose taxes or subsidies on consumption), etc.

Thus, a basic role for public policy is to offset private market failures. But note there can also be government failures in doing so.

In this context, several principles exist for policy making:

1. If there is a single distortion, the best ("first-best") approach is to remove it or offset it directly.
2. If the goal is to distort the economy to achieve some non-economic goal, do so directly with the policy that most directly achieves it.
3. "Second-best" theory: if there are 2 or more distortions, removing or offsetting a subset of them can raise or lower welfare. And introducing a second distortion can also raise or lower welfare.

All pretty complex. We analyze these ideas with a number of cases.

We should start by recalling the conditions for Pareto Optimality (economic efficiency):

A. $p_x = MC_x$ $p_y = MC_y$ This happens with perfect competition in goods and factor markets.

B. $p = MC_x / MC_y = MRT = MRS$ Relative price equals slope of PPF and also equals slope of community indifference curve.

C. $w/r = MPL_x / MPK_x = MPL_y / MPK_y$ This is required for undistorted equilibrium in factor markets and ensures that the economy produces on its contract curve (and therefore on its PPF).

We defined these relationships earlier simply by reference to market prices and costs. But now we may need to conceive of prices, marginal costs and productivities as reflecting both private and social factors. For example, if production of X generates air pollution we should count the costs of cleaning it up in that industry's total and marginal costs.

For now we can think of different types of distortions as departures from Pareto Optimality.

For example, let q_x and q_y be the consumer prices of X and Y, which could differ from producer prices given by p_x and p_y. This could be due to a sales tax, output subsidy or tax, or many other factors. Let q be the relative consumer price, p the relative producer price

Then we could have

$MRS = q_x/q_y \neq p_x/p_y = MRT$ (slope of indifference curve different from slope of PPF; tax or subsidy)

$MRS = q = p \neq MRT$ (price line cuts through PPF; output externality or monopoly)

$MRS \neq q = p = MRT$ (consumer price line cuts through indifference curve; consumption externality)

$w/r = MPL_x /MPK_x \neq MPL_y /MPK_y$ (isoquants are not both tangent to price line; factor tax or subsidy)

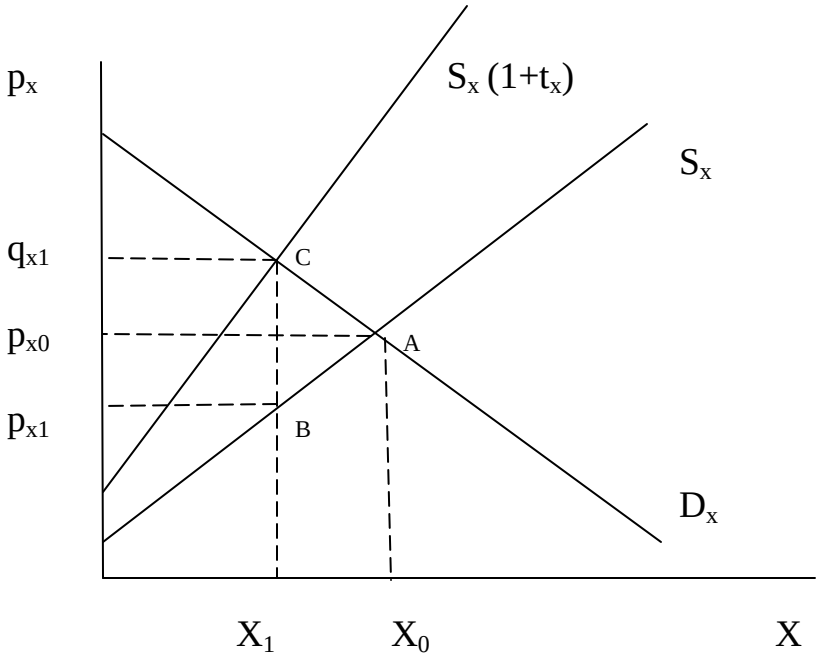
$(w/r)_x \neq (w/r)_y$ (different relative factor prices in 2 goods; labor union or labor monopsony)

Many cases could be analyzed, one at a time or in combination. In essence this is what public economists and trade economists do. But it gets complicated so we'll try to build up two simple cases:

1. Production tax or subsidy;
2. Externality from pollution.

To make life as easy as possible, assume we have a small open economy (SOE) so that international relative prices p* are fixed.

Consider an *ad valorem* (percentage) production tax on good X but not on Y. Here is the simple analysis for a closed economy (autarky), partial equilibrium:



An ad valorem tax of t_x means the government imposes a t_x percent tax at the point of output (often called an excise tax or indirect tax; could be a value added tax). So the price to consumers must be t_x percent higher than the "net" price producers get.

