Recitation 5 - Tax Incidence *

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Three key points that are helpful to remember when it comes to taxes and incidence:

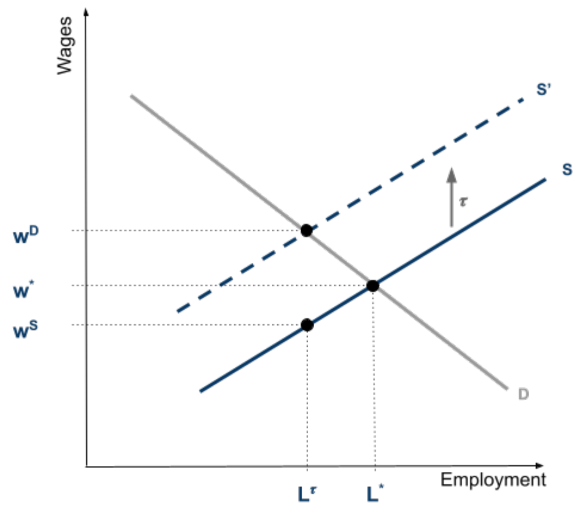
1. Regardless of which side of the market the government "applies" the tax on (e.g. producers or consumers, firms or workers), the new equilibrium price and quantity will be the same
2. Nominal (or statutory) incidence $\neq$ economic incidence
3. The more inelastic side of the market bears a higher fraction of the burden

Example: Tax τ on income, paid for by workers

In the Figure below, we examine the effect of a tax τ on income paid for nominally by workers. Graphically, this is shown as a vertical upwards shift by τ in the labor supply curve. Why is that the case? Recall that the labor supply curve captures the opportunity cost of the marginal worker. At L^τ, the marginal worker has opportunity cost (or reservation wage) w^s. It is upward sloping because to pull in more workers, you would need to pay them more as those that aren't already working have higher opportunity costs. With that in mind, when workers have to pay \$$\tau$ of tax on their wages, the supply curve shifts up vertically by τ since each marginal worker now needs to get paid τ on top of their opportunity cost to be indifferent between supplying labor vs. not. This new supply curve intersects with firm labor demand at L^τ where $L^\tau < L^*$. While firms pay workers w^D, workers effectively receive $w^D - \tau = w^S$. [1] Does that mean workers are bearing the economic incidence? *No!* So what determines economic incidence?

*Thanks to Professor Autor and Cristine von Dessauer for sharing materials from previous years.

[1] that this figure would look exactly the same if firms "paid" the tax τ except that it would be the labor demand curve that would shift downward by τ. The equilibrium quantity and price would be the same.



Elasticities determine economic incidence

Holding worker elasticity fixed, we will consider below two examples. In one, the firm's demand for labor is highly inelastic and in the other, the firm's demand for labor is highly elastic. The figures below show what would happen.

Figure A: Inelastic Demand

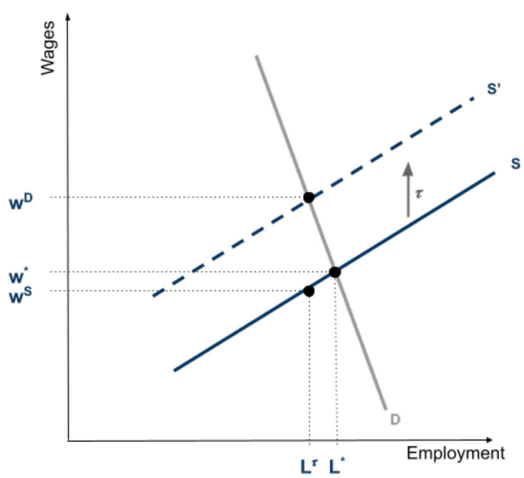
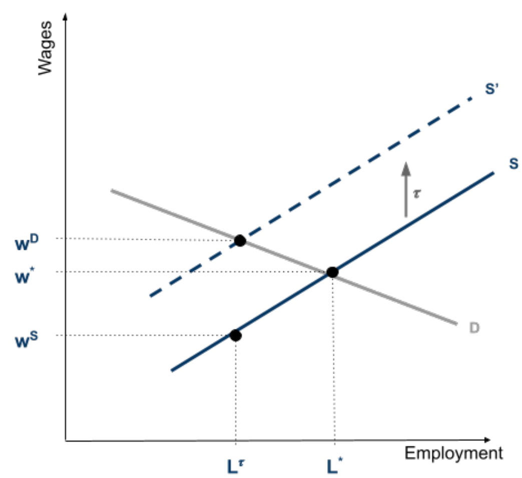


