Incidence and Efficiency Costs of Taxation

(Chapters 19-20 of Gruber's textbook)

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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 mechanical 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

We consider partial equilibrium model with a single good (illustrates well key mechanisms)

Government levies an excise tax on good x

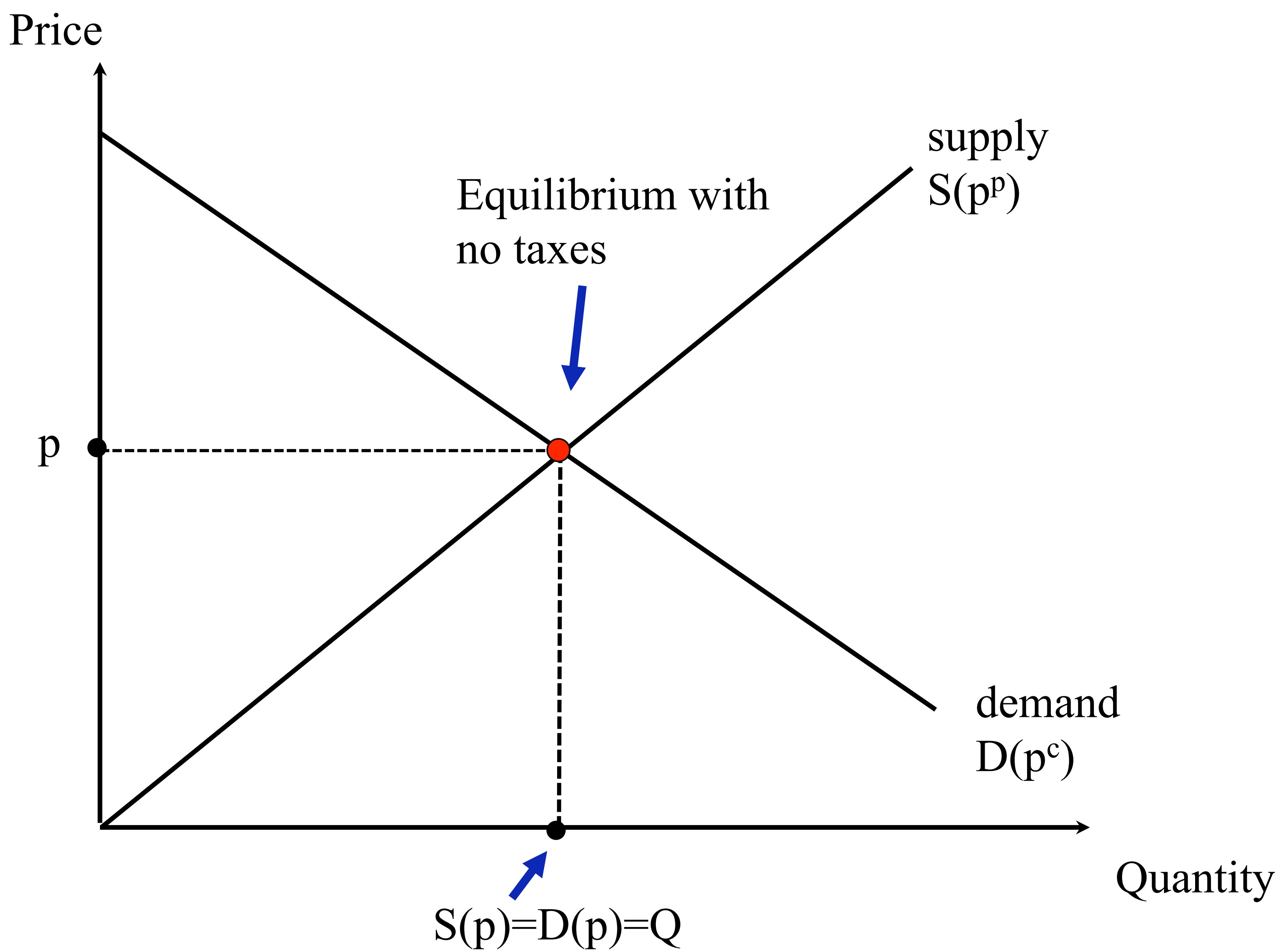
Excise means it is levied on a quantity (gallon, pack, ton, ...). Typically fixed in nominal terms (e.g, $1 per pack)

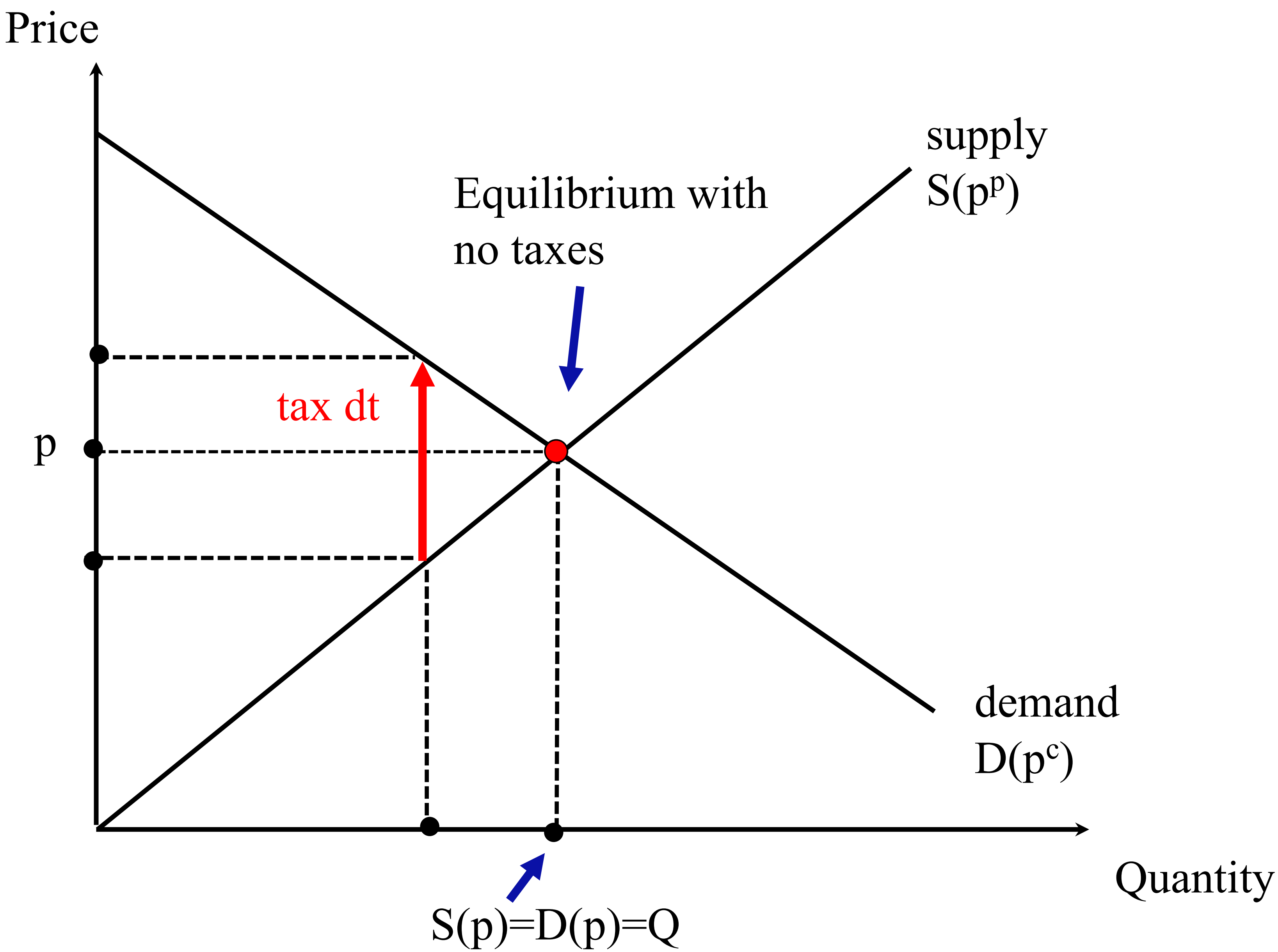
[ad-valorem tax is a fraction of prices (e.g. 5% sales tax)]

