Competition and Incentives with Motivated Agents

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- Organization design for provision of collective goods (schools, hospitals etc).

- Most of the existing debates focus on public versus private provision/ownership.

- We suggest an alternative approach which focuses on two key issues:
  - How to structure incentives
  - Role of competition between providers

Three Key Ideas

- Motivated Agents
  - Often people care about the level and quality of the good or service they provide, independent of any monetary rewards
  - There are many examples:
    * Doctors who care about patient health
    * Teachers who are about educating future citizens
  - Such preferences are natural with collective goods as the benefits/costs are not internalized in the firm's profit.
  - However, even with private goods one can have "professional pride"
  - Not career concern type of rewards

Three Key Ideas (continued)

- Mission-orientation
  - Two motivated individuals can have very different mission-preferences (e.g., whether to have a religious component in education).
  - Collective goods production whether in the public or private sectors is typically mission driven:
    - Literature on public bureaucracies (James Q. Wilson)
    - Literature on non-profit organizations/charities.
  - Missions replace profit-orientation in this context.

Three Key Ideas (continued)

- Matching
  - The role of competition in mission-oriented production is to sort principals and agents by mission preference.
  - Decentralized provision permits autonomous creation of diverse missions.
  - This economizes on the need for monetary incentives and increases productivity

Aim of the Paper

- To develop a simple and tractable model of incentives and competition where agents differ in terms of motivation & mission preferences
  - Compensating differentials (Rosen) literature: wage, occupational choice can depend on taste-differences
  - This paper: how taste-differences can economize on need to give monetary incentives & importance of non-pecuniary aspects of orgn. design
  - The model could apply equally well to public or private organizations.

- The model can be used to contrast incentives in mission-oriented and (traditional) profit-oriented production.
  - The role of competition developed here is quite different (when everyone is greedy matching is not so important).

- To develop applications of these ideas to real-world mission-oriented organizations
  - School competition
  - Organization of non-profits
  - Incentives in the public sector.

The Model

- A firm consists of a risk neutral principal & a risk neutral agent who is needed to carry out a project.

- The project's outcome is high ($Y_H = 1$) or low($Y_L = 0$) .

- The probability of the high outcome is the effort supplied by the agent, e, at a cost $c(e) = e^2/2$.

- Effort is unobservable and hence non-contractible.

- The agent has no wealth which can be used as a performance bond.

- Minimum consumption constraint of $\underline{w} \geq 0$ every period.

- Moral hazard problem bites due to this & is the ONLY informational/contractual imperfection in our model.

- Principal and agent can obtain an autarky payoff of zero.

- Projects differ in terms of their missions.

- Mission: attributes of a project that make some principals & agents value its success over & above any monetary income they receive in the process. Could be based on:

  - what the organization does (charitable versus commercial)

  - how they do it (environment-friendly or not)

  - who is the principal (kind and caring versus strict profit-maximizer) etc.

- Mapping from effort to outcome is same for all projects
- Agents have the ability to work on any project
- Basic model: missions are exogenously given attributes of a project associated with a given principal.
- Three *types* of principals and agents labelled $i \in \{0, 1, 2\}$ and $j \in \{0, 1, 2\}$
- If project successful, a type i principal receives $\pi_i > 0$. If project fails, receives 0.
- For type 0 principals, payoff is entirely monetary
- For type 1 & 2 principals, payoff may have a non-monetary component. Assume $\pi_1 = \pi_2 \equiv \hat{\pi}$ to focus on horizontal sorting.

- Like principals, all agents are assumed to receive 0 if the project fails.

- Agents of type 0 have standard pecuniary incentives.

- An agent of type 1 (type 2) receives a non-pecuniary benefit of $\overline{\theta}$ from project success if he works for a principal of type 1 (type 2) & $\underline{\theta}$ if matched with a principal of type 2 (type 1), where $\overline{\theta} > \underline{\theta} \geq 0$. *Motivated* agents.

