Market Equilibrium

\[ D(p^*) = S(p^*); \text{ market is in equilibrium} \]

Excess Supply

\[ D(p') < S(p'); \text{ Market price must fall towards } p^* \]

Excess Demand

\[ D(p'') > S(p''); \text{ Market price must rise towards } p^* \]
Quantity Taxes: Introduction

- Quantity tax - a tax of $t$ paid on each unit traded
- What is the effect of quantity tax on equilibrium?
- How are prices affected?
- How is the quantity traded affected?
- Who pays the tax?
- How are gains-to-trade altered?

Mathematically

- Market equilibrium is described by:
  - $p_b - p_s = t$ and
  - $D(p_b) = S(p_s)$
- So, we can solve for either
  - $D(p_s + t) = S(p_s)$ or
  - $D(p_b) = S(p_b + t)$
- Note that it doesn’t matter whether you tax producers or consumers
- Prices, quantities, and tax collected are the same

Quantity Taxes

- A tax rate $t$ makes price paid by buyers, $p_b$, higher by $t$ from the price received by sellers, $p_s$
- Consumers make their decisions based on what they actually pay ($p_b$)
- Producers make their decisions based on what they actually receive ($p_s$)
- But $p_s \neq p_b$, Rather: $p_s + t = p_b$
- Even with tax (different consumer and producer prices) the market must clear
  - That is: $D(p_b) = S(p_s)$

Quantity Taxes on Producers

No tax

$D(p), S(p)$
Quantity Taxes on Producers

A producer tax raises market supply curve by $t$

Quantity Taxes on Producers

A producer tax raises the buyers' price, lowers q

Quantity Taxes on Producers

And sellers receive only $p_s = p_b - t$

Quantity Taxes on Consumers

No tax
A consumer tax lowers market demand by $t$

Consumer tax lowers sellers’ price, reduces $q$

And buyers pay $p_b = p_s + t$

Identical effects, whether quantity tax levied on sellers or producers
Tax Incidence

- Who pays the tax of $t per unit traded?
- Economic incidence (of a tax)
  - division of tax burden between buyers and sellers after all market adjustments
  - Not statutory incidence

Quantity Tax Example

- Linear market demand and supply curves:
  - \( D(p_b) = a - bp_b \)
  - \( S(p_s) = a - bp_s \)
- We seek
  - Pretax equilibrium
  - Post-tax equilibrium
  - Tax Share
- Where Tax shares are
  - Seller’s Share = \( p^* - p_s \)
  - Buyer’s Share = \( p_b - p^* \)

Tax Incidence and Own-Price Elasticities

- The incidence of a quantity tax can be expressed in terms of own-price elasticities of demand and supply
Tax Incidence and Own-Price Elasticities

Around $p = p^*$ the own-price elasticity of demand is approximately

$$\varepsilon_D \approx \frac{\Delta q}{q} \frac{p_b - p^*}{p^*} \Rightarrow p_b - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_D \times q}$$

Tax Incidence and Own-Price Elasticities

Around $p = p^*$ the own-price elasticity of supply is approximately

$$\varepsilon_S \approx \frac{\Delta q}{q} \frac{p_s - p^*}{p^*} \Rightarrow p_s - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_S \times q}$$

Tax Incidence and Own-Price Elasticities

Tax incidence ratio is:

$$\frac{p_b - p^*}{p - p_s} = -\frac{\varepsilon_S}{\varepsilon_D}$$

Consumer Share is:

$$-\frac{\varepsilon_S}{\varepsilon_D - \varepsilon_S}$$

Producer Share is:

$$\frac{\varepsilon_D}{\varepsilon_D - \varepsilon_S}$$
Tax Incidence and Own-Price Elasticities

- Fraction of quantity tax paid by buyers rises as
  - supply becomes more own-price elastic
  - as demand becomes less own-price elastic
- When $\varepsilon_D = 0$, buyers pay entire tax, even though it is levied on the sellers
- The fraction of quantity tax paid by sellers rises as
  - supply becomes less own-price elastic or
  - as demand becomes more own-price elastic
- When $\varepsilon_s = 0$, sellers pay entire tax, even though it is levied on the buyers

DWL and Own-Price Elasticities

- A quantity tax imposed on a competitive market
  - reduces quantity traded
  - reduces gains-to-trade (i.e. the sum of Consumers’ and Producers’ Surpluses)
- Deadweight loss - lost total surplus
  - Excess burden
  - Welfare cost
  - Efficiency cost

DWL and Own-Price Elasticities: Graph

The tax reduces both CS and PS, transfers some of this surplus to government as tax revenue
DWL and Own-Price Elasticities: Graph

Dead-weight Loss is surplus lost as a result of the tax

\[ D(p), S(p) \]

<table>
<thead>
<tr>
<th>p</th>
<th>Mkt D</th>
<th>Mkt S</th>
</tr>
</thead>
<tbody>
<tr>
<td>p^*</td>
<td>CS</td>
<td>PS</td>
</tr>
<tr>
<td>p_b</td>
<td>Tax</td>
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</tbody>
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When \( \varepsilon_D = 0 \), the tax causes no deadweight loss

<table>
<thead>
<tr>
<th>p</th>
<th>Mkt D</th>
<th>Mkt S</th>
</tr>
</thead>
<tbody>
<tr>
<td>p_b</td>
<td>p_s = p^*</td>
<td></td>
</tr>
<tr>
<td>q^t = q^*</td>
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DWL and Own-Price Elasticities

- DWL due to a quantity tax rises as either market demand/supply becomes more own-price elastic
- If either \( \varepsilon_D = 0 \) or \( \varepsilon_s = 0 \) then the DWL is zero