Economics 4413
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Answers to Problem Set 2

Ricardian Model

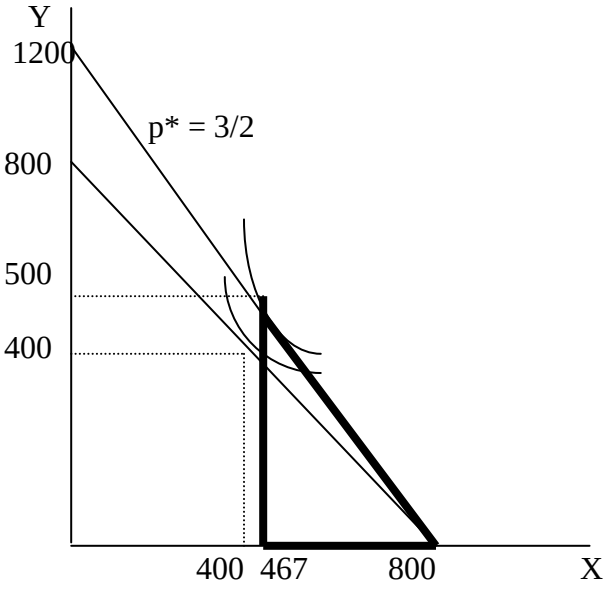
1. You already have answers for problem 1.

2. a. (i). A has absolute advantage in X and B has absolute advantage in Y. A has comparative advantage in X and B has comparative advantage in Y. Because one laborer can produce either 3X or 9Y in B, but 4X or 4Y in A, clearly Y is relatively cheap in B, so that X is relatively cheap in A. In A it must be that 1X = 1Y; in B we have 1X = 3Y (opportunity costs).
(ii). p_x/p_y in A is 4/4 = 1. In B it is 9/3 = 3. So limits to the price ratio are:

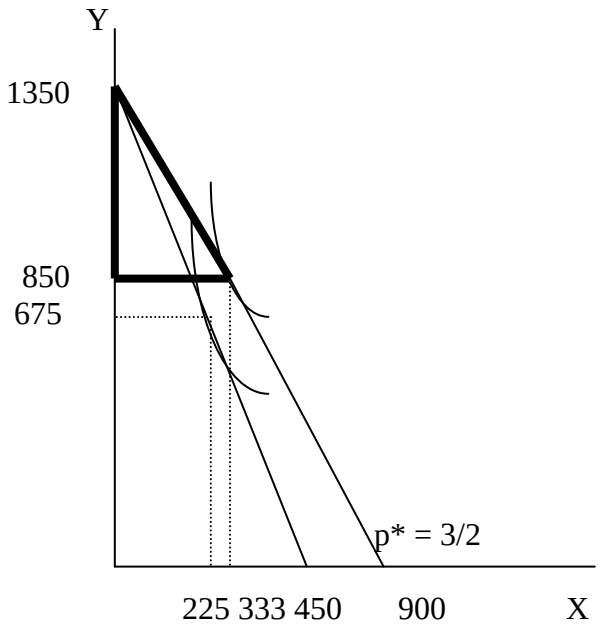
$$1 \leq p^* \leq 3.$$

These are limits because at any price outside these ratios both countries would try to specialize in the same good, which cannot happen in equilibrium trade. Put another way, only if the price ratio lies within these limits will both countries gain from trade.

(iii).



A



Gains from Trade:

A's consumption goes from 400X, 400Y to 467X, 500Y, so gains are 67X, 100Y.

B's consumption goes from 225X, 675Y to 333.33X, 850Y, so gains are 108.33X, 175Y.

Sorry I didn't draw the trade triangles to scale very well.

Here it appears that B got the bigger GFT because of the relatively large change in the price ratio from autarky to free trade.

If Country A were much smaller it would specialize in X but B would not be able to specialize in Y. This is because A's capacity to produce X would lie below the global demand (A + B) for good X. As a result, B would have to produce both X and Y in free trade and the price ratio in trade would equal 3 (B's autarky price ratio). In this case A would get all the gains from trade and B would neither gain nor lose from trade.

(v) Real wages (note the problem should have read countries A and B, not H and F):

In autarky these are equal to MPLs: Country A: 4 in X, 4 in Y
Country B: 3 in X, 9 in Y

In free trade the same MPLs still determine real wages for each country's export good (because it still produces that good). For the import goods, though, we need to determine real wages based on the fact that they are produced in the other country.