Eg, if t_x = 20% (0.2) and producer price = \$5 then consumer price = \$6; if p price = \$10 then c price = \$12.

This relationship is easily stated as $q_x = p_x (1 + t_x)$. In the diagram above, D is the demand curve and S is the supply curve. What this tax then does is "distort" the supply curve upward in proportion to the tax, so

New supply curve = $S_x(1+t_x)$

(*Here's a hint on analyzing these problems: first figure out if the distortion is on the supply side (so it shifts supply curve) or the demand side (so it shifts demand curve). In this case of the closed economy it wouldn't actually*

matter if we thought of this as a consumption tax and reduced the demand curve. But it will matter in the open economy.)

So in the initial no-tax equilibrium at A, q and p are the same. With the tax in place we have a "two-point equilibrium" where consumers are at C and producers are at B. The effect of the tax is to raise the price consumers pay and reduce the price producers receive.

An important aside: how much consumer price rises versus producer price calls is referred to as the "incidence" of the tax. What determines how much these prices change? (Hint: what would happen with a steep demand curve and flat supply curve? Steep supply curve and flat demand curve?)

Some basic welfare analysis can be done here. This is a partial-equilibrium story you are familiar with and it is not entirely accurate in general equilibrium. But it's useful to understand this.

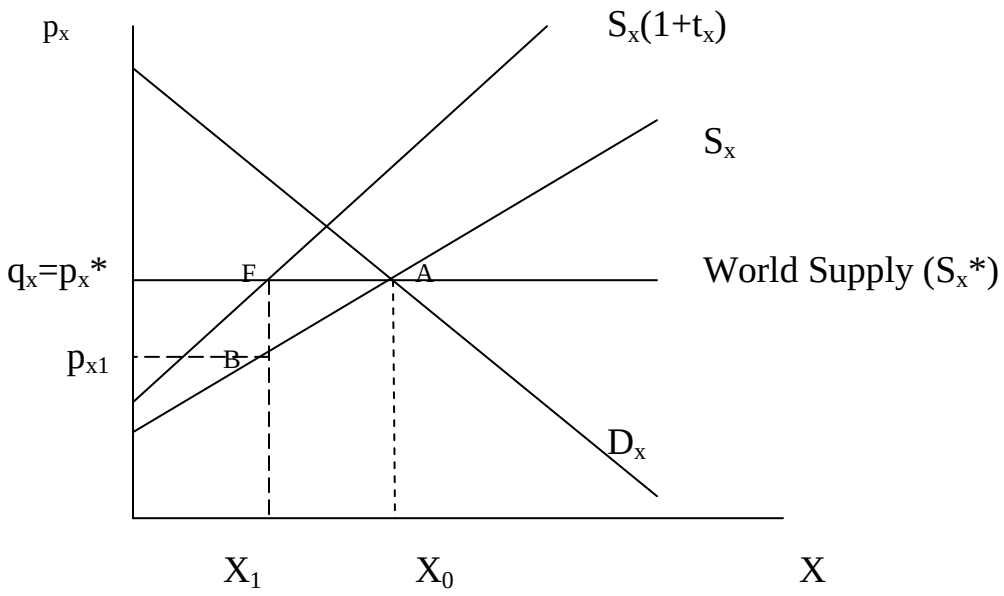
In moving from A to C the tax reduces *consumer surplus* by the shape q_{x1} p_{x0} AC (a welfare loss).

It reduces *producer surplus* by the shape p_{x1} p_{x0} AB (a welfare loss).

It generates *tax revenue* of q_{x1} p_{x1} BC (a welfare gain).

There is a "deadweight loss" of triangle BCA. This is also called the *burden* of the tax. In essence it is the loss in efficiency the economy is willing to sacrifice in order to raise the tax revenues and use them for some socially beneficial purpose. Simplest case is to assume they are given back to consumers in a simple 1/n lump sum.

Now let's try the same analysis in an open economy (free trade). Let's suppose the economy imports good X at a fixed world price p_x* along the perfectly elastic rest of world (ROW) supply curve below. We immediately see 2 big differences: the government cannot make foreigners pay a domestic production tax and consumers do not have to pay more than p_x* for X. So now the diagram becomes:



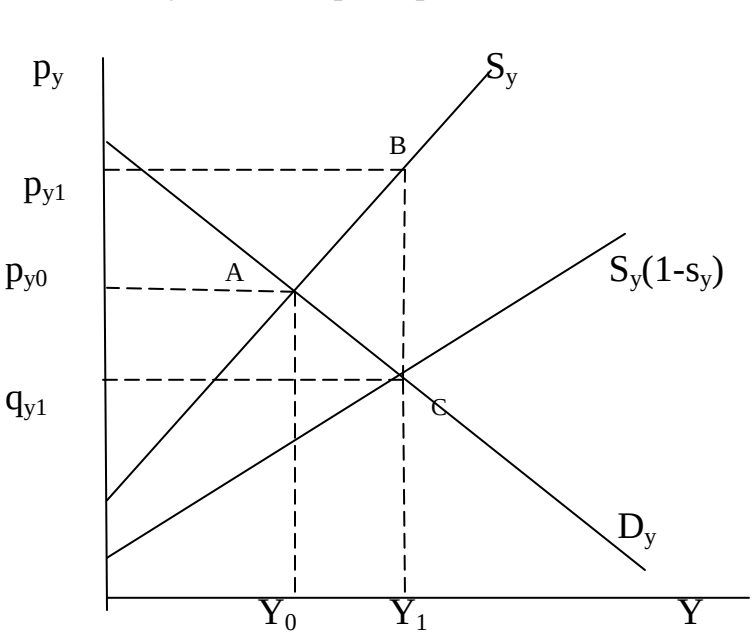
Suppose (strongly) that the economy is initially at A, where there is no trade simply because the price generated by domestic supply and demand equals world price. (We are implicitly considering what happens to trade when there is no comparative advantage). Now let the government impose the production tax. Consumer price remains constant at $q_x=p_x^*$. But the tax has to be paid on domestic output, so producers are at B and the tax-inclusive price on that lower output is $q_x=p_x^*$. But consumers pay the same price so they remain in equilibrium at A.

Results: 1. Producer price falls by full amount of the tax (producers pay the full burden in a small open economy because consumer price can't rise). In effect the "demand curve" in this case goes from p_x^* to A then D_x. 2. Consumer price does not rise. 3. Output falls to X_1. 4. Imports are generated by the tax! Imports = X_1X_0.

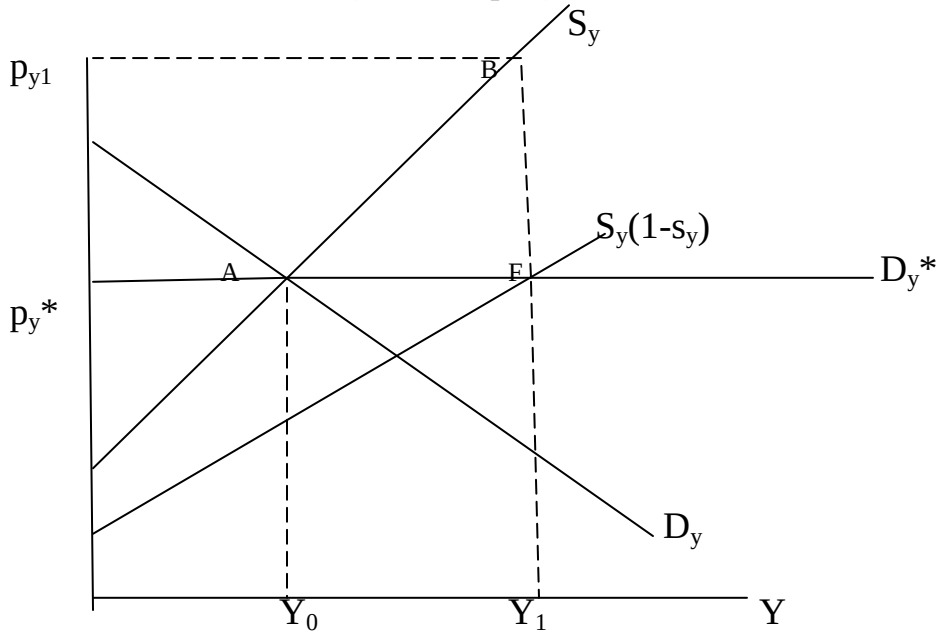
Welfare? Loss in producer surplus = $p_x*p_{x1}BA$. No change in consumer surplus. Tax revenue = $p_x*p_{x1}BF$. Deadweight loss = FBA.

Note that since there is a welfare loss here it suggests that trade generated by a distortion may not be welfare-increasing. We'll want to show that in general equilibrium below.

Before that, what happens with an ad valorem (percentage) production subsidy? (Can you think of any examples?) The subsidy would expand production rather than contract it. The 2 cases (closed, open) would be this:



Closed



Open

If a subsidy s is paid to Y producers it reduces their marginal cost of producing by s%. This shifts down (expands) the supply curve in proportion : new supply curve = $S_y(1-s_y)$. This means in turn that price to consumers will fall in proportion and the basic price relationship is

$q_y = p_y (1 - s_y)$. Thus, if the producer price is \$5 and the subsidy is 10% (0.1) then the consumer price is \$4.50.

