Ramsey Asset Taxation
Under Asymmetric Information

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Objective

- Consider competitive (Walrasian) asset/insurance markets with moral hazard (hidden effort)
  - Agents can trade in markets for contingent claims
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  - Agents' trades are non-observable (*non exclusivity*)
- Study optimal taxation of capital and assets, when government only observes net aggregate trades in each market (less than insurance firms)
- Examine properties of attainable allocations and optimal taxes, and how they vary with:
  - severity of moral hazard

  $\Longrightarrow$ whether private insurance attainable by trading in markets
  - information available to government over income shocks' realizations

  $\Longrightarrow$ whether public insurance can be provided

Outline

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  $\Rightarrow$ anonymous and linear taxes on asset trades

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  $\Rightarrow$ anonymous and linear taxes on asset trades
- Taxes only present to enhance incentives.
- *Optimal tax on capital*:
  i) when no insurance can be provided, $\tau_k^* = 0$
  ii) when only public insurance can be provided, $\tau_k^* > 0$
  iii) when private insurance can be obtained, sign of τ_k^* depends on claims traded in equilibrium

Outline

- Complementarity between the role of markets and government (via its taxes).
  (may have nonzero trades in assets at an optimum)

- Identify conditions under which constrained efficient allocations can be decentralized, but study also situations where they cannot.

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  - b. government provides insurance (state contingent lump sum transfers)
  - c1. tax on asset returns depends on ex post realization of individual states (K)
  - c2. or tax on ex post income depends on asset portfolio (AS, GT)

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- Insurance with nonobservable trades:
  i. optimal contracts: Cole-Kocherlakota 2001, Abraham-Pavoni 2008a-b, Bisin Rampini 2007
  ii. competitive equilibria with anonymous trades in all markets: Bisin-Gottardi 1999

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- Possibility of taxing trades only considered in ii. by Bisin-Geanakoplos-Gottardi-Minelli-Polemarchakis (2011).
- Golosov-Tsyvinski 2007: consider primary (exclusive) insurance and secondary (nonexclusive) bond markets
  show that equilibria can be welfare improved, using same information
  do not consider taxes on trades

Basic Economy

Here: 2-period economy, only idiosyncratic risk

- Consumers: continuum, ex-ante heterogeneity (also to capture past histories): $h = 1, .., H$:
  - endowments: y_0^h at date 0, $\tilde{y}_1^h$ at date 1,
  $\tilde{y}_1^h$ independent across all consumers, with support
  $y_1^h < ... < y_S^h$
  $\pi_s(e) := \Pr\left\{\tilde{y}_1^h = y_s^h \,\middle|\, e\right\}$ for $e \in E$
  - additive separable preferences:

$$u(c_0) + \beta \sum_{s=1}^{S} \pi_s\left(e\right) u(c_s) - v\left(e\right)$$

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- Firms:
  - produce good at date 1 with technology $F(k)$,
  - trade in the asset market (for insurance and credit)

Asset Markets

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ii) - claims contingent on each individual state $(h, s) \in H \times S$: (Standardized securities)

- individual effort e private information to the agent, while the realization of individual state (h, s) is observable by his 'trading partners': moral hazard

- prices linear in trades (individual trades not observable, non exclusivity),
  with different price for buying $(+)$ and selling (-): $q^{+}_{h,s}$, $q^{-}_{h,s}$
  (needed for viability of markets, Bisin-Gottardi ('99))

Taxes and Government Information

No public production or consumption.

