

Technical Appendix

Econ HW 2

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1. Aggregate Demand, Supply, and Surplus

High income demand curve:

$$Price = 23.3914418 - (1.2966378 \times 10^{-4})Q$$

Low income demand curve:

$$Price = 21.9908534 - (1.3551741 \times 10^{-4})Q$$

a. Find aggregate demand

Aggregate demand curve:

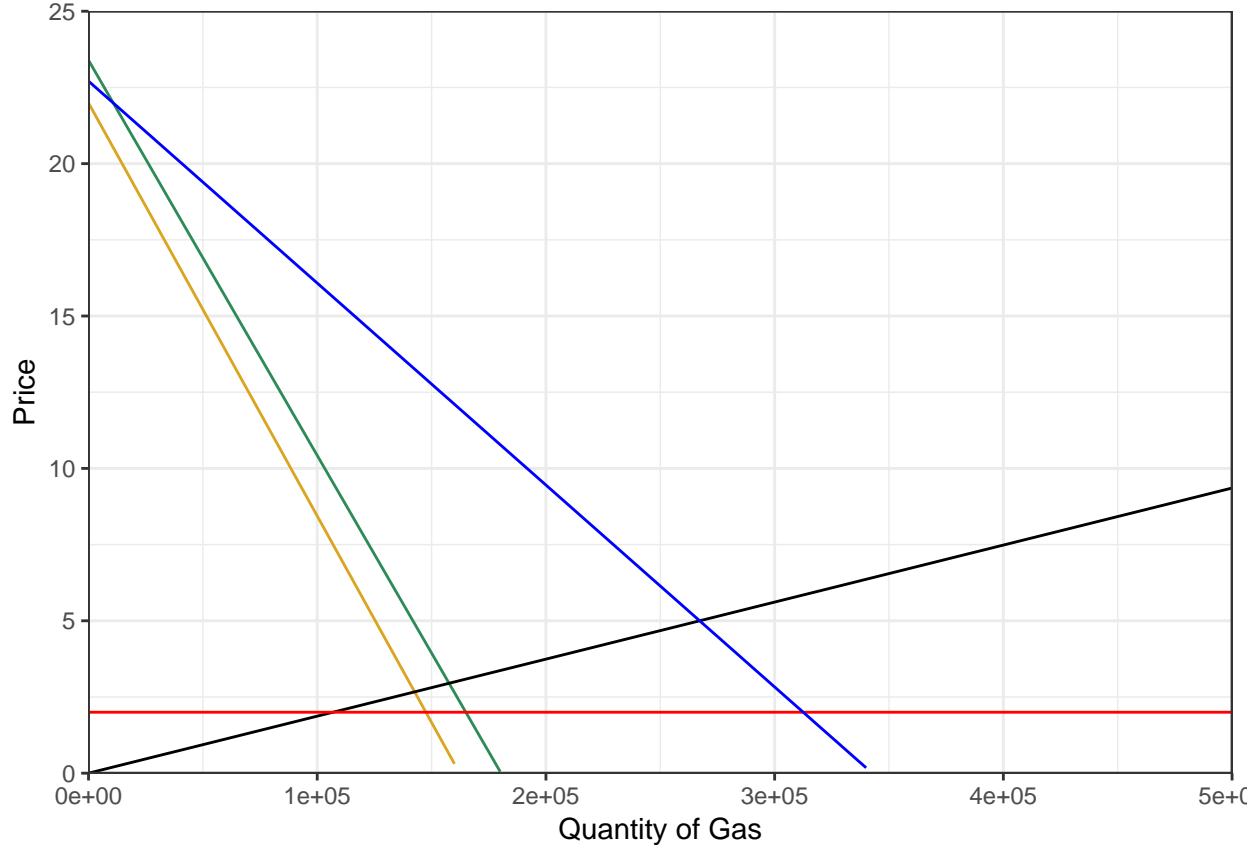
$$Price = 23.3913121Q \text{ if } 0 \leq Q \leq 10802$$

$$Price = 22.7066059 - (6.6262994 \times 10^{-5})Q \text{ if } Q > 10802$$

b. Find the supply curve

Supply curve:

$$Price = (1.8711376 \times 10^{-5})Q$$



c. Surplus under the status quo

Consumers:

$$CS = 2.3694528 \text{ Million USD}$$

Producers:

$$PS = 0.6680428 \text{ Million USD}$$

d. Environmental Cost under the Status Quo

$$\text{Environmental Cost} = 0.5344342 \text{ Million USD}$$

2. Division of Consumer Benefit

Consumer Surplus for High Income:

$$CS_{High} = 1.3043162 \text{ Million USD}$$

Consumer Surplus for Low Income:

$$CS_{Low} = 1.0651366 \text{ Million USD}$$

3. Implement a Gas Tax of \$0.50/gallon

a. New quantity of gasoline

$$Q_{Tax} = 2.6133299 \times 10^5$$

b. New price of gasoline

$$P_{Tax} = 5.3898999$$

c. Surplus to high income consumers

$$CS_{High} = 1.2495992 \text{ Million USD}$$

d. Surplus to low income consumers

$$CS_{Low} = 1.0168127 \text{ Million USD}$$

e. Producer surplus

$$PS_{Tax} = 0.6389461 \text{ Million USD}$$

f. Environmental damage

$$TEC_{Tax} = 0.522666 \text{ Million USD}$$

g. Tax revenue

$$\text{Tax Revenue} = 0.1306665 \text{ Million USD}$$

4. Tax Revenues for Infrastructure Repairs

a. Surplus to high income consumers

Table 1: High Income Consumer Welfare at Variable Gas Tax Amounts

Tax Amount	High Income Consumer Welfare (Million USD)
0.25	1.3119
0.50	1.3190
0.75	1.3257
1.00	1.3319
1.25	1.3376
1.50	1.3429
1.75	1.3477
2.00	1.3521
2.25	1.3560
2.50	1.3595
2.75	1.3625
3.00	1.3650
3.25	1.3671
3.50	1.3687
3.75	1.3698
4.00	1.3705
4.25	1.3708
4.50	1.3706
4.75	1.3699
5.00	1.3688

b. Surplus to low income consumers

Table 2: Low Income Consumer Welfare at Variable Gas Tax Amounts

Tax Amount	Low Income Consumer Welfare (Million USD)
0.25	0.5433
0.50	0.5554
0.75	0.5671
1.00	0.5783
1.25	0.5891
1.50	0.5995
1.75	0.6095
2.00	0.6189
2.25	0.6280
2.50	0.6366
2.75	0.6448
3.00	0.6525
3.25	0.6598
3.50	0.6667
3.75	0.6731
4.00	0.6791
4.25	0.6847
4.50	0.6898
4.75	0.6944
5.00	0.6987

c. Surplus to producers

Table 3: Producer Welfare at Variable Gas Tax Amounts

Tax Amount	Producer Welfare (Million USD)
0.25	0.6534
0.50	0.6389
0.75	0.6246
1.00	0.6105
1.25	0.5965
1.50	0.5827
1.75	0.5690
2.00	0.5555
2.25	0.5422
2.50	0.5290
2.75	0.5160
3.00	0.5032
3.25	0.4905
3.50	0.4780
3.75	0.4656
4.00	0.4534
4.25	0.4414
4.50	0.4295
4.75	0.4178
5.00	0.4062

Possible Revenues and Welfare Changes from Gas Tax:

Assumptions

- Benefits from infrastructure repairs are proportional to amount driven
- Low income consumers pay the entire environmental cost

Table 4: Comparison of Revenue and Welfare Potential with Variable Gas Tax Amounts

Tax Amount (USD)	Tax Revenue (Million USD)	Welfare Change Low Income (%)	Welfare Change High Income (%)	Welfare Change Producers (%)
0.25	0.0661	-48.9954	0.5811	-2.1899
0.50	0.1307	-47.8567	1.1270	-4.3555
0.75	0.1938	-46.7593	1.6377	-6.4969
1.00	0.2554	-45.7031	2.1133	-8.6141
1.25	0.3156	-44.6881	2.5537	-10.7070
1.50	0.3743	-43.7142	2.9589	-12.7756
1.75	0.4316	-42.7816	3.3290	-14.8200
2.00	0.4874	-41.8902	3.6640	-16.8402
2.25	0.5417	-41.0399	3.9637	-18.8361
2.50	0.5945	-40.2309	4.2283	-20.8078
2.75	0.6458	-39.4631	4.4577	-22.7553
3.00	0.6957	-38.7365	4.6520	-24.6785
3.25	0.7442	-38.0510	4.8111	-26.5774
3.50	0.7911	-37.4068	4.9351	-28.4521
3.75	0.8366	-36.8038	5.0238	-30.3026
4.00	0.8806	-36.2419	5.0774	-32.1288
4.25	0.9231	-35.7213	5.0959	-33.9308
4.50	0.9642	-35.2419	5.0792	-35.7085
4.75	1.0038	-34.8036	5.0273	-37.4620
5.00	1.0419	-34.4066	4.9403	-39.1912

5. Electric cars lower demand for each group by one half (vertically)

a. & b. Gas consumption by High/Low income Consumers

Low Income Consumption:

$$Q_{Low} = 6.2688822 \times 10^4$$

High Income Consumption:

$$Q_{High} = 7.0919736 \times 10^4$$

Aggregate Consumption:

$$Q_{Aggregate} = 1.3360856 \times 10^5$$

c. New price of gasoline with higher EV use and lower gas demand

$$Price = 2.5$$

d. Environmental Cost

$$Environmental\ Cost = 0.2672171\ Million\ USD$$

6. Compare a 2.00 per gal tax to the influence of EV

Table 5: Environmental Cost Comparison

	Environmental Cost (USD)	Reduction (%)
Baseline	0.5344	0.000
\$2.00 Gas Tax	0.4874	8.808
High EV Demand	0.2672	50.000