Final Exam - *Answers*
August 15, 2002

Answer all questions, in blue book. Plan ahead and budget your time. The questions are worth a total of 90 points, as indicated. You will have 120 minutes to complete the exam.

1. [18 points] The figure on the next page shows domestic demand and supply curves for a country. (The same figure appears twice on the page, for your convenience.) Use them, together with the grid for measuring prices, quantities, and areas, to give numerical answers the questions below, assuming that
    *   The world price of the good is $8 per ounce.
    *   The country is small.
    *   When it initially trades, the country levies a tariff on imports of $4 per ounce.
    You should show your work if you want a chance for partial credit for wrong answers.

    a. (2 points) What is the country's autarky price?

        Equals price at intersection of domestic supply and demand: $18.

    b. (4 points) With trade and with the $4 tariff, what is the domestic price, and what quantity does the country import?

        Domestic price equals world price plus tariff: $8 + 4 = $12. At that price, reading off the figure, domestic supply is 10 and domestic demand is 19, so imports are 19-10 = 9.

    c. (8 points) Suppose that the size of the tariff is increased from $4 to $8, the world price remaining unchanged. Find the following changes that are due to this tariff increase (you are *not* comparing here to free trade, but rather to the initial situation with the $4 tariff):

        Price rises to 8+8 = $16; supply rises to 14 and demand falls to 17, so imports fall to 3

        i.   The change in welfare of suppliers.
             Area "a" = +$48
        ii. The change in welfare of demanders.
             Area –"a+b+c+d" = –$72
        iii. The change in tariff revenue.
             Area "c+f" minus "e+f+g" = "c–(e+g)" = 12–24 = –$12
        iv. The change in welfare of the country as a whole.

Sum of the above = 48–72–12 = –$36

d. (2 points) Suppose that in part (c) the new tariff had been $12 instead of $8. What would the change in welfare of suppliers (compared again to the initial $4 tariff) have been in that case?

   Imports are now available only for 8+12=$20, which is above the autarky price. At a domestic price of $20 there would be excess supply of the good, and the market would not clear, since suppliers cannot sell abroad for more than $8. Therefore the tariff is "prohibitive," and the domestic price rises only to its autarky level, $18. The change in welfare of suppliers is therefore "a+h"=+$78

e. (2 points) Suppose that the country were to replace its tariff with a quota permitting imports of 6 ounces of the good. What would be the tariff equivalent of that quota?

   Domestic price must now rise to a level such that the demand for imports (domestic demand minus domestic supply) equals exactly 6 ounces. From the figure, that occurs at price $14, where supply is 12 and demand is 18. The tariff equivalent is the difference between this domestic price and the world price: 14–8=$6.
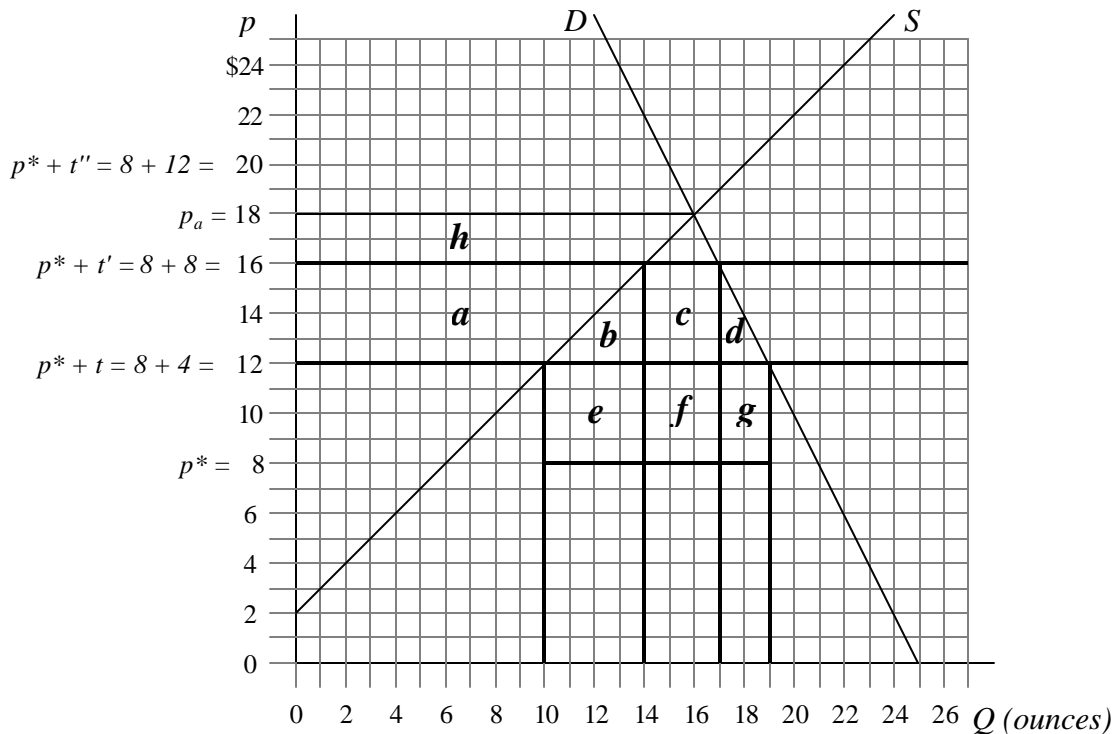
2. [24 points] Consider a small economy, initially in autarky, in a world where there are two goods that can be produced, food and cloth. The relative price of food in the country in autarky is lower than the relative price of food on the world market. Suppose that the country now opens to free international trade. Then for each of the models listed below, answer the following questions, showing the reasoning behind your answers.

