Optimal Second Best Taxation of Addictive Goods

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Motivation

- Popular for local, state, and federal governments to raise revenue through taxation of addictive goods, including cigarettes, alcohol, and gambling.
- Addictive goods are taxed at a higher rate than non-addictive (ordinary) consumption goods.
- Under what conditions will tax rates on addictive goods differ from taxes on labor and ordinary consumption goods, when the government must raise revenue to finance expenditures?
- Revenue raising motivation.
Reasons to tax addictive goods: Externalities

- Addictive goods are frequently associated with external costs such as second-hand smoke, drunk driving, and crime.

- **Unusual feature:** only some users create externalities.

- **Result:** If government cannot discriminate between responsible and irresponsible consumers, tax addictive goods at a rate lower than if taxing only irresponsible consumers. Kenkel (1996), Pogue and Sgontz (1989).

- **'Second best' instrument:** Penalizing irresponsible behavior is more efficient, even after including deadweight costs of incarceration.
Reasons to tax addictive goods: Internalities

- **Internality**: Damage to the addict which is not (or cannot be) taken into account when making the consumption decision. Kruber and Koszegi (2001).

- **Examples**: ignoring health benefits of quitting smoking, time inconsistent preferences.

- Difficult to measure and requires strong assumptions to model, but must raise the optimal tax rate.
Reasons to tax addictive goods: Revenue Raising

Strong anecdotal evidence of revenue raising motivation:

1. Lottery advertising.
2. Last two federal alcohol tax increases part of deficit reduction packages.
3. “We will pay for (insert favorite program here) with cigarette taxes.” (e.g. SCHIP)

Parry Laxminarayan and West (2006): Tax alcohol at a relatively high rate because its consumption is correlated with leisure and reduces productivity.

No paper says how addiction affects optimal second best tax rates.
Firms

- **Competitive firms** at time $t$ rent capital $k_t$ and labor $h_t$ from households to produce a composite good using technology $F(k_t, h_t)$.

- **Homogeneous produced good** can be used for investment or addictive or ordinary consumption. Standard assumptions for $F$.

\[
\max_{k_t, h_t} \{ F(k_t, h_t) - r_t k_t - w_t h_t \}.
\]

Subscripts on functions denote partial derivatives. Equilibrium rental rate ($r_t$) and wage rate ($w_t$):

\[
r_t = F_k(k_t, h_t),
\]

\[
w_t = F_h(k_t, h_t).
\]
Representative household derives utility from consumption of an ordinary good, $c_t$, the fraction of time allocated to leisure, $1 - h_t \equiv l_t \in [0, 1]$, and addictive consumption $d_t$. Rational addiction framework in the spirit of Becker and Murphy (1988).

**Effective Consumption**: Consumption in excess of that required to sustain addiction, $s_t$.

**Lifetime utility**:

$$ U = \sum_{t=0}^{\infty} \beta^t u (c_t, s_t, l_t). $$

$\beta$ is discount factor and $u$ is per-period utility.

**Standard assumptions on $u$.**
Effective Consumption

- **Effective consumption**: \( s = s(d_t, d_{t-1}) \).
- **Assume**:
  1. \( s_1 > 0 \) (positive utility),
  2. \( s_2 < 0 \) (tolerance),
  3. \( s_{11} \leq 0 \) (for concavity),
  4. \( s \) is homogeneous degree \( \alpha \) in \([d_t, d_{t-1}]\) (HD-\( \alpha \)).

Much weaker assumptions than the literature, which assumes either

1. **subtractive**: \( s = d_t - \gamma d_{t-1} \) (HD-1) or
2. **multiplicative**: \( s = d_t d_{t-1}^{\gamma} \). (HD-(1 − \( \gamma \)).

