Lecture 3: Tax Incidence and Efficiency Costs of Taxation

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Tax Incidence

Sources of federal government revenue, 1960 and 2008:

Category:	1960	2008
Income taxes	44.5%	43.7%
Corporate taxes	22.8	11.3
Payroll tax	17.0	37.8
Excise taxes	12.8	2.6
Other	2.9	4.5

- **Tax incidence:** Assessing which party (consumers or producers) bears the true burden of a tax.

TAX INCIDENCE

Tax incidence is the study of the effects of tax policies on prices and the 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.

Statutory incidence $\neq$ economic incidence.

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 econ incidence = statutory 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.

Argument neglects implicitly GE price effects: 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)
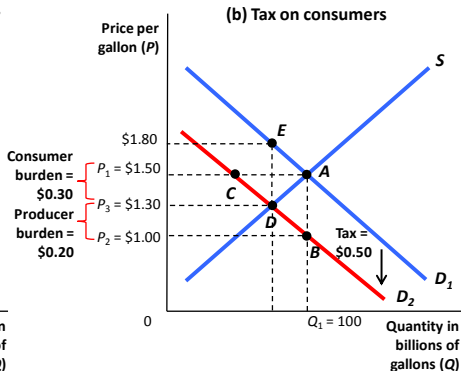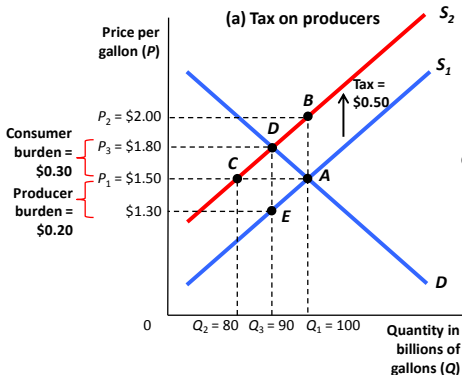
[ad-valorem tax is a fraction of prices (e.g. 5% sales tax)]

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

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

19.1

The Statutory Burden of a Tax Does Not Describe Who Really Bears the Tax, and Is Irrelevant to the Tax Burden

TAX INCIDENCE

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

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

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

Start from $t = 0$ and $S(p) = D(p)$. We want to characterize dp/dt: effect of a small tax increase on price, which determines who bears effective burden of tax:

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

Useful to use elasticities in economics because elasticities are unit free

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

$\varepsilon_D = \frac{q}{D}\frac{dD}{dq} = \frac{qD'(q)}{D(q)} < 0$ 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

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

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

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 $dq/dt = 1$)

1) $\varepsilon_D = 0$ [inelastic demand] (e.g: short-run demand for gasoline inelastic (need to drive to work))

2) $\varepsilon_S = \infty$ [perfectly elastic supply] (e.g.: perfectly competitive industry)

When do producers bear the entire burden of the tax? ($dp/dt = -1$ and $dq/dt = 0$)

1) $\varepsilon_S = 0$ [inelastic supply] (e.g.: fixed capacity and sunk investment, hard to convert).

