ESM 204 HW 3:
Distributional consequences of climate policy

Spring, 2021

The Biden Administration recently assembled an Inter-agency Working Group (IWG) tasked with updating the United States Government's Social Cost of Carbon (SCC), which has not been comprehensively updated since 2010. The Administration has also called on government agencies to address environmental justice, racism, and equity concerns when considering policies designed to mitigate climate change.

While the Interagency Working Group develops a new SCC, the Biden Administration's "interim" value is \$51 per metric ton of CO_2. In this homework, you will consider the distributional consequences of imposing a gasoline tax based on the SCC to address the climate change problem.

We recommend using `R` and writing functions to compute your answers wherever possible.

Use the following set of facts:

- Consumers can be separated into two income groups: "high" and "low." The data set provides price (in \$) and quantity (in gallons) estimates of demand per day for the two groups. Run linear regressions (with an intercept) to estimate the demand curves for "high" and "low" income consumers.
- Initially, there is no tax on gasoline.
- The current gas price (without any taxes) is \$3.00 per gallon.
- The marginal cost of producing a gallon of gasoline is linear and has a price-intercept of 0. For the purposes of this exercise, you can assume that the US is self-contained in supply and demand (you don't need to worry about global markets).

1. One gallon of gasoline emits 19.6 pounds of CO_2. Assuming that the interim SCC correctly reflects the total social cost of one metric ton of CO_2, what is the marginal externality cost per gallon of gas?
2. What is the aggregate daily demand curve for gasoline? What is the supply curve for gasoline? What is the "benefit" to consumers under the status quo? What is the "benefit" to producers under the status quo? What is the environmental cost under the status quo?
3. How is the current consumer benefit divided between "high" and "low" income consumers?
4. Derive the optimal gas tax (in \$ per gallon of gasoline) using the interim SCC. Noting that recent research has shown the poor face a disproportionate share of the impacts from climate change, assume that the climate externality is borne entirely by the "low" income group. What would be the effects of this tax on:
   (a) The amount of gasoline produced and consumed
   (b) The price of gasoline
   (c) Overall welfare of "high" income consumers
   (d) Overall welfare of "low" income consumers

(e) Gas producers

(f) Total environmental damage

(g) Total tax revenue generated

5. Now, assume that all revenue from the gas tax will be redistributed to the consumers in proportion to their pre-tax consumption of gas. For example, if 80% of the gas was consumed by "high" income consumers, then they get 80% of the tax revenue. Additionally, consider the fact that current scientific evidence suggests the true SCC may be much higher than \$51. For a range of SCC values (\$51, \$75, \$100, \$125, \$150 per metric ton of CO_2), calculate the effects of an SCC-based gasoline tax on:
   (a) Overall welfare of "high" income consumers
   (b) Overall welfare of "low" income consumers
   (c) Gas producers
6. Suppose a new electric car technology is invented but only the "high" income group has access to these expensive new cars. This lowers the gasoline demand curve for the "high" income group by half (vertically). Under this new demand:
   (a) What is total gas consumption?
   (b) What is the total environmental externality?
   (c) What value of the gasoline tax makes the total environmental damage the same as the electric car technology?