Optimal Taxation with Behavioral Agents (with other models at the end)

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Introduction

- Behavioral version of three pillars of optimal taxation theory:
  - Ramsey (linear taxation to raise revenues and redistribute)
  - Pigou (linear taxation to correct for externalities)
  - Mirrlees (nonlinear taxation to raise revenues and redistribute)
- General behavioral biases, including:
  - Misperceptions of taxes
  - "Internalities"
  - Mental accounts

Related Literature

- Behavioral Public Finance: Gruber and Koszegi 01, Liebman and Zeckhauser 04, O'Donoghue and Rabin '06, Chetty, Kroft Looney 09, Finkelstein 09, Bernheim Rangel 09, Mullainathan Schwartzstein Cogdon 12, Allcott Mullainathan Taubinsky 14, Allcott Taubinsky 15, Baicker, Mullainathan, Schwartzstein 15, Lockwood and Taubinsky 15, Taubinsky and Rees-Jones 17, Lockwood 17, Yu 17 Moser and Olea 17
- Inattention / salience: Sims 03, Gabaix and Laibson 02, 06, Mankiw Reis 02, Reis 06, Abel, Eberly and Panageas 09, Maćkowiak and Wiederholt 10, Masatlioglu and Ok 10, Veldkamp 11, Matejka and McKay 14, Spiegler and Piccione 12, Woodford 12, Bordalo, Gennaioli and Shleifer 12,13, Caplin and Dean 14, Gabaix 14, Schwarzstein 15
- Law and Economics: Thaler and Sunstein '09, Gamage & Shanske '11, Galle '14, Goldin '15.
- Behavioral economics: $k-$level models, Crawford et al., Jéhiel et al., Hong and Stein, Koszegi and Szeidl, Schwartzstein, Furster-Laibson-Mendel, Eyster-Rabin,...
- Bounded Rationality: Sargent 93, Rubinstein 98, Tirole 11, Aguiar Serrano 14, Gul Pesendorfer Strzalecki 15 ...

Empirical motivation

- Income tax: do you know your marginal tax rate? People are confused about their true marginal tax rate, and indeed use instead their average tax rate: De Bartolome '95, Liebman and Zeckhauser '04
- Evidence for inattention: Chetty, Kroft Looney 09, Taubinsky and Rees-Jones 15: People are partially inattentive to taxes
- Government react to that inattention by increasing taxes: Finkelstein 09 on EZ-pay
- Lots of evidence of "neglect" of various kinds: e.g. people underweigh the present value of cost of gas when they buy a car: Allcott and Wozny '14 vs Busse Knittel Zettelmeneyer 13.
- Evidence on mental accounts: Thaler '85, Hastings and Shapiro '13
- Evidence on hyperbolic discounting / temptation

Decision utility vs Experienced utility model

$$\boldsymbol{c}\left(\boldsymbol{q}, w\right) = \arg\max_{\boldsymbol{c}} u^s\left(\boldsymbol{c}\right) \text{ s.t. } \boldsymbol{q} \cdot \boldsymbol{c} \leq w$$

- u^s ="decision" utility (s for $s$ubjective)
- u ="experienced" utility
- Ex. internalities from temptation, hyperbolic discounting,...

Misperception model

- True price $\boldsymbol{q}$ and perceived price $\boldsymbol{q}^s(\boldsymbol{q}, w)$
- Agent behavior (Gabaix 2014):

$$\boldsymbol{c}(\boldsymbol{q}, w) = \arg \underset{\boldsymbol{c} \in \mathbb{R}^n | \boldsymbol{q}^s(\boldsymbol{q}, w)}{\text{smax}} (\boldsymbol{c}) \text{ s.t. } \boldsymbol{q} \cdot \boldsymbol{c} = w$$

i.e.

$$u'(\boldsymbol{c}(\boldsymbol{q}, w)) = \lambda \boldsymbol{q}^s(\boldsymbol{q}, w) \text{ with } \lambda \text{ such that } \boldsymbol{q} \cdot \boldsymbol{c}(\boldsymbol{q}, w) = w$$

- The "trade-off" intuition works:

$$\frac{u'_{c_1}}{u'_{c_2}} = \frac{q_1^s}{q_2^s}$$

- Budget constraint is satisfied: $\boldsymbol{q} \cdot \boldsymbol{c}(\boldsymbol{q}, w) = w$

