### EC2106 PUBLIC ECONOMICS LECTURE 4 - Tax Incidence

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Who pays the tax?

We will make two types of distinctions:

- 1. Consumers versus Producers?
- 2. Rich versus Poor?

- How does the price of a plastic bag respond when a tax of 3 SEK on such bags is introduced?

CA Shop online Offers ICA's lunch box Find store Prescription Inspiration Health Buffet Customer service

#### Therefore, tax is introduced on plastic carrier bags

The government aims to reduce the number of plastic carrier bags to 40 per person and year by 2025. An interesting figure to compare with is that the Swedish Environmental Protection Agency in 2018 estimated that the average Swede uses 102 plastic bags per year. This is one of the reasons for introducing a tax on plastic carrier bags from 1 May. The purpose of the new tax is to reduce the use of plastic bags and thereby reduce the risk of littering and spreading of plastic in nature. the E-shop

#### What will the plastic carrier bags cost?

For you as a consumer, this means that the price of the plastic carrier bag in which you carry your goods home will be increased by a tax of SEK 3 + 75 öre in VAT. In addition to the bags offered for packing and carrying goods, smaller bags and bags where a non-negligible part is made of plastic are also affected. Examples of such bags are bags for fruit and vegetables, bread bags and plastic bags at the freezer counter. The tax for these smaller bags is 30 öre + VAT. These figures only concern the tax itself, in addition to that there is the cost of what a plastic bag normally costs.

- Interestingly, this tax projected additional tax revenue of 2.1 billion SEK per year. It generated 0.2 billion
  - $\Rightarrow$  Behavioral responses important.

- Example questions:
  - Government's budget reduces the gas tax. What happens to the price when the tax on gas  $\downarrow$  by 1 SEK?
  - How does the price of alcohol change when alcohol taxes  $\uparrow?$
  - How does the wage respond when the payroll tax  $\uparrow?$
- Naive answer:

price/wage changes by the same amount as the tax.

- Tax incidence studies who bears the burden of the tax. Positive analysis.
- The burden is shared between producers and consumers  $\Rightarrow$  consumer price responds less than tax change.
- Why important?
  - Informs us about **distributional effects of taxes**.

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#### Tax incidence examples

- 1. Goal: increase after-tax income for low-income households.
- $\Rightarrow$  Lower the income tax on low-incomes.

Tax incidence: wages grow more slowly after the tax cut so employers get a share of the tax cut!

- 2. Goal: Reduce inequality by taxing the rich.
- $\Rightarrow$  capital income tax  $\uparrow$ 
  - Tax incidence: savings  $\downarrow$  b/c of capital inc. tax  $\rightarrow$  capital stock  $\downarrow \rightarrow$  wages  $\downarrow$  hurting workers.
  - Tax incidence is not an **accounting exercise**, but is the effect of market interactions and depends on supply and demand.
  - **Statutory incidence:** The party that transfers the money to the government.
  - **Economic incidence:** The share of the tax borne by producers and consumers.

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### Tax Incidence - No tax



### Tax Incidence - Tax Levied on Producers



#### Tax Incidence - Tax Levied on Consumers



- Tax Neutrality - **Economic incidence** the same independent of who bears the tax.

- Start from t = 0 and S(p) = D(p).
- What is dp/dt, i.e. the effect of a small tax increase on **pre-tax price**?
  - We typically express incidence in percentage terms: e.g. X% pass-through of the tax onto consumer prices ( $X \in [0, 100]$ ).
- Polar cases for intuition:
- Consumers bear entire burden:
  - Demand is not price-sensitive ( $\varepsilon^D \approx 0$ ).

Example: short-run demand for gas **inelastic** (need to drive to work).

- Supply is very price-sensitive ( $\varepsilon^{S} \approx \infty$ ). Ex: perfectly competitive industry (**perfectly elastic**)
- Producers bear entire burden.
  - Supply is not price-sensitive (ε<sup>S</sup> ≈ 0).
     Example: fixed quantities are supplied (inelastic supply).
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- Change dt generates change dp of pre-tax price so that equilibrium holds:

$$\begin{split} S(p+dp) &= D(p+dp+dt) \Rightarrow \\ S(p) + S'(p)dp &= D(p) + D'(p)(dp+dt) \Rightarrow \\ S'(p)dp &= D'(p)(dp+dt) \Rightarrow \end{split}$$

$$\frac{dp}{dt} = \frac{D'(p)}{S'(p) - D'(p)}$$
$$\frac{dp}{dt} = \frac{\varepsilon^D}{\varepsilon^S - \varepsilon^D}$$

- Consumers bear entire burden when dp/dt = 0
- Producers bear entire burden when dp/dt = -1.

