Lecture 1: Tax Incidence

I. Tax Incidence

(reference: Fullerton & Metcalf 2002 in the *Handbook of Public Economics* (FM))

The **statutory incidence** of a tax refers to the distribution of payment responsibility based on the legal obligation to remit taxes to the government.

The **economic incidence** of a tax measures the changes in economic welfare in society arising from a tax, and differs from statutory incidence as a result of changes in agents' behaviors made to avoid the tax.

Dividing taxpayers into incidence groups:

1. Consumers v. Producers (or suppliers of factors)

2. Capital and Labor (Harberger 1962)

3. Income categories (current (eg Browning 1985), lifetime (Fullerton & Rogers 1993))

4. Regional grouping (Bul et al 1994)

5. Generational accounting

A **uses-side** study analyzes changes in relative product prices and how those changes affect groups differently depending on how they use their income.

A **sources-side** study analyzes changes in relative factor prices and how these changes affect groups differently depending on their sources of income.

Progressivity and Regressivity Define T as the economic burden of the tax, and Y as income.

A proportional tax: $T = mY$

A progressive tax: T/Y increases with income

A regressive tax: T/Y decreases with income

Some tricky cases: Flat tax structure $T = \max\{m(Y - A), 0\}$ is progressive; T/Y starts at 0 and then asymptotes to m.

Medicare payroll tax is regressive, since it applies only to wage income.

How do we assume the government spends its tax revenue?

In what follows we will use the approach of **differential incidence** studies (in which revenue is used to reduce some other tax) where the tax rebate is lump-sum. For more detail on other types of incidence approaches see FM.

Advantage: differential incidence analyses are **additive—**we can study shifts between tax systems

Equivalent variation (EV): We will measure the burden of a tax through the EV, the lump-sum income an agent would give up to avoid the tax.

[to FM Figure 1.1]

The EV in 1.1 is ABEC.

Another approach: change in CS. In figure 1.1 change in CS is ABFC.

Change in CS is a good approximation of EV ONLY when the income elasticity of demand for the taxed good is small.

Unit tax $p+t$ **Ad valorem tax** $p(1+t)$ **Conversion:** $t = t/p$

We'll use just ad valorem.

A Very Simple Model of Incidence with Log Linearization Examples

Untaxed wage w Taxed wage $w(1+t)$ Price of consumption p

Real gross w cost to firm $W = w(1+t)/p$

Log linearize

$$\ln(W) = \ln(w) + \ln(1+t) - \ln(p)$$

Differentiate

$$\frac{dW}{W} = \frac{dw}{w} + \frac{dt}{(1+t)} - \frac{dp}{p}$$

Define $\frac{dW}{W} = \widehat{W}$, etc. (the t case will be different)

$$\widehat{W} = \widehat{w} + \hat{t} - \widehat{p}$$

We'll be interested in changes in equilibrium prices $(\widehat{W}, \widehat{w}, \widehat{p})$ and equilibrium labor (later also capital and output) in response to tax change $\hat{t}$.

Start by fixing the price change $\widehat{p} = 0$.

Labor supply elasticity (set exogenously)

$$h^s \equiv \frac{dL^s / L^s}{dw / w}$$

$$\Rightarrow \widehat{L^s} = h^s \widehat{w} \tag{1.1}$$

Defining labor demand elasticity (h^D) similarly, we find

$$\widehat{L^D} = h^D(\widehat{w} + \widehat{t}) \tag{1.2}$$

Equilibrium condition

$$\widehat{L^D} = \widehat{L^S} \tag{1.3}$$

Solving the 3 eq'ns in our unknown labor supply, demand and tax change we find:

$$\frac{\widehat{w}}{\hat{t}} = \frac{h^D}{h^S - h^D} \tag{1.4}$$

This expression lies btwn 0 and –1 and gives the cost of the tax change to workers as a portion of the total change.

At what values of the elasticities does the burden fall entirely on the employer? on the worker?

Exercise: Derive the solution when the tax is levied on the worker rather than the employer. Does the incidence change?