Behavioral Price theory: General Model

- Two primitives:
  - Marshallian demand function $\boldsymbol{c}(\boldsymbol{q}, w)$ with $\boldsymbol{q} \cdot \boldsymbol{c}(\boldsymbol{q}, w) = w$
  - "Experienced" utility function $u(\boldsymbol{c})$
- Indirect utility: $v(\boldsymbol{q}, w) = u(\boldsymbol{c}(\boldsymbol{q}, w))$.
- Misoptimization wedge

$$\boldsymbol{\tau}^b := \boldsymbol{q} - \frac{u_{\boldsymbol{c}}(\boldsymbol{c}(\boldsymbol{q}, w))}{v_w(\boldsymbol{q}, w)}$$

- $\boldsymbol{\tau}^b = 0$ for traditional, rational agent.
- Slutsky matrix

$$\boldsymbol{S}_j^C(\boldsymbol{q}, w) = \boldsymbol{c}_{q_j}(\boldsymbol{q}, w) + \boldsymbol{c}_w(\boldsymbol{q}, w) c_j(\boldsymbol{q}, w)$$

Behavioral Price theory: General Model

- Modified Roy's identity

$$\frac{v_{q_j}(\boldsymbol{q}, w)}{v_w(\boldsymbol{q}, w)} = -c_j - \boldsymbol{\tau}^b \cdot \boldsymbol{S}_j^C$$

- Example. Take $c_j = 1$ pack per day, $\tau_j^b = \$10/\text{pack}$ (Gruber and Koszegi 2004), $S_{jj}^C = -\frac{\psi c_j}{q_j} = -0.14$ packs per dollar per day. Then, $-\boldsymbol{\tau}^b \cdot \boldsymbol{S}_j^C = -\tau_j^b S_{jj}^C = 1.5$ dollars per day.
- So, $\frac{v_{q_j}(\boldsymbol{q},w)}{v_w(\boldsymbol{q},w)} = -1 + 1.5 = 0.5 > 0$
- So, increasing the cigarette tax makes consumers better off.

More behavioral consumer theory: Concrete models

- General model nests many concrete models
- **Decision vs. Experienced utility model**

$$\boldsymbol{\tau}^b = \frac{u_c^s}{v_w^s} - \frac{u_c}{v_w}$$

- $\tau_i^b > 0$ for "tempting" goods: drugs, fats, etc.
- Slutsky: $S_{ij} = S_{ij}^s$
- **Misperception model**

$$\boldsymbol{\tau}^b = \boldsymbol{q} - \boldsymbol{q}^s$$

- $\tau_i^b > 0$ for goods with non-salient taxes
- Slutsky, typically non-symmetric: $S_{ij}^H = \sum_k S_{ik}^r \frac{\partial q_k^s(\boldsymbol{q},w)}{\partial q_j}$

Many-person Ramsey (Diamond 1975)

$$L(\boldsymbol{\tau}) = W\left(\left(v^h(\boldsymbol{p}+\boldsymbol{\tau}, w)\right)_{h=1\ldots H}\right) + \lambda \sum_h \left[\boldsymbol{\tau} \cdot \boldsymbol{c}^h(\boldsymbol{p}+\boldsymbol{\tau}, w) - w\right]$$

- Optimal tax formula in "target form" in term of sufficient statistics:

$$0 = \frac{\partial L(\boldsymbol{\tau})}{\partial \tau_i} = \sum_h [\left(\lambda - \gamma^h\right) c_i^h + \lambda(\boldsymbol{\tau} - \widetilde{\boldsymbol{\tau}}^{b,h}) \cdot \boldsymbol{S}_i^{C,h}]$$

- Sufficient statistics
  - Social marginal welfare weight $\beta^h = W_{v^h} v_w^h$
  - Social marginal utility of income $\gamma^h = W_{v^h} v_w^h + \lambda \boldsymbol{\tau} \cdot \boldsymbol{c}_w^h$
  - Substitution elasticities $\boldsymbol{S}_i^{C,h}$
  - Weighted misoptimization wedge $\widetilde{\boldsymbol{\tau}}^{b,h} = \frac{\beta^h}{\lambda} \boldsymbol{\tau}^{b,h}$
- Mechanical $\left(\lambda - \gamma^h\right) c_i^h$, substitution $\lambda \boldsymbol{\tau} \cdot \boldsymbol{S}_i^{C,h}$ (distortion from fiscal externality), misoptimization $\widetilde{\boldsymbol{\tau}}^{b,h} \cdot \boldsymbol{S}_i^{C,h}$ (distortion from failure of envelope theorem)
- Extends to Pigou

