ECON 7670: Incidence

Elliott Isaac

Department of Economics
Tulane University

January 26, 2023

Tax Incidence in Theory

Tax Incidence

- **Tax incidence**: assessing which party (consumers or producers) bears the true burden of a tax
- Just because the government levies a tax on producers doesn't mean that producers actually end up paying for it
  - **Statutory incidence**: the burden of a tax borne by the party that sends the check to the government
  - **Economic incidence**: the burden of taxation measured by the change in the resources available to any economic agent as a result of taxation

Tax Incidence

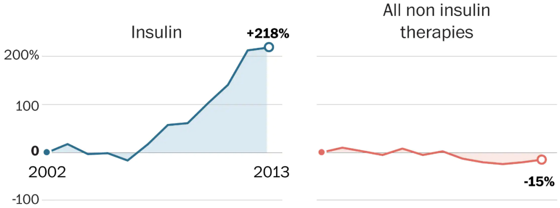
- Example: Insulin

The New York Times

U.S. Insulin Costs Per Patient Nearly Doubled From 2012 to 2016: Study

Spending on insulin has increased faster than other diabetes drugs

Spending on insulin per patient has skyrocketed, driven by price hikes and increased use. In 2013, insulin spending was more than all other diabetes medications combined.



Note: Does not include rebates or discounts

Source: Journal of the American Medical Association

THE WASHINGTON POST

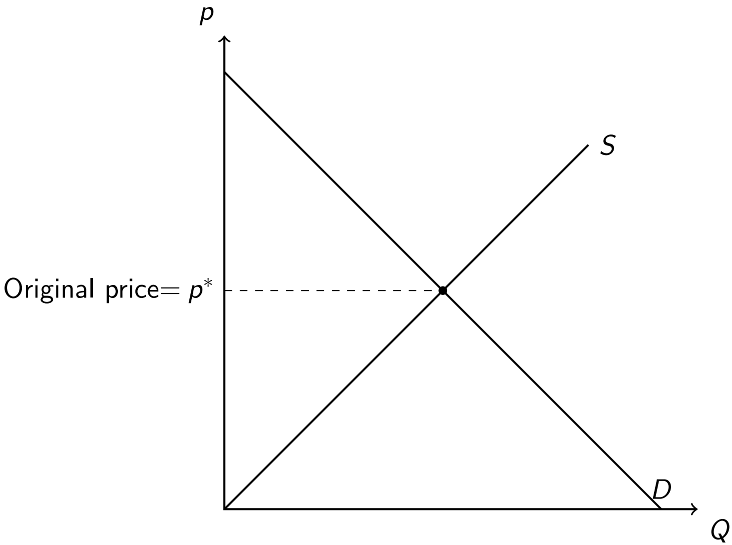
Tax Incidence

- Example: Insulin
    - Patients with diabetes need to buy insulin
    - Suppose the government levies a tax on insulin producers, so that the producers need to pay $1 per unit sold
    - The producers know that their patients need to buy insulin no matter what, so they could just raise their price by $1 per unit
    - The producers pass the cost of the tax along to the consumer instead, even though the government levied the tax on producers

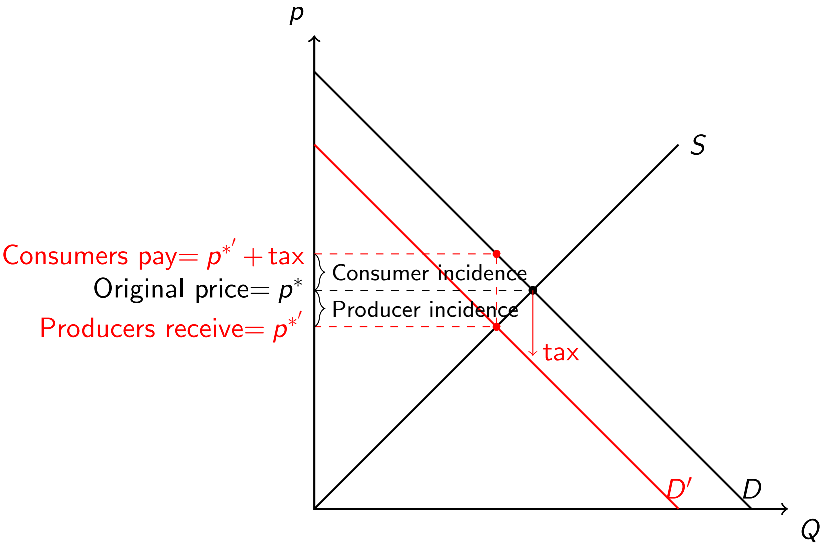
Tax Incidence

- Taxes cause a difference between the prices producers/consumers receive/pay
- **Tax wedge**: the difference between what consumers pay and what producers receive (net of tax) from a transaction
- **Sticker/equilibrium price**: the equilibrium price in the market (gross price excluding taxes/subsidies)
- After-tax price differs for consumers/producers:
  - **After-tax price producers receive**: sticker price **minus** the amount of the tax (if a tax) or **plus** the amount of the subsidy (if a subsidy)
  - **After-tax price consumers receive**: sticker price **plus** the amount of the tax (if a tax) or **minus** the amount of the subsidy (if a subsidy)

