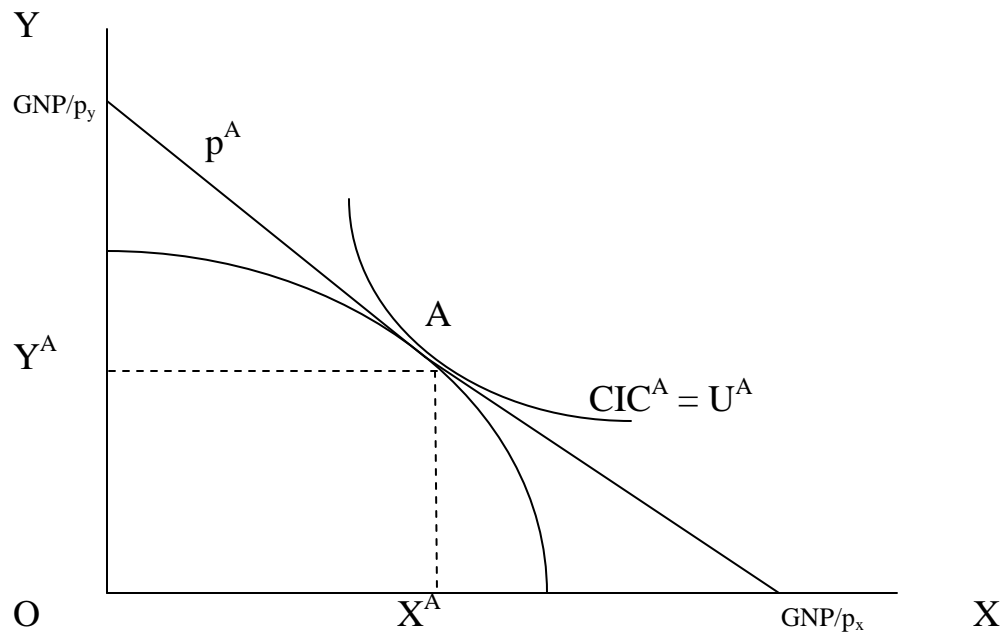


## General Equilibrium: Chapter 4

We saw in the notes to chapter 2 that the undistorted market leads to maximization of real GDP for the given price ratio  $p$ . Now let's bring together the supply side and demand side to show that the market also generates maximum welfare for the given constraints.

Consider the general equilibrium (GE) without trade, that is in "autarky".



Here (see also Figure 4.1) the PPF indicates the maximum production of  $Y$  for each  $X$ , so it is a supply constraint. Clearly point  $A$  along  $CIC_A$  represents the highest level of national welfare available. The  $CIC$  represents the

utility function (normative) and demand functions (positive) for X and Y. In autarky the economy produces and consumes  $(X^A, Y^A)$  at price ratio  $p^A$ . Note that the endpoints of the price line give real GNP in either good.

This equilibrium demonstrates:

1. Pareto Optimality
  - a.  $MRT = MRS = p$  (slope of PPF equals slope of indifference curve equals price).
  - b.  $MRS_x = MRS_y = w/r$  (both goods have isoquants tangent to  $w/r$  line, so we're on PPF).
  - c.  $MRS_1 = MRS_2 = p$  (both individuals have isoquants tangent to price line).
2. Market clearing: quantities consumed equal quantities produced.
3. Value of output (income) equals value of consumption:
  - a.  $pX_q + Y_q = pX_c + Y_c$

Point 3 indicates there is no saving or dissaving in the economy; strictly a static GE.

Extend these concepts to an open economy. Let the country move from autarky at  $p^A$  to free trade at  $p^*$ .  $p^*$  reflects the existing global prices, which for now we take as given (our country is “small”). Notice immediately that “comparative advantage” (CA) is simply a comparison of prices:

- If  $p^* > p^A$  the economy has a CA in X and would export X, import Y.
- If  $p^* < p^A$  the economy has a CA in Y and would export Y, import X.
- If  $p^* = p^A$  the economy has no CA in either good.