Nudges

- Nudge χ influences demand $\boldsymbol{c}(\boldsymbol{q}, w, \chi)$, possibly utility $u(\boldsymbol{c}, \chi)$ but not budget $\boldsymbol{q} \cdot \boldsymbol{c} = w$.
- Concrete model: decision utility u^s, perceived price $\boldsymbol{q}^{s,*}$, nudgeability $\eta \geq 0$

$$\boldsymbol{c}(\boldsymbol{q}, w, \chi) = \arg smax_{\boldsymbol{c}|u^s, B^s} u^s(\boldsymbol{c}) \text{ s.t. } \boldsymbol{q} \cdot \boldsymbol{c} \leq w$$

i.e. $\boldsymbol{c}$ is s.t.

$$u^{s\prime}(\boldsymbol{c}) = \Lambda B^s_{\boldsymbol{c}}(\boldsymbol{q}, \boldsymbol{c}, \chi) \text{ with } \Lambda \text{ s.t. } \boldsymbol{q} \bullet \boldsymbol{c}(\boldsymbol{q}, w, \chi) = w$$

- Nudge as a psychic tax: $B^s(\boldsymbol{q}, \boldsymbol{c}, \chi) = \boldsymbol{q}^{s,*} \cdot \boldsymbol{c} + \chi \eta c_i$,
- Nudge as an anchor: $B^s(\boldsymbol{q}, \boldsymbol{c}, \chi) = \boldsymbol{q}^{s,*} \cdot \boldsymbol{c} + \eta |c_i - \chi|$

Optimal Nudges

- Optimal nudge formula

$$0 = \frac{\partial L}{\partial \chi} = \sum_h [\lambda \left(\boldsymbol{\tau} - \boldsymbol{\tau}^{\xi,h} - \widetilde{\boldsymbol{\tau}}^{b,h} \right) \cdot \boldsymbol{c}_\chi^h + \beta^h \frac{u_\chi^h}{v_w^h}]$$

- Integrates nudges into canonical optimal taxation framework

Taking Stock

- So far:
  - General taxation motive (revenue raising, redistribution, correcting for externalities, internalities)
  - Arbitrary behavioral biases
  - Generalize canonical optimal tax formulas
  - Sufficient statistics approach
- Now:
  - More structure: specific behavioral model, taxation motive
  - Concrete lessons for taxes

Modified Ramsey Inverse Elasticity Rule

- Representative agent with quasilinear utility

$$u(\boldsymbol{c}) = c_0 + \sum_{i>0} u^i(c_i)$$

- Misperception of taxes $\tau_i^s = m_i \tau_i$
- Limit of small taxes ($\Lambda = \lambda - 1$ small)

$$L(\boldsymbol{\tau}) = -\sum_i \frac{1}{2} (\tau_i^s)^2 \psi_i y_i + \Lambda \sum_i \tau_i y_i$$

where ψ_i rational demand elasticity, y_i expenditure with no tax

Modified Ramsey Inverse Elasticity Rule

- Behavioral elasticity $m_i \psi_i$
- Behavioral Ramsey formula

$$\tau_i = \frac{\Lambda}{m_i^2 \psi_i}$$

Proof: $\max_{\tau_i} \frac{-1}{2} m_i^2 \tau_i^2 \psi_i + \Lambda \tau_i$ gives $-m_i^2 \tau_i \psi_i + \Lambda = 0.\square$

- Contrast with traditional Ramsey:

$$\tau_i^R = \frac{\Lambda}{\psi_i}$$

Quantitative Illustration

- With heterogeneity, $\tau_i = \frac{\Lambda}{\mathbb{E}\left[{m_i^h}^2\right]\psi_i}$
- Taubinsky and Rees-Jones (2017) find:

$$\mathbb{E}\left[m^h\right] = 0.25$$

  and $var\left(m^h\right) = 0.13$, so that heterogeneity is very large, $\frac{var\left(m^h\right)}{\mathbb{E}[m^h]^2} = \frac{0.13}{0.25^2} = 2.1$.
- Take $\psi = 1$, $\Lambda = 1.25\%$, so $\tau = 7.3\%$.
- If tax was fully salient, optimal tax would be divided by 6
- If heterogeneity disappeared, optimal tax would be multiplied by 3.