In the closed economy above, the no-subsidy equilibrium is at A. The subsidy expands production to Y_1 and consumers are in equilibrium at C while producers are at B. Note the results:

Producer price rises (this is what induces them to produce more); consumer price falls, output rises. There is again an incidence of the subsidy.

Welfare: producer surplus rises by $p_{y1}\ p_{y0}$ AB (welfare gain).
Consumer surplus rises by $q_{y1}\ p_{y0}$ AC (welfare gain).
Subsidy cost (expenditure) rises by $q_{y1}\ p_{y1}$ BC (welfare loss).

The deadweight loss or burden is triangle ABC.

In the open economy case, suppose no initial trade at point A. The subsidy expands domestic supply as shown. But the consumer price is fixed by the world price p_y* as shown on the perfectly elastic ROW demand curve. The reason is that foreigners can buy at the subsidized (consumer) price so if that goes below p_y* the world would just buy it and the price would be bid up to the world price. This means the producers get the full benefit of the subsidy at equilibrium B while consumers remain at A at the same price.

Results: 1. Producer price rises by the full amount of the subsidy because consumer price can't fall. 2. Output expands to Y_1. 3. Consumption remains at its original point. 4. The subsidy generates exports in the amount Y_0Y_1.

Welfare: Gain in producer surplus = $p_y * p_{y1}$ BA (welfare gain)
Consumer surplus no change.
Subsidy cost = $p_y * p_{y1}$ BF (welfare loss)

Deadweight loss = ABF. Again, trade generated by the subsidy contracts welfare.

Basic result: in a small open economy the consumer price is fixed. So a tax or subsidy is fully felt by an adjustment in producer prices and outputs. This generates imports (tax) or exports (subsidy) but this trade is not beneficial.

Now let's do this tax or subsidy analysis in general equilibrium (2 goods). First consider a closed economy without worrying about trade.

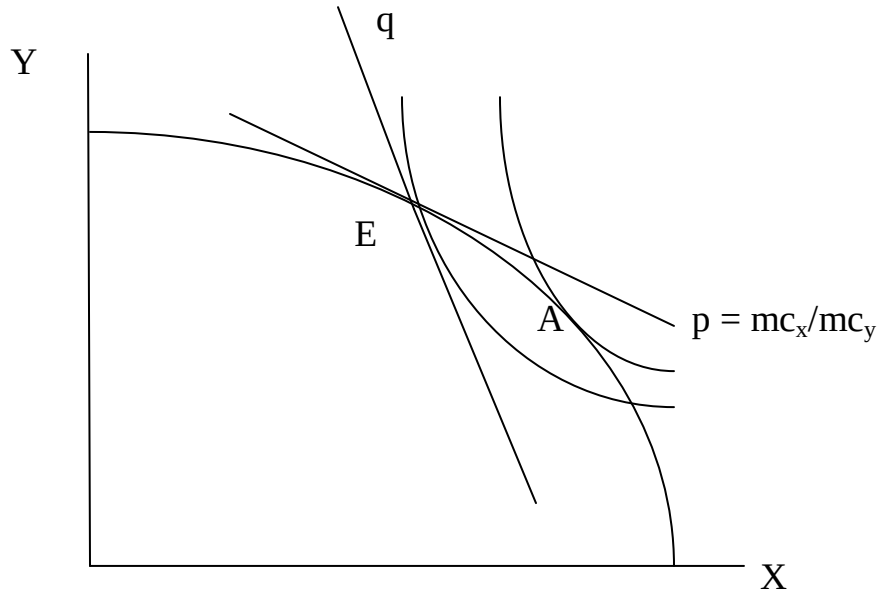
Suppose there is a production tax on X but no tax or subsidy on Y. Then our relative price relationship is

$$q = q_x/q_y = p_x (1 + t_x) / p_y$$

Autarky (closed economy) would then look like this case with a tax (see also Fig 10.1). One reminder: the MRT (slope of the PPF) actually reflects relative marginal costs of production (see chapter 2 discussion).

MRT = mc_x/mc_y . Also in equilibrium with perfect competition producer prices will equilibrate to marginal costs: $p_x = mc_x$ and $p_y = mc_y$

So what we have in total is $q > p$ and $p = mc_x/mc_y = MRT$.

