Lecture 12a

Tax Incidence

Introduction

- Many policies center around whether the tax burden is distributed fairly.
- Not as simple as analyzing how much in taxes each person actually paid, because of tax-induced changes to price.

Introduction

- Two main concepts of how a tax is distributed:
  - ***Statutory incidence*** – who is legally responsible for tax
  - ***Economic incidence*** – the true change in the distribution of income induced by tax.
  - These two concepts differ because of ***tax shifting*.**

Tax Incidence: General Remarks

- Only people can bear taxes
  - Business paying their fair share simply shifts the tax burden to different people
  - Can study people whose total income consists of different proportions of labor earnings, capital income, and so on.
  - Sometimes appropriate to study incidence of a tax across regions.

Tax Incidence: General Remarks

- Both **Sources** and **Uses** of Income should be considered
  - Tax affects consumers, workers in industry, and owners of factors of production.
  - Economists often ignore the sources side

Tax Incidence: General Remarks

- Incidence depends on how prices are determined
  - Industry structure matters
  - Short- versus long-run responses

Tax Incidence: General Remarks

- Incidence depends on disposition of tax revenue
  - ***Balanced budget incidence*** computes the combined effects of levying taxes and government spending financed by those taxes.
  - ***Differential tax incidence*** compares the incidence of one tax to another, ignoring how the money is spent.
    - Often the comparison tax is a ***lump sum tax*** – a tax that does not depend on a person's behavior.

Tax Incidence: General Remarks

- There are three basic rules for figuring out who ultimately bears the burden of paying a tax.
  - ***The statutory burden of a tax does not describe who really bears the tax.***
  - ***The side of the market on which the tax is imposed is irrelevant to the distribution of tax burdens.***
  - ***Parties with inelastic supply or demand bear the burden of a tax.***

Tax Incidence: General Remarks

- ***Statutory incidence*** is the burden of the tax borne by the party that sends the check to the government.
  - For example, the government could impose a 50¢ per litre tax on suppliers of gasoline.
- ***Economic incidence*** is the burden of taxation measured by the change in resources available to any economic agent as a result of taxation.
  - If gas stations raise gasoline prices by 25¢ per litre as a result, then consumers are bearing half of the tax.

Tax Incidence: General Remarks

Incidence can be analysed at a number of levels:

1. Producer vs. consumer (tax on cigarettes)
2. Source of income (labour vs. capital)
3. Income level (rich vs. poor)
4. Region or country (local property taxes)
5. Across generations (social Security reform)

Partial Equilibrium Incidence: Key Assumptions

- **Two good economy**
  - Only one relative price → partial and general equilibrium are same.
- Can be viewed as an approx. of incidence in a multi-good model if
  - the market being taxed is small
  - there are no close substitutes/complements in the utility function
- **Tax revenue is not spent on the taxed good**
  - Tax revenue is used to buy untaxed good or thrown away
- **Perfect competition among producers**
  - Relaxed in some studies of monopolistic or oligopolistic markets

Partial Equilibrium Incidence: Specific tax

- Consider, for ease of exposition, a ***specific tax***.
- A specific tax is where the tax is expressed as an amount per unit of the good: e.g. €1 per litre bottle of wine or 20 cents per cigarette.
- The alternative to a specific tax is an ***ad valorem tax*** where the tax is expressed as a proportion of the price; hence a tax of 20% on a good that costs €2 corresponds to a tax per unit of 40 cents.
- For a specific tax the tax is the difference between the consumer paid by the consumer P_d and that received by the supplier, P_s.

$$\mathbf{P_d - P_s = t} \qquad (1)$$

Partial Equilibrium Incidence: Specific tax

- Changes in the tax then generate some combination of changes in the two prices:

$$dP_d - dP_s = dt \qquad (2)$$

where the "d" is the differential operator.

- To find out how much quantities change when the price changes we use the slope of the demand or supply curve:

$$dQ_d = D_p.dP_d \qquad (3)$$

- D_p (<0) is the slope of the demand curve, so if we multiply the change in P_d (the price paid by the consumer) by the slope this gives the corresponding change in quantity demanded.

Partial Equilibrium Incidence: Specific tax

- By the same logic, where S_p (>0) is the slope of the supply curve:

$$dQ_s = S_p.dP_s \qquad (4)$$

- Use (2) to substitute dP_s out of (4):

$$dQ_s = S_p.(dP_d - d\,t) = S_p.\, dP_d - S_p.\, d\,t \qquad (5)$$

- So that supply is equal to demand after the tax is introduced it must be the case that the *change* in quantity demanded has to be equal to the *change* in quantity supplied so:

$$dQ_s = dQ_d \qquad (6)$$

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Partial Equilibrium Incidence: Specific tax

