Markets Incentives and the Evolution of Intrinsic Motivation

Tim Besley and Maitreesh Ghatak

February 2016

Motivation

- Connection with the theme of the conference
    - Endogenous preferences
    - How socialization affects it
    - How it interacts with the structure of incentives

- Many commentators e.g. Durkheim, Weber and Polanyi remark on how *culture* changes with economic development
    - a key example is changes in the nature of employment relations from systems based on reciprocity and trust towards modern wage-labor contracts
    - economists have not paid much attention to cultural dynamics

Motivation

- There has been some recent interest in the importance of intrinsic motivation
  - highlights role of preferences & heterogeneity in it
  - the possibility that people do not need to be incentivized to perform tasks
  - indeed, incentives can sometimes be counter-productive - e.g., when people are engaged in an activity they consider intrinsically worthwhile, offering them money may weaken their motivation by "crowding out" their intrinsic interest or commitment.

- There is not much on what socializes people into being intrinsically motivated
  - endogeneity of preferences through social interactions at the workplace
  - dynamics of the process

This Paper

- A static model of firms and workers
  - firms offer wage contracts
  - workers sort across firms
  - socialization changes "type" with some probability when interacting with those who are *different* from you
  - influence depends on the "fitness" of each type in terms of expected payoff

- Dynamics of intrinsic motivation
  - show how intrinsic motivation in the population as a whole can increase or diminish over time
  - two way feedback from pattern of rewards to distribution of intrinsic motivation
  - show that converge to degenerate distributions, depending on initial condition - all or none intrinsically motivated

- Welfare and policy implications
  - In the long run both steady states have the same average income but the one with (full) intrinsic motivation has higher welfare
  - Of two economies that differ in the distribution of productivity, the more productive one is more likely to converge to the lower welfare (no intrinsic-motivation) equilibrium

Link to Literatures

- Literature on intrinsic motivation
  - anomie when intrinsically motivated workers are monitored and incentivized
- Optimal and Equilibrium Labor contracts
  - show that we cannot have a separating equilibrium with unobserved heterogeneous motivation, moral hazard and team production
- Literature on cultural evolution
  - mostly in anthropology but recently small literature in economics

Cultural Evolution Literature

- Key contributions by Boyd & Richerson (1985) and Cavalli-Sforza & Feldman (1981)
    - uses evolutionary models with exposure to a range of "cultural parents"
    - emphasizes dynamics due to social learning
- In economics Bisin & Verdier (2001)
    - adds a strategic dimension to intergenerational socialization
    - applied, for example, in Tabellini (2008).
- Approach taken here is essentially the indirect evolutionary approach of Guth & Yaari (1992) and Guth (1995)
    - mainly focused on small group interactions and preference change
    - espoused by Ostrom (2000) to study collective action.

Road Map

- Lay out core model with three features
  - team production with moral hazard
  - heterogeneous motivation and firms
  - competition for workers
- Derive optimal labor contracts
- Dynamic model of socialization
- Role of productivity growth and migration
- Welfare results

Production

- Worker population normalized to 1
- $\frac{N}{2} < 1$ firms each employing 2 workers
- Workers are of two types : motivated (m) and selfish (s)
- Output is positive (π) if *both* workers supply effort, zero otherwise

Production

- Workers can choose to put in one unit effort $e \in \{0, 1\}$
- Intrinsically motivated agents get $\theta > 0$ from effort
- But they incur a cost of γ where $0 < \gamma < \theta$ if they are incentivized (e.g., disutility from lack of trust).
- Still, shirking leads to a disutility $\delta > 0$, and $\theta - \gamma > -\delta$ so that honest types always work
- Effort costs c to a selfish agent who decides whether to put in effort or not
- An output contingent payment (bonus) $b \geq c$ will induce effort from a worker of type s

Contracting

- Firms post contracts with a wage, w, and an output contingent payment (bonus) b
- (w_τ, b_τ) can be type-specific with $\tau \in \{m, s\}$
- Effort is not contractible and workers have no wealth which they can post as a bond against poor performance.
- Worker type is not observable to the firm

Contracting

- Workers need to be paid z up-front, the same they can produce in a subsistence activity, as part of a minimum consumption constraint
- In addition, a limited liability constraint implies $b \geq 0$
- Firm owner gets $\pi \in [2(c+z), \Pi]$ with cdf $G(\pi)$ where $z \geq 0$ is subsistence consumption.
- Workers have a common outside option $\bar{u}$
- Disutility $\varepsilon > 0$ from being unemployed, and so $\bar{u} = z - \varepsilon$

Labor Market

- Firms compete for workers.
- We will require that contracts are incentive compatible in two senses:
  1. workers select the contract intended for their type and
  2. effort decisions are optimal (for selfish types).
- Firms post contracts & workers apply to a set of firms posting a specific contract (or a pair of contracts)
- We assume every worker of each type applies to every firm, and is chosen at random from among the applicants
- At the end of this process, some workers remain unmatched and engage in the subsistence activity.
- Standard notion of competitive equilibrium: no firm can offer a new contract that attracts workers and make more profits

Timing

1. There is a fraction μ_t of motivated workers in the population
2. Firms post contracts $\{w_m, b_m, w_s, b_s\} \in C^*$.
3. Firms and workers match and workers choose their effort levels.
4. Socialization takes place and the fraction of motivated workers is updated to μ_{t+1}.