    - How will trade change the fraction of the labor force that is employed in the food sector?
    - How will trade change the real wage of labor that was initially employed in the food sector?
    - If non-distorting transfers were possible and used within the country, would it be possible for trade to benefit everybody in it? And if so, to whom would such transfers have to be given?

    In all of the models, the autarky relative price of food is (minus) the slope of the PPF at the autarky equilibrium, where supply and demand are equal ($S_a=D_a$), in a diagram with food on the horizontal axis and cloth on the vertical. When the country opens to free trade at a world relative price of food that is greater than this (a steeper price line, with slope p*), production moves, if necessary, to a tangency of the PPF with this new price line, and consumption moves to a tangency of an indifference curve with this price line.

    a. The Ricardian Model

    Production moves from S_a to S_f, with the country completely specializing in food. Thus all labor that was not already in the food sector moves there, and the fraction of employment there expands to 100%.

    Labor in the food sector continues to be paid the value of its marginal product, which in the Ricardian model does not change. So w/p_F is unchanged. However, since $p=p_F/p_C$ rises, $w/p_C=(w/p_F)(p_F/p_C)$ rises, and the real wage of labor in the food sector goes up.

    Welfare of the country rises from u_a to u_f, which means that it is possible for everyone to be made better off with non-distorting transfers. In fact, in this model, since everyone earns income only from labor, nobody will lose even without such transfers, so no transfers have to be given.
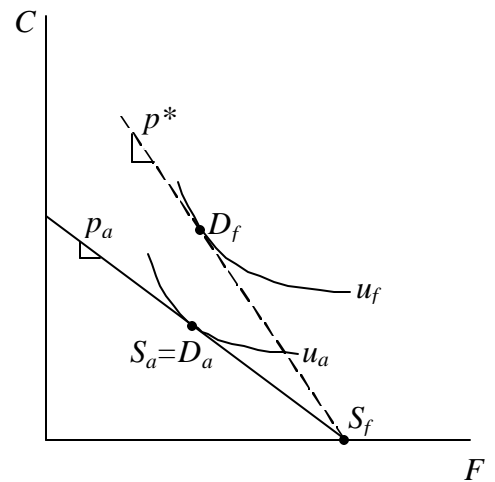
    b. The Extreme Specific Factors Model (all factors immobile)

