

ECON 301, Professor Hogendorn

Problem Set 7

1. *OilProducers.* Suppose there are two oil-producing regions in the world, and in each one there are perfectly competitive producers. The factor price for extraction equipment is w , and the long-run average costs of one of these firms are

$$AC(y) = \sqrt{w}(1 + y^2)$$

There are 20 firms in the Middle East, and for them extraction equipment costs 400. There are 10 firms in Alberta who must pay 900 for extraction equipment.

- (a) Suppose the world needs an amount of oil equal to \hat{y} . What value of \hat{y} would result in a price of oil of \$25?
 - (b) What is the short-run market supply curve for oil (holding the number of firms fixed)?
 - (c) What value of \hat{y} would result in a price of oil of \$32?
2. *OilRefineries.* A common argument against environmental regulations is that they will act like a tax and raise the price of goods. When there is a lumpiness to costs, however, this may turn out not to be true. For example, in 1990 several amendments were passed to the Clean Air Act which required oil refineries to significantly upgrade their capital. The surprising result was that the refining industry increased its total supply and the market prices of refined products actually fell, *ceteris paribus*. Here's how this can happen. Suppose the demand for oil in the U.S. is 15.4 million barrels per day, and is perfectly inelastic. Suppose we can treat all U.S. oil refineries as a single firm with production function

$$f(L, K) = 0.147L^{0.3}K^{0.6}$$

Let $w = 10$, but keep r as a parameter.

- (a) Use the Lagrangian to find the conditional factor demands for labor and capital.
- (b) Suppose that in 1989, the refining industry had $K = 359$ and was stuck in the short-run. Show that the short-run marginal cost curve for the whole industry is

$$MC(y|K = 359) = 0.153y^{2.33}$$

- (c) During the early 1990's, oil refineries did not move into the long run because there were additional costs associated with shutting down the refineries in order to replace the capital. If the firms remain stuck in the short run, and if $r = 1$ what would be the price of oil assuming perfectly competitive behavior?
- (d) Now suppose that the government regulation raises the cost of capital to $r = 1.15$ and it forces the firms to move to the long run so they can adjust their capital. If demand is still 15.4, what would be the price of oil?
- (e) Graph the supply and demand equilibrium of parts (c) and (d).
- (f) For each part above, a-d, what, in your opinion, is the most limiting assumption underlying the choice of modeling approach. For example for part (a), your answer might be "It is not realistic to treat all refineries as a single firm because." (This example is not a very good answer, however.) For each limitation, say what is being oversimplified, and how addressing the concern might be expected to change the answer.