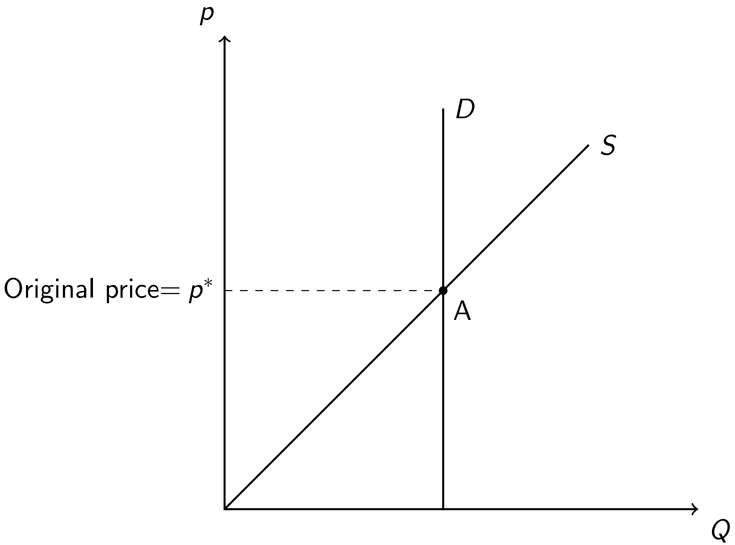
Tax Incidence: Visual Representations



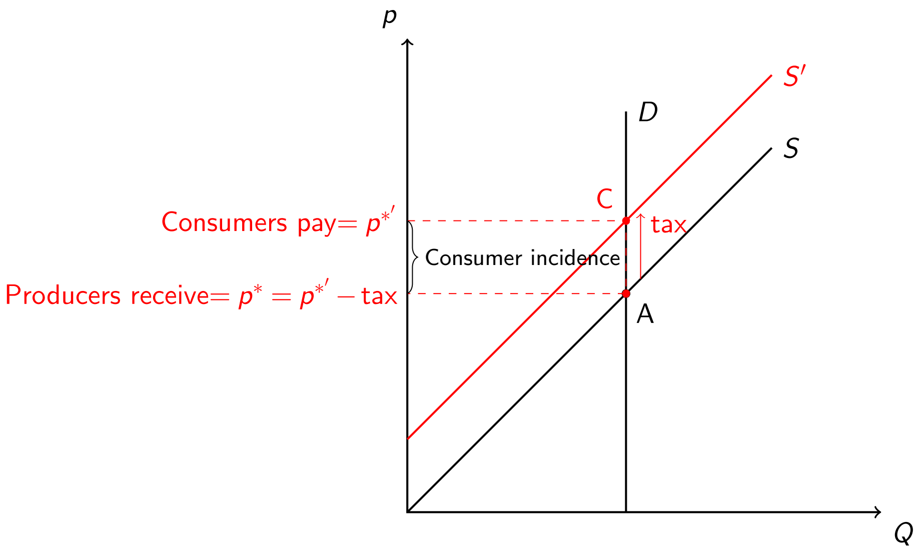
Tax Incidence: Visual Representations



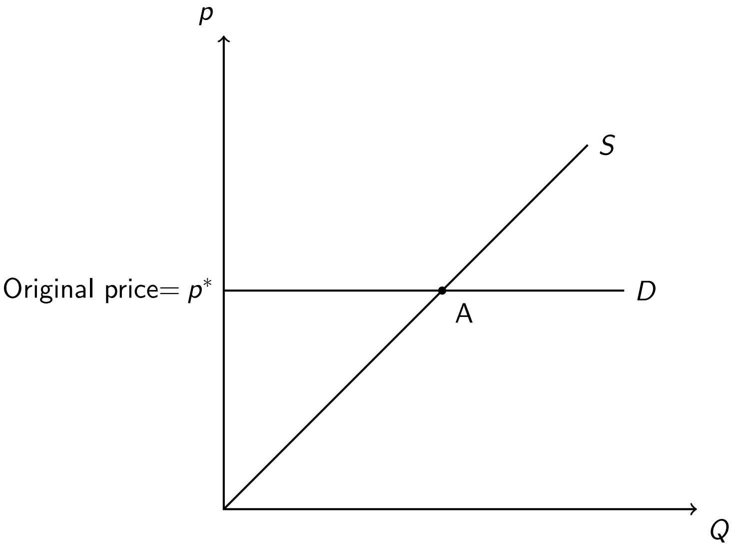
Tax Incidence: Visual Representations



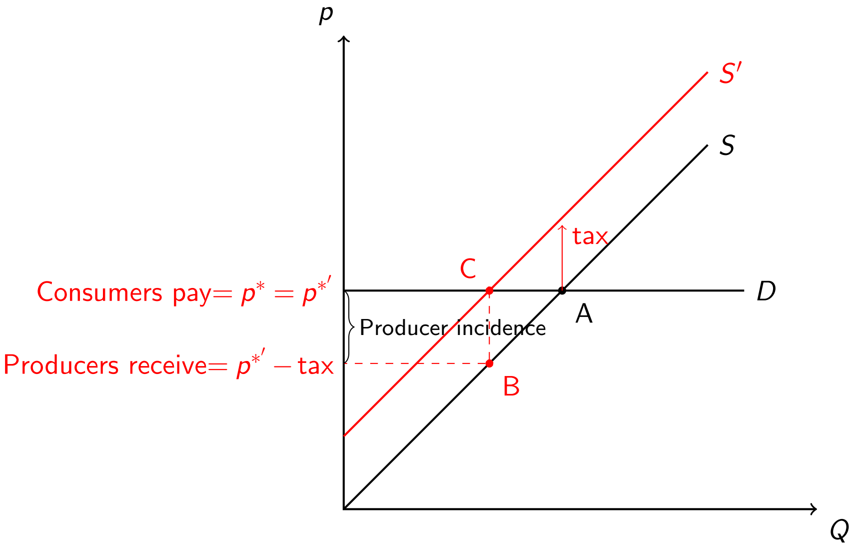
Tax Incidence: Visual Representations



Tax Incidence: Visual Representations



Tax Incidence: Visual Representations



Tax Incidence: Mathematical Representation

Key assumptions:

1. **Two good economy**
   - Only 1 relative price $\rightarrow$ partial and general equilibrium are the same
   - Can be viewed as an approximation of incidence in a multi-good model if:
     - Market being taxed is "small"
     - There are no close substitutes/complements in utility
2. **Tax revenue is not spent on taxed good**
   - Tax revenue is used to buy untaxed good or thrown away
3. **Perfect competition among producers**

Tax Incidence: Mathematical Representation

- Two goods: x and y
- Government levies an **excise tax** on good x (paid by consumers)
  - **Excise/specific/per-unit tax**: levied on a quantity (e.g., gallon, pack, ton)
  - **Ad-valorem tax**: fraction of prices (e.g., sales tax)
- Let p denote sticker price of x, and $p + t$ denote tax-inclusive price of x
- Good y (numeraire) is not taxed, and has a price of 1

Tax Incidence: Mathematical Representation

Demand:

- Consumer has income Z and utility function $u(x,y)$
- Solving the consumer's utility maximization problem yields $x_i^*(p+t,Z)$ and $y_i^*(p+t,Z)$
- Holding $Z=\bar{Z}$ constant and varying $p+t$ reveals the individual consumer's demand function for good $x_i^*(p+t,\bar{Z})=D_i(p+t)$
