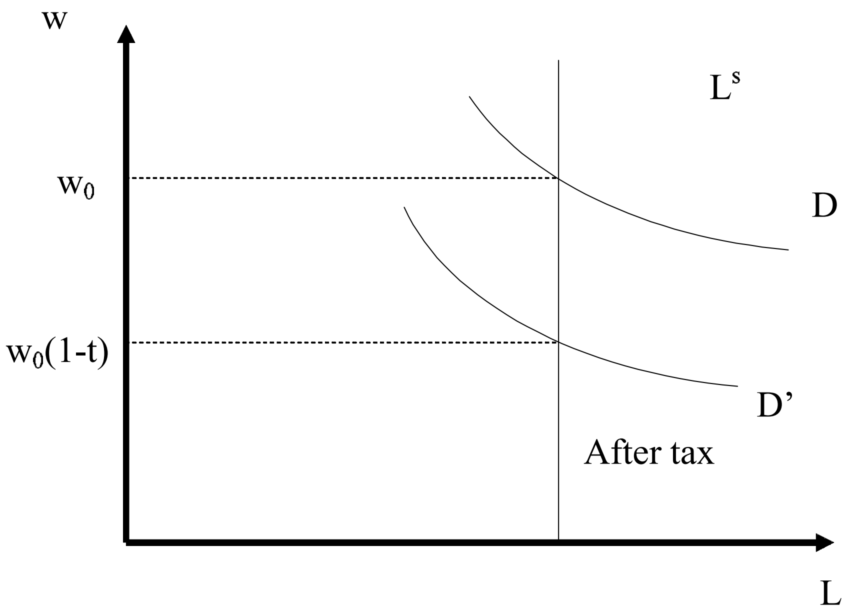
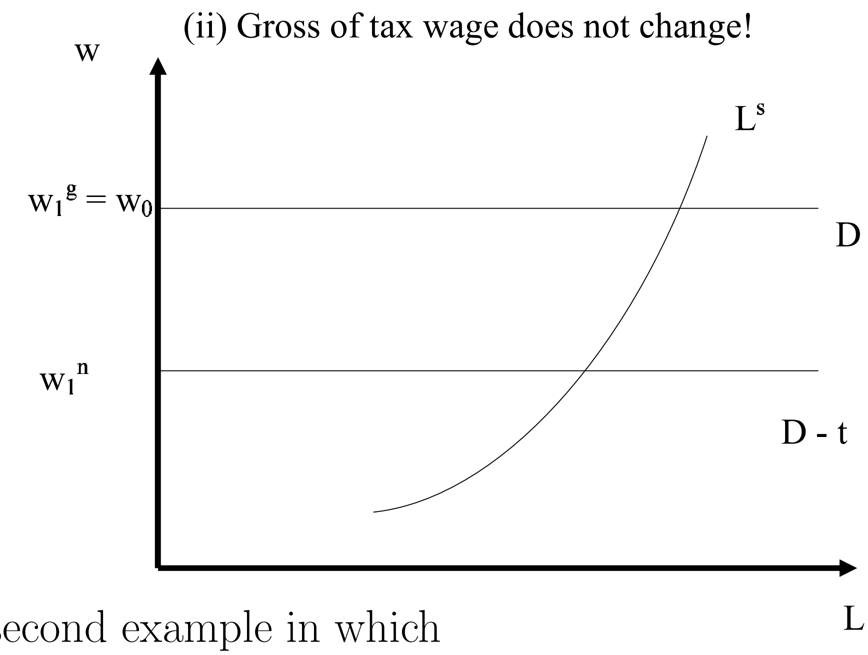
Tax Incidence

Overview

- Incidence means the tax "burden".
- The interesting question is whether or not one's tax payment to tax authorities is a correct representation of his tax burden?
- Example:
  - One earns a salary of $50,000$,
  - pays a tax of tax $10,000$,
  - has a net pay of $40,000$.
  - Is his burden of the tax $10,000$?
- Clearly, the answer depends on what the person's salary would be if the tax is abolished.