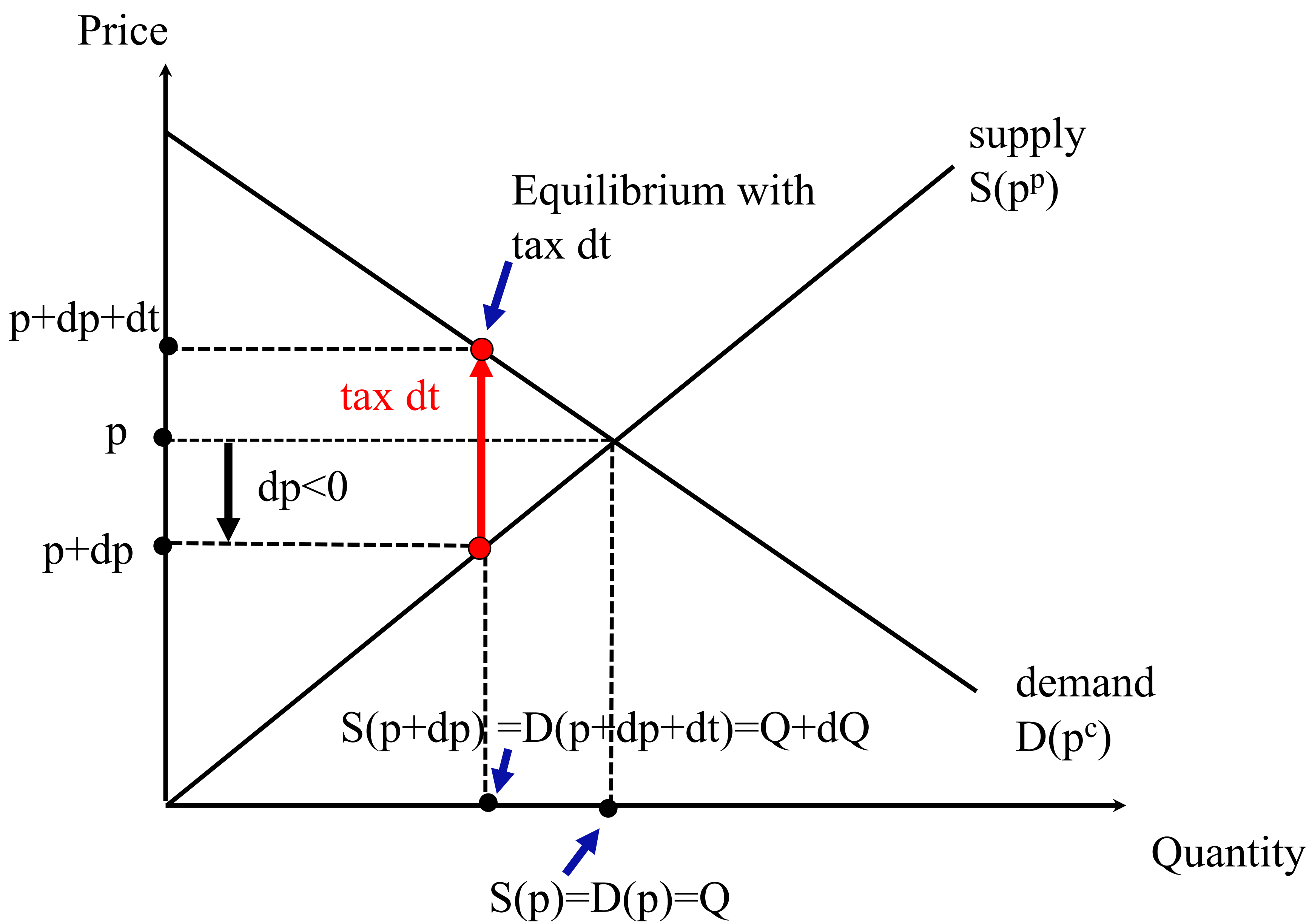
Let p denote the pretax price of x (producer price)

Let $p^c = p + dt$ denote the tax inclusive price of x (consumer price) where dt is the tax per unit

We assume that dt is small and trace out the impact dp and dQ on p and Q using calculus


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

Supply of good x is $S(p)$ increases with producer price $p^p = p$

Demand is $D(p^c)$ decreases with consumer price $p^c = p + dt$

Start from $t = 0$ and no tax equilibrium $S(p) = D(p)$

Effect of a small tax dt on price p:

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

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

Consumers bear the entire tax burden ($dp/dt = 0$) when either:

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: competitive industry with constant cost of production per unit

Producers bear entire tax burden ($dp/dt = -1$) when either:

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

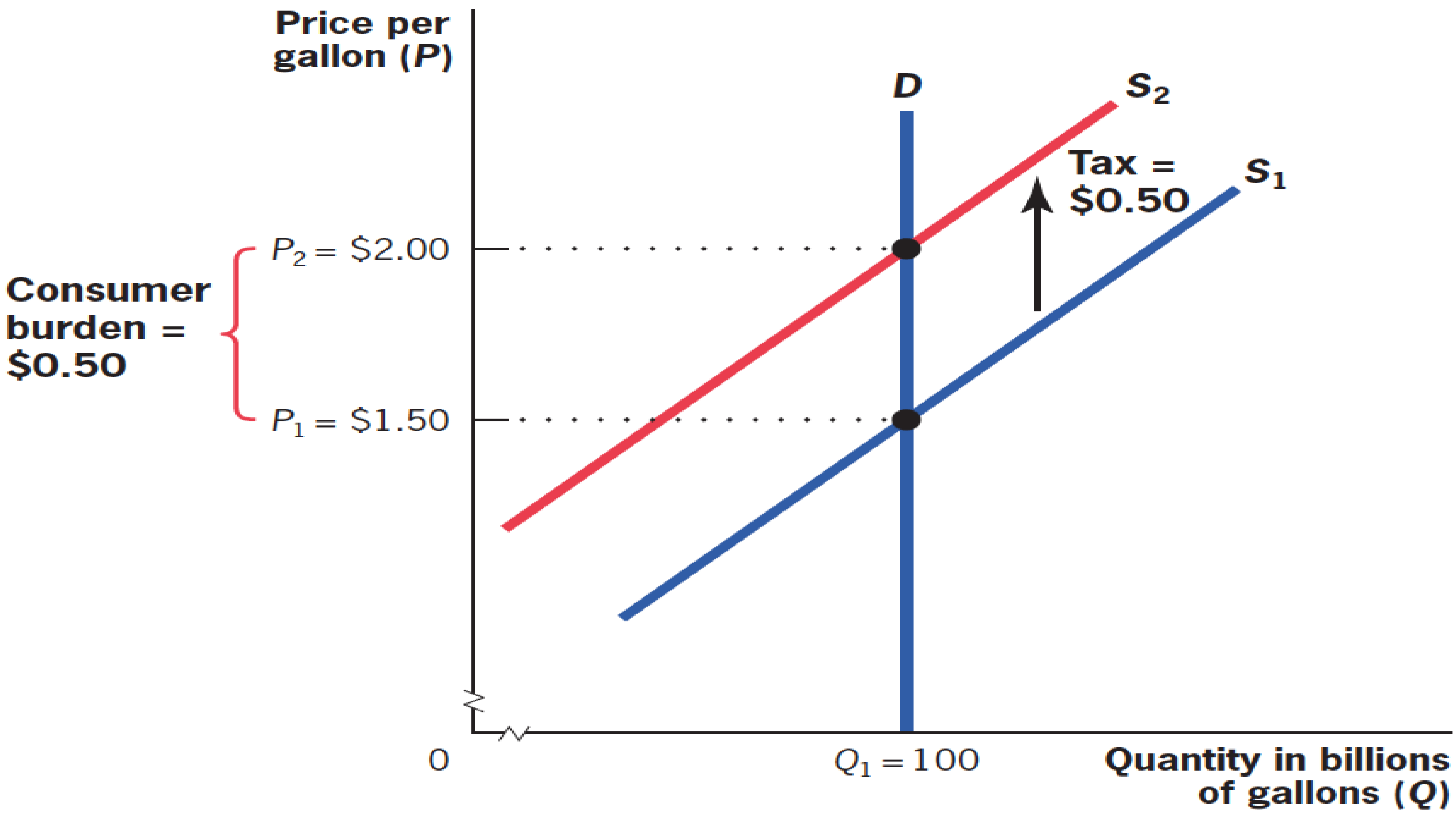
example: fixed quantity supplied (can only extract so much oil given oil wells)