- Assuming all consumers are identical, market demand is $D(p+t)=\sum_i D_i(p+t)$
- $\varepsilon_D=\frac{\partial D(p+t)}{\partial(p+t)}\frac{p+t}{D(p+t)}=\frac{\partial \log D(p+t)}{\partial \log(p+t)}$ is the price elasticity of demand for good x

Tax Incidence: Mathematical Representation

Supply:

- Perfectly competitive (price-taking) firms use $c(S)$ units of y (numeraire) to produce S units of x
- Cost of production is increasing and convex: $c'(S) > 0$ and $c''(S) \geq 0$
- Firm's profit at sticker price p is $\pi_j = pS - c(S)$
  - Profit maximization with perfect competition implies $p = c'(S_j(p))$
  - $S_j(p)$ is the firm's (implicitly defined) supply function of good $x_j^*(p) = S_j(p)$
- Assuming all firms are identical, market supply is $S(p) = \sum_j S_j(p)$
- $\varepsilon_S = \frac{\partial S(p)}{\partial p}\frac{p}{S(p)} = \frac{\partial \log S(p)}{\partial \log p}$ is the price elasticity of supply for good x

Tax Incidence: Mathematical Representation

- **Equilibrium**:

- Equilibrium occurs when $Q = D(p + t) = S(p)$

- Equilibrium implicitly defines an equation $p(t)$

- Goal: characterize $\frac{dp}{dt}$, the effect of a tax increase on price

Tax Incidence: Mathematical Representation

- Implicitly differentiate equilibrium condition wrt t to get:

$$D(p+t) = S(p)$$

$$\frac{\partial D(p+t)}{\partial p}\left(\frac{dp}{dt}+1\right) = \frac{\partial S(p)}{\partial p}\frac{dp}{dt}$$

$$\frac{\partial D(p+t)}{\partial p} = \left(\frac{\partial S(p)}{\partial p} - \frac{\partial D(p+t)}{\partial p}\right)\frac{dp}{dt}$$

$$\frac{dp}{dt} = \frac{\frac{\partial D(p+t)}{\partial p}}{\frac{\partial S(p)}{\partial p} - \frac{\partial D(p+t)}{\partial p}}$$