- The payoff of an agent of type j who is matched with a principal of type i when the project succeeds can be summarized as:

$$\theta_{ij} = \begin{cases} 0 & i = 0 \text{ and/or } j = 0 \\ \underline{\theta} & i \in \{1,2\}, j \in \{1,2\}, i \neq j \\ \overline{\theta} & i \in \{1,2\}, j \in \{1,2\}, i = j. \end{cases}$$

- Economy is divided into a *mission-oriented sector* ($i = 1, 2$) & a *profit-oriented sector* ($i = 0$).

Optimal Contracts

- Optimal contract for an exogenously given match of a principal of type i & an agent of type j.

- Two components: a *fixed* wage w_{ij} paid regardless of project outcome & a bonus b_{ij} if outcome is Y_H.

- Take agent's reservation payoff $\overline{u}_j \geq 0$ as exogenously given (endogenize later)

- **First-best** (effort contractible). Solve

$$\max_{e_{ij}} \left(\pi_i + \theta_{ij}\right) e_{ij} - \frac{1}{2} e_{ij}^2.$$

  - effort: $\pi_i + \theta_{ij}$

  - expected joint surplus: $\frac{1}{2}(\pi_i + \theta_{ij})^2$.

- **Second best.** Solve:

$$\max_{\{b_{ij},w_{ij}\}} u_{ij}^{p} = \left(\pi_i - b_{ij}\right) e_{ij} - w_{ij} \qquad (1)$$

subject to:

(i) *limited liability constraint* (LLC):

$$b_{ij} + w_{ij} \geq \underline{w}, w_{ij} \geq \underline{w}. \qquad (2)$$

(ii) *participation constraint* (PC):

$$u_{ij}^{a} = e_{ij}\left(b_{ij} + \theta_{ij}\right) + w_{ij} - \frac{1}{2}e_{ij}^{2} \geq \overline{u}_j. \qquad (3)$$

(iii) *incentive-compatibility constraint* (ICC):

$$\begin{aligned} e_{ij} &= \arg\max_{e_{ij}\in[0,1]} \left(e_{ij}\left(b_{ij} + \theta_{ij}\right) + w_{ij} - \frac{1}{2}e_{ij}^{2}\right) \\ &= b_{ij} + \theta_{ij} \end{aligned} \qquad (4)$$

- **Effort** less than first-best level $\pi_i + \theta_{ij}$, otherwise principal earns negative expected payoff

- $\overline{v}_{ij} \equiv$ value of reservation payoff of an agent of type j s.t. a principal of type i gets zero expected profits under an optimal contract

- $\underline{v}_{ij} \equiv$ value of reservation payoff such that for $\overline{u}_j \geq \underline{v}_{ij}$ the agent's PC binds.

- For *a given reservation payoff* $\overline{u}_j \in \left[0, \bar{v}_{ij}\right]$ an optimal contract exists.

- Fixed wage is set at subsistence level $\underline{w}$ (no risk sharing issues, & has no effect on incentives). Anything else is paid as a bonus

- Due to limited liability in choosing b principal faces trade-off between providing incentives to agent (b higher) & transferring surplus from agent to himself (b lower).

- Accordingly, reservation payoff of agent plays an important role in determining b (higher it is, the higher is b)

- Agent motivation plays a role as well in the choice of b: for same level of b, an agent with greater motivation will supply higher effort.

- To principal b is a costly instrument of eliciting effort. As agent motivation is a perfect substitute motivated agents receive lower incentive pay.