- Hence re-write (5) as

$$D_p.dP_d = S_p.\,dP_d - S_p.dt \qquad (7)$$

- Rearranging this gives:

$$S_p.d\,t = (S_p - D_p).dP_d \qquad (8)$$

$$\frac{dP_d}{dt} = \frac{S_p}{S_p - D_p} \qquad (9)$$

- This is an expression for the incidence of the tax on the consumers price and is a positive number. We get a more intuitive expression by multiplying above and below by the ratio of price to quantity:

Partial Equilibrium Incidence: Specific tax

- We get a more intuitive expression by multiplying above and below by the ratio of price to quantity:

$$\frac{dP_d}{dt} = \frac{S_p \cdot \left(P/Q\right)}{S_p\left(P/Q\right) - D_p\left(P/Q\right)} \equiv \frac{e_s}{e_s - e_d} \qquad (10)$$

where $\boldsymbol{e_s}$ is the elasticity of supply and $\boldsymbol{e_d}$ is the elasticity of demand (expressed as a negative number). This expression ranges from 1 to 0.

- Following similar steps we get an expression for the impact on the supply price:

$$\frac{dP_s}{dt} - \frac{dP_d}{dt} = 1 \qquad (11)$$

Partial Equilibrium Incidence: Specific tax

- For example, say a sales tax of 50¢ per unit is put on a good. The elasticity of demand is -0.4 and the elasticity of supply is 0.6. Then using the formulae above the price paid by the consumer *rises* by 60% of the tax per unit

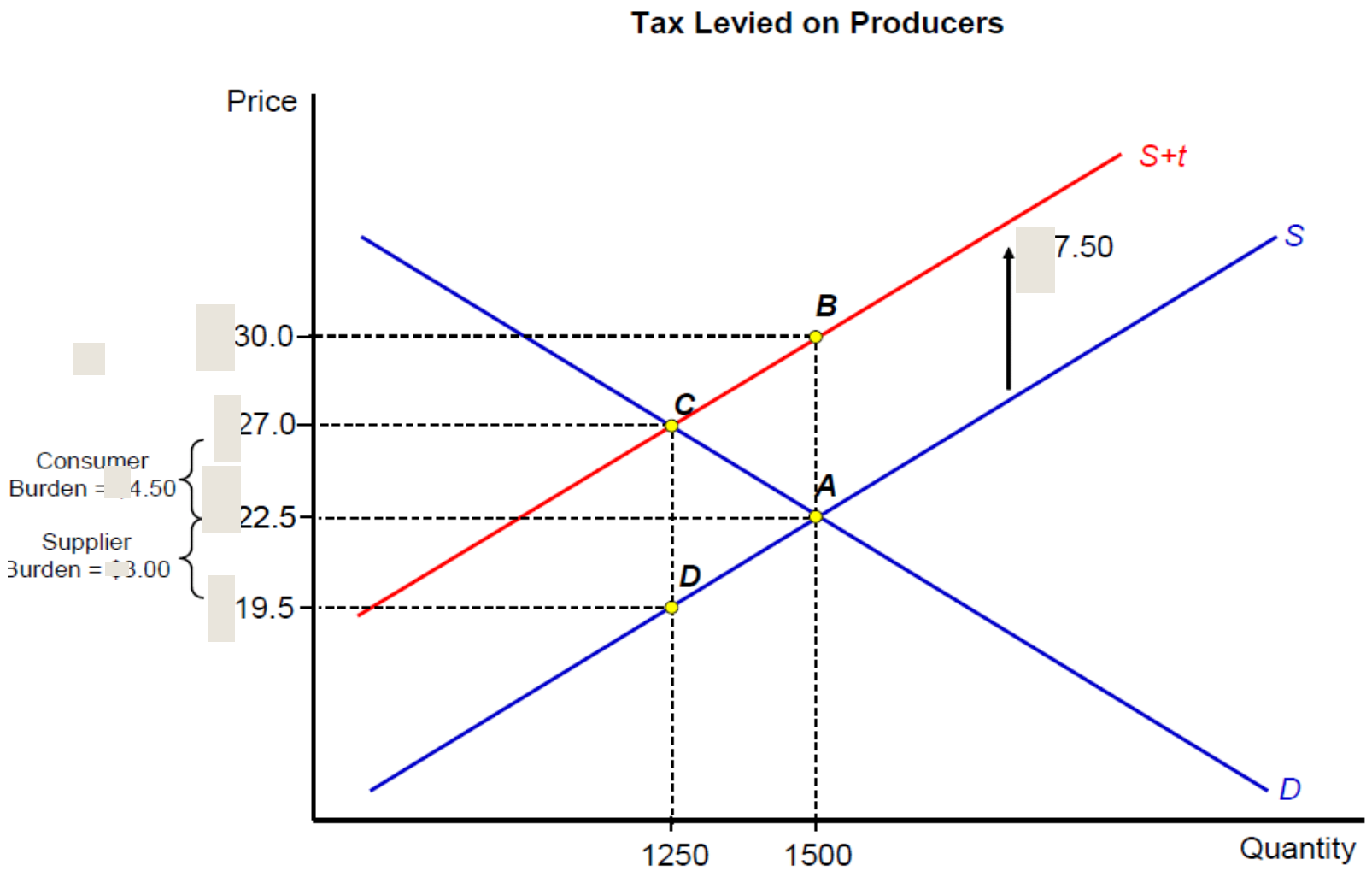
  {= 0.6/[0.6 - (-.4)] = 0.6} that is 30¢.
- The price that the seller must charge *falls* by 40% of the tax per unit, that is 50c x -0.4 = -20¢. The gap or "wedge" between the buyers price and seller's price must be equal to the tax per unit , 50 ¢ in this case since this is what the government collects per unit.

