US alcohol taxes: too low, too high or just about right?

James Fogarty (U. West. Aust.) & Giri Parameswaran (Haverford College)
Current alcohol taxes

• Percent of retail price
• $ per gallon of ethanol
Current alcohol taxes

Mean beer tax rate of $18.53 per gallon pure alcohol
Current alcohol taxes

Mean wine tax rate of $15.27 per gallon pure alcohol
Current alcohol taxes

Mean spirits tax rate of $44.54 per gallon pure alcohol

Tax per gallon pure alcohol

International tax comparison

Mean beer tax rate of $39.66 per gallon pure alcohol
International tax comparison

Mean wine tax rate of $30.43 per gallon pure alcohol
International tax comparison

Mean spirit tax rate of $88.51 per gallon pure alcohol

Tax per gallon pure alcohol

Belgium  Bulgaria  Czech republic  Denmark  Germany  Estonia  Greece  Spain  France  Croatia  Ireland  Italy  Cyprus  Latvia  Lithuania  Luxembourg  Hungary  Malta  Netherlands  Austria  Poland  Portugal  Romania  Slovnia  Slovakia  Finland  Sweden  United Kingdom  Canada
Unthinking decision rule?

Mean tax rate $173 per gallon pure alcohol
Implied tax increase: Beer

Mean beer tax rate increase of 9.9 times
Implied tax increase: Wine

Mean wine tax rate increase of 12.4 times
Implied tax increase: Spirits

Mean spirit tax rate increase 4.1 times
Bad news for beer drinkers

Mean beer tax $65 per gallon of pure alcohol
About the same for wine drinkers

Mean wine tax $18 per gallon of pure alcohol
Good news for spirit drinkers

Mean spirit tax $24 per gallon of pure alcohol
Overview of the model

Scale is the individual person level

Price ($)

Price

Quantity of alcohol consumed (per person/period)

$q_m^1$, $q_h^1$, $q_u^1$

$D_{\text{moderate}}$, $D_{\text{informed heavy}}$, $D_{\text{uninformed heavy}}$

Price + Externality

Marginal Externality Cost
Overview of the model

Scale is the individual person level

Price ($)

Quantitative of alcohol consumed (per person/period)

\[ D_{\text{moderate}} \]

\[ D_{\text{informed heavy}} \]

\[ D_{\text{uninformed heavy}} \]

True marginal benefit less than marginal cost
Overview of the model

Total welfare loss from the tax

Total moderate loss =  \[ \text{\triangle} \times \text{No. moderate consumers} \]

Total abuser loss =  \[ \text{\triangle} \times \text{No. informed heavy consumers} \]
Overview of the model

Total externality cost reduction from the tax

Externality cost reduction = \[ \times \text{No. informed heavy consumers} \]

Externality cost reduction = \[ \times \text{No. uninformed heavy consumers} \]
Overview of the model

Welfare gain to uniformed heavy consumers

Private welfare gain = \times \text{No. uninformed heavy consumers}
Driver of results I

- Extent of externality costs

![Diagram showing the relationship between price, quantity of alcohol consumed, and externality costs. The diagram includes demand curves for different groups: moderate, informed heavy, and uninformed heavy, with corresponding quantities of alcohol consumed per person/period.]
Driver of results I

- Extent of externality costs

![Graph showing price and quantity of alcohol consumed](image)
Driver of results II

- Proportion of consumers in each category

![Graph showing demand curves for different categories of consumers.](image)
Driver of results II

- Proportion of consumers in each category

- Price
  - Price + Tax
  - Price + Externality

- Moderate
- Informed heavy
- Uninformed heavy

- Quantity of alcohol consumed (per person/period)
Driver of results II

• Proportion of consumers in each category

Price ($) \[\text{Price + Tax} \quad \text{Price + Externality}\]

Price

\[q_m^2 \quad q_m^1\]
\[q_h^2 \quad q_h^1\]
\[q_u^2 \quad q_u^1\]

Quantity of alcohol consumed (per person/period)
Driver of results III

- Consumer responsiveness

Diagram:

- Price ($)
- Quantity of alcohol consumed (per person/period)
- Price + Tax
- Price + Externality
- $D_{\text{moderate}}$
- $D_{\text{informed heavy}}$
- $q_m^2$, $q_m^1$, $q_h^2$, $q_h^1$
Drivers of results III

Price ($) vs. Quantity of alcohol consumed (per person/period)