2) $\varepsilon_D = -\infty$ [perfectly elastic demand] (e.g.: there is a close substitute, and demand shifts to this substitute if price changes).
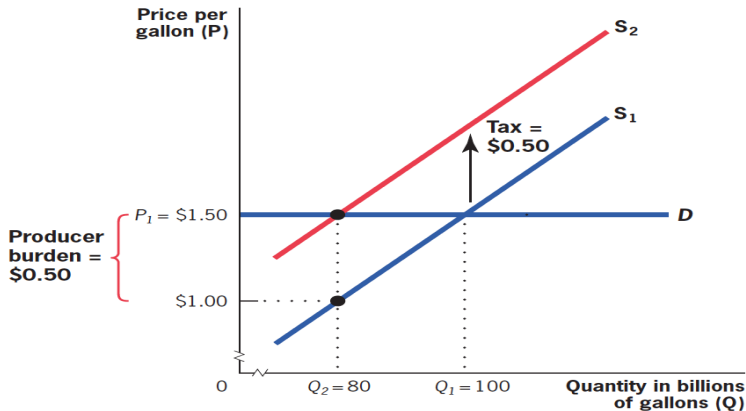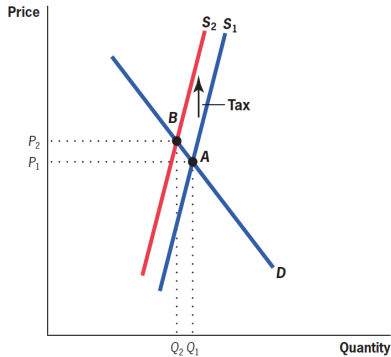
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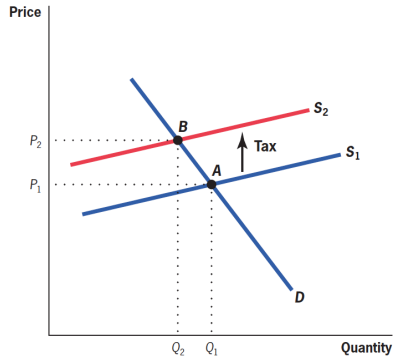# Perfectly Inelastic Demand
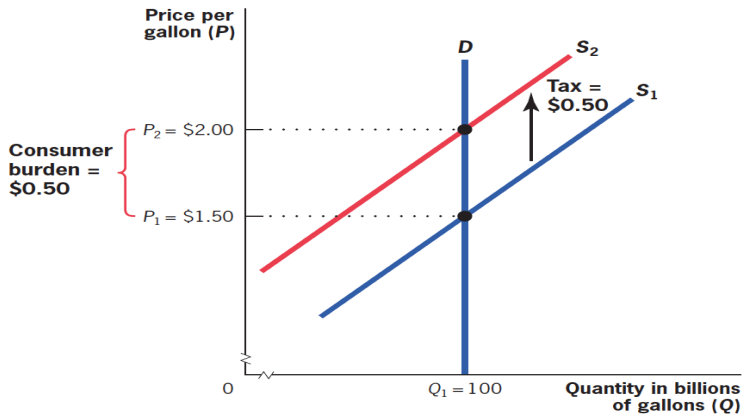
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Perfectly Elastic Demand

19.1

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

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Taxation and Economic Efficiency: Graphical Approach
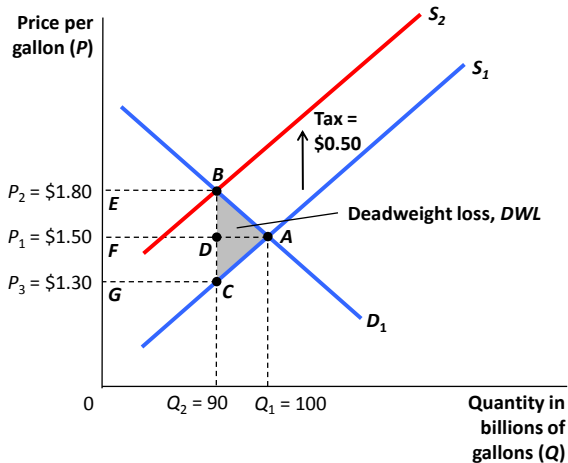
Efficiency Costs of Taxation

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

$\Rightarrow$ More efficient 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 (think of status quo!!!)
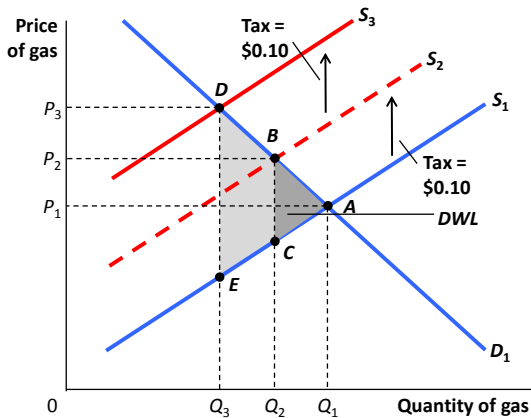
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Elasticities Determine Tax Inefficiency