Tax Incidence: Mathematical Representation

- Multiply rhs by $\frac{\frac{p}{D(p+t)}}{\frac{p}{D(p+t)}}$, noting that $D(p+t) = S(p)$ in equilibrium:

$$
\begin{aligned}
\frac{dp}{dt} &= \frac{\frac{\partial D(p+t)}{\partial p}}{\frac{\partial S(p)}{\partial p} - \frac{\partial D(p+t)}{\partial p}} \\
\frac{dp}{dt} &= \frac{\frac{\partial D(p+t)}{\partial p}\frac{p}{D(p+t)}}{\frac{\partial S(p)}{\partial p}\frac{p}{D(p+t)} - \frac{\partial D(p+t)}{\partial p}\frac{p}{D(p+t)}} \\
\frac{dp}{dt} &= \frac{\varepsilon_D}{\varepsilon_S - \varepsilon_D}
\end{aligned}
\tag{1}
$$

- Consumer incidence is $\frac{d(p+t)}{dt} = \frac{dp}{dt} + 1 = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D}$

Estimating Tax Incidence

- You need estimates of ε_D and ε_S to estimate tax incidence
- What data do you need to estimate ε_D and ε_S?

Estimating Tax Incidence

- You need estimates of ε_D and ε_S to estimate tax incidence
- What data do you need to estimate ε_D and ε_S?
  - Prices
  - Quantities
  - Identifying variation in prices and quantities

IV Estimation of Price Elasticities

- How to estimate price elasticity of demand when tax and prices do not move together 1-1?
    - Instrument for prices using taxes
- First stage, taking note of F-stat:

  $$P_{jt} = \alpha' + \gamma_t' + \delta_j' + \beta T_{jt} + \varepsilon_{jt}$$

- Second stage:

  $$Q_{jt} = \alpha + \gamma_t + \delta_j + \lambda \widehat{P}_{jt} + \varepsilon_{jt}$$

- Reduced form, using T_{jt} as an instrument for P_{jt}:

  $$Q_{jt} = \alpha + \gamma_t + \delta_j + \mu T_{jt} + \varepsilon_{jt}$$

- 2SLS regression coeff. is ratio of redued-form to first-stage coeff.:

  $$\hat{\lambda} = \hat{\mu} / \hat{\beta}$$

- 2SLS rescales reduced-form to account for $\Delta P / \Delta T \neq 1$

IV Estimation of Price Elasticities

- Estimating ε_D requires instrumenting for *post-tax* price with tax
- Estimating ε_S requires instrumenting for *pre-tax* price with tax

Curve	**First Stage**	**Reduced Form**	**IV Elasticity Estimate**
Demand	$\frac{d(p+t)}{dt}$	$\frac{dQ}{dt}$	$\varepsilon_D = \frac{\frac{dQ}{dt}}{\frac{d(p+t)}{dt}}$
Supply	$\frac{dp}{dt}$	$\frac{dQ}{dt}$	$\varepsilon_S = \frac{\frac{dQ}{dt}}{\frac{dp}{dt}}$

- Incidence formula: $\frac{dp}{dt} = \frac{\varepsilon_D}{\varepsilon_S - \varepsilon_D}$ and $\frac{d(p+t)}{dt} = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D} \Rightarrow \frac{\frac{dp}{dt}}{\frac{d(p+t)}{dt}} = \frac{\varepsilon_D}{\varepsilon_S}$
- Identify both slopes using two moments: price and quantity effects

Evans, Ringel, and Stech (1999)

Evans, Ringel, and Stech (1999)

- Research question: How do cigarette tax increases affect prices?
    - Do taxes take money from cigarette companies or smokers?

Evans, Ringel, and Stech (1999)

- Cigarettes taxed at both federal and state levels in U.S.
- Total revenue of about $35 billion per year
- Federal tax increased from $0.39 to $1.01 per pack in 2009
- State taxes vary across states: from $0.30 per pack to $4.35 per pack in 2012

Evans, Ringel, and Stech (1999)

- Since 1975 there have been more than 200 state tax changes $\rightarrow$ natural experiments to investigate tax incidence
- Exploit these state-level changes in excise tax rates using simple difference-in-differences design
- First difference: Compare cigarette prices before and after the change within area A

  $$D = [P_{A1} - P_{A0}]$$

- Identification assumption: Absent the tax change, there would have been no change in cigarette price

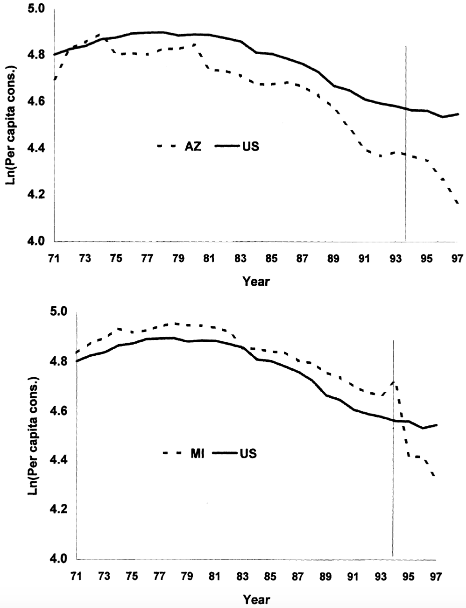
Evans, Ringel, and Stech (1999)