Homogeneity may or may not depend on tolerance (\( \gamma \)).
household budget

1. After tax wage and rental income plus
2. government bond redemptions equals
3. after tax expenditures on ordinary and addictive consumption plus
4. net investment plus
5. government bond issues.

\[ r_t k_t + (1 - \tau_{h,t}) w_t h_t + R^b_t b_t = (1 + \tau_{c,t}) c_t + (1 + \tau_{d,t}) d_t + i_t + b_{t+1}. \]

Pre-tax price normalized to one. Three tax instruments.

\[ i_t = k_{t+1} - (1 - \delta) k_t. \]
Key Wedge

Household first order conditions imply:

\[
\frac{1 + \tau_{d,t}}{1 + \tau_{c,t}} = \frac{u_s (c_t, s_t, l_t) s_1 (d_t, d_{t-1}) + \beta u_s (c_{t+1}, s_{t+1}, l_{t+1}) s_2 (d_{t+1}, d_t)}{u_c (c_t, s_t, l_t)} \equiv \frac{MU_{d,t}}{MU_{c,t}};
\]

where \(MU_{i,t}\) represents the marginal utility of good \(i\) at time \(t\).

- Thus \(\tau_{d,t} > \tau_{c,t}\) if and only if \(MU_{d,t} > MU_{c,t}\).
- Rest of the paper: find conditions for which \(\tau_d > \tau_c\).
Government

- Exogenous government expenditures $g_t$.
- Government budget constraint:

$$g_t = \tau_{h,t} w_t h_t + \tau_{c,t} c_t + \tau_{d,t} d_t + b_{t+1} - R_t b_t.$$

- **Three wedges:** MU-leisure versus MU-working, MU-ordinary consumption versus MU-addictive consumption, and rate of interest versus intertemporal marginal rate of substitution.
- Three taxes form a **complete tax system**: government may affect all three wedges.
- Tax on capital is possible via a time varying consumption tax. Can tax addictive goods with other taxes in other tax systems. Key is the wedge.
- Full committment.
Ramsey Problem

Ramsey approach: use first order conditions to eliminate prices and policies from the equations that define the competitive equilibrium. The planner then chooses allocations to maximize welfare subject to the remaining equations from the competitive equilibrium. These equations are the resource constraint:

\[ F(k_t, h_t) = c_t + d_t + k_{t+1} - (1 - \delta) k_t + g_t, \]

and the implementability constraint (IMC):

\[
\frac{u_c(c_0, s_0, l_0) R_0(k_0 + b_0)}{1 + \tau_{c,0}} = \sum_{t=0}^{\infty} \beta^t (u_c(c_t, s_t, l_t) c_t \\
+ u_s(c_t, s_t, l_t) s_1(d_t, d_{t-1}) + \beta u_s(c_{t+1}, s_{t+1}, l_{t+1}) s_2(d_{t+1}, d_t)) d_t \\
- u_l(c_t, s_t, l_t) h_t).
\]
Homothetic Utility

\[ u(c_t, s_t, l_t) = q(v(c_t, s_t), l_t), \]

where \( v(.) \) is homothetic and \( q(.) \) is increasing. Elasticities:

\[
\sigma_{cs,t} \equiv \frac{u_{cs}(c_t, s_t, l_t)c_t}{u_{s}(c_t, s_t, l_t)}, \quad \sigma_{sc,t} \equiv \frac{u_{cs}(c_t, s_t, l_t)s_t}{u_{c}(c_t, s_t, l_t)}, \quad \sigma_{hs,t} \equiv \frac{u_{sl}(c_t, s_t, l_t)h_t}{u_{s}(c_t, s_t, l_t)}.
\]

**PROPOSITION**

Let assumptions 1-3 hold \( u(.) \) be of the form given above. Then \( \tau_{d,t} > \tau_{c,t} \) if and only if:

\[
(1 - \alpha)(1 - \sigma_{s,t} - \sigma_{sc,t}) > -\frac{\beta u_{s,t+1}s_{2,t+1}}{MU_{d,t}} \left( \alpha \left( \sigma_{s,t+1} - \sigma_{s,t} \right) - (\sigma_{cs,t+1} - \sigma_{cs,t}) + (\sigma_{hs,t+1} - \sigma_{hs,t}) \right)
\]
Homothetic: Key Equation

Homotheticity does not generally imply uniform taxation for two reasons: tolerance and because $d$ is taxed but homotheticity is in $c$ and $s$.  

$c$ and $s$ versus $c$ and $d$. Let $s_2 \to 0$ and $s$ be HD-$\eta$ in $d$, then:

$$(1 - \eta) (1 - \sigma_{s,t} - \sigma_{sc,t}) > 0$$

$\eta = 1$ iff $s = d$. Term vanishes if we assume homothetic in $c$ and $d$.