(a) Inelastic demand

(b) Elastic demand
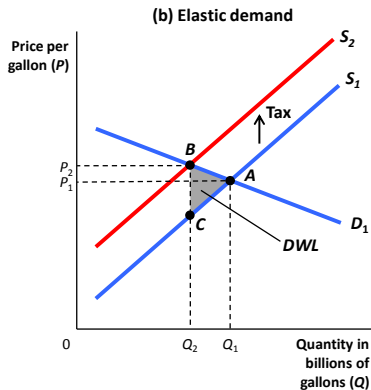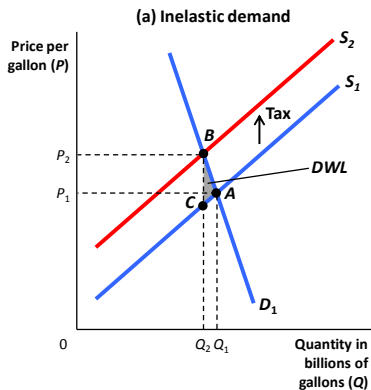
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Marginal DWL Rises with Tax Rate

Application: Optimal Commodity Taxation

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

Consumer 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

Ramsey Rule: $MDWL_i = \text{constant} \times MR_i$

(constant = marginal value of govt revenues).

$\Rightarrow$ 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

Doyle and Sampatharank (2008) study the Gas Tax Holidays in Indiana (IN) and Illinois (IL).

Are gas tax cuts passed through to consumers? or do producers pocket the tax cut and leave consumer price unchanged?

Study this question using state-level gas tax reforms

Gas prices spike above $2.00 in 2000

IN suspends 5% gas tax on July 1. Reinstated on Oct 30.

IL suspends 5% gas tax on July 1. Reinstated on Dec 31.

Tax Incidence: Empirical Application

Empirical approach in paper: difference-in-difference (DD), compare
treated states with neighboring states (MI, OH, MO, IA, WI) before and after
tax change

Graphical evidence is most transparent. Findings:

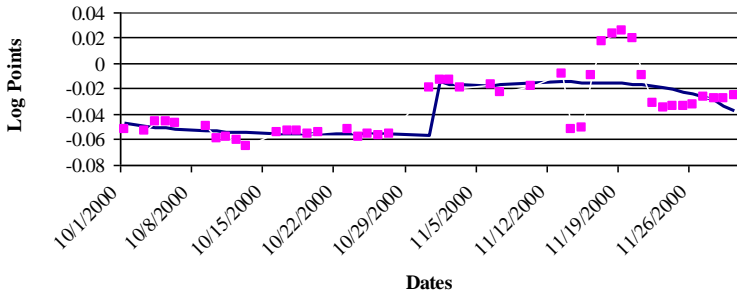1) 10 cent increase in gas tax $\Rightarrow$ 7 cent increase in price paid by consumers

2) Consumers bear 70% of incidence of the gas tax (and conversely, get 70%
of the benefit of a gas tax cut)

Figure 2A: Summer 2000 Difference in Log Gas Prices
IL/IN vs. Neighboring States: MI, OH, MO, IA, WI
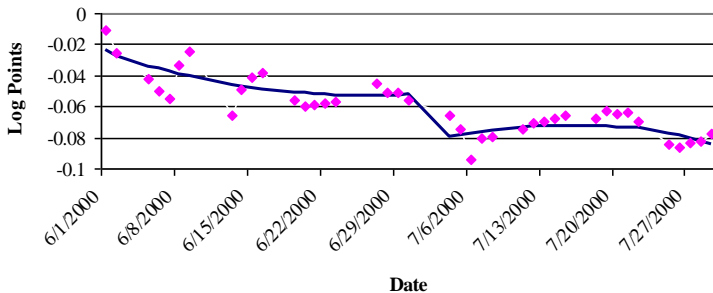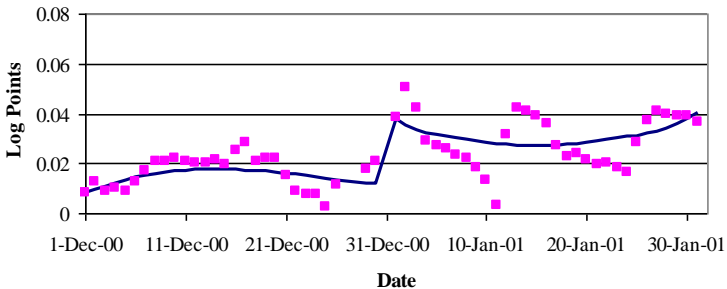
Source: Doyle and Samphantharak 2008.

