Equilibrium

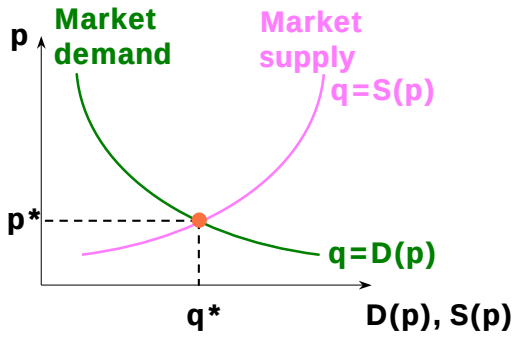
ECON 370: Microeconomic Theory

Summer 2004 – Rice University

Stanley Gilbert

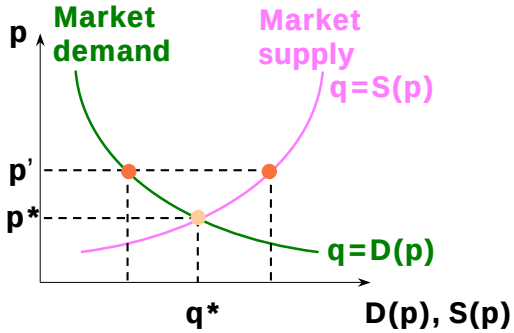
Market Equilibrium

D(p*) = S(p*); market is in equilibrium



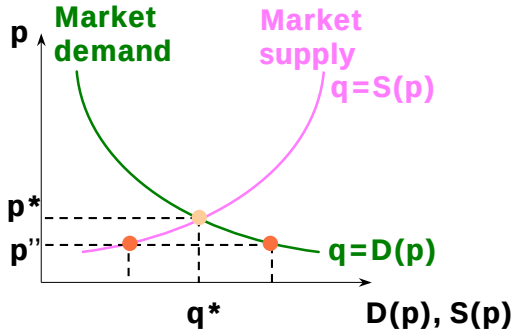
Excess Supply

D(p') < S(p'); Market price must fall towards p*



Excess Demand

D(p") > S(p"); 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?

Quantity Taxes

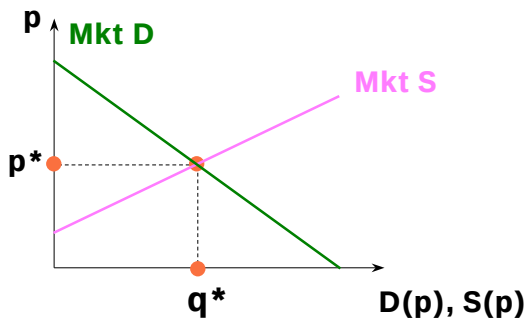
- A tax rate t makes price paid by buyers, p_b higher by t from the price received by sellers, p_s
- Consumers make their decisions based on what they actually pay (p_b)
- Producers make their decisions based on what they actually receive (p_s)
- But $p_s \neq p_b$, Rather: $p_s + t = p_b$
- Even with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