- There are four polar cases as we consider high or low values for each elasticity:

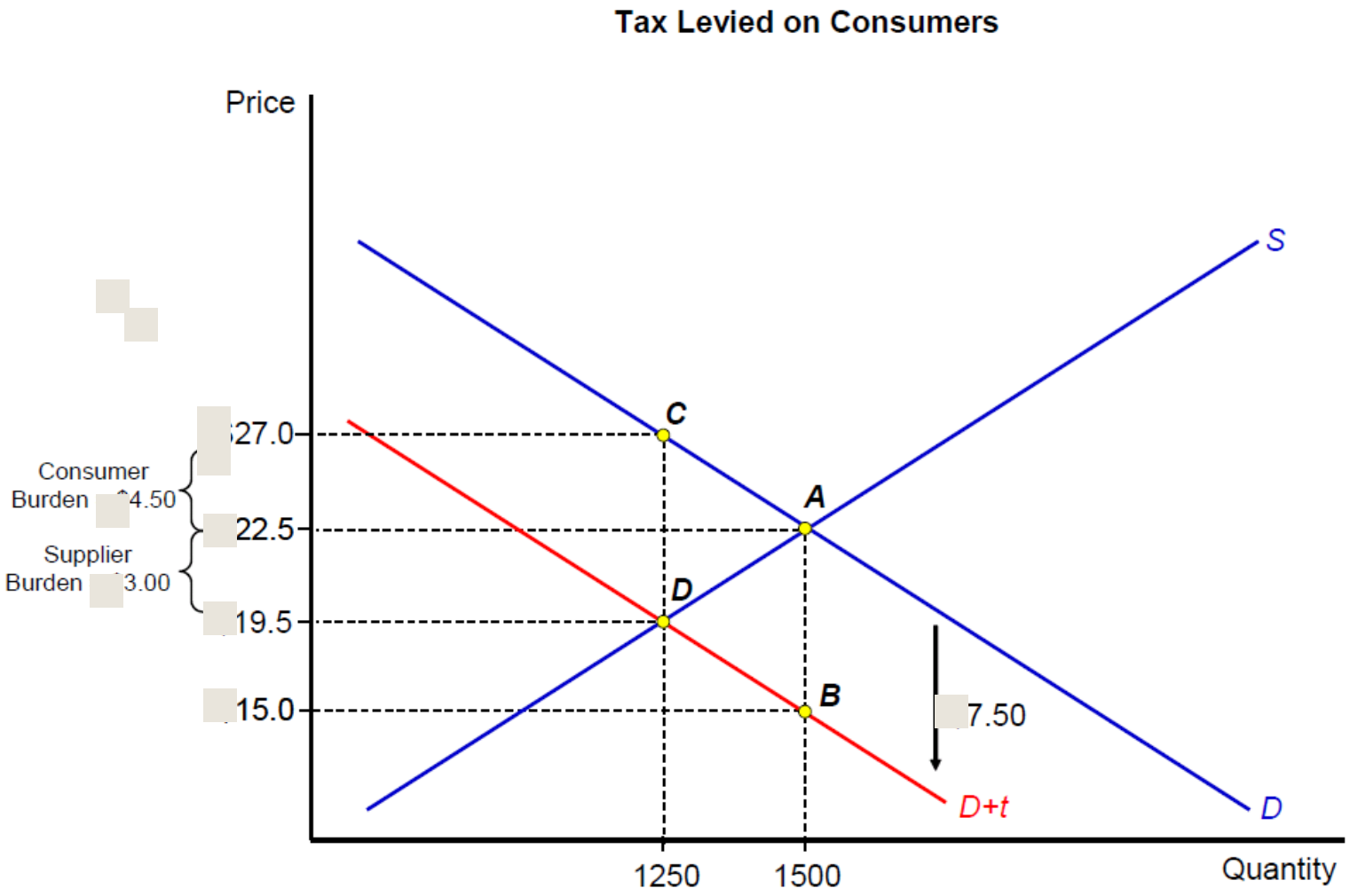
Partial Equilibrium Incidence: Specific tax