Pigou: "Dollar for Dollar" Principle

- Representative agent with quasilinear utility
- One taxed good with price p and externality $-\xi c$
- Inattention to tax $\tau^s = m\tau$
- Welfare

$$W^{\text{social}} = U(c) - (p + \xi)\, c$$

- Consumer maximizes

$$W^{\text{private}} = U(c) - (p + m\tau)\, c$$

- Opimtal tax is $m\tau = \xi$, i.e.

$$\tau = \frac{\xi}{m}$$

- Modifies "dollar for dollar" Pigouvian principle
- Constrast with Ramsey: Pigou $\frac{1}{m}$ vs Ramsey $\frac{1}{m^2}$

Pigou: Quantitative Illustration

- Previous numbers by Taubinsky and Rees-Jones (2017)
- $\tau^* = \xi \frac{\mathbb{E}\left[m^h\right]}{\mathbb{E}\left[m^h\right]^2 + var\left(m^h\right)}$.
- With heterogeneity, $\tau^* = 1.3\xi$.
- If the tax became fully salient (i.e. $m^h = 1$), it would be divided by 1.3.
- If heterogeneity disappeared (i.e. $m^h = 0.25$), the optimal tax would be multiplied by 3.

Pigou: Taxes vs. Quantity Restrictions

- Traditional presumption that Pigouvian taxes dominate quantity restrictions because allow agents to express intensity of preferences
- Heterogeneity
  - misperception m_h
  - externality ξ_h
- Quasilinear + quadratic utility
  - bliss point c_h^*
  - "elasticity" $\Psi = -1/U_{cc}(c_h^*)$

Pigou: Taxes vs. Quantity Restrictions

- First Best achievable iff $\frac{\xi_h}{m_h}$ independent of h
- Optimal tax $\tau^* = E\left[\xi_h m_h\right] / E\left[m_h^2\right]$
- Alternatively, optimal quantity restriction $c^* = E\left[c_h^*\right]$
- Quantity restrictions better than taxation iff:

$$\frac{1}{\Psi} var\left(c_h^*\right) \leq \Psi \frac{E\left[\xi_h^2\right] E\left[m_h^2\right] - \left(E\left[\xi_h m_h\right]\right)^2}{E\left[m_h^2\right]}$$

1. enough heterogeneity in attention (m_h) or externality (ξ_h)
2. not too much heterogeneity in preferences (c_h^*)
3. if high demand elasticity (Ψ high) (cf. Weitzman).

Interactions between internalities and redistribution

- Good 1 is just consumed by agents of type h^* ("the poor"), $u^{h^*}(c) = c_0 + U_1^{h^*}(c_1) + U_{>1}^{h^*}(c_2, ..., c_n)$
- Good 1 has internality $\tau_1^{X,h} > 0$. E.g.: sugary sodas.
- Optimal tax:

$$\frac{\tau_1}{q_1} = \frac{\lambda + \gamma^{h^*}\left(\frac{\tau_1^{b,h^*}}{q_1}\psi_1 - 1\right)}{\lambda \psi_1}$$

- 2 forces:
- Internality correction: If $\gamma^h = \lambda$, $\tau^1 > 0$
- Redistribution: If $\gamma^h \gg \lambda$, and $\frac{\tau_1^{b,h^*}}{q_1}\psi_1 < 1$, $\tau_1 < 0$: good should be subsidized.
- So sign is ambiguous (cf Lockwood and Taubinsky '15)
- Internalities and redistribution: e.g. generally, you tax sugary sodas, except if consumed by agents with high welfare weights (the poor), who are not too biased.

