Carnegie Mellon University

ENERGY POLICY & ECONOMICS

<u>**PROBLEM SET #1 SUBMISSION**</u>

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a)

From the given supply and demand schedules, in order to derive the equilibrium price:

Q_D = 116.25 - P/2
Q_S = 200P – 400

At equilibrium: $Q_D=Q_S$
Thus,
116.25-P/2=200P-400
From this,
P*=2.57 $/gallon
Using this,
Q*=114.96 million gallon
Equilibrium pair: **(Q*, P*)** = (114.96 mil. Gallon, 2.57 $/gallon)

b)
Upon including the federal tax and state tax, the supply curve shifts leading to an increase in the equilibrium price.
Q_D = 116.25 - P/2
Q_S = 200(P-0.59-0.1) – 400
At equilibrium: $Q_D=Q_S$
Thus,
116.25-P/2=200(P-0.59-0.1)-400
From this,
P_t*=3.26 $/gallon
Using this,
Q_t*=114.62 million gallon
Equilibrium pair: **(Q$_t$*, P$_t$*)** = (114.62 mil. Gallon, 3.26 $/gallon)

c)
Deadweight loss=$\frac{1}{2}(P_t^* - P^*)(Q^* - Q_t^*)$
Substituting the values obtained in (a, b):
Deadweight loss, dl1=0.5*(3.26-2.57)(114.96-114.62)
Thus, Deadweight loss is 0.118 million $.

d)
The same steps are continued from b-c but with the state tax as 0.69 $/gallon and 0.1 $/gallon as the federal tax
Following the same steps:
New equilibrium points are:
(Q$_t$*, P$_t$*) = (114.57 mil. Gallon, 3.36 $/gallon)
Using this, the new Deadweight loss is 0.155 million $.

e)
State tax revenue generated in (b) is: 0.59*114.62=67.62 million $
State tax revenue generated in (c) is: 0.69*114.57=79.05 million $
Increase in state tax revenue: 11.42 million $
Increase in deadweight loss: 36815 $
From this, we can infer that with a 0.1$/gallon increase in tax, there is a 16% increase in revenue, but a 31% increase in the deadweight loss.

f)
An increase in the taxation decreases the equilibrium demand for the product. However, the increase in taxes has a higher contribution thereby leading to an increase in revenue.
However, as the taxation is increased, there is a forced shift for the supply curve towards the demand curve. There is a loss in the productive output, thereby facing a loss in the economic efficiency and production [1].
Thus, although increasing taxes suggests an increase in the revenue, there is an increase in the cost of production creating a larger gap between the taxed and tax-free production, leading to higher dead weight loss.

g)
Gasoline tax appears as an acceptable and viable source of revenue. The shift in the demand is not very significant, and thus in such a case of elastic demand, additional taxation helps in garnering additional revenue without it affecting the productivity to a great extent.

h)
CO_2 emitted: 20 lb/gallon
Marginal external cost: 40\$/short ton= 0.02 \$/lb
Using this,
Amount saved through avoided carbon emissions
$$= 20\frac{lb}{gallon} * 0.02\frac{\$}{lb} * (114.62 - 114.57)\ million\ gallon$$
= 19950 \$
Thus, the benefits of incremental gasoline tax is that it helps in saving 19950\$ of carbon emission treatment cost along with environmental benefits.

i)
Gasoline tax could serve as an effective tool in reducing the CO_2 emissions. Because of the shift in demand because of the tax, there is an additional amount saved due to the avoided carbon emission costs. Thus, in a way, the gasoline tax serves as a pseudo-environmental tax, which helps in increasing the revenue while having environmental benefits.

j)
I would advise the Secretary of Transportation to adopt the incremental tax increase. The state of Pennsylvania requires 10 million \$ to make repairs for the road infrastructure. From the analysis, it can be seen that there is a roughly 11.42 million \$ increase in the revenue because of the additional tax levied on gasoline. Because of the inelastic nature of gasoline, there is a slight shift in the equilibrium demand, thereby having a lower scale of productivity loss and burden on the standard of living of the people. Although not relative to the revenue, the increase in tax also helps in a slight reduction of the carbon emissions, proving benevolent to the environment.

References:
[1] https://www.investopedia.com/terms/d/deadweight-loss-of-taxation.asp