

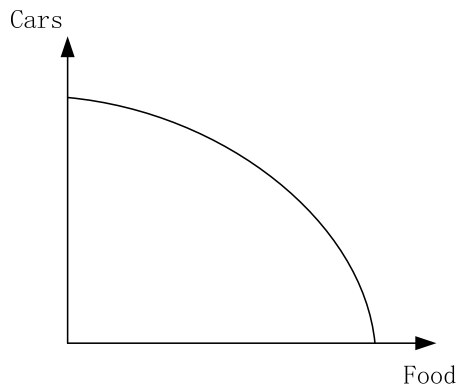
Econ/EEP 181: International Trade  
 ASSIGNMENT #3 SOLUTIONS  
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 Due: November 12, 2008

1. *Import Tariffs and Export Promotion in a Small Open Economy's General Equilibrium*

A small open economy produces cars and grows food with some unspecified number of factors of production. The opportunity costs of car production in terms of food change with the production pattern but are lower than those of its trading partners.

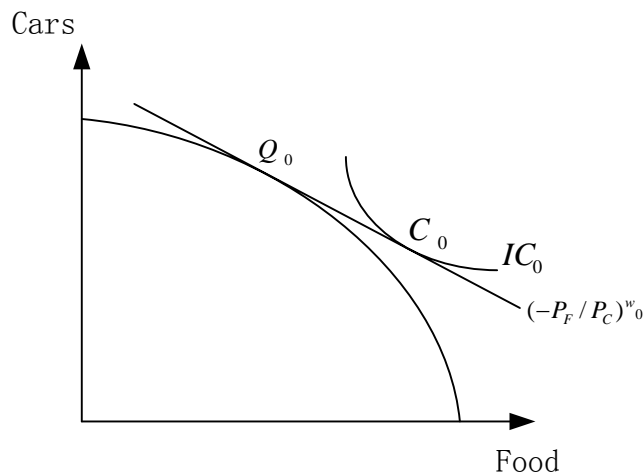
1) Draw a production possibility frontier that is consistent with the above assumptions.

Answer:



2) Depict initial world trade equilibrium and the consumption possibilities of the small open economy, consistent with the above assumptions.

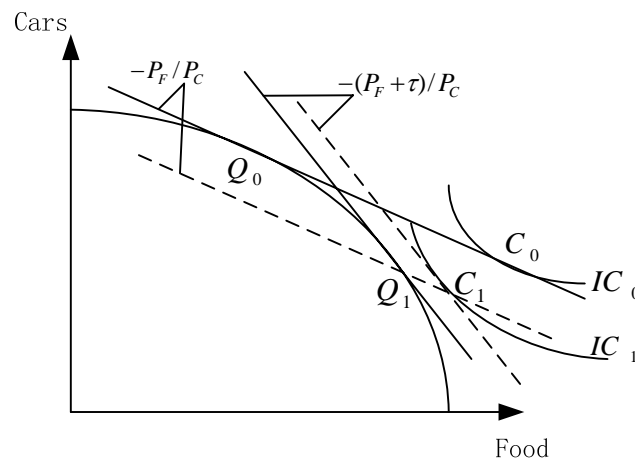
Answer:



3) Suppose the small open economy imposes a tariff on its imports. How do the country's Terms of Trade change? How does the domestic price ratio change? How will be the small open economy's production pattern change? How will the small open economy's consumption and trade pattern change? How is welfare affected?

Answer: Since this economy is small, the introduction of an import tariff will not change world prices; therefore the country's TOT will not change. However, imposing a tariff on food will increase the domestic