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

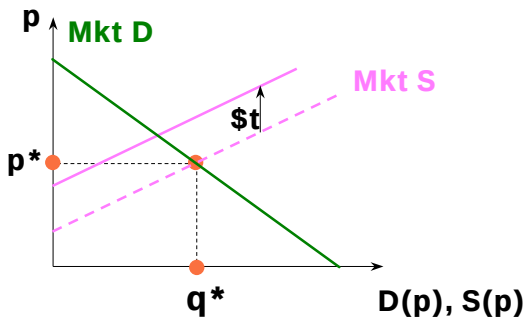
Quantity Taxes on Producers

No tax



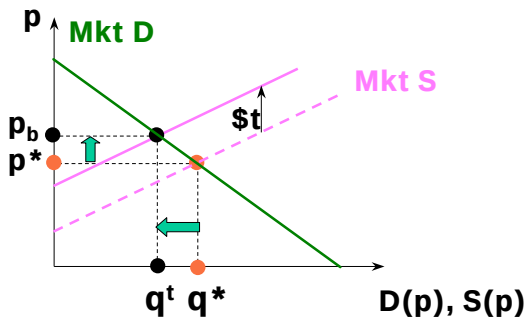
Quantity Taxes on Producers

A producer tax raises market supply curve by $t



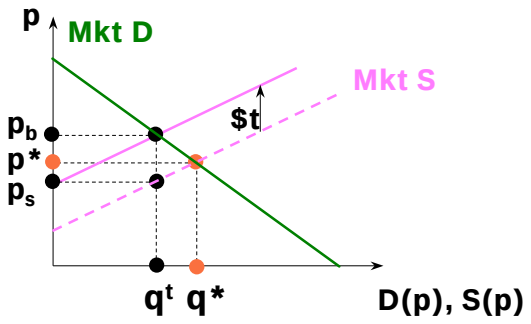
Quantity Taxes on Producers

A producer tax raises the buyers' price, lowers q



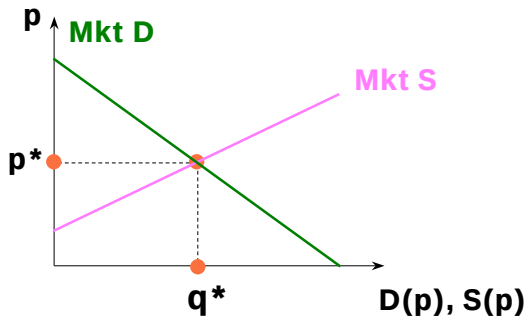
Quantity Taxes on Producers

And sellers receive only $p_s = p_b - t$



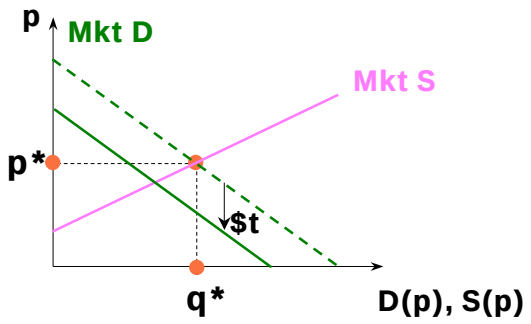
Quantity Taxes on Consumers

No tax



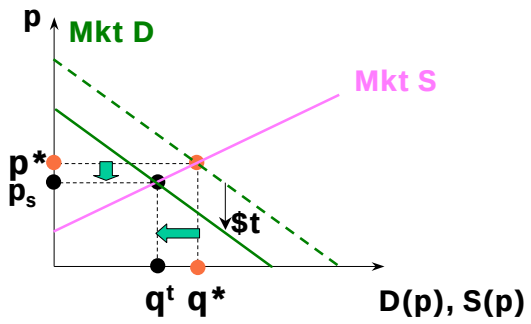
Quantity Taxes on Consumers

A consumer tax lowers market demand by $t



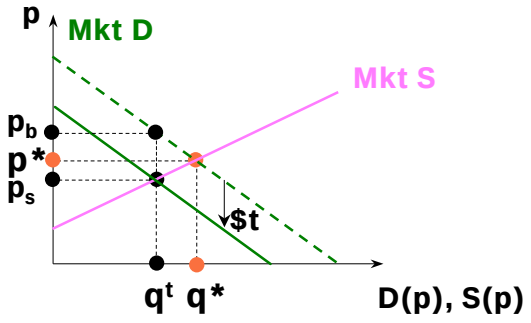
Quantity Taxes on Consumers

Consumer tax lowers sellers' price, reduces q



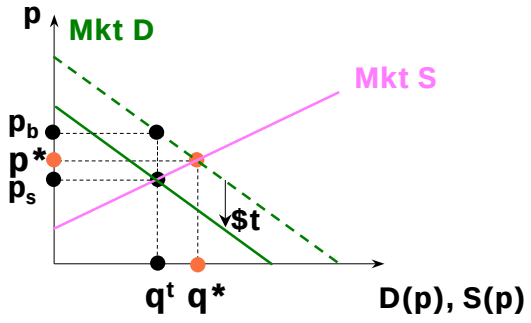
Quantity Taxes on Consumers

And buyers pay $p_b = p_s + t$



Quantity Taxes on Consumers

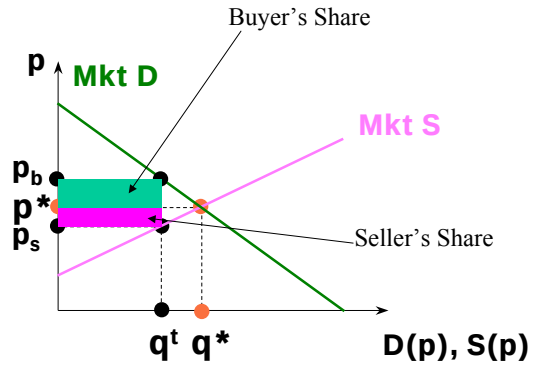
Identical effects, whether quantity tax levied on sellers or producers