For country A, the real wage in good Y is $w^{*A} / p^*_y = 4p^*_x / p^*_y = 4(3/2) = 6$.
For country B, the real wage in good X is $w^{*B} / p^*_x = 9p^*_y / p^*_x = 9(2/3) = 6$.

(To see this, recall that the price of a good is the wage rate divided by the marginal product, so $p^*_x = w^{*A}/4$ etc.)

So in free trade the real wages are: Country A: 4 in X, 6 in Y
Country B: 6 in X, 9 in Y

Note that A is 4/3 times as productive as B in good X, while A is only 4/9 times as productive as B in good Y. So the limits to the international wage ratio are:

$$4/9 \leq w^{*A} / w^{*B} \leq 4/3.$$

If nominal wages were $w^{*A} = \$20$ per hour and $w^{*B} = \$10$ per hour the relative wage ratio would be $w^{*A} / w^{*B} = 2$, which is higher than the maximum limit. This means that labor in A is too costly for equilibrium and labor in B is too cheap. To see this, calculate average costs = prices in both countries with these wages:

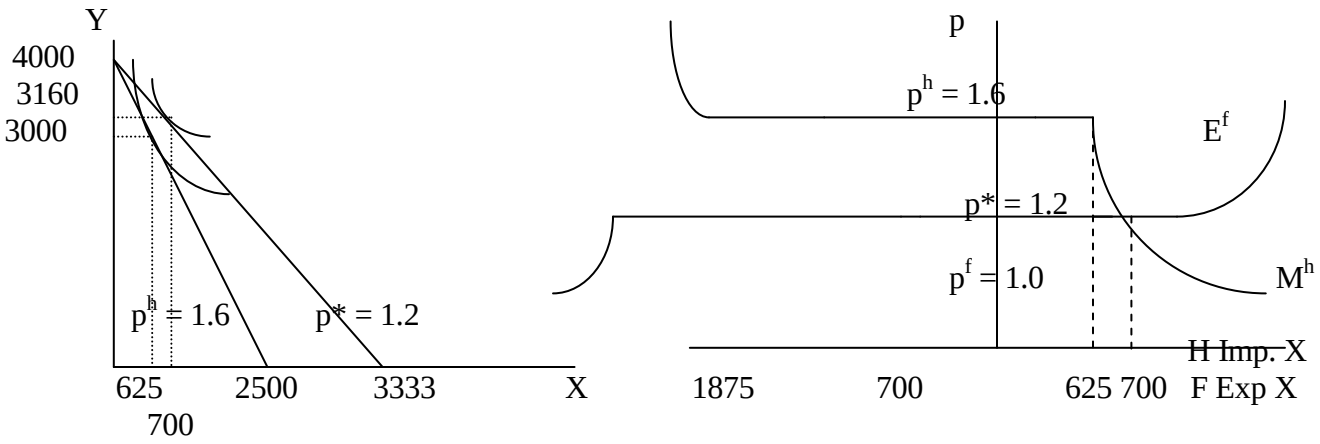
In A, $p^*_x = \$20/4 = \$5$; $p^*_y = \$20/4 = \$5$.
In B, $p^*_x = \$10/3 = \$3.33$; $p^*_y = \$10/9 = \$\$1.11$.

In this situation B would export both goods to A and A would produce nothing. Clearly this could not be an equilibrium and the wage in B would rise while the wage in A would fall until it came into equilibrium within the range set out above.