Tolerance. Let $\eta = 1$. All terms are now due to tolerance. Labor supply terms:

$$u_{s,t} s_{1,t} \sigma_{hs,t} + \beta u_{s,t+1} s_{2,t+1} \sigma_{hs,t+1} > \sigma_{hs,t} (u_{s,t} s_{1,t} + \beta u_{s,t+1} s_{2,t+1}).$$

$\sigma'_{hs} < \sigma_{hs}$: Taxing $d$ at a higher rate $\to$ less addicted in the future $\to$ higher effective consumption $\to$ more future labor tax revenues (strong complements). Taxing $d$ smooths distortions over time.
Separable Utility

**PROPOSITION**

Let assumptions 1-3 hold and $u(.)$ be additively separable. Then $\tau_{d,t} > \tau_{c,t}$ iff:

$$\alpha \sigma_{s,t} + 1 - \alpha - \sigma_{c,t} > -\frac{\beta \alpha u_{s,t+1}s_{2,t+1}}{MU_{d,t}} (\sigma_{s,t+1} - \sigma_{s,t}).$$

Two effects: $c$ and $d$ have different static income elasticities and tolerance. 
$c$ and $s$ versus $c$ and $d$. Let $s_2 \to 0$ and $s$ be HD-$\eta$ in $d$, then:

$$\eta \sigma_{s,t} + 1 - \eta > \sigma_{c,t}$$

Holds iff $d$ is more income inelastic than $c$ ($d$ is the necessity).
Tolerance. Let $\eta = 1$. All terms are now due to tolerance.

$$\left(\alpha \sigma_{s,t} + 1 - \alpha\right) u_{s,t} s_{1,t} + \left(\alpha \sigma_{s,t+1} + 1 - \alpha\right) \beta u_{s,t+1} s_{2,t+1}$$

$$> \sigma_{c,t} \left( u_{s,t} s_{1,t} + \beta u_{s,t+1} s_{2,t+1} \right).$$

$\sigma_{s,t+1} > \sigma_{s,t}$: $d$ is becoming more income inelastic. Tax $d$ more today $\rightarrow$ less addicted in the future $\rightarrow$ more income elastic in the future. Offsets fall income elasticity.

**Smooth distortions.**
Differential Labor Supply Effects

\[ u(s_t, d_t, l_t) = q(c_t) + v(s_t, l_t). \]

**PROPOSITION**

Let assumptions 1-3 hold and \( u(.) \) be as above. Then \( \tau_{d,t} > \tau_{c,t} \) iff:

\[
1 - \alpha + \alpha \sigma_{s,t} + \sigma_{hs,t} - \sigma_{c,t} > -\frac{\beta u_{s,t+1}s_{2,t+1}}{MU_{d,t}} \left( \frac{\sigma_{hs,t+1} - \sigma_{hs,t}}{\sigma_{s,t+1} - \sigma_{s,t}} + \alpha \left( \sigma_{s,t+1} - \sigma_{s,t} \right) \right).
\]

Extra terms favor taxing \( d \) if complementary with leisure.

\[
\frac{u_{s,t}s_{1,t}}{MU_{d,t}} \left( 1 - \alpha + \alpha \sigma_{s,t} + \sigma_{hs,t} \right) + \frac{\beta u_{s,t+1}s_{2,t+1}}{MU_{d,t}} \left( 1 - \alpha + \alpha \sigma_{s,t+1} + \sigma_{hs,t+1} \right)
\]

Smooth labor supply elasticities.
Conclusions

1. First attempt to show how addiction affects optimal revenue raising through dynamic effects.

2. **Smooth distortions.** If in the future taxing addictive consumption causes little distortion, raise addictive taxes today. Lower future addiction will make taxing addictive consumption more distortionary.

3. If addictive goods are complementary with leisure, high addictive taxes reduce addictive consumption, making working more attractive, which raises labor tax revenues. But, households become less addicted, which raises future effective consumption. But then leisure rises, and future labor tax revenues fall.

4. Many special cases have constant elasticities. Do not excessively tax addictive goods.

5. Moderate addictive taxation is consistent with the data.