Incidence and Efficiency Costs of Taxation

(Chapters 19-20 of Gruber's textbook)

131 Undergraduate Public Economics

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TAX INCIDENCE

Tax incidence is the study of the effects of tax policies on prices and the economic welfare of individuals

What happens to market prices when a tax is introduced or changed?

Example: what happens when impose $1 per pack tax on cigarettes?

Effect on price $\Rightarrow$ distributional effects on smokers, profits of producers, shareholders, farmers, etc.

This is positive analysis: typically the first step in policy evaluation; it is an input to later thinking about what policy maximizes social welfare.

TAX INCIDENCE

Tax incidence is not an accounting exercise but an analytical characterization of changes in economic equilibria when taxes are changed.

Key point: Taxes can be shifted: taxes affect directly prices, which affect quantities because of behavioral responses, which affect indirectly the price of other goods.

If prices are constant economic incidence would be the same as legislative incidence.

Example: Liberals favor capital income taxation because capital income is concentrated at the high end of the income distribution. Taxing capital means taxing disproportionately the rich.

Conservatives respond: if people save less because of capital taxes, capital stock may go down driving also the wages down and hurting workers. The capital tax might be shifted partly on workers.

Partial Equilibrium Tax Incidence

Partial Equilibrium Model:

Simple model goes a long way to showing main results.

Government levies an excise tax on good x

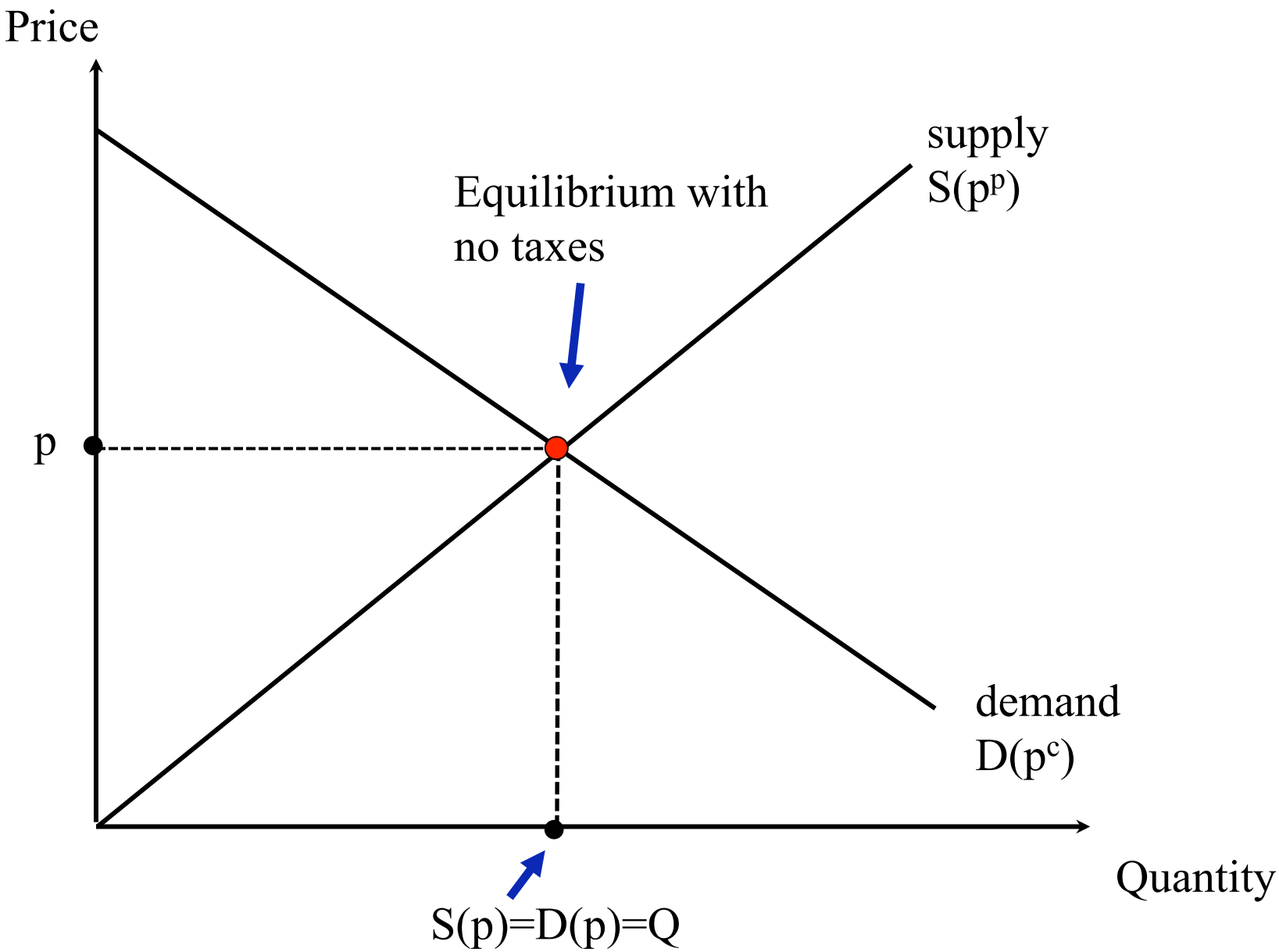
Excise means it is levied on a quantity (gallon, pack, ton, ...). Typically fixed in nominal terms (e.g, \$1 per pack)

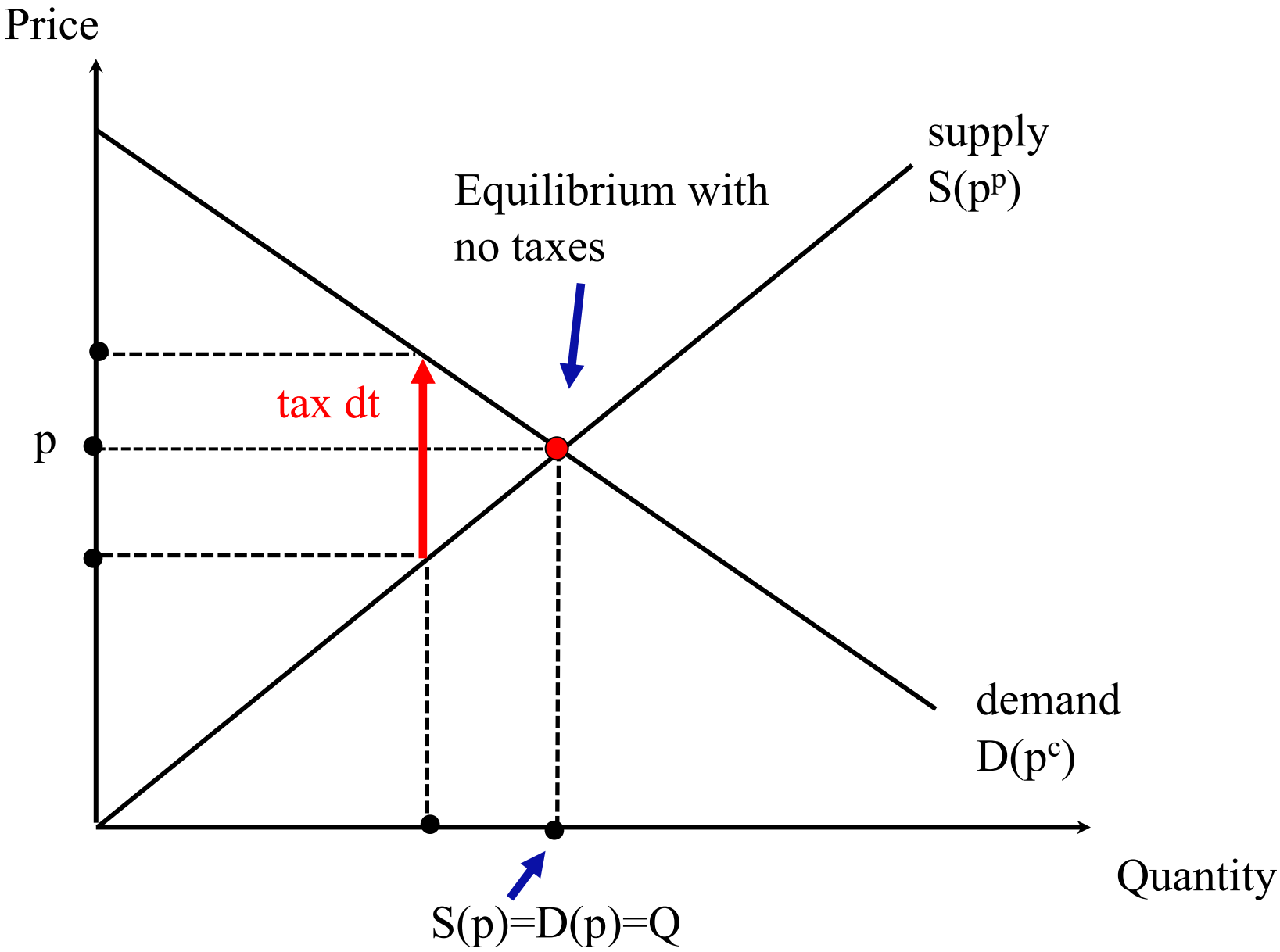
[ad-valorem tax is a fraction of prices (e.g. 5% sales tax)]

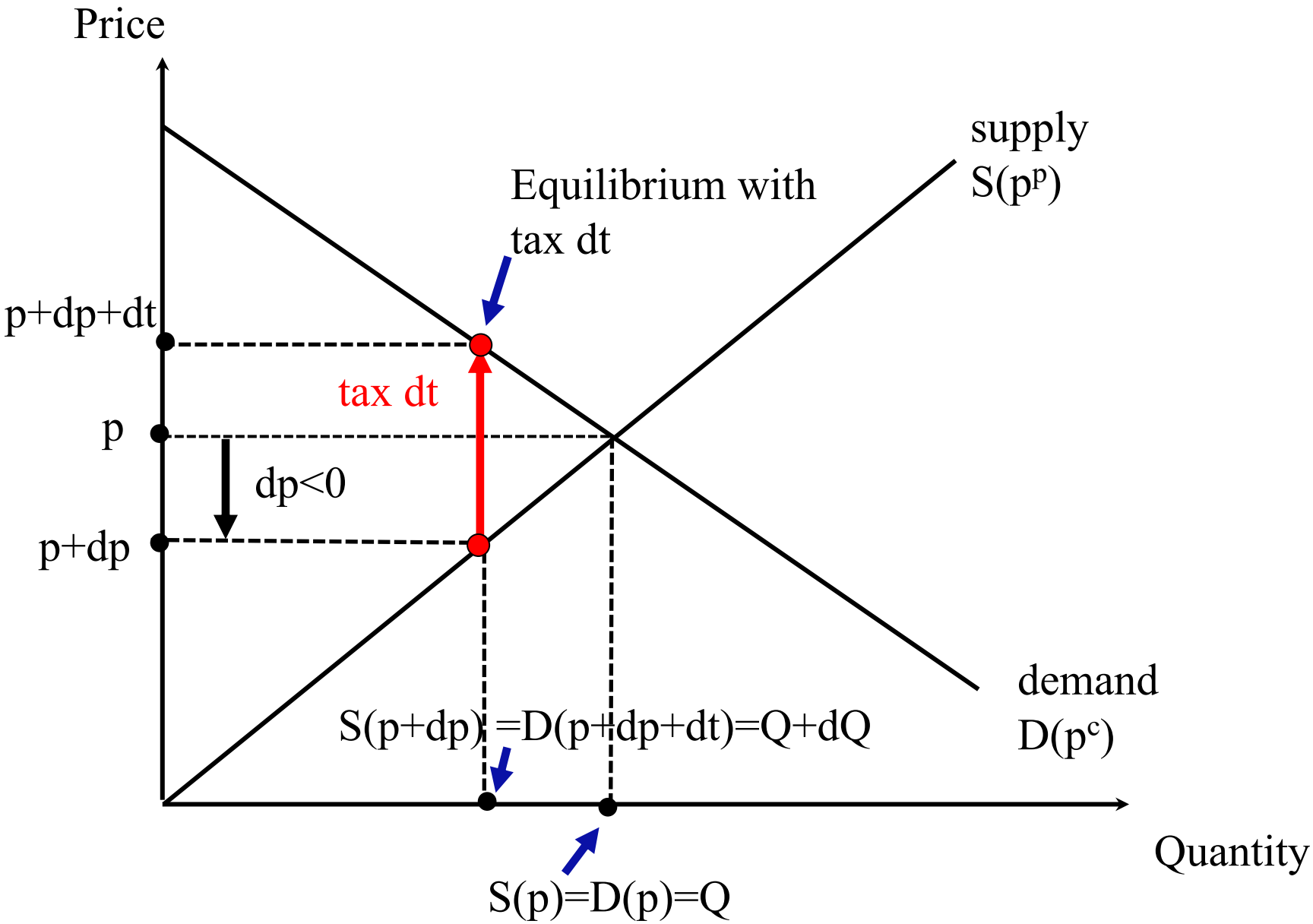
Let p denote the pretax price of x (producer price)