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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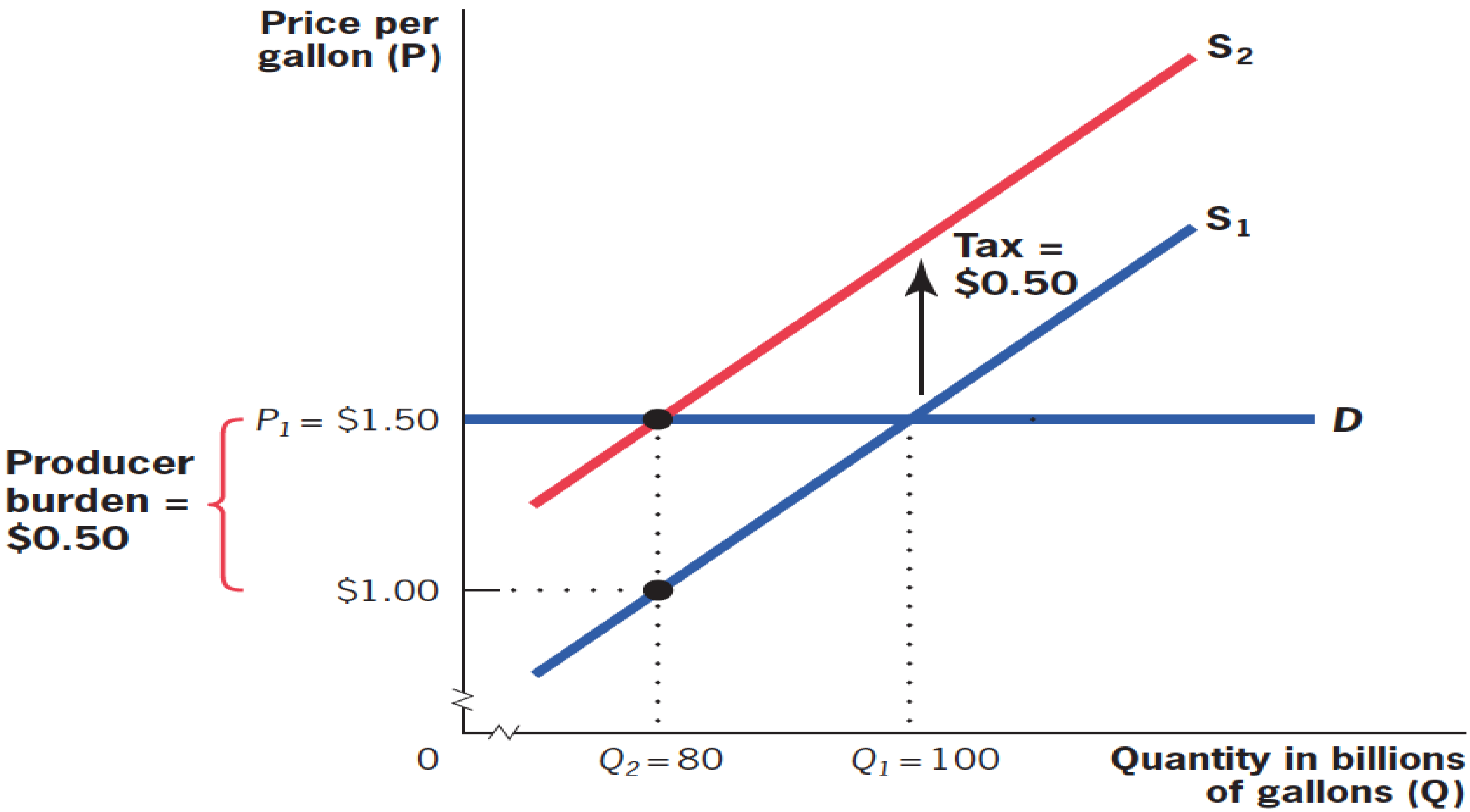
Perfectly Elastic Demand



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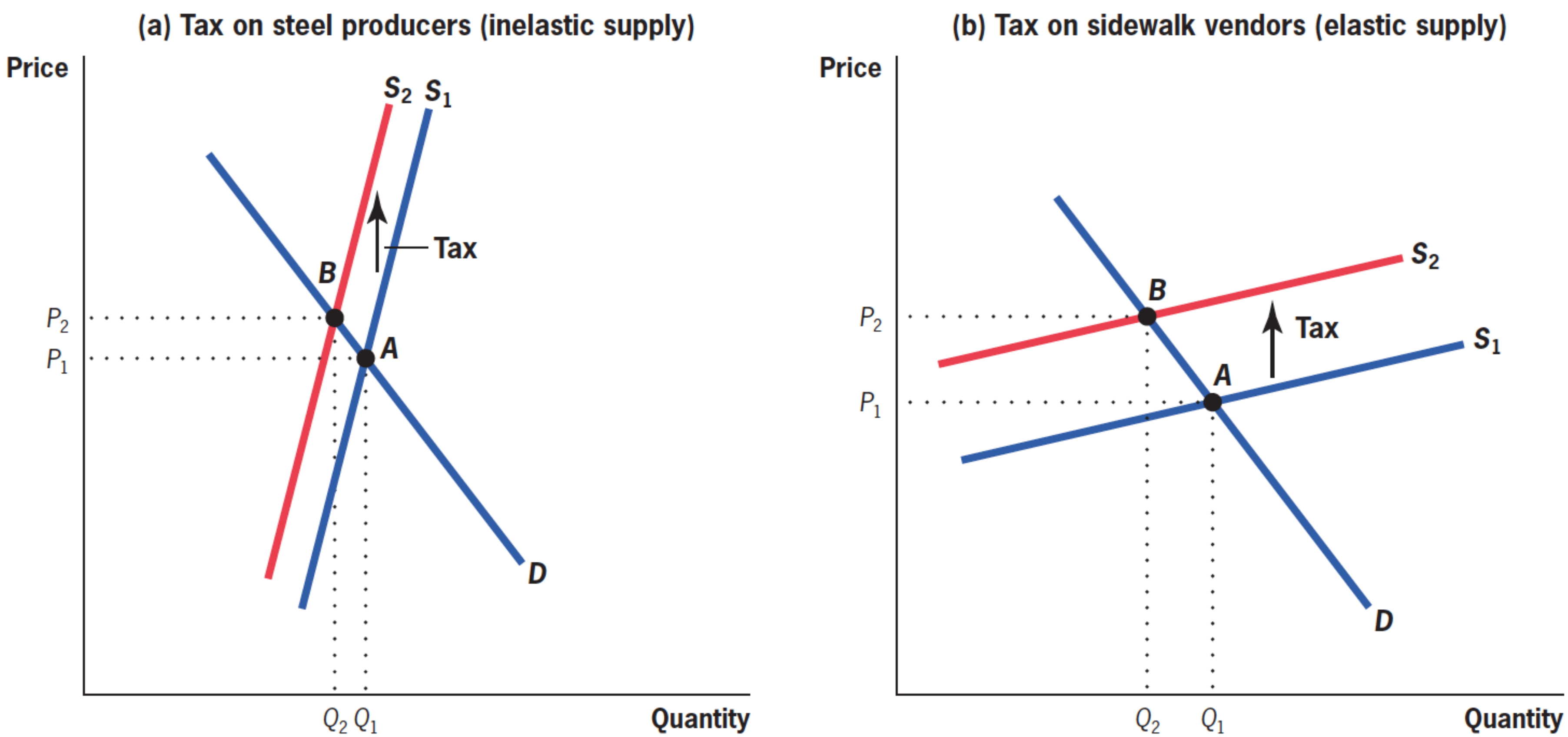
Supply Elasticities



TAX INCIDENCE IN COMPETITIVE MODEL: TWO KEY RESULTS

1) equilibrium is independent of who statutorily pays the tax (whether tax is charged on producer or consumer)

2) more inelastic factor bears more of the tax

These are robust conclusions of the standard economic model with perfect competition where consumer and producers are price takers (extends to case with many goods)

Quiz

Trump has just imposed 10% tariff on Canadian oil. Who bears the cost in the short-run?