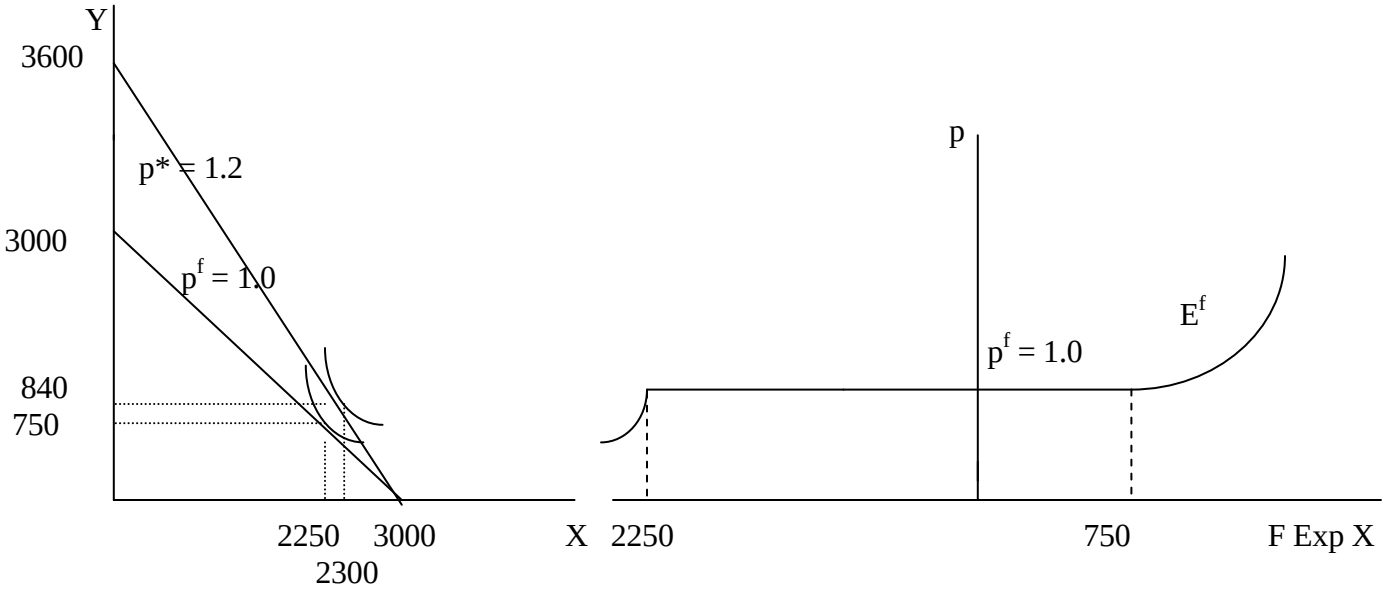
3.a. Foreign has an absolute advantage in both goods. Home has a comparative advantage in Y and foreign has a comparative advantage in X. Home's autarky price ratio is 40/25 = 1.6 and F's autarky price ratio is 50/50 =1. Thus, the limits to the free-trade relative price are $1 \leq p^* \leq 1.6$. (Note the equality possibilities here refer to cases in which either H or F ends up *not* completely specialized in trade, so that it would have to produce both goods, requiring a price ratio equal to its autarky price ratio.)

b. The four curves are below.

HOME



FOREIGN



c. Trade equilibrium is shown above. Since $p^* = 1.2$, each X is worth 1.2 Y, so 700 X exports bring back 840 units of Y as imports. Home gains (160Y, 75X), while foreign gains (90Y, 50X). Home receives the larger share of the gains from trade because it enjoys a larger percentage change in its price ratio in going from autarky to free trade.

d. Real wages in autarky are just equal to marginal products, so that:

Home real wages: 25 in X, 40 in Y

Foreign real wages: 50 in X, 50 in Y

In free trade, real wages in the export good don't change because they are still given by marginal products of the good produced. Thus, H real wage in Y is still 40; F real wage in X is still 50. But as we discussed in class, the real wage in Home for X becomes β_h/p^* in free trade, or 40/1.2 = 33.33. Thus, H's real wage in X went from 25 to 33.33, a gain of 8.33 units per laborer. You should be able to show that the real wage in F in terms of good Y becomes $\alpha_f * p^*$ in free trade. Thus, F's real wage in Y becomes 50*1.2 = 60, or a gain of 10 units of Y per laborer. Putting these together:

Home real wages: 33.33 in X, 40 in Y

Foreign real wages: 50 in X, 60 in Y

Clearly, foreign has higher real wages because of its higher labor productivity.

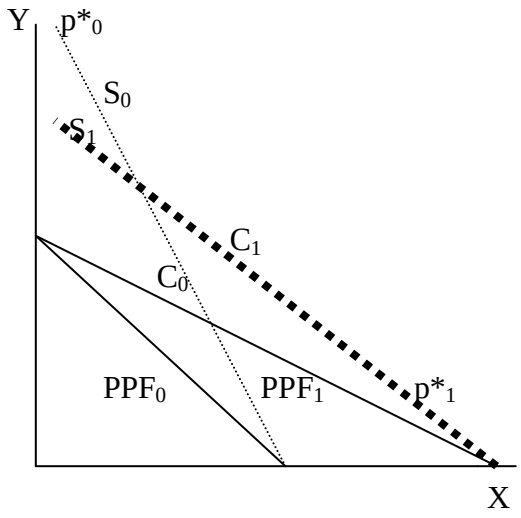
d. Again, limits to relative wage ratio are given by productivities:

maximum $(w_F/w_H)^* = 50/25 = 2.0$

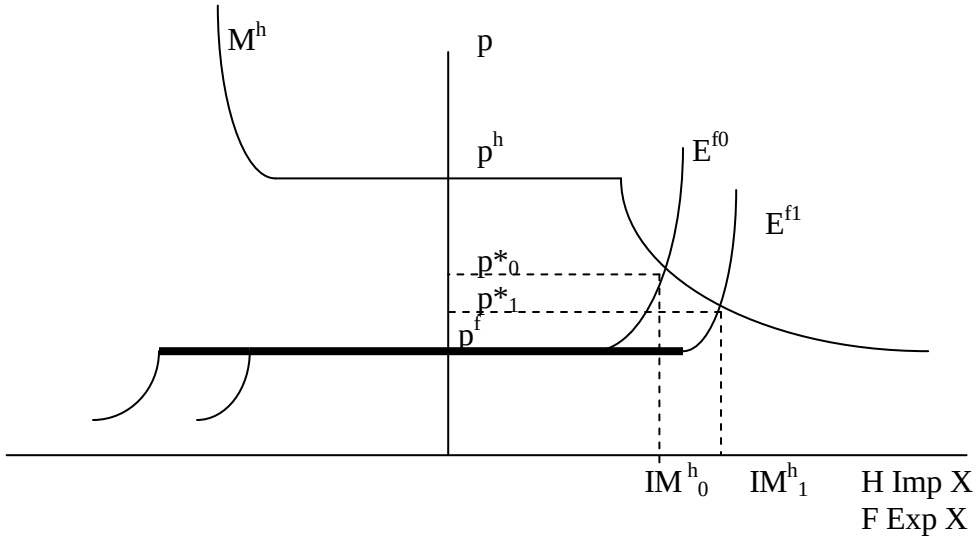
minimum $(w_F/w_H)^* = 50/40 = 1.25$

Try computing unit costs if w_H = \$25 and w_F = \$75, and discuss what would happen to these wages in free trade.

4. Case of foreign having an improvement in productivity in its export sector, assumed to be X:



The maximum intercept in X on F's PPF would rise; there would be no effect on H's PPF. Because of this, F's export supply curve would expand as shown below, driving down the price of X, its export good. New international price ratio is p^*_1. Note this is a decline in F's terms of trade but an improvement in H's terms of trade.

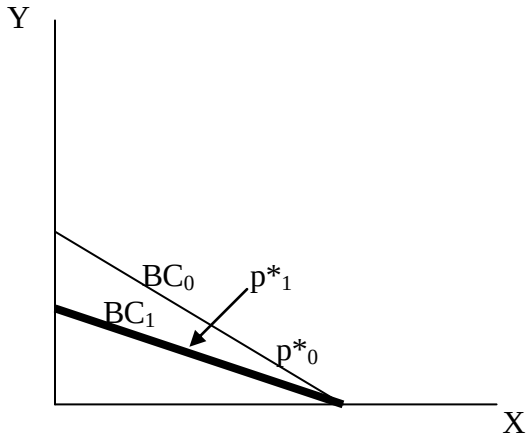


The welfare effects in H are clear: because of the improved terms of trade each worker is better off in H (and would have a higher real wage in terms of buying X, the import good). In F things are more complex. On the one hand, each worker is more productive and has a higher real wage in X, the export good. On the other hand, the terms of trade have become worse, making the relative price of Y (the import good) higher. The answer depends on preferences. Thus, if the consumption point for F (see first diagram) goes from C_0 to C_1, F is better off. If it goes from S_0 to S_1, F is worse off. (You might find it useful to do the same analysis with individual worker budget constraints.)

The idea that F could be worse off due to the productivity gain due to the loss in terms of trade is an example of what we call "immiserizing growth".