#### Perfectly Inelastic Demand

19.1



#### Perfectly Elastic Demand

19.1



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#### 19.1 Supply Elasticities



- Q: What is the effect of cigarette taxes on **price** and **quantity**? Evans, Ringel Stech (1999): "Tobacco Taxes and Public Policy to Discourage Smoking"
  - Motivation:
    - Who bears the burden of the tax: consumers of tobacco companies?
    - Negative health consequences
    - Non-negligible source of govt revenue.
      - Around 11.4 billion SEK / year (compare with tax on plastic bags 0.2 bSEK/year)
  - What is the rationale for imposing cigarette taxes?
    - (i) Market failure: externality on nonsmokers (e.g. unborn children)
    - (ii) Sin taxes Chicago-view vs Paternalistic approach
  - What about **distributional effects**?

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### Progressive and Regressive Taxes

- A tax is progressive (regressive) if the average tax rate is increasing (decreasing) in the tax base (e.g. income).
- Marginal tax rate = tax rate paid on the last unit. For income tax: taxes paid in SEK on the last unit divided by 1 SEK.
- Average tax rate = tax rate paid on the all units.

For income tax: total taxes paid in SEK on all units divided by total income.

- Is a **flat** tax progressive? (Flat tax = constant marginal tax rate)
- A tax features absolute progressivity (regressivity) if the tax **amount** is increasing in the tax base (e.g. income).
- Most taxes feature absolute progressivity.
- A flat tax exhibits **absolute progressivity** but neither **progressivity** or **regressivity**.
- What about cigarette taxes?

### **Background Facts**

- In US, cigarettes taxed at local, federal and state level.
- Levied as an excise tax, varying from 30 cents per pack to \$4.35.
- Comparison: In Sweden, a combination of excise and ad valorem taxes used (28.1 SEK per pack + 1% of the posted price).
- Generates 877 SEK per capita in US, compared to about 170 in Sweden.

#### Demographic Facts

- Since 1964 when it was generally shown that smoking is harmful, **massive campaigns** against tobacco use have been implemented.



# Is the Trend Indicating Fewer Smokers or Fewer Packs per Smoker?



### Distributional Effects of Cigarette Taxes?

- How do we test whether the cigarette tax is regressive?
- Need data **at the individual level** about (i) smoking and (ii) income.
- Example: Surveys that include both.
- LNU survey of living standards that you as students can access.
  - Useful dataset for bachelor's and master' theses.

#### Distributional Effects of Cigarette Taxes?



### Analyzing the Data

- Goal: Estimate the effect of cigarette tax on price (quantity). Depends critically on the supply and demand *elasticities*. What do we expect?
  - Close to full pass-through?
- 1. Need data with variation in taxes and prices.
  - Example: variation across US states.
- 2. Naive approach. Estimate:

$$p_{a,it} = \alpha + \beta \tau_{it} + \varepsilon_{it}$$

- where  $p_{a,it}$  is the tax-inclusive price (facing consumers).
- Why problematic?
- States that have higher cigarette taxes may have more anti-tobacco sentiment  $\Rightarrow$  lower tobacco consumption.

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### Identification Problem

**Correlation:** Two economic variables are correlated if they move together.

## **Causation:** Two economic variables are causally related if the movement of one causes movement in the other.

For any correlation between the tax,  $\tau$  and the price p, there are three possible explanations, one or more of which result in the correlation:

- 1. The tax  $\tau$  has a causal impact on the price p.
- 2. The price p has a causal impact on the tax  $\tau$ .
- 3. Some third factor is causing both.

Empirical work tries to distinguish between those.

- What is the causal effect of this slide on your knowledge of causation?
- If I compare the average knowledge of causation among this class to an average of random individuals from the street, is the difference in averages the causal effect?

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Which of the three categories does this belong to?

s when	Rigby Enough with the wind already Received April 1	same Com judg
legis- Brent ters' f	Ever since they installed all those big fans up on the hill it's become even windier. Whose bright idea was that? I've noticed when they're off, we get a nice calm spell. Please turn them off, at least on weekends. (Word count: 40) JEFF FORBES Idaho Falls	proto Tern "the issue from J selc
ds max	Guest columns, solicited: 450 words max • Guest o	column

How can we estimate the **true**, **causal** effect of cigarette taxes on prices?