A. Canadian producers because they send it by pipeline and can't easily sell it to others

B. American consumers because US can't quickly produce more or buy more oil from others

C. Not clear because both A. and B. are true

D. None of A, B, C

Efficiency Costs of Taxation

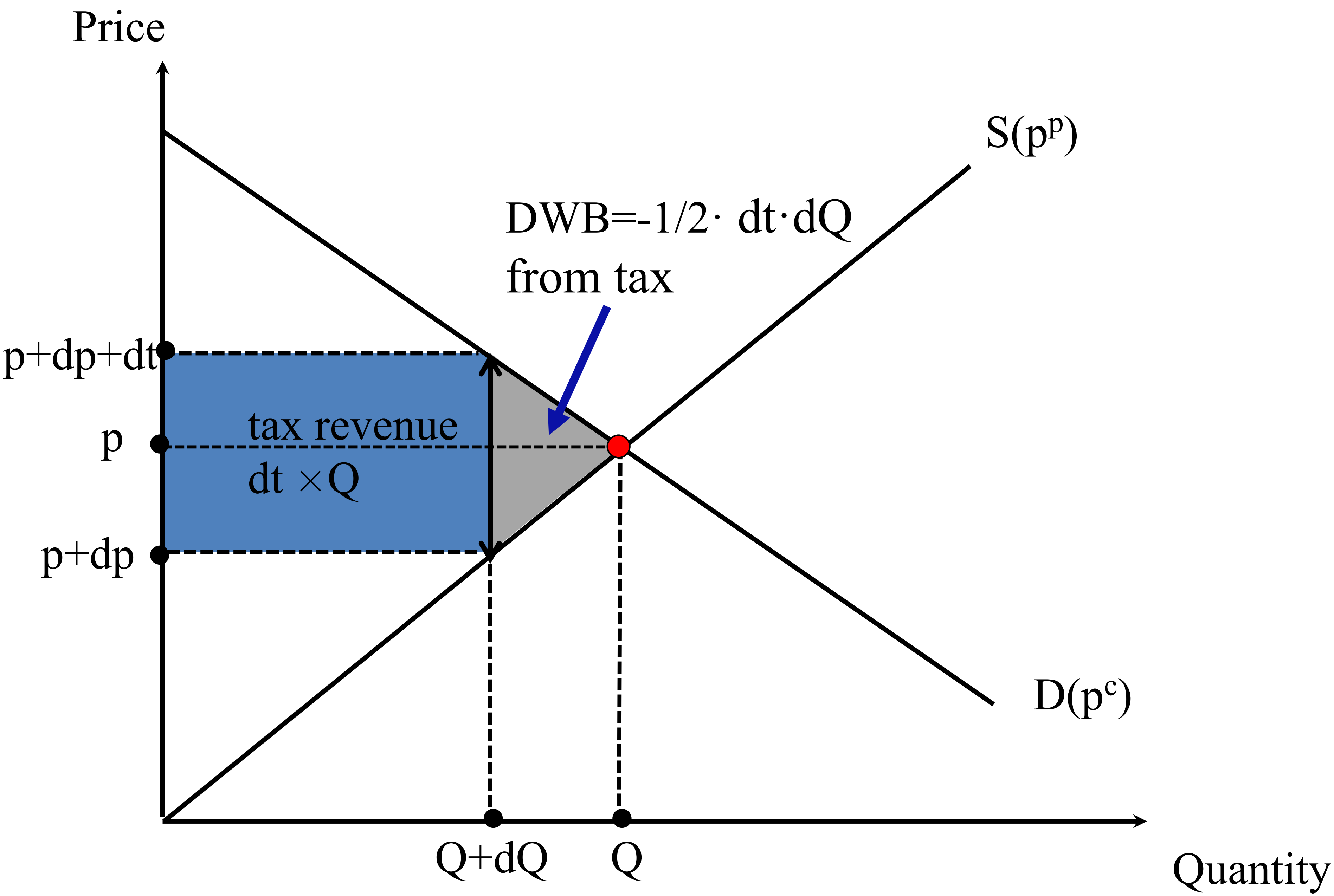
Deadweight burden (also called excess burden) of taxation is defined as the welfare loss (measured in dollars) created by a tax over and above the tax revenue generated by the tax

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, 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:

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

Efficiency Costs of Taxation

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

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 dt: small taxes have relatively small efficiency costs, large taxes have relatively large efficiency costs

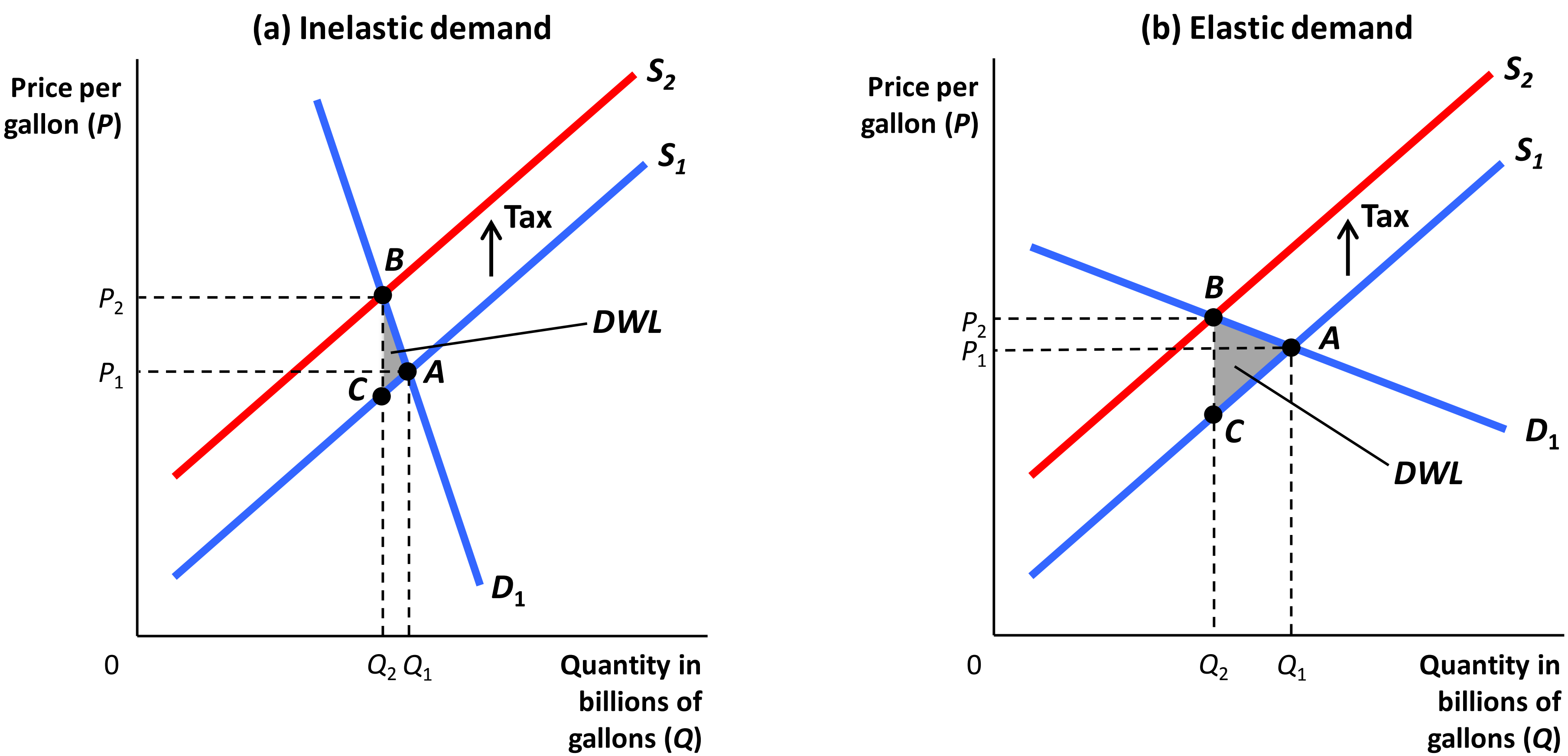
$\Rightarrow$ Better to spread taxes across all goods to keep each tax rate low

$\Rightarrow$ Better to fund large one time govt expense (such as a war) with debt and repay slowly afterwards with long-term higher taxes 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

20.1

Elasticities Determine Tax Inefficiency



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Marginal DWL Rises with Tax Rate