- An example in which:
  - * the gross of tax salary,w^g, remains unaffected, and the net of tax salary, w^n, is reduced by the full amount of the tax.
  - * Note: In this example, the level of labor supply before and after tax is the same.
- The individual is worse off by the full amount of his tax payment.
- ⇒ the incidence on him is equal to his tax payment.



- A second example in which
  - * w^g remains unaffected, and w^n is reduced by the full amount of the tax.
  - * Note: In this example, labor supply changes as a result of the tax.
- If the tax is abolished, the individual would recoup all the tax he currently pays.
- The individual is thus worse off, *in terms of income,* by the full amount of his tax payment.
- That the individual will increase the number of hours he works if the tax is abolished, however, has a bearing on how much "better off" he will be without the tax. Specifically, his utility decreases as his leisure consumption decreases.

- We call the first effect (the taxes the individual pays effectively—and also here nominally—to the government) as a "first-order" effect.
- We call the second effect (the change in the individual's utility because of changes in the number of hours worked) as a "second-order" effect.
- For the time being, we concentrate only on the first-order effect.
  - This is sufficient for determining the "division" of incidence between the two sides of the market.
  - The second-order effects become relevant when one wants to "exactly" measure the "true" incidence of the tax.

- There are two sides to any transaction: employer and employee, seller and buyer etc.
- One side pays cash to the other for the goods or services rendered by the other side.
- In the absence of taxation, what one side pays is equivalent to what the other side receives.
- Tax is a tax on transaction $\Rightarrow$ It creates a wedge between what one side pays and what the other receives.
- It is plain that both sides together pay the tax. That is, the tax transfers resources from the private to the public sector.

- If we ignore the second-order effects, the incidence on the private sector is equal to the taxes paid.
- The government can levy a tax on either side of the market.
- Yet this does not mean that the side which is taxed is necessarily bearing the burden of the tax. One side can "shift" it to other.
- The key is how the tax changes the prices faced by the two sides of the market.

The irrelevance of who nominally pays the tax

- p^c versus p^s:

$$\begin{cases} q_d = f(p^c) \\ q_s = \phi(p^s) \end{cases}$$

- It is crucial to recognize the very obvious point that what matters to consumers is p^c and to sellers, p^s.
- Why should consumers care about p^s; or producers about p^c!
- When we write $q_d = f(p)$ and $q_s = \phi(p)$, we are effectively assuming that $p^c = p^s$.
- This assumption is correct in the absence of taxation, *and in equilibrium*.
  - * Draw a diagram to illustrate this point.

- In the presence of taxation, the equilibrium condition changes to: $p^c = p^s + t$.
- Observe that $p^c = p^s + t$ holds regardless of which side of the market the tax is levied on.
- The equilibrium is thus characterized by:

$$\begin{cases} q_d = f(p^c) \\ q_s = f(p^s) \\ p^c = p^s + t \\ q_s = q_d \end{cases}$$

- Note that the equilibrium and the values of p^c and p^s depend only on the size of t, and not the division of t between the two sides of the market.
- Diagrammatic representation: the so called “Shifting” of D and S curves.
- Real examples (health costs, social security, etc.)
- The same principle applies to realtor fees.
- Non-competitive markets.

An Example

- Assume:

$$\begin{cases} L_d = a - bw^g \\ L_s = cw^n \end{cases}$$

- $\Rightarrow$

$$\begin{cases} w_g = \frac{a-L^d}{b}, \text{Inverse demand function,} \\ w_n = \frac{L^s}{c}, \text{Inverse supply function.} \end{cases}$$

- Subtracting:

  $w_g - w_n = \frac{a-L^d}{b} - \frac{L^s}{c}$.

- In equilibrium:

  $L^d = L^s = L$.

- Therefore: $w_g - w_n = \frac{a-L}{b} - \frac{L}{c} = \frac{ac-(b+c)L}{bc}$

- Or $L = \frac{ac-bc(w_g-w_n)}{b+c}$.