Consider now the case of foreign having a growth in its labor force. I will let you do the diagrams. What you'll find is that F's PPF shifts outward in a parallel fashion (there is no change in productivity of workers so PPF is higher). Again, this will expand F's excess demand curve (by making the horizontal part longer). As a result p* will fall and H will gain because of the improvement in its terms of trade. It would seem at first that the effect on F would also be ambiguous. But consider that no worker has higher productivity but now each worker's individual budget constraint is lower (as shown below) due to the higher relative price of the import good Y. Since each worker is worse off, F must be worse off in the aggregate. This is clearly a case of "immiserizing growth"; it is this basic idea (of population growth without productivity improvements) that led Thomas Malthus in the past to predict that countries with growing populations were doomed to seeing their wages fall to some basic subsistence level. (And this is why economics was called "The Dismal Science".) Of course, it hasn't worked out that way in most of the world.

Individual budget constraint for an F worker after labor-force growth in F:



Here, F is worse off on a per-capita basis due to the loss in the terms of trade. H is better off.

5. This is true; problem 3 was an example. We've discussed this a lot, surely you can develop an answer.

Heckscher-Ohlin Model

6. You can develop this answer on your own. Do know this material; it is essential.

*7. I prefer the algebra:

$K/L = (K_x + K_y)/L = (K_x/L_x)*(L_x/L) + (K_y/L_y)*(L_y/L) = k_x(L_x/L) + k_y(L_y/L)$.

[Note carefully what this equation means. It says that the overall endowment ratio of the economy is a *weighted average* of the capital-labor ratios used in goods X and Y. The weights are given by the percentage amounts of labor used in X and Y ($L_x/L + L_y/L = 1$). Thus, if the economy is completely specialized in X ($L_x/L = 1$) it must be that the endowment ratio equals the capital-labor ratio in X. A similar statement holds for Y. If the country is not completely specialized, the endowment ratio is strictly between the factor intensities: $k_x < k < k_y$, where Y is capital-intensive. Finally, note that as the economy produces more X and less Y (L_X/L rises and L_y/L falls), the capital-labor ratio in X becomes closer to the endowment ratio.]

Back to the question. Applying the figures given to this equation we have:

$30/20 = 1*(L_x/20) + 2*((20-L_x)/20)$. You can solve this to show that $L_x = 10$, $L_y = 10$, $K_x = 10$, $K_y = 20$. Notice that in the solution all capital and labor are fully employed.

8. The Rybczynski theorem assumes constant relative commodity and factor prices. In turn, this means it holds constant the capital-labor ratios in industries, relative factor prices, and relative commodity prices. It does not hold constant factor endowments and commodity outputs; permitting these to change is the essence of the theorem.

9. You can simply use the analysis of the Stolper-Samuelson theorem. In the HO model, abundant factors gain and scarce factors lose (the Stolper-Samuelson theorem). So if you consider a labor-abundant and capital-scarce country the movement to free trade makes each worker better off but each capitalist worse off. You should show this with their individual budget constraints. Of course it helps explain controversies over trade liberalization -- why else would American lower-skilled workers, Japanese farmers, and many, many others oppose free trade? Why else would higher-skilled workers and capital owners in the U.S. prefer free trade?

10. On your own.

11. (1) we would expect wheat and software outputs to rise, shirts to fall.
(2) real incomes of land owners and skilled labor would rise, of unskilled labor would fall.
(3) assuming a university education is the ticket to becoming a skilled laborer, the incentives to go to University would rise due to the growing gap between skilled-labor and unskilled-labor living standards. (By the way, it is true that investments in college education pay a very large return in terms of lifetime incomes in the U.S.)
(4) If skilled workers and landowners are at the high end of the income distribution and unskilled workers are at the low end, trade would tend to increase income inequality. You should think about how this process would work in a country that has an abundance of unskilled workers.

12. An interesting question, indeed. Consult the unit-value isoquant diagram in the class notes and notice that as relative endowments for, say the foreign country rise from k_x (the intensity ratio in X) to k_y, there would be no impact on relative factor prices, though outputs would be changing from X to Y. (Of course, this description is really only valid for a small country accumulating capital in a world with fixed factor prices; if a large country were to change its relative endowments it would have an effect on world commodity and factor prices, a case you might want to think about.) But once the endowment ratio exceeds k_y the economy would fully specialize in good Y and would have a higher relative wage after further accumulation of capital.
Interesting implication: as an economy accumulates capital (and skills), we would observe its outputs shifting toward capital-intensive (skill-intensive) goods. Its exports would also shift from being labor-intensive to being capital-intensive (skill-intensive) after enough capital (skills) accumulation. However, there might not be much impact on real labor incomes until enough capital has been accumulated to shift fully out of producing, say clothing and textiles. As this process continues, countries move up a "ladder" involving successively more capital-intensive goods in production and exports, with discrete jumps in labor wages. Sound like Japan? Korea?