- 1. $e_s = 0 \Rightarrow \frac{dP_s}{dt} = -1 \qquad \frac{dP_d}{dt} = 0$
- 2 $e_s = \infty \Rightarrow \frac{dP_s}{dt} = 0 \qquad \frac{dP_d}{dt} = 1$
- 3 $e_d = 0 \Rightarrow \frac{dP_s}{dt} = 0 \qquad \frac{dP_d}{dt} = 1$
- 4 $e_d = \infty \Rightarrow \frac{dP_s}{dt} = -1 \qquad \frac{dP_d}{dt} = 0$

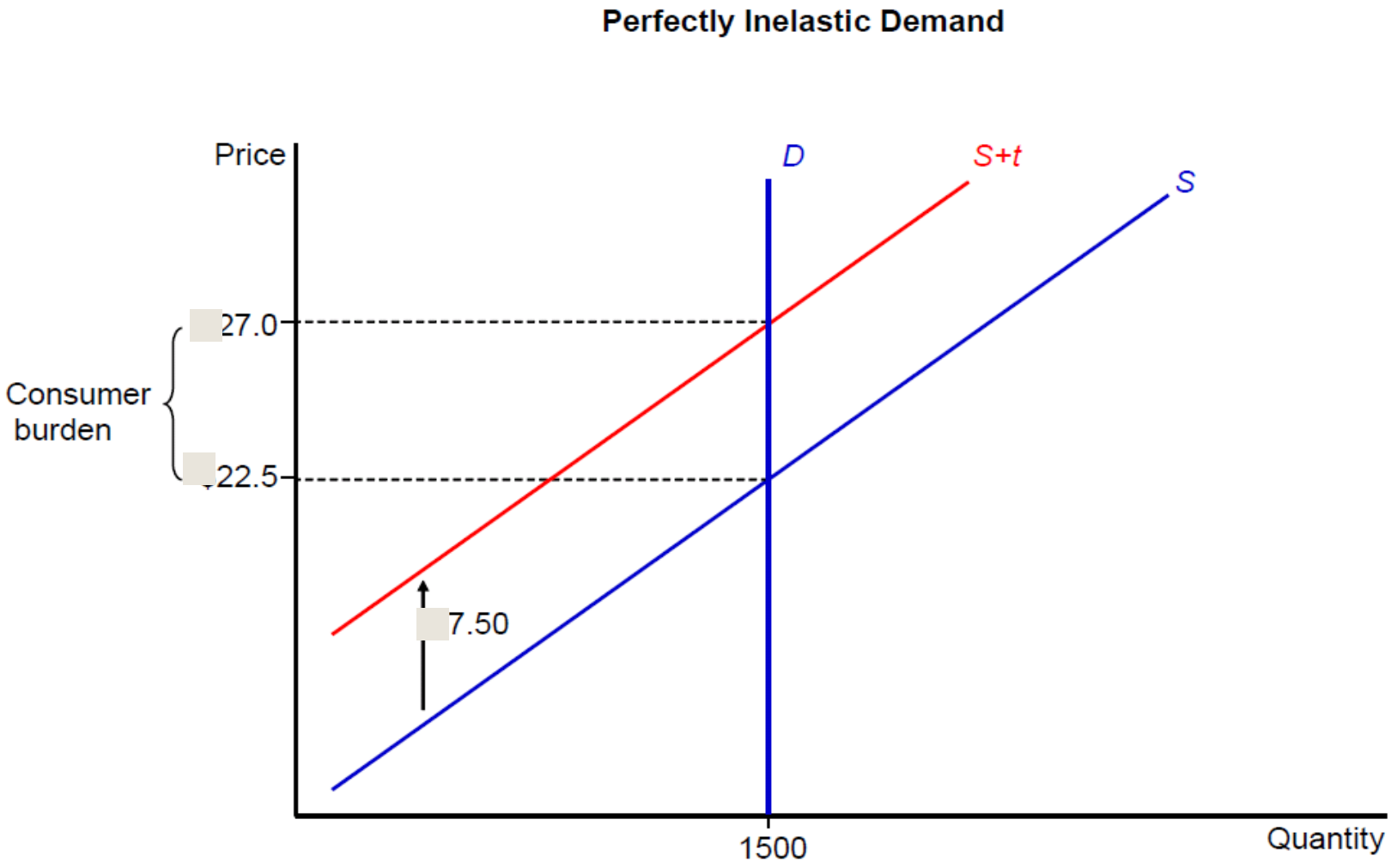
Partial Equilibrium Incidence: Specific tax: Diagram