Since factors cannot move between industries, outputs of the industries must remain unchanged, and production S_f remains at the autarky point. However, the price change still permits the country to trade, since it can and does change the amounts that it demands. Employment in the food sector remains unchanged, as does the fraction of the labor force employed there, since labor cannot move in or out.
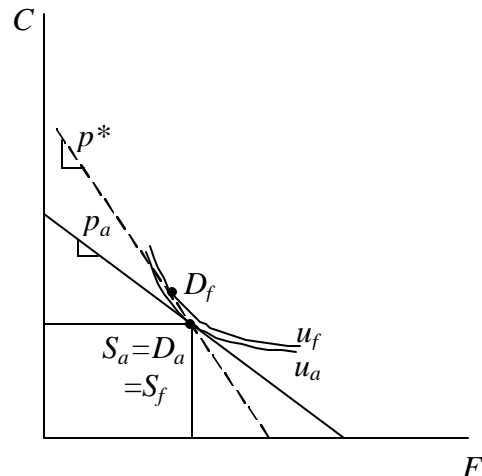
The wage of labor in the food sector rises, since just as in the Ricardian model, the marginal product of labor in food is unchanged (here, though, because the inputs are the same), so w/p_F is unchanged, while $w/p_C=(w/p_F)(p_F/p_C)$ rises.

Aggregate welfare of the country improves, from u_a to u_f, though presumably by a small amount, since there is no increase in the value of output. Thus it is possible to make everybody better off. The recipients of the transfers to make this happen would be the owners of both factors employed in the cloth industry, whose real wage and rental have declined due to the fall in price of their product.

c. The Standard Specific Factors Model (capital immobile between sectors, labor mobile)

With labor (but not capital) mobile between sectors, the PPF becomes curved, as shown, and the change in price induces a reallocation of labor out of cloth and into the food sector. The amount of this reallocation is determined in the specific factors diagram below, where the increase in relative price of food is shown as a rise in its nominal price holding the price of cloth constant. The effect is to increase employment in the food sector, and thus the fraction of the labor force employed there.
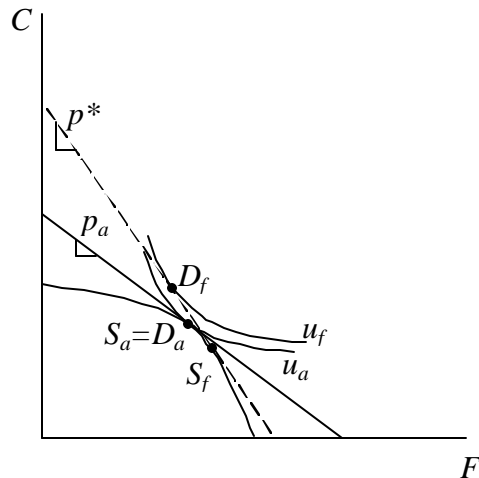
This raises the wage of labor relative to the price of cloth, but lowers it relative to the price of food, leaving the effect on the real wage (of all labor) ambiguous.

The country as a whole gains from this, as shown by the movement from u_a to u_f. For everyone to gain, non-distorting transfers would need to be
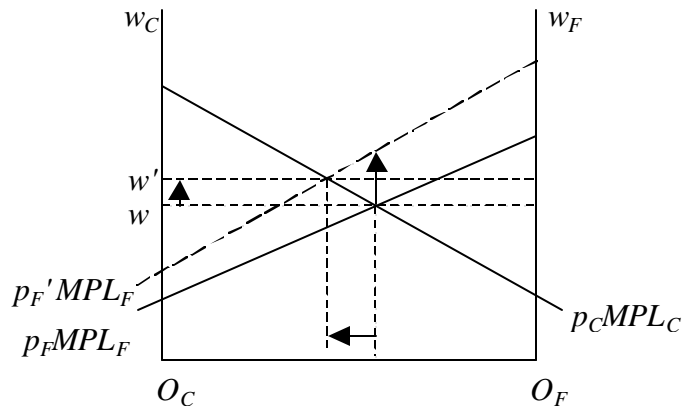
paid certainly to the owners of capital in the cloth sector, since they lose from both the fall in the relative price of cloth and from the outflow of labor from the cloth industry. Transfers might also be needed to workers, to the extent that their consumption of food causes them to lose from its rise in price.

d. The Heckscher-Ohlin Model (assume here that food is relatively labor intensive, compared to cloth)

The picture here is essentially the same as in the standard specific factors model, except that the changes in output are larger (since both factors move) and include the possibility (not shown) that the country may completely specialize in food if the price increase is large enough. Whether it does or not, the fraction of the labor force employed in the food sector rises.

