MIT 14.01: Principles of Microeconomics
Sp 2025, Lecture 5: Policy (Intro)

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Plan for Today

- Impacts of various economic policies (taxes, subsidies, price controls, quantity controls)
- Concept of social waste – deadweight loss
- Incidence of policies – who "pays" the tax?

Introduction to Economic Policy

- Recall the First Welfare Theorem: the competitive equilibrium – *without* taxes or regulations – is Pareto Efficient
  - At least under the "no market failures" assumption that we'll probe later in this class
- But policies such as taxation and regulation are common features of modern economies.
- What are some examples from specific markets you know well?
- Important to understand what effects these policies are likely to have, in order to gauge whether they are a good idea

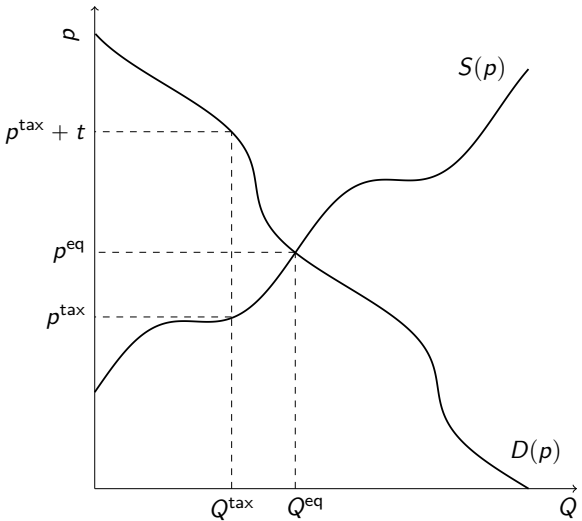
A Tax

- Start with the simplest policy of them all: a per-unit (also sometimes called a "specific") *tax* t on the sale or consumption of the good we are examining (e.g. bednets)
- NB: Per-unit is different from "ad-valorem" (i.e. "per-value", often written as a % of the value), which is more common nowadays (e.g. MA sales tax is 6.25% of the sticker price in dollars)
  - Specific and ad-valorem taxes have similar effects, but the math is easier for specific, so we'll work with that case

Taxation Basics (cont.)

- Think for a second about how the MA 6.25% sales tax actually works:
  - Firm puts a sticker on an item at price p per unit sold
  - Law says consumer actually has to pay the firm $(1.0625) \times p$ per unit sold
  - Firm takes these receipts ($(1.0625) \times p$ per unit sold), keeps p per unit sold, and transmits the difference ($0.0625 \times p$ per unit sold) to the government at the end of each month/year
- But who actually "pays" the tax? The consumer?
- As we shall see, it's complicated...but, a few things are clear:
  - The *statutory incidence* of the tax (i.e. whose price needs to be adjusted by t) is on the consumer
  - However, the system asks the firm to actually *collect* the tax payment, on the government's behalf, and rebate it later to the government. (Why the firm?)
  - (Aside: in most of the world the statutory incidence of sales taxes is actually different: consumer pays p, but the firm gets to keep only $p(1-t)$ and gives the difference, pt, to the government. That said, in the US "excise" taxes, e.g. on alcohol, do work this way.)

Positive (As Opposed to Normative) Effects of a Tax



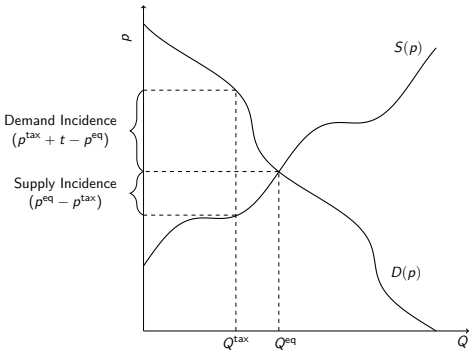
- Drawn for case of a specific (i.e. per-unit) tax t on this good, and where the statutory incidence of the tax t is on the consumer:

$$D(p^{tax} + t) = S(p^{tax}) = Q^{tax}$$

- Also shown: p^{eq} is the equilibrium price if there were no tax
- But note (think about it!) we'd have gotten the same quantity if statutory incidence of (equal-sized) tax t were instead on the producer:

$$D(p^{tax}) = S(p^{tax} - t) = Q^{tax}$$

Positive (As Opposed to Normative) Effects of a Tax



Five key points to note:

1. $t > 0 \Rightarrow Q^{tax} \leqslant Q^{eq}$. Quantity falls.
2. $p^{tax} + t \geqslant p^{eq}$. Tax raises the price the consumer pays (bad for them).
3. $p^{tax} \leqslant p^{eq}$. Tax lowers the price the firm gets (also bad for them).
4. Firm and consumer "share" the *economic incidence* (e.g. consumer pays $\leqslant p^{eq} + t$)—in the same way that we saw them share the incidence of (say) a supply shock last lecture.
5. *Government revenue*: $GR \equiv t \times Q^{tax}$

And all of these statements are true no matter who has the statutory incidence

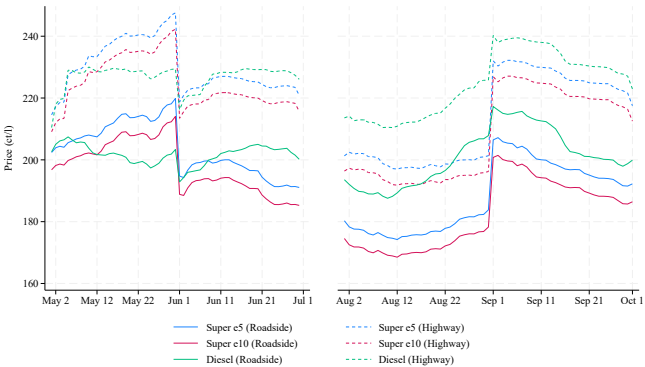
What Affects the Incidence?

- If we differentiate $D(p^{\text{tax}} + t) = S(p^{\text{tax}})$ w.r.t. t (not something you need to worry about) we can solve for the effect on the price the supplier receives (i.e. p^{tax}):

$$\frac{dp^{\text{tax}}}{dt} = \left(\frac{\varepsilon_{S,p}}{\varepsilon_{D,p}} - 1\right)^{-1}$$

- But since consumer pays $p^{\text{tax}} + t$, effect on consumer price is just $\frac{dp^{\text{tax}}}{dt} + 1$
- So we have:
  - When supply is perfectly elastic ($\varepsilon_{S,p} = \infty$): all incidence falls on demand (i.e. $\frac{dp^{\text{tax}}}{dt} = 0$ and $\frac{dp^{\text{tax}}}{dt} + 1 = 1$)
  - When supply is perfectly inelastic ($\varepsilon_{S,p} = 0$): all incidence falls on supply (i.e. $\frac{dp^{\text{tax}}}{dt} = -1$ and $\frac{dp^{\text{tax}}}{dt} + 1 = 0$)
  - And analogously if you flip supply and demand in these statements
  - Try visualizing these on the previous figure!
- Bottom line: the side that is *relatively* more inelastic (in absolute value) bears more of the incidence

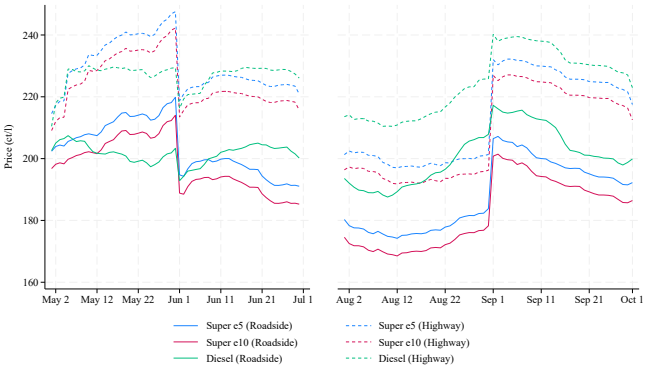
Incidence of Two Changes in German Fuel Taxes