Figure 4.2 shows the case where  $p^* < p^A$ . Because world price of Y (X) is higher (lower) than in autarky this economy would move resources toward Y, producing at point  $X^*$ . But it now has the opportunity to export Y for X along price line  $p^*$  (just called  $p$  in 4.2). This permits consumption at point  $D^*$ . Label by “V” the point where line  $X^*X$  crosses line  $DD^*$ . Then we have the following features:

1. Exports =  $VX^*$ ; imports =  $VD^*$ ; price =  $p^*$  (“trade triangle”).

2. Balanced trade  $p^*[VD^*] = VX^*$  (we know this because  $p^* = VX^*/VD^*$ ). Written differently,  $p_x^* M_x = p_y^* E_y$  where  $M$  means imports and  $E$  means exports. This means there is no international saving or borrowing and also that the value of domestic output still equals value of domestic consumption.

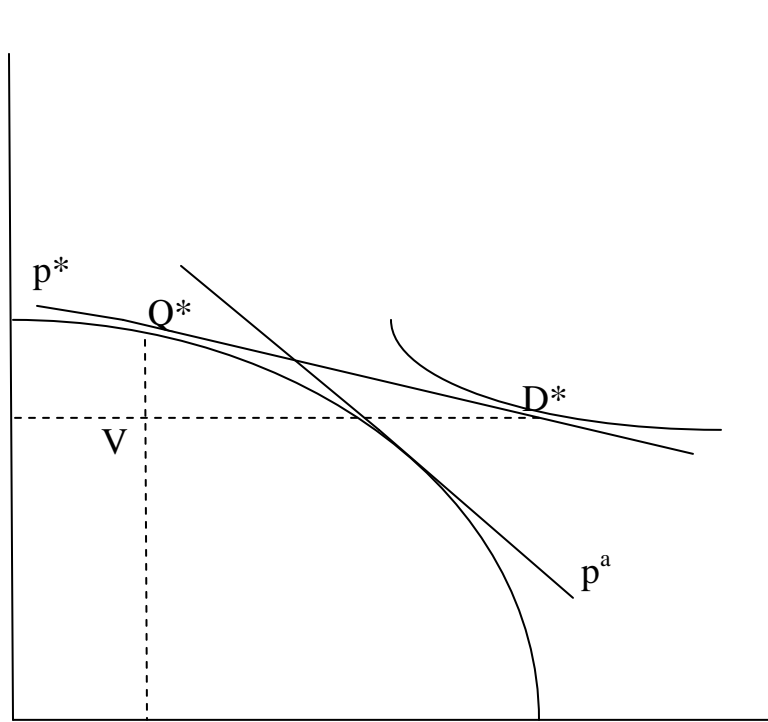
Note that economic welfare rises moving from autarky to free trade. In this case it rises continuously as  $p$  gets flatter and there is more specialization toward good  $Y$ . The gain from trade comes from exposing the economy to world prices, which permits (i) allocation of resources according to comparative advantage and (ii) consumers to benefit from new prices.

Figure 4.3 shows that the same analysis holds for  $p^* > p^a$ , in which case the economy would specialize toward  $X$  and export  $X$ , import  $Y$ . You should draw the trade triangle for the second case (production point  $X$  and consumption point  $D^{*2}$ ) and verify that the 2 conditions above also hold. And welfare also rises the further price moves away from autarky in this direction.

Since it's a pain to draw PPFs and trade triangles together we usually rely on the *excess demand* curve, which can also be interpreted as an import demand curve (but be careful; see below).