- Now in the most general case:

$$\begin{aligned} w_g &= w + \tau, \\ w_n &= w - \theta. \end{aligned}$$

- Substituting in above yields:

$$L = \frac{ac - bc(\tau + \theta)}{b + c}.$$

- Consequently, the equilibrium level of L does not change as long as we keep $\tau + \theta$ constant.
- What matters is $\theta + \tau$ and not θ and τ alone!
- Note: The distribution of θ and τ affect w, but w in and out itself is not important. For employers w^g matter and for employers w^n. These depend only on $\tau + \theta$. To see this, substitute for L in the inverse functions:

$$\begin{cases} w_g &= \frac{a}{b} - \frac{ac - bc(\tau+\theta)}{b(b+c)} = (\frac{a}{b} - \frac{ac}{b(b+c)}) + \frac{bc}{b(b+c)}(\tau + \theta) \\ &= \frac{a}{b+c} + \frac{c}{b+c}(\tau + \theta) \\ \\ w_n &= \frac{a - b(\tau+\theta)}{b+c} = \frac{a}{b+c} - \frac{b(\tau+\theta)}{b+c} \end{cases}$$

- Of course, from $w = w^n + \theta$, we have:

$$\begin{aligned} w &= \frac{a}{b+c} - \frac{b}{b+c}(\tau + \theta) + \theta \\ &= \frac{a}{b+c} - \frac{b\tau}{b+c} + \frac{\theta c}{b+c}. \end{aligned}$$

- Similarly, from $w = w^g - \tau$,

$$\begin{aligned} w &= \frac{a}{b+c} + \frac{c(\tau + \theta)}{b+c} - \theta \\ &= \frac{a}{b+c} - \frac{b\tau}{b+c} + \frac{\theta c}{b+c}. \end{aligned}$$

- But, as we observed, w in and out of itself does not matter.

A general formulation:

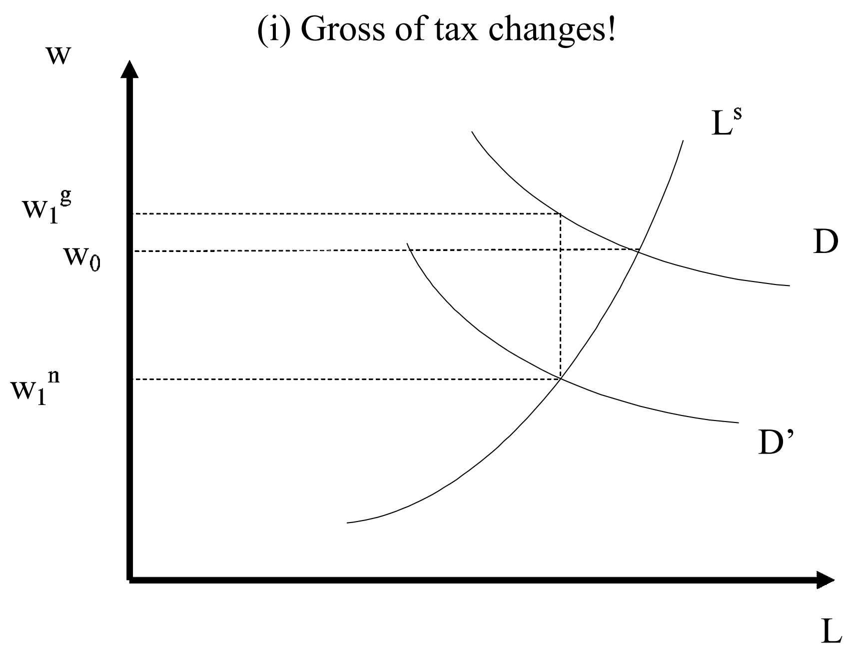
$$\begin{cases} L^d = \phi(w^g) \\ L^s = \Omega(w^n) \\ L^d = L^s \\ w^g = w + \tau \\ w^n = w - \theta \end{cases}$$