Some techniques & assumptions we'll need

Producing good X with inputs L and K:

$$X = F(K, L)$$

We want a nice linear form. Differentiate an divide through by X to get

$$\frac{dX}{X} = \frac{F_K K}{X} \cdot \frac{dK}{K} + \frac{F_L L}{X}\frac{dL}{L}$$

Some definitions: r price of capital, p_X is the price of X,

q_K factor share for capital $= (rK / p_X X)$

Perfect competition implies

$$q_K = \frac{F_K K}{X}\text{, and similarly the labor share } q_L = \frac{F_L L}{X}$$

CRS implies factor shares sum to 1. Redefining $q = q_K$; $q_L = 1 - q$,

$$\widehat{X} = q\widehat{K} + (1-q)\widehat{L} \qquad (1.5)$$

Pre-tax **elasticity of substitution btwn K and L** in production (briefly ignoring tax):

$$s = \frac{d(K/L)/(K/L)}{d(w/r)/(w/r)}$$

We find $d(K/L)/(K/L) = \widehat{K} - \widehat{L}$ (check this on own) and so

$$s = \frac{\widehat{K} - \widehat{L}}{\widehat{w} - \widehat{r}}$$

With the tax

$$\widehat{K} - \widehat{L} = s(\widehat{w} + \widehat{t} - \widehat{r}). \qquad (1.6)$$

Note that our log linearization technique means that our solution is a good approximation only for small changes in the tax.

Note also that the log-linearization approach does not require fixed q (as C-D prod'n) or fixed s (as CES prod'n), only that we know initial q & s . We trade off using an approximation that is valid only locally to gain generality in the assumed form of production.

A Model of the Incidence of a Tax on the Consumption Good with Leisure

A special case of the Harberger (1962) 2 sector GE incidence model—
Please study the section on the Harberger model in FM.

$$X = F(K, L), \quad \overline{L} = L + Y \text{ , Y is leisure.}$$

$\overline{L}$ is the fixed total supply of worker hours. Clearly the price of leisure to the worker is the foregone wY. We assume K fixed.

Totally differentiating the labor equation

$$l_{LX}\hat{L} + l_{LY}\hat{Y} = 0 \tag{1.7}$$

where l_{LX} is the labor share that goes into the production of X and l_{LY} goes into the production of Y.

From (1.6) we know

$$\hat{L} = s_X(\hat{r} + \widehat{t_K} - \hat{w} - \widehat{t_L}) \tag{1.8}$$

where $\widehat{t_i}$ is the tax on factor income i.

Under our PC assumption, the value of output = factor payments, or

$$p_X X = w(1 + t_L)L + r(1 + t_K)K$$

Totally differentiating and evaluating at t_i = 0 for *i* = 1,2,

$$\widehat{p_X} + \widehat{X} = q_K(\hat{r} + \widehat{t_K}) + q_L(\hat{w} + \widehat{t_L} + \hat{L}) \tag{1.9}$$

Additionally, we totally differentiate F to find

$$\widehat{X} = q_L\hat{L} \tag{1.10}$$

(since K change is 0, and referring to (1.5)).

Finally, the elasticity of substitution in demand between X and Y for the worker (s_D) is such that

$$\widehat{X} - \widehat{Y} = s_D(\widehat{w} - \widehat{p_X} - \widehat{t_X}), \tag{1.11}$$

where $\widehat{t_X}$ is an *ad valorem* tax on *X*. We have 5 eq'ns (1.7 – 1.11) in 5 unknowns $(\widehat{X}, \hat{L}, \widehat{p_X}, \widehat{w}, \hat{r})$ ($\hat{Y}$ is defined once we know $\hat{L}$.) The solution to this system describes the responses of production and goods and factor prices to a vector of exogenous tax changes.

Substituting (1.7) into (1.11):

$$\widehat{X} + f\hat{L} = s_D(\widehat{w} - \widehat{p_X} - \widehat{t_X}) \tag{1.12}$$

where $f = l_{LX} / l_{LY}$.

Analysis of a tax on capital

Capital is supplied inelastically in this model. Since supplied capital cannot react to a change in its rate of return here the burden of a tax on capital will fall entirely on the owners of capital.

Note that the capital return and tax always appear together as $\hat{r} + \widehat{t_K}$.

If we tax only capital, so $\widehat{t_L} = \widehat{t_X} = 0$, then the solution to the system is

$$\hat{r} = -\widehat{t_K}, \qquad \hat{L} = \hat{p}_X = \widehat{X} = \widehat{w} = 0.$$

FM describe Harberger's general 2 sector GE model of incidence. Here capital is supplied to each sector, and shifting out of capital in sector X to capital in sector Y may occur in response to a tax. Please consider their exposition of this case on your own.

Analysis of a tax on labor

Tax labor only, set $\widehat{t_K} = \widehat{t_X} = 0$.