Interactions between internalities and redistribution

- Optimal tax:

$$\frac{\tau_1}{q_1} = \frac{\lambda + \gamma^{h^*}\left(\frac{\tau_1^{b,h^*}}{q_1}\psi_1 - 1\right)}{\lambda\psi_1}$$

- Calibration following Lockwood and Taubinsky (2017)
- Cost of life of can of soda: $C = 12$ minutes
- So, $C^{\$} = \$1$
- With $\beta - \delta$ model, externality $\xi^{h^*} = (1-\beta)\, C^{\$} = \$0.35$.
- If no redistributive motive ($\frac{\gamma^{h^*}}{\lambda} = 1$), then $\tau_1 = \xi^{h^*} = \$0.35$
- If strong redistributive motive ($\frac{\gamma^{h^*}}{\lambda} = 1.5$), then for $\psi_1 = 0.2$, 1, 2, we find $\tau_1 = -\$0.5$, $\$0$, $\$0.2$

Optimal nudges

- Take $U^h(c) = \frac{a^h c - \frac{1}{2}c^2}{\Psi}$, nudge χ as a tax:

$$c^h(\tau,\chi) = c_0^h - \Psi\left(\chi\eta^h + m^h\tau\right)$$

- First, set $\tau = 0$. Optimal nudge:

$$\chi = \frac{E\left[\tau^{X,h}\eta^h\right]}{E\left[\eta_h^2\right]}$$

- Nudge is bigger when (i) it is well-targeted (high $E\left[\tau^{X,h}\eta^h\right]$), (ii) has low variance (low $E\left[\eta_h^2\right]$)
- For nudge literature: estimating variance of nudgeability is important!
- Nudges and taxes are substitutes ($\frac{\partial^2 L}{\partial\tau\partial\chi} < 0$) iff:

$$E\left[\left(\lambda - \gamma^h\left(1 - m^h\right)\right)\eta^h\right] > 0$$

- Typically, they are substitutes (if $m^h = 1$), but can be complements if the nudge reduces consumption of poor agent, and the good can be taxed.

Mental Accounts: Food stamps (SNAPs)

- Hastings and Shapiro (2017) find a high MPC_{Food} out of "SNAP money"
- Here's a model + way to think about optimal policy.
- Take good 1 = food, and

$$u^s(c_1, c_2) = c_1^{\alpha_1^s} c_2^{\alpha_2^s}, \qquad u(c_1, c_2) = c_1^{\alpha_1} c_2^{\alpha_2},$$

  with $\alpha_1^s < \alpha_1$: agent would spend too little on food
- Government gives voucher b (which has to be spent on food) and general transfer t
- Income is $w = w^* + t + b$
- But default food expenditure is: $\omega_1^d = \alpha_1^s w + \beta b$
- Mental accounting: perceived budget is: $c_1 + c_2 + \kappa_1 \left| c_1 - \omega_1^d \right| = w$, true budget is $c_1 + c_2 = w$
- Outcome: if κ_1 large enough, $c_1 = \omega_1^d = \alpha_1^s (w^* + t + b) + \beta b$, and so the marginal propensity to consume food (MPCF) out of the voucher is larger than out of a general transfer ($\alpha_1^s + \beta$ vs. α_1^s).

Other Applications

- Do more mistakes by the poor lead to more redistribution?
  - Not necessarily, if they "misuse" their transfers
- Internalities and redistribution: if the poor consume a lot of sugary sodas, should you tax sugary sodas?
  - You won't tax sodas if: elasticity of demand is low, and social welfare weight on the poor is high
- Nudges
  - Nudges and taxes typically substitutes, except if strong redistributive motives
  - More powerful nudges for high-internality people $\rightarrow$ more nudges, fewer taxes
  - "Nudge the poor, tax the rich": nudges are better for the poor (e.g. don't tax sodas, nudge the poor away from them)
- Modification of "principle of targeting"

Mirrlees problem: Nonlinear income tax

- General behavioral biases with non-linear income tax $T(z)$
- Behavioral Saez (2011) formula
- Sufficient statistics
  - traditional: elasticity of labor supply, welfare weights, hazard...
  - behavioral: misoptimization wedge, behavioral cross-influence

