

Some Background: Estimation PART 2

How much oil is consumed in the US?

This is a timely and relevant question given the current war and its repercussions on stability in the Middle East. We approached this in class in a somewhat different order from what follows, but the strategy is the same.

Solution: Where do you begin such an estimate? Well, the use of oil (or its byproducts) with which you are probably most familiar is the use of gasoline in your car or your family's car. Approximating your gasoline consumption will be a good starting point. Then estimating the number of cars in the country will give the next bit of necessary data. A factor for other motor vehicles will be needed also, i.e. trucks, buses, airplanes. Finally a guess at the amount of gasoline produced by each gallon or barrel of crude oil will be needed. What about heating oil, oil for generating electricity, and other petroleum products like plastics?

To begin the oil consumption estimation consider a single personal automobile. If you own one (or have noticed what family or friends spend on gasoline), then you know that a typical fuel tank holds on the order of 10 gallons (and gas costs locally over \$2.40 per gallon as of Jan.,2006). Furthermore such cars run about 200 or so miles on 1 tank, so that the "mileage" or fuel efficiency is about 20 miles per gallon (20 mpg). How many miles does a typical car cover in one year? There is obviously a lot of variation, but a typical distance (that the I.R.S. assumes average for auto expenses on the income tax forms) is 10,000 miles. Hence for 1 car the consumption is

$$\frac{10,000 \text{ miles}}{20 \text{ miles/gal}} = 500 \text{ gal in 1 year.}$$

Next we need an estimate of how many cars are in use in the US. The population is about 300 million and perhaps 1 in 3 or 4 or 5 drive a car; say 100 million cars for simplicity. Then all passenger cars consume $500 \times 100 \times 10^6 = 5 \times 10^4 \times 10^6 = 5 \times 10^{10}$ gallons of gasoline in 1 year. At \$2.40 per gallon that amounts to roughly \$100 billion. Consider what effect a 50% increase in fuel efficiency would have on the US economy, particularly the oil industry!

Now a barrel of oil is defined as 42 gallons, so assuming that most of the crude oil becomes gasoline we obtain

$$\frac{5 \times 10^{10} \text{ gal/yr}}{42 \text{ gal/bbl}} = \frac{50 \times 10^9}{42} = 1.2 \times 10^9 \text{ bbl/yr ,}$$

or in terms of barrels per day we have

$$\frac{1.2 \times 10^9 \text{ bbl/yr}}{365 \text{ day/yr}} \cong \frac{12 \times 10^8}{4 \times 10^2} = 3 \times 10^6 \text{ bbl/day.}$$

So 3 million barrels per day is our estimate, without taking account of trucks, buses, airplanes, heating oil and electricity generation. We also have not allowed for the fact that not all of the barrel of crude oil becomes gasoline, perhaps 2/3. Also a factor of 2 is probably appropriate for other motor vehicles (which are less numerous but travel further and are much less efficient) and another factor of 2 for heating and electricity. Multiplying all of these additional factors, $3/2 \times 2 \times 2 = 6$, times the 3 million gives 18 million barrels per day.

Is that reasonable? Looking in the New York Times Almanac for 2006, which has petroleum consumption figures for 2004, we see that 40 Quadrillion Btu's was the total consumption of petroleum (for transportation, heating, electricity production). That translates into some 20 million barrels per day as the total figure. Not bad at all, considering how rough the approximations had to be!

To connect all of this to recent history, note that about half of that consumption is supplied by imports. OPEC countries in the Middle East produced about 22 million barrels per day (in 2003) and the US imported about 5 million bbl/day from them (and 7 million bbl/day from other countries). So the US must have bought over 20% of all the Mideast OPEC oil. What would happen if the US lost access to that oil? Much of US Mideast policy concerns these questions.

For more information on Consumption Jan.2006 from US DOE

www.eia.doe.gov/emeu/cabs/usa.html#oil