- In 5 variables: L^d, L^s, w^g, w^n and w.
- Exogenous variables: τ and θ
- Note:

$$\begin{aligned} L^d &= \Phi(w + \tau) \\ L^s &= = \Omega(w - \theta). \end{aligned}$$

- $L^d = L^s \Rightarrow \Phi(w + \tau) = \Omega(w - \theta)$.
- $\Rightarrow w$ depends on τ and θ.
- But $w^g - w^n = \tau + \theta = f(L^d) - h(L^s) = f(L) - h(L)$.
- $\Rightarrow L^d = L^s = L$, depends on $\tau + \theta$ only; *not* on θ and τ separately.

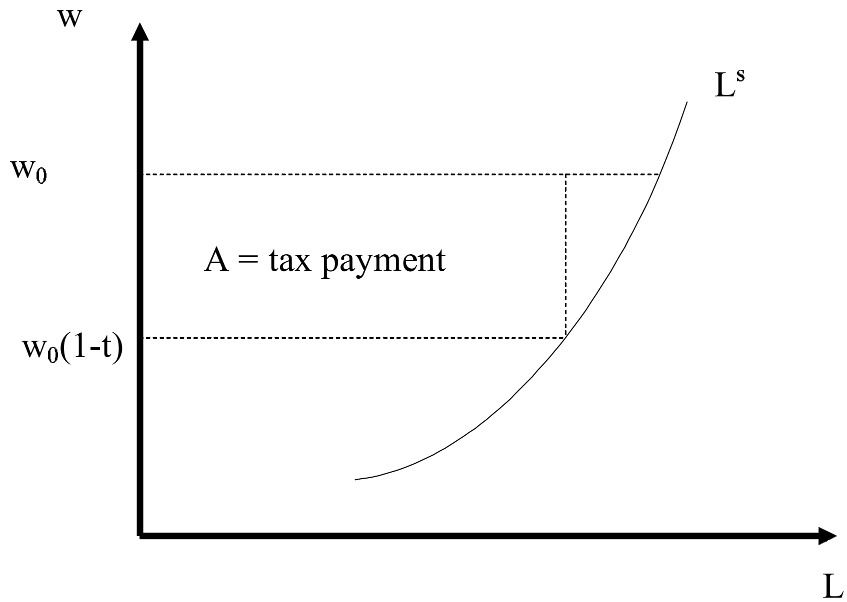
- Determination of "effective" tax payments in the general case.



- The case of a perfectly inelastic demand curve.
- The case of a perfectly elastic supply curve.

Measuring incidence (including the second-order effects)

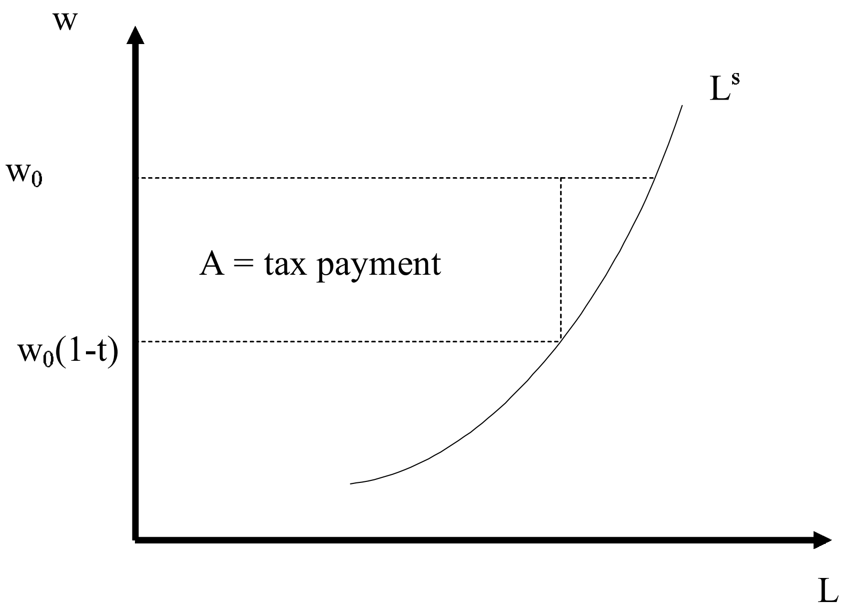
- Recall the earlier diagram with w^g unaffected but hours of work changed.