Let $p^c = p + t$ denote the tax inclusive price of x (consumer price)

Draw graph on blackboard


Price
supply
$S(p^p)$
Equilibrium with
no taxes
p
demand
$D(p^c)$
Quantity
S(p)=D(p)=Q


Price
supply
$S(p^p)$
Equilibrium with
no taxes
tax dt
p
demand
$D(p^c)$
Quantity
S(p)=D(p)=Q


Price
supply
$S(p^p)$
Equilibrium with
tax dt
p+dp+dt
tax dt
p
dp<0
p+dp
demand
$D(p^c)$
S(p+dp) =D(p+dp+dt)=Q+dQ
Quantity
S(p)=D(p)=Q

TAX INCIDENCE

Demand for good x is $D(p^c)$ decreases with $p^c = p + t$

Supply for good x is $S(p)$ increases with p

Equilibrium condition with tax t: $Q = S(p) = D(p + t)$

Start from $t = 0$ and $S(p) = D(p)$

We want the effect of a small tax dt on price p: dp/dt:

Change dt generates change dp so that equilibrium holds:

$$S(p + dp) = D(p + dp + dt) \Rightarrow$$

$$S(p) + S'(p)dp = D(p) + D'(p)(dp + dt) \Rightarrow$$

$$S'(p)dp = D'(p)(dp + dt) \Rightarrow$$

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

TAX INCIDENCE FOR SMALL TAX dt

Elasticities useful in economics because they are unit free

Elasticity: percentage change in quantity when price changes by one percent

$\varepsilon_D = \frac{p^c}{D}\frac{dD}{dp^c} = \frac{p^c D'(p^c)}{D(p^c)} < 0$ denotes the price elasticity of demand

$\varepsilon_S = \frac{p}{S}\frac{dS}{dp} = \frac{pS'(p)}{S(p)} > 0$ denotes the price elasticity of supply

$$\frac{dp}{dt} = \frac{D'(p)}{S'(p) - D'(p)} = \frac{pD'(p)/D(p)}{pS'(p)/S(p) - pD'(p)/D(p)} = \frac{\varepsilon_D}{\varepsilon_S - \varepsilon_D}$$

$$-1 \leq \frac{dp}{dt} \leq 0 \quad \text{and} \quad 0 \leq \frac{dp^c}{dt} = 1 + \frac{dp}{dt} \leq 1$$

TAX INCIDENCE

$$\frac{dp}{dt} = \frac{\varepsilon_D}{\varepsilon_S - \varepsilon_D}$$

When do consumers bear the entire burden of the tax? ($dp/dt = 0$ and $dp^c/dt = 1$)

1) $\varepsilon_D = 0$ [inelastic demand]

example: short-run demand for gasoline 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 $dp^c/dt = 0$)

1) $\varepsilon_S = 0$ [inelastic supply]

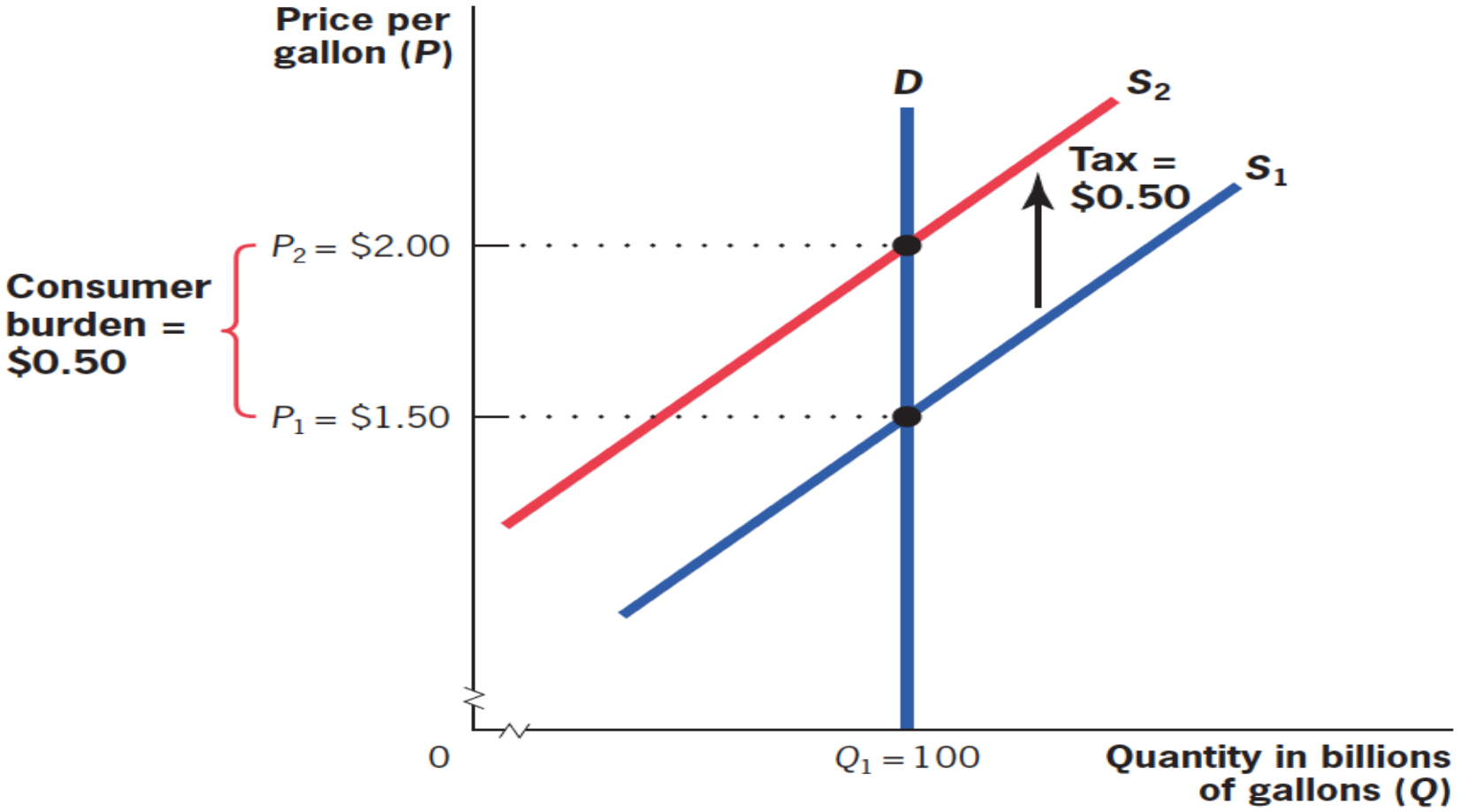
example: fixed quantity supplied

2) $\varepsilon_D = -\infty$ [perfectly elastic demand]

example: there is a close substitute, and demand shifts to this substitute if price changes.

19.1

Perfectly Inelastic Demand



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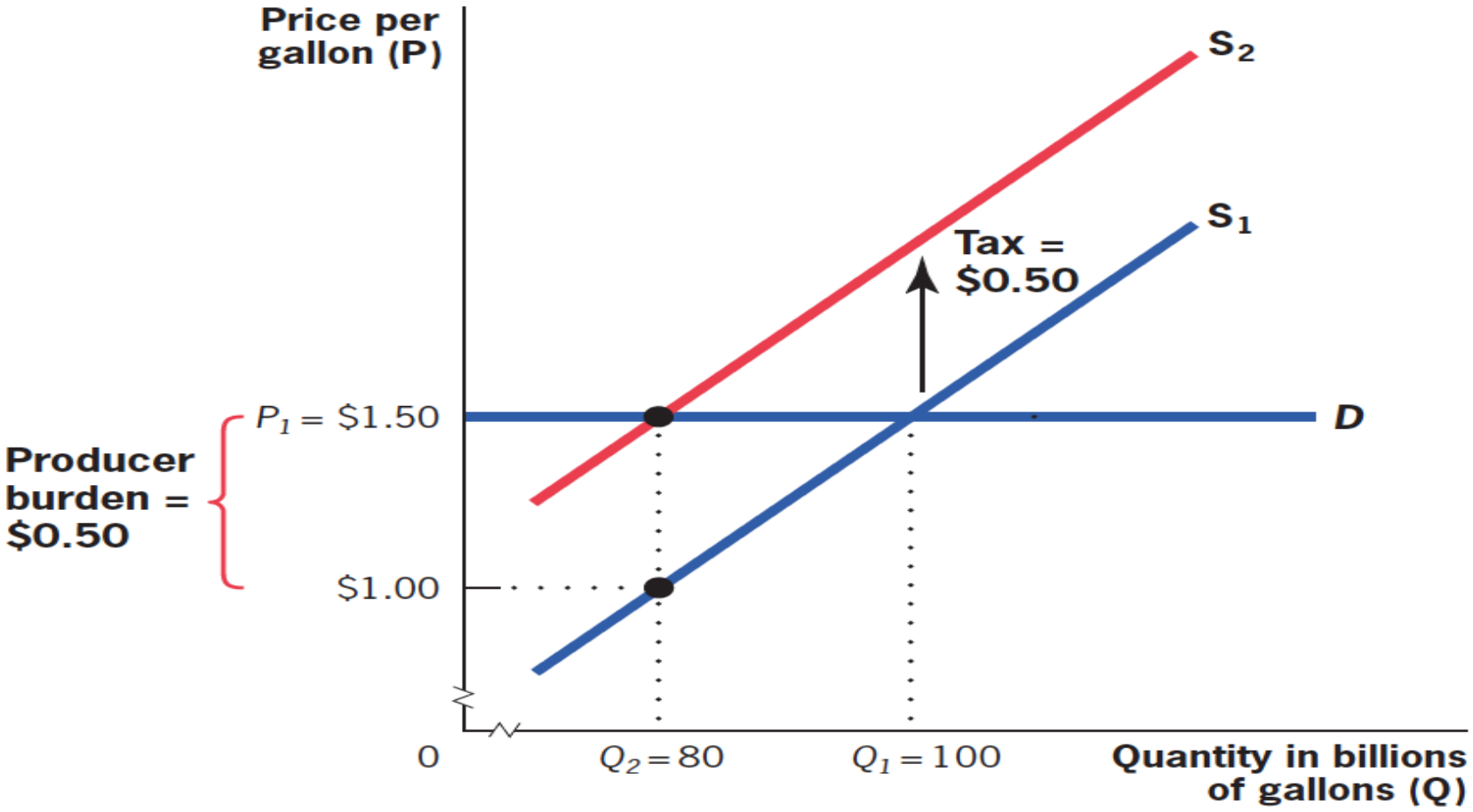
Perfectly Elastic Demand