Figure B: Elastic Demand



What do you notice in the figures above?

- With inelastic demand, wages change more than with elastic demand

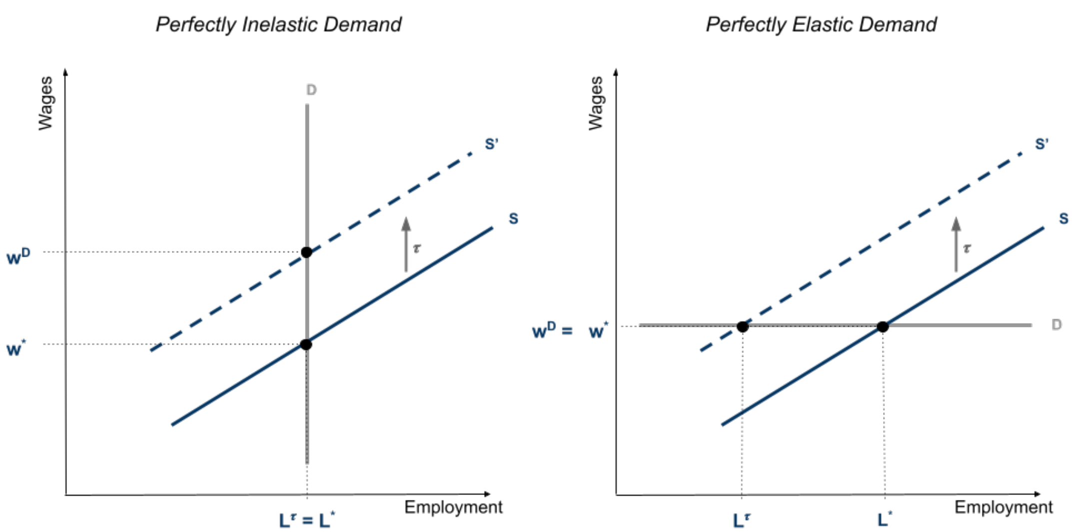
- With inelastic demand, employment changes less than with elastic demand

Which side of the market do you think bears most of the incidence in Figure A? In Figure B?

- In A, inelastic firms hire fewer workers under the higher price regime but raise wages by a lot! $|w^* - w^D|$ is not that much smaller than τ
- In B, elastic firms hire far fewer workers after raising wages slightly. In particular, $|w^* - w^D| << \tau$
- In A, firms bear most of the incidence while in B, workers do

Example: Perfectly Inelastic / Elastic Demand

What does incidence look like in at the extremes? We consider below on the left a firm with perfectly inelastic demand and on the right a firm with perfectly elastic demand. Recall that the elasticity of demand is defined as $\varepsilon_D = \frac{w}{L}\frac{dL}{dw} = 0$ for perfectly inelastic demand and $\varepsilon_D = \frac{w}{L}\frac{dL}{dw} = \infty$ for perfectly elastic demand.[2]



Under perfectly inelastic demand for labor:

- $w^D - w^* = \tau$

[2]Note that because w is on the y-axis and L is on the x-axis, a vertical line for the demand curve corresponds to perfectly inelastic demand and similarly a horizontal line for the demand curve corresponds to a perfectly elastic demand.