- June 1, 2022: Germany lowered gasoline taxes by 0.35 EUR/liter (and diesel by 0.17 EUR/liter) as relief against price rises caused by Ukraine war;
- Sept 1, 2022: policy reverted

von Waldow and Link (2024)

Incidence of Two Changes in Fuel Taxes (Germany)



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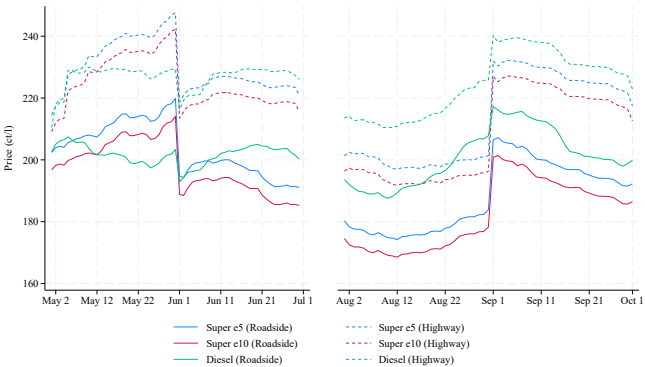
- This is an "event study" (or "first-difference", "time series", or "RD in time") method of causal inference
- The assumption is that potential outcomes at any time t (such as some outcome Y under "treatment" of the tax cut, $Y_t(T)$) wouldn't jump at date $\bar{t}$ in the absence of treatment; that is, for small ε we might believe that

$$\mathbb{E}[Y_t(T)|t = \bar{t} + \varepsilon] = \mathbb{E}[Y_t(T)|t = \bar{t} - \varepsilon]$$

Incidence of Two Changes in Fuel Taxes (Germany)



von Waldow and Link (2024)

- Price change (right around change dates) is about 75% as big as the tax change, so consumers bore 75% of the incidence
- So seems that $\varepsilon_{S,p}$ is big relative to $|\varepsilon_{D,p}|$. Are you surprised?

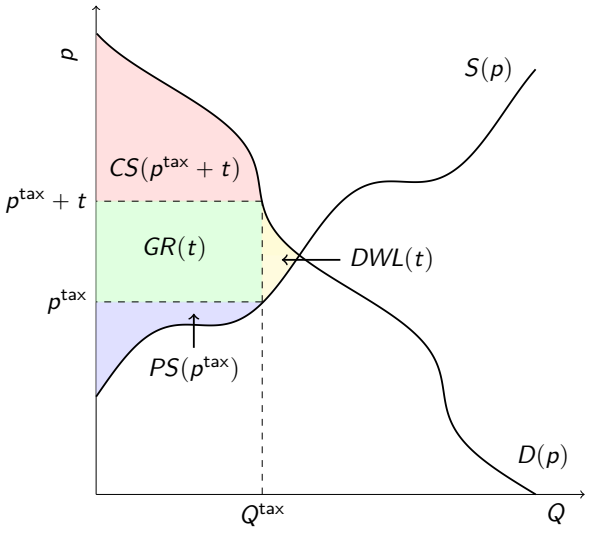
Normative Effects of a Tax (the "Welfare" Effect of Tax $t > 0$)