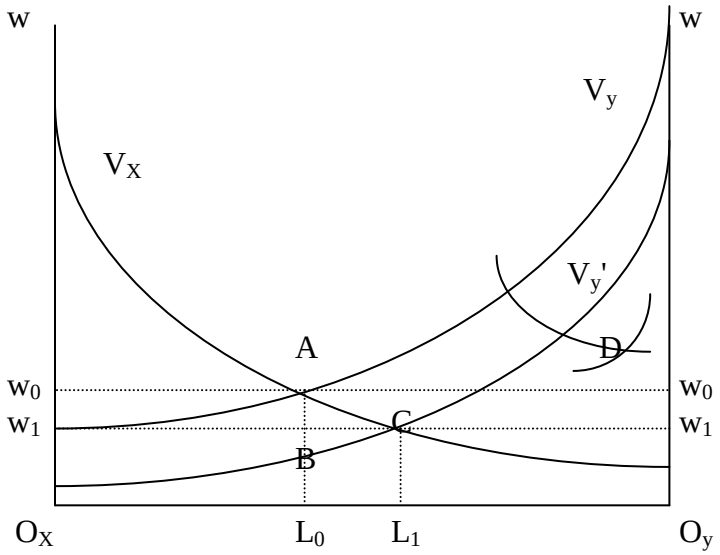
Specific Factors Model

13. The tariff on X raises the domestic relative price of X. The remainder of the analysis is the same as that in the first diagram in chapter 9 notes in the short run and is the same as

Stolper-Samuelson in the long run. So: Short Run: Nominal wage up, real wages ambiguous, nominal and real r up (R gains), nominal and real s down (S loses).

Long Run: Real wages up (labor gains), real capital price down with respect to both goods (capital loses). This assumes that X is labor-intensive in the long run.

14.



The fall in price of Y would shift the V_y down, as shown (the percentage reduction in price of Y would be AB/AL_0). This would cause sector Y to produce less and labor would move from Y to X (see allocation L_1 at the new short-run equilibrium point C). But for this to happen the nominal wage must fall to w_1.

The above is all the question calls for. But it's worth working through short-run and long-run effects on real incomes here as practice. Note that the nominal wage falls but by less than the price of Y, so labor is better off (has a higher real wage) in terms of buying Y in the short run. But the price of X did not fall, so labor is worse off (has a lower real wage) in terms of buying X. This is true for all laborers (the mobile factor), whether they work in the Y or X sector. Another way to see this is through marginal products of labor. Because there is more labor in X but the same capital stock (R), there is a lower capital-labor ratio. So labor has a lower marginal product in X and a lower real wage in terms of X. But there is less labor in Y and the same capital stock (S), so there is a higher capital-labor ratio. As a result, labor has a higher marginal product in Y and a higher real wage in terms of Y.

With labor flowing into good X, the marginal product of capital in X goes up, so the real income of capital in terms of X is higher. This must mean the price of capital (r) went up. In turn, because the price of Y is lower, the real income of capital in terms of Y is higher. So R capital in the X sector gains in terms of both goods in the short run. For the opposite reasons, S capital in the Y sector loses in terms of both goods in the short run.

In the long run, the Stolper-Samuelson theorem operates. If good Y is capital intensive in the long run, a fall in its price must generate a rise in the real wage in terms of both goods

and a fall in the real price of capital in terms of both goods. The process here is that there would be a further movement of labor into X AND ALSO CAPITAL WOULD SHIFT FROM Y TO X IN THE LONG RUN AFTER CAPITAL BECOMES MOBILE. The capital movements would shift up the Vx curve and shift the Vy curve down even further, so that the long-run equilibrium would appear at a point like D.

15. You should draw diagrams for these cases.

a. An export tax on Y would reduce the domestic price of Y (figure out why), shifting down the VMP_{Ly} curve. Output of Y falls, of X rises. Impact on real wages is ambiguous (lower nominal wage but higher real wage in Y and lower real wage in X); S loses; R gains in short run. In long run, use SS theorem to show that capital loses and labor gains if Y is capital-intensive (same as above answer in question 14).

b. On your own; it's in the book and the class notes.

c. On your own; this is case 2 in the class notes.