To find the effect on the real wage of labor, we use or derive the Stolper-Samuelson Theorem, which tells us that, since labor is used intensively in the food sector, the real wage of labor goes up. This is illustrated in the Lerner Diagram below, where the rise in price of food (holding the price of cloth constant) pulls the unit value isoquant for food inward, leading to a rise in the nominal wage to a level higher than w_p, which is the wage whose increase would just equal the increase in the price of food. Thus the wage rises relative to both p_C and p_F.

Aggregate welfare again increases, shown by the move from u_a to u_f. Here, since labor gains unambiguously, the transfers needed for everyone to gain would be to the owners of capital.
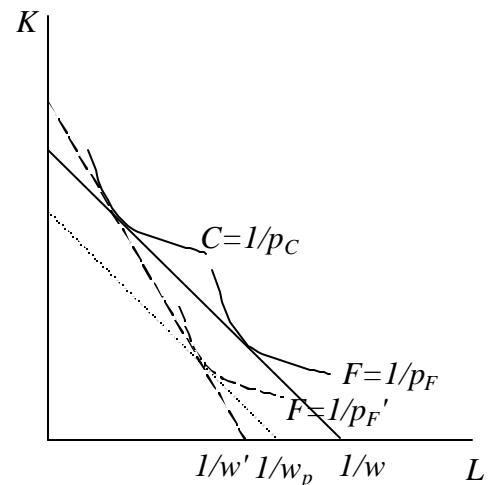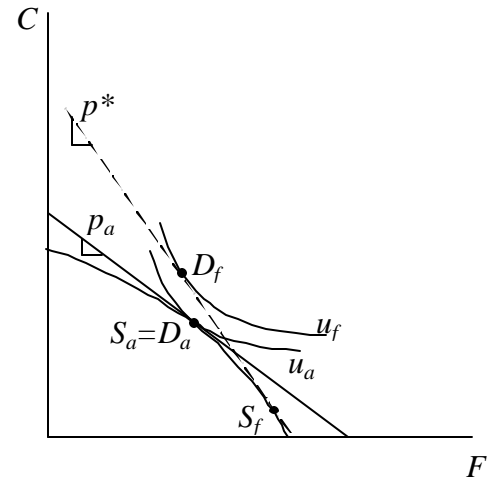
3. [18 points] The world produces three goods using two factors, labor and capital. Prices with free trade are such that there exist two cones of diversification. Consider a country, Ignominia, that produces a small amount of the most labor-intensive good, X_1; it produces and exports the good of intermediate labor-intensity, X_2; and it produces none at all of the most capital-intensive good, X_3.

   a. (4 points) Draw the Lerner Diagram to illustrate how Ignominia's factors are allocated among the three sectors.
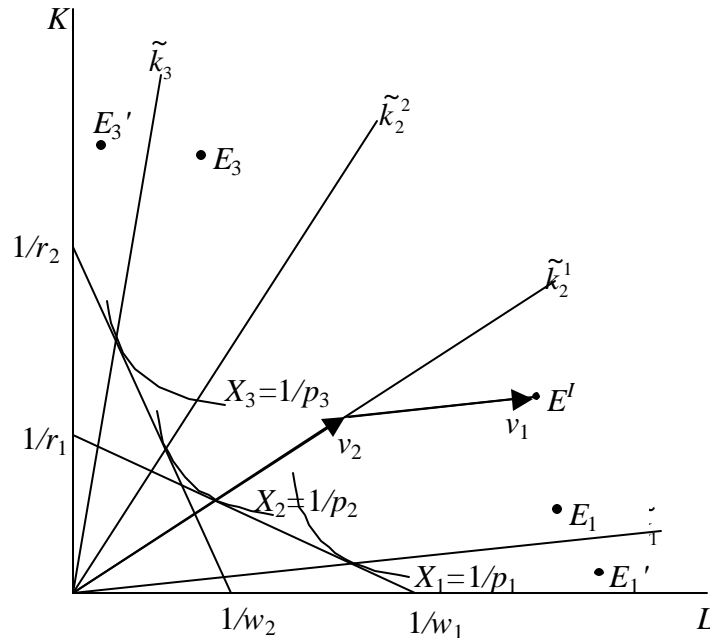
   Because Ignominia produces goods X_1 and X_2, the country's endowment point, E^I, must lie inside the more labor-intensive of the two cones of diversification. Since it exports X_2, its endowment probably lies closer to $\tilde{k}_2^1$ than to $\tilde{k}_1$. The factors employed are the vectors v_2 in X_2 and v_1 in X_1. It employs no factors in X_3.

