The Oil Market and Drilling in the Arctic National Wildlife Refuge

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The Arctic National Wildlife Refuge (ANWR), the largest of Alaska's 16 national wildlife refuges, covers 19.6 million acres. It also contains massive deposits of petroleum. It is owned by the citizens of the United States, who must collectively decide how to use it. Should it continue in its undeveloped state or should it be opened for oil drilling? Recent increases in the price of gasoline and the war in Iraq have only heightened this intense debate.

We can use information about demand and supply elasticities to answer an important public policy question: Would selling oil from the Arctic National Wildlife Refuge (ANWR) substantially affect the price of oil? Established in 1980, ANWR covers 20 million acres and is the largest of Alaska's 16 national wildlife refuges. It is believed to contain massive deposits of petroleum. For decades, a debate has raged over whether ANWR'S owners—the citizens of the United States—should keep it undeveloped or permit oil drilling.[1]

In the simplest form of this complex debate, environmentalists stress that drilling would harm the wildlife refuge and pollute the environment, while President George W. Bush and other drilling proponents argue that extracting this oil would substantially reduce the price of petroleum (as well as decrease U.S. dependence on foreign oil and bring in large royalties). Recent spurts in the price of gasoline and the war in Iraq have heightened this intense debate.

The effect of the sale of ANWR oil on the world price of oil is a key element of this debate. We can combine oil production information with supply and demand elasticities to make a "back of the envelope" estimate of the price effects.

A number of studies estimate that the long-run elasticity of demand, ε, for oil is about –0.4 and the long-run supply elasticity, η, is about 0.3. Analysts agree less about how much ANWR oil will be produced. The Department of Energy's Energy Information Service (EIS) predicts that production from ANWR would average about 800,000 barrels per day (the EIS estimates that ANWR's oil would increase the volume of production by about 0.7% in 2020). That production would be about 1% of the worldwide oil production, which averaged about 82 million barrels per day in 2004 (and was slightly higher in 2005 and 2006).

A report of the U.S. Department of Energy predicted that ANWR drilling could lower the price of oil by about 50¢ a barrel or 1%, given that the price of a barrel of oil was slightly above $50 at the beginning of 2007. Severin Borenstein, an economist who is the director of the U.C. Energy Institute, concluded that ANWR might reduce oil prices by up to a few percentage points so that "drilling in ANWR will never noticeably affect gasoline prices."

In the following solved problem, we can make our own calculations of the price effect of drilling in ANWR. Here and in many of the solved problems in this book, you

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[1] I am grateful to Robert Whaples, who wrote an earlier version of this analysis. In the following discussion, we assume for simplicity that the oil market is competitive, and use current values of price and quantities even though drilling in ANWR could not take place for at least a decade.

are asked to determine how a change in a variable or policy affects one or more variables. In this problem, the policy changes from not allowing to permitting drilling in ANWR, which affects the world's equilibrium price of oil.

SOLVED PROBLEM

What would be the effect of ANWR production on the world equilibrium price of oil given that $\varepsilon = -0.4$, $\eta = 0.3$, the pre-ANWR daily world production of oil is $Q_1 = 82$ million barrels per day, the pre-ANWR world price is $p_1 = \$50$ per barrel, and daily ANWR production would be 0.8 million barrels per day? For specificity, assume that the supply and demand curves are linear and that the introduction of ANWR oil would cause a parallel shift in the world supply curve to the right by 0.8 million barrels per day.

Answer

1. *Determine the long-run linear demand function that is consistent with pre-ANWR world output and price:* At the original equilibrium, e_1, in the figure, $p_1 = \$50$ and $Q_1 = 82$. There the elasticity of demand is $\varepsilon = (dQ/dp)(p_1/Q_1) = (dQ/dp)(50/82) = -0.4$. Using algebra, we find that dQ/dp equals $-0.4(82/50) = -0.656$, which is the inverse of the slope of the demand curve, *D,* in the figure. Knowing this slope and that demand equals 82 at \$50 per barrel, we can solve for the intercept, because the quantity demanded rises by 0.656 for each dollar by which the price falls. The demand when price is zero is $82 + (0.656 \times 50) = 114.8$. Thus the equation for the demand curve is $Q = 114.8 - 0.656p$.