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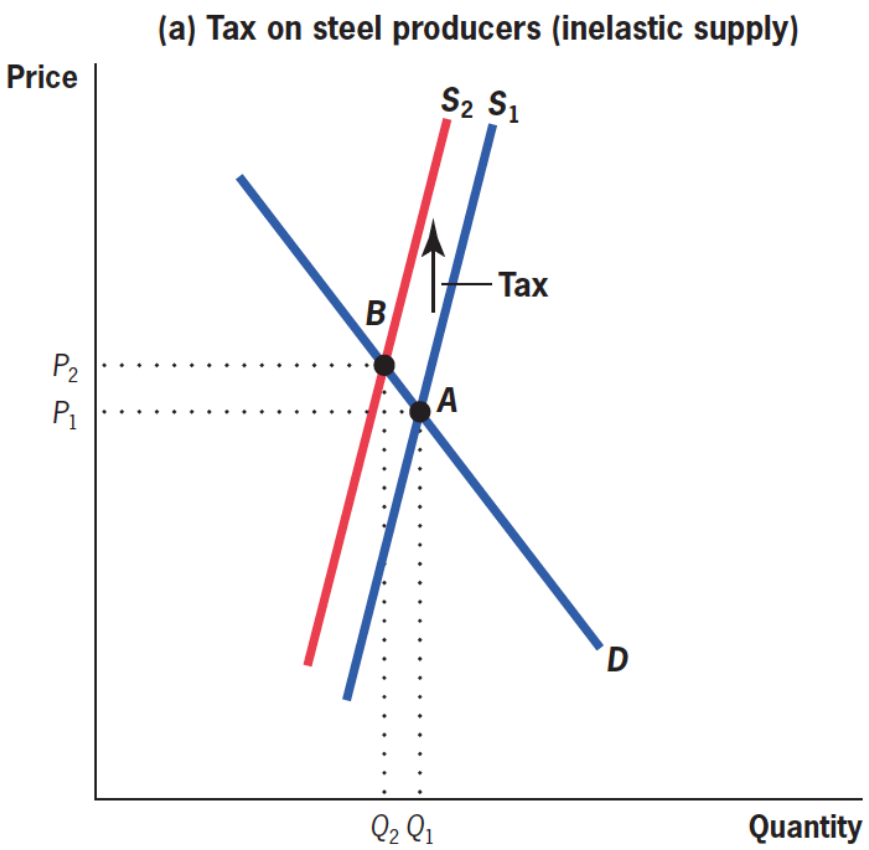
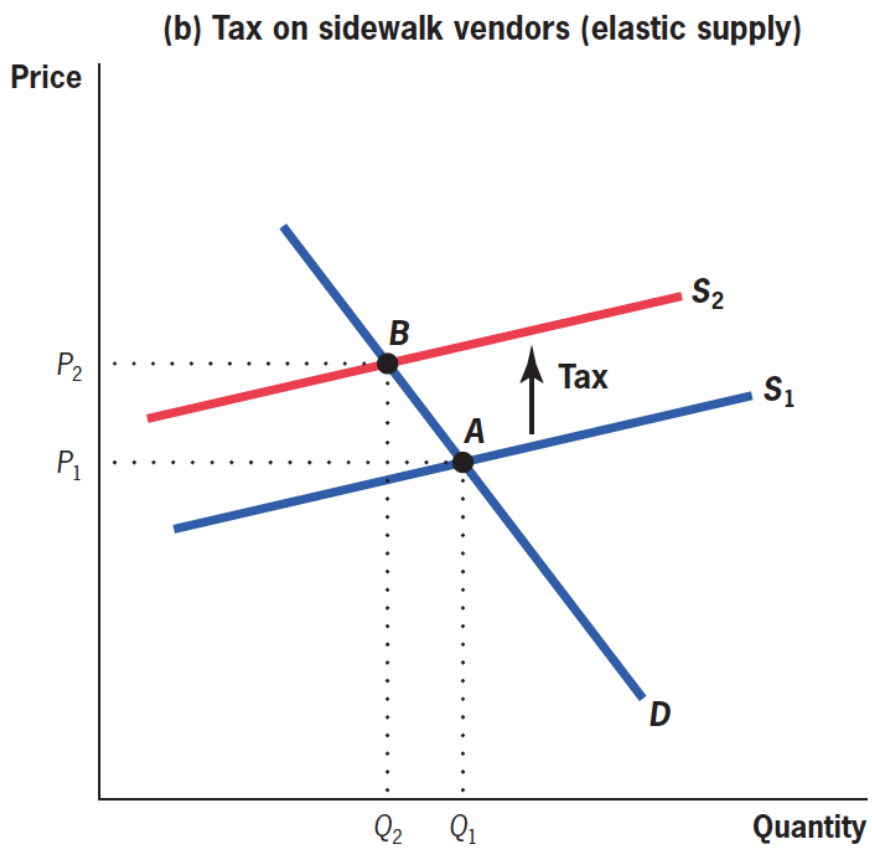
Supply Elasticities





TAX INCIDENCE: KEY RESULTS

1) statutory incidence not equal to economic incidence

2) equilibrium is independent of who nominally pays the tax

3) more inelastic factor bears more of the tax

These are robust conclusions that hold with more complicated models

Efficiency Costs of Taxation

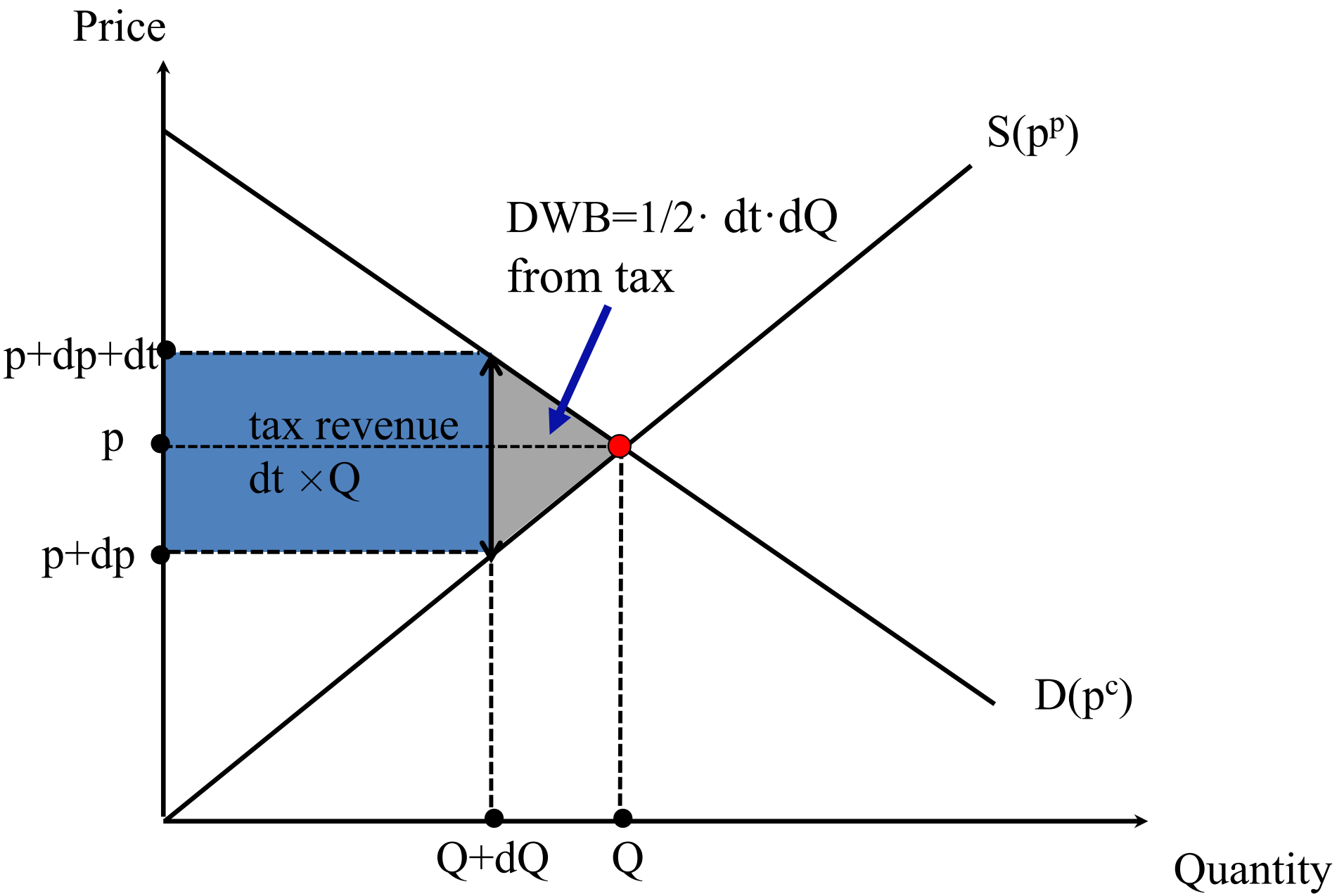
Deadweight burden (also called excess burden) of taxation is defined as the welfare loss (measured in dollars) created by a tax over and above the tax revenue generated by the tax

In the simple supply and demand diagram, welfare is measured by the sum of the consumer surplus and producer surplus

The welfare loss of taxation is measured as 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


Price
S(p^p)
DWB=1/2· dt·dQ
from tax
p+dp+dt
p
tax revenue
dt ×Q
p+dp
D(p^c)
Q+dQ
Q
Quantity

Efficiency Costs of Taxation

Deadweight burden (or deadweight loss) of small tax dt (starting from zero tax) is measured by the **Harberger Triangle**:

$$DWB = \frac{1}{2} dQ \cdot dt = \frac{1}{2} S'(p) \cdot dp \cdot dt = \frac{1}{2} \frac{pS'(p)}{S(p)} \cdot \frac{Q}{p} \cdot dp \cdot dt$$

[recall that $Q = S(p)$ and hence $dQ = S'(p)dp$]

Recall that $dp/dt = \varepsilon_D/(\varepsilon_S - \varepsilon_D)$, hence:

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

Efficiency Costs of Taxation

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

1) DWB increases with the absolute size of elasticities $\varepsilon_S > 0$ and $-\varepsilon_D > 0$

$\Rightarrow$ More efficient to tax relatively inelastic goods

2) DWB increases with the square of the tax rate t: small taxes have relatively small efficiency costs, large taxes have relatively large efficiency costs

