ECON 8000/9000 Empirical Energy Economics
PS5: Replication Exercise: Back-of-envelop Calculation for Valuation Ratio (VR) + Rebound Effect
Christy Zhou

Instruction and Notes:

- Deadline: Sunday 3/8 @ 5pm
- Submission: Please compile all results into a single PDF.
- Group: Everyone can work together, but only **up to two students** can submit the assignment together. If so, make sure you include both names at the top when you submit.

Q1. Replicate Gillingham et al. (2021) AEJ-EP "Consumer Myopia in Vehicle Purchases: Evidence from a Natural Experiment" WTP and VR

In class, we have replicated the $355 in Table 7 when demand elasticity is -4 and quantity effect is -1%. In this question, you will be asked to simulate other numbers in Table 7. Then you will compute the implied VR based on your WTP calculation.

TABLE 7—INTERPRETATION OF EQUILIBRIUM CHANGE IN PRICES WITH RESPECT TO DIFFERENT SUPPLY CURVES

Quantity effect (%)	Willingness to Pay ($) $\eta_D = -6$	Willingness to Pay ($) $\eta_D = -4$
−5	498	600
−1	335	355
0	294	294
1	253	233
5	90	−12

Notes: The table shows how a given equilibrium change in price translates into willingness to pay for fuel economy (under perfect competition). η_D refers to the price elasticity of demand that we use in our calculations. For all rows, we use an equilibrium change in transaction prices of $294, following our primary results. These illustrative calculations are also based on an average prerestatement price of $24,500.

Tasks:

- 1. WTP exercise: Replicate the top 3 rows of Table 7.
  - You will replicate all scenarios in Table 7 when the equilibrium quantity effect is non-positive following a downward shift in demand, ergo, when supply is either inelastic or upward-sloping. As in Table 7, you will calculate WTP under the assumption that the quantity effect is 0%, -1%, and -5%. You will study these 3 cases when demand elasticity is either -4 or -6.
  - You will calculate 6 different WTP. They should match Table 7. You are expected to show how you compute them.
- 2. VR exercise: Compute implied VR given the WTP calculation in task 1.
  - You are expected to report 6 different VRs for the above 6 WTPs. This will give us a range of VR.
  - Amongst the 6 VRs, two of them are already given. Note that VR = 17% when the equilibrium quantity effect = 0%, following Table 6 and an assumed interest rate $r = 4\%$.
  - You will only need to compute 4 remaining VRs.
  - After reporting 6 VRs, check if they are roughly within the range that the authors compute in Table 8, which is from 17% to 44%.

Q2. Replicate Linn (2016) Energy Journal "The Rebound Effect for Passenger Vehicles" Back of envelope in Table 7

In class, we replicated Column (2) of Table 7 using the average number of fuel economy improvement 31% as the shock considered in the table. In this exercise, you will simulate the rebound effect for 4 scenarios, including columns 1, 2, and 4. The goal is to understand the impact of energy efficiency policy, such as a fuel economy standard, with and without the rebound effect.

Table 7: Effect of Increasing Fuel Economy on VMT and Gasoline Consumption

	(1)	(2)	(3)	(4)	(5)
VMT (fractional change)	0.09	0.18	0.04	0.34	0.41
Gas consumption (fractional change)	−0.25	−0.19	−0.29	−0.07	−0.03
Specification used for simulations	Baseline, OLS (Table 3, column 1, Panel A)	Baseline, IV (Table 3, column 1, Panel B)	Omit model fixed effects (Table 6, column 1)	Omit other vehicle fuel economy (Table 6, column 3)	Fuel costs (Table 6, column 5)

Notes: Each column in each panel reports a separate simulation. The simulations include the assumption that each vehicle's fuel economy increases by the amount predicted by US EPA (2011). Assuming no rebound effect, both scenarios would reduce gasoline consumption by 31 percent. Each column uses the regression results from the specification indicated at the bottom of the table. The table reports the fractional change in VMT and gas consumption using the estimated coefficients and comparing the miles traveled and gasoline consumption in the 2009 NHTS with the counterfactual miles traveled and gasoline consumption under the fuel economy increases.

Consider 4 scenarios:

A. No rebound effect (done in class): Use rebound elasticity = 0
B. Rebound effect in Table 7 Column 1: Use rebound elasticity = 0.222 estimated by OLS in Table 2
C. Rebound effect in Table 7 Column 2: Use rebound elasticity = 0.438 estimated by IV in Table 2 (done in class)
D. Rebound effect in Table 7 Column 4: Use rebound elasticity = 0.793 estimated by IV in Table 6 while ignoring other vehicles in the household

Task:

- 1. For the above 4 scenarios:
  - Compute $\Delta VMT\%$, the percentage change in VMT (row 1 of Table 7)
  - Compute $\Delta FuelConsumption$, the percentage change in total fuel consumption (row 2 of Table 7)
  - Show your calculation and results. Summarize your results in one table.
    (Note: Here we are computing for an average vehicle. Therefore, the numbers you compute will be slightly different from the author's Table 7.)
- 2. Compare scenario A vs B-D: Explain how failing to consider the rebound effect may exaggerate the impact of an energy efficiency policy that regulates energy efficiency directly (aka fuel economy in this example).
- 3. Compare scenario B vs C. Explain why Case B understates the rebound effect and overstates the energy consumption reduction from the energy efficiency regulation.
- 4. Compare scenario D vs C. Explain why Case D overstates the rebound effect and understates the energy consumption reduction from the energy efficiency regulation