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Open economy microeconomics  
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### Problem set 3

The purpose of the first two problems is to get you accustomed to using graphical methods to analyze economic problems. You need to know how to identify producer and consumer surplus on a graph, and you need to be able to graph an excess supply (or demand) function - i.e. you have to be able to graph the difference between two functions. That part is easy. The trickier part is in using these simple tools. The third problem makes sure that you know how taxes affect relative prices. The fourth problem makes sure that you know the relation between a social planner's problem and a competitive equilibrium. The fifth problem makes sure that you can use graphical methods to identify the effect of returning tax revenues to consumers (rather than throwing them away).

- 1) (Background) Use a two-panel diagram.
  - i) In panel a draw a linear supply and demand curve for "the US", and identify the consumer and producer surplus in an autarkic equilibrium.
  - ii) In panel b draw the excess supply function that corresponds to the functions you drew in panel a.
  - iii) In panel b draw a perfectly elastic rest-of-world (ROW) excess demand curve at a price higher than the US autarky price. Use this figure to identify the world equilibrium price and the level of US exports.
  - iv) In both panels identify the increase in the sum of US producer and consumer welfare that results in moving from autarky to free trade. This increase is the partial equilibrium representation of the gains from trade, for the US. (Be sure you understand this. Don't bother to continue with the problem until you do.) This exercise should convince you that you can identify the gains from trade (in this partial equilibrium model) either by (i) using the domestic supply and demand curves and looking at the changes in producer and consumer surplus associated with these two curves, or by (ii)

using the excess supply (or excess demand) curve, and finding the surplus associated with this curve.

2) (This is the real problem) As in the previous question, draw (linear) US supply and demand curves (in the first figure) and the corresponding US excess supply in the figure next to it.

Now I want you to figure out how a particular policy changes one or both of the supply and/or demand curves, and the resulting change in equilibrium.

Suppose that the US institutes a "target price" of  $p^*$  for US producers. With this policy, markets are allowed to clear. (Private Supply = Private demand, i.e., the government does not purchase any of the commodity). If the market clearing price,  $\hat{p}$ , is less than  $p^*$ , then producers receive a "deficiency payment" of  $p^* - \hat{p}$  from the government for each unit sold; consumers pay the market clearing price  $\hat{p}$ . (You can imagine the government buying from producers at a high price and selling to consumers at a lower price. Of course, this transaction does not literally occur. The actual transaction is between producers and consumers, but the government steps in to make up the "deficiency" in the market price, by paying producers an extra amount.) If the market clearing price is above  $p^*$ , then the government does not intervene.

a) Consider the autarkic economy. Using only the first panel, show how the policy changes one or both curves. Identify the market clearing price under autarky (with the policy), and label it  $\hat{p}^a$ . (The market clearing price is the price that consumers pay; the price that producers receive equals the fixed target price, providing that the target price exceeds the market clearing price. Assume that it does exceed the market price.) Identify (on the graph) the change in consumer surplus, the change in producer surplus, and the cost of the policy to taxpayers (the deficiency payment times supply). Identify the "deadweight cost" of the policy, defined as the sum of the change in consumer, producer and taxpayer welfare.

(Note that in the previous paragraph you are asked about the welfare effect of the policy. You hold the trade regime fixed (autarky) and compare the (autarkic) equilibrium with and without the target price policy.)

In the adjacent figure draw the US excess supply curve under the policy. (Remember, the excess supply curve is just the difference between the domestic supply and demand curves. If you know how the target price policy affects one or more of these curves, you can figure out how the policy affects the excess supply curve.)

Now allow for trade. Suppose that ROW excess demand is perfectly

elastic at a price higher than the US autarkic price with the policy, and lower than the US target price. Identify US exports and US gains from trade in the two panels. Remember, the gains from trade measure the difference in welfare under trade and under autarky. Welfare (as before) is the sum of producer and consumer welfare, minus the cost to the treasury. (Look at part iv of the first question for a clue.)