$\Rightarrow$ Better to spread taxes across all goods to keep each tax rate low

$\Rightarrow$ Better to fund large one time govt expense (such as a war) with debt and repay slowly afterwards than have very high taxes only during war

3) Pre-existing distortions (such as an existing tax) makes the cost of taxation higher: move from the triangle to trapezoid

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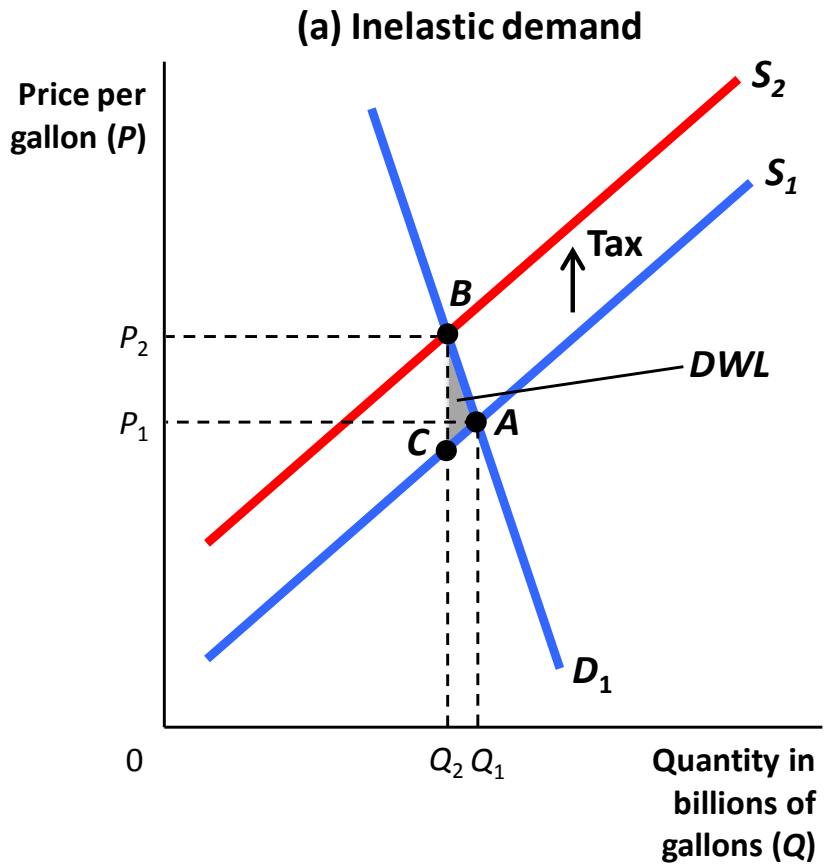
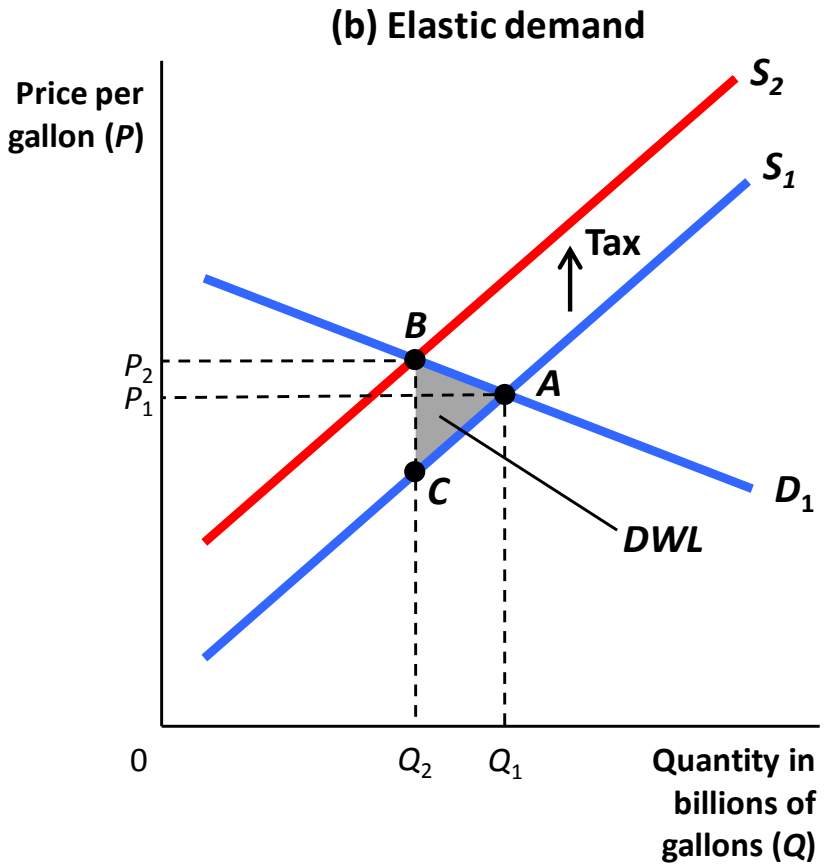
Elasticities Determine Tax Inefficiency





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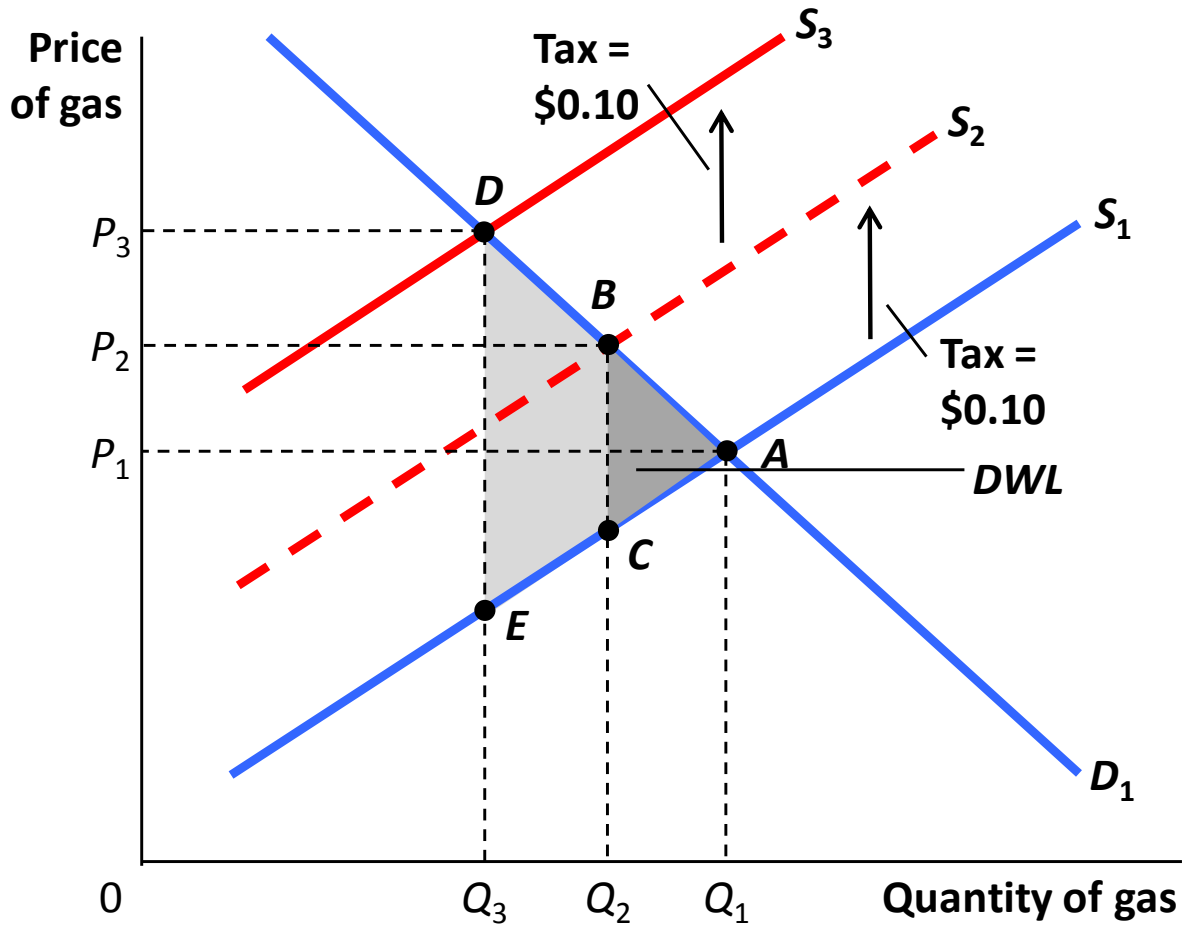
Marginal DWL Rises with Tax Rate



Application: Optimal Commodity Taxation

Ramsey (1927) asked by Pigou to solve the following problem:

Consider one consumer who consumes K different goods

What are the tax rates $t_1, .., t_K$ of each good that raise a given amount of revenue while minimizing the welfare loss to the individual?

Uniform tax rates $t = t_1 = .. = t_K$ is not optimal if the individual has more elastic demand for some goods than for others

Optimum is called the **Ramsey tax rule**: optimal tax rates are such that the marginal DWB for last dollar of tax collected is the same across all goods

$\Rightarrow$ Tax more the goods that have inelastic demands [and tax less the goods that have elastic demands]

Note: this abstracts from redistribution and focuses solely on efficiency

Tax Incidence: Empirical Application

European countries have large taxes on consumption: Value Added Tax (VAT)

Normal VAT rates are high (15-25%) but some goods/services have lower rates (or are exempt)

Benzarti et al. (2020) study the effects of VAT rates $\uparrow$ and $\downarrow$

Nice illustrative case study: hairdressers in Finland got a VAT cut of 14 points in Jan 2007 that was repealed in Jan 2012

Provide a basic graphical **difference-in-difference** analysis of prices of hairdressers (treatment) with beauty salons (control)