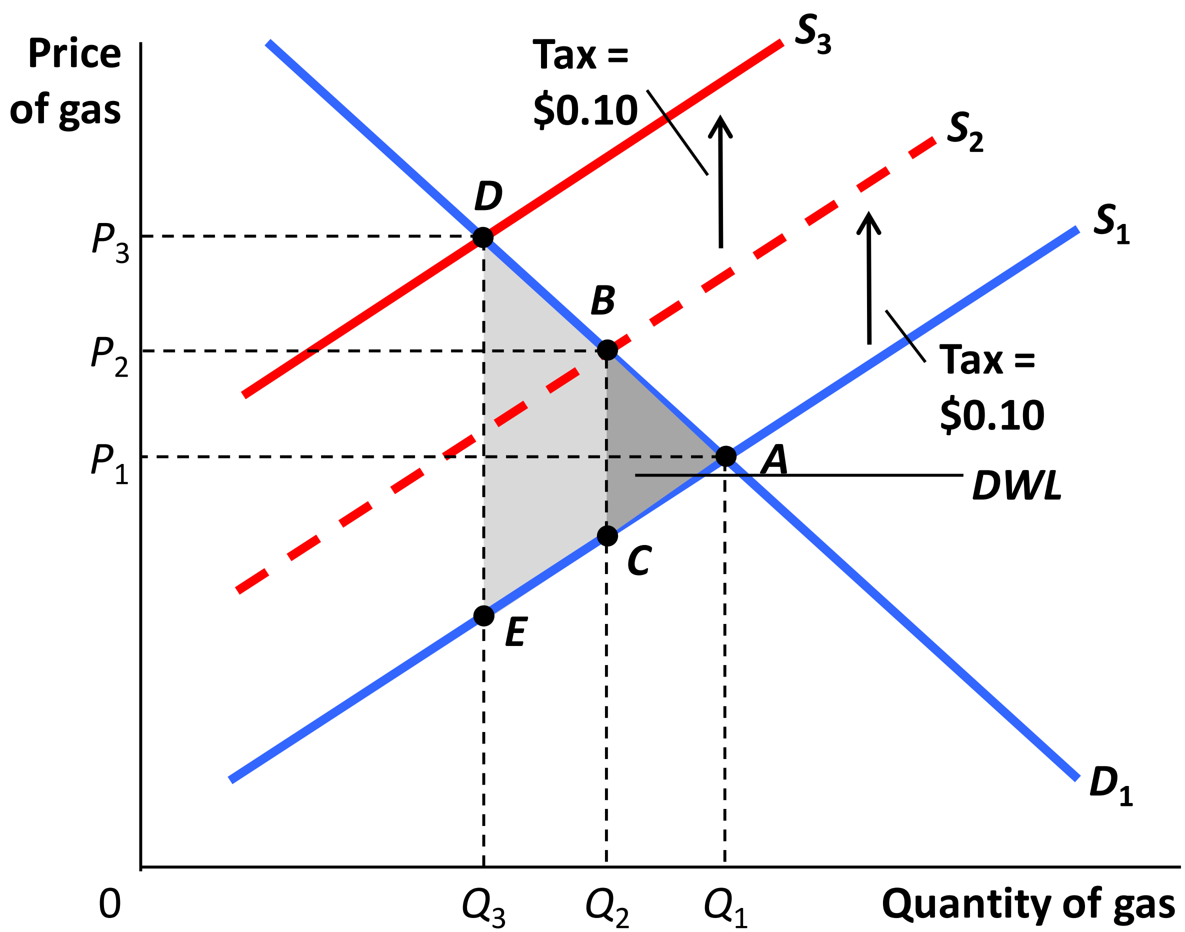


Illustration: Efficiency Costs of Taxation

Britain had a window tax on buildings from 1700 to 1850
$\Rightarrow$ Inefficiently dark buildings

Efficiency Costs of Trump Tariffs on Canadian crude oil

If Trump tariffs last and are increased, what happens in the long-run?

Canada will sell its crude oil to other countries such as Europe to avoid tax

US will replace Canadian oil with oil from somewhere else (shipped from Venezuela or extracted from marginal US producers)

Inefficient to ship crude oil to Europe across Atlantic rather than to the US through existing pipelines!

Quiz

In the equilibrium with a tax, which component is NOT part of the economic surplus?

A. The consumer surplus

B. The producer surplus

C. The tax revenue

D. The deadweight loss

E. All A,B,C,D are in the economic surplus

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)

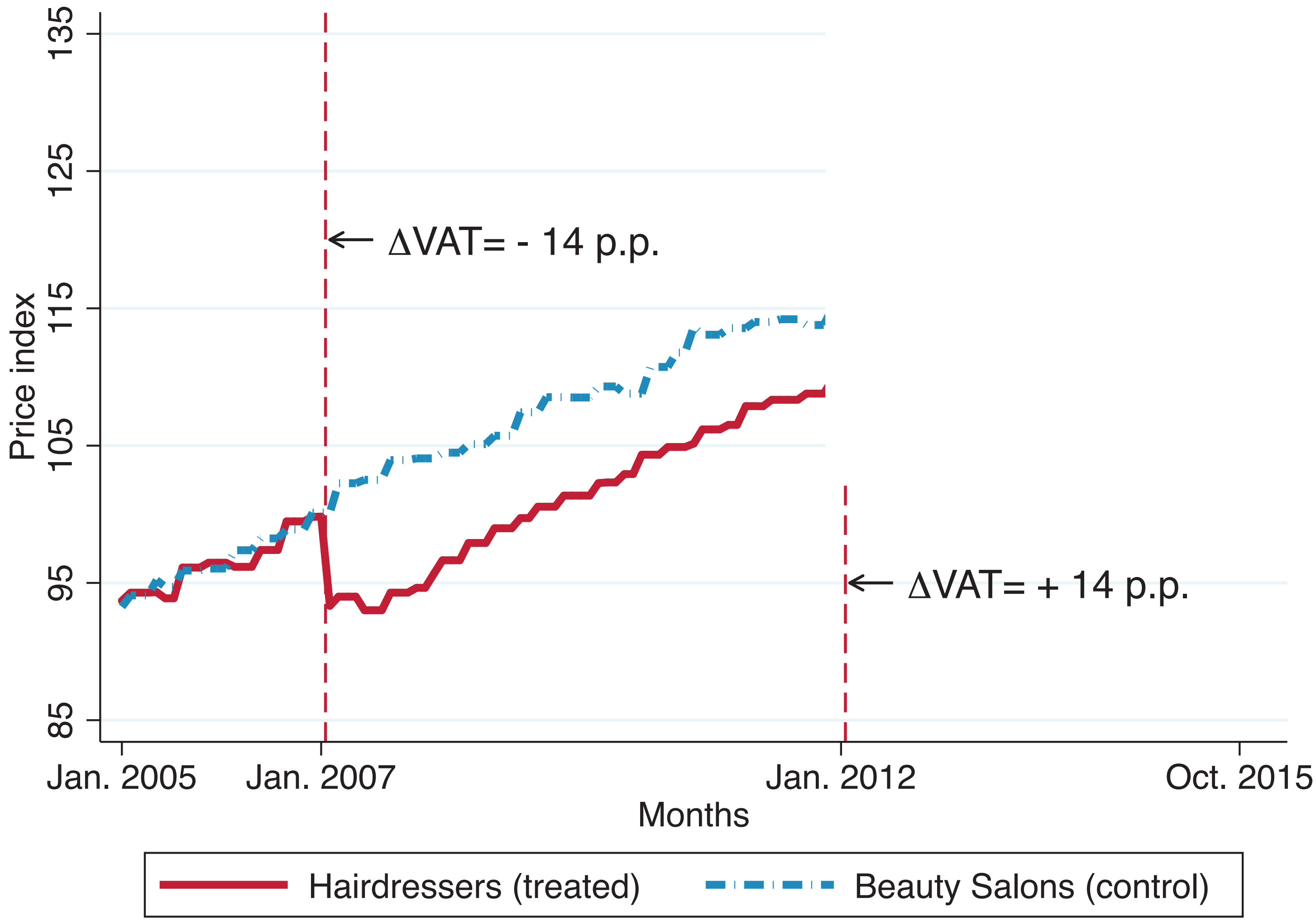
$\Rightarrow$ Find that tax decreases are only 50% passed on consumers while tax increases are almost fully passed on consumers.

Most likely explanation: producers pocket tax cut because 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 competitive model

