### Tax Incidence

#### Sources of federal government revenue, 1960 and 2008:

<table>
<thead>
<tr>
<th>Category</th>
<th>1960</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income taxes</td>
<td>44.5%</td>
<td>43.7%</td>
</tr>
<tr>
<td>Corporate taxes</td>
<td>22.8</td>
<td>11.3</td>
</tr>
<tr>
<td>Payroll tax</td>
<td>17.0</td>
<td>37.8</td>
</tr>
<tr>
<td>Excise taxes</td>
<td>12.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Other</td>
<td>2.9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

- **Tax incidence**: Assessing which party (consumers or producers) bears the true burden of a tax.
The Statutory Burden of a Tax Does Not Describe Who Really Bears the Tax, and Is Irrelevant to the Tax Burden

(a) Tax on producers

- Price per gallon ($P$)
  - $P_1 = $1.50
  - $P_2 = $2.00
  - $P_3 = $1.80
- Quantity in billions of gallons ($Q$)
  - $Q_1 = 100$
  - $Q_2 = 80$
  - $Q_3 = 90$
- Tax = $0.50

(b) Tax on consumers

- Price per gallon ($P$)
  - $P_1 = $1.50
  - $P_2 = $1.00
  - $P_3 = $1.30
- Tax = $0.50

Consumer burden = $0.30
Producer burden = $0.20
19.1 Perfectly Inelastic Demand

The diagram illustrates consumer demand and supply in a market. The price per gallon ($P$) is shown on the vertical axis, and the quantity in billions of gallons ($Q$) is shown on the horizontal axis. The demand curve ($D$) and supply curves ($S_1$ and $S_2$) are depicted.

At the initial equilibrium, the price is $P_1 = $1.50 and the quantity is $Q_1 = 100$ billion gallons. Applying a tax of $0.50 per gallon leads to a new price of $P_2 = $2.00. The consumer burden is $0.50.

The graph shows the impact of taxation on the market, with the consumer and producer burden clearly illustrated.
19.1 Perfectly Elastic Demand

Perfectly elastic demand implies that the demand curve is perfectly vertical. In this case, the quantity demanded is completely insensitive to changes in price. The diagram shows two supply curves, $S_1$ and $S_2$, intersecting with a demand curve $D$. The tax imposition at a price of $0.50$ shifts the supply curve from $S_1$ to $S_2$, but since demand is perfectly elastic, the price remains at $1.50$, and the quantity demanded changes. The producer burden is $0.50$.
Supply Elasticities

(a) Tax on steel producers (inelastic supply)

(b) Tax on sidewalk vendors (elastic supply)
19.2 Tax Incidence in Factor Markets

(a) Tax on workers

- Wage (W)
- Firm burden = $0.50
- Workers: $W_2 = 7.75$, $W_1 = 7.25$, $W_3 = 6.75$

(b) Tax on firms

- Wage (W)
- Firm burden = $0.50
- Workers: $W_2 = 7.75$, $W_1 = 7.25$, $W_3 = 6.75$

Tax = $1.00
19.2

Impediments to Wage Adjustment

(a) Tax on workers

- Wage function: $W = W(M) = 7.25$
- Firm burden: $\$0.50$
- Worker burden: $\$0.50$
- Wage after tax: $W_2 = 7.75$
- Wage before tax: $W_3 = 6.75$
- Tax: $\$1.00$

(b) Tax on firms

- Wage function: $W = W(M) = 7.25$
- Firm burden: $\$1.00$
- Worker burden: $\$0.50$
- Wage after tax: $W_2 = 8.25$
- Wage before tax: $W_3 = 6.75$
- Tax: $\$1.00$
Taxation and Economic Efficiency: Graphical Approach