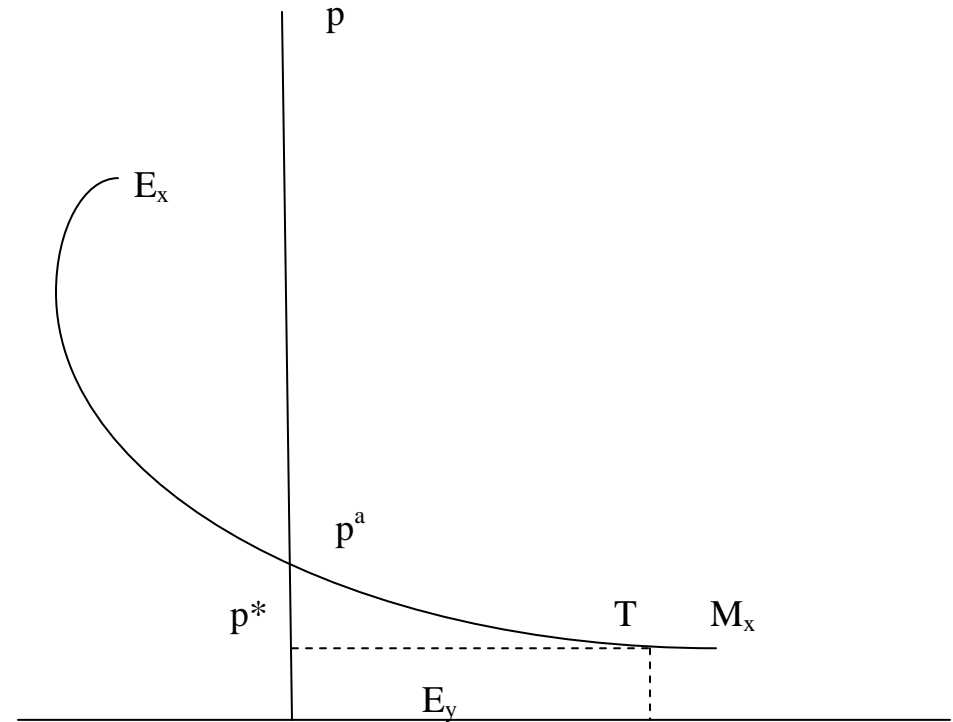
I will draw the theory here to make some points not in the text. Take the case where our economy exports  $X$  and imports  $Y$  at  $p^* < p^a$ . (Note: the notation in Figures 4.3 and 4.4 is confusing; try to follow it here).

Y



O

X



$E_x$

$O(V)$

$D^*$

Free trade induces the economy to produce at  $Q^*$  and consume at  $D^*$ , with  $VQ^*$  being exports and  $VD^*$  being imports. Translate this to the diagram on the right and we see that  $OD^*$  is the same as  $VD^*$  at  $p^*$ . Convince yourself that exports of Y are given by the box  $p^*VD^*T$ . (In what units are these exports measured?) Hint: balanced trade requires  $p^*M_x = E_y$ .

Note that for  $p^* > p^a$  the economy would export good X so the part to the left of vertical line is an export supply curve (reflects an excess domestic supply).

We'll generally just draw import demand as downward-sloping but some of its properties are important.

1. General shape. Let world  $p$  fall below  $p^a$  so the economy imports  $X$ . As this price falls we get:
  - a. Production effect: more  $Y$ , less  $X$  therefore economy imports more  $X$ , exports more  $Y$ .
  - b. Consumption effect: there are 2 components:
    - i. Substitution effect: Consume more  $X$ , less  $Y$  therefore economy imports more  $X$ , exports more  $Y$ .
    - ii. Income effect: Consume more  $X$  and more  $Y$  if both goods are normal (real income rises due to increase in price of export good  $Y$ ). This would mean more imports of  $X$  but fewer exports of  $Y$ .

All together we get a *law of demand* for imports: as the relative price of imports falls the quantity of imports rises. But on the export side as  $p$  falls (and  $1/p$  rises so  $Y$  is worth more) there are offsetting effects and if the income effect is larger than the substitution and production effects the economy would export less. There is a *backward-bending* export supply curve as shown above.

Note the income effect around autarky is zero (if there are no exports you get no income from a higher price) and so only as exports rise beyond that point can the curve bend backward.

2. Elasticity. Recall basic elasticity concepts for a regular demand curve.
  - a. Total expenditure  $E = PQ$  for good  $X$ . Then  $\% \Delta E = \% \Delta P + \% \Delta Q$ . Let price fall then  $\% \Delta P < 0$  and  $\% \Delta Q > 0$ . Whether  $E$  rises depends on elasticity  $e = -(\% \Delta Q / \% \Delta P)$ .
    - i. If  $e > 1$  then  $E$  rises.
    - ii. If  $e = 1$  then  $E$  stays the same.
    - iii. If  $e < 1$  then  $E$  falls.