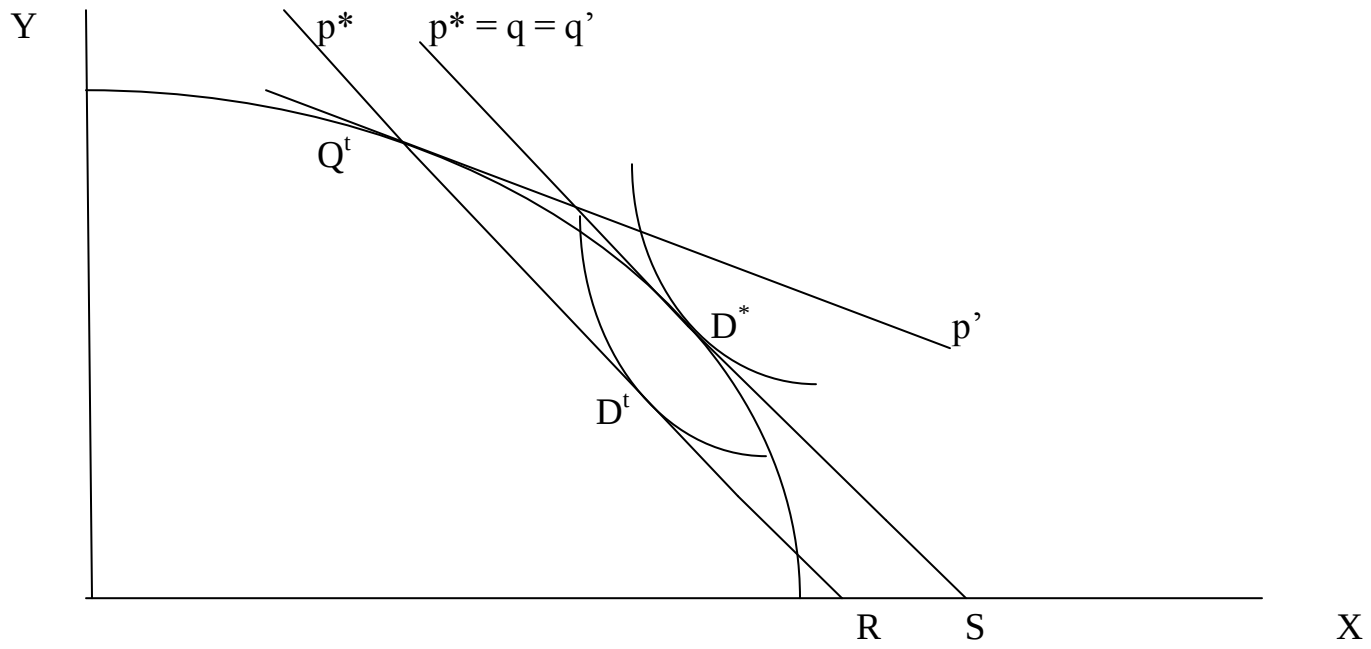


In this basic case the undistorted autarky equilibrium is at A. But the tax on X raises the relative consumer price of X (to q) and reduces the relative producer price of x (to p). This causes output and consumption of X to fall (so that output and consumption of Y rise) compared to A. The autarky equilibrium at E is inefficient, the welfare loss is the movement from A to E.

Now what happens if we do this analysis for the SOE? Again assume autarky prices at A above are equal to world prices p*. Here are the price relationships (let a prime indicate new level):

$p^* = q' = p'_x (1 + t_x) / p'_y > p'$

So we need to show an equilibrium with a lower producer price ratio and the same consumer price ratio (see Figure 10.2 also).



Here let D* indicate the consumption point in free trade before the tax is imposed; there would be no trade. Now put in the tax; the effect is to reduce the relative producer price of X, shifting output to a point like Q^t. But consumption must lie along the free-trade price line through Q^t, meaning that the consumption bundle moves to D^t.

So there is a welfare loss from D* to D^t, which corresponds to our deadweight loss above. We can also think of this in terms of the reduced real GDP in terms of good X, which is the distance RS.

We can see why doing this in general equilibrium is important. In the partial-equilibrium case above we concluded consumption of X would not change for the SOE with the tax imposed. But the reduction in real GDP actually does reduce consumption. Also the fall in X output implies a rise in Y output so the tax on X is not neutral across

sectors. Also there is trade generated: the economy imports X and exports Y. But this is associated with lower welfare.

Next important point: the same percentage subsidy on Y output would yield the same equilibrium as above. This is easy to see with price relationships:

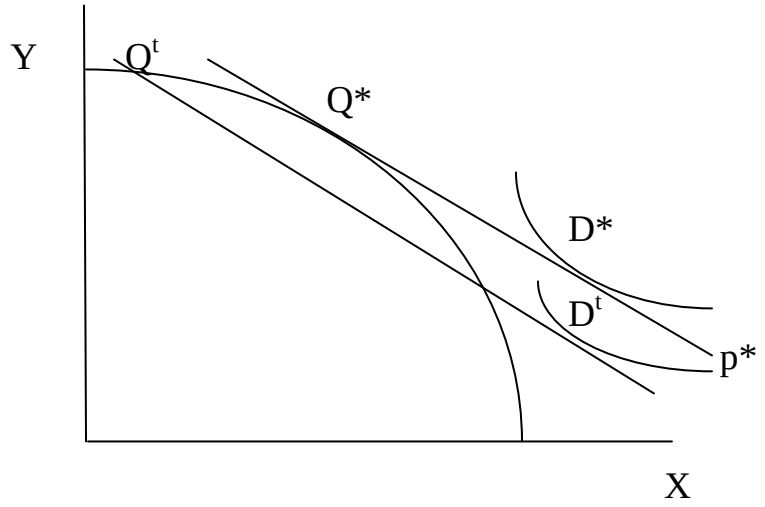
$$p^* = q' = p'_x / p'_y (1 - s_y) > p'$$

So exactly the same diagrams as above would work for this case and we would get the same production, consumption, and trade outcomes. And the same welfare loss.

There is a symmetry between a production tax on X and a production subsidy on Y. If t_x and s_y are the same percentage, each would have the same impact on the economy.

Next question: what if the economy has comparative advantage due to endowments (or something) but imposes this kind of tax on X? As shown below, the no-tax case involves exports of Y, imports of X. Now impose the tax but hold world prices and consumer prices the same. Producer price of X falls, so output shifts toward Y from X. Now consumption has to be along p* from the new production point, so welfare falls compared to free trade. Note that the trade volume could be bigger.

Result: trade based on comparative advantage generates GFT. Distorting the situation from that point reduces the GFT.

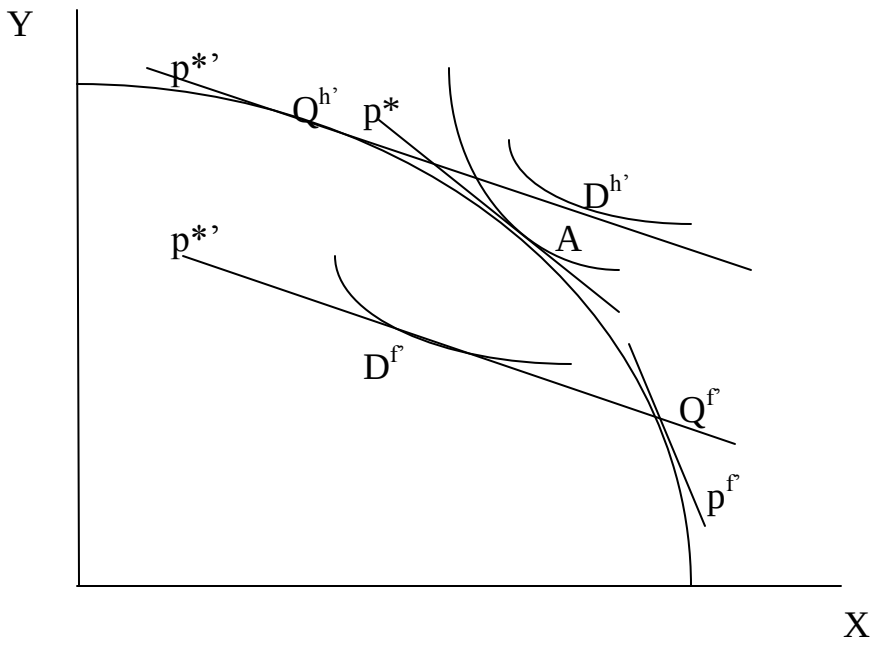


A final point to make is that if we have two identical countries (h and f) so that neither is an SOE and trade between them affects prices, the tax or subsidy would have an impact on both countries. (Figure 10.3 shows a tax on X in h). Just to get a little more practice, let's suppose it's a subsidy to X production in f.

Let h and f have the same PPFs and preferences, so no comparative advantage. Both would be at point A below in free trade without the subsidy, but there would be no trade.

Now let f put a subsidy on X output, meaning its price relationship is:

$q^f = p_x^f (1 - s_x)/ p_y^f < p_x^f / p_y^f = p^f$. This implies an increase in the relative producer price of X so f would produce more X and less Y. But h would want to remain at A initially, so we would be out of equilibrium. There would be an excess supply of X and an excess demand for Y, pushing down the free-trade relative price of X to $p^{*'}$.