- **Price per gallon (P)**
  - $P_1 = 1.50$
  - $P_2 = 1.80$
  - $P_3 = 1.30$

- **Quantity in billions of gallons (Q)**
  - $Q_1 = 100$
  - $Q_2 = 90$

- **Supply and Demand Lines**
  - $S_1$
  - $S_2$
  - $D_1$

- **Taxation**
  - Tax = $0.50

- **Deadweight Loss, DWL**

The diagram illustrates the effects of taxation on the market equilibrium, showing the shift from the pre-tax equilibrium at $P_1$ and $Q_1$ to the post-tax equilibrium at $P_2$ and $Q_2$, with a subsequent decrease in quantity demanded and an increase in the price paid by consumers due to the tax.
20.1 Elasticities Determine Tax Inefficiency

(a) Inelastic demand

- Price per gallon ($P$)
- Quantity in billions of gallons ($Q$)
- Supply ($S_1$, $S_2$)
- Demand ($D_1$)
- Tax
- Deadweight loss (DWL)

(b) Elastic demand

- Price per gallon ($P$)
- Quantity in billions of gallons ($Q$)
- Supply ($S_1$, $S_2$)
- Demand ($D_1$)
- Tax
- Deadweight loss (DWL)
Marginal DWL Rises with Tax Rate

- **Price of gas**
  - $P_1$
  - $P_2$
  - $P_3$

- **Quantity of gas**
  - $Q_1$
  - $Q_2$
  - $Q_3$

Graph showing the relationship between the price of gas and the quantity of gas. The graph illustrates how the demand curve ($D_1$) intersects with the supply curves ($S_1$, $S_2$, $S_3$) at different tax rates ($\text{Tax} = $0.10). The diagram highlights the deadweight loss (DWL) associated with each tax rate, with the marginal DWL rising with the tax rate.
A Tax System’s Efficiency Is Affected by a Market’s Preexisting Distortions

(a) No externality

(b) Positive production externality

Effect of tax

Additional DWL due to tax

Effect of externality

DWL due to externality
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

Source: Doyle and Samphantharak 2008.
Figure 2C: Winter 2000/2001 Difference in Log Gas Prices
IL vs. Neighboring States: MO, IA, WI, IN

Source: Doyle and Samphantharak 2008.
19.4

**EVIDENCE: The Incidence of Excise Taxation**

- Excises tax on cigarettes varies widely across the United States.
  - Low of $0.025/pack per pack in VA.
  - High of $1.51/pack in CT and MA.
  - Since 1990, NJ increased its tax rate nearly sixfold.
  - 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.
Effects of a Restaurant Tax: A General Equilibrium Example

![Graph showing the effects of a restaurant tax]

- **Price per meal \( P \):** $20
- **Tax:** $1
- **Initial equilibrium:**
  - Price: \( P_1 = $20 \)
  - Quantity: \( Q_1 = 1,000 \) meals per day
- **Post-tax equilibrium:**
  - Price: \( P_2 \)
  - Quantity: \( Q_2 = 950 \) meals per day
19.3 General Equilibrium Tax Incidence

(a) Labor market

Wage ($W$)

$W_1 = $8

Rate of return ($r$)

$r_1 = 10\%$

$r_2 = 8\%$

Hours of labor ($H$)

$H_2 = 900$

$H_1 = 1,000$

(b) Capital market

Investment ($I$)

$I_1 = $50 million

Points:

- A
- B

Lines:

- $D_1$
- $D_2$
- $S$

Notes:

- The labor market shows the equilibrium wage at $W_1 = $8 with labor supply and demand curves $D_1$ and $D_2$.
- The capital market shows the equilibrium rate of return at $r_1 = 10\%$ and $r_2 = 8\%$ with investment demand curves $D_1$ and $D_2$. 
### The Incidence of Taxation in the United States