- $L^* = L^\tau$
- Firms absorb the entire tax into their wage increase
- There is no deadweight loss because the inefficiency arises from changes in quantity (compare to the real estate agents discussion in class, the DWL arises from workers changing their behavior chasing rents but there is no DWL before more real estate agents enter the market).
- Firms bear the entire burden of the tax

Under perfectly elastic demand for labor:

- $w^D = w^*$
- $L^* \neq L^\tau$
- Workers absorb the entire tax by cutting labor supply until the marginal worker is indifferent between working and getting $w^* - \tau$ or not working
- Workers bear the entire burden of the tax

How do we see this mathematically? Hint: this is useful for one of the problems in Problem Set 3.

Measuring Incidence

Suppose you have demand for some good x given by $D(p)$ and supply for good x given by $S(p)$. At $t = 0$, i.e. when there is no tax, the equilibrium condition $S(p) = D(p)$ must hold. What is the effect of a small tax increase on price $\frac{dp}{dt}$? To derive this result, start at the beginning when there is no tax and perturb the tax by a small amount dt that causes a change in price dp such that the following equilibrium holds:

$$\begin{aligned}
S(p + dp) &= D(p + dp + dt) \\
S(p) + S'(p)dp &= D(p) + D'(p)(dp + dt) \\
S'(p)dp - D'(p)dp &= D'(p)dt \\
dp(S'(p) - D'(p)) &= D'(p)dt \\
\frac{dp}{dt} &= \frac{D'(p)}{S'(p) - D'(p)}
\end{aligned}$$

In your problem set, you will do a similar derivation but instead consider the effect of a small change in taxes and its impact on prices when changes in taxes are *less salient* than changes in price. Hopefully this derivation combined with the examples above builds the intuition that $\frac{dp}{dt}$ captures the notion of tax incidence. When $\frac{dp}{dt} = -1$, the suppliers bear the entire burden while when $\frac{dp}{dt} = 0$ consumers bear the entire burden. Another simple formula to calculate incidence is therefore:

- Incidence on producers $\frac{|\varepsilon_D|}{|\varepsilon_D|+|\varepsilon_S|}$
- Incidence on consumers $\frac{|\varepsilon_S|}{|\varepsilon_D|+|\varepsilon_S|}$

Thus, without knowing anything about the tax (nominal incidence or amount), you can compute the share of the incidence on each side of the market if you can compute the elasticities of both sides (you will also do this in your problem set).

Taxes with Rebates

Sometimes the government may want to tax a product to change behavior (e.g. gas taxes, sugar-sweetened beverages). However, these taxes are regressive so the government may want to then give people some form of rebate so that they are financially compensated (while still affecting consumption behavior). We will consider a few different ways to design this rebate and work through an example to build intuition on how each rebate affects consumers.

Consider two goods X and Y at prices $p_x = 2$, $p_y = 1$, and $I = 10$. Suppose that the consumer's utility function is known and given by $\frac{1}{2}\ln(x) + \frac{1}{2}\ln(y)$. Solving this using the Lagrangian as we did earlier in this class gives you the Marshallian demand functions $d_x(p_x, p_y, I) = \frac{I}{2p_x}$ and $d_y(p_x, p_y, I) = \frac{I}{2p_y}$. Consider a tax $\tau = \$0.50$ and three rebate options:

1. Refund based on pre-tax bundle in terms of consumption of X, i.e. $R = \tau \times d_x(p_x, p_y, I)$ [3]
2. Refund based on post-tax (but pre-rebate) bundle in terms of consumption of X, i.e. $R = \tau \times d_x(p_x + \tau, p_y, I)$
3. Refund based on post-tax and post-rebate bundle in terms of consumption of X, where the rebate happens to be such that the consumer is rebated the exact amount they paid in tax, [4] i.e. $R = \tau \times d_x(p_x + \tau, p_y, I + R)$

[3] Note: this is similar to the question in Exam 1 about burritos and salads

[4] As discussed in the lecture notes, it is important to remember here that the consumer is not choosing consumption of X assuming to be rebated for whatever amount they purchase. Rather, you can think of this as for instance the government has chosen this rebate amount based on the national average and this person *happens* to be at the average.