Figure 2B: Fall 2000 Difference in Log Gas Prices
IN vs. Neighboring States: MI, OH, IL

Figure 2C: Winter 2000/2001 Difference in Log Gas Prices
IL vs. Neighboring States: MO, IA, WI, IN

EVIDENCE: The Incidence of Excise Taxation

- Excises tax on cigarettes varies widely across the United States.

    o Low of $0.025/pack per pack in VA.

    o High of $1.51/pack in CT and MA.

    o Since 1990, NJ increased its tax rate nearly sixfold.

    o Arizona has increased its tax nearly eightfold.

- Many studies examine how taxes affect prices.

- These studies uniformly conclude that the price of cigarettes rises by the full amount of the excise tax.

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 (voted in 2014)
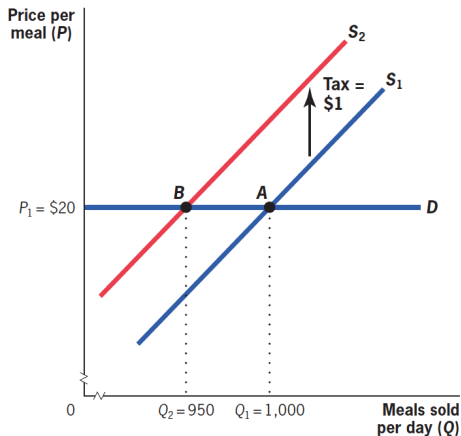
Who bears the incidence?

If soda demand in Berkeley is inelastic, then 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 buy Soda in Oakland

Consider extreme case of perfectly elastic demand

19.3

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) 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 if of course an idealized example, in practice, demand, labor, and capital are not fully elastic
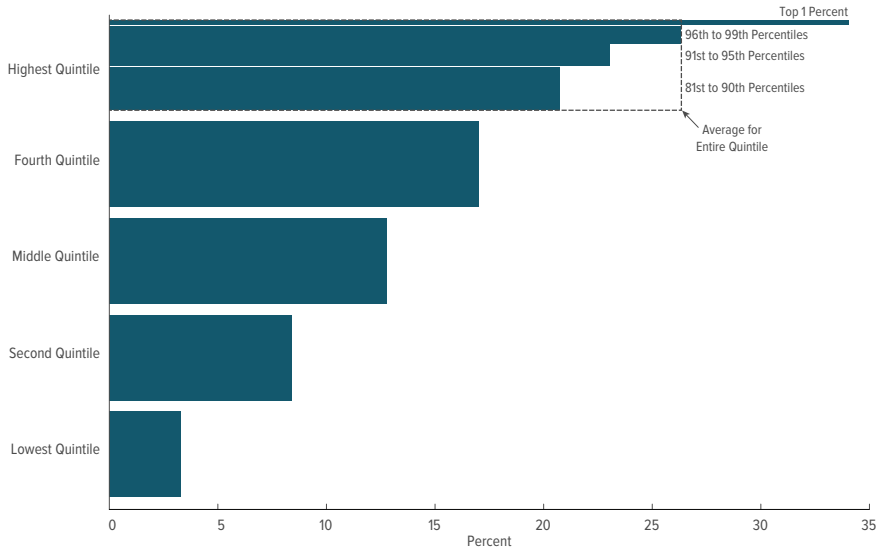
CBO TAX INCIDENCE ASSUMPTIONS

The Congressional Budget Office (CBO) analysis considers the incidence of the full set of taxes levied by the *federal government*. Their key assumptions follow:

1. **Individual Income taxes** are borne fully by the households that pay them.

2. **Payroll taxes** are borne fully by workers, regardless of whether these taxes are paid by the workers or by the firm.

3. **Excise taxes** are fully shifted to prices and so are borne by individuals in proportion to their consumption of the taxed item.

4. **Corporate taxes** are allocated 75% to owners of capital (not only shareholders but owners of capital in general) in proportion to capital income and 25% to labor in proportion to labor income [Most controversial] Debate whether corporate tax really as progressive as CBO typically assumed.

Figure 4.