- Case 1 (PC does not bind as $\overline{u}_j$ low)
  - Principal maximizes $(\pi_i - b)(b + \theta_{ij}) - \underline{w}$
  - Bonus is $b^*_{ij} = \max\left\{\frac{\pi_i - \theta_{ij}}{2}, 0\right\}$
  - Case 1a: Agent is more motivated than principal ($\theta_{ij} \geq \pi_i$): $b^*_{ij} = 0$ (no incentive pay)
  - Case 1b: Principal is more motivated than agent ($\pi_i > \theta_{ij}$): $b^*_{ij} = \frac{1}{2}\left(\pi_i - \theta_{ij}\right)$ (decreasing in agent motivation)

- Case 2 (PC binds as $\overline{u}_j$ high) Agent's binding PC: $\frac{1}{2}\left(b_{ij} + \theta_{ij}\right)^2 + \underline{w} = \overline{u}_j$.
  - Yields $b^*_{ij} = \sqrt{2\left(\overline{u}_j - \underline{w}\right)} - \theta_{ij}$.
  - Bonus is set by the outside market with a discount depending on agent's motivation.

- Agents in profit oriented sector ($i = 0$) must always be offered incentive pay to put in effort as $\theta_{0j} = 0$ for $j = 0, 1, 2$.

- Assuming $\bar{u}_0 = \bar{u}_1 = \bar{u}_2$ effort is higher & bonus payment lower if agent's type is same as that of principal in mission-oriented sector ($i = 1, 2$).

- Example (Case 1b)

$$b_{11} = \frac{\pi_1 - \overline{\theta}}{2} < b_{12} = \frac{\pi_1 - \underline{\theta}}{2}$$

$$e_{11} = b_{11} + \overline{\theta} = \frac{\pi_1 + \overline{\theta}}{2} > e_{12} = b_{12} + \underline{\theta} = \frac{\pi_1 + \underline{\theta}}{2}$$

- Organizations with "well-matched" principals & agents will have higher levels of productivity, other things being the same.

- In the mission-oriented sector bonus payments & effort will be negatively correlated in a cross-section of organizations! Pure *selection* effect.

Endogenous Motivation

- Suppose principals can pick mission of organization
- Let $x \in [0, 1]$ be mission choice (e.g., school curriculum with 0 denoting secular education & 1 denoting very religious orientation)
- Let $g^i(x)$ & $h^j(x)$ denote payoff of a principal of type i & an agent of type j ($i = 1, 2$ & $j = 1, 2$)
- Basic model can be thought as a case in which mission is not contractible & is picked by principal after he hires an agent: $x_i^* = \arg\max_{x \in X} \left\{ g^i(x) \right\}$.
- If mission choice is contractible, might be optimal for principal to use mission choice to incentivize the agent

- Can pick a "compromise" mission or even agent's preferred mission.

- Example: Let α_i & α_j be "ideal" missions of a i principal & a j agent, and let

$$\begin{aligned} g^i(x) &= P - \frac{1}{2}(x-\alpha_i)^2 \\ h^j(x) &= A - \frac{1}{2}\left(x-\alpha_j\right)^2 \end{aligned}$$

- Can show that in case 2 above $x_{ij}^* = \frac{\alpha_j+\alpha_i}{2}$.

- Increases θ_{ij} relative to case where principal picks his ideal mission of α_i

- As a result, reduces b_{ij}^* and increases e_{ij}^*

- Absent perfect matching, mission choice can be manipulated to raise agent motivation & is a substitute for financial motivation.

Competition & Matching

- Do not model competitive process explicitly

- Focus on implications of stable matching: allocations that are immune to a deviation in which *any* principal & agent can negotiate a contract which makes at least one of them strictly better off without making the other worse off.

- Consider matching function μ that assigns each principal (agent) to at most one agent (principal) & allows for possibility that a principal (agent) remains unmatched, in which case he is described as "matched to himself"

- Let n_i^p & n_j^a denote no. of principals of type i & no. of agents of type j.

- Assume that $n_1^a = n_1^p$ & $n_2^a = n_2^p$ for simplicity.

- However, population of principals & agents of type 0 need not be balanced – we consider both *unemployment* ($n_0^a > n_0^p$) & *full employment* ($n_0^a < n_0^p$).