- Price + Tax
- Price + Externality

D moderate
D informed heavy

q_m^2 q_m^1 q_h^2 q_h^1
Model components

• Consumption of beer, wine, spirits
  • By consumer type (mod., heavy., uniform.)
• Price of beer, wine, spirits (ex. tax)
• Own and cross-price elasticity beer, wine, spirits
  • By consumer type (mod., heavy., uniform.)
• Externality cost for beer, wine, spirits
• Uniformed excess consumption cost
What people are drinking

Wine dominant

Spirit dominant

Beer dominant
Alcohol consumption per capita in 1972
Alcohol consumption per capita in 1982

![Triangular diagram showing alcohol consumption per capita in 1982. The diagram is labeled with the three main types of alcohol: Wine, Beer, and Spirits. Each point on the diagram represents the consumption of different combinations of these three types. The legend on the right indicates that dots represent different levels of consumption: 2, 3, 4, and 5 gallons of alcohol.](image_url)
Alcohol consumption per capita in 1992

[Graph showing the consumption of wine, beer, and spirits with points indicating different ethanol levels: 2, 3, and 4.]
Alcohol consumption per capita in 2002

![Alcohol consumption per capita in 2002](image)
Alcohol consumption per capita in 2012

![Triangle graph showing the consumption of wine, beer, and spirits per capita with different symbols representing different levels of ethanol consumption in gallons: 2, 3, and 4.](image)
Alabama per capita alcohol consumption forecasts

Spirits ARIMA(1,1,0)

Spirits ARIMA(1,1,0) with drift

Wine ARIMA(0,1,0)

Wine ARIMA(0,1,0) with drift

Beer ARIMA(0,2,1)

Beer ARIMA(0,1,2) with drift
Alcohol consumption per capita in 2022?

[Diagram showing a ternary plot with axes for Wine, Beer, and Spirits, and different shades representing ethanol levels in gallons: 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5]
Alcohol consumption per capita in 2012
The drinking distribution

Males
Mean = 1.0
St. Dev. = 1.6
Median = 0.5
Maximum = 25

Average number of drinks per day Males (trimmed)

Females
Mean = 0.5
St. Dev. = 0.9
Median = 0.2
Maximum = 25

Average number of drinks per day Females (trimmed)
The drinking distribution

Source: Behavioral Risk Factor Survey (2012)
Variation in recommend drinks

Source: NHMRC (2009) Australian Guidelines to reduce health risks from drinking alcohol
**Moderate versus Heavy (prefer)**

*Mean heavy consumption share 31 percent*

Source: Behavioral Risk Factor Survey (2012)
Moderate versus Heavy (alt)

Mean heavy consumption share 46 percent (alt)

Source: Behavioral Risk Factor Survey (2012)
# Beverage specific heavy v moderate

<table>
<thead>
<tr>
<th>Binge drinkers beverage of choice</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer only</td>
<td>44.8</td>
</tr>
<tr>
<td>Wine only</td>
<td>4.9</td>
</tr>
<tr>
<td>Spirits only</td>
<td>9.0</td>
</tr>
<tr>
<td>Beer + spirits</td>
<td>23.5</td>
</tr>
<tr>
<td>Beer + wine</td>
<td>6.0</td>
</tr>
<tr>
<td>Spirits + wine</td>
<td>3.5</td>
</tr>
<tr>
<td>Beer + wine + spirits</td>
<td>8.3</td>
</tr>
</tbody>
</table>

# Beverage specific heavy v moderate

## Total binge drink share

<table>
<thead>
<tr>
<th>Binge share</th>
<th>(%)</th>
<th>Ratio to beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beer</td>
<td>67</td>
<td>1.0</td>
</tr>
<tr>
<td>Wine</td>
<td>11</td>
<td>0.16</td>
</tr>
<tr>
<td>Spirits</td>
<td>22</td>
<td>0.33</td>
</tr>
</tbody>
</table>


Total heavy share equals global share
Teenager (the uniformed) drinker

• Siegel et al. (2011) Am J of Prev Med
  • Spirits share twice beer, wine very low

• Naimi et al. (2014) J of Sub Use
  • Spirits and beer the same; wine low

• Weights broadly reflect this, but always a small proportion of consumption
Consumption allocation by state

Total alcohol consumption

- Beer
  - Moderate
  - Heavy
  - Uniformed
- Wine
- Spirits
Beverage prices by state

• Beer - Heineken, 6-pack, 12-oz containers, excluding any deposit

• Wine - Livingston Cellars or Gallo Chablis or Chenin blanc, 1.5-liter bottle

• Spirits – Jack Daniels (single bottle, single store)