Figure 1: Finnish Hairdressing Sector VAT Reforms

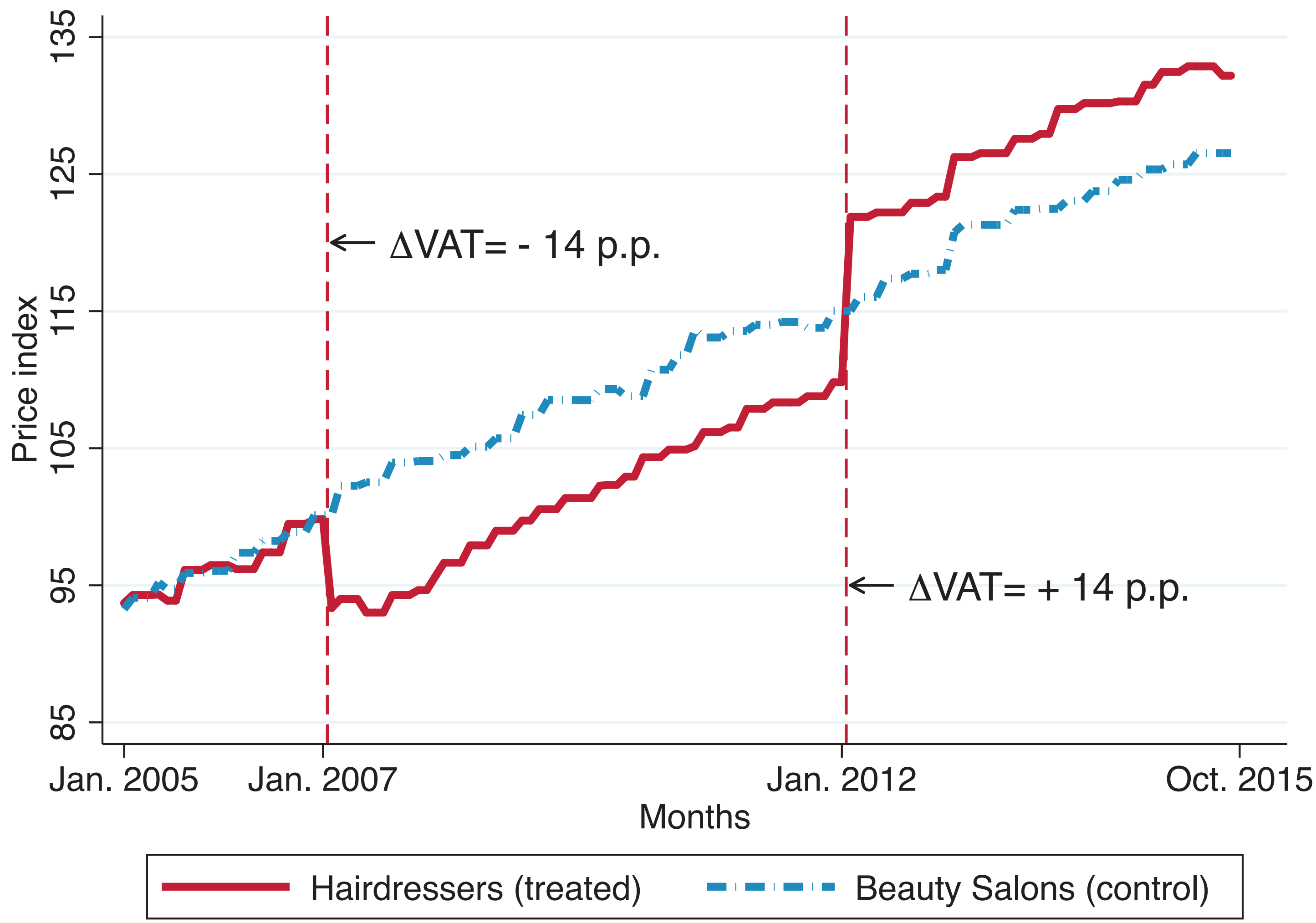
Source: Benzarti et al. (2017)



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.

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 [hairdressers] 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)

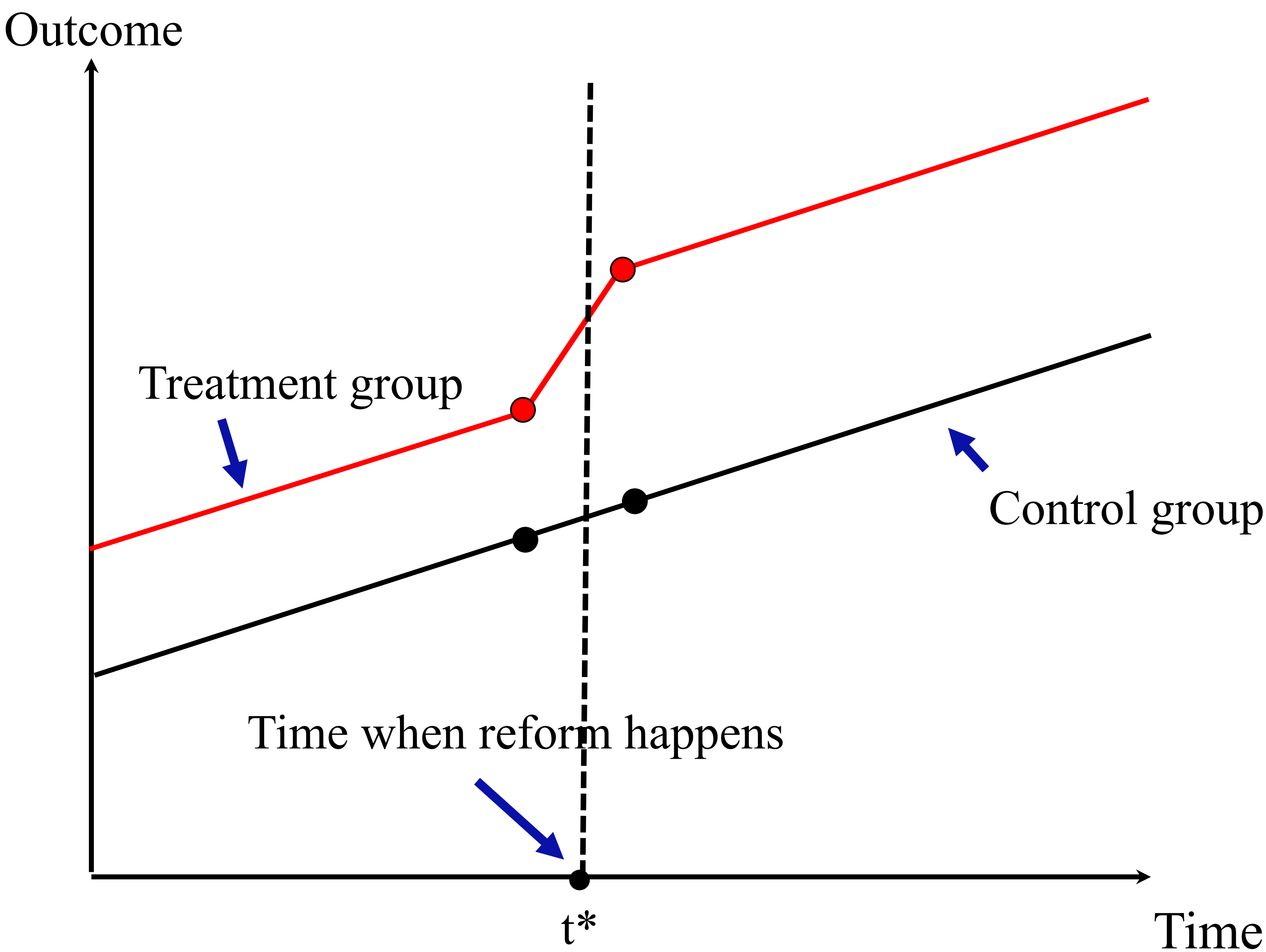
DD identifies the **treatment effect** if the parallel trend assumption holds:

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

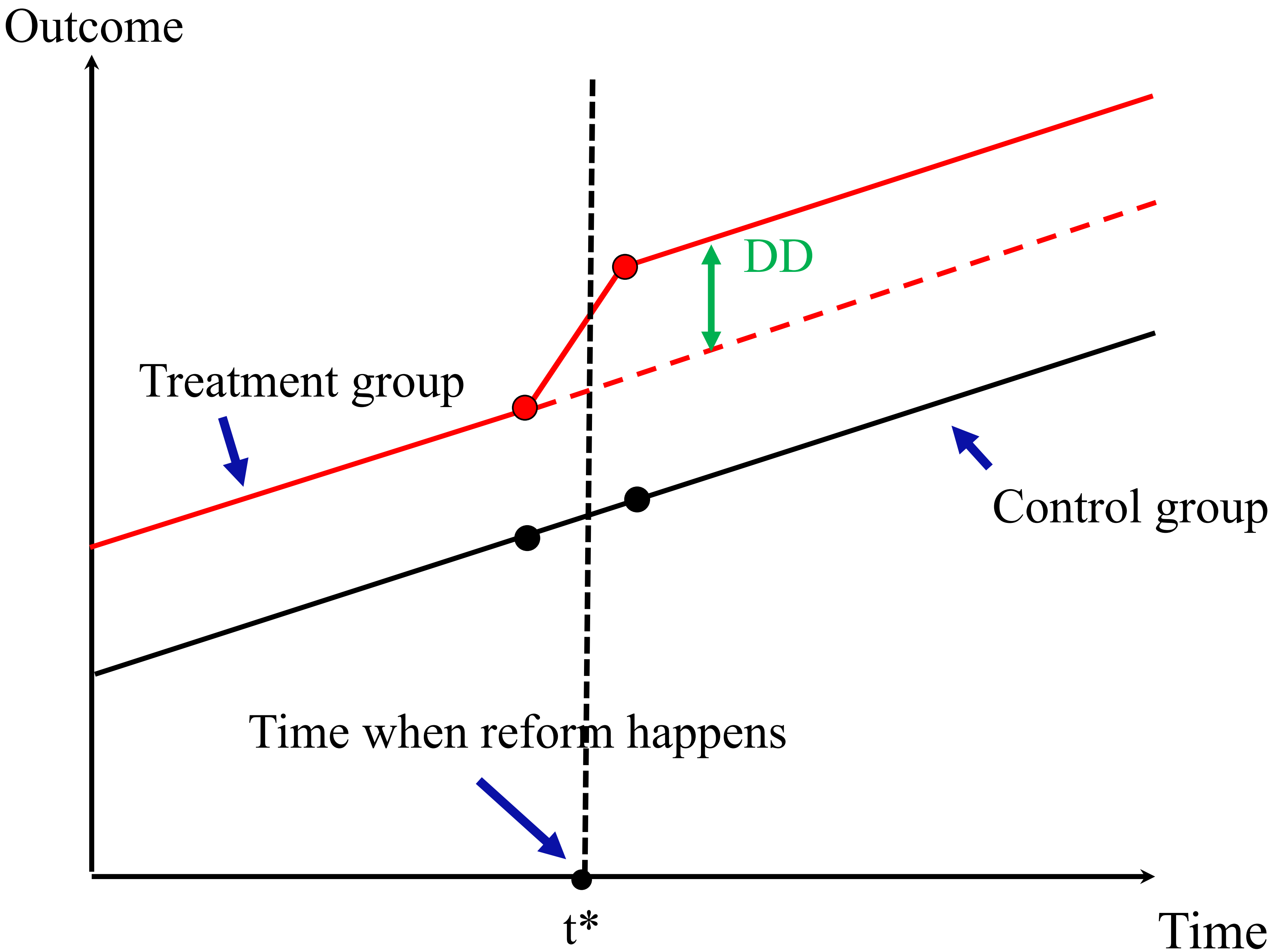
DD most convincing when groups are very similar to start with