   b. (6 points) How do Ignominia's factor prices compare to those in the country or countries from which it imports X_1? How do they compare to those in countries from which it imports X_3?

   Ignominia imports X_1 from countries that produce it, whose endowments may lie either in this same cone, or below it: endowments such as E_1 and E_1'. Ignominia's factor prices are the same as those in countries like E_1 (w_1 and r_1). Compared to countries like E_1', whose factor prices are determined by the tangent to the X_1 isoquant at their capital-labor ratio, Ignominia has a higher wage and lower rental.

   Ignominia imports X_3 from countries that produce X_3, which requires that their endowment point lie about the line $\tilde{k}_2^2$, as at E_3 or E_3'. In either case, Ignominia has a lower wage and a higher rental than they do.

c. (2 points) Suppose that Ignominia's government were now to pay a small subsidy for exports of X_2, and simultaneously prevent any of X_2 from being imported. Assuming that Ignominia is small enough for world prices to remain unchanged, how will prices inside Ignominia change?

An export subsidy increases the amount that exporters get for sales abroad. Since domestic demanders cannot import, they will have to pay that same higher price or producers will sell them nothing. So the price of X_2 rises inside the country by the amount of the subsidy.

d. (6 points) For the price change you found in part (c), determine the effect on the real wage of labor in Ignominia, assuming that it continues to produce both X_1 and X_2. (If you got the price change wrong in part (c), you'll be graded here on how well you analyze whatever price change you found, so be sure to answer this for *some* price change.)

The increase in price of X_2 causes the unit-value isoquant of X_2 to shift in towards the origin. This flattens the common tangent to the X_1 and X_2 isoquants, thus increasing $1/w_1$. This is a fall in the nominal wage, and since wage earners are paying the same prices as before for X_1 and X_3, and a higher price for X_2, this is unambiguously a fall in their real wage.
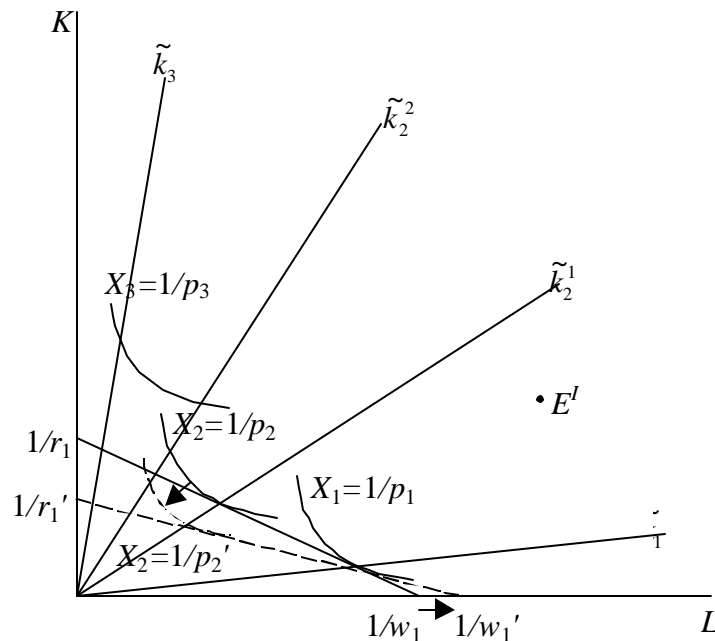
4. [18 points] In the Reciprocal Dumping Model with free trade, assume that the two
    firms have equal costs of production, while the foreign firm incurs a transport cost on
    sales to the Home country's market.

    a. (6 points) Compare the following for the two firms in their operations in the
        domestic market. That is, are they the same or different, and why? And if they
        are different, which is larger?
        i.   The price that they charge on the domestic market.
        ii. The profit that they make per unit of sales.
        iii. The quantity that they sell.