- 1. Have two markets with the **same characteristics**, but different taxes and prices.
  - Virtually impossible to find such a setting.
- 2. Randomized Trial: ideal experiment. Take a large group of markets with different characteristics. Randomly, divide them into two groups (called T (treatment) and C (control)).

On average, these markets are similar.

Raise cigarette taxes in all markets in the T-group (mimics an **experiment**).

Study prices in both market groups.

Randomized trials are common practice in medical studies, but also popular in economics.

- This example is extremely difficult to implement.

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### Analyzing the Data – **Difference in differences**

- Experiments not always possible.
- Two groups: Treatment group (T) which faces a change [state with tax reform] and control group (C) which does not [state with no reform]
- Compare the evolution of **T**-group (before and after change) to the evolution of the C-group (before and after change)
- Identifies causal effect of taxes off of **differences in changes** over time and not **differences in levels**.
- DD identifies the **treatment effect** if the **parallel trend assumption** holds:
- Absent the change, T and C would have evolved in parallel
- Should always test DD using data from more periods and plot the two time series to check parallel trend assumption.

- More than 200 state tax changes since 1975 to exploit.
- Resarch Design: Difference-in-difference

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

where state A experienced a tax reform (treatment) and state B did not.

#### Graphical Assessment of Diff-in-Diff



- Plotting the data **non-parametrically** allow visual permutation tests.

#### Research Design: Fixed Effects

- Effect of tax on tax-inclusive price (pass-through):

$$p_{it} = \beta \tau_{it} + \mu_i + \eta_t + \varepsilon_{it}$$

- $p_{it}$  average price per pack in state *i* at time *t*;  $\tau$  total tax (state + federal);  $\mu$  and  $\eta$  are state and time fixed effects.
- Advantage of FE rel. to DD: exploit more reforms. Disadvantage: harder to assess identification assumptions.
- Same assumptions in FE as in DD.

#### Effect on Prices

	Average state retail price, 1985–1996		Net retail price in Tennessee, 1970–1994	
Independent variable	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 <sup>2</sup>	0.972	0.933	0.989	0.963
Observations	612	612	25	25

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

- Tax increase fully reflected in consumer price.
- What do we learn about the slopes of demand and/or supply?

### Quantity Effects

#### **TABLE 3**

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

	Coefficients (standard errors) on					
Independent	Real tax			Real price		
variable	(1)	(2)	(3)	(4)	(5)	(6)
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 <sup>2</sup>	0.975	0.977	0.977	0.975	0.975	0.976

- Why can we interpret the tax elasticity as a price elasticity?

#### Conclusion

- Companies profits are to-first-order unaffected by the tax.
- Incidence falling on consumers not necessarily bad if people are making mistakes (Gruber and Koszegi, 2004)
- Adda and Cornaglia (2006): People smoke fewer cigarettes, but they smoke them longer when taxes go up. No effect on biomarkers, even with effects on quantity.
- Less **regressivity** in life-time perspective.

### How regressive are gas taxes?



How regressive are gas taxes?

- Gas tax corrects for negative externality of CO2-emissions.
  Pigouvian tax.
- Incidence-issue:
- Demand for gas inelastic  $\Rightarrow$  incidence borne by consumers.
- Especially true in rural parts, with no alternatives to driving.
- Correcting externalities  $\rightarrow$  Distributional effects.
- How to measure?

#### Share of income to gas – Individual



#### Share of income to gas – Individual







Circle radius represents size of the county.



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### Poll time

- www.menti.com

- Many countries have large taxes on consumption goods, Value Added Tax (VAT) (MOMS in Swedish). How does the VAT work?
- Normal rates are high (15-25%) but some goods/services have lower rates (or are exempt)

**Example:** Swedish gov't as of 2022 wants to raise VAT on maintenance / reparations from 6 % to 12 %.

- Benzarti et al. (2019) study the effects of VAT rates  $\uparrow$  and  $\downarrow$
- Standard theoretical prediction: Tax ↑ and ↓ have symmetric effects on prices.
- Empirical test:
- Haird ressers in Finland: VAT  $\downarrow$  14 points in Jan 2007; then  $\uparrow$  in Jan 2012
- Provide a basic graphical **difference-in-difference** analysis of prices of hairdressers (treatment) with beauty salons (control)

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Figure 1: Finnish Hairdressing Sector VAT Reforms Source: Benzarti et al. (2017)



*Notes:* This figure shows the price of hairdressing services and beauty salons before and after the 14 percentage point hairdressing services VAT cut in January 2007 and the 14 percentage point VAT hairdressing services hike in January 2012.