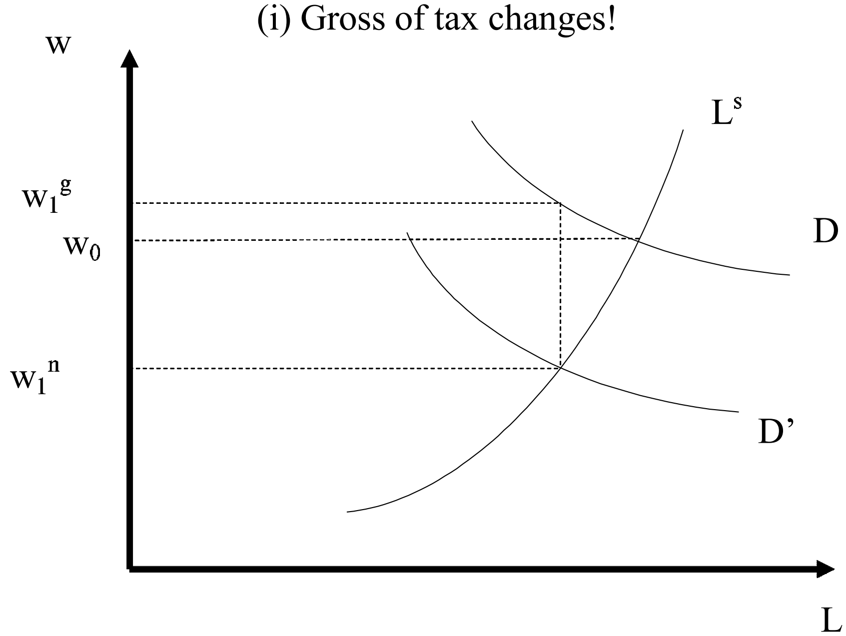
- "First-order" loss= tax payment.
- "Second-order" effect:
  - Additional loss = $w_0 \Delta L$ earnings lost because your work less (= a rectangle in the diagram).
  - Additional gain = value of ΔL that you have in terms of extra leisure (area under the labor supply curve).
  - Net additional loss = additional loss minus additional gain ($\Rightarrow$= a triangle).
- Total incidence: First-order plus second-order effects (rectangle + triangle).

The consumer's and producer's surplus

- Finding the total incidence in the previous diagram in a different way:



- The general case:



Incidence and Elasticities of Demand and Supply

- Diagrammatic expositions.
- Diagrammatic conclusions.
- Perfectly elastic and perfectly inelastic demand and supply curves.

Unit versus ad valorem taxes

- Expressed per unit of output or as a percentage of the price.
- One does not changes with market price and the other does automatically.
- We have

$$\begin{cases} p^c &= p^s + t \\ p^c &= p^s(1+\theta). \end{cases}$$

- The two are identical if t is set equal to θp^s, or $\theta = t/p^s$.
- Numerical examples.
- Some caveats.

  * The problem with the definition of a "unit".
  * Non-competitive markets.

A two-sector General Equilibrium Model

- Two consumption goods: X and Y.
- Two factors of production: L (labor) and K (capital).
- Aggregate available endowments of labor and capital in the economy: $\overline{L}$ and $\overline{K}$.
- The producer prices of X and Y: p_x and p_y.
- Net of tax wage and returns to capital: w and r.
- Marginal products of L and K in sector producing X are denoted by subscripts L and K on $F(.)$.
- Marginal products of L and K in sector producing Y are denoted by subscripts L and K on $G(.)$.
- Consumption taxes on goods X and Y: t_x and t_y.
- t_{Lx} and t_{Kx} are the tax rates on labor and capital in industry X.
- t_{Ly} and t_{Ky} are the tax rates on labor and capital in industry Y.