- Suppose the tax revenue ($GR(t) \equiv t \times Q^{\text{tax}}$) gets redistributed back to the consumers and firms
  - And this redistribution is uniform (i.e if tax revenue is GR then each firm or consumer gets $GR/(N_C + N_F)$ back)
  - Of course, the real world is more complicated: GR gets spent on programs, which people value differently (and which cost resources to deliver). But start here.
- Then, given t, the total surplus inclusive of redistribution is

$$W(t) \equiv PS(p^{\text{tax}}) + CS(p^{\text{tax}} + t) + GR(t)$$

  - But don't forget the value judgements required to call $W(t)$ a good measure of total social welfare
- What value of t would maximize this? We can use our earlier model of supply and demand to think about this with one caveat:
  - Have to augment it to include fact that firms and consumers get a transfer of $GR/(N_C + N_F)$ back
  - This assumes that every firm/consumer ignores the fact that their action will have a tiny effect on the total GR, and hence on the transfer they get back. But this effect is tiny (if N_C or N_F large) so seems fine to ignore.

Normative Effects of a Tax

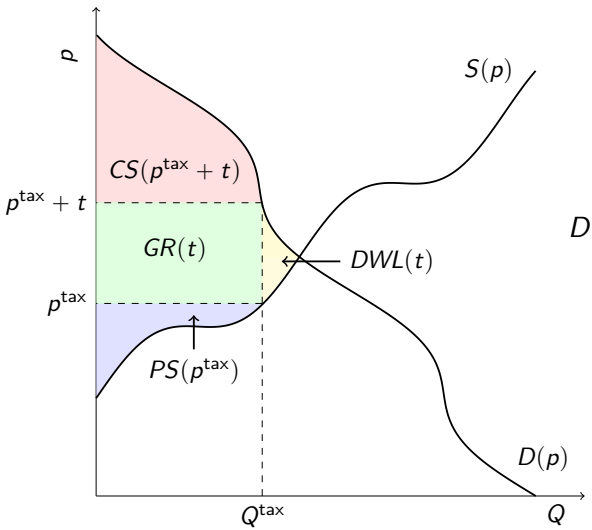


- We know from Lecture #4 that the CE without taxes maximizes TS, so any $t \neq 0$ has to cause a drop in TS
- *Deadweight loss* (= "excess burden") of tax t defined as:

$$DWL(t) \equiv W(0) - W(t)$$

- Intuition: $DWL(t) \geqslant 0$ because $t > 0$ prevents some trades (and hence eliminates some gains from trade)...
- Therefore sometimes refer to a tax as a "distortion"

How Large Is the Deadweight Loss from a Tax?



- If the tax t is "small" we can do a Taylor approximation for $DWL(t)$
- To second-order, we can derive (but you don't need to) the *Harberger triangle* formula:

$$\begin{aligned} DWL(t) &\approx \frac{1}{2}(Q^{\text{eq}} - Q^{\text{tax}})t \\ &\approx \frac{\varepsilon_{S,p}}{2} \cdot \left(\frac{\varepsilon_{S,p}}{\varepsilon_{D,p}} - 1\right)^{-1} \cdot \frac{Q^{\text{eq}}}{p^{\text{eq}}} \cdot t^2 \end{aligned}$$

- Of course, if $D(p)$ and $S(p)$ are linear then $DWL(t) = \frac{1}{2}(Q^{\text{eq}} - Q^{\text{tax}})t$ holds exactly (but elasticity formula still only approximate...why?)

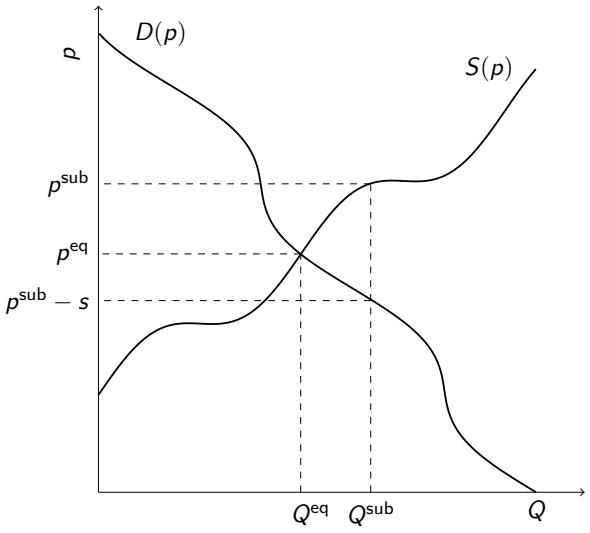
How Large Is the Deadweight Loss from a Tax?