        *The two firms charge the same price in the domestic market, as they must since
        buyers would otherwise buy from only the firm with the lower price.*

        *Because they get the same price, but the foreign firm has a higher cost, it earns a
        smaller profit.*

        *To compare the quantities that they sell, we must solve the model for the Nash
        equilibrium, and that requires that we first derive the two firms' reaction curves
        from their profit maximization problems: Since the firms have the same
        production cost, c, but the foreign firm incurs a transport cost, t, its marginal cost
        of serving the domestic market is higher than that of the domestic firm. For any
        given sales by the other firm, q', therefore, the foreign firm will choose to sell a
        smaller quantity (its higher MC intersects the same MR at a lower Q, as shown on
        the left below). Therefore the foreign firm's reaction curve lies closer to the
        origin than the reaction curve of the domestic firm, as shown on the right below.
        $y^S(x)$ is the reaction curve that the foreign firm* would *have had if transport cost
        were zero, so that it would be symmetric to x(y) and cross it along the 45° line,
        y=x. Because of the transport cost, however, the actual reaction curve of the
        foreign firm, y(x) has it selling less than that, and it lies closer to the origin. As a
        result, it crosses x(y) below the 45° line, resulting in a Nash equilibrium with
        $x^N > y^N$.*
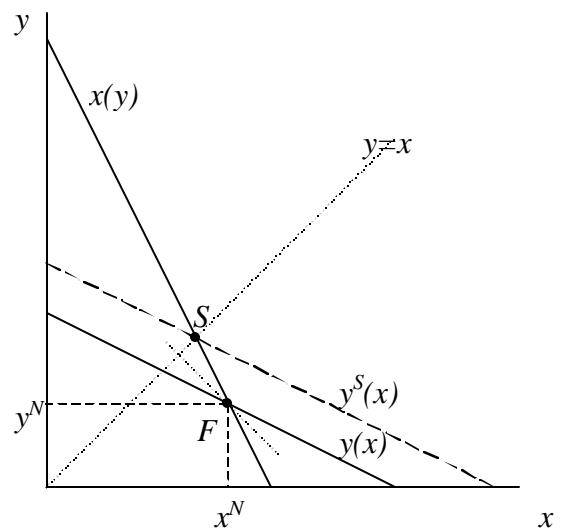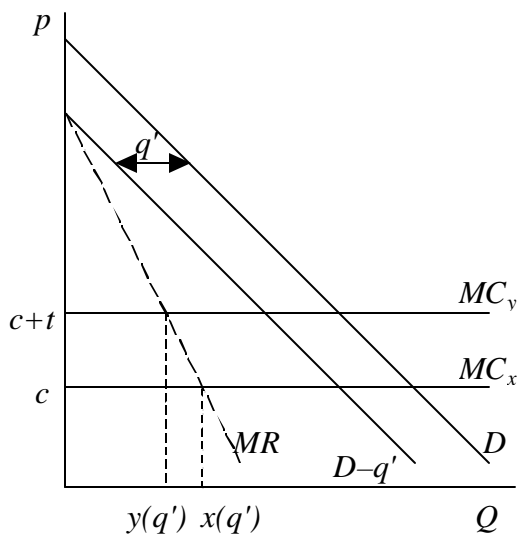
b. (4 points) If the foreign government were now to pay an export subsidy to the foreign firm, for sales to the domestic market, exactly equal to the size of the transport cost, how would the answers to part (a) be changed?

A subsidy equal to the transport cost will reduce the marginal cost of the foreign firm to the same level c as the domestic firm. Its reaction curve will now be exactly symmetric to that of the domestic firm (y(q')=x(q') for all q'). In fact, it will be the one shown as $y^S(x)$ above.

The foreign firm will still charge the same price on the domestic market as the domestic firm (again, they must do so, for both to sell there), though of course it will now actually receive more money for its sales, since it will get the subsidy.