- But what if price fluctuates because of climatic conditions or trends in demand?
- Then $D = [P_{A1} - P_{A0}]$ estimate will be biased
- Relax identifying assumption using difference-in-differences

$$DD = [P_{A1} - P_{A0}] - [P_{B1} - P_{B0}]$$

- Area A experienced a tax change (treatment group)
- Area B did not experience any tax change (control group)
- Identification assumption: Absent the policy change, $P_1 - P_0$ would have been the same for A and B (parallel trends)

Evans, Ringel, and Stech (1999)



Evans, Ringel, and Stech (1999)

- Can use placebo *DD* to test parallel trends assumption
  - Pretend the reform occurred at other points and replicate the estimate
- If *DD* in other periods is not zero, then $DD_{t=1}$ is likely biased
  - Useful to plot long time series of outcomes for treatment and control
  - Pattern should be parallel lines, with sharp change just after reform
  - Rest of U.S. is good control for Michigan, but not Arizona

Evans, Ringel, and Stech (1999)

- Some studies use a "triple difference" (DDD)
- Chetty, Looney, and Kroft (2009): experiment using treatment/control products and treatment/control stores

  $DDD = DD_{TS} - DD_{CS}$

- DD_{TS}: Difference between treatment/control products within treatment store
- DD_{CS} Difference between treatment/control products within control store
- DDD is mainly useful as a robustness check
  - If $DD_{CS} \neq 0$, then unconvincing that DDD removes all bias
  - If $DD_{CS} = 0$, then $DD = DDD$, but DD has smaller SE

Evans, Ringel, and Stech (1999)

- Data for 50 states, $\sim$30 years, and many tax changes
- Want to pool all this data to obtain a single incidence estimate
- Fixed effects generalize DD with $S > 2$ periods and $J > 2$ groups
- Suppose group j in year t experiences policy T of intensity T_{jt}
- We want to identify the effect of T on price P
- OLS regression: $P_{jt} = \alpha + \beta T_{jt} + \varepsilon_{jt}$
- Without fixed effects, $\hat{\beta}$ is biased if T_{jt} is correlated with ε_{jt}
  - Ex.: States with higher tax rates may have more anti-tobacco campaigns, which can influence cigarette price through demand

Evans, Ringel, and Stech (1999)

- Include state and year fixed effects to solve this problem:

$$P_{jt} = \alpha + \gamma_t + \delta_j + \beta T_{jt} + \varepsilon_{jt}$$

- Identification comes from within-state variation over time

- Common changes that apply to all groups (e.g., federal tax change) is captured by year fixed effect and is not a source of identifying variation for β

Evans, Ringel, and Stech (1999)

- Advantage relative to *DD*: more precise estimates by pooling several changes
- Disadvantage: fixed effects is a black-box regression, more difficult to check trends non-parametrically as with a single change
  - Combine with graphical, non-parametric evidence around certain policy changes
  - Recent literature demonstrates you need to be very careful with staggered treatment settings (Callaway and Sant'Anna 2021; Goodman-Bacon 2021; Sun and Abraham 2021; Wooldridge 2021)
- Same parallel trends identification assumption as *DD*
  - Potential violation: policy reforms may respond to trends in outcomes
  - Ex: tobacco prices falling → state decides to raise tax rate

Evans, Ringel, and Stech (1999)

TABLE 2
OLS Estimates, Retail Price Model: Tobacco Institute Data

Independent variable	Average state retail price, 1985–1996		Net retail price in Tennessee, 1970–1994	
	Nominal (1)	Real (2)	Nominal (3)	Real (4)
Nominal/real tax	1.01 (0.04)	0.92 (0.04)		
Nominal/real wholesale price			1.07 (0.02)	0.86 (0.04)
R^2	0.972	0.933	0.989	0.963
Observations	612	612	25	25

Standard errors in parentheses. Real prices in 1997 cents/pack. Models in columns (1) and (2) control for state effects.