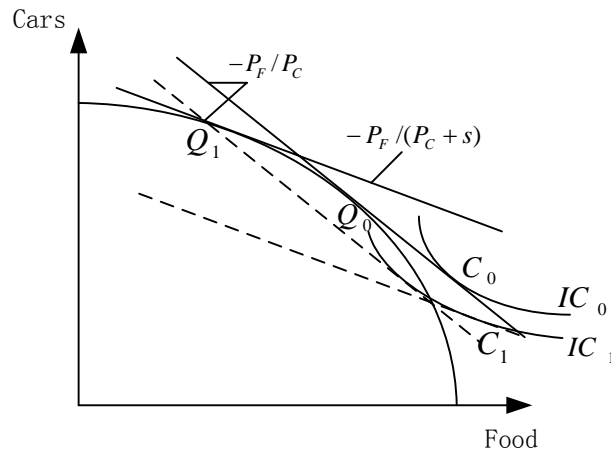
price of food, so domestic relative price of food to cars will increase to  $P_f + \tau / P_c$ . Since the price of food increases relative to the price of cars, this small country will produce more food relative to cars. The production point shifts to the right (from  $Q_0$  to  $Q_1$ ). However, the effect on consumption is more complicated. Both the substitution and income effects make consumers want less food (food is relatively more expensive, and they have lower incomes). The substitution effect makes them want more cars (since they are relatively less expensive) but the income effect makes them want fewer cars (they have less income), so they may consume more or fewer cars, depending on whether the substitution or income effect dominates. As shown on the graph below, the country will reduce both imports and exports, and its welfare will decrease; consumers now consume along a lower indifference curve  $IC_1$  instead of  $IC_0$ .



4) Suppose the small open economy promotes its exports with a cost subsidy to producers. How do the country's Terms of Trade change? How does the domestic price ratio change? How will be the small open economy's production pattern change? How will the small open economy's consumption and trade pattern change? How is welfare affected? Is there a difference to the import tariff?

Answer: Similarly, granting an export subsidy will not change world prices, so the country's TOT will not change. However, introducing an export subsidy on cars will increase the domestic price of cars, so the domestic relative price of food to cars will decrease to  $(P_f/P_c + s)$ . Since the price of cars increases relative to the price of food, this small country will produce more cars relative to food. The production point shifts to the left (from  $Q_0$  to  $Q_1$ ). This export subsidy will increase Home's exports. However, this country's welfare will decrease (it now consumes along from  $IC_1$  instead of  $IC_0$ ). Consumers will consume fewer cars (since the relative price of cars has increased and income has fallen) and may consume more or less food, depending on whether the income or substitution effect dominates.

The export subsidy and import tariff both cause national welfare to fall. However, the export subsidy results in a shift towards production of the exported good, and towards consumption of the imported good, while an import tariff results in a shift toward production of the imported good, and towards consumption of the exported good. The export subsidy benefits producers in the export sector, while the import tariff benefits producers in the import sector. Finally, the government gains tariff revenues from the import tariff, but must collect a tax in order to pay for the export subsidy.



Additional notes on part 3) and part 4): the steps for determining the new indifference curve. 1) The tangency between the new domestic price line and the PPF gives you the new production point ( $Q_1$ ); 2) Draw the new Balance of Payments (BOP) line (budget constraint) which is parallel to the original BOP and passes through the new production point; 3) for the case of an import tariff, if we assume the tariff revenues will be returned to consumers, consumers' incomes will rise. Therefore, the new domestic price line shifts up a little bit. However, for the case of an export subsidy, government spending rises. If we assume the government will collect taxes from consumers in order to pay the subsidy, consumers' incomes will fall. Thus, there is a downward shift of the new domestic price line; 4) Finally, draw the new indifference curve. This new curve should be on the new BOP, but tangent to the upward/downward shifted domestic price line (the point of consumption is  $C_1$ ).

## 2. Intra-industry Trade

Monopolistic chair makers produce with a total cost function

$$TC = F + c \cdot Q_c$$

where  $F=500,000$  and  $c=100$ .

1) What are average and marginal cost functions of a chair maker?

Answer:  $AC = \frac{TC}{Q_c} = \frac{F}{Q_c} + c$  and  $MC = TC'(Q_c) = c$ .

2) Each of  $n$  chair makers faces residual demand of

$$Q_c^d = S \cdot [1/n - b \cdot (P_c - \bar{P}_c)]$$

where  $S=50,000$ ,  $b=1/1,000$  and  $\bar{P}_c$  is average equilibrium price. What are marginal revenues?