- Linear, anonymous taxes on trades of each of the existing assets: τ_k, $\tau_{h,s}$ for each h, s
  (government can only observe consumers' aggregate net trades in each market)

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- Lump sum taxes/transfers
  Their specification depends on Government Information.
  Consider two cases:

  i) Gov't observes individual type and shock realization: T_0^h, $T_{1,s}^h$
  gov't has same information as private market participants, can provide insurance (as primary, public insurance scheme)

Taxes and Government Information, cts.

ii) Gov't does not observe individual type and income history: $T_0^{\sigma(h)}$, $T_{1,\sigma(s)}^{\sigma(h)}$, depend on consumers' reporting over h, s

Lemma 1 (NO PUBLIC INSURANCE) When government is unable to observe individual states h, s, consumers' reporting strategies are truthful in equilibrium if and only if:

$$\begin{aligned} T_{1s}^h &= T_1^h \text{ for all } s, h \\ T_0^h + q(1+\tau_k)T_1^h &= T_0^{h'} + q(1+\tau_k)T_1^{h'} \text{ for all } h, h' \end{aligned}$$

Proof: (similar to Allen ('85) and Attanasio & Pavoni ('10))

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Proof: (similar to Allen ('85) and Attanasio & Pavoni ('10))
- If T_{1s}^h is not s-invariant, a consumer would lie and always report the state with the highest value of T_{1s}^h.
- Symmetrically, since consumers are free to transfer (deterministic) income between dates 0 and 1 at the price $q(1+\tau_k)$, they are indifferent between any transfer with the same present discounted value $T_0^h + q(1+\tau_k)T_1^h$. QED

Household h choice problem

$$U^h(T,\tau) := \max_{c,e^h,\theta^h,\{a_{h,s},b_{h,s}\}_s} \quad u\left(c_0^h\right) + \beta \sum_{s=1}^{S} \pi_s\left(e^h\right) u\left(c_s^h\right) - v\left(e^h\right)$$

s.t.

$$\begin{aligned} c_0^h &= y_0^h - (1+\tau_k)\, q\theta^h - \sum_{s=1}^{S} (1+\tau_{h,s}) \left(q_{h,s}^{+} a_{h,s} - q_{h,s}^{-} b_{h,s}\right) + T_0^h + \Pi \\ c_s^h &= y_s + \theta^h + a_{h,s} - b_{h,s} + T_{1,s}^h \end{aligned}$$

- Firm's choice problem

$$\max_{k,\theta^f,\{a_s^f,b_s^f\}_s} \Pi = \frac{1}{H}\sum_{h,s}\left(q_{h,s}^{+}a_{h,s}^{f} - q_{h,s}^{-}b_{h,s}^{f}\right) - k - q\theta^f$$

$$\text{s.t.} \qquad F(k) \geq \frac{1}{H}\sum_{s,h}\left(\pi_s\left(\hat{e}_s^{h+}\right)a_{h,s}^{f} - \pi_s\left(\hat{e}_s^{h-}\right)b_{h,s}^{f}\right) - \theta^f$$

with $\hat{e}_s^{h+}(\hat{e}_s^{h-})$ firm's conjecture over the effort level undertaken by type h agents whenever they buy (resp. sell) a claim contingent on s

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- Government budget constraint:

$$\frac{1}{H}\sum_h\left[\tau q\theta^h - T^h_0 + \sum_s\left(\tau_{h,s}\left(q^+_{h,s}a_{h,s} - q^-_{h,s}b_{h,s}\right) - q\pi_s\left(e^h\right)T^h_{1,s}\right)\right] = 0$$

Competitive Equilibrium (C.Eq.)

Def.: A symmetric C.Eq. with taxes $\tau_k, \left(T_0^h, T_{1,s}^h, \tau_{h,s}\right)_{h,s}$ is: prices of claims, consumers' and firms' optimal choices such that markets clear:

$$\begin{array}{r} a_{h,s}^f = a_{h,s} \\ b_{h,s}^f = b_{h,s} \end{array} \quad \text{for all } h, s$$

$$\theta^f + \frac{1}{H}\sum_h \left(\theta^h + \sum_s \pi_s\left(e^h\right) T_{1,s}^h\right) = 0$$

gov't budget constraint is satisfied, and
firms' conjectures are correct (for traded claims):

$$\begin{aligned} q_{h,s}^+ &= q\pi_s\left(\bar{e}^h\right) \text{ if } \bar{a}_{h,s} > 0 \\ q_{h,s}^- &= q\pi_s\left(\bar{e}^h\right) \text{ if } \bar{b}_{h,s} > 0 \end{aligned}$$

Competitive Equilibrium: properties

- Will consider C.Eq. with 'pessimistic' conjectures for non traded claims:

$$
\begin{aligned}
q_{h,s}^{+} &= q \max_{e \in E} \pi_s(e) \ \text{ if } \bar{a}_{h,s} = 0 \\
q_{h,s}^{-} &= q \min_{e \in E} \pi_s(e) \ \text{ if } \bar{b}_{h,s} = 0
\end{aligned}
$$

- From Bisin Gottardi ('99) it follows that existence holds if allow for asymmetric behavior of consumers.