- A person on "long-side" of market gets none of the surplus. Pins down equilibrium reservation payoff of all types of agents.

- From previous analysis for a given value of $\overline{u}_j$ we can uniquely characterize optimal contracts.

- Result: Any stable matching must have agents matched with principals of the same type.

- Intuition

  - If all agents have same reservation payoff, an assortatively matched principal-agent pair can generate more surplus than one where principal & agent are of different types.

  - So if a type 1 principal wants to hire a type 2 agent, must be $\overline{u}_2 < \overline{u}_1$.

  - Given balanced population one poss. is that some type 2 principal wants to hire a type 1 agent. But that means $\overline{u}_2 > \overline{u}_1$, a contradiction.

- With full employment ($n_0^a < n_0^p$) agents receive all the surplus.

- As before, fixed wage is *set at* $\underline{w}$.

- Bonus payment is solved from principal's zero-profit constraint.

- In profit-oriented sector:

$$b_{00}^* = \frac{\pi_0 + \sqrt{\pi_0^2 - 4\underline{w}}}{2}.$$

- In mission-oriented sector, there will be assortative matching. Since $\pi_1 = \pi_2 = \hat{\pi}$, agents in both types of mission-oriented organizations ($i = 1, 2$) will receive the *same* bonus.

- Suppose π_0 is high so that the outside option of motivated agents to find a job in the profit-oriented sector binds. Then their bonuses will be:

$$b_{11}^* = b_{22}^* = \frac{\pi_0 + \sqrt{\pi_0^2 - 4\underline{w}}}{2} - \overline{\theta}$$

- As before, they work for a lower bonus due to their motivation.

- If π_0 is not high, then

$$b_{11}^* = b_{22}^* = \frac{\max\{\overline{\theta}, \hat{\pi}\} - \overline{\theta}}{2}$$

- Effort level: $e_{jj}^* = b_{jj}^* + \overline{\theta}$ for $j = 1, 2$ & $e_{00}^* = b_{00}^*$.

- Illustrates how competition & incentives interact. Two effects:
  - *Matching*
    - Reduces heterogeneity in contracts observed in mission-oriented sector relative to before
    - Ignoring effect of outside option bonuses are lower.
    - Raises organizational productivity
  - *Outside option*
    - Competition among principals pins down equilibrium value of outside option (highest poss. as agents are on short side)
    - If PC binding in mission oriented sector, bonuses go up.
    - Productivity goes up, but due to higher incentive pay.

- The result that incentives are more high powered in profit-oriented sector may not hold:
  - If PC binds level of incentive pay in mission-oriented sector is less than in private sector by an amount $\overline{\theta}$
  - Otherwise:
    - If $\overline{\theta} > \hat{\pi}$ $b_{11}^* = b_{22}^* = 0 < b_{00}^*$
    - But if $\hat{\pi} > \overline{\theta}$ & the gap is high enough, possible to have $b_{11}^* = b_{22}^* > b_{00}^*$.

- With unemployment ($n_0^a > n_0^p$)
  - Principals in profit-oriented sector receive all the surplus
  - Some agents of type 0 are unemployed.
  - Outside option of agents of types 1 & 2 is 0 (so PC does not bind)

- Now

$$\begin{aligned} b_{00}^* &= \frac{\pi_0}{2} \\ b_{11}^* &= b_{22}^* = \frac{\max\{\overline{\theta}, \hat{\pi}\} - \overline{\theta}}{2}. \end{aligned}$$

- Competition works only through the matching effect.

- Unemployment unhinges incentives in mission-oriented & profit-oriented sectors.

