Regressive Sin Taxes by Lockwood and Taubinsky: A Critical Review

Nathan Mather

University of Michigan

2019

Introduction

Two conflicting forces at play when considering sin taxes

- People make bad decisions
  - Correcting this can potentially increase welfare
  - Similar logic to Pigouvian tax
- Sin taxes can be regressive
  - Cigarettes and sugary drinks consumed disproportionately by the poor
  - High efficiency subsidies disproportionately taken by rich

Goal of Model

- A model that addresses both of these concerns
- Includes variable income tax.
- Consumers have heterogeneous earnings, abilities, and tastes, and can choose labor supply and consumption bundles
- Policy makers choose linear commodity tax and non-linear income tax.
- Policy maker and consumers disagree about what is best for them.

The Model

The Environment

- Variable definitions

Variable	Meaning
θ	Consumer Type
$\mu(\theta)$	Distribution of Type
z	Earnings
$T(z)$	nonlinear income tax
c_2	Sin Good
t	Linear Commodit tax on c_2
c_1	Numeraire good
p	Price of c_2
$U(c_1, c_2.z; \theta)$	Decision Utility
$V(c_1, c_2.z; \theta)$	Policymaker "correct" utility
$\alpha(\theta)$	Pareto Weights

- Functional form assumptions
  - U is increasing and weakly concave in c_1 and c_2 and decreasing and strictly concave in z

The Model

Policymaker's Problem

- Policymaker wants to maximize experienced utility V
  - Weight consumers by Pareto weights
  - Can choose $T(\cdot)$ and t to do this
  - Subject to budget constraint
  - Subject to individuals doing what they want

$$\max_{T,t} \int \alpha(\theta) V(c_1(\theta), c_2(\theta), z(\theta); \theta) \mu(\theta)$$

Subject to the budget constraint

$$\int (tc_2(\theta) + T(z(\theta))) \mu(\theta) = 0$$

and individual maximization

$$\{c_1(\theta), c_2\theta, z(\theta)\} = \arg\max_{c_1, c_2, z} U(c_1, c_2, z; \theta)$$

$$s.t. \quad c_1 + (1+t)c_2 < z - T(z) \quad \forall \quad \theta$$

The Model

Difference between U and V

- Incorrect beliefs
  - Calorie content of food
  - Health costs of food or drugs
  - Energy efficiency of products
- Limited attention or salience bias
  - People think "fat free" ice cream is healthy
- Present Bias/ Time Inconsistency
  - Hyperbolic discounting ($\beta - \delta$ discounting)
  - The model can treat β as a bias.
  - Policy maker could also weight present and future selves arbitrarily

The Model

A Price Metric for Consumer Bias

Variable	Meaning
y	$z - T(z)$
$c_2(\theta, y, p, t, T)$	Consumption chosen by individual of type θ given constraints
$c_2^V(\theta, y, p, t, T)$	What individual would choose if maximizing over V
$\gamma(\theta, z, t, T)$ or "Bias"	γ s.t. $c_2(\theta, y, p, t, T) = c_2^V(\theta, y - c_2\gamma, p - \gamma, t, T)$

- This is the compensated price change that produces the same effect on demand as the bias does
- In some cases this can be measure directly
  - Chetty et al. (2009)
    - Tax salience
    - Δ price that alters demand as much as tax-inclusive price

The Model

Redistributive Motives

- Marginal Social welfare weights
  - Marginal social welfare generated by a marginal unit of consumption of c_1 for a given individual
  - Formally, $g(\theta) = \alpha(\theta) V_1 / \lambda$
  - $\bar{g} = \int_{\Theta} g(\theta) d\mu(\theta)$
  - If there are no income effects on consumption and labor supply, then $\bar{g} = 1$ by construction.
- Formulas for optimal taxes will thus depend on the policymaker's (or society's) preferences for wealth equality

Optimal Tax With Discrete Types

- $\theta \in L, H$
- $w_L < w_H$
- Internality is harmful $\gamma(\theta) > 0$
- L consumes more c_2 than H
- Normalize c_2 so $p = 1$
- $c_1^*(\theta) = z^*(\theta) - T_\theta - (1+t)c_2^*(\theta)$