- The model:

$$\begin{cases} X & = F(L_x, K_x) \\ Y & = G(L_y, K_y) \\ p_x F_L(L_x, K_x) & = w(1 + t_{Lx}) \\ p_x F_K(L_x, K_x) & = r(1 + t_{Kx}) \\ p_y G_L(L_y, K_y) & = w(1 + t_{Ly}) \\ p_y G_K(L_y, K_y) & = r(1 + t_{Ky}) \\ K_x + K_y & = \overline{K} \\ L_x + L_y & = \overline{L} \\ \frac{X}{Y} & = \phi\left(\frac{p_x(1+t_x)}{p_y(1+t_y)}\right). \end{cases}$$

- Exogenous variables: $\overline{K}, \overline{L}, t_{Lx}, t_{Kx}, t_{Ly}, t_{Ky}, t_x, t_y$.
- Endogenous variables:$X, Y, L_x, K_x, L_y, K_y, w, r, p_x$.
- $p_y \equiv 1$; is the numeraire.

- The important point in GE is that a tax in one sector affects the other sectors as well.
- $\Rightarrow$ The welfare of people working in the untaxed sectors are also affected and thus they also bear some tax burden.
- The emphasis here is what happens to the net of tax returns to labor and capital: w and r.
- In GE, p_x/p_y changes as a result of tax changes $\Rightarrow$
  * When considering incidence for workers, we should look at *both* w/p_y and w/p_x.
  * When considering incidence for owners of capital, workers we should look at *both* r/p_y and r/p_x.
- Taxing a good is equal to taxing the factors of production that produce that good.

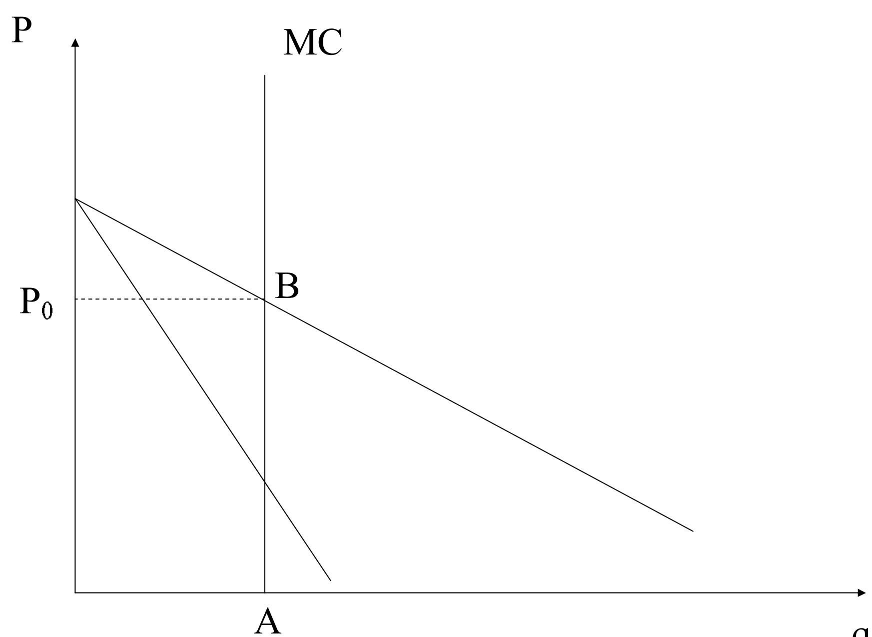
- Important factors determining incidence:
  * Factor mobility.
  * Factor intensity effect.
  * Factor substitution effect.
- Factor mobility and the "law of one price".
  - If labor in X is taxed and labor is mobile it will move elsewhere until the net of tax wage is equalized everywhere. This means *all* workers are equally affected not just labor in X.
  - This cannot be the case with land which is immobile.