#### Results of CBO Incidence Analysis

<table>
<thead>
<tr>
<th>TABLE 19-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective Tax Rates</strong></td>
</tr>
<tr>
<td><strong>Total effective tax rate</strong></td>
</tr>
<tr>
<td>All households</td>
</tr>
<tr>
<td>Bottom quintile</td>
</tr>
<tr>
<td>Top quintile</td>
</tr>
<tr>
<td><strong>Effective income tax rate</strong></td>
</tr>
<tr>
<td>All households</td>
</tr>
<tr>
<td>Bottom quintile</td>
</tr>
<tr>
<td>Top quintile</td>
</tr>
<tr>
<td><strong>Effective payroll tax rate</strong></td>
</tr>
<tr>
<td>All households</td>
</tr>
<tr>
<td>Bottom quintile</td>
</tr>
<tr>
<td>Top quintile</td>
</tr>
<tr>
<td><strong>Effective corporate tax rate</strong></td>
</tr>
<tr>
<td>All households</td>
</tr>
<tr>
<td>Bottom quintile</td>
</tr>
<tr>
<td>Top quintile</td>
</tr>
<tr>
<td><strong>Effective excise tax rate</strong></td>
</tr>
<tr>
<td>All households</td>
</tr>
<tr>
<td>Bottom quintile</td>
</tr>
<tr>
<td>Top quintile</td>
</tr>
</tbody>
</table>

The top panel of this table shows the total effective federal tax rate on all households and on the top and bottom quintiles of the income distribution. The other panels show the effective tax rates of various other types of federal taxes.
# The Incidence of Taxation in the United States

## Results of CBO Incidence Analysis

<table>
<thead>
<tr>
<th>TABLE 19-2</th>
</tr>
</thead>
</table>

## Top and Bottom Quintile’s Share of Income and Tax Liabilities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Top quintile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of income</td>
<td>45.5%</td>
<td>48.6%</td>
<td>49.5%</td>
<td>50.2%</td>
<td>54.8%</td>
<td>55.7%</td>
</tr>
<tr>
<td>Share of tax liabilities</td>
<td>56.4%</td>
<td>55.8%</td>
<td>57.9%</td>
<td>61.9%</td>
<td>66.6%</td>
<td>69.3%</td>
</tr>
<tr>
<td><strong>Bottom quintile</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of income</td>
<td>5.8%</td>
<td>4.8%</td>
<td>4.6%</td>
<td>4.6%</td>
<td>4.0%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Share of tax liabilities</td>
<td>2.1%</td>
<td>2.3%</td>
<td>1.9%</td>
<td>1.3%</td>
<td>1.1%</td>
<td>0.8%</td>
</tr>
<tr>
<td><strong>Top 1%</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of income</td>
<td>9.3%</td>
<td>11.5%</td>
<td>12.1%</td>
<td>12.5%</td>
<td>17.8%</td>
<td>18.8%</td>
</tr>
<tr>
<td>Share of tax liabilities</td>
<td>15.4%</td>
<td>14.8%</td>
<td>16.2%</td>
<td>20.1%</td>
<td>25.5%</td>
<td>28.3%</td>
</tr>
</tbody>
</table>

This table shows the share of income and tax liabilities accruing to the top and bottom income quintiles over time.
Illustration of Identification Strategy

Source: Linden and Rockoff 2008.
Figure 3a: Price Trends Before and After Offenders' Arrivals
Parcels Within Tenth Mile of Offender Location

Note: Results from local polynomial regressions (bandwidth=90 days) of sale price on days before/after offender arrival.

Source: Linden and Rockoff 2008.
Figure 3b: Price Trends Before and After Offenders' Arrivals
Parcels Within 1/3 Mile of Offender Location

Note: Results from local polynomial regressions (bandwidth=90 days) of sale price on days before/after offender arrival.

Source: Linden and Rockoff 2008.
Figure 1: Mandated Benefit

Source: Raj Chetty's Undergraduate Lecture Note
Figure 1: Mandated Benefit

Source: Raj Chetty's Undergraduate Lecture Note
Figure 1: Mandated Benefit

Source: Raj Chetty's Undergraduate Lecture Note
### Effect of Posting Tax-Inclusive Prices: Mean Quantity Sold

#### TREATMENT STORE

<table>
<thead>
<tr>
<th>Period</th>
<th>Control Categories</th>
<th>Treated Categories</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>26.48</td>
<td>25.17</td>
<td>-1.31</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.37)</td>
<td>(0.43)</td>
</tr>
<tr>
<td>Experiment</td>
<td>27.32</td>
<td>23.87</td>
<td>-3.45</td>
</tr>
<tr>
<td></td>
<td>(0.87)</td>
<td>(1.02)</td>
<td>(0.64)</td>
</tr>
<tr>
<td>Difference</td>
<td>0.84</td>
<td>-1.30</td>
<td></td>
</tr>
<tr>
<td>over time</td>
<td>(0.75)</td>
<td>(0.92)</td>
<td>(0.64)</td>
</tr>
</tbody>
</table>

\[ \text{DD}_{TS} = -2.14 \]

