ENGM90011: Economic Analysis for Engineers Exam Notes

Semester 1, 2022

Elasticities

<u>Own Price Elasticity of Demand for good i</u>

- Own Price Elasticity of $i = \dfrac{\%Chang\ \ in\ Quantity\ Demanded\ of\ i}{\%Chang\ \ in\ price\ of\ i}$

$$\epsilon_i = -\frac{\partial x_i}{\partial p_i}\frac{p_i}{x_i}$$

- Good i is said to be an ordinary good if $\frac{\partial x_i}{\partial p_i} < 0$
- Good i is said to be a Giffen good if $\frac{\partial x_i}{\partial p_i} > 0$
- If $\epsilon = 0$ demand is said to be perfectly inelastic
- If $\epsilon < 1$ demand is said to be inelastic
- If $\epsilon = 1$ demand is said to be unit inelastic
- If $\epsilon > 1$ demand is said to be elastic
- If $\epsilon = \infty$ demand is said to be perfectly elastic

<u>Income Elasticity of Demand for good i</u>

$$\eta_i = \frac{\partial x_i}{\partial M}\frac{M}{x_i}$$

- Good i is said to be a normal good if $\frac{\partial x_i}{\partial M}\frac{M}{x_i} \geq 0$ and so $\eta_i \geq 0$
    - Normal good if demand and income change in the same direction
    - Normal good if quantity decreases as the other good's quantity increases
- Good i is said to be an inferior good if $\frac{\partial x_i}{\partial M}\frac{M}{x_i} < 0$ and so $\eta_i < 0$
    - Inferior good if demand and income change in opposite direction
    - Inferior good if price increases and quantity purchased increases
- Necessary normal good: $0 \leq \eta < 1$ (i.e. income inelastic)
    - Unit Elastic normal good if $\eta_i = 1$
- Luxury good: $\eta > 1$ (i.e. income elastic)

<u>Cross-price Elasticity of Demand of good i and for good j</u>

- Cross-price Elasticity of Demand of good i for good j $= \dfrac{\%Change\ in\ Quantitiy\ of\ j\ demanded}{\%Change\ in\ Price\ of\ i}$

$$\varepsilon_{ij} = \frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i}$$

- Good i is said to be a substitute for good j, if the demand for good i increases as the price of j, p_j, increases: $\frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i} > 0$
    - Substitute goods if the demand of both are inversely related. i.e. there is an increase in quantity of good i and a decrease in quantity of good j.
- Good i is said to be a compliment for good j, if the demand for good i decreases as the price of j, p_j, increases: $\frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i} < 0$

Welfare Analysis

<u>Consumer Surplus:</u> A measure of the net benefit to customers from the consumption of a good or service.

- The area below the demand curve and above the price to the consumer up to the quantity consumed.

<u>Producer Surplus:</u> A measure of the net benefit to producers from the production and sale of a good or service.

- The area above the supply curve and below the price to the producer (firm) up to the quantity sold.

<u>Social Benefit:</u>

- When there are no externalities, taxes, subsidies, etc., the only economic agents affecter are the consumers and producers (firms) in the market. Therefore, the social benefit in the competitive equilibrium is just the sum of consumer surplus and producer surplus:

$$SB^C = CS + PS$$

- No externalities also means the competitive market output is allocatively efficient i.e.

$$SB^C = SB^e$$

<u>Deadweight loss:</u> A measure of how much smaller the social benefit SB is compared to the allocatively efficient social benefit SB^e.

$$DWL^C = SB^e - SB^C$$

- When there are no externalities, as the Social Benefit is allocatively efficient there is no deadweight loss:

$$DWL^C = SB^e - SB^C = 0$$

- In a tax scenario:

$$DWL = SB^e - SB^{tax} = 0$$

<u>Social Marginal Benefit SMB and Social Marginal Cost SMC</u>

- The Social Marginal Benefit SMB of a unit of output is the benefit to society as a whole from that unit of output
  - SMB ↓ as Q ↑: the benefit to society of the next unit of output is less than the previous unit of output
  - If we add up the SMBs of all the output we get the total social benefit
  - SMB is related to the inverse of the demand function (SMB in terms of Q^D)

- The Social Marginal Cost SMC of a unit of output is the cost to society as a whole from that unit of output
  - SMC ↑ as Q ↑: the cost to society of the next unit of output is more than the previous unit of output

- o If we add up the SMCs of all the output we get the total social cost
- o If there is no production externality, the Social Marginal Cost is the same as the firm's Marginal Cost (MC) – which in a competitive market is the inverse supply function (SMC in terms of Q^S)

