Contracting with Diversely Naïve Agents

Kfir Eliaz & Ran Spiegler

Miguel Acosta[2]

Behavioral Economics w/ Mark Dean

October 2017

[2] With material taken from Silvio's slides marked with a †.

Outline

Introduction

Model

Results

Motivation

- Contracting with heterogeneous agents.
- Agents identical in preference in cost parameters.
- Different in their ability to forecast their future selves; they have a *time inconsistency problem*.
- Principal can exploit agents since she knows the truth; i.e., the principal and agent do not share a *common prior*.

Outline

Key Features of the Model

- Agents utility changes over time
  - First period utility: u
  - Second period utility: v
- Agent *believes* that second period utility
  - is v w.p. θ
  - is u w.p. $1-\theta$
- The higher θ is, the more naïve the agent is.
- The principal knows the truth. So, she can use this to extract the most surplus out of every type.
- Future actions evaluated according to (expected) u.

Toy Example

- Imagine two agents, Mark (sophisticated) and Miguel (naïve). They have identical utilities:

$$u = \begin{cases} \$6 & \text{First gamble} \\ -\$\infty & \text{Further gambles} \end{cases}$$
$$v = \$5 \text{ Second, third, ..., gambles}$$

- The casino knows this. Mark knows this. Miguel doesn't. The casino offers two options
  1. First gamble free! 10 more gambles for \$49.99
  2. All gambles \$6
- Miguel chooses the first. Mark chooses the second.
- Raises the issue that there's some "preferred" utility ex-ante. When this is over, Miguel gets utility of \$6.01, Mark gets \$0. From the "preferred" point of view, Miguel gets $\$\infty$, and Mark gets \$0. Here, it's expected u utility.

More on the Model

- Principal offers agent the opportunity to choose an action $a \in [0,1]$ (cost of providing the action to the principal is $c(a)$).
- Contracts are transfers from the P to the A: $t : \{a : a \in [0,1]\} \to \mathbb{R}$.
- Quasi-linear utility over transfers and actions (transfers are the linear part). Define

$$a^v \equiv \underset{a}{\operatorname{argmax}}[v(a) - t(a)]$$

$$a^u \equiv \underset{a}{\operatorname{argmax}}[u(a) - t(a)]$$

- Agent maximizes first-period expected utility, defined as:

$$\theta[u(a^u) - t(a^u)] + (1-\theta)[u(a^v) - t(a^v)]$$

- Revelation principle implies that the principal's problem (maximizing profits) is equivalent to finding the optimal contracts, $\{t_\theta(a)\}_{\theta \in [0,1]}$, since agents will reveal their types.

Principal's Problem †

Maximization problem to obtain the optimal menu of contracts:

$max_{t_\theta(a)} \int_0^1 [t_\theta(a_\theta^v) - c(a_\theta^v)]dF(\theta)$

subject to

$IR_\theta \qquad \theta[u(a_\theta^u) - t_\theta(a_\theta^u)] + (1-\theta)[u(a_\theta^v) - t_\theta(a_\theta^v)] \geq 0$

$IC_{\theta,\phi} \qquad \theta[u(a_\theta^u) - t_\theta(a_\theta^u)] + (1-\theta)[u(a_\theta^v) - t_\theta(a_\theta^v)] = U(\theta,\theta) \geq U(\phi,\theta)$

for all types ϕ and the (predicted) optimal actions are

$UR_\theta \qquad a^u = argmax_a[u(a) - t_\theta(a)]$

$VR_\theta \qquad a^v = argmax_a[v(a) - t_\theta(a)]$

Outline

Threshold level for exploitative contract †

The type space can be partitioned into two intervals: (relatively) sophisticated and (relatively) naive agents. Only the latter are exploited (the principal extracts more than the agent's WTP).

There exists a type $\bar{\theta}$ such that for every $\theta > \bar{\theta}$ the contract is exploitative, while for every $\theta < \bar{\theta}$ the contract is not exploitative. Moreover, w.l.o.g., there is a unique non-exploitative contract $t(a^*) = u(a^*)$ and $t(a') = \infty$ for every $a' \neq a$.

As long as $max_a[u(a) - c(a)] > 0$ (i.e. there is a positive surplus in the interaction with fully sophisticated agents), the optimal menu does not exclude any type.

Optimum

- Separating equilibrium: Sophisticated types choose contracts that accord with u, and naïve types choose exploitative contracts (in the sense of the preferred utility)
- As $\theta \uparrow$ (more naïve)
  - Principal profit $\uparrow$
  - Transfer associated with imaginary action[3] $\downarrow$
  - First-period net utility $\downarrow$.

[3] The action you think, ex-ante, will happen, but doesn't when the time comes

Three examples †

- **Credit card teaser rates**
  - The second period self is tempted to increase the consumption level
  - The non-exploitative contract charges a prohibitively high rate for $a > \frac{1}{2}$
- **Negative option offers**
  - Reference point effect: difference between choosing and canceling a contract
  - The optimal menu contains a single exploitative contract
  - Low types opt out
- **Casino players' clubs**
  - Consumption (gambling) increases the satiation point.
  - A non exploitative contract represents a commitment device
  - An exploitative contract contains a gift component that the principal uses to attract naive customers

Alternative models I †

- **Restore time consistency, maintain biased beliefs**
  - Agents evaluate second period actions according to the state dependent utility function u or v
  - The principal can no longer offer agents a commitment device
  - The optimal menu may exclude some types
- **Restore common priors, maintain time inconsistency**
  - Now θ is the objective probability (common prior)
  - The optimal menu consists of a single contract: $t(a^*) = u(a)$ and $t(\cdot) = \infty$
  - No discrimination, hence no space for exploitation

Alternative models II †

- **Heterogeneity in stability of preferences**
  - Each agent is characterized by a pair (θ, p) (subjective and objective probability of taste change)
  - p is not observable, the principal beliefs (θ, p) is distributed on $[0, 1]^2$ based on a joint cdf
  - Both the "final" actions have a positive probability, hence smaller probability to try exploiting the agent (as in the casino example)
  - Higher cutoff; higher to solve.
- **Alternative notions of partial naivete**
  - O'Donoghue and Rabin (2001): time-inconsistent (β, δ) framework, a naive agent believes that her present bias is given by $\hat{\beta} \in (\beta, 1)$
  - Loewenstein, O'Donoghue and Rabin (2003): same two-periods framework of this paper, naive agent believes that her second period utility will be w, that is between u and v (magnitude change instead of probability of change)