We study symmetric equilibria
Will provide sufficient conditions for existence of symmetric equil.

What we do

1. We investigate the properties of *Ramsey allocations* (RA): tax schemes such that associated competitive equilibrium maximizes $\sum_h \lambda_h U_h$ for given welfare weights λ_h

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1. We investigate the properties of *Ramsey allocations* (RA): tax schemes such that associated competitive equilibrium maximizes $\sum_h \lambda_h U_h$ for given welfare weights λ_h
2. Relate them to Constrained Efficient allocations (C.Eff.): maximize $\sum_h \lambda_h U_h$, subject to:
   i) resource feasibility and
   ii) IC constraints:
   iia) Observable individual states:

$$e^h \in \arg\max_e \quad u\left(c_0^h\right) - v\left(e\right) + \beta \sum_s \pi_s\left(e\right) u\left(c_s^h\right)$$

   iib) Non observable individual states: $\left[e^h, id\left(h\right), id\left(s\right)\right] \in$

$$\arg \max_{e,\sigma_1(h),\sigma_2(s)} \quad u\left(c_0^h + \left(c_0^{\sigma(h)} - c_0^h\right) - \left(y_0^{\sigma(h)} - y_0^h\right)\right) - v\left(e\right) +$$

$$+\beta \sum_s \pi_s\left(e\right) u\left(c_s^h + \left(c_{\sigma_2(s)}^{\sigma_1(h)} - c_s^h\right) - \left(y_{\sigma_2(s)}^{\sigma_1(h)} - y_s^h\right)\right)$$

Ramsey Allocations and Constrained Efficiency

Proposition 0: When gov't can observe individual states, RA are Incentive Feasible for the planner (necessity). When it cannot, markets may do more.

- When RA are C.Eff., we provide conditions for simple implementation of 'known' allocations (sufficiency, FO approach).
  This is similar to the exercises in the NDPF literature

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- When RA are C.Eff., we provide conditions for simple implementation of 'known' allocations (sufficiency, FO approach).
  This is similar to the exercises in the NDPF literature
- When RA are not C.Eff., we study the properties of optimal simple taxes and of RA in this case.
  This contrasts to the approach adopted in the NDPF literature. It typically complicates taxes to get C.Eff.

Available Insurance Markets: Full controllability

We also consider various specifications of severity of moral hazard: properties of the map $e \longrightarrow \pi_s$

Definition 1 : (π, E) displays full controllability if:
for each $s \in S$ there is $\hat{e} \in E$ such that $\pi_s(\hat{e}) = 1$
(Mirrlees framework)

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Lemma 2 : *Under full controllability, if $u(.)$ is unbounded above, no contingent claim is ever traded at a competitive equilibrium, only the bond.*

Proof: no arbitrage on contingent claims vs. bond requires:

for all h, s : $\quad (1+\tau_{h,s})q^{-}_{h,s} \leq (1+\tau_k)q \quad$ and $\quad (1+\tau_{h,s})q^{+}_{h,s} \geq (1+\tau_k)$

Full controllability and NO govt. insurance

Proposition 1: *i) Under full controllability, and deterministic lump sum transfers, if a (symmetric) C.Eq. with zero taxes* $(\tau, T) = 0$ *exists, it is C.Eff.*
ii) *If u is NIARA and* $\pi(\cdot)$ *has log-convex DF, or if* $F(.)$ is linear, *a symmetric C.E. exists for all* τ.