• Subtract existing tax rates

• Convert to ethanol:
  • Beer 4.8%, Wine 12.5%, Spirits 40% (abv)
Elasticity values

• Fogarty (2010)
  • Beer -.52   Wine -.55   Spirits -.60
• Nelson (2014) (two papers)
  • Beer -.20   Wine -.45   Spirits -.55
• Issues with meta studies
  • Double log models
  • Pooling conditional and unconditional
  • Data dependence
# Unconditional demand: Beer

## Forest Plot

<table>
<thead>
<tr>
<th>Studies</th>
<th>Weight</th>
<th>Elasticity</th>
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<tbody>
<tr>
<td>Gao et al. (1995) Syn./ AID</td>
<td>5.974</td>
<td>-0.219</td>
</tr>
<tr>
<td>Hein and Pompelli (1989) AID</td>
<td>3.416</td>
<td>-0.840</td>
</tr>
<tr>
<td>Nelson (1997) Rott.</td>
<td>3.626</td>
<td>-0.273</td>
</tr>
<tr>
<td>Nelson and Moran (1995) Rott.</td>
<td>0.701</td>
<td>-0.159</td>
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<tr>
<td>Nelson and Moran (1995) AID</td>
<td>0.701</td>
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</tr>
<tr>
<td>Nelson and Moran (1995) CBS</td>
<td>0.701</td>
<td>-0.185</td>
</tr>
<tr>
<td>Nelson and Moran (1995) NBR</td>
<td>0.701</td>
<td>-0.190</td>
</tr>
<tr>
<td>Selvanathan and selvanathan(2005) Rott.</td>
<td>3.416</td>
<td>-0.251</td>
</tr>
<tr>
<td>Selvanathan and selvanathan(2007) Rott.</td>
<td>3.416</td>
<td>-0.240</td>
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</table>
Unconditional demand: Beer

Forest Plot

Studies
- Gao et al. (1995)
  Synthetic/ AID
  Weight: 7.058, Elasticity: -0.219
- Hein and Pompelli (1989)
  AID
  Weight: 3.745, Elasticity: -0.840
- Nelson (1997)
  Rotterdam
  Weight: 3.999, Elasticity: -0.273
  NBR
  Weight: 3.020, Elasticity: -0.190
- Selvanathan and Selvanathan (2005)
  Rotterdam
  Weight: 3.745, Elasticity: -0.251
- Selvanathan and Selvanathan (2007)
  Rotterdam
  Weight: 3.745, Elasticity: -0.240
Unconditional demand: Beer

Studies

Brewers Association Canada, Distilled Spirit Council
Selvanathan and Selvanathan (2005)
Selvanathan and Selvanathan (2007)

Household Food Survey 1977-78
Hein and Pompelli (1989)

Household Food Survey 1987-88
Gao et al. (1995)

Jobson Handbooks, Brewers Almanac
Nelson (1997)

Forest Plot

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<td>-0.251</td>
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<td>Selvanathan and Selvanathan (2005)</td>
<td>1.872</td>
<td>-0.240</td>
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<td>Selvanathan and Selvanathan (2007)</td>
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<td>1.721</td>
<td>-0.273</td>
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<tr>
<td>Nelson (1997)</td>
<td>1.721</td>
<td>-0.190</td>
</tr>
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Summary values

- Beer -0.37 (0.13)  Wine -0.54 (0.10)  Spirits -0.45 (0.08)

Cross price relationships

- Imprecise from substitutes to complements
- Not much going on
- Any relationship can be explored
Demand heterogeneity?
Demand heterogeneity Manning et al. (1995)

Quantiles

Own-price elasticity

-2.0 -1.6 -1.2 -0.8 -0.4 0.0 0.4 0.8
Demand heterogeneity (Ayyagari et al. 2013)

Heavy consumers: ave 52 drinks (27% share)

All consumers: ave 19 drinks (100% share)

Light consumers: ave 4 drinks (73% share)

Own-price elasticity
Other evidence

• Auld (2005)
  - Price no impact heavy drinking

• Nelson (2007)
  - Taxes no effect on binge drinking

• Sloan et al. (1994)
  - Price no impact alcohol primary deaths

• Stout et al. (2007)
  - Price no impact on heavy drinking and DD
Moderate v heavy elasticity

• Moderate is six times heavy
• The values are equal for each state
• Budget share constraint

• Moderate consumers
  - Beer -.54  Wine -.66  Spirits -.56

• Heavy consumers
  - Beer -.09  Wine -.11  Spirits -.09
Habit/ Rational addiction models

Long-run spirit response

Baltagi and Griffin (2002)
Panel R. Add. 1 (SE added)
Panel R. Add. 2 (SE added)
Panel R. Add. 3 (SE added)
Baltagi and Griffin (1995)
Panel Habit 1 (SE added)
Panel Habit 2 (SE added)
Panel Habit 3 (SE added)
Panel Habit 4 (SE added)
Panel Habit 5 (SE added)

Own-price elasticity
## Externality costs

<table>
<thead>
<tr>
<th>Externality cost category</th>
<th>Social Cost $M</th>
<th>Externality share (%)</th>
<th>Externality $M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health care</td>
<td>24,556</td>
<td>89.7</td>
<td>22,026</td>
</tr>
<tr>
<td>Lost productivity</td>
<td>161,286</td>
<td>45.5</td>
<td>73,385</td>
</tr>
<tr>
<td>Criminal justice</td>
<td>20,973</td>
<td>98.9</td>
<td>20,742</td>
</tr>
<tr>
<td>Motor vehicle crashes</td>
<td>13,718</td>
<td>85.8</td>
<td>11,770</td>
</tr>
<tr>
<td>Fire loses</td>
<td>2,137</td>
<td>93.3</td>
<td>1,994</td>
</tr>
<tr>
<td>Other crime</td>
<td>440</td>
<td>100.0</td>
<td>440</td>
</tr>
<tr>
<td>Foetal alcohol costs</td>
<td>369</td>
<td>100.0</td>
<td>369</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>223,479</strong></td>
<td></td>
<td><strong>130,727</strong></td>
</tr>
</tbody>
</table>

Externality costs reality check

• WHO → total cost around 2.5 percent GDP
• Survey of 17 studies → 0.7 percent GDP for externality costs only
• Recent Australian study 0.6 - 0.9 percent GDP
• Implied for US 0.9 percent of GDP
• State allocation model (Sacks et al. 2013)
• Inflate up to 2012
Externality/ government cost

Mean cost $864 per person (2012 dollars)

Source: Sacks et al. (2013) American Journal of Preventative Medicine
Beverage specific externality costs

• Two part:
  • Binge drinking share (varies with beverage)
  • All other category cost constant all beverages
Cost for uniformed consumers

- Quantity of alcohol consumed (per person/period)
- Price ($)

- Price + Externality

- \( D_{\text{moderate}} \)
- \( D_{\text{informed heavy}} \)
- \( D_{\text{uninformed heavy}} \)

Estimate this distance
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Beer</th>
<th>Wine</th>
<th>Spirits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing tax rates</td>
<td>18.5</td>
<td>15.3</td>
<td>44.5</td>
</tr>
<tr>
<td>Base case results</td>
<td>65.5</td>
<td>18.7</td>
<td>24.2</td>
</tr>
<tr>
<td>Alt heavy definition</td>
<td>87.8</td>
<td>21.4</td>
<td>28.6</td>
</tr>
<tr>
<td>Drop uniformed category</td>
<td>61.1</td>
<td>18.1</td>
<td>21.1</td>
</tr>
<tr>
<td>More elastic overall demand</td>
<td>64.1</td>
<td>18.6</td>
<td>23.6</td>
</tr>
<tr>
<td>Less elastic overall demand</td>
<td>66.9</td>
<td>19.0</td>
<td>24.8</td>
</tr>
<tr>
<td>Heavy less responsive</td>
<td>57.4</td>
<td>16.3</td>
<td>21.1</td>
</tr>
<tr>
<td>Heavy more responsive</td>
<td>76.6</td>
<td>22.2</td>
<td>28.2</td>
</tr>
<tr>
<td>Lower beverage prices</td>
<td>64.7</td>
<td>18.6</td>
<td>23.6</td>
</tr>
<tr>
<td>Higher beverage prices</td>
<td>66.3</td>
<td>18.8</td>
<td>24.8</td>
</tr>
<tr>
<td>Lower externality costs</td>
<td>53.2</td>
<td>15.1</td>
<td>19.8</td>
</tr>
</tbody>
</table>
Summary

• Results are sensitive to:
  - Externality cost assumptions for beverages
  - Relative demand responsiveness
  - Heavy consumption share

• Results are insensitive to:
  - Overall price elasticity
  - Inclusion of uninformed consumers
  - Price assumption
Value of the approach

- Broadens the discussion: the cost of taxes
- Changes producer incentives
- ...creates demand for alcohol economics...