Answer:

Step 1) rewrite the residual demand so that  $P_c$  as a function of  $Q_c$ ,

$$P_c = \frac{1}{b \cdot n} - \frac{Q_c}{b \cdot S} + \bar{P}_c \quad (1).$$

Step 2) derive the general form for the marginal revenue,

Total Revenue  $\equiv R = P_c(Q_c) \cdot Q_c$ , then the marginal revenue is  $MR = \partial R / \partial Q_c$ , which is equal

to  $MR = P_c(Q_c) + P'_c(Q_c) \cdot Q_c$  (2).

Step 3) derive  $P'_c(Q_c)$  from (1) and then plug it into (2).

From (1), we know  $P'_c(Q_c) = -\frac{1}{b \cdot S}$  and  $Q_c = S/n$ . Therefore,

$$MR = P_c - \frac{1}{b \cdot S} \cdot \frac{S}{n} = P_c - \frac{1}{b \cdot n} \quad (3).$$

3) Graph the average-cost-variety (CC) and the price-variety (PP) schedules for this industry in a diagram that shows price, average cost and number of firms (varieties).

Answer:

To derive the PP curve, we need to start from the profit-maximization problem in this specific set-up,

$$\text{Max } \pi = P_c(Q_c) \cdot Q_c - c \cdot Q_c - F.$$

Then we take partial derivative with respect to  $Q_c$  and, get the following,

$$\partial \pi / \partial Q_c = P_c(Q_c) + P'_c(Q_c) \cdot Q_c - c = 0$$

$$\Rightarrow P_c(Q_c) + P'_c(Q_c) \cdot Q_c = c$$

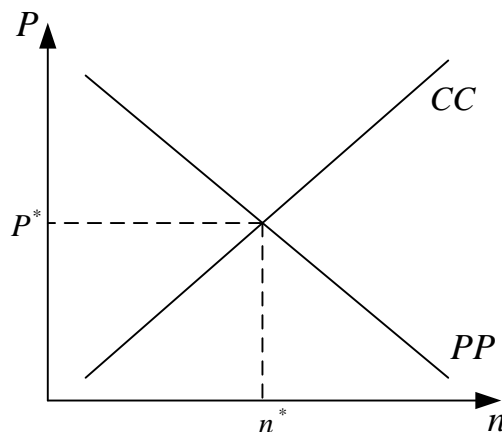
$$\Rightarrow MR = c$$

$$\Rightarrow P_c - \frac{1}{b \cdot n} = c \quad (\text{from equation (3) obtained in part 2))$$

$$\Rightarrow P_c = c + \frac{1}{b \cdot n} \quad (PP).$$

The CC curve is obtained directly from the average cost (AC) function:

$$CC: AC = \frac{TC}{Q_c} = \frac{F}{Q_c} + c = \frac{F}{(S/n)} + c = \frac{n \cdot F}{S} + c. \text{ Now, we can graph these two curves.}$$



4) Find the number of firms (varieties) in this industry in the absence of trade. What is price in symmetric autarky equilibrium?

Answer: Given that  $F=500,000$ ;  $c=100$ ;  $S=50,000$ , and  $b=1/1,000$ , we can plug these number into CC and PP

curve to get equilibrium  $n^*$  and  $P^*$ .

$$CC: AC = \frac{n \cdot F}{S} + c = \frac{n \cdot 500,000}{50,000} + 100 = 10 \cdot n + 100$$

$$PP: P_c = c + \frac{1}{b \cdot n} = 100 + \frac{1}{1/1000 \cdot n} = 1000 \cdot n + 100$$

