Public Economics (ECON 131)
Section #3: Tax Incidence and Efficiency Costs

February 8, 2017

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1 Tax Incidence

1.1 Key results to keep in mind

1. The *statutory incidence* of a tax is **not generally equal** to its *economic incidence*.
2. The equilibrium outcome is **independent** of who nominally pays the tax; it does not matter if the statutory incidence is on the buyer or the seller.
3. The **more inelastic** side bears more of the tax burden.

1.2 Formulas

- Start with the following:
  - Demand for good x is $D(p')$ decreases with $p' = p + t$, where p' is the price including tax that the consumers pay.
  - Supply for good x is $S(p)$ increases with p, where p is the price received by suppliers.
  - Equilibrium condition: $Q = S(p) = D(p + t)$
- Starting from $t = 0$ and $S(p) = D(p)$, we want to characterize dp/dt: the effect of a tax increase on price, which determines who bears the effective burden of a tax:
- A small change in the tax, dt, generates a small price change, dp, so that equilibrium holds:

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

- Use the following useful definitions:
  - **Elasticity:** Percentage change in quantity when price changes by one percent. We often use elasticities in economic analysis because they are unit-free.
  - **Price elasticity of demand:** $\varepsilon_D = \frac{p'}{D}\frac{dD}{dp'} = \frac{p'D'(p')}{D(p')} < 0$
  - **Price elasticity of supply:** $\varepsilon_S = \frac{p}{S}\frac{dS}{dp} = \frac{pS'(p)}{S(p)} > 0$
- Then, we have the following formulas summarizing responses to taxes:

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

- Also, $-1 \leq \frac{dp}{dt} \leq 0 \quad \text{and} \quad 0 \leq \frac{dp'}{dt} = 1 + \frac{dp}{dt} \leq 1.$
- When do consumers bear the entire burden of the tax? ($dp/dt = 0$ and $dp'/dt = 1$)
  1. $\varepsilon_D = 0$ [inelastic demand]
     - Example: short-run demand for gas inelastic (need to drive to work)
  2. $\varepsilon_S = \infty$ [perfectly elastic supply]
     - Example: perfectly competitive industry

- When do producers bear the entire burden of the tax? ($dp/dt = -1$ and $dp'/dt = 0$)
  1. $\varepsilon_S = 0$ [inelastic supply]
     - Example: fixed quantity supplied (land)
  2. $\varepsilon_D = -\infty$ [perfectly elastic demand]
     - Example: there is a close substitute, and demand shifts to this substitute if price changes.

1.3 Practice problems

1.3.1 Gruber, Ch.19, Q.2 (modified)

The demand for rutabagas is $Q = 2,000 - 100P$ and the supply of rutabagas is $Q = -100 + 200P$.

1. *Who bears the statutory incidence of a $2 per unit sales tax on rutabagas, paid by the producer and reflected in the sticker price?*
2. *Who bears the economic incidence of this tax? (Discuss)*
3. *What is the equilibrium price without the tax?*
4. *What is the equilibrium price with the tax?*
5. *What are the tax burdens on the consumer and producer?*

1.3.2 Gruber, Ch.19, Q.3 (modified)

The demand for rutabagas is still $Q = 2,000 - 100P$ and the supply is still $Q = -100 + 200P$, as in Question 2. Governor Sloop decides that instead of imposing the \$2 sales tax described in Question 2, the government will instead force consumers to pay the tax, such that the tax is no longer reflected in the sticker price. What will happen to the "sticker price" on rutabagas? How will the size of the consumer tax burden change?

1.3.3 Gruber, Ch.19, Q.4

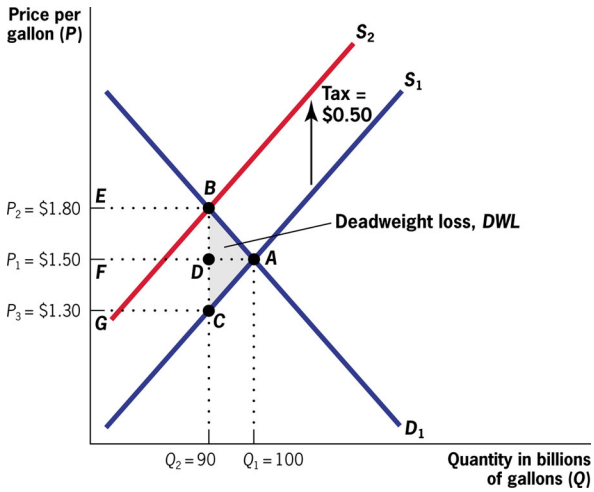
The demand for football tickets is $Q = 360 - 10P$ and the supply of football tickets is $Q = 20P$. Calculate the gross price paid by consumers after a per-ticket tax of \$4. Calculate the after-tax price received by ticket sellers.

2 Efficiency Costs of Taxation

- We know that governments use tax revenue to finance public goods or to redistribute income from rich to poor. As you saw in lecture if the government could do lump-sum taxes and transfers based on earning ability then any redistributive equilibrium could be reached.
- However, in practice earning ability is hard to observe: The government does not know if a person's income is low because they cannot work (e.g disability) or because they do not want to work. Therefore the government taxes observed outcome such as income and consumption.
- As a consequence tax revenue generally has an efficiency cost: to generate \$1 of revenue, need to reduce welfare of the taxed individuals by more than \$1. Efficiency costs come from distortion of behavior.
- **Deadweight burden** (also called excess burden) of taxation is defined as the welfare loss (measured in dollars) created by a tax over and above the tax revenue generated by the tax.
- We can measure the deadweight burden of a tax by the **Harberger Triangle**:

$$DWB = \frac{1}{2} dQ \cdot dt = \frac{1}{2} \cdot \frac{\varepsilon_S \cdot \varepsilon_D}{\varepsilon_S - \varepsilon_D} \cdot \frac{Q}{p} (dt)^2$$

- In a simple supply and demand diagram, welfare is measured by the sum of the consumer surplus and producer surplus. We can measure the **welfare loss of taxation** as the change in consumer + producer surplus minus tax collected: it is the triangle on the figure.



- The inefficiency of any tax is determined by the extent to which consumers and producers change their behavior to avoid the tax; deadweight loss is caused by individuals and firms making inefficient consumption and production choices in order to avoid taxation.
- If there is no change in quantities consumed, the tax has no efficiency costs.

2.1 Practice problems

2.1.1 Gruber, Ch.20, Q.2

The government of Washlovia wants to impose a tax on clothes dryers. In East Washlovia the demand elasticity for clothes dryers is -2.4 while in West Washlovia the demand elasticity is -1.7. Where will the tax inefficiency be greater? Explain.

2.1.2 Gruber, Ch.20, Q.10 (adapted)

The market demand for pet turtles is $Q = 2,600 - 20P$, and the government intends to place a \$4 per turtle tax on pet turtle purchases. Calculate the deadweight loss of this tax when:

1. *Supply of pet turtles is $Q = 400$.*
2. *Supply of pet turtles is $Q = 12P$.*
3. *Explain why the deadweight loss calculations differ between 1 and 2.*