Eample 1: Regressivity Caused by Heterogeneous Preferences

Functional Form Assumptions

$$U(c_1, c_2, z; \theta) = G(c_1 + v(c_2, \theta) - \Psi(z/w_\theta))$$

$$V(c_1, c_2, z; \theta) = G(c_1 + v(c_2, \theta) - \gamma(\theta)c_2 - \Psi(z/w_\theta))$$

- $c_2^*(H) < c_2^*(L)$
- G is concave
- No income effects for choice of c_2 or labor supply

Eample 1: Regressivity Caused by Heterogeneous Preferences

Policy Maker's problem

Policymaker solves

$$\max_{t, T_L, T_H} \sum_{\theta} V(c_1^*(\theta), c_2^*(\theta, z^*(\theta); \theta)\mu(\theta)$$

S.T.

$$\frac{1}{2} \sum_{\theta} (T_\theta + t c_2^*(\theta)) \geq 0$$

and

$(c_1^*(\theta), c_2^*(\theta), z^*(\theta))$ Maximizes $U(c_1, c_2, z; \theta)$ given cnstraints

Eample 1: Regressivity Caused by Heterogeneous Preferences

result

$$t^* = \underbrace{\frac{\sum_\theta g(\theta)\gamma(\theta)\frac{dc_2^*(\theta}{dt}}{\sum_\theta \frac{dc_2^*(\theta)}{dt}}}_{\text{corrective benefits}} - \underbrace{\frac{\sum_\theta c_2^*(\theta)(g(\theta)-1)}{\sum_\theta \frac{dc_2^*(\theta)}{dt}}}_{\text{Regressivity Costs}}$$

- *NOTE: in the paper they incorrectly have $1 - g(\theta)$ in the second term
- Correction is more valuable with greater bias $\gamma(\theta)$ and higher welfare weight $g(\theta)$
- Regressivity cost reduces optimal tax since $g(L) > 1$, $g(H) < 1$, and $c_2^*(H) < c_2^*(L)$

Example 2: Regressivity Caused by Income Effects

Functional Form Assumptions

$$U(c_1, c_2, z; \theta) = G(c_1 + v(c_2, c_1) - \Psi(z/w_\theta)$$

$$V(c_1, c_2, z; \theta) = G(c_1 + v(c_2, c_1) - \gamma(\theta)c_2 - \Psi(z/w_\theta)$$

Perturbation argument Raise commodity tax and adjust income tax to neutralize effect on wealth. At the optimum, this has zero first oder effect on welfare. Giving

$$\underbrace{t\left(\sum_\theta \frac{dc_2^*(\theta)}{dt}\bigg|_u\right)}_{\text{Effect on Gvernment Revenue}} - \underbrace{\sum_\theta \left(g(\theta)\gamma\frac{dc_2^*(\theta)}{dt}\bigg|_u\right)}_{\text{Effect on Consumer Welfare}} = 0$$

Example 2: Regressivity Caused by Income Effects

Result

$$t^* = \frac{\sum_\theta \left(g(\theta)\gamma \frac{dc_2^*(\theta)}{dt}\Big|_u \right)}{\sum_\theta \frac{dc_2^*(\theta}{dt}\Big|_u}$$

- No Regressivity costs in this case
- Income tax reform can perfectly neutralize the effects of the commodity tax on income

Understanding The Difference

- Progressive taxes make people work less
- Heterogeneous Preferences
  - Changing income will not alter consumption
  - c_2 tax is regressive from societal standpoint
  - Not regressive for individual.
    - Doesn't alter z
  - Progressive income tax lowers z
- Income Effects
  - c_2 good is inferior
  - c_2 tax is regressive from societal standpoint
  - c_2 tax is also regressive for individual
    - If I work more, I can buy less c_2 and avoid the tax
    - leads to higher z
  - Progressive income tax lowers z
    - z effects offset, total output unchanged

A General Formula for The Optimal Commodity Tax

Assumptions and elasticity concepts

assumptions

- No Labor supply mis-optimization
- Constant Marginal Social Welfare weights conditional on income
- U and V are smooth, strictly concave in c_1, c_2, z and μ is differentiable with full support
- $T(\cdot)$ is twice differentiable and each consumer's choice of income z admits a unique global optimum