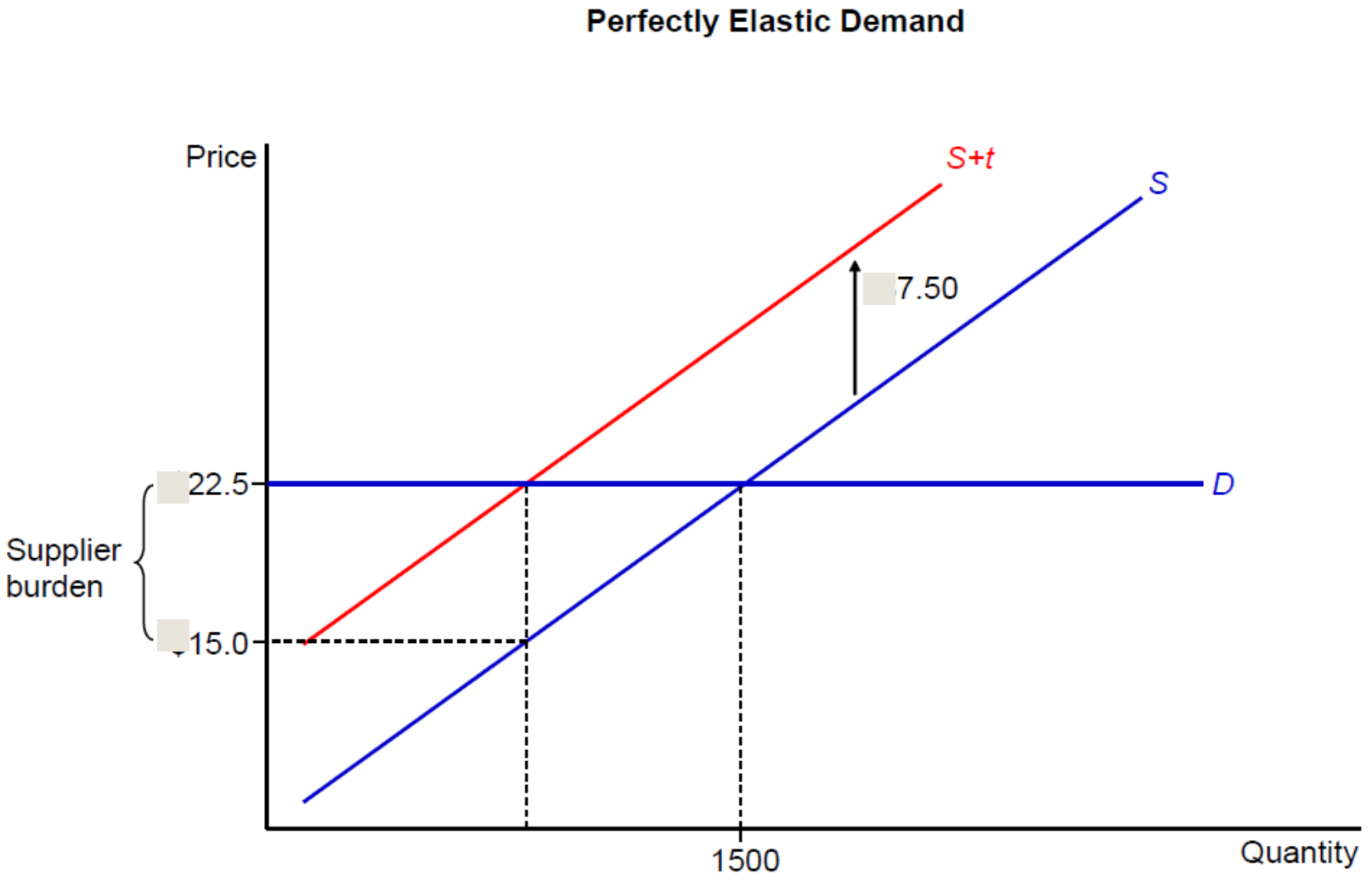
Partial Equilibrium Incidence: Specific tax: Diagram



Partial Equilibrium Incidence: Specific tax: Diagram



Partial Equilibrium Incidence: Specific tax: Diagram



Partial Equilibrium Incidence: Monopoly

- If a market is not perfectly competitive then this analysis does not apply. There are lots of forms of imperfect competition (duopoly, oligopoly, monopolistic competition and so on) so there are no real general results here. We look at perhaps the simplest case, simple monopoly, which shows one interesting possibility. It will be shown that it is possible to have *over-shifting*, that is the degree of tax shifting can be greater than 100%.
- For example, if the government introduced a tax of €1 on a good and the price to buyers rose by €1.20 the degree of shifting is 120%. To see how this happens consider the simplest case of a monopoly, a market with a single firm, that has constant marginal costs and faces a demand curve with a constant elasticity of demand.

Partial Equilibrium Incidence: Monopoly

- After tax profits are given by

$$\pi = P.Q - c.Q - T.Q$$

- T is the amount of tax paid per unit and c is the marginal cost (that is of producing one extra unit). We can re-write after-tax profits as:

$$\pi = P.Q - (T + c).Q$$

- The marginal cost to the firm of an extra unit is effectively the marginal cost of production plus the amount it must pay the government.