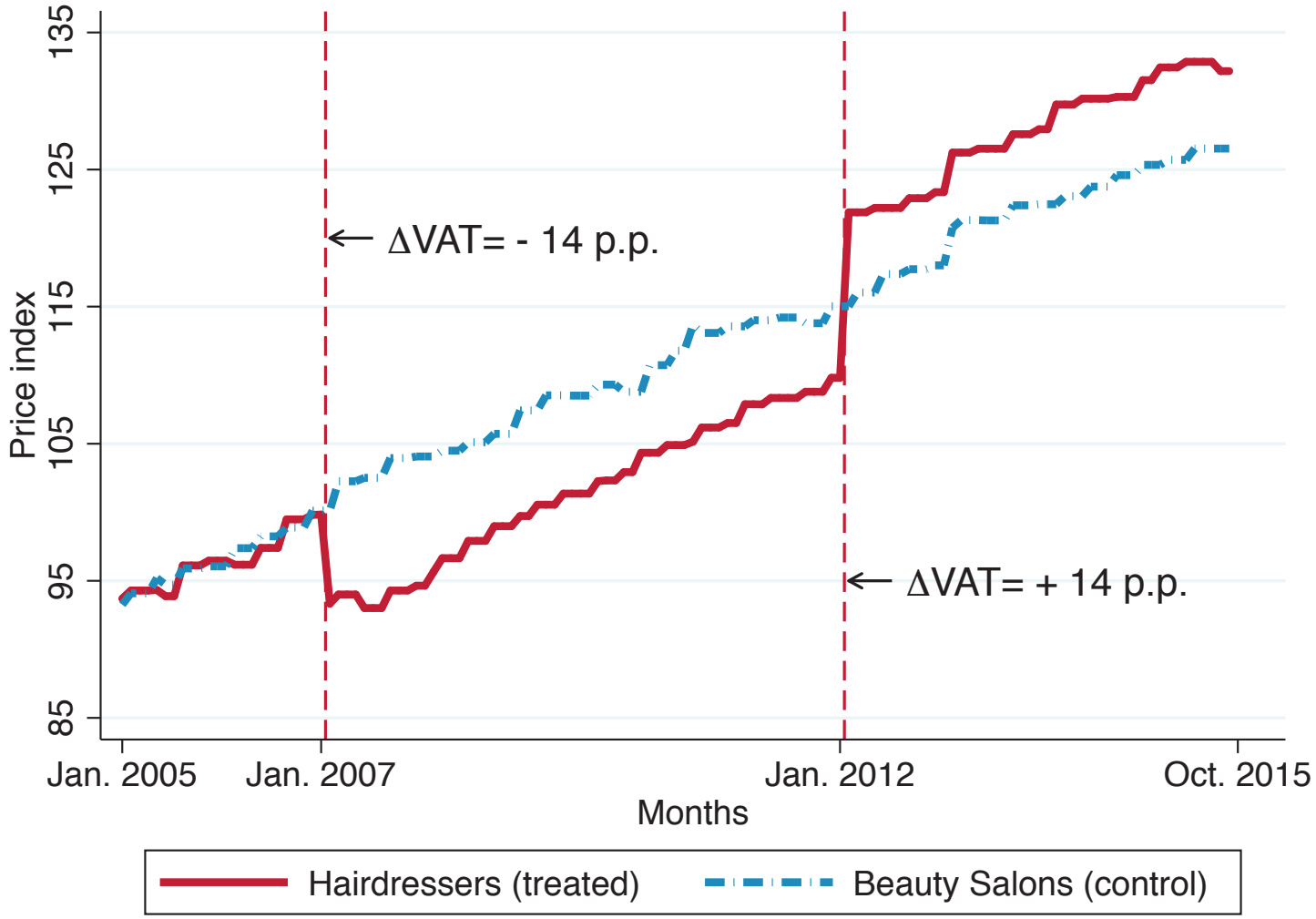
$\Rightarrow$ Find that tax decreases are only 50% passed on consumers while tax increases are almost fully passed on consumers.

Most likely explanation: producers pocket tax cut bc consumers are inattentive to taxes. Producers pass tax increase because they can justify the price increase to consumers.

$\Rightarrow$ Price determination does not work like basic model

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.

Difference-in-Difference (DD) methodology

Two groups: Treatment group (T) which faces a change [hair-dressers] and control group (C) which does not [beauty salons]

Compare the evolution of T group (before and after change) to the evolution of the C group (before and after change)

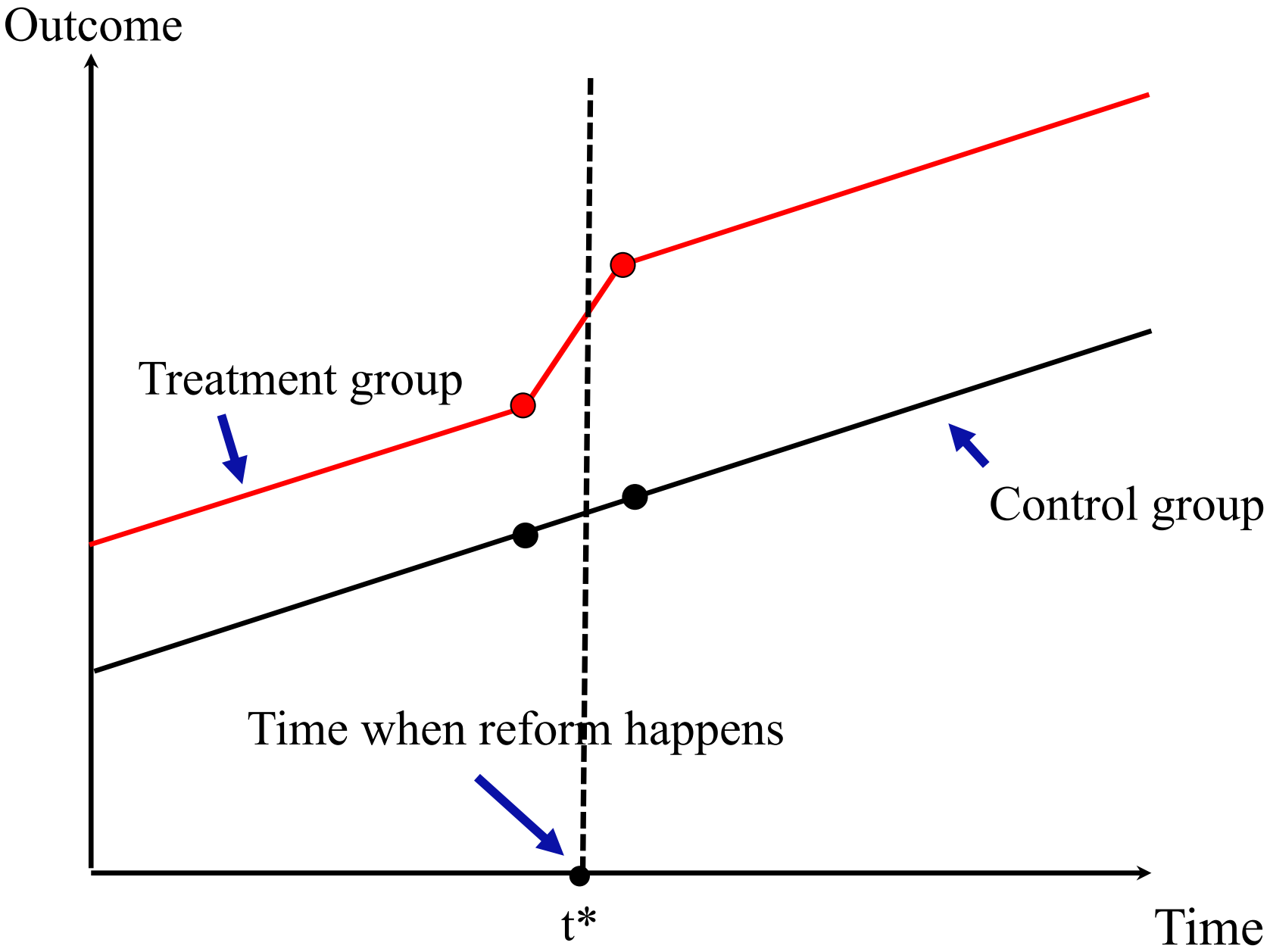
DD identifies the **treatment effect** if the parallel trend assumption holds:

Absent the change, T and C would have evolved in parallel

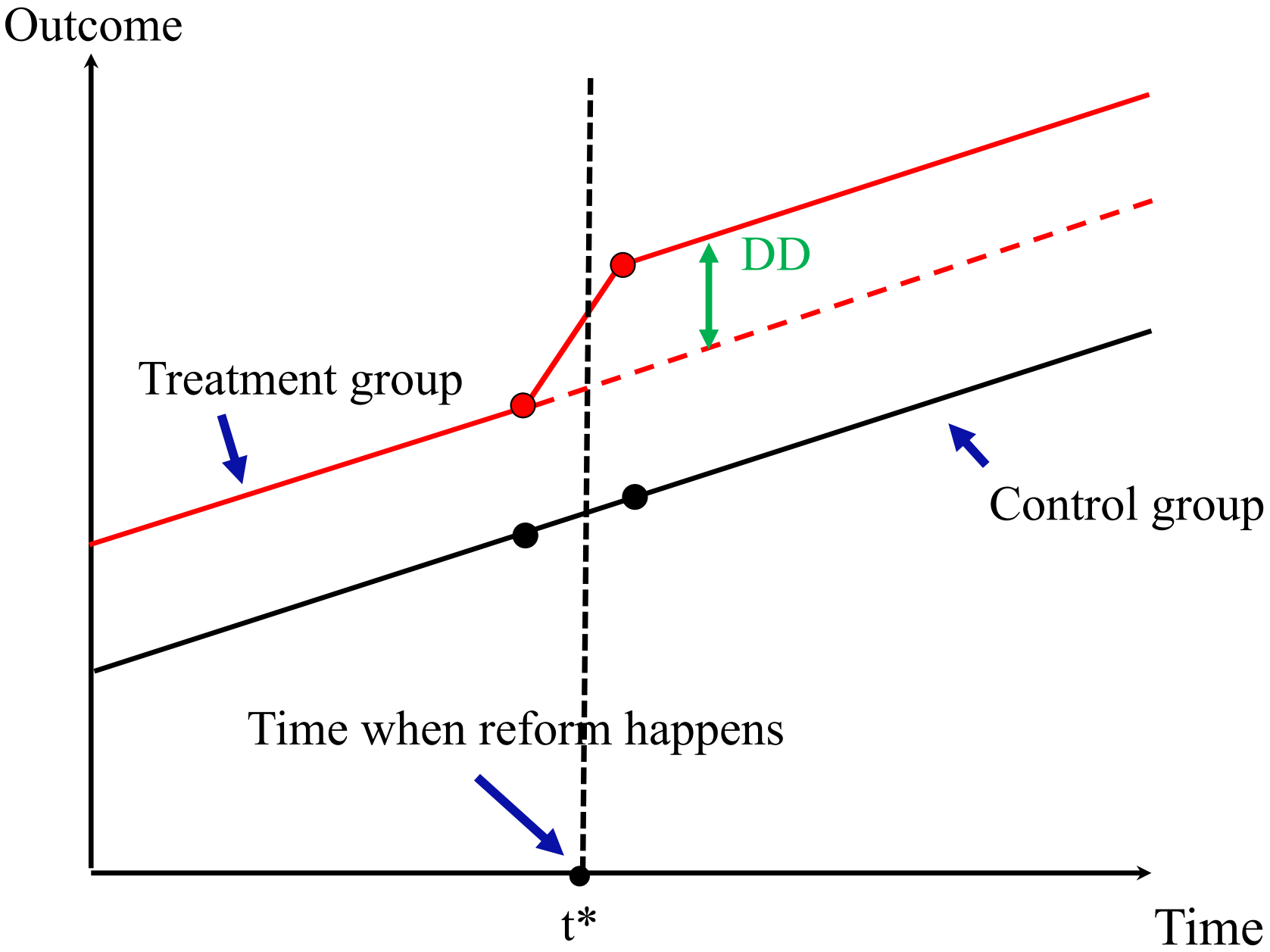
DD most convincing when groups are very similar to start with

Should always test DD using data from more periods and plot the two time series to check parallel trend assumption