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

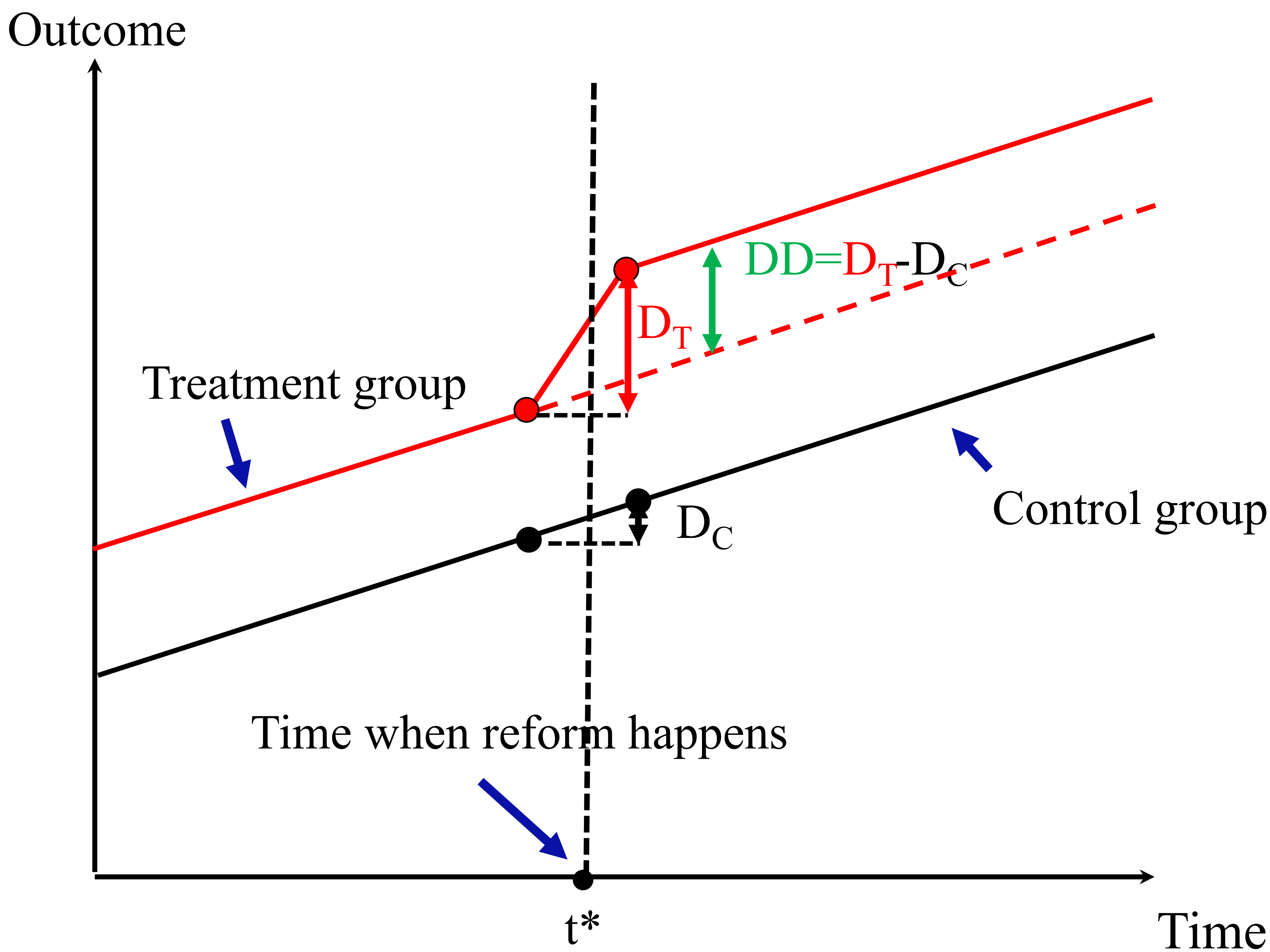
Difference-in-Difference Econometric Method



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 sodas). 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 [unintended effect]

Consider extreme case of perfectly elastic demand

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, equipment, etc.

Labor: cashier staff, managers, 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 in Berkeley 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 PROGRESSIVITY IN THE US

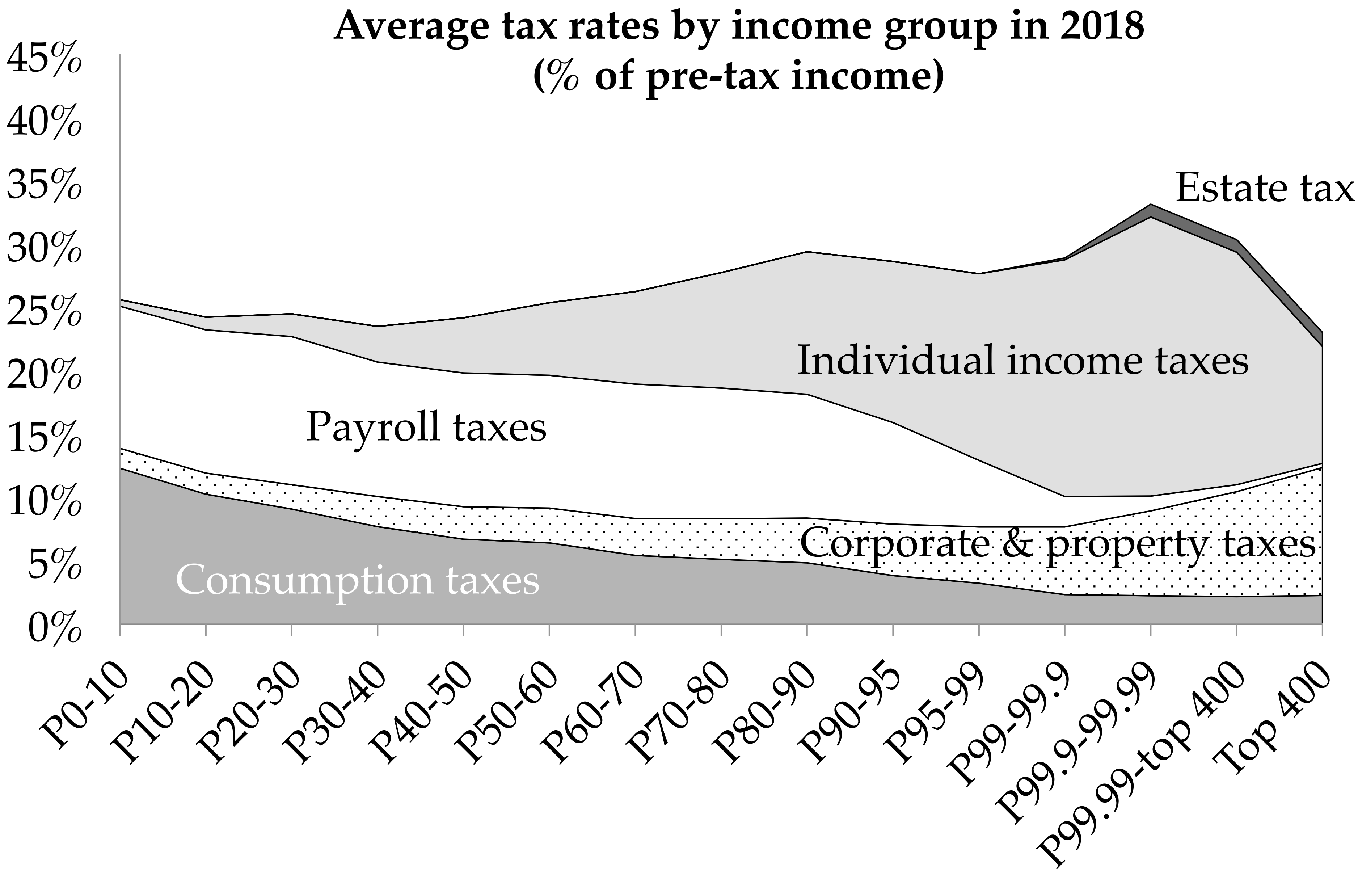
Saez-Zucman (2019) distribute taxes by factor. At Taxjusticenow.org, you can explore changing the current tax system.