Partial Equilibrium Incidence: Monopoly

- Demand is given by a constant elasticity demand function: $Q = P^{-\eta}$ where η (>0) is the elasticity of demand.
- Remember that a monopolist will never operate on an *inelastic* part of the demand curve, that is where 0<η<1. Why? If it did then assume it increased the price by 1%. Demand would fall by less than 1% by assumption. So revenue would increase, approximately by (1-η)%.
- Since demand (i.e. quantity) has fallen the firm's costs have also fallen. With an increase in revenue and a decrease in costs its profits must have risen. So this cannot be equilibrium. As long as demand is inelastic (η<1) the firm can make greater profits by raising the price. So in a profit maximizing equilibrium it must be the case that η>1.

Partial Equilibrium Incidence: Monopoly

- Let us examine how a monopolist maximises its profits. With the above equations we get.

$$MR = MC + T = c + T$$

$$MR = \frac{d(PQ)}{dQ} = P.\frac{dQ}{dQ} + Q.\frac{dP}{dQ} = P + Q.\frac{dP}{dQ}$$

$$= P\left(1 + \frac{Q}{P}.\frac{dP}{dQ}\right) = P\left(1 - \frac{1}{\eta}\right)$$

- As the elasticity of demand is

$$\eta \equiv -\frac{dQ}{dP}.\frac{P}{Q}$$

Partial Equilibrium Incidence: Monopoly

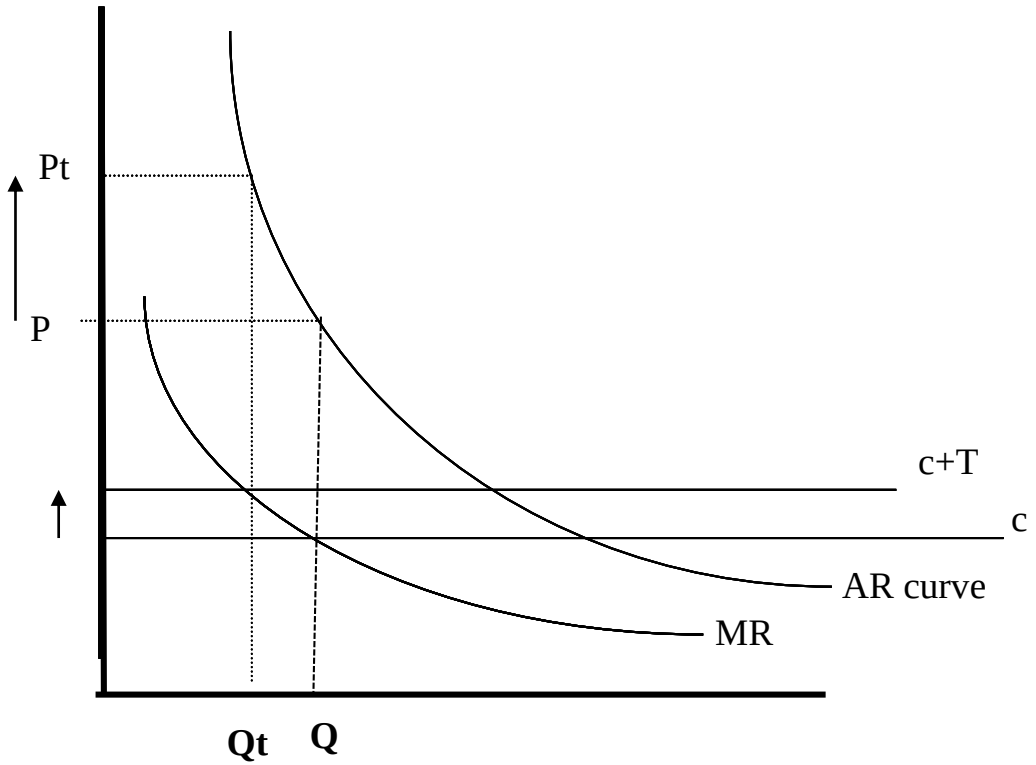
- Setting Marginal Revenue equal to Marginal Cost (including the tax) implies:

$$P\left(1-\frac{1}{\eta}\right)=T+c \quad \Rightarrow \quad P=\frac{c+T}{1-\frac{1}{\eta}}$$

$$\Rightarrow \frac{dP}{dT}=\frac{1}{\left\{1-\frac{1}{\eta}\right\}}>1$$

- Since η>1, it follows that the last term is greater than 1: the denominator in {braces} is positive but less than 1. In other words the ***increase in price is greater than the amount of the tax*** (per unit). This is precisely what we mean by over-shifting. As the elasticity of demand goes towards infinity the degree of shifting falls towards one. In other words it is the firm's market power which enables it to pass on the tax.