Allocative Efficiency

- The (Net) Social Benefit SB of an allocation (i.e. amount of output) is the net benefit to society as a whole = Total Social Benefit – Total Social Cost
- We say that an output is allocatively efficient if it maximizes social benefit SB
- This occurs where Social Marginal Benefit SMB = Social Marginal Cost SMC
  - o Equate SMB and SMC solve for the allocatively efficient output Q^e

Change in Consumer Surplus Integration Questions

- If the price falls from p_1 to p_2 the change in Consumer's Surplus CS is

$$\Delta CS = \int_{p_2}^{p_1} x(p) \, dp$$

- If the price increases from p_1 to p_2 the change in Consumer's Surplus CS is

$$\Delta CS = -\int_{p_1}^{p_2} x(p) \, dp$$

where x is the demand function of p, where p is the price of x.

Tax and Subsidies

Per Unit Tax $t

- Let t be the tax per unit of output sold
- With a per unit tax t, the difference between the price the buyers (demanders) pay, p^D, and the price the sellers (suppliers) receive, p^S, is equal to t
    - $p_d - p_s = t$
   - Equilibrium still $Q^S = Q^D$ but $Q^S(p_s)$ and $Q^D(p_a)$

Market Equilibrium with Tax where $p_a - p_s = t$ i.e. $Q^S(p_s) = Q^D(p_a)$
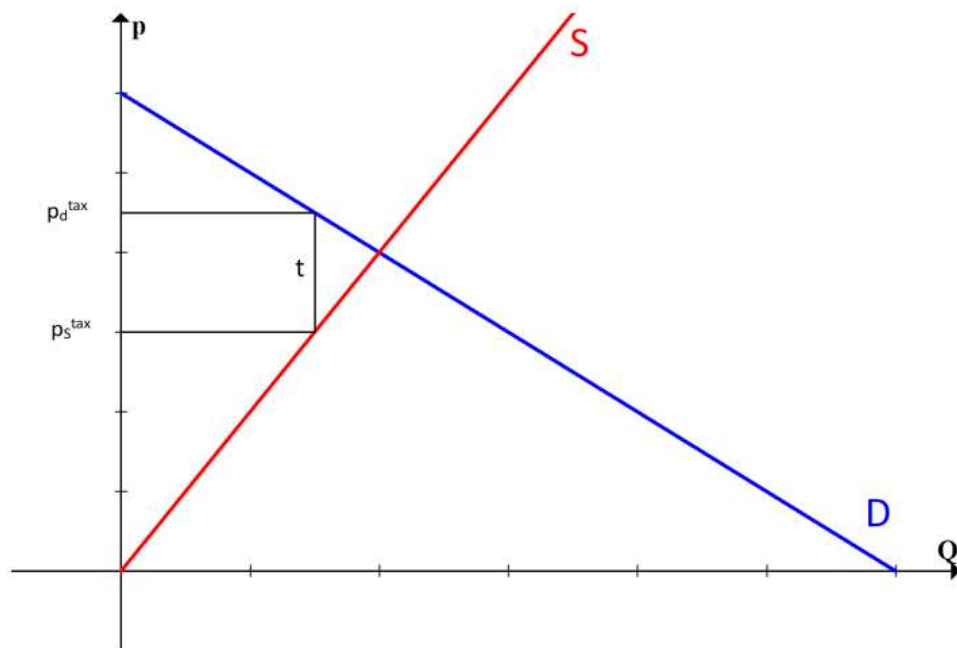
Welfare Analysis of Tax: Consumer Surplus and Producer Surplus (PS)