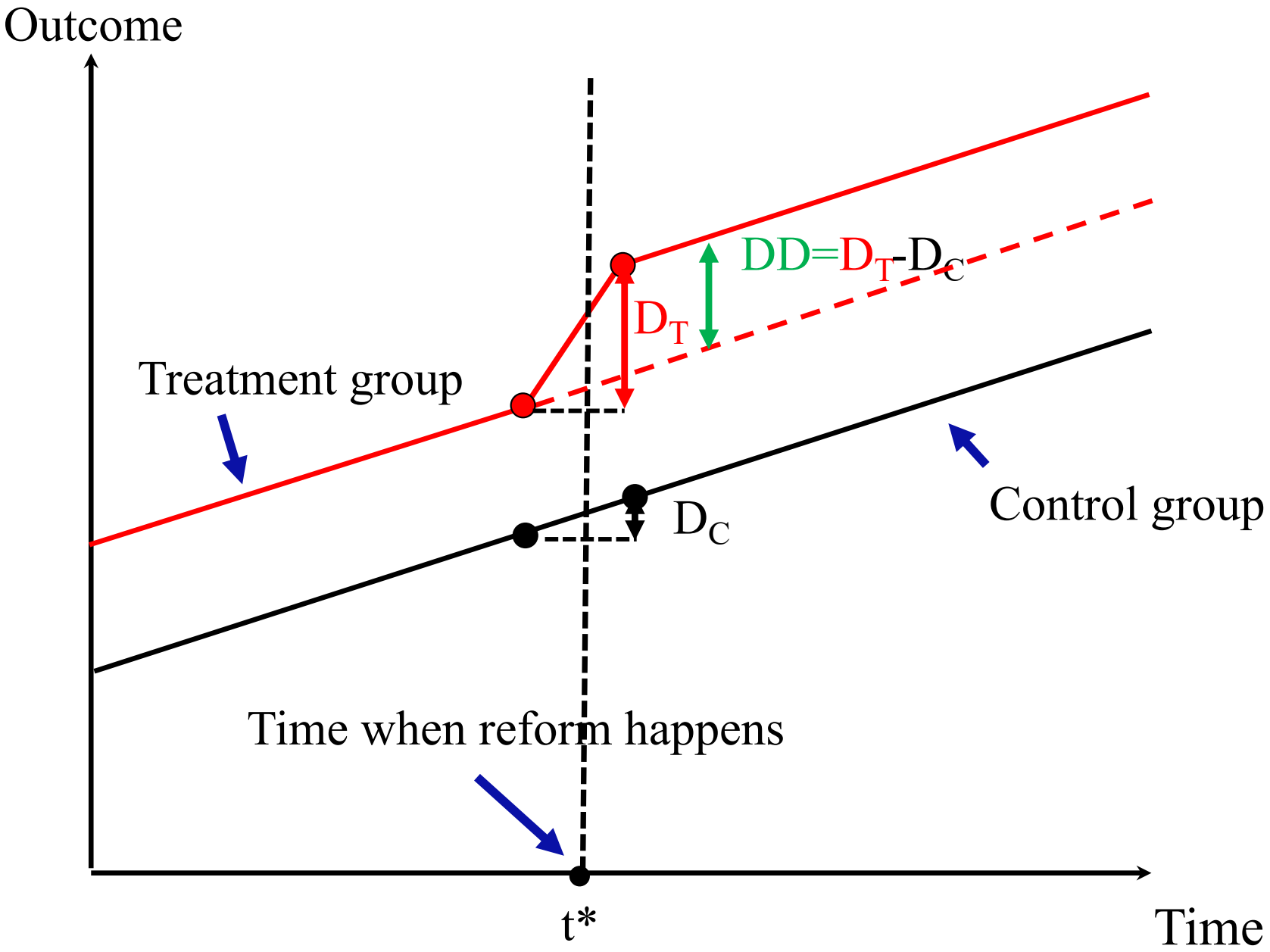
Difference-in-Difference Econometric Method



Difference-in-Difference Econometric Method



Difference-in-Difference Econometric Method



General Equilibrium Tax Incidence

Examples so far have focused on **partial equilibrium** incidence which considers impact of a tax on one market in isolation

General equilibrium models consider the effects on related markets of a tax imposed on one market

E.g. imposition of a tax on cars may reduce demand for steel $\Rightarrow$ additional effects on prices in equilibrium beyond car market.

General Equilibrium Tax Incidence: Example: Soda Tax in Berkeley

Consider the market for Soda beverages in Berkeley

Berkeley imposes a Soda tax since 2015: \$.01 per ounce (=\$.12/can)

Goal was to reduce soda consumption for better health (people overdrink). See Allcott et al. '18 for merits of soda tax.

Here narrower question: Who bears the incidence?

If soda demand in Berkeley is inelastic, consumers bear burden

Demand for Soda in Berkeley is likely to be elastic: if price of Soda in Berkeley goes up, you consume less Soda [intention of the tax] or you buy Soda elsewhere

Consider extreme case of perfectly elastic demand

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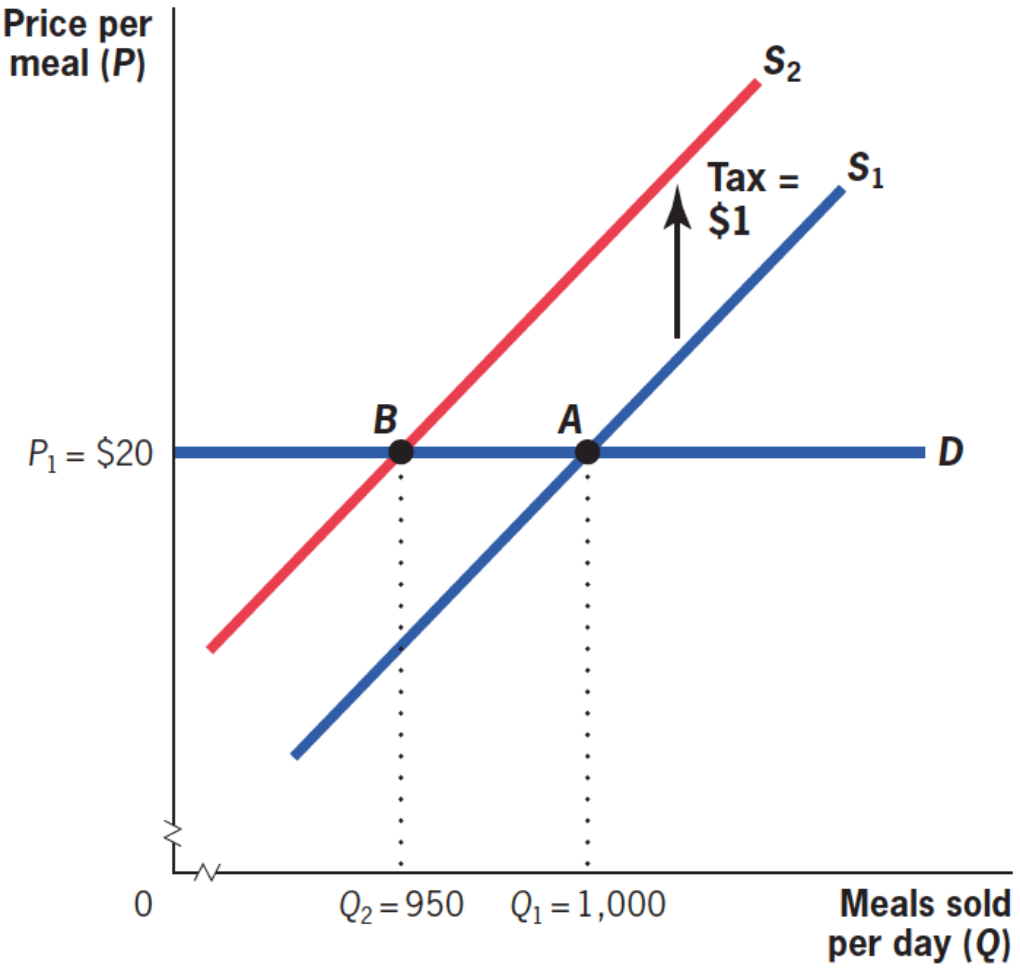
Effects of a Restaurant Tax: A General Equilibrium Example



General Equilibrium Tax Incidence: Example: Soda Tax

If Soda demand perfectly elastic then:

1) Berkeley Soda sellers (supermarkets, restaurants) cannot charge more and hence bear the full burden of the tax.

2) But Soda sellers are not self-contained entities

Companies are just a technology for combining capital and labor to produce an output.

Capital: land, physical inputs like building, kitchen equipment, etc.

Labor: cashier staff, cooks, waitstaff, etc.

3) Ultimately, these two factors (capital or labor) must bear the loss in profits due to the tax [if consumer demand is perfectly elastic]

General Equilibrium Tax Incidence: Example: Soda Tax

Incidence is "shifted backward" to capital and labor.

Assume that labor supply is perfectly elastic because Berkeley restaurant/supermarket workers can always go and work in Oakland if they get paid less in Berkeley

Capital, in contrast, is perfectly inelastic in short-run: you cannot pick up the shop and move it in the short run.

In short run, capital bears tax because it is completely inelastic $\Rightarrow$ Soda business owners lose (not consumers or workers)

In the longer-run, the supply of capital is also likely to be highly elastic: Investors can close or sell the shop, take their money, and invest it elsewhere.

General Equilibrium Tax Incidence: Long-run effects

If both labor and capital are highly elastic in the long run, who bears the tax?

The one additional inelastic factor is land.

The supply is clearly fixed.

When both labor and capital can avoid the tax, the only way Soda sellers will remain in Berleley is if they pay a lower rent on their land.

$\Rightarrow$ Soda tax ends up hurting Berkeley landowners in general equilibrium [if Soda demand, labor and capital are fully elastic]

This is of course an idealized example, in practice, demand, labor, and capital are not fully elastic so that incidence is shared

Tax Salience: A New Theory

Traditional model assumes that all individuals are fully aware of taxes that they pay

Is this true in practice? May be not be because many taxes are not fully salient.

Do you know your exact marginal income tax rate? Do you think about it when choosing a job?

Do you know the sales tax you have to pay in addition to posted prices at cash register?