Effort Decisions

- We show that if $b \geq c$, then there is an equilibrium in which all selfish agents put in effort whether they are matched with a selfish or a motivated agent.
- Motivated workers always put in effort
- Let $E(b, \tau)$ be the effort decision of type τ when the bonus is b.
- Focus on the case where:

$$E(b, s) = \begin{cases} 1 & \text{if } b \geq c \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

- The payoff of an employed selfish worker is:

$$V(b, s) = E(b, s)[b - c].$$

- That of an employed motivated worker is:

$$V(b, m) = \begin{cases} \theta & \text{if } b = 0 \\ \theta + b - \gamma & \text{otherwise.} \end{cases}$$

Characterization of Equilibrium

- Efficient allocation is for both types of workers to put in effort if employed, and firms to prefer employing m workers if available

- Suppose $\mu > N$ and so there are enough m-type workers

- If $w = z$ and $b = 0$ is offered, selfish workers would prefer to take this contract than engage in subsistence activity but not put in effort

- A firm of type π will therefore have an expected profit of $\mu^2 \pi - 2z$.

- The only way selfish workers could be discouraged is if the minimum consumption constraint was not binding and w was set at $z - \theta$ so that only motivated workers would take this contract

- The other options would be to offer a pair of separating contracts that will satisfy the self-selection constraints for both types of workers or a pooling contract such that selfish workers will put in effort under it

- Key result: there are no separating contracts, only two possible pooling contracts

Proposition

All contracts in C^* set subsistence wages, i.e. $w_m = w_s = z$. For bonuses, the market offers two possible contracts: a bonus contract where $b_s = b_m = c$ and a fixed-wage contract where $b_s = b_m = 0$. Firms choose which contract to offer as follows:

1. *if $\pi \geq \frac{2c}{1-\mu^2}$ then $b_s = b_m = c$*
2. *if $\pi < \frac{2c}{1-\mu^2}$ then $b_s = b_m = 0$*

Intuition

- Given the slack in the labour market both types of workers have identical outside options.
- Therefore, if both types of workers put in effort, from a firm's point of view they are equivalent, and so competition among profit-maximizing firms implies $b_s + w_s = b_m + w_m$
- This, coupled with the self-selection and limited liability constraints restrict the set of different contracts that can be offered considerably (e.g., 0 bonus higher wage for m types, positive bonus and low wage for s types will not work)
- Two possible pooling contracts on offer by firms and different from high and low productivity firms.

Intuition

- If the firm is highly productive relative to the cost of effort, all of its workers receive an incentive contract which guarantees an output of π.

- Low productivity firms will choose not to incentivize workers and hence will only produce π if they happen to get two motivated workers which happens with probability $(\mu_t)^2$

- Since both these are pooling equilibria, some firms will have a mixture of motivated and selfish workers and these are the firms in which on-the-job socialization will, with some probability, lead to changes in worker motivation.

- This result is important for the study of cultural evolution as it says that workers of different types will be mixing in the workplace and hence there is the possibility of one group influencing the other

Socialization

- Time is infinite and indexed by t
- No long-term worker-firm relationships
- Let μ_t be the fraction of motivated workers in the population at date t.
- Given a set of equilibrium contracts C^* and a fraction of motivated workers, let $U(C^*, \mu, \tau)$ be the expected utility of being a type τ and let the utility difference between the motivated type and the selfish type be

$$\Delta(\mu) = U(C^*, \mu, m) - U(C^*, \mu, s)$$

- We will characterize $\Delta(\mu)$ below.
- Co-workers serve as "cultural parents".

Socialization

- Let probability of becoming motivated from selfish in a mixed setting is

$$\rho\left(\Delta\left(\mu_t\right)\right) = \frac{\exp\left[\Delta\left(\mu_t\right)\right]}{1 + \exp\left[\Delta\left(\mu_t\right)\right]}.$$

- $\rho\left(\Delta\left(\mu_t\right)\right) > \frac{1}{2}$ for $\Delta\left(\mu_t\right) > 