Use (1.8) and (1.10) to get expressions for $\hat{L}$ and $\widehat{X}$, and substitute these into (1.9) and (1.12) to get a system of 2 eq'ns in unknowns $\hat{r}$ and $\widehat{w}$.

$$\left(\frac{s_D}{f + q_L}\right)\widehat{w} = s_X(\hat{r} - \widehat{w} - \widehat{t_L})$$

$$q_K\hat{r} + q_L(\widehat{w} + \widehat{t_L}) = 0$$

From the second eq'n:

$$\hat{r} = -(q_L / q_K)(\hat{w} + \widehat{t_L})$$

Substituting the above into (1.8):

$$\hat{L} = -\frac{s_X}{q_K}(\hat{w} + \widehat{t_L}) \equiv h^D(\hat{w} + \widehat{t_L})$$

where h^D is the **elasticity of demand for labor** with respect to its cost,

and we've derived the labor demand response to the tax change as before in the simple partial equilibrium (exogenous elasticities) model.

To get the **elasticity of supply for labor**, we use the worker's BC:

$$pX = wL + M$$

Totally differentiate, assuming nonlabor income fixed

$$\hat{p} + \hat{X} = q_L(\hat{w} + \hat{L}) + q_K \hat{M}$$

and substitute into (1.12) to get

$$(q_L + f)\hat{L} = (s_D - q_L)(\hat{w} - \hat{p}) + q_K(\hat{M} - \hat{p})$$

Note that labor supply responds only to changes in the real wage and real income. If all prices, wages and nonlabor income change by the same percentage, then $\hat{L} = \hat{w} = \hat{p} = \hat{M} = 0$. Holding real non-labor income constant,

$$\hat{L} = \frac{s_D - q_L}{q_L + f}(\hat{w} - \hat{p}) \equiv h^S(\hat{w} - \hat{p})$$

Numerator of h^S: q_L is the income effect and s_D the substitution.

The h^S is an uncompensated labor elasticity. Since in our incidence analysis we assume no initial tax AND we return the tax revenue to households lump-sum, we need a compensated elasticity (h_c^S).

$$h_c^S = \frac{s_D}{q_L + f}$$

We can see that the compensated elasticity removes the income effect, and solving our new system

$$\hat{L} = \eta_C^S \hat{w}$$

$$\hat{L} = \eta^D(\hat{w} + \widehat{t_L})$$

we find the GE effects of the labor tax on the factor prices

$$\frac{\hat{w}}{\widehat{t_L}} = \frac{\eta^D}{\eta_C^S - \eta^D} \qquad (1.13)$$

$$\frac{\hat{r}}{\widehat{t_L}} = \left(\frac{q_L}{q_K}\right)\left(\frac{-\eta_C^S}{\eta_C^S - \eta^D}\right) \qquad (1.14)$$

Compare (1.13) to (1.4). The difference between the incidence on labor here and in the simplest PE model is that here we account for the use of the revenue and employ the compensated elasticity of labor supply.

Further, the GE incidence analysis includes analysis of the incidence on capital. Note that the burden on capital responds to both the relative elasticities of labor supply and demand and the value shares of labor and capital.

Tax Equivalencies in the Harberger 2 Sector GE Model

[FM Table 2.2 here]

Empirics: Does the Burden of the Corporate tax Fall Entirely on K?

Harberger found

- The corporate sector is labor-intensive

Capital bears approximately the full burden of the corporate income tax

Krzyaniak and Musgrave (1963) found in time series data on corporate output p and corporate tax rate

> The tax is 'overshifted'—the corp sector raises p by *more* than the amount of the tax, indicating imperfect competition

This finding has been largely discredited as due to reverse causality, and the empirical debate over whether capital bears the burden of the corporate tax continues today.

How does the burden of the US tax system vary across the income distribution?

Pechman and Okner (1974) use data on 72,000 households to answer this question.
They make a range of assumptions on the burdens of payroll, income and corporate taxes (for example: they assume that all of the burden of the employee's payroll tax falls on the worker in all cases, and then they shift the burden of the employer's payroll tax between the employer and the employee.)

Result: They find at both the most progressive set of assumptions and the most regressive that the burden is roughly proportional to income, with higher rates for the first and last deciles.

One problem with their approach is that they look only at the annual and not the lifetime burden.

Fullerton and Rogers (1993) built a model of different-aged consumers with different labor endowments making decisions over the lifetime.

They find approximate proportionality across the middle 8 deciles, with progressivity at the top end and bottom ends.

[FM Table 5.1 here]

Empirical test of annual incidence assumptions

Gruber (1997) and several before have found full burden of employer's and employee's share of the payroll tax on the employee.

Mixed results on whether excise taxes are borne by the consumer:
Fullerton and Metcalf (1999): the burden *could* in some cases be shared with producers
Poterba (1996): overshifting to consumers, indicating market power.

Income tax burden same as statutory: generally assumed, but untested

Property tax: burden on owners of capital or renters? Or simply a payment for local services? No consensus here.