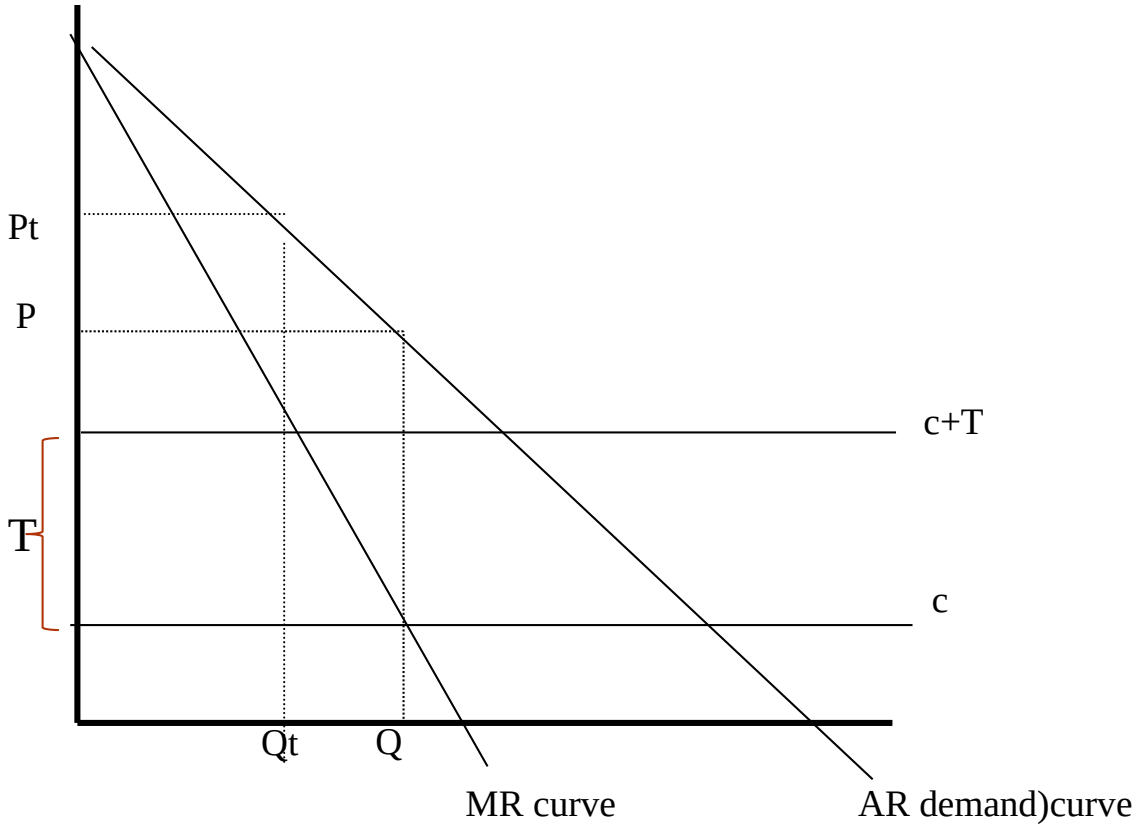
Partial Equilibrium Incidence: Monopoly: Overshifting of Taxes



Partial Equilibrium Incidence: Monopoly: Linear demand curve

- For the linear case, say. $Q = a - bP \Leftrightarrow P = (a - Q)/b$
- Then the slope of the demand curve is $\frac{dP}{dQ} = \frac{-1}{b}$
- Total Revenue is given by P by $TR = (aQ - Q^2)/b$
- The Marginal Revenue is $MR = (a - 2Q)/b$
- The slope of the Marginal Revenue curve is: $\frac{dMR}{dQ} = \frac{-2}{b}$
- So for the linear case the marginal revenue slopes down twice as fast as the demand curve. This corresponds to Figure below.

Partial Equilibrium Incidence: Monopoly: Linear demand curve



Extensions of Basic Partial Equilibrium Analysis

- With price floors, incidence can differ
- Consider incidence of social security taxes with minimum wage
- Statutory incidence: 12% on employer and 8% on employee
- Share of each should not matter as long as total is constant because wages will fall to adjust
- But with binding minimum wage, employers cannot cut wage further so statutory incidence determines economic incidence on the margin

Extensions of Basic Partial Equilibrium Analysis

- **Market rigidities**
- **Imperfect competition**
  - Overshifting: possible to get an increase in after-tax price > level of the tax
  - Ad valorem and excise taxation are no longer equivalent
- **Effects on other markets:**
- Increase in cigarette tax ! substitute cigarettes for cigars, increasing price of cigars and shifting cigarette demand curve
- Revenue effects on other markets: tax increases make agents poorer; less to spend on other markets
- This motivates general equilibrium analysis of incidence

General Equilibrium Analysis

- Trace out full incidence of taxes back to original owners of factors
- Partial equilibrium: .producer. vs. consumer
- General equilibrium: capital owners vs. labor vs. landlords, etc.
- Two types of models:
- **Static: many sectors or many factors of production**
- Basic analytical model: Harberger (1962): 2 sector and 2 factors of production. Also many sectors and factors.
- **Dynamic**
- Intergenerational incidence: Soc Sec reform
- Asset price effects: capitalization