In the case of international trade, think of expenditure as exports of  $Y$  ( $E$ ). Because of balanced trade we have  $E_y = p^* M_x$  implying that  $\% \Delta E_y = \% \Delta p^* + \% \Delta M_x$ . Let price fall and  $M_x$  rise to the right of origin. Let  $\epsilon_x = -(\% \Delta M_x / \% \Delta p^*)$  be the import demand elasticity. Also define the export-supply elasticity as

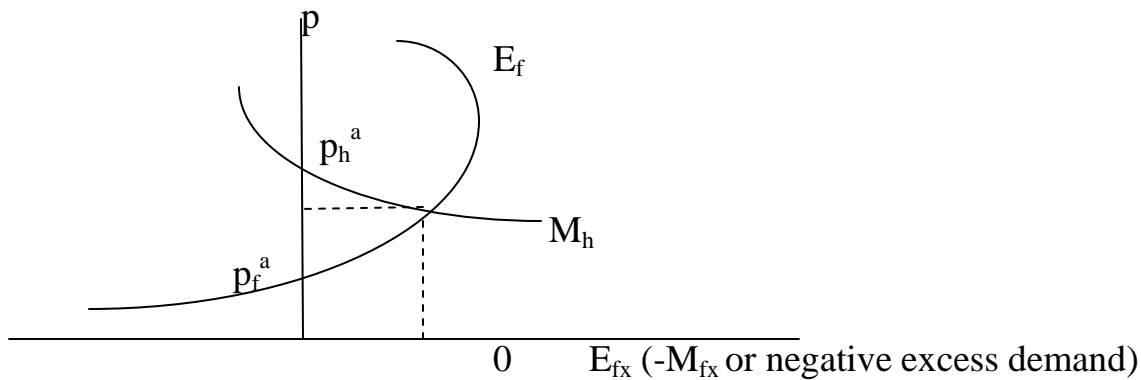
$\phi_y = (\% \Delta E_{xy} / \% \Delta [1/p^*])$ . ( $1/p$  is the relative price of exports.) We then have

- i. If  $\epsilon > 1$  then  $E_y$  rises (and  $\phi_y > 0$ )
- ii. If  $\epsilon = 1$  then  $E_y$  stays the same (and  $\phi_y = 0$ )
- iii. If  $\epsilon < 1$  then  $E_y$  falls (and  $\phi_y < 0$ ).

3. Welfare rises in either direction as you move away from autarky due to changes in the terms of trade. Define  $T$  or  $T =$  price of export good/price of import good (generally a ratio of price indexes). The higher this ratio the better off the country.

In the analysis above,  $X$  is the import good below  $p^a$  so  $p$  is really the inverse of the  $T$  of  $T$ . But as  $p$  falls the economy gains due to lower (higher) import (export) price. Above autarky price  $X$  is the export good so a rise is a standard  $T$  of  $T$  gain.

Now we need to look at free trade between two countries. Let the import demand curve above refer to the home country  $h$ . There will be a similar curve for the foreign country  $f$ . If it has a lower autarky price than  $h$  then its import demand curve is below the one for  $h$ . But it's easier to see equilibrium if we just flip  $f$ 's curve from right to left so it would look like this:



We depict international equilibrium as in Figure 4.5.

Features:

1.  $p_h^a > p^* > p_h^a$ . This reflects *comparative advantage*.
2. Trade is balanced in quantity terms: h imports what f exports (good X) and f imports what h exports (good Y).
3. Trade is balanced in value terms for both countries.
4. Both h and f gain from trade due to improved T of T.

We're now in a position to move to the gains from trade in Chapter 5.

Note: do not read section 4.6 in the text. We won't cover it. Figures 4.6 and 4.7 demonstrate that it is possible to simulate welfare gains as the terms of trade changes.