Chetty, Looney, Kroft AER '09: test this assumption in the context of commodity taxes and develop a theory of taxation with inattentive consumers

Tax Salience: A New Theory

Chetty, Looney, Kroft AER'09 develop two empirical strategies to test whether salience matters for sales tax incidence

Sales tax is paid at the cash register and not displayed on price tags in stores

1) Randomized field experiment with supermarket stores

In one treatment store: they display new price tags showing the level of sales tax and total price on a **subset** of products

Compare shopping behavior for treated products vs. control products in treated store, before and after new tags are implemented (this is called difference-in-difference [DD] strategy)

Repeat the analysis in control stores as a placebo DD strategy

2) Policy experiment using changes in beer excise and sales taxes across states

Excise tax is salient because built into posted price while sales tax is not salient because it is not included in posted price

Source: Chetty, Looney, Kroft (2009)

Effect of Posting Tax-Inclusive Prices: Mean Quantity Sold

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 over time	0.84	-1.30	**DD_{TS} = -2.14**
	(0.75)	(0.92)	(0.64)

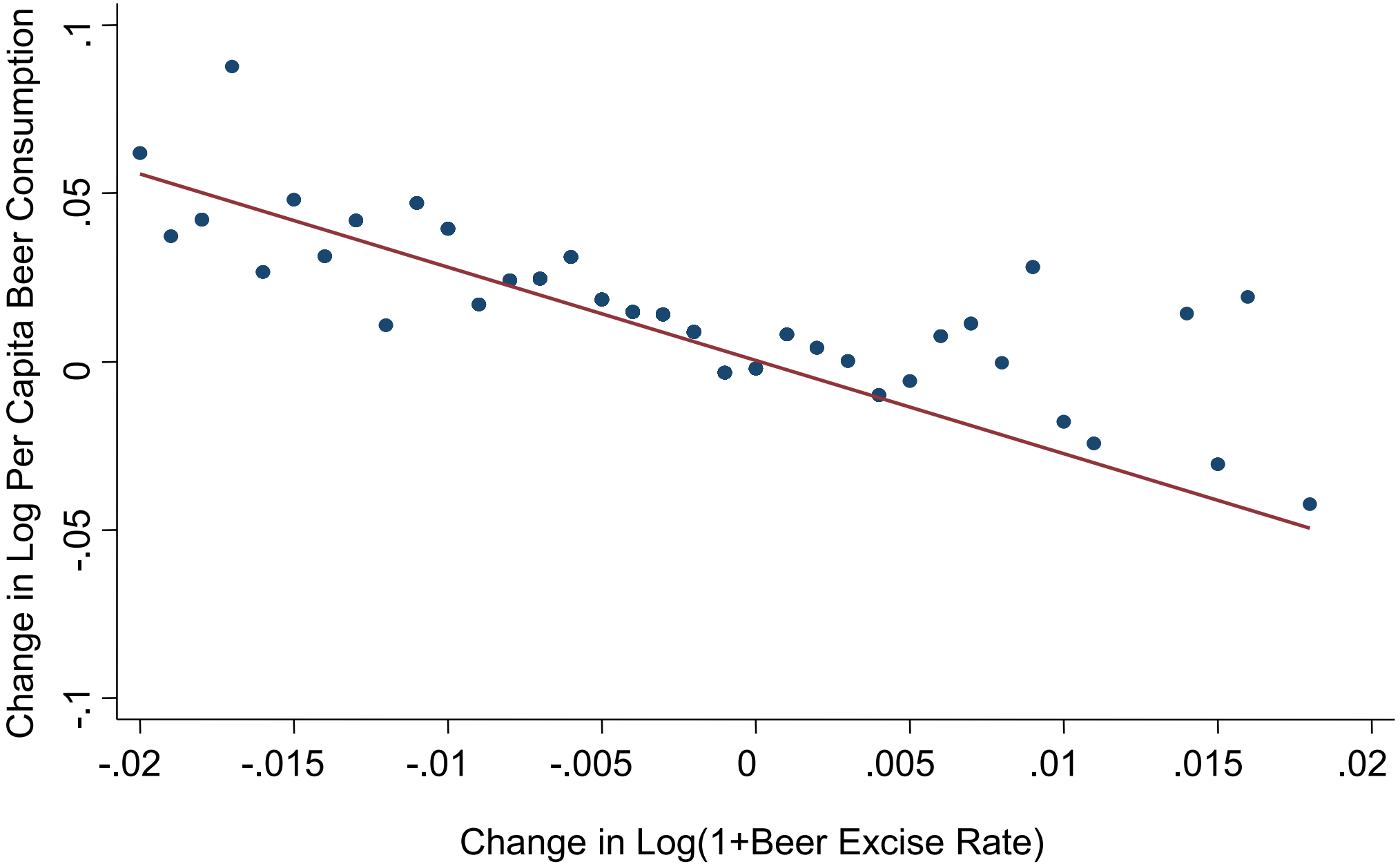
CONTROL STORES

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 over time	0.19	0.25	**DD_{CS} = 0.06**
	(0.64)	(0.92)	(0.90)
		DDD Estimate	***-2.20***
			(0.58)

Source: Chetty, Looney, Kroft (2009)

Figure 2a

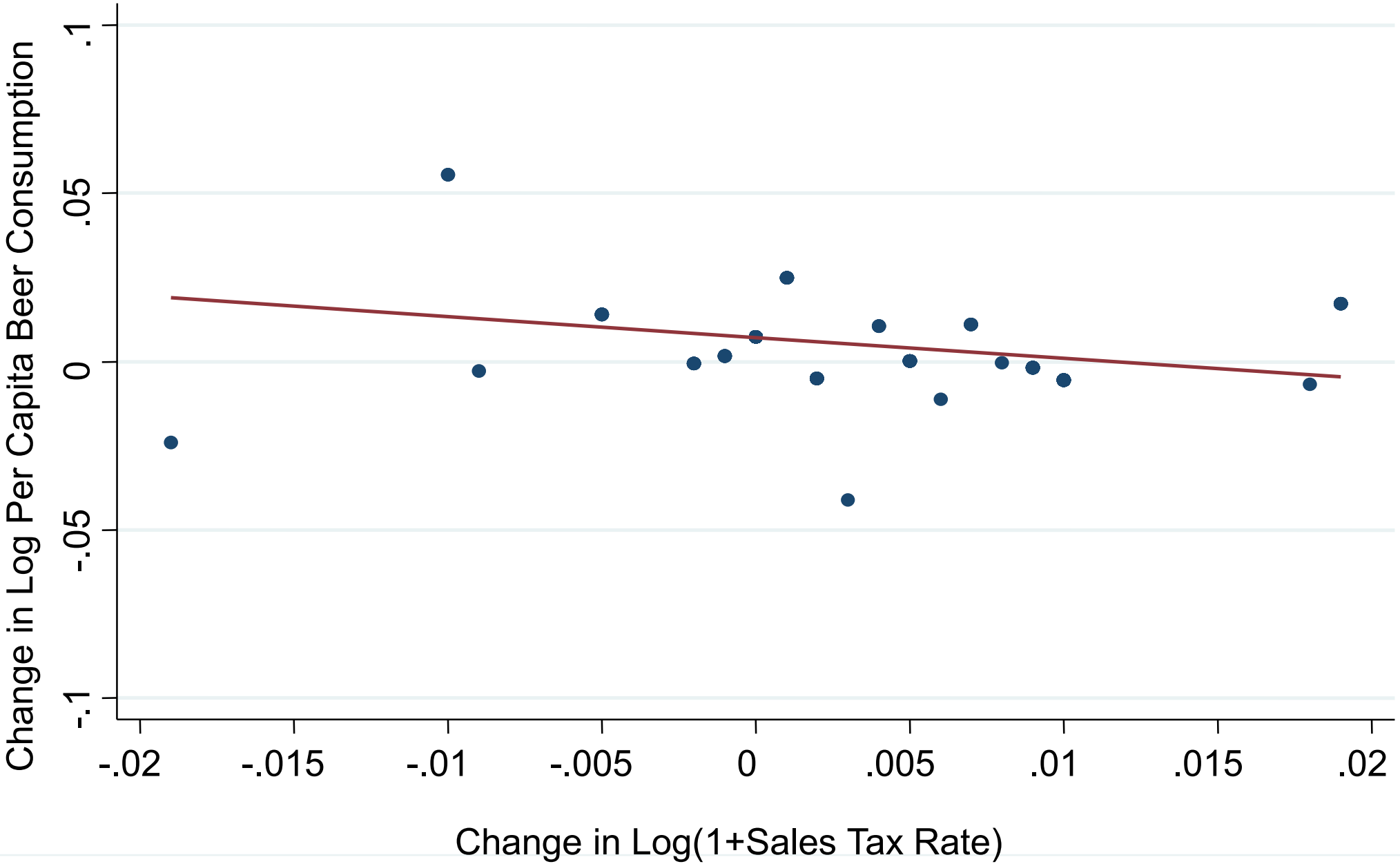
Per Capita Beer Consumption and State Beer Excise Taxes



Source: Chetty, Looney, Kroft (2009)

Figure 2b

Per Capita Beer Consumption and State Sales Taxes



Source: Chetty, Looney, Kroft (2009)

Effect of Excise and Sales Taxes on Beer Consumption

Dependent Variable: Change in Log(per capita beer consumption)

	Baseline	Bus Cyc, Alc Regs.	3-Year Diffs	Food Exempt
	(1)	(2)	(3)	(4)
ΔLog(1+Excise Tax Rate)	**-0.87**	**-0.89**	**-1.11**	**-0.91**
	(0.17)***	(0.17)***	(0.46)**	(0.22)***
ΔLog(1+Sales Tax Rate)	**-0.20**	**-0.02**	**-0.00**	**-0.14**
	(0.30)	(0.30)	(0.32)	(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

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

Source: Chetty, Looney, Kroft (2009)

Tax Salience: A New Theory

Key Empirical Result: **Salience matters**

1) Posting sales taxes reduces demand for those goods

2) Beer consumption is elastic to excise tax rate (built in posted price) but not to the sales tax rate (not built in the posted price)

$\Rightarrow$ If tax is not salient to consumers, they are less elastic, and hence more likely to bear the tax burden

A number of recent empirical studies show that individuals are not fully informed and fully rational and this has large consequences for policy

TAX PROGRESSIVITY IN THE US

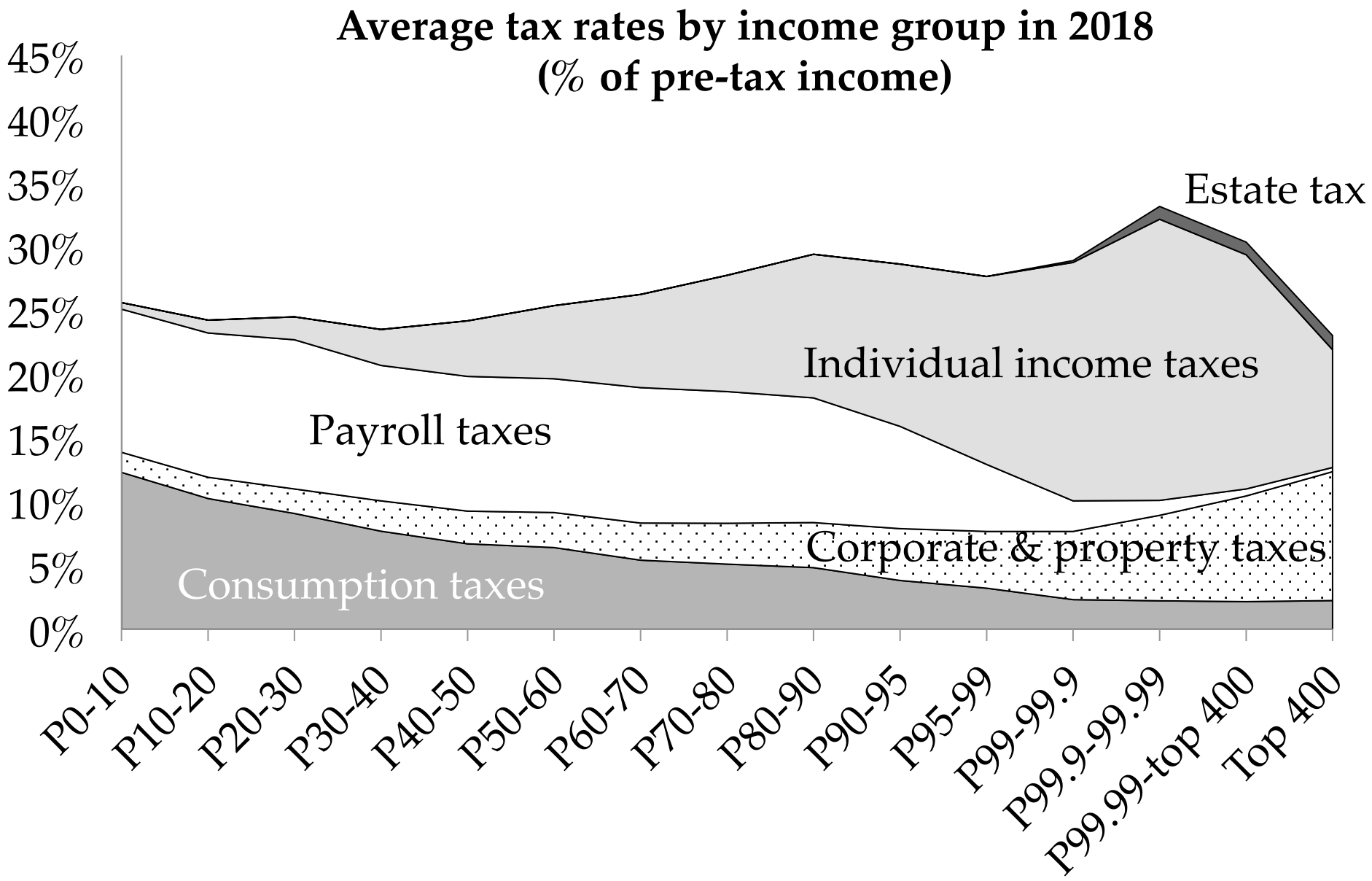
Saez-Zucman (2019) distribute taxes by factor. At Taxjusticenow.org, you can explore changing the current tax system.