Evans, Ringel, and Stech (1999)

- 100% pass through implies supply elasticity of $\varepsilon_S = \infty$ at state level
    - Theory suggests that pass through would be lower at national level
    - Important to understand how the variation you are using determines what parameter you are identifying

Evans, Ringel, and Stech (1999)

TABLE 3
OLS Estimates, Log Per Capita Consumption Model, Tobacco Institute Data, 1985–1996

Independent variable	Real tax (1)	Real tax (2)	Real tax (3)	Real price (4)	Real price (5)	Real price (6)
	Coefficients (standard errors) on					
Current value	−0.254 (0.037)	−0.165 (0.040)	−0.173 (0.041)	−0.176 (0.027)	−0.176 (0.027)	−0.167 (0.029)
1-year lag		−0.215 (0.413)	−0.188 (0.047)		−0.027 (0.032)	−0.031 (0.032)
2-year lag			−0.061 (0.045)			−0.017 (0.033)
Price elasticity	−0.424 (0.062)	−0.635 (0.074)	−0.705 (0.090)	−0.294 (0.045)	−0.337 (0.058)	−0.359 (0.072)
R^2	0.975	0.977	0.977	0.975	0.975	0.976

Evans, Ringel, and Stech (1999)

- Demand model estimate implies that: $\varepsilon_D = -0.42 \rightarrow$ 10% increase in price induces a 4.2% reduction in consumption
- How to compute price elasticity of demand when using variation arising from tax changes?
- Tax passed 1-1 onto consumers, so we can substitute $\Delta P = \Delta T$ here
- Then compute ε_D from $\hat{\beta} = (\Delta Q/Q)/\Delta T$ from regression coefficient of log demand on cigarette tax:

  $\varepsilon_D = \frac{P}{Q}\frac{\Delta Q}{\Delta T} = \hat{\beta} \times P$

  with P (price) and Q (quantity) are sample means

Evans, Ringel, and Stech (1999)

- *DD* before and after one year captures short term response: effect of current price P_{jt} on current consumption Q_{jt}
- F.E. also captures short term responses
- What if full response takes more than one period? Especially important considering nature of cigarette use
  - F.E. estimate biased. One solution: include lags ($T_{j,t-1}, T_{j,t-2}, ...$)
- Are identification assumptions still valid here? Tradeoff between LR and validity of identification assumptions

Hastings and Washington (2010)

Hastings and Washington (2010)

- Question: How does food stamps subsidy affect grocery store pricing?
- Food stamps typically arrive at the same time for a large group of people, e.g. first of the month
- Use this variation to study:
  1. Whether demand changes at beginning of month (violating PIH)
  2. How much of the food stamp benefit is taken by firms by increased prices rather than consumers (intended recipients)

Hastings and Washington (2010)

- Scanner data from several grocery stores in Nevada
- Data from stores in high-poverty areas ($>$15% food stamp recipients) and in low-poverty areas ($<$3%)
- Club card data on whether each individual used food stamps
- Data from other states where food stamps are staggered across month used as a control
- Research design: use variation across stores, individuals, and time of month to measure pricing responses

Hastings and Washington (2010)

TABLE 2—CHANGE IN EXPENDITURES ACROSS STORES

	All	Storable	Perishable	Splurge	Alcohol and tobacco
Benefit household × week 2	−0.189**	−0.201**	−0.190**	−0.112**	−0.029*
	(0.007)	(0.009)	(0.008)	(0.008)	(0.015)
Benefit household × week 3	−0.264**	−0.261**	−0.244**	−0.180**	−0.037*
	(0.008)	(0.009)	(0.009)	(0.008)	(0.014)
Benefit household × week 4	−0.299**	−0.285**	−0.272**	−0.206**	−0.029*
	(0.008)	(0.010)	(0.009)	(0.009)	(0.015)
Week 2	−0.017**	−0.010**	−0.019**	−0.002	−0.016*
	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)
Week 3	−0.006*	−0.005	−0.011**	0.009*	0.003
	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)
Week 4	−0.005	−0.023**	−0.016**	0.011**	0.002
	(0.003)	(0.004)	(0.003)	(0.004)	(0.006)
Mean expenditures by					
Benefit households	34.51	14.19	19.19	9.11	13.99
Non-Benefit households	27.95	11.67	16.29	8.00	16.57
Observations	1,395,925	876,610	1,097,039	915,550	242,187

- Interpret these coefficients in words

Hastings and Washington (2010)

TABLE 6—CHANGE IN PRICES ACROSS THE MONTH

	All	Store 1	Store 2	Store 3
Log (price index)				
Week 2	−0.018**	−0.016**	−0.020**	−0.018**
	(0.002)	(0.004)	(0.003)	(0.004)
Week 3	−0.023**	−0.013**	−0.025**	−0.031**
	(0.002)	(0.004)	(0.003)	(0.004)
Week 4	−0.025**	−0.016**	−0.028**	−0.034**
	(0.002)	(0.004)	(0.003)	(0.004)
Log (first week price index)				
Week 2	−0.021**	−0.018**	−0.024**	−0.022**
	(0.002)	(0.005)	(0.003)	(0.004)
Week 3	−0.027**	−0.015**	−0.031**	−0.037**
	(0.002)	(0.005)	(0.003)	(0.004)
Week 4	−0.031**	−0.019**	−0.034**	−0.040**
	(0.002)	(0.005)	(0.003)	(0.004)
Observation	2,086	723	723	640
Percent store benefit purchases	0.257	0.141	0.259	0.454

Hastings and Washington (2010)