Average Federal Tax Rates, by Before-Tax Income Group, 2013

Top 1 Percent

96th to 99th Percentiles

91st to 95th Percentiles

81st to 90th Percentiles

Highest Quintile

Average for
Entire Quintile

Fourth Quintile

Middle Quintile

Second Quintile

Lowest Quintile

Percent

Average federal tax rates are calculated by dividing federal taxes by before-tax income.

Figure 5.

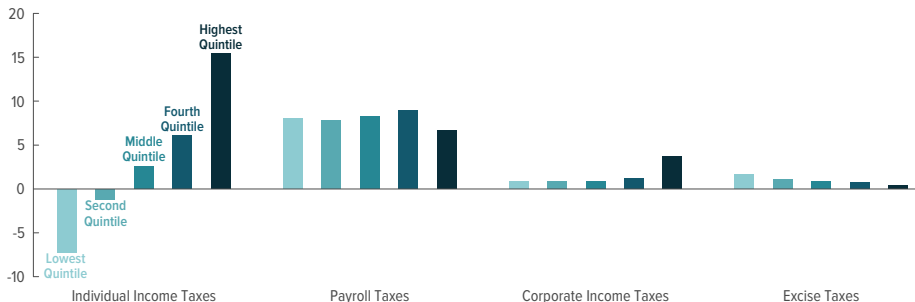## Average Federal Tax Rates, by Before-Tax Income Group and Tax Source, 2013

Source: Congressional Budget Office.

Average federal tax rates are calculated by dividing federal taxes by before-tax income.

Before-tax income is market income plus government transfers. Market income consists of labor income, business income, capital gains (profits realized from the sale of assets), capital income excluding capital gains, income received in retirement for past services, and other sources of income. Government transfers are cash payments and in-kind benefits from social insurance and other government assistance programs. Those transfers include payments and benefits from federal, state, and local governments.

Negative average tax rates for individual income taxes result when refundable tax credits, such as the earned income tax credit and the child tax credit, exceed the other income tax liabilities of the households in an income group.
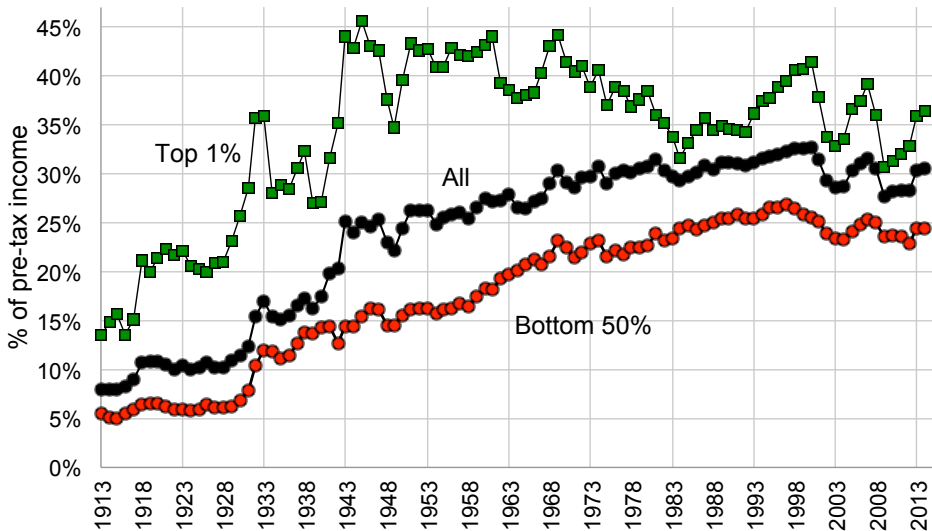
INCIDENCE OF FEDERAL TAXES

1. **Individual Income taxes** is progressive due to tax credits for low earners and progressive tax brackets

2. **Payroll taxes** are a constant tax rate of 15% but only up to $120K of earnings $\Rightarrow$ Regressive at the top

3. **Excise taxes** are regressive because share of income devoted to consumption of goods with excise tax (alcohol, tobacco, gas) falls with income

4. **Corporate taxes** are progressive because capital income is highly concentrated