Parameters

- $\zeta(\theta, t, T)$: Price elasticity of demand for c_2 of type θ
- $\zeta^c(\theta, t, T)$: Compensated price elasticity of demand for c_2
- $\eta(\theta, t, T)$: The income effect on c_2 Equal to $\zeta - \zeta^c$
- $\zeta_z^c(\theta, t, T)$: The compensated elasticity of taxable income with respect to the marginal income tax rate
- $\eta_z(\theta, t, T)$: Income effect on labor supply

A General Formula for The Optimal Commodity Tax

Assumptions and elasticity concepts

- $\bar{X}(z)$ is the average of Variable X for given income z
- C_2 is $\int_\Theta 1z(\theta) \leq z d\mu(\theta)$
- $H(z)$ is the income Distribution
- $\phi(z)$ is how much c_2 an average z-earner would consume if all variation in c_2 was explained solely by income effects.
- Let $\tilde{\phi}(z) := \frac{\bar{c}_2(z) - \phi(z)}{C_2}$
  - This measures how much difference between $\bar{c}_2(z)$ and $\bar{c}_2(0)$ is explained by preference heterogeneity. (normalize by average c_2)

A General Formula for The Optimal Commodity Tax

An expression for the optimal commodity tax 1

Average Marginal Bias

$$\bar{\gamma}(t, T) = \frac{\int_{\Theta} \gamma(\theta, t, T) \left(\left. \frac{dc_2(\theta,t,T)}{dt} \right|_u \right) d\mu(\theta)}{\int_{\Theta} \left(\left. \frac{dc_2(\theta,t,T)}{dt} \right|_u \right) d\mu(\theta)}$$

Average Marginal Bias Given z

$$\bar{\gamma}(z, t, T) = \frac{\int_{\Theta} \gamma(\theta, t, T) \left(\left. \frac{dc_2(\theta,t,T)}{dt} \right|_u \right) 1\{z(\theta, t, T) = z\} d\mu(\theta)}{\int_{\Theta} \left(\left. \frac{dc_2(\theta,t,T)}{dt} \right|_u \right) 1\{z(\theta, t, T) = z\} d\mu(\theta)}$$

This is the marginal bias weighted by individuals marginal responses to a compensated change in t.

Covariance of welfare weight with consumption-weighted bias and elasticity

$$\sigma := \mathrm{Cov}_H \left[g(z), \frac{\bar{\gamma(z)}}{\bar{\gamma}} \frac{\bar{\zeta^c}(z)}{\bar{\zeta^c}} \frac{\bar{c}_2(z)}{C_2} \right]$$

This captures the extent to which bias correction is concentrated on the low-end of the income distribution

A General Formula for The Optimal Commodity Tax

An expression for the optimal commodity tax 1

- Start by using social marginal utility of income $\hat{g}(z)$ rather than social marginal welfare weights.
- Average welfare effect of marginally increasing the incomes of consumers currently earning income z.
- rather than marginally increasing numeraire consumption c_1
- This accounts for fiscal externalities resulting from income effects, and for the fact that some of this additional consumption will be mis-spent due to bias.

A General Formula for The Optimal Commodity Tax

An expression for the optimal commodity tax 1

Proposition 1

$$t = \bar{\gamma}(\bar{g} + \sigma) - \frac{p+t}{\bar{\zeta}^c}\mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right] \tag{1}$$

$$= \frac{\bar{\zeta}^c \bar{\gamma}(\bar{g} + \sigma) - p\mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right]}{\bar{\zeta}^c + \mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right]} \tag{2}$$

- Corrective benefit is increase in
  - Average marginal bias $\bar{\gamma}$
  - Average social welfare weight $\bar{g}$
  - Extent to which bias correction is concentrated with low income consumers σ
- $\mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right]$ is roughly regressivity cost that cannot be offset by progressive income taxes.
  - Depends on extent to which c_2 differential is due to preference heterogeneity or income effects.

A General Formula for The Optimal Commodity Tax

An expression for the optimal commodity tax 2

Lemma 2 Let $\chi(z) := \phi(z) - \int_0^z w(x,z) \frac{\eta_z}{\zeta_z^c x}(c_2(x) - \phi(x))dx$, where $w(x,z) = e^{\int_{z'=x}^{x'=z} \frac{\eta_z}{\zeta_z^c z} dx'}$. Then increasing the commodity tax by dt and decreasing the income tax by $\chi(z)dt$ leaves the average labor supply of z-earners unchanged.