#### CONTROL STORES

<table>
<thead>
<tr>
<th>Period</th>
<th>Control Categories</th>
<th>Treated Categories</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>30.57</td>
<td>27.94</td>
<td>-2.63</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.30)</td>
<td>(0.32)</td>
</tr>
<tr>
<td>Experiment</td>
<td>30.76</td>
<td>28.19</td>
<td>-2.57</td>
</tr>
<tr>
<td></td>
<td>(0.72)</td>
<td>(1.06)</td>
<td>(1.09)</td>
</tr>
<tr>
<td>Difference</td>
<td>0.19</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>over time</td>
<td>(0.64)</td>
<td>(0.92)</td>
<td>(0.90)</td>
</tr>
</tbody>
</table>

\[ \text{DD}_{CS} = 0.06 \]

\[ \text{DDD Estimate} = -2.20 \]

Source: Chetty, Looney, Kroft (2009)
Figure 2a
Per Capita Beer Consumption and State Beer Excise Taxes

Change in Log Per Capita Beer Consumption
Change in Log(1+Beer Excise Rate)

Source: Chetty, Looney, Kroft (2009)
Figure 2b
Per Capita Beer Consumption and State Sales Taxes

Change in Log Per Capita Beer Consumption
Change in Log(1+Sales Tax Rate)

Source: Chetty, Looney, Kroft (2009)
## Effect of Excise and Sales Taxes on Beer Consumption

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

Note: Estimates imply $\theta_t \approx 0.06$

Source: Chetty, Looney, Kroft (2009)
Average Federal Tax Rates, by Before-Tax Income Group, 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.

Federal taxes include individual income taxes, payroll taxes, corporate income taxes, and excise taxes.

Income groups are created by ranking households by before-tax income, adjusted for household size. Quintiles (fifths) contain equal numbers of people; percentiles (hundredths) contain equal numbers of people as well.

For more detailed definitions of income, see the appendix.

Corporate Income Taxes. The average corporate income tax borne by households increases with income. CBO allocates most of that tax in proportion to each household’s share of total capital income (including adjusted capital gains), which constitutes a larger share of income at the top of the distribution. In 2013, the average corporate income tax rate—corporate taxes divided by before-tax household income—was 3.7 percent for households in the highest quintile and around

21. CBO allocates 75 percent of the corporate income tax to households in proportion to their share of capital income and 25 percent to households in proportion to their share of labor income. For more discussion of the incidence of the corporate income tax, see Congressional Budget Office, The Distribution of Household Income and Federal Taxes, 2008 and 2009 (July 2012), www.cbo.gov/publication/43373. For more discussion of the adjustments made to realized capital gains when allocating the corporate tax to households, see the appendix.
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.

Income groups are created by ranking households by before-tax income, adjusted for household size. Quintiles (fifths) contain equal numbers of people; percentiles (hundredths) contain equal numbers of people as well.

For more detailed definitions of income, see the appendix.

1 percent for households in the other four income quintiles, CBO estimates. In that year, almost 80 percent of the total corporate tax burden was borne by households in the highest income quintile; about 47 percent of the total corporate tax burden was borne by households in the top 1 percent of the income distribution.

**Excise Taxes.** Sales of a wide variety of goods and services are subject to federal excise taxes. Most of the revenues raised come from taxes on the sale of motor fuels (gasoline and diesel fuel), tobacco products, alcoholic beverages, and aviation-related goods and services (such as aviation fuel and airline tickets). Excise taxes are regressive—that is, the burden of excise taxes relative to income is greatest for lower-income households, which tend to spend a larger share of their income on those taxed goods and services. In 2013, average excise tax rates were 1.7 percent for households in the lowest income quintile, 0.9 percent for households in the middle income quintile, and 0.4 percent for households in the highest income quintile, CBO estimates.