Its profit will now be the same as that of the domestic firm, since the transport cost is offset by the subsidy.

And as the symmetric reaction curves above demonstrate, the two firms will now sell the same quantities.

c. (8 points) What can you say about the gains and losses to the following due to the foreign export subsidy of part (b)?

      i.   The profits of the domestic firm.
     ii.   Domestic-country consumers.
   iii.   The profits of the foreign firm.
   iv.   The foreign country, including both the firm and its government.

Note first that the subsidy has moved the equilibrium from point F (free trade) to point S (with the subsidy) in the reaction curve diagram above, and that this has a larger quantity being sold on the domestic market (since we've moved outside the dotted downward-sloping 45° line through F). With a larger quantity sold, the price must be reduced along the demand curve.

It follows that: the domestic firm makes a smaller profit at S than at F, since it sells a smaller quantity for a lower price; domestic-country consumers are better off, since they pay a lower price; the foreign firm earns a higher profit, since it sells a larger quantity for a higher price, and in addition receives the subsidy.

As for the foreign country including both the firm and its government, we can't say. By drawing an iso-profit curve for the foreign firm (exclusive of subsidy), which must be vertical where it crosses y(x), we know that it is possible for it to do better than at F by moving somewhere along x(y), and a small enough subsidy could accomplish this. But we don't know that this subsidy, set arbitrarily equal to the transport cost, is small enough. The two cases below show both possibilities. On the left, the foreign firm's profit (exclusive of subsidy) goes up, and the firm and country both gain from the subsidy. On the right, the profit exclusive of subsidy goes down, and the country (but not the firm) loses. The

difference is the size of the transport cost, which is larger in the case on the right, as indicated by y(x) being smaller. If the transport cost is large, then it doesn't make sense to use a subsidy to offset all of it.
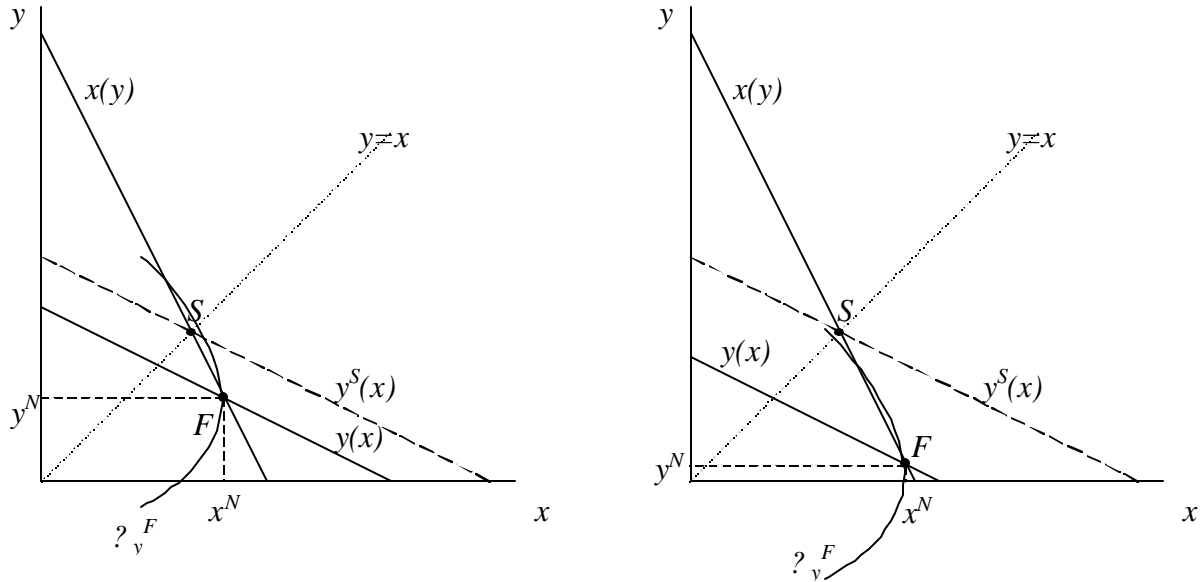
5. [12 points] Suppose that Mexico, before the formation of NAFTA, had the option of importing stoves either from the United States at a constant cost of $500, or from Brazil at a constant cost of $400. It had a 30% tariff on all imports of stoves. Under these circumstances, Mexico was importing stoves and also producing stoves in its domestic stove industry, with an upward sloping domestic supply curve.

   a. (2 points) From which country did Mexico import stoves, prior to NAFTA, and why?