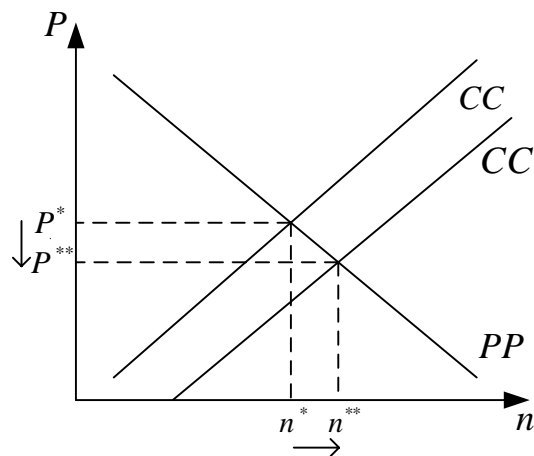
$$\Rightarrow \text{At equilibrium: } AC = P_c$$

$$\Rightarrow 10 \cdot n + 100 = 1000 \cdot n + 100$$

$$\Rightarrow n^* = 10 \text{ and then } P^* = 200$$

5) Chairs can be traded with other countries at no cost. Using the average-cost-variety (CC) and the price-variety (PP) schedules above, show how equilibrium price and the equilibrium number of firms change after trade.

Answer: If we allow trade, chair makers will face a larger market. Besides the domestic market, they can also sell their products to the world market. Therefore, industry-level sales will increase ( $S$  will increase). Looking back at our CC and PP curves, we observe that CC is decreasing in  $S$ . Therefore, as  $S$  increases, the CC curve will shift down (shown in the graph below). As a result of trade, the equilibrium number of firms will increase to  $n^{**}$  while the equilibrium price will go down to  $P^{**}$ .



6) How could you measure the gains from trade? Explain briefly.

Answer: There are two sources of gains from trade. First, since we are in a “monopolistic competition” framework, each firm produces a different variety. Thus, consumers have access to more varieties (measured by the number of firms,  $n$ ), after trade. Second, with economies of scale, the more firms produce, the lower their average costs are. Since the increase in market size shifts the average cost curve down, the equilibrium price of products falls, and consumers are better off.

### 3. Import Tariff in Partial Equilibrium

Home’s demand and supply for cars are given by:  $D = 130 - 30 \cdot P$  and  $S = 10 + 30 \cdot P$ , while Foreign’s

demand and supply for cars are:  $D^* = 60 - 30 \cdot P$  and  $S^* = 40 + 30 \cdot P$  ( $P$  is thousands of US\$). Assume Home is a small country while Foreign is a large country.

1) Determine the autarky equilibrium, and calculate domestic price for each country. Illustrate your answer with suitable graphs.

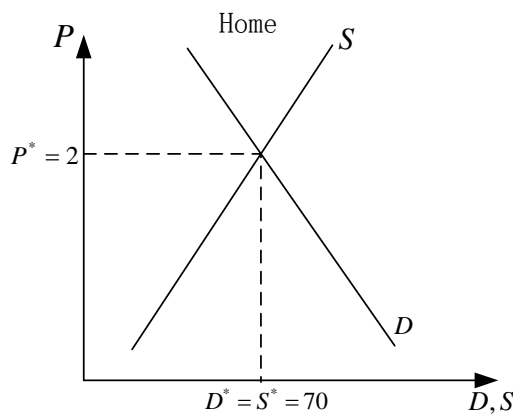
Answer: to determine the autarky equilibrium price and quantity, we need to equate demand and supply for each country.

Home:

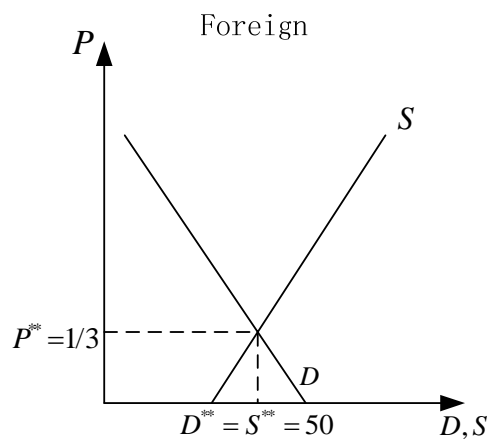
$$D = S$$

$$\Rightarrow 130 - 30 \cdot P = 10 + 30 \cdot P$$

$$\Rightarrow P^* = 2 \text{ and } D^* = S^* = 70$$



Similarly, we find that equilibrium price and quantity for Foreign are:  $P^{**} = 1/3$  and  $D^{**} = S^{**} = 50$ .