Mirrlees problem: Labor supply

- Let's think about the non-linear labor supply with misperception
- Tax $T(z)$ given income z, so disposable income $R(z) = z - T(z)$
- Rational model: with wage w

$$\max_L u(R(wL), L)$$

$$R'(wL) w u_c + u_L = 0$$

at $(c, L) = (R(wL), L)$
- With misperception of the tax:

$$R'^s(wL) w u_c + u_L = 0$$

at $(c, L) = (R(wL), L)$.
- For instance,

$$R'^s(z) = mR'(z) + (1-m)\left(1 - \tau^d\right)$$

Saez-like formula

$$\frac{T'(z^*) - \tilde{\tau}^b(z^*)}{1 - T'(z^*)} + \int_0^\infty \omega(z^*, z) \frac{T'(z) - \tilde{\tau}^b(z)}{1 - T'(z)} dz$$

$$= \frac{1}{\zeta^c(z^*)} \frac{1 - H(z^*)}{z^* h^*(z^*)} \int_{z^*}^\infty e^{-\int_{z^*}^z \rho(s) ds} \left(1 - g(z) - \frac{\eta \tilde{\tau}^b(z)}{1 - T'(z)}\right) \frac{h(z)}{1 - H(z^*)}$$

where $\rho(s) = \frac{\eta(z)}{\zeta^c(z)} \frac{1}{z}$ and

$$\omega(z^*, z) = \frac{\zeta^c_{Q_{z^*}}(z) - \int_{z^*}^\infty e^{-\int_{z^*}^{z'} \rho(s) ds} \rho(z') \zeta^c_{Q_{z'}}(z)\, dz'}{\zeta^c(z^*)} \frac{z h^*(z)}{z^* h^*(z^*)}.$$

Original Saez: $\tilde{\tau}^b(z) = \zeta^c_{Q_{z'}} = \omega(z^*, z) = 0$

Mirrlees-Saez: Some Applications

- Nonzero taxes at top and bottom (bounded log skills)
- Behavioral Saez top tax formula (unbounded skills)
- Possibility of negative marginal income tax rates:
  - Rationalization of EITC if the poor undervalue the benefits of work (see also Lockwood JMP).
- Schmeduling (Liebman and Zeckhauser 2004): confusion of average for marginal tax rates

Additional General Results (see paper)

- **Endogenous attention**
  - Taxes are lower when attention is endogenous (typically, for Ramsey)
  - Attention as a good, discuss sub/optimal attention
- **Salience as policy choice: Government prefers:**
  - low salience to raise taxes
  - high salience to correct for externalities.

Additional General Results (see paper)

- **Diamond-Mirrlees (1971):**
  - Traditional: productive efficiency (ex. no taxes on intermediate goods) if complete set of taxes on final goods
  - Behavioral: productive efficiency if complete set of *salient* taxes on final goods
  - In both cases, no productive efficiency $\rightarrow$ supply elasticities matter
- **Atkinson-Stiglitz(1972):**
  - Traditional: uniform commodity taxation if homogenous preferences
  - Behavioral: not true anymore in general, e.g. tax more obscure goods and sin goods.

Conclusion

- Traditional optimal taxation theory:
  - general using traditional price theory
  - unification $\rightarrow$ tax formulas with sufficient statistics
  - concrete lessons
- Behavioral optimal taxation theory:
  - general using behavioral price theory
  - unification $\rightarrow$ tax formulas with old and new sufficient statistics
  - new concrete lessons

This is a lively field

- This a lively field
- Taubinsky and Rees-Jones "Measuring schmeduling": measurement of perception of the income tax
- Related literature: optimal taxation with hyperbolic agents
  - Ex: Amador, Werning, Angeletos, ECTA 2006. "Commitment vs. Flexibility
    - They find that a "minimum savings" is part of a solution.
  - There are lots of papers in that vein. The hyperbolic framework is accepted for sophisticated work
  - Likely, more general forms of attention seem promising: again, hyperbolic discounting i myopia about the whole future; but in practice, there's also myopia about some specific parts of the future.

This is a lively field: Open questions

- Open question: For dynamic problems with inattention.
- Take just goods taxes, with $\tau^s = m\tau + (1-m)\,\tau^d$. But do it dynamically
  - Initially, maybe $\tau^d = 0$. But in the long run, τ^d will increase (say towards τ).
  - What's the optimal dynamic strategy then?
- Optimal taxation of capital / labor.
  - A likely result: if people don't pay much attention to the real rate of return when choosing their labor supply (sounds plausible), then taxing capital is a good thing.
  - It's worth working out.
  - ... and finding evidence on this.