Application 1: Non-Profit Organizations

- "Non-profit organizations may act differently from private firms not only because of the constraint on distributing profit but also, perhaps, because the motivations and goals of managers and directors ... differ." (Weisbrod, 1988)

- "Managers will ... sort themselves, each gravitating to the types of organizations that he or she finds least restrictive – most compatible with his or her personal preferences" (page 32).[23] (Weisbrod, 1988)

- Empirical studies suggest that in industries where both for-profits & non-profits are in operation (e.g., hospitals) the former use performance-based bonus compensation relative to base salary for managers significantly more (Ballou and Weisbrod, 2003)

- However, researchers are unable to explain this empirical finding: "While the compensating differentials may explain why levels of compensation differ across organizational forms, it does not explain the differentials in the use of strong relative to weak incentives." Our framework provides a simple explanation for this finding.

- Arnould, Bertrand, and Hallock (2000) find that spread of managed care in the US, which increases market competition, led to strengthening of relationship between economic performance & top managerial pay in nonprofit hospitals

- Role of non-profit organizations in achieving diversity - active in situations where there is greater underlying diversity in preferences for collective goods (e.g., U.S. vs. Japan)

- We show diversity is not only goo for the standard reason, namely, consumers get more choice, but also in productive efficiency.

Application 2: School Competition

- Policy debate: school competition leads to greater efficiency
- Mechanism not clear as schools are not profit-maximizing firms.
- The model gives a notion of idealized school competition based on sorting on mission preferences
- Compared to a centralized system where government picks the mission that all schools are supposed to follow, a decentralized system would be more efficient.
- Possible value of pluralism in schooling.

- This is an alternative to views based on
  - yardstick competition.
  - liquidation effects.
- Problems
  - Vertical as opposed to horizontal sorting may lead to greater inequality.
  - Even with horizontal sorting, society may become more polarized.

Application 3: Incentives in Public-Sector

- Our explanation for lower-powered incentives in public sector complements existing explanations based on multi-tasking & multiple principals.

- New Public Administration - need to incentivize public sector.
  - Need for greater incentive pay may reflect bad matching
  - Greater emphasis on decentralization may be more efficient.

- Public-sector as well as non-profits tend to conservative & resistant to change as anything that interferes with original mission will demotivate employees

Conclusions and Future Research

- Understand different institutional forms - these differ in how they restrict or enhance contracting possibilities & have accountability mechanisms
  - Private: oversight by trustees or shareholders
  - Public: electoral discipline.

- Organizations may "profitably" eschew the profit motive.
  - Non-Profit Status: If mission choice is not perfectly contractible, might be used as credible commitment by principal not to change the mission *ex post*
  - Corporate Social Responsibility: Can increase productivity if it increases agent motivation. Consistent with profit-maximization & competition.

Alternative Formulations of Motivation

- Does θ_{ij} capture ability or motivation?

- Case 1: agent had lower disutility of effort

$$be - \left(\frac{1}{2}e^2 - \theta e\right)$$

- The IC is

$$e = \arg\max be - \left(\frac{1}{2}e^2 - \theta e\right) = b + \theta.$$

- Motivation is the same as lower disutility of effort. Identical to our model.

- Case 2: Probability of high outcome depends on agent's type : $e + \delta$

- The IC is now

$$e = \arg\max b\,(e + \delta) - \frac{1}{2}e^2 = b$$

- Suppose PC does not bind. Then principal's choice of b

$$\begin{aligned} b &= \arg\max(b + \delta)(\pi - b) \\ &= \frac{\pi - \delta}{2} \end{aligned}$$

- Case 3: Realized output is higher with some agents. Principal receives $\pi + \varepsilon$ when outcome is high, 0 otherwise.

- The IC is $e = b$.

- Principal's choice of b :

$$\begin{aligned} b &= \arg\max(\pi + \varepsilon - b)b \\ &= \frac{\pi + \varepsilon}{2}. \end{aligned}$$

- Cases 1 & 2: agent supplies more effort for free, & so principal cuts the price of effort, b.

- Case 3: principal values agent's effort more, & so pays him more.

- Negative correlation between e and b only in case 1, which is identical to our formulation.