In each of these rebate structures 1, 2, and 3 – is the consumer worse off, better off, or indifferent as a result of the rebate?

1. $R = \tau \times d_x(p_x, p_y, I)$

Recall from Exam 1 that this leads to an overcompensation in that the rebate is more than the amount necessary to keep the person on the same indifference curve. Thus, even without solving we should know that the consumer is better off. Intuitively, under the new price ratio induced by the tax, the consumer would substitute away from X to Y so assuming the same bundle *as if* the consumer still purchases the same amount of X is an overcompensation. Computationally, we first plug the parameters into the expressions for Marshallian demand:

$$d_x(p_x, p_y, I) = d_x(2, 1, 10) = \frac{10}{4}$$
$$d_y(p_x, p_y, I) = d_x(2, 1, 10) = 5$$

We then plug these values into the utility function to compute the pre-tax utility:

$$U_{pretax} = \frac{1}{2}\ln(\frac{10}{4}) + \frac{1}{2}\ln(5) \approx 1.262$$

We then compute the amount of the rebate:

$$R = \frac{1}{2} \times \frac{5}{2} = \frac{5}{4}$$

Lastly, we compute the new bundles and the corresponding utility under the new prices (that incorporate tax) and the additional income from the rebate:

$$d_x(p_x + \tau, p_y, I) = d_x(2.5, 1, 10 + \frac{5}{4}) = 2.25$$

$$d_y(p_x + \tau, p_y, I) = d_x(2.5, 1, 10 + \frac{5}{4}) = 5.625$$

$$U_{posttax} = \frac{1}{2}\ln(2.25 + \frac{1}{2}\ln(5.625) \approx 1.269$$

2. $R = \tau \times d_x(p_x + \tau, p_y, I)$

In this case, intuitively we can see that the consumer is likely worse off. The rebate is structure such that the post-tax (but pre-refund) bundle is used to determine the amount of the compensation so the consumer is "undercompensated" in a sense. Computationally, we first plug the parameters into the expressions for Marshallian demand:

$$d_x(p_x+\tau, p_y, I) = d_x(2.5, 1, 10) = 2$$

$$d_y(p_x+\tau, p_y, I) = d_x(2.5, 1, 10) = 5$$

We then compute the amount of the rebate:

$$R = \frac{1}{2} \times 2 = 1$$

Lastly, we compute the new bundles and the corresponding utility under the new prices (that incorporate tax) and the additional income from the rebate:

$$d_x(p_x+\tau, p_y, I+1) = d_x(2.5, 1, 11) = 2.2$$

$$d_y(p_x+\tau, p_y, I+1) = d_x(2.5, 1, 11) = 5.5$$

$$U_{posttax} = \frac{1}{2}\ln(2.25) + \frac{1}{2}\ln(5.5) \approx 1.246$$

3. $R = \tau \times d_x(p_x+\tau, p_y, I+R)$

In this case, because of the tax, the price ratio has change and so the budget constraint has rotated. The rotated budget curve intersects with the original budget set and thus the rebate puts the consumer on a new point on the original budget set. Graphically, there must be an indifference curve tangent to this new point, and this indifference is a lower indifference curve than that which the consumer was on prior to the tax/rebate. However, the consumer's expenditure is unaffected. Computationally, we solve for the amount of the rebate:

$$R = \frac{1}{2} \times \frac{10+R}{2(2+0.5)} \implies R = \frac{10}{9}$$

Lastly, we compute the new bundles and the corresponding utility under the new prices (that incorporate tax) and the additional income from the rebate:

$$d_x(p_x+\tau, p_y, I+1) = d_x(2.5, 1, \frac{10}{9}) = \frac{10}{45}$$

$$d_y(p_x+\tau, p_y, I+1) = d_x(2.5, 1, \frac{10}{9}) = \frac{100}{18}$$

$$U_{posttax} = \frac{1}{2}\ln(\frac{10}{45}) + \frac{1}{2}\ln(\frac{100}{18}) \approx 1.256$$