State+local taxes are less progressive than Federal taxes
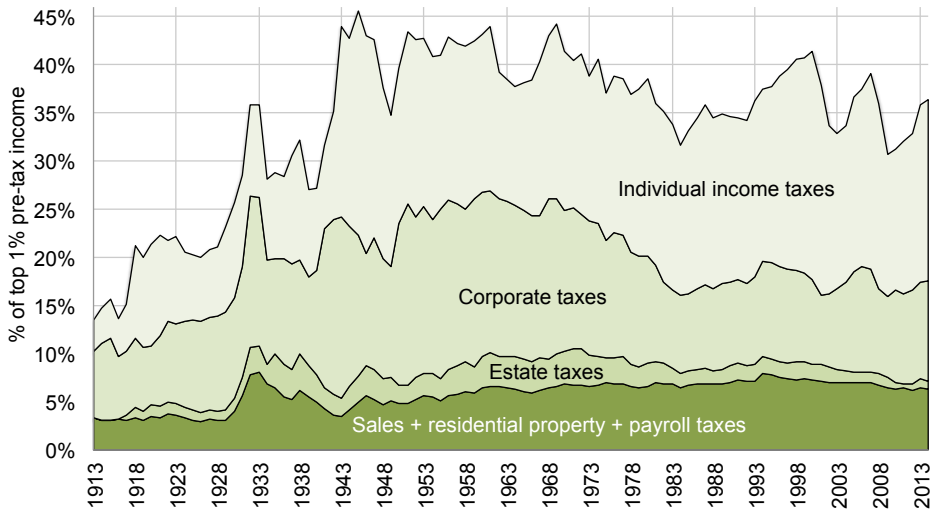
Piketty, Saez, Zucman '16 estimate total tax rates (Fed+state+local) overtime relative to National Income

Average tax rates by pre-tax income group

Top 1%

All

Bottom 50%

Source: Appendix Table II-G1.

Figure S.22: Taxes paid by the top 1%

Individual income taxes

Corporate taxes

Estate taxes

Sales + residential property + payroll taxes

Source: Appendix Table II-G2

Taxes paid by the bottom 50%

- Payroll taxes
- Individual income taxes
- Capital taxes
- Sales taxes

y-axis: % of bottom 50% pre-tax income (0% to 30%)

x-axis: 1913–2013
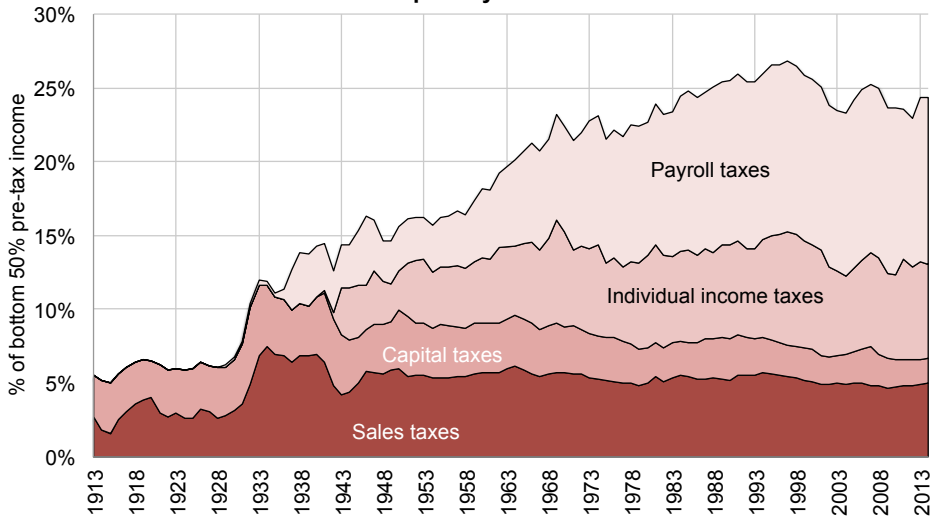
Source: Appendix Table II-G2

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 (unlike gas tax) 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 variation in beer excise and sales taxes across states

Orig.
Tag

Exp.
Tag

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 (0.22)	25.17 (0.37)	-1.31 (0.43)
Experiment	27.32 (0.87)	23.87 (1.02)	-3.45 (0.64)
Difference over time	0.84 (0.75)	-1.30 (0.92)	DD_{TS} = -2.14 (0.64)