**After-Tax Income Across the Income Scale**

In 2013, households in each income group paid a positive amount of federal taxes, on average. Consequently, average after-tax income was lower than average before-tax income for each income group. Because average federal tax rates rise with income, the difference between before-tax and after-tax income grows as income rises, and the distribution of after-tax income is slightly more even than the distribution of before-tax income. In the lowest quintile of before-tax income, average after-tax income was more than $800 lower than average before-tax income ($24,500 versus $25,400); for households in the middle quintile of before-tax income, the difference was approximately $8,900 ($60,800 versus $69,700); for households in the highest quintile of before-tax income, the difference was approximately $69,700 ($195,300 versus $265,000); see Table 1 on page 2. For households in the top 1 percent, the difference was approximately $534,000 ($1,037,000 versus $1,572,000), CBO estimates.

Another metric used to examine how the distributions of before- and after-tax income differ is the differences in the shares of those income measures going to each
Figure S.22: Taxes paid by the top 1%

% of top 1% pre-tax income

- Individual income taxes
- Corporate taxes
- Estate taxes
- Sales + residential property + payroll taxes

Source: Appendix Table II-G2
Average tax rates by pre-tax income group

% of pre-tax income


Top 1%
All
Bottom 50%

Source: Appendix Table II-G1.
demand $D(p)$

Consumer surplus

$P^*$

$Q^*$
Producer surplus

\[ P^* \]

\[ Q^* \]

Supply: \( S(p) \)
Market equilibrium
Demand \( D(p) \)

Supply \( S(p) \)

Producer surplus

Consumer surplus

Market equilibrium

\( P^* \)

\( Q^* \)
The diagram illustrates a market equilibrium with demand and supply curves. The intersection of the demand curve $D(p)$ and the supply curve $S(p)$ determines the market equilibrium at $P^*$ and $Q^*$. The area within the green box represents the consumer surplus, while the area within the grey triangle indicates the producer surplus and the deadweight burden triangle. The area outside the triangle but inside the green and grey areas represents the inefficient production level $Q$. The diagram clearly shows the different surplus components and the inefficiency caused by market imbalances.
Equilibrium with no taxes

S(p) = D(p) = Q

Price

Supply S(p^p)

Demand D(p^c)

p

Quantity
Equilibrium with no taxes

$S(p) = D(p) = Q$
\[ S(p+dp) = D(p+dp+dt) = Q+dQ \]

**Equilibrium with tax dt**

\[ S(p+dp+dt) = D(p+dp+dt) = Q+dQ \]

Price

supply \( S(p^p) \)

demand \( D(p^c) \)

Quantity

\( p+dp+dt \)

\( p+dp \)

\( p \)

\( p+dp+dt \)

\( p+dp \)

\( dp<0 \)

\[ S(p)=D(p)=Q \]
\[ \text{DWB} = \frac{1}{2} \cdot dt \cdot dQ \]
from tax

\[ Q + dQ \quad Q \]

\[ p + dp + dt \quad p + dp \]

\[ \text{tax revenue} \quad dt \times Q \]
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 2: Proportion of Prices Changed by Hairdresser

Notes: This figure plots the distribution of the within-hairdresser ratio of services for which prices were changed over total services offered following the VAT cut and hike.
Average tax rate (% of pre-tax income)

Top 0.1%

Bottom 90%
Average tax rate of the top 0.1% (% of pre-tax income)

- Estate taxes
- Individual income taxes
- Corporate taxes
- Sales and property taxes
**Difference-in-Difference Econometric Method**

- **Outcome**
- **Time**

- **Treatment group**
  - Line: Red
  - Mark: Red circle
  - Time when reform happens: Vertical dotted line
  - Difference (DD): Green arrow

- **Control group**
  - Line: Black
  - Mark: Black circle

- **Time when reform happens**
  - Mark: Red circle
  - Time: $t^*$
Difference-in-Difference Econometric Method

Treatment group

Control group

Time when reform happens

Outcome

Time

$DD = D_T - D_C$