$$SB^C = CS^C + PS^C = SB^e$$

$$SB^{Tax} = CS^{Tax} + PS^{Tax} + T < SB^e$$
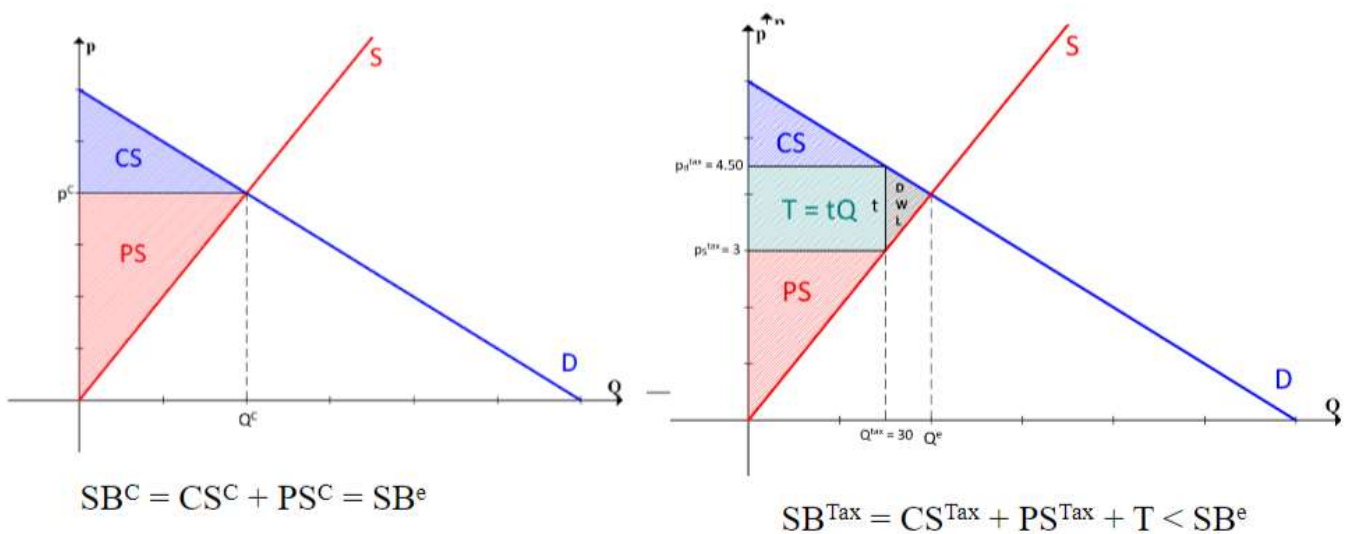
Burden of Tax: Perfectly Elastic Supply – Buyer pays all of the tax; Seller pays none of the tax

Buyer pays all of the tax
Seller pays none of the tax

$p_d^{tax} = p^C + t$

t

$p_s^{tax} = p^C$

S

D

Q^{tax} Q^C
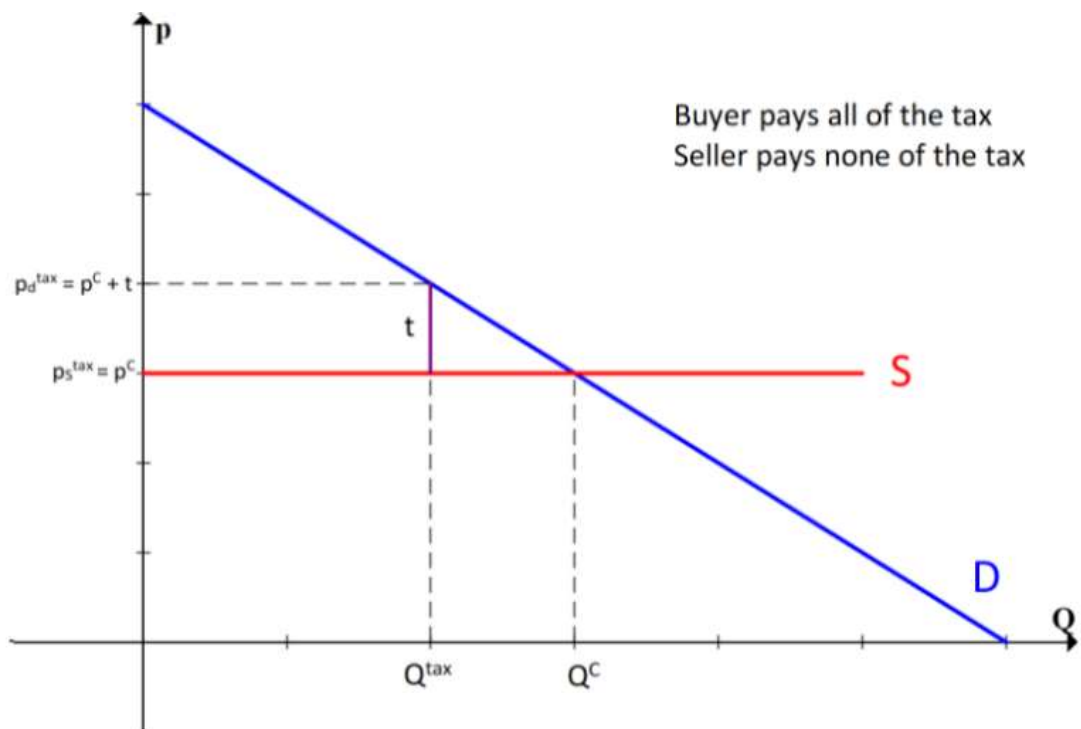
Burden of Tax: Perfectly Inelastic Supply - Seller pays all of the tax, Buyer pays none of the tax

S

Seller pays all of the tax
Buyer pays none of the tax

$p_d^{tax} = p^C$

t

$p_s^{tax} = p^C - t$

D

$Q^{tax} = Q^C$