		CONTROL STORES		
Period	Control Categories	Treated Categories	Difference
Baseline	30.57 (0.24)	27.94 (0.30)	-2.63 (0.32)
Experiment	30.76 (0.72)	28.19 (1.06)	-2.57 (1.09)
Difference over time	0.19 (0.64)	0.25 (0.92)	DD_{CS} = 0.06 (0.90)
		DDD Estimate	*-2.20* (0.58)

Figure 2a
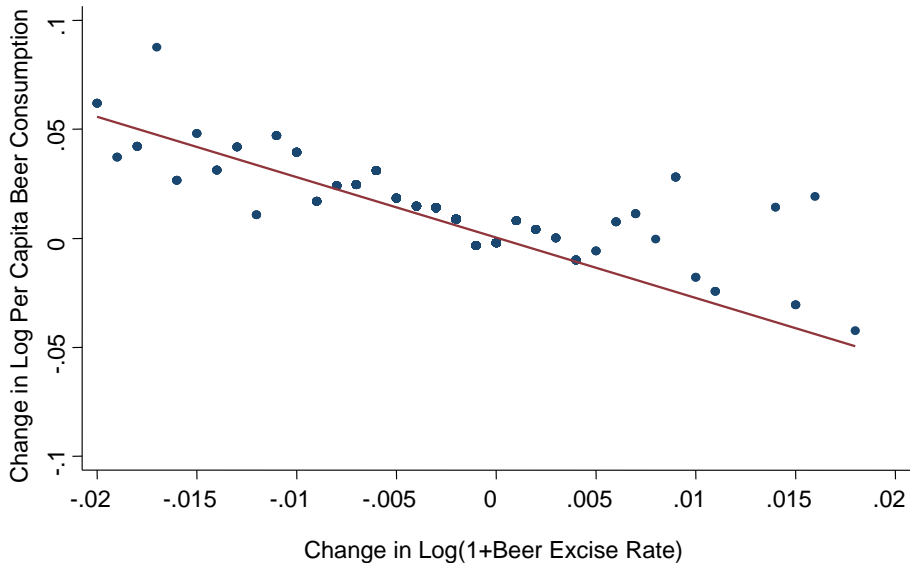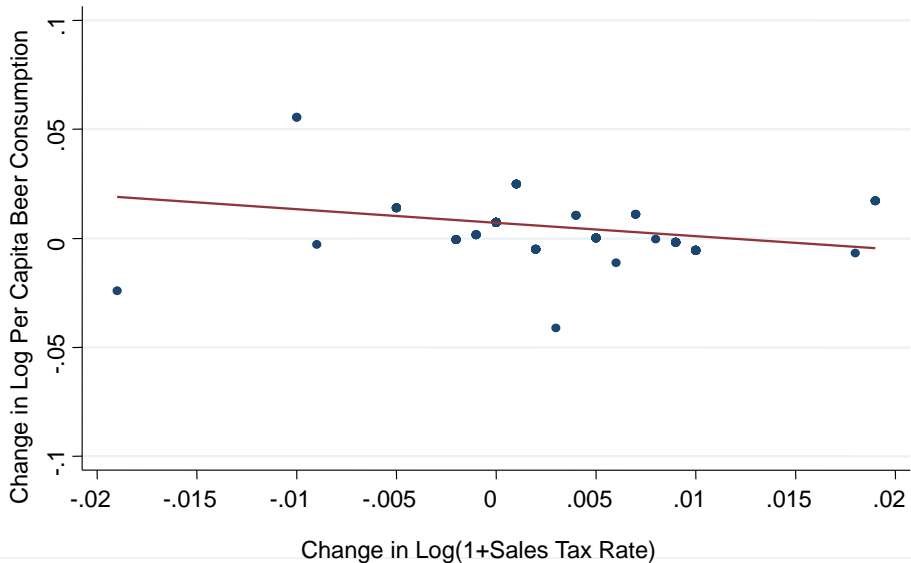Per Capita Beer Consumption and State Beer Excise Taxes

Figure 2b
Per Capita Beer Consumption and State Sales Taxes

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 $\theta_\tau \approx 0.06$

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

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