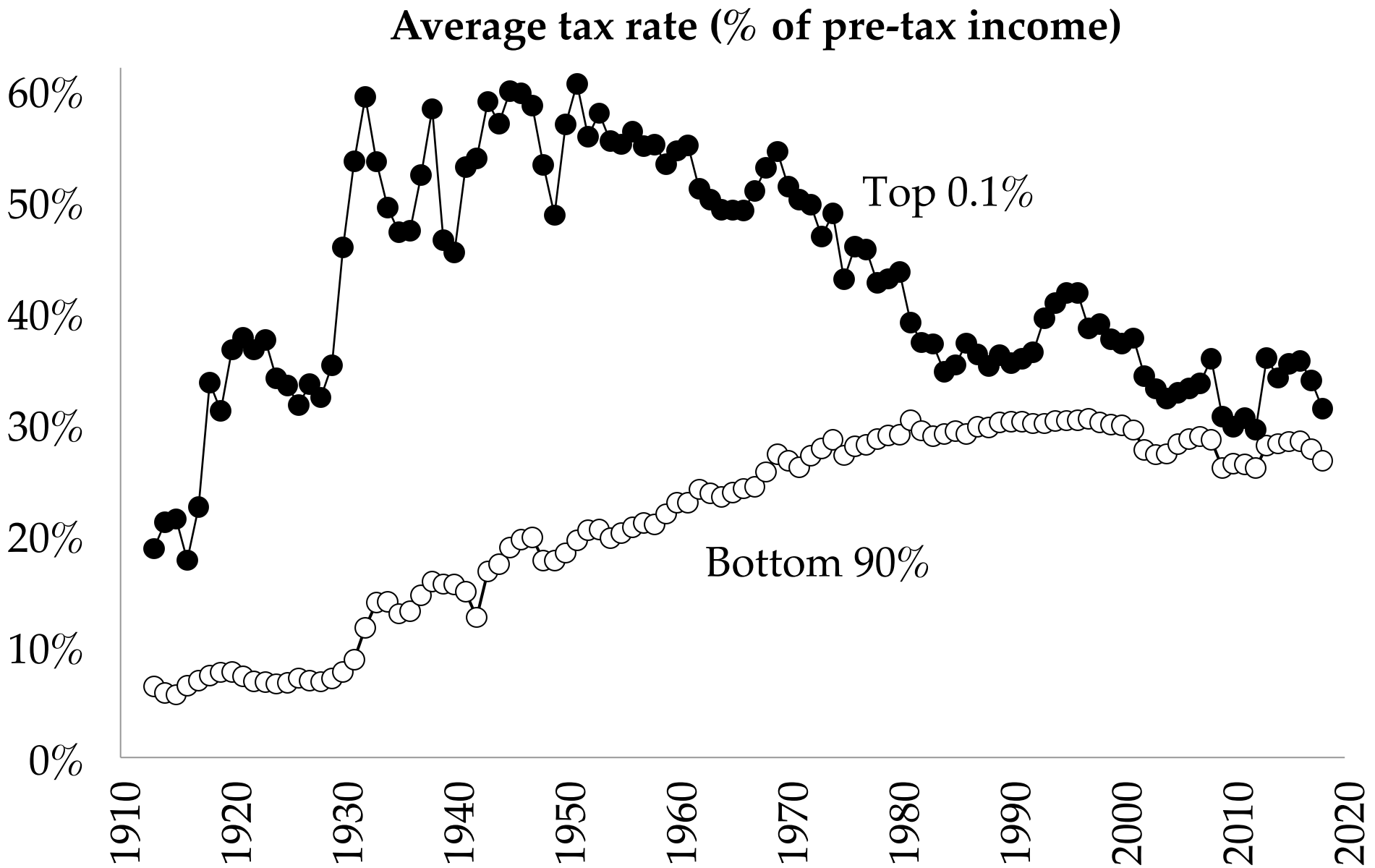
1) Labor taxes (payroll taxes and individual income taxes) assigned to corresponding workers (whether tax remitted by the workers or employers)

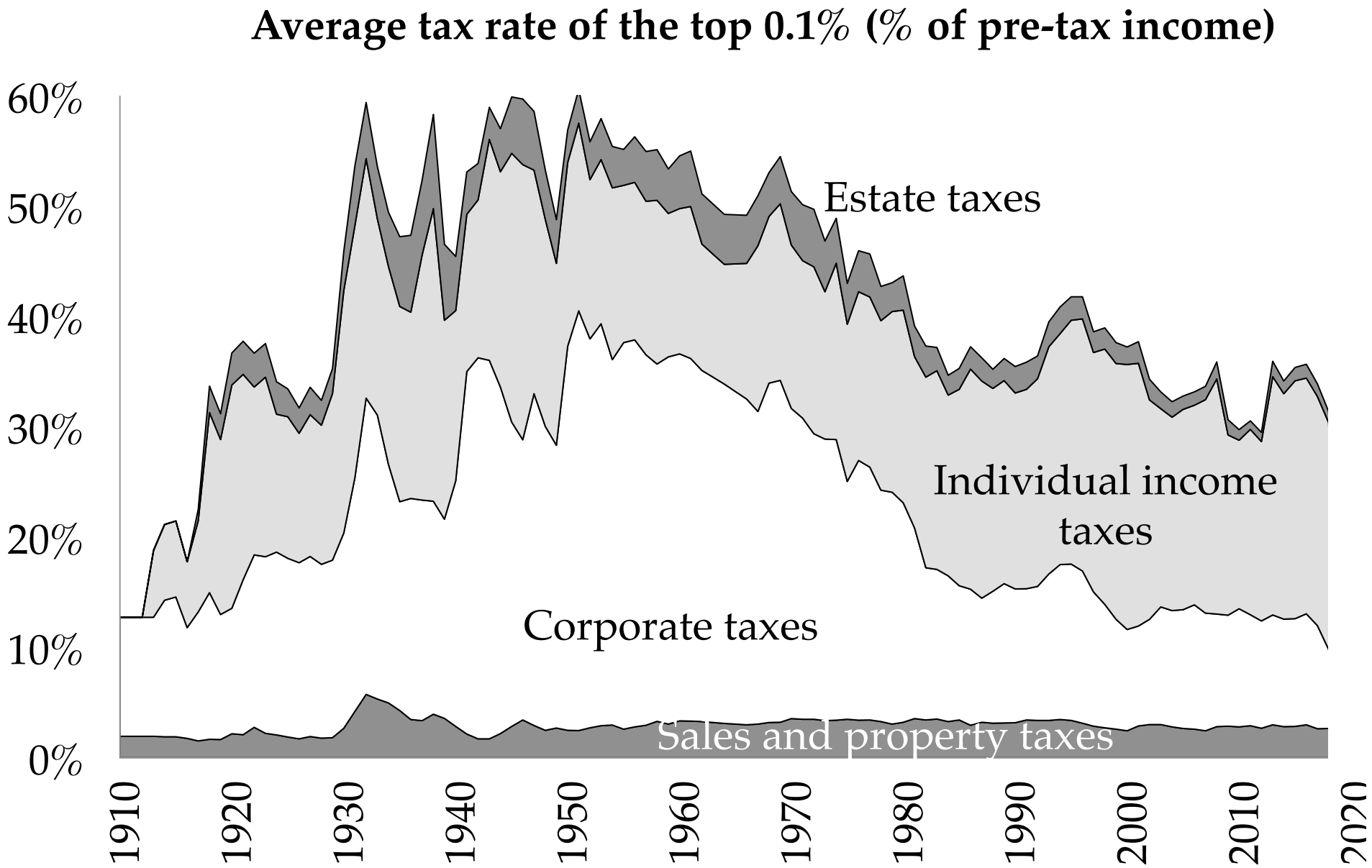
2) Consumption taxes (excise and sales) assigned to corresponding consumers

3) Capital taxes (corporate tax, property tax, taxes on capital income) assigned to corresponding owners of the capital assets

This distribution by factor does not capture ultimate incidence nor DWB if taxes are shifted through incidence


Average tax rates by income group in 2018
(% of pre-tax income)
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
Estate tax
Individual income taxes
Payroll taxes
Corporate & property taxes
Consumption taxes
P0-10
P10-20
P20-30
P30-40
P40-50
P50-60
P60-70
P70-80
P80-90
P90-95
P95-99
P99-99.9
P99.9-99.99
P99.99-top 400
Top 400


Average tax rate (% of pre-tax income)
60%
50%
40%
30%
20%
10%
0%
Top 0.1%
Bottom 90%
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020


Average tax rate of the top 0.1% (% of pre-tax income)
60%
50%
40%
30%
20%
10%
0%
Estate taxes
Individual income taxes
Corporate taxes
Sales and property taxes
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020

US TAX PROGRESSIVITY BY TYPE OF TAX

1. **Individual Income tax** is progressive (exempts the bottom 50% and increasing rates by brackets)

2. **Payroll taxes** on earnings are a constant tax rate of 15% but only up to $137K of earnings $\Rightarrow$ Regressive at the top

3. **Excise and sales taxes** are regressive because share of income devoted to consumption of goods falls with income

4. **Corporate tax** is progressive because corporate owners tend to be at the top (**property tax** somewhat progressive)

5. **Estate tax** on large fortunes at death progressive but small

Federal taxes are more progressive than state+local taxes. Official stats from CBO focus on federal taxes only

Is Distribution by Factor Close to True Incidence?

1) Labor taxes borne by workers if wages set as in competitive model and labor supply less elastic than labor demand

In practice, wages are rigid in short-run so employer vs. employee payroll tax don't have the same effect (evidence from France and Greece). In long-run incidence likely on wages (as employer payroll taxes haven't reduced macro capital share)

2) Consumption taxes borne by consumers if prices set competitively and demand for goods less elastic than supply

VAT evidence and salience evidence show non-standard incidence in short and medium-run but long-run incidence likely on consumers

3) Capital taxes borne by owners of capital if supply of capital (savings) less elastic than demand for capital (investment)

Evidence here is most disputed. Official CBO statistics shift 1/4 of corporate tax on workers without much evidence (see corp tax lecture)

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