- Factor intensity effect concerns the *relative* employment of labor and capital in different sectors of the economy.
- Definition: If K/L in Y industry is greater that K/L in X industry, Y is termed "capital intensive".
- $\Rightarrow$ X will then be labor intensive.
- Analysis:
  - When an industry is taxed, that industry shrinks and reduces its employment of labor and capital.
  - The unemployed labor and capital will have to find employment in the other industry.
  - If the taxed industry is, say, labor intensive, its downsizing releases more labor relative to capital.
  - Thus relatively more labor would be seeking employment than capital.
  - $\Rightarrow$ There will be relatively more pressure on wages in the labor market .
  - $\Rightarrow$ Worse for the labor. seeks empshow up Taxing a labor intensive industry is bad for labor. Why?

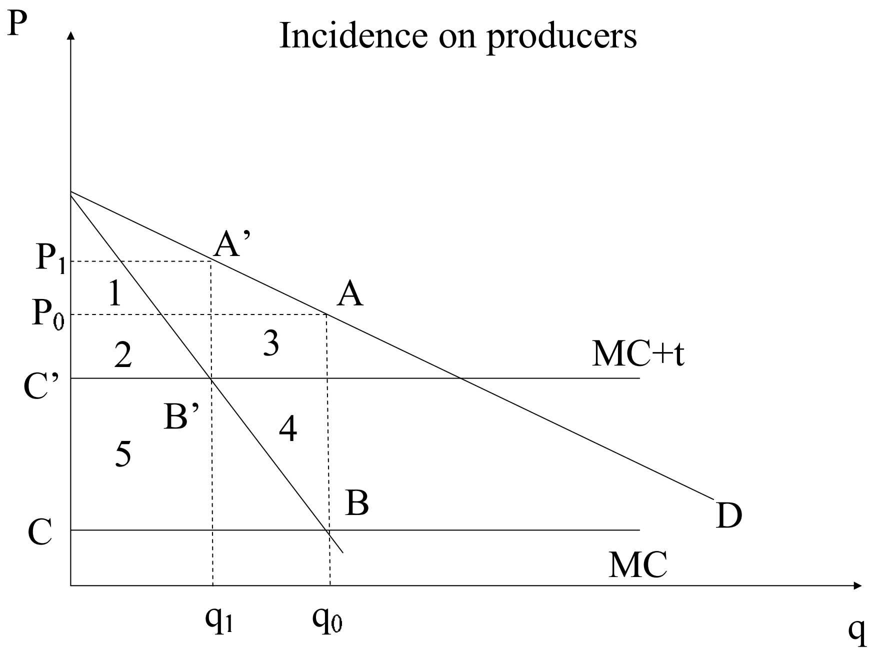
- Factor substitution effect.
  - This refers to the "ease" of substituting one factor of production for another.
  - It is measured by the "lasticity of substitution"
  - When a factor, say labor, is taxed in one industry but not another, incidence is greatly affected by the elasticity of substitution in the taxed industry as wll as in the untaxed industry.
  - If the elasticity of substitution is high in the taxed industry, the industry can turn to the untaxed factor (capital) and substitute that for the taxed factor (labor). ⇒ This will hurt labor in that it pushes its wage down.
  - If the elasticity of substitution is low in the taxed industry, the industry cannot easily turn to the untaxed factor (capital) for the purpose of substitution. ⇒ This will be advantageous to labor.
  - If the elasticity of substitution is high in the untaxed industry, the taxed factor (labor) can easily be hired there. ⇒ This will be good for the labor and lowers the downward pressure on wages.
  - If the elasticity of substitution is low in the untaxed industry, the taxed factor (labor) cannot easily be hired there. ⇒ This will hurt labor in that it pushes its wage down in order to find employment.