General Equilibrium Analysis

Harberger Two Sector Model

1. Fixed total supply of labor L and capital K (short-run, closed economy)
2. Constant returns to scale in both production sectors
3. Full employment of L and K
4. Firms are perfectly competitive
5. All consumers are identical with homothetic utility functions

- Implicit assumption: no adjustment costs for capital and labor, when the are relocated from one sector to the other

General Equilibrium Analysis

Harberger Two Sector Model: Setup

- Production in sectors 1 (food) and 2 (cars):
- $X_1 = F_1(K_1, L_1) = L_1 f(k_1)$ $\quad\quad$ $X_2 = F_2(K_2, L_2) = L_2 f(k_2)$
- with full employment conditions $K_1 + K_2 = K$ and $L_1 + L_2 = L$
- Factors w and L fully mobile so returns must be equal:
- $w = p_1 F_{1L} = p_2 F_{2L}$ $\quad\quad$ $r = p_1 F_{1K} = p_2 F_{2K}$
- Demand functions for goods 1 and 2:
- $X_1 = X_1(p_1/p_2)$ and $X_2 = X_2(p_1/p_2)$
- Note: Since all consumers are identical redistribution of incomes via tax system does not affect demand via a feedback effect
- System of ten equations and ten unknowns: K_i , L_i , p_i ,X_i ,w, r, i=1,2.

General Equilibrium Analysis

Harberger Two Sector Model: Setup

- Introduce small tax *dt* on rental of capital in sector 2 (K_2)
- All eqns the same as above except $r = (1 - dt)p_2F_{2K}$
- Linearize the 10 eq'ns around initial equilibrium to compute the effect of *dt on all 10 variables (dw, dr , dL_1, ...)*
- Labor income = wL with L fixed, rK = capital income with K fixed
- Therefore change in prices dw/dt *and* dr/dt *describes how tax is* shifted from capital to labor
- Changes in prices dp_1/dt, dp_2/dt *describe how tax is shifted from* sector 2 to sector 1.

General Equilibrium Analysis

Harberger Two Sector Model: Main Effects

- **Substitution effects**: capital bears incidence
- Tax on K_2 shifts production in Sector 2 away from K so aggregate demand for K goes down
- Because total K is fixed, r falls so K bears some of the burden

General Equilibrium Analysis

Harberger Two Sector Model: Main Effects

- **Output effects**: capital may not bear incidence
- Tax on K_2 implies that sector 2 output becomes more expensive relative to sector one
- Therefore demand shifts toward sector 1
- ***Case 1: $K_1/L_1 < K_2/L_2$ (1: food, 2: cars)***
- Sector 1 is less capital intensive so aggregate demand for K goes down
- Output effect reinforces substitution effect: K bears the burden of the tax
- ***Case 2: $K_1/L_1 > K_2/L_2$ (1: cars, 2: food)***
- Sector 1 is more capital intensive, aggregate demand for K increases
- Substitution and output effects have opposite signs; labor may bear some or all the tax

General Equilibrium Analysis

Harberger Two Sector Model: Main Effects

- **Substitution + Output = Overshifting effects**
- ***Case 1: $K_1/L_1 < K_2/L_2$***
- Can get overshifting of tax, dr < - d*t and dw > 0*
- Capital bears more than 100% of the burden if output effect sufficiently strong
- Taxing capital in sector 2 raises prices of cars which implies more demand for food, less demand for cars
- With very elastic demand (two goods are highly substitutable), demand for labor rises sharply and demand for capital falls sharply
- Capital loses more than direct tax effect and labor suppliers gain

General Equilibrium Analysis

Harberger Two Sector Model: Main Effects

- **Substitution + Output = Overshifting effects**
- ***Case 2: $K_1/L_1 > K_2/L_2$***
- Possible that capital is made better off by capital tax
- Labor forced to bear more than 100% of incidence of capital tax in sector 2
- E.g. Consider tax on capital in food sector: demand for food falls, demand for cars rises
- Capital in greater demand than it was before. Thus price of labor falls substantially, capital owners actually gain
- Bottom line: taxed factor may bear less than 0 or more than 100% of tax.

General Equilibrium Analysis

Harberger Two Sector Model

- Theory not very informative: model mainly used to illustrate negativeresult that “anything goes”.
- More interest now in developing methods to identify what actually happens
- Original Application of this framework by Harberger: sectors = housing and corporations
- Capital in these sectors taxed differently because of corporate income tax and many tax subsidies to housing
- E.g: Deductions for mortgage interest and
- Harberger made assumptions about elasticities and calculated incidence of corporate tax given potential to substitute into housing

Computable General Equilibrium Models

- Harberger analyzed two sectors;
- Subsequent literature expanded analysis to multiple sectors
- Analytical methods infeasible in multi-sector models
- Instead, use numerical simulations to investigate tax incidence effects after specifying full model
- Pioneered by Shoven and Whalley (1972). See Kotlikoff andSummers section 2.3 for a review
- Produced a voluminous body of research in PF, trade, and development economics