- Demand increases by 30% in 1st week, prices by about 3%
- Very compelling because of multiple dimensions of tests: cross-individual, cross-store, cross-category, and cross-state
- Interesting theoretical implication: subsidies in markets where low-income recipients are pooled with others have better distributional effects
    - May favor food stamps as a way to transfer money to low incomes relative to a subsidy such as the EITC

Chetty, Looney, and Kroft (2009)

Tax Incidence with Salience Effects

- Central assumption of basic model: taxes are equivalent to prices ($\frac{dx}{dt} = \frac{dx}{dp}$)
- In practice, are people fully aware of marginal tax rates?
- Chetty, Looney, and Kroft (2009) test this assumption and generalize theory to allow for salience effects
- **Part 1**: Test whether "salience" (visibility of tax-inclusive price) affects behavioral responses to commodity taxation
  - Does effect of a tax on demand depend on whether it is included in **posted** price?
- **Part 2**: Develop formulas for incidence and efficiency costs of taxation that permit salience effects and other optimization errors

Tax Incidence with Salience Effects

- Two goods: x and y
- Let p denote sticker price of x, and $(1+\tau)p$ denote tax-inclusive price of x (ad-valorem tax)
- Good y (numeraire) is not taxed, and has a price of 1
- Let demand for good x be denoted by $x(p,\tau)$

Tax Incidence with Salience Effects

- If agents optimize fully, then:
  - Demand should only depend on tax-inclusive price: $x(p,\tau) = x((1+\tau)p, 0)$
  - Price elasticity equals gross-of-tax elasticity: $\varepsilon_{x,p} = -\frac{\partial \log x}{\partial \log p} = \varepsilon_{x,1+\tau} = -\frac{\partial \log x}{\partial \log(1+\tau)}$
- How to test this hypothesis?
- Assume a log-linear demand function to obtain the estimating equation:

$$\log x(p,\tau) = \alpha + \beta \log p + \theta\beta \log(1+\tau)$$

Tax Incidence with Salience Effects

- Estimating equation implies:

$$\beta = \varepsilon_{x,p} \qquad\qquad \theta\beta = \varepsilon_{x,1+\tau} \tag{2}$$

- If consumers are fully aware of the tax, then $\varepsilon_{x,p} = \varepsilon_{x,1+\tau}$ and $\theta = \frac{\varepsilon_{x,1+\tau}}{\varepsilon_{x,p}} = 1$

- If consumers do not respond to taxes at all, then $\varepsilon_{x,1+\tau} = 0$ and $\theta = 0$

- θ can be interpreted as the degree to which consumers under-react to a tax

Tax Incidence with Salience Effects

- Going back to the beginning, equilibrium occurs when $Q = D(p,t,Z) = S(p)$, where effect of p and t on $D(p,t,Z)$ can differ
- Implicitly differentiate equilibrium condition wrt t to get:

$$\begin{aligned} D(p,t,Z) &= S(p) \\ \frac{\partial D(p,t,Z)}{\partial p}\frac{dp}{dt} + \frac{\partial D(p,t,Z)}{\partial t} &= \frac{\partial S(p)}{\partial p}\frac{dp}{dt} \\ \frac{\partial D(p,t,Z)}{\partial t} &= \left(\frac{\partial S(p)}{\partial p} - \frac{\partial D(p,t,Z)}{\partial p}\right)\frac{dp}{dt} \\ \frac{dp}{dt} &= \frac{\frac{\partial D(p,t,Z)}{\partial t}}{\frac{\partial S(p)}{\partial p} - \frac{\partial D(p,t,Z)}{\partial p}} \end{aligned}$$

Tax Incidence with Salience Effects

- $\varepsilon_{x,p+t|t} = -\frac{\partial x}{\partial t}\frac{p+t}{x(p,t,Z)}$ measures the percentage change in demand caused by a 1% increase in total price of good x through a **tax change**
- $\varepsilon_{x,p+t|p} = -\frac{\partial x}{\partial p}\frac{p+t}{x(p,t,Z)}$ measures the percentage change in demand caused by a 1% increase in total price of good x through a **change in** p
- Define $\theta = \frac{\varepsilon_{x,p+t|t}}{\varepsilon_{x,p+t|p}}$

Tax Incidence with Salience Effects

- Multiply rhs by $\frac{\frac{p+t}{D(p,t,Z)}}{\frac{p+t}{D(p,t,Z)}}$, noting that $D(p,t,Z) = S(p)$ in equilibrium:

$$\begin{aligned}
\frac{dp}{dt} &= \frac{\frac{\partial D(p,t,Z)}{\partial t}}{\frac{\partial S(p)}{\partial p} - \frac{\partial D(p,t,Z)}{\partial p}} \\
\frac{dp}{dt} &= \frac{\frac{\partial D(p,t,Z)}{\partial t}\frac{p+t}{D(p,t,Z)}}{\frac{\partial S(p)}{\partial p}\frac{p+t}{D(p,t,Z)}\frac{p}{D(p,t,Z)}\frac{D(p,t,Z)}{p} - \frac{\partial D(p,t,Z)}{\partial p}\frac{p+t}{D(p,t,Z)}} \\
\frac{dp}{dt} &= \frac{\varepsilon_{D,p+t|t}}{\frac{p+t}{p}\varepsilon_{S,p} - \varepsilon_{D,p+t|p}} \\
\frac{dp}{dt} &= \frac{\theta\varepsilon_{D,p+t|p}}{\frac{p+t}{p}\varepsilon_{S,p} - \varepsilon_{D,p+t|p}}
\end{aligned} \tag{3}$$