- Note how (holding constant the elasticities and Q^{eq}/p^{eq}) *DWL* scales with t^2....
  - That is, small taxes are pretty harmless, but big taxes are a lot worse
  - Intuition: tax destroys gains from trade; at small t those trades aren't worth much (recall marginal trade has zero surplus); but starting at large t if we increase the tax a bit then the trades we destroy are worth more and more

- In fact, starting at $t = 0$, an infinitesimally small tax creates no *DWL*
  - Math: $\frac{dDWL(t)}{dt} = \kappa t$ for some constant $\kappa \geqslant 0$. So derivative at $t = 0$
  - Intuition: the trades destroyed by a tax, starting at $t = 0$, had zero surplus anyway

- Also, note how it all comes down to the change in Q: $Q^{eq} - Q^{tax}$...
  - That is, $DWL(t) = 0$ if either $\varepsilon_{S,p} = 0$ or $\varepsilon_{D,p} = 0$
  - Intuition: if the Q doesn't change then no trades get destroyed
  - Implication: if you do have to tax some good (e.g. to raise government revenue *GR*), it's better to choose a good that is either inelastically demanded (e.g. cigarettes?) or supplied (e.g. land?), or (even better) both

What About the Case of a Subsidy?

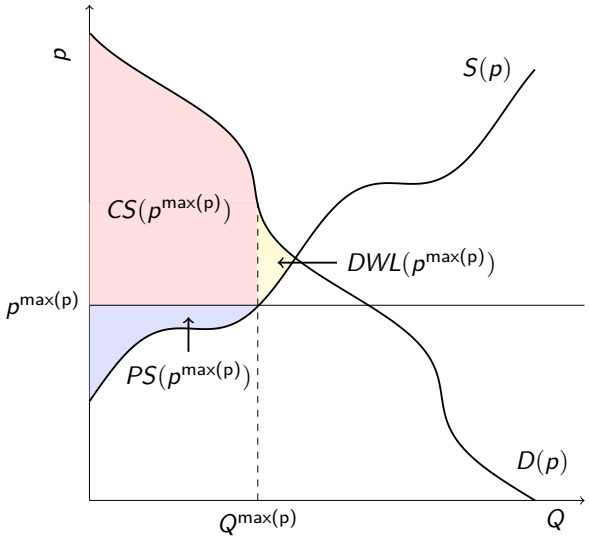


- Now suppose we *subsidize* the sale of this good at $s > 0$ per unit: producer gets p^{sub} but consumer pays $p^{\text{sub}} - s$
- Now $GR(s) < 0$ since govt. is paying out s on each unit sold
- And $DWL(s) \approx \frac{1}{2}(Q^{\text{sub}} - Q^{\text{eq}})s > 0$ by reverse of previous intuition: govt is paying people to conduct trades that aren't worth it (creating trades with negative gains from trade)
- Note how a subsidy of s has the same effects as a tax of $-t$...which makes sense, since a subsidy is just a negative tax