Here the subsidy to X production in f generates:

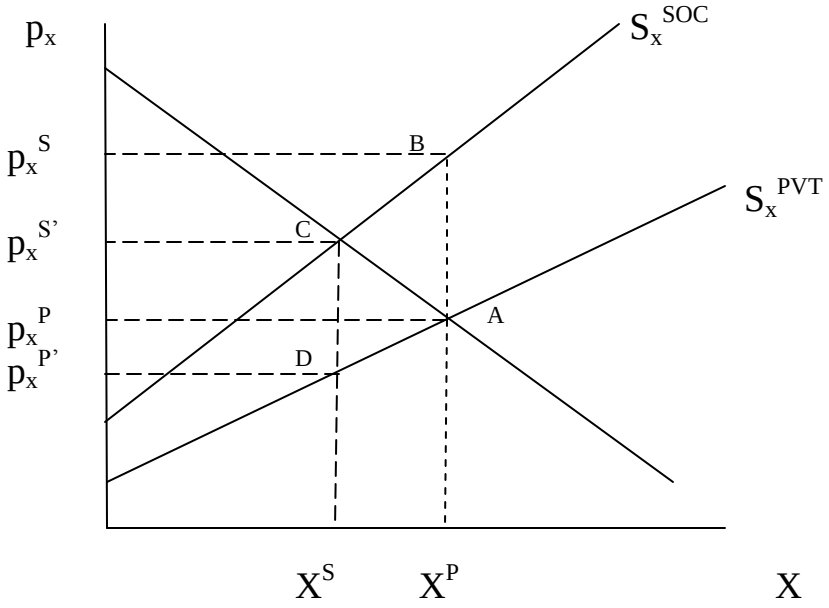
1. Output effect in f: X up, Y down. Output effect in h: X down, Y up.
2. Consumer relative price falls in both countries to p*', so consumption shifts in both.
3. World price ratio falls to p*'.
4. Trade is generated: h exports Y and imports X; f imports Y and exports X.
5. Country h is made better off; country f makes itself worse off.

Now let's consider the issue of trade subject to an output externality. Common example: air pollution, a negative externality since it raises costs to other firms, industries, and individuals. It also is an externality that carries across borders, an issue we'll consider later in the course.

For now consider the effects of a *negative externality*.

Let output of X raise marginal costs of production in Y (eg, X is steel or chemicals that pollute water or air, Y is agriculture).

An unregulated market will fail to price ("internalize") this externality and X will be over-produced => Y will be under-produced in the market equilibrium. Again, start with partial equilibrium, closed economy.



The private (lower) supply curve reflects private marginal costs for the X industry, which takes no account of its externality. The social (higher) supply curve adds the marginal cost imposed on the Y industry (could also be on consumers but let's avoid this complication since that would affect demand curves). Drawn here is a percentage increase in social marginal cost: the higher is X output the higher is the additional cost imposed on Y. In essence:

$$mc_x^{SOC} = mc_x^{PVT}(1 + c_{xy})$$

We can translate this into prices:

$p_x^S = mc_x^{SOC} = mc_x^{PVT}(1 + c_{xy}) > mc_x^{PVT} = p_x^P$ where S and P in exponents also mean SOC and PVT.

We can see that the private production level is higher than the socially optimal ("internalized") level. Put differently, with output at point A, price should be up at B. So appropriate policy needs to induce less production of X, which itself requires a lower private producer price of X. We can achieve this with a tax on X output to move the economy to points C and D. This would be established by setting the percentage tax rate as:

$t_x = c_{xy}$ Then we would get $p_x^{S'} = p_x^{P'}(1 + t_x)$

Note again that consumer price would rise and (net) producer price would fall.

BRIEF SIDE COMMENT: WHAT IS A "GREEN TAX"? In the simplest case, solve $(1 + t_x) = p_x^S/p_x^P$ for the tax rate. This yields $t_x = p_x^S/p_x^P - 1$. Thus, if $p_x^S/p_x^P = 1.5$ the tax rate should be 0.5 (50%).

Let's put this analysis into general equilibrium. Start with relative prices.

Without the tax, we consider private relative prices. A first note, very important. When thinking about the PPF, its slope should reflect all marginal costs, including the additional costs imposed on Y from X production. So the true MRT (slope of PPF) would be