 $\Rightarrow$  Tax decreases are only 50% passed on to consumers while tax increases are almost fully passed on consumers.

Strong **asymmetry** of effects contrasts canonical model.

- Why? producers pocket tax cut be consumers are inattentive to taxes.

#### $\Rightarrow$ Price determination does **not** work like basic model.

- What would happen to the price of plastic bags if the 3 SEK tax was removed?
- Do we see the same effect of gas tax reduction on price as we do for increase?

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- Traditional model assumes individuals are fully aware of taxes they pay.
- Q: Is this assumption realistic?
  - Do you know the marginal income tax rate you face?
  - Was your education choice (field of study) influenced by taxes?
  - Chetty, Looney and Kroft (2009):
    - How salient are taxes?
    - Do individuals respond the same to price changes that are due to tax changes versus other causes?

(According to the theory, they should.)

#### Tax salience

- CLK (2009) test whether salience matters for incidence with two strategies.
- Setting: **Sales tax** in the US is paid at the cash register and **not** displayed on price tags in stores.
- 1. Randomized field experiment in stores:
  - In one store they display prices **including** the tax for a **subset** of products.
- 2. Policy variation in beer excise and sales taxes across states:
  - Excise tax is **included** in the price while sales tax is not.

**Research design:** Experiment + Difference-in-differences.



	<u> </u>		/		
TREATMENT STORE					
Period	Control Categories	Treated Categories	Difference		
Baseline	26.48	25.17	-1.31		
	(0.22)	(0.37)	(0.43)		
Experiment	27.32	23.87	-3.45		
	(0.87)	(1.02)	(0.64)		
Difference	0.84	-1.30	DD <sub>TS</sub> = -2.14		
over time	(0.75)	(0.92)	(0.64)		

Effect of Posting Tax-Inclusive Prices: Mean Quantity Sold

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	CON	TROL STORES	
Period	Control Categories	Treated Categories	Difference
Baseline	30.57	27.94	-2.63
	(0.24)	(0.30)	(0.32)
Experiment	30.76	28.19	-2.57
	(0.72)	(1.06)	(1.09)
Difference	0.19	0.25	DD <sub>cs</sub> = 0.06
over time	(0.64)	(0.92)	(0.90)

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over time	(0.64)	(0.92)	(0.90)
		DDD Estimate	-2.20

Source: Chetty, Looney, Kroft (2008)

(0.58)

### Potential Problems?

- 1. What does it mean that people reduce demand less when tax increases than when price increases?
  - Competing stories:
    - i. Salience being reminded of the tax changes behavior.
    - ii. Imperfect information do not know what the tax is.
- 2. Are these results representative of what would happen if we posted tax-inclusive prices in other contexts?
  - **Hawthorne-effect:** You behave in a specific way just b/c you know that you are in an experiment.

### Proposed Solutions

- 1. Survey people about what they know about the tax rate  $\rightarrow$  most people are correct
- 2. Use alternative research design:
  - Compare changes in quantity accruing from tax changes that are more or less salient:
    - Excise tax: levied on producers, included in price
    - Sales tax: added at register, not shown in posted price.

#### Figure 2a



#### Figure 2b





#### Effect of Excise and Sales Taxes on Beer Consumption

Dependent Variable:	Change in Log(per	capita beer consumption)
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	Baseline	Bus Cyc, Alc Regs.	3-Year Diffs	Food Exempt
	(1)	(2)	(3)	(4)
ΔLog(1+Excise Tax Rate)	<b>-0.87</b> (0.17)***	<b>-0.89</b> (0.17)***	<b>-1.11</b> (0.46)**	<b>-0.91</b> (0.22)***
ΔLog(1+Sales Tax Rate)	<b>-0.20</b> (0.30)	<b>-0.02</b> (0.30)	<b>-0.00</b> (0.32)	<b>-0.14</b> (0.30)
Business Cycle Controls		x	x	x
Alcohol Regulation Controls		x	x	x
Year Fixed Effects	x	x	x	x
F-Test for Equality of Coeffs.	0.05	0.01	0.05	0.04
Sample Size	1,607	1,487	1,389	937

Source: Chetty, Looney, Kroft (2009)

Note: Estimates imply  $\theta_{\tau}\approx 0.06$ 

### Implications

- No tax neutrality: producers can pass on more of the tax to consumers if tax is nominally paid by producers (therefore less salient).

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