Price Controls

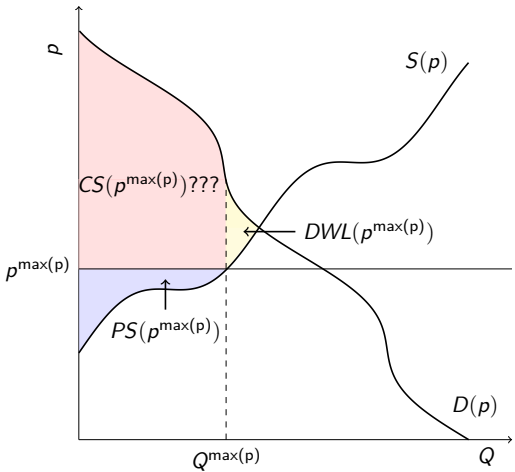
- So far we've covered taxes: for every exchange, one side has to pay an amount to the government
- Another common form of policy intervention in markets is a *price control*: when law says that all exchanges are allowed to happen, but only if:
  - $p \geqslant p^{\min(p)}$ in the case of a price floor
  - $p \leqslant p^{\max(p)}$ in the case of a price ceiling
- Can you think of any examples?

What Are the Effects of Price Controls? (An Optimistic View)



- Say that $p^{\max(p)} < p^{eq}$ (i.e. the price ceiling is "binding")
- Drawn here it looks like the only downside of the policy (for total welfare) is the $DWL > 0$—no GR collected, but the policy has engineered a transfer of surplus from producers to consumers
- BUT: this was drawn for a (probably highly unrealistic) best-case scenario in regards to the question of "which consumers will be lucky enough to get the good?"

What Are the Effects of Price Controls? (A Pessimistic View)



- The problem:
  - At $p^{\max(p)}$, firms will only supply $Q^{\max(p)} = S(p^{\max(p)})$
  - But $Q^{\max(p)}$ is less than $D(p^{\max(p)})$, the amount consumers want at $p^{\max(p)}$
- Best case scenario: somehow, the right to buy at $p^{\max(p)}$ is given to those consumers with the relatively largest *WTP*s—but why would that happen?
- If instead the right to buy at $p^{\max(p)}$ is given out randomly, will end up destroying lots of *CS* (leading to more *DWL*)
- And even random assignment might be naively overoptimistic if consumers "lobby" for these rights (aka "rent-seeking")

Quantity Restrictions

- Another common type of policy is a *quantity restriction*:
  - E.g. $Q \leqslant Q^{\max(q)}$ in case of occupational licensing (e.g. teachers, doctors...)
  - E.g. $Q \geqslant Q^{\min(q)}$ in case of a compulsory military draft
  - Sometimes quantity restrictions are placed at the individual level (e.g. wartime food rationing)
- The analysis of these policies is similar to that of price controls

Summary of Policy Effects

- The FWT told us that, in the absence of market failures, the competitive equilibrium without taxes (CE) is the best allocation in the Pareto efficiency sense
  - And it maximizes total surplus (TS) in the case of our particular supply-demand model
- So no surprise that TS falls (i.e. $DWL > 0$ happens) whenever a policy intervenes and moves away from the CE
- But such policies may nevertheless be a good thing if:
  - Society values people differently (e.g *CS* over *PS*)
  - Society really needs the *GR* for *other* people
  - Left to its own devices, the market wouldn't arrive at the CE (e.g. perfect competition seems unrealistic)—will study later in semester
  - There are market failures (externalities, public goods)—will study later in semester
- Bottom line: understand well the negative effects of policies that we've seen today so as to compare them to potential offsetting benefits

Concluding Remarks

- **Key concepts from today's lecture:**
  - Economic incidence of tax depends on whether supply-side or demand-side is more inelastic—incidence borne more by side that is more inelastic
  - Statutory incidence of tax is irrelevant in the model we've seen
  - Policies create deadweight loss "triangle", increasing quadratically with the size of the policy (as long as neither side is perfectly inelastic)
  - Price/quantity controls create DWL
  - And quantity controls usually create an extra distortionary costs (due to inefficient allocation of the good when there is no price mechanism to control who gets the goods that are rationed)
  - New method for causal inference: event study (aka regression discontinuity in time)

- **Next lecture:**
  - Dig into the consumer problem in more detail so that we can understand wider sets of economic phenomena and policy