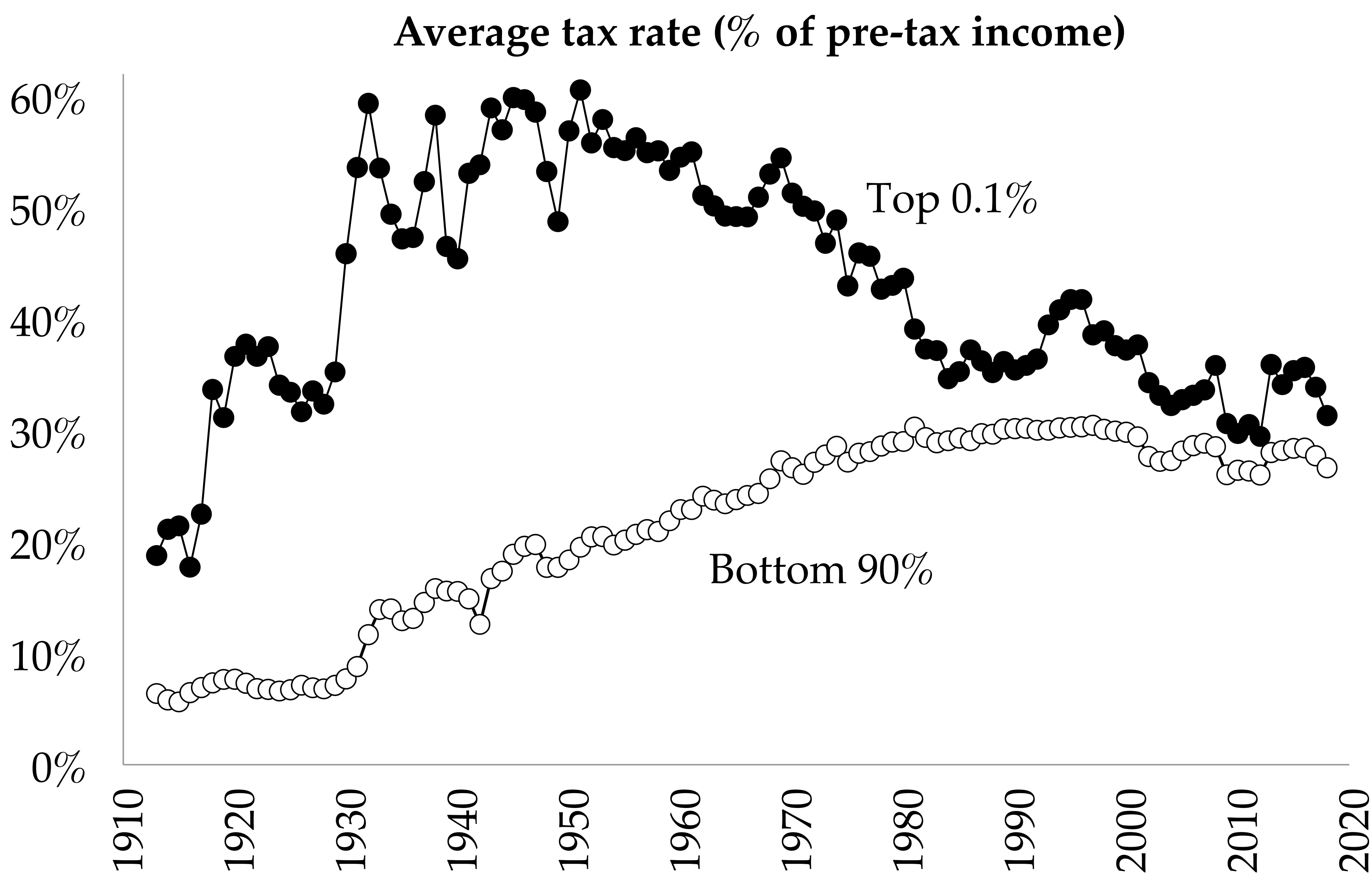
1) Labor taxes (payroll taxes and individual income taxes) assigned to corresponding workers (whether tax remitted by the workers or employers)

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

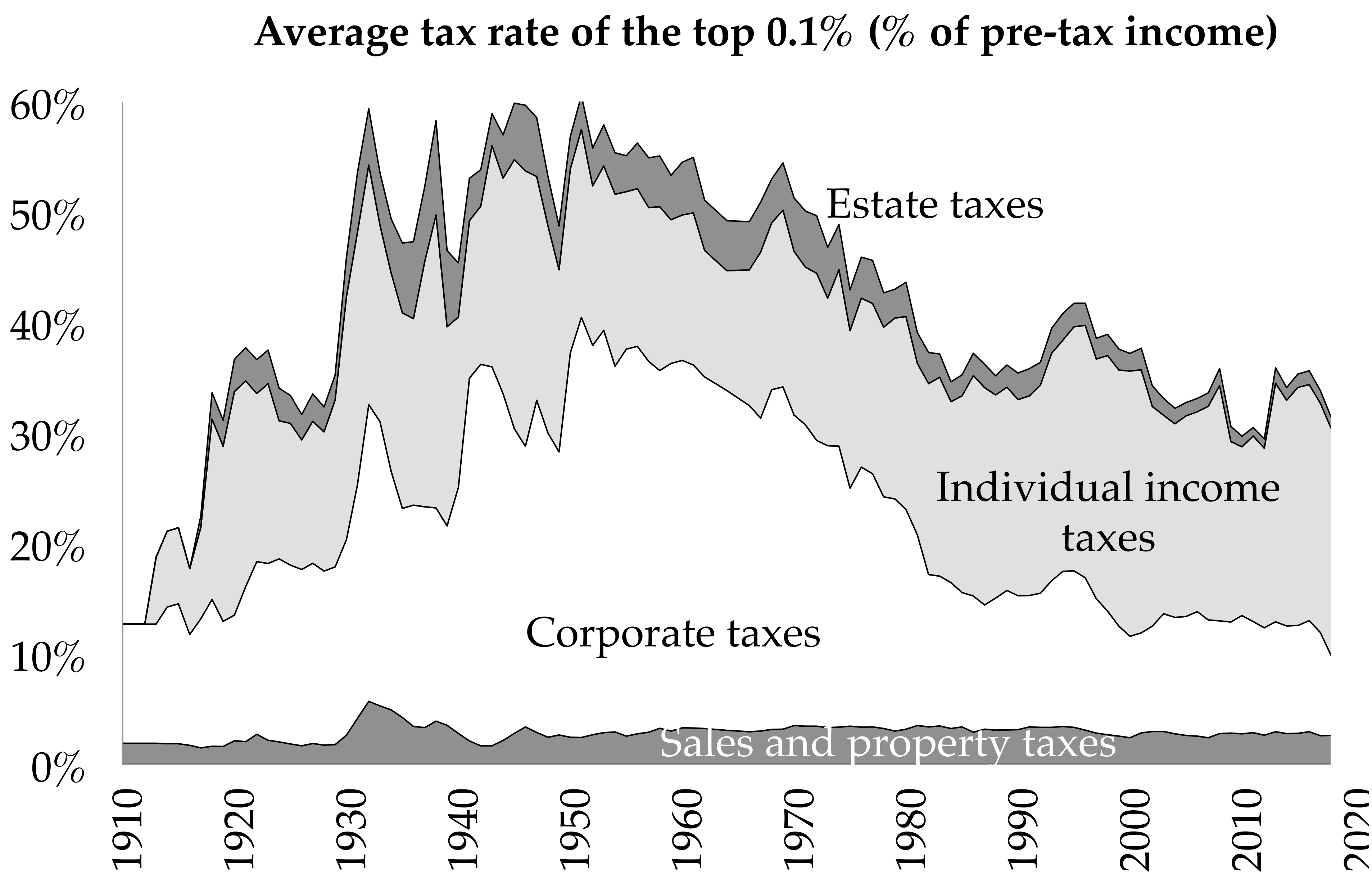
3) Capital taxes (corporate tax, property tax, taxes on capital income) assigned to corresponding owners of the capital assets

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%
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
Top 0.1%
Bottom 90%



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 $160K 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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