2) Derive Home's import demand schedule and Foreign's export supply schedule. Calculate and depict the world price when both countries trade, and show the traded quantities.

Answer:

Home's import demand schedule (MD):  $MD = D - S = 130 - 30P - (10 + 30P) = 120 - 60P$

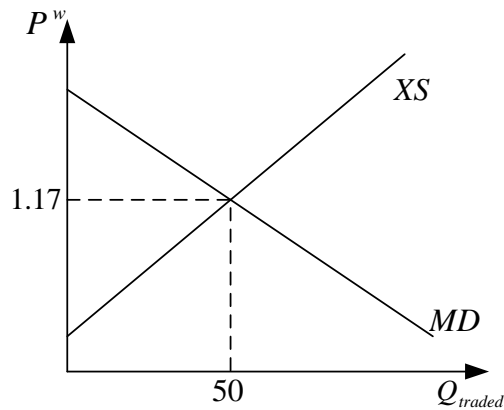
Foreign's export supply schedule (XS):  $XS = S^* - D^* = 40 + 30P - (60 - 30P) = -20 + 60P$

To calculate world price and quantity traded, we need to equate MD and XS:

$$MD = XS$$

$$\Rightarrow 120 - 60P = -20 + 60P$$

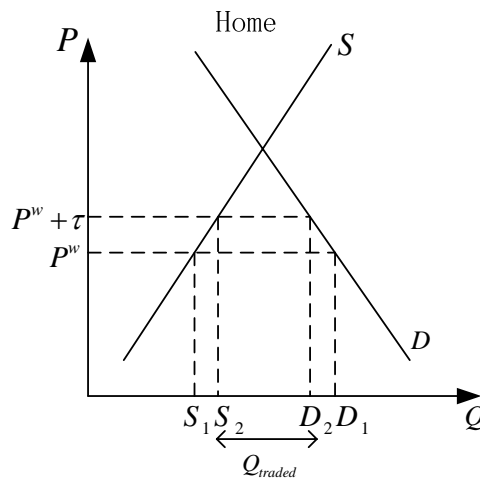
$$\Rightarrow P^w = 7/6 \approx 1.17 \text{ and } Q_{traded} = 50$$



Note: we asked you to assume that Home was small to make the next part of this problem simpler. However, in order to solve for world price by setting Home's import demand equal to Foreign's excess supply, both countries would have to be large (otherwise Home's import demand wouldn't affect world price at all).

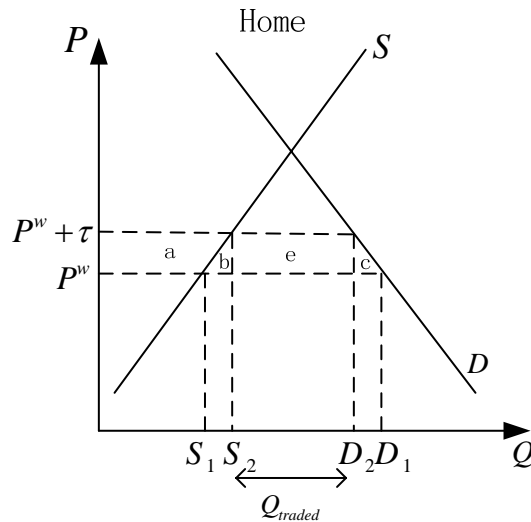
3) Home imposes a specific tariff of  $t=0.4$  per car. Calculate and depict the price that Home consumers pay. Show domestic consumption, production and the trade volume.

Answer: Since Home is a small country, imposing a tariff will not change Foreign's domestic price or the world price. The price of cars at Home is increased by \$0.40. Therefore, the price that Home consumers pay per car is  $\$1.17 + \$0.4 = \$1.57$ . Domestic consumption, production and the imports after imposing a tariff are shown on the graph below (denoted by  $D_2$ ,  $Q_2$  and  $Q_{traded}$  respectively).



4) Show graphically how the tariff affects Home welfare. Distinguish Home consumer surplus, producer surplus and government revenues.

Answer: See the next page.