$\chi(z) := \phi(z)$ when $\eta_z = 0$. i.e. when there are no labor supply income effects.

Define $\tilde{\chi}(z) := \frac{\bar{c}_2(z) - \chi(z)}{C_2}$

A General Formula for The Optimal Commodity Tax

An expression for the optimal commodity tax 2

Proposition 2 The optimal commodity tax t satisfies.

$$t = \underbrace{\bar{\gamma}(\bar{g}+\sigma)}_{\text{corrective benefits}} + \underbrace{\frac{p+t}{\bar{\zeta}^c}\mathrm{E}[(g(z)-1)\tilde{\chi}(z)]}_{\text{regressivity costs}} - \underbrace{\frac{1}{\bar{\zeta}^c}\int \tilde{\chi}(z)\eta(z)(t-g(z)\bar{\gamma}(z))}_{\text{additional impact from income effect}}$$

In the absence of income effects

$$t = \bar{\gamma}(\bar{g}+\sigma) - \frac{p+t}{\bar{\zeta}^c}\mathrm{Cov}\left[g(z),\tilde{\phi}(z)\right]$$

Interpretations and Implication

Optimal taxes in the Absence of Redistributive Concerns

Corollary 2 suppose that either
1) $z(\theta)$ is constant in θ or
2) $g(\theta) = 1 \ \forall \ \theta$
Then $t^* = \bar{\gamma}$ (From Proposition 1).

- Optimal commodity tax exactly offsets the average marginal bias.

When there are no corrective concerns

$$t = -\frac{p\mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right]}{\bar{\zeta}^c + \mathrm{Cov}\left[\hat{g}(z), \tilde{\phi}(z)\right]}$$

- The Atkinson-Stiglitz theorem itself obtains as a special case of (6) when all variation in c_2 consumption is driven by income effects, which then implies that t $= 0$

Interpretations and Implication

Optimal Taxes When Income Effects do not Affect c_2 consumption

Corollary 3 Suppose that there are no income effects: $\eta \equiv 0$ and $\eta_z \equiv 0$ then

$$t = \underbrace{\bar{\gamma}(\bar{g} + \sigma)}_{\text{Corrective Benefits}} \underbrace{- \frac{p+t}{\bar{\zeta}^c} \mathrm{Cov}\left[g(z), \tilde{\phi}(z)\right]}_{\text{Regressivity Costs}}$$

- Generalizes the result in Example 1
- First term now depends of σ (concentration of corrective benefits among low income)
- Second term persists because progressive income tax. Fiscal externalities outweigh re-distributive benefit
- As consumption of c_2 becomes inelastic, t become a sin subsidy.

Interpretations and Implication

Optimal taxes when all differences in c_2 consumption are due to income effects

Corolalry 4 Suppose that $U_2(c_1, c_2, \theta, z)/U_1(c_1, c_2, \theta, z)$ is constant in θ for each z. Then

$$t^* = \bar{\gamma}(\bar{g} + \sigma)$$

- Generalizes Example 2
- higher σ implies higher benefit to bias correction
- Policymaker will spend more that $1 to eliminate $1 mistake made by poor consumers.

extensions

- Tax salience on the labor supply margin
  - Effect of commodity taxes on labor supply my be minimal
  - If people don't consider commodity taxes in in labor supply, moves us closer to preference heterogeneity case.
- N $>$ 2 Dimension of Consumption
  - Considers substitutability of goods
- Externalities
  - Special case of this framework
- Without te First-order approach
- labor supply misoptimization

Conclusion

- reconciles the role for corrective taxes with the concern that such taxes may be regressive
- Clarifies that the optimal policy depends on a number of statistics.
  - Preference heterogeneity vs. Income effects
  - Bias of both rich and poor
  - Elasticity of demand and how it varies across income
  - salience of commodity taxes on labor supply margin

Citation

B. Lockwood and D. Taubinsky, "Regressive Sin Taxes," NBER WP No. 23085, March 2017.