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

Tax Incidence Graph



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

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

Tax Incidence and Own-Price Elasticities

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

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

Tax Incidence and Own-Price Elasticities

Tax incidence ratio = $\frac{p_b - p^*}{p^* - p_s}$

$p_b - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_D \times q^*}$ $\qquad$ $p_s - p^* \approx \frac{\Delta q \times p^*}{\varepsilon_S \times q^*}$

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

Tax Incidence and Own-Price Elasticities

Tax incidence ratio is: $\frac{p_b - p^*}{p^* - p_s} \approx -\frac{\varepsilon_S}{\varepsilon_D}$

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

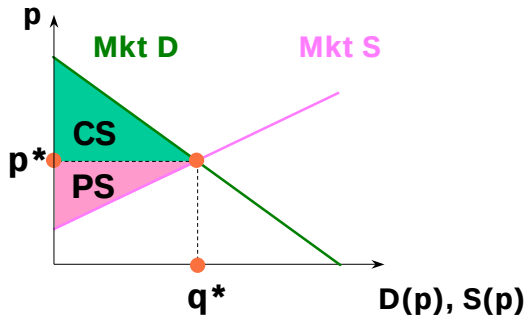
- Fraction of quantity tax paid by buyers rises as
  - supply becomes more own-price elastic
  - as demand becomes less own-price elastic
- When $\varepsilon_D = 0$, buyers pay entire tax, even though it is levied on the sellers
- The fraction of quantity tax paid by sellers rises as
  - supply becomes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

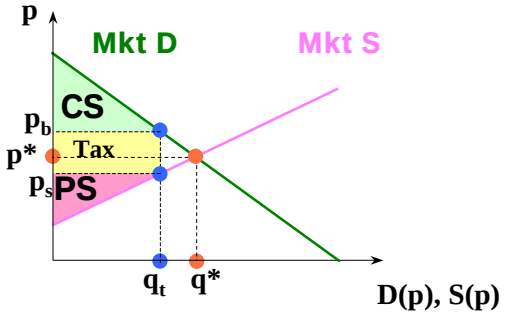
DWL and Own-Price Elasticities: Graph

No tax



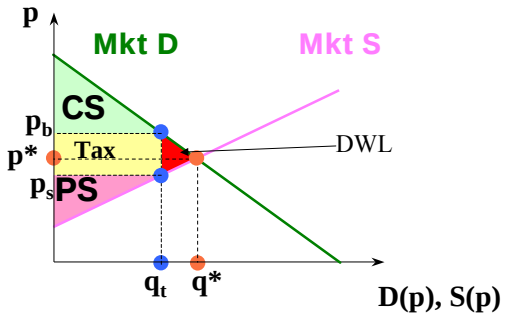
DWL and Own-Price Elasticities: Graph

The tax reduces both CS and PS, transfers some of this surplus to government as tax revenue



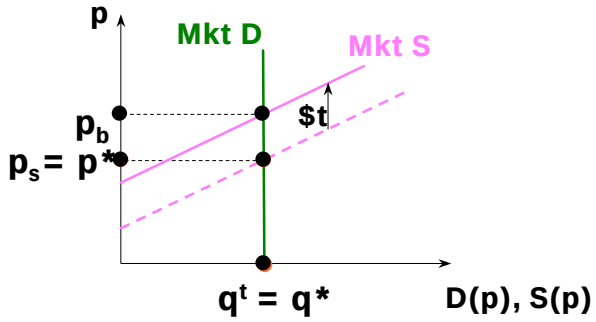
DWL and Own-Price Elasticities: Graph

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



DWL and Own-Price Elasticities: Graph

When $\varepsilon_D = 0$, the tax causes no deadweight loss



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