Notes: Change in consumer surplus:  $-(a+b+e+c)$ ; Change in producer surplus:  $+a$ ; Government revenues:  $+e$ .

5) Did the tariff improve efficiency? Show the net efficiency gain or loss graphically.

Answer: After figuring out the consumer surplus, producer surplus and government revenues, we can calculate the net cost of a tariff. The net cost of a tariff =  $-(a+b+e+c) + a + e = -(b + c)$ . Since Home is a small country, it has to bear all costs that result from a tariff. The triangles b and c represent the deadweight loss (efficiency loss) of the tariff.

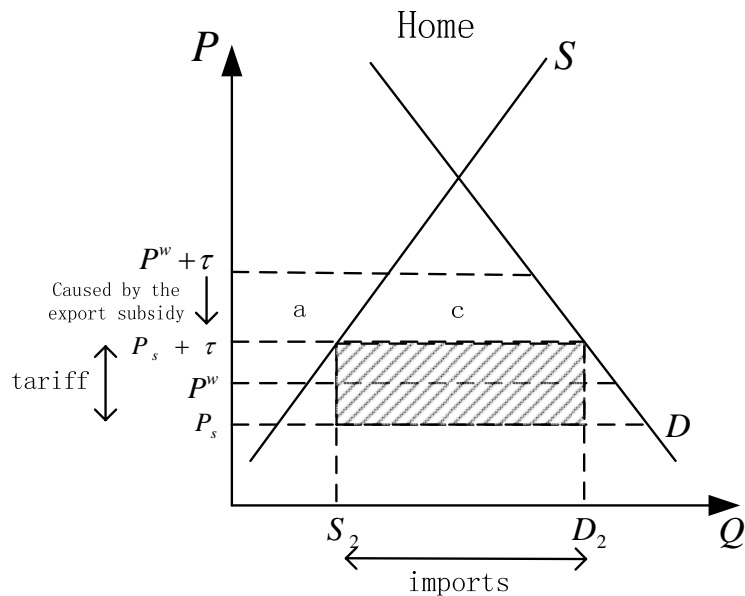
#### 4. Export Promotion in Partial Equilibrium

Consider the two countries from question 3 gain. Home has a specific tariff of  $\tau=0.4$  per car in place. The Foreign government now decides to grant a specific export subsidy of  $s=0.4$  per exported car. Again, we assume that Home is a small country while Foreign is a large country.

1) How does this subsidy affect Home's welfare?

Answer: When Foreign offers an export subsidy, this shifts out its excess supply curve. The vertical distance of the shift in the XS curve is equal to the subsidy  $s$ , so the world price of cars therefore falls (from  $P^w$  to  $P_s$ ), but by less than the amount of the subsidy. Therefore, Home faces a new, lower world price, which is equal to  $P_s$  (shown below). Home is still charging the tariff, though, so the actual price that consumers and producers face at Home is  $P_s + \tau$ .

However, the new domestic price at Home,  $P_s + \tau$ , is still lower than the old domestic price at home with the tariff,  $P^w + \tau$ . Therefore, at Home, consumers gain but producers are hurt. As shown on the diagram below, the consumers' gains are  $(a+c)$ ; the producers' loss is  $a$ . Imports have increased because when facing a lower price, consumers are willing to buy more but producers would supply less. Therefore, government revenues (shown as the shaded rectangular area below) have risen, since they still receive the tariff  $\tau$  on all imports, and imports have increased. Thus, the net effect on Home's welfare as a result of export subsidy granted by Foreign is positive.



2) Show the changes to surpluses and tax revenues for Foreign.

Answer: As discussed above, the introduction of an export subsidy decreases the world price, but by less than  $s$ . As shown below, the price in Foreign therefore increases to  $P_s^*$ . In Foreign, consumers are hurt, producers gain, and the government loses because it must spend money on the subsidy. The consumer loss is the area  $a+b$ ; the producer gain is the area  $a+b+c$ ; the government subsidy is the area  $b+c+d+e+f+g$ . The net welfare loss is therefore the sum of the areas  $b+d+e+f+g$ .