      It imported stoves from Brazil, because their cost with tariff was (1.3)400 = $520 from Brazil and (1.3)500 = $650 from the United States.

   b. (6 points) When NAFTA was formed, Mexico reduced its tariffs on all imports from the United States to zero. How, if at all, should that have changed each of the following? (You need only indicate the direction of change, but explain your reasoning.)

      i. The domestic price of stoves in Mexico?
      ii. The quantity of stoves imported?
      iii. The country from which it imported?
      iv. Production of stoves in Mexico?
      v. Consumption of stoves in Mexico?
      vi. Mexican tariff revenue?

      Elimination of the tariff on stove imports from the U.S. makes them cheaper, at $500, than stoves from Brazil that still, with the tariff, cost $520. So, in the figure

below, the domestic price of stoves in Mexico falls from $520 to $500. This reduces the production of stoves in Mexico along its domestic supply curve and increases consumption of stoves along the demand curve. More stoves are imported, and all of them are now imported from the United States. The Mexican government no longer collects any tariff revenue at all on stoves, since none are
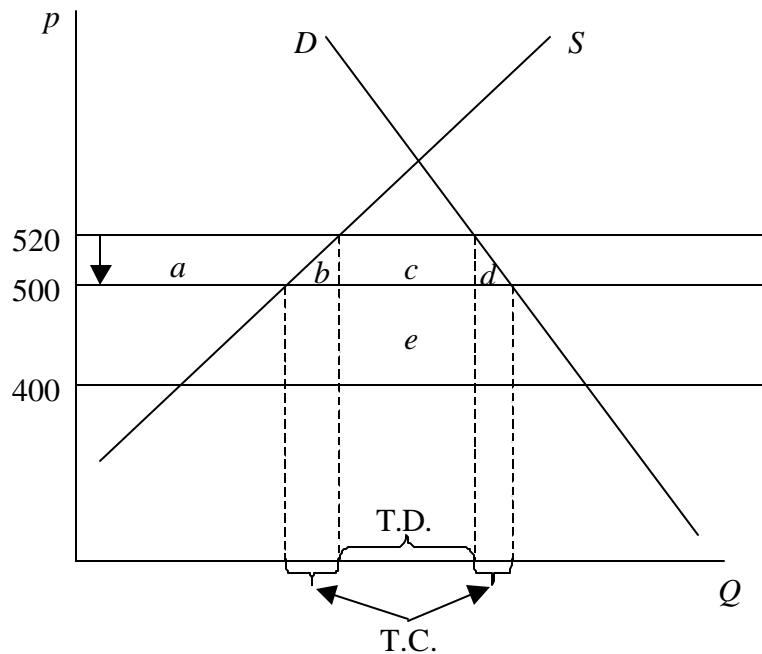
being imported from Brazil: the tariff revenue therefore falls.

c. (4 points) Identify "trade creation" and "trade diversion" in this case, and explain how these matter for the welfare of Mexico?

Trade diversion refers to the imports that existed previously but have been diverted by the FTA away from the outside supplier, Brazil, to an inside supplier, the United States. These imports are shown above as "T.D." Trade creation refers to new imports that are caused by the FTA: stoves that Mexico is now importing from the United States that it did not previously import at all. These are the units marked "T.C.", and they include both the stoves that were previously bought from Mexican suppliers and are now bought from the U.S., as well as stoves that were previously not bought at all because of their price, but now are bought from the U.S. when the price goes down.

Trade diversion is harmful to the welfare of Mexico, because these stoves previously cost the country only $400 (the extra 520-400=120 was a cost to consumers, but not to the country, since it was tariff revenue for the Mexican government). Trade creation is beneficial to Mexico as a country, since it generates benefits to consumers of areas "b" and "d" above that are not losses to anyone else in Mexico.