- Consumer incidence is $\frac{d(p+t)}{dt} = \frac{dp}{dt} + 1 = \frac{\frac{p+t}{p}\varepsilon_{S,p} + (1-\theta)\varepsilon_{D,p+t|p}}{\frac{p+t}{p}\varepsilon_{S,p} - \varepsilon_{D,p+t|p}}$

Tax Incidence with Salience Effects

Implications of salience effects:

1. Incidence on producers is attenuated by θ
2. No tax neutrality: taxes levied on producers have greater incidence on producers than non-salient taxes levied on consumers

Intuition: producers need to cut pre-tax prices less when consumers are less responsive to the tax

Chetty, Looney, and Kroft (2009)

Two strategies to estimate θ:

1. **Manipulate tax salience**: make sales tax as visible as pre-tax price (experiment)
   - Effect of intervention on demand is $v = \log x((1+\tau)p, 0) - \log x(p,\tau)$

$$
\begin{aligned}
v &= \log x((1+\tau)p, 0) - \log x(p,\tau) \\
v &= [\alpha + \beta \log(1+\tau)p + 0] - [\alpha + \beta \log p + \theta\beta \log(1+\tau)] \\
v &= \beta \log(1+\tau)p - \beta \log p - \theta\beta \log(1+\tau) \\
v &= \beta \log(1+\tau) + \beta \log p - \beta \log p - \theta\beta \log(1+\tau) \\
v &= (1-\theta)\beta \log(1+\tau)
\end{aligned}
$$

$$\Rightarrow 1-\theta = \frac{v}{\beta \log(1+\tau)} = -\frac{v}{\varepsilon_{x,p} \log(1+\tau)}$$

2. **Manipulate tax rate**: compare $\varepsilon_{x,p}$ and $\varepsilon_{x,1+\tau}$ (natural experiment)

$\theta = \frac{\varepsilon_{x,1+\tau}}{\varepsilon_{x,p}}$

Chetty, Looney, and Kroft (2009)

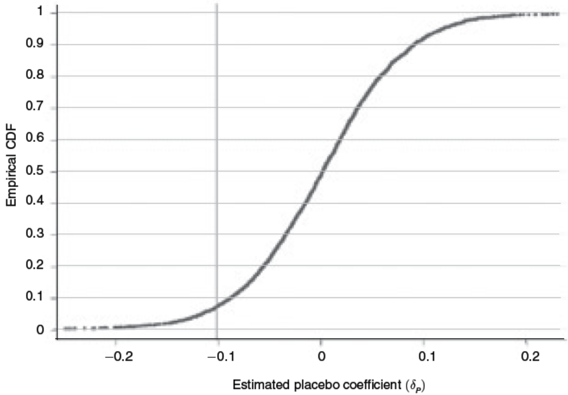


FIGURE 1. DISTRIBUTION OF PLACEBO ESTIMATES: LOG QUANTITY

Notes: This figure plots the empirical distribution of placebo effects (G) for log quantity. The CDF is constructed from 4,725 estimates of δ_p using the specification in column 3 of Table 4. No parametric smoothing is applied: the CDF appears smooth because of the large number of points used to construct it. The vertical line shows the treatment effect estimate reported in Table 4.

References I

Callaway, Brantly, and Pedro H.C. Sant'Anna. 2021. "Difference-in-Differences with multiple time periods." *Journal of Econometrics* 225 (2): 200–230.

Chetty, Raj, Adam Looney, and Kory Kroft. 2009. "Salience and Taxation: Theory and Evidence." *American Economic Review* 99 (4): 1145–1177.

Evans, William N., Jeanne S. Ringel, and Diana Stech. 1999. "Tobacco Taxes and Public Policy to Discourage Smoking." *Tax Policy and the Economy* 13:1–55.

Goodman-Bacon, Andrew. 2021. "Difference-in-differences with variation in treatment timing." *Journal of Econometrics* 225 (2): 254–277.

References II

Hastings, Justine, and Ebonya Washington. 2010. "The First of the Month Effect: Consumer Behavior and Store Responses." *American Economic Journal: Economic Policy* 2 (2): 142–162.

Sun, Liyang, and Sarah Abraham. 2021. "Estimating dynamic treatment effects in event studies with heterogeneous treatment effects." *Journal of Econometrics* 225 (2): 175–199.

Wooldridge, Jeffrey M. 2021. "Two-Way Fixed Effects, the Two-Way Mundlak Regression, and Difference-in-Differences Estimators." *Working Paper.*