Corollary: *Under the above conditions, 'absent distributional issues', the optimal tax on the bond is zero:* $\tau_k^* = 0$.

- Message: No insurance possibility available (only self-insurance).
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- No reopening of markets hence no pecuniary externalities (in contrast with, e.g., Davila et al. ('05), Gottardi et al. ('09))
- Concavity of agents' problems suffices for existence (Abraham, Koehne, and Pavoni ('10))

Full controllability + govt. insurance

Propositions 2: Assume *full controllability, state contingent lump sum transfers are feasible,*

i) *If* u *is NIARA and* $\pi(\cdot)$ has log-convex DF, *when* $\lambda^h = \lambda$ for all h *C.Eff. allocations (second best) can be decentralized as a C.Eq. with* $\tau_k^* > 0$.

ii) If IC binds only wrt one effort level and u is NIARA, *at a RA we have* $\tau_k^* > 0$.

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Remarks: FOC for a C.Eq. with taxes are again the same as FOC for a C.Eff. allocation, joint deviations in effort and trades in the riskless bond are now more problematic.
IC binds here, tax helps to sustain incentives since insurance is attained here at a C.Eq.

A Ramsey allocation: solves

$$\max_{c_0^h,\{c_s^h\}_s,\tilde{q},\hat{\theta}^h,e^h} \quad \sum_h \lambda^h \left[u(c_0^h) + \sum_{s=1}^{S} \pi_s\left(e^h\right)\beta u(c_s^h) - v\left(e^h\right)\right],$$

s.t. for all h

$$u'(c_0^h)\tilde{q} = \sum_{s=1}^{S} \pi_s\left(e^h\right)\beta u'(c_s^h)$$

$$u(c_0^h) + \beta \mathbb{E}_{\pi(e^h)} u(c_1^h) - v\left(e^h\right) \geq u(c_0^h - \tilde{q}\hat{\theta}^h) + \beta \mathbb{E}_{\pi(\hat{e}^h)} u(c_1^h + \hat{\theta}^h) - v\left(\hat{e}^h\right)$$

$$u'(c_0^h - \tilde{q}\hat{\theta}^h)\tilde{q} = \sum_{s=1}^{S} \pi_s\left(\hat{e}^h\right)\beta u'(c_s^h + \hat{\theta}^h)$$

$$\sum_h \left(y_0^h - c_0^h\right) - k \quad \geq \quad 0$$

$$\sum_{s,h} \pi_s\left(e^h\right)(y_s^h - c_s^h) + F(k) \quad \geq \quad 0$$

Remarks

1. Differently from the case of non anonymous trades, can only ensure decentralization of C.Eff. when FO approach holds (same conditions as previous case).
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2. Positive tax on riskless bonds/capital: allows to make (deviations in (i) and) in (ii) joint deviations (to other effort levels and higher savings) less desirable (sign depends on sign of $\hat{\theta}^h$)
3. The level of tax is limited in order to prevent the agents who comply from borrowing

No controllability

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- Market for contingent claims may now be active
- Insurance also attainable in the market

NO controllability + govt. insurance

Main Message: Positive tax on insurance ...

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Proposition 3: *Under no controllability, with state contingent lump sum transfers, when* $\lambda^h = \lambda$ for all h *C.Eff. (second best) allocations can be decentralized as competitive equilibria:*
(i) always when there is no market for the riskless bond (separate from contingent claims).
(ii) whenever the consumer's choice problem at the supporting prices and taxes is concave.
Then: $sign(\tau_s^{h*}) = sign\left(\frac{\pi_s(\hat{e}^h)}{\pi_s(e^{h*})} - 1\right)$ and $\tau_k^* = \sum_s \pi_s(e^{h*})\tau_s^{h*} > 0$.