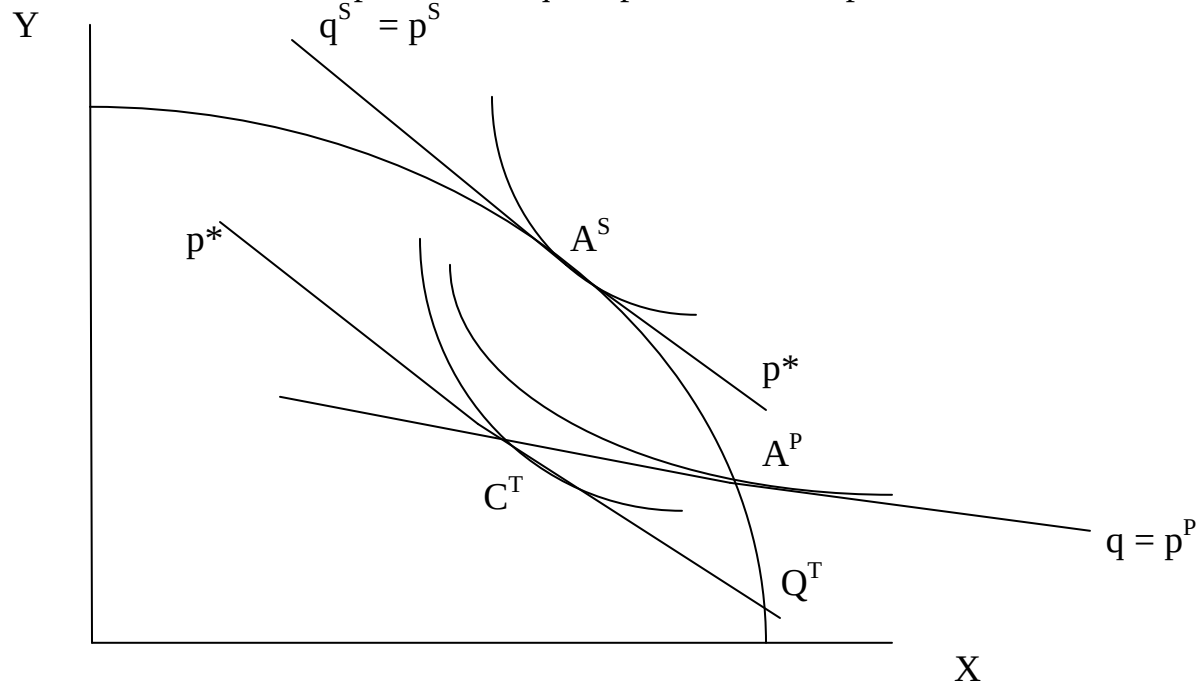
$MRT = mc_x^{SOC}/mc_y$ (we are assuming no externality from the Y sector).

Consumers of X pay the market price. So

$q_x = p_x^P = mc_x^{PVT} = p_x^S/(1 + c_{xy})$

then $q = q_x / q_y = p_x^P / p_y = [p_x^S/(1 + c_{xy})]/p_y = MRT/(1 + c_{xy}) < MRT$.

In words, the consumer price ratio equals private market price ratio, which is less than the slope of the PPF.



Here consider A^S to be the optimal, undistorted equilibrium in autarky. But the private market equilibrium is at A^P. There is clearly lower welfare in autarky due to the pollution externality.

What is the optimal policy? Impose the green tax on X production listed above so that $p_x^{P'} = p_x^{S'}/(1 + t_x)$. The tax exactly offsets the production externality. The lower producer price in X generates a producer price ratio that is equal to the MRT. And the higher consumer price ratio also equals the MRT. ($q^S = p^S = MRT$).

What can we say about international trade here? Suppose this is a small open economy and there is a ROW with an (undistorted) world price $p^* = p^S$. But in autarky let this country have the distortion in place => $p^P < p^*$. The

point here is that ROW can buy from this country at p^P. So this country has an *apparent* comparative advantage in good X, even though it's based on a failure to internalize the pollution externality. *A distortion can be the cause of trade.*

The world price is fixed at p* and so in free trade this will become the consumer price ratio and the *market* price ratio for consumers in this country. So it will export good X and import good Y as shown. Note that trade causes an expansion of the good that is causing the externality and a contraction of the other. Here I've shown free-trade output at Q^T and consumption at C^T.

Is welfare in (distorted) free trade higher or lower than in (distorted) autarky? Here I've shown it to be lower. But you can see that Q^T could be further up the PPF, in which case welfare could be higher than in (distorted) autarky.

What is the difference in these 2 cases? Both situations offer gains from trade through changing prices faced by consumers ("exchange gains"). But in both cases there was a movement of production toward more of the distorting good ("specialization losses"). In the first case, there was a large expansion of the distorting good, making the distortion worse by a lot and overwhelming the exchange gain. In the second case there was a small expansion, making the distortion worse by less than the exchange gain.

General result: *moving to free trade in the presence of an existing distortion can make a country better off or worse off. If it increases the distortion significantly the economy would be worse off.*
But does this country have to suffer the potential loss from trade? No. The "first-best" policy is to put in the green tax and then move to free trade. But moving to free trade without correcting the distortion is "second-best" and could worsen welfare.

Homework 1: in the diagram above, work out the gain from exchange and the loss from specialization.
Homework 2: figure out what this situation would look like if there were 2 identical large economies (as we did at the end of the production tax analysis) but just one of them had the pollution externality. (You'll find that trade again is generated, with the polluter exporting X, importing Y. Trade makes the other country better off but makes the polluting country better off or worse off).