(Reread the previous paragraph. Note that you are asked to identify the welfare effects of trade under an existing target price policy. You are not asked to identify the welfare effects of the target price policy. You hold the target price policy fixed, and compare the equilibrium with and without trade.)

b) Now draw a downward sloping ROW excess demand curve, with the property that the US would be an exporter with or without the target price policy. Identify the equilibrium world price with and without the US policy. How does the US policy affect the world price?

c) Maintain the assumption of part (b): the US would be an exporter with or without the target price policy. Also assume that the equilibrium world price is lower than the target price.

Does the presence of the target price policy increase or decrease the gains from trade for the US? Explain your conclusion. (Remember, the gains from trade is the difference in welfare with and without trade. Look at part (a) again. There are gains from trade without the policy, and gains from trade with the policy. You are asked to compare the size of these two gains. In some cases - but not in this problem - the gains from trade might be negative.)

[Hint: You might think that your answer depends on the shape of the ROW excess demand curve relative to the US excess supply curves (with and without the policy). To help in discovering the correct answer, it may be useful to experiment with "limiting cases" (i.e., "extreme cases") for the ROW demand curve. It is up to you to think of what these "limiting cases" might be. It's nothing subtle!)

d) What does your answer to (c) say about the effect of the policy on US welfare? (Remember (again!) the gains from trade is the difference in welfare with and without trade.)

e) How would your answers to (c) and (d) have changed if I did not tell you to assume that the US would be an exporter with or without the target price policy?

3. There are two commodities, food and cloth. Food is the numeraire. The relative world price of cloth is  $p$ . Home, a small country, imports food.

a) Home uses (only) an ad valorem import tariff of  $\tau$ . The relative price of cloth for domestic consumers is \_\_\_\_\_ and the relative price for producers is \_\_\_\_\_ .

b) Home uses (only) an ad valorem export subsidy of  $s$ , The relative price of cloth for domestic consumers is \_\_\_\_\_ and the relative price of cloth for domestic producers is \_\_\_\_\_ .

c) Home uses (only) an ad valorem production tax of  $t$  on cloth. The relative price of cloth for consumers is \_\_\_\_\_ and the relative price of cloth for producers is \_\_\_\_\_ .

d) How would your answer to part (a) have changed if Home is a large country rather than a small country? (Explain briefly)

4 Production of food and cloth require mobile factors capital and labor using production functions  $F(L, K)$  and  $C(L, K)$ . The fixed supplies of the factors are  $\bar{L}$  and  $\bar{K}$ , and the world relative price of cloth is  $p$ . (Food is the numeraire good.) Define  $y(p, \bar{L}, \bar{K})$  as national revenue (the maximized value of production, given the output price and the available supplies of factors). Assume that both goods are produced. Show that in the absence of market failures, the competitive wage,  $w$ , equals the shadow value of labor,  $\partial y / \partial \bar{L}$ . Hint: Write the Lagrangian for the social planner and the profit maximization problem for a competitive firm. Compare the necessary conditions in the two problems. Then use the envelope theorem.

5 Consider a small country that produces both corn and umbrellas; this country imports umbrellas. The world relative price of corn is  $p^w$ . (Umbrella is the numeraire good: its price is set to 1.) The country imposes a small tax on corn production. Using a graph, identify the production and consumption points under two scenarios: (i) the government returns the tax revenue to consumers in a lump sum, and (ii) the government throws the tax revenue into the sea.

Identify the production point under free trade as A; the consumption point under free trade as B; the consumption point when the tax revenue is returned to consumers as G and the consumption point when the tax revenue is thrown into the sea as D. Identify the value of consumption under scenario i, measured in units of corn, as point F<sup>1</sup>; identify the value of consumption under scenario ii, measured in units of corn, as point H. Identify other points as needed. What is the economic interpretation of the distance  $F - H$ ?

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<sup>1</sup>If consumers had the endowment of F units of corn and faced domestic prices, they would consume at the point G.