Likelihood ratio affects the pattern of consumption across states at second best and hence the tax on contingent claims.
Supporting prices and taxes here depend on the pattern of trades

NO controllability + govt. insurance

Proposition 4: *Under no controllability, with state contingent lump sum transfers, if $S = 2$, IC binds only wrt one effort level and u is* NIARA, *then either (i)* $\frac{1+\tau_k^*}{1+\tau_H^*} > 1$ *and* $\tau_k^* > 0$, *or (ii)* $\frac{1+\tau_k^*}{1+\tau_L^*} < 1$. *In case (ii), if u is CARA* $\tau_k^* < 0$ *(subsidy).*

Here tax on capital depends then on available assets
In case (i): deviation by selling claim contingent on high state ($\hat{a}_H > 0$) and buying bond ($\hat{\theta} \geq 0$).
In (ii): $\hat{b}_L > 0$ and $\hat{\theta} \leq 0$.

NO controllability and NO govt. insurance

- With only deterministic lump sum transfers, insurance only attainable via the market.
- Optimal taxes now also ease trades in the markets for contingent claims: RA may obtain at C.Eq. with nonzero trades in markets.

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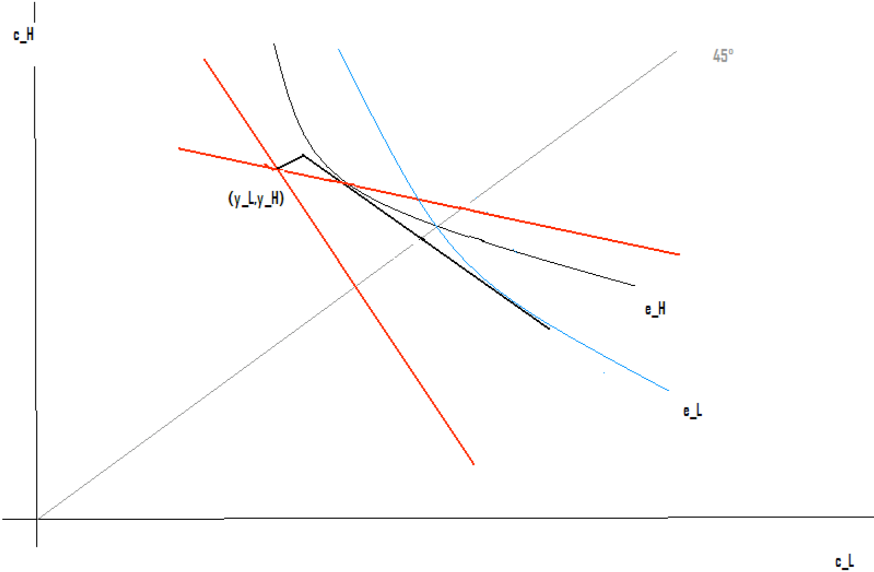
Remark Second best can only be decentralized with nonzero trades when the agents' choice problem at the supporting prices and taxes (not very likely because with nonzero trades tangency condition holds)

NO controllability and NO govt. insurance

- With only deterministic lump sum transfers, insurance only attainable via the market.
- Optimal taxes now also ease trades in the markets for contingent claims: RA may obtain at C.Eq. with nonzero trades in markets.

Remark Second best can only be decentralized with nonzero trades when the agents' choice problem at the supporting prices and taxes (not very likely because with nonzero trades tangency condition holds)

$\Longrightarrow$ Next Slide: Example illustrating that interaction between markets and government intervention enhances insurance possibilities and efficiency of allocations: RA with nonzero trades and taxes


c_H
45°
(y_L,y_H)
e_H
e_L
c_L

Summary and Conclusions

- We study optimal linear taxation of asset trades (Ramsey) in presence of moral hazard and limited gov't information
- Messages:
  1. When agents' problems are concave at the supporting prices and there are no distributional issues, Ramsey allocations are Constrained Efficient (except when insurance only provided by markets)
  2. Capital taxes (distortions) are motivated by need to enhance incentives when insurance is attained at Ramsey allocataions
  3. The sign of capital tax depends on the whole set of assets available to the agents: typically $\tau_k^* > 0$ but we have cases where $\tau_k^* < 0$ (if other securities delivering insurance are traded)
  4. When insurance is only provided by markets Ramsey allocations exhibit nonzero trade