2. *Determine the long-run linear supply function that is consistent with pre-ANWR world output and price:* Where S^1 intercepts *D* at the original equilibrium, e_1, the elasticity of supply is $\eta = (dQ/dp)(p_1/Q_1) = (dQ/dp)(50/82) = 0.3$. Solving, we find that $dQ/dp = 0.3(82/50) = 0.492$. Because the quantity supplied falls by 0.492 for each dollar by which the price drops, the quantity supplied when price is zero is $82 - (0.492 \times 50) = 57.4$. Thus the equation for the pre-ANWR supply curve, S^1 in the figure, is $Q = 57.4 + 0.492p$.

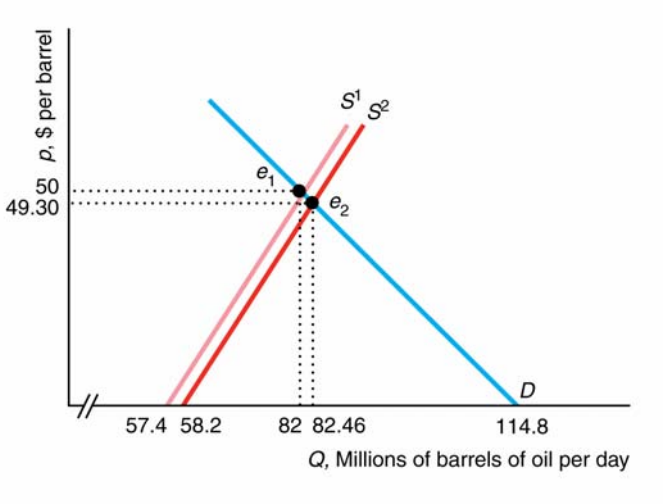
3. *Determine the post-ANWR long-run linear supply function:* The oil pumped from ANWR would cause a parallel shift in the supply curve, moving S^1 to the right by 0.8 to S^2. That is, the slope remains the same, but the intercept on the quantity axis increases by 0.8. Thus the supply function for S^2 is $Q = 58.2 + 0.492p$.

4. *Use the demand curve and the post-ANWR supply function to calculate the new equilibrium price and quantity:* The new equilibrium, e_2, occurs where S^2 intersects *D.* Setting the right-hand sides of the demand function and the post-ANWR supply function equal, we obtain an expression in the new price, p_2:

$$58.2 + 0.492p_2 = 114.8 - 0.656p_2.$$

We can solve this expression for the new equilibrium price: $p_2 \approx \$49.30$. That is, the price drops about 70¢, or approximately 1.4%. If we substitute this new price into either the demand curve or the post-ANWR supply curve, we find that the new equilibrium quantity is 82.46 million barrels per day. That is, equilibrium output rises by 0.46 million barrels per day (0.56%), which is only a little more than half of the predicted daily ANWR supply, because other suppliers will decrease their output slightly in response to the lower price.

Comment: Our estimate of a small drop in the world oil price if ANWR oil is sold would not change substantially if our estimates of the elasticities of supply and demand were moderately larger or smaller. The main reason for this result is that the ANWR output would be a very small portion of worldwide supply—the new supply curve is only slightly to the right of the initial supply curve. Thus drilling in ANWR cannot insulate the American market from international events that roil the oil market. A new war in the Persian Gulf could shift the worldwide supply curve to the left by 3 million barrels a day or more (nearly four times the ANWR production). Such a shock would cause the price of oil to soar whether or not we drill in ANWR.



Sources: Dwight Lee, "To Drill or Not to Drill: Let the Environmentalists Decide," *The Independent Review,* Fall 2001, pp. 217–226; Energy Information Administration, "The Effects of Alaska Oil and Natural Gas Provisions of H.R. 4 and S. 1776 on U.S. Energy Markets," February 2002; United States Geological Survey, "Arctic National Wildlife Refuge, 1002 Area, Petroleum Assessment, 1998, Including Economic Analysis." **pubs.usgs.gov/fs/fs-0028-01/fs-0028-01.pdf**; "Oil Companies Could Benefit from Alaska Drilling," VNU Business Media, In., November 22, 2004; Severin Borenstein, "ANWR Oil and the Price of Gasoline," U.C. Energy Institute, *Energy Notes,* 3(2), June 2005.