Tax Incidence in non-competitive markets

- More complicated; no unified theory. No unified price theory!
- The point is that with non-competitive markets; there are "pure profits" and these can be taken away through taxation. [Note that the "producer surplus" in competitive markets is a short-run phenomenon. In the long run we do not have "profits".]
- Two illustrations:
  1. Vertical MC:

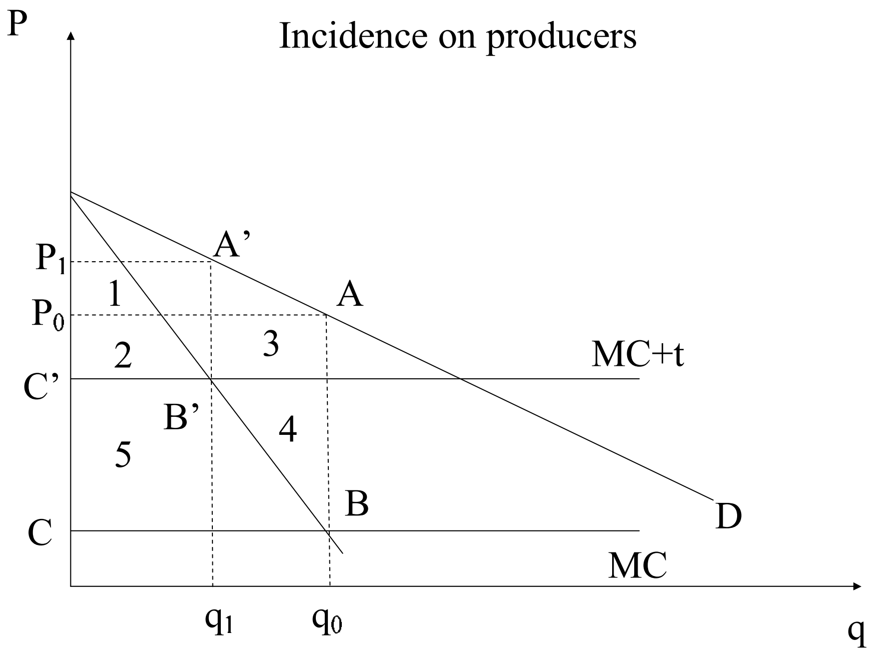


  - All the incidence is on producers.
  - This is precisely the same outcome as in competitive markets.



2. Horizontal MC:

* "Profit" in the absence of tax = P_0ABC (ignoring fixed costs).
* "Profit" with tax = $P_1A'B'C'$ (ignoring fixed costs).
* Reduction in profits= area of P_0ABC − area of $P_1A'B'C'$.
* Reduction in profits= Areas 2+3+4+5−(1+2) = 3+4+5−1.
* Note with a linear demand curve Area 5 is twice as much as Area 1.
* Therefore, with a linear demand, difference = areas $3 + 4 + 1$



- Intuition:
  - When output is cut from q_0 to q_1 producers lose all the profit associated with $q_1 q_0$ units of output (i.e. areas 3 + 4). In addition, in selling q_1 they gain area 1 because of the price increase from p_0 to p_1, but they lose area 5 to taxes. The net reduction in their profits is thus $3 + 4 - 1 + 5 = 3 + 4 + 1$.
- Compare with the incidence on consumers which is area 1 plus the small triangle (the "second-order" effect).

- Linear demand and the change in consumer price:
  * Demand: $p = a - bq$, with $a > 0, b > 0$.
  * $\Rightarrow MR = a - 2bq$.
  * This can be proved by differentiating $TR = pq = aq - bq^2$.
  * Write MR as a function of price (by substituting for bq from the demand curve).
  * $MR = a - 2(a - p) = -a + 2p$.
  * In equilibrium, for all t, including $t = 0$,
  * $MR = MC + t \Rightarrow$
  * $-a + 2p = MC + t \Rightarrow$
  * $\Rightarrow p = \frac{a+MC}{2} + \frac{t}{2}$.
  * $\Rightarrow \frac{dp}{dt} = \frac{1}{2}$.
  * Note a and MC are independent of the tax.