A1. Online Appendix

Table A1

<table>
<thead>
<tr>
<th></th>
<th>Wholesale Price ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>State tax ($)</td>
<td>0.76*** (0.20)</td>
</tr>
</tbody>
</table>

Covariates

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Month-year fixed effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State fixed effects</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Brand fixed effects</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

N 2,580 23,417
R² 0.94 0.91

Notes: Standard errors in parentheses and clustered at the state level. *p < 0.1, **p < 0.05, ***p < 0.01. Each column represents one regression as in Equation (5). The sample in Column 1 includes only the five highest market share cigarette brands (Marlboro, Doral, Winston, Misty, USA Gold). The sample in Column 2 excludes the five highest market share cigarette brands. Market share is defined from the Nielsen Homescan data from 2004 to 2014. Prices and taxes adjusted to 2016 dollars by the CPI.
A1.1 Derivation of Sufficient Statistic

This appendix derives a sufficient statistic that accounts for potential state-tax induced changes in consumer discounts. Again consider the model in Section III. For illustrative purposes here, consider a simple two-period version of the model where the tax-induced change in producer surplus is rewritten in terms margins for the upstream and downstream firms rather than using \( \frac{dPS}{d\tau} = -(1 - \rho)Q \) as in Weyl and Fabinger (2013). Let’s first derive the same sufficient statistic for the split of the firm share of the tax burden in terms margins for the upstream and downstream firms. Denote period zero taxes and prices as \( \tau_0, w_0, \) and \( p_0. \)

In period 1, taxes increase by \( \Delta \tau \) to \( \tau_1 = \tau_0 + \Delta \tau. \) Equilibrium wholesale prices increase by the tax pass through rate to wholesale prices \( \rho \) times the size of the tax increase:

\[
w_1 = w_0 + \rho \tau \times (\tau_1 - \tau_0).
\]

Equilibrium prices increase by the tax pass through rate \( \rho \) times the size of the tax increase:

\[
p_1 = p_0 + \rho \times (\tau_1 - \tau_0).
\]

The change in margins for the upstream producer is:

\[
\Delta m_u = (w_1 - \tau_1) - (w_0 - \tau_0).
\]

The change in margins for the downstream retailer is:

\[
\Delta m_d = (p_1 - w_1) - (p_0 - w_0).
\]

Given that the upstream and downstream firms face the same changes in quantity, the proportion of the tax burden borne by the retailer is:

\[
I_d = \frac{\Delta Q \Delta m_d}{\Delta Q (\Delta m_d + \Delta m_u)}
\]

\[
I_d = \frac{(p_1 - w_1) - (p_0 - w_0)}{(p_1 - w_1) - (p_0 - w_0) + (w_1 - \tau_1) - (w_0 - \tau_0)}
\]
\[ I_d = \frac{(p_1 - p_0) - (w_1 - w_0)}{(p_1 - p_0) - (\tau_1 - \tau_0)}, \]

now plug in \( w_1 = w_0 + \rho_w \times (\tau_1 - \tau_0) \) and \( p_1 = p_0 + \rho \times (\tau_1 - \tau_0) \):

\[ I_d = \frac{(p_0 + \rho \times (\tau_1 - \tau_0) - p_0) - (w_0 + \rho_w \times (\tau_1 - \tau_0) - w_0)}{(p_0 + \rho \times (\tau_1 - \tau_0) - p_0) - (\tau_1 - \tau_0)}, \]

\[ I_d = \frac{\rho \times \Delta \tau - \rho_w \times \Delta \tau}{\rho \times \Delta \tau - \Delta \tau}, \]

\[ I_d = -\frac{\rho - \rho_w}{1 - \rho}. \]

Now let’s relax the assumption that there are no discounts such that the consumer price (the price paid by consumers after discounts) is not equal to the retail price (the posted price). Define consumer price as \( c = r - a \), where \( r \) is the retail price and \( a \) is the discount that reduces the retail price. Suppose that the coupons are reimbursed by the upstream firm, meaning the margins of the upstream producer are \( w - a - \tau \) and the margins of the downstream retailer are \( r - w \). Suppose the discount increases in period two to \( a_1 = a_0 + \rho_a (\tau_1 - \tau_0) \), where \( \rho_a \) is the rate at which the monetary value of consumer discounts increase in taxes. Then, we can write the tax pass through rate to consumer prices \( \rho_c \) as the tax pass through rate to retail prices \( \rho_r \) and \( \rho_a \):

\[ \rho_c = \rho_r - \rho_a. \]

Plugging in these new definitions to the definition of \( I_d \), we have:

\[ I_d = \frac{(r_1 - w_1) - (r_0 - w_0)}{(r_1 - w_1) - (r_0 - w_0) + ((w_1 - a_1 - \tau_1) - (w_0 - a_0 - \tau_0))}, \]

\[ I_d = \frac{(r_1 - r_0) - (w_1 - w_0)}{(r_1 - r_0) - (a_1 - a_0) - (\tau_1 - \tau_0)}, \]

\[ I_d = -\frac{\rho_r - \rho_w}{1 + \rho_a - \rho_r}, \]

\[ I_d = -\frac{\rho_r - \rho_w}{1 - \rho_c}. \]
If discounts are orthogonal to taxes \((\rho_u = 0)\), Equation (6) reduces to Equation (4). If not, ignoring any potential tax-induced change in consumer coupons biases the expression in Equation (4). It does so partly through the denominator. If an increase in taxes increases the value of coupons used (i.e., \(\rho_u > 0\)), then the total firm share of the tax burden (the denominator in Equation (4)) would be understated by \(\rho_u\). Therefore, any consumer discount that is paid for by the upstream producer would lead us to overestimate the downstream firm share of the tax burden. Equation (6) also shows how not distinguishing the tax pass through rate to consumer prices from the tax pass through rate to retail prices can bias the incidence formula. This is shown in the numerator, where the term \(\rho\) in Equation (4) should be \(\rho_r\) as in Equation (6).

### A1.2 Discounts Paid by Upstream Producer to Downstream Retailer

This section derives the tax incidence expression that incorporates changes in merchant discounts \(b\). Suppose the discount to the retailer increases in period two to \(b_1 = b_0 + \rho_b(\tau_1 - \tau_0)\), where \(\rho_b\) is the rate at which the monetary value of merchant discounts increase in taxes. Plugging in these new definitions to the definition of \(I_d\), we have:

\[
\hat{I}_d = \frac{(r_1 - (w_1 - b_1)) - (r_0 - (w_0 - b_0))}{(r_1 - (w_1 - b_1)) - (r_0 - (w_0 - b_0)) + ([w_1 - a_1 - b_1 - \tau_1] - (w_0 - a_0 - b_0 - \tau_0))}
\]

\[
\hat{I}_d = \frac{(r_1 - r_0) - (w_1 - w_0) + (b_1 - b_0)}{(r_1 - r_0) - (a_1 - a_0) - (\tau_1 - \tau_0)}
\]

\[
\hat{I}_d = -\frac{\rho_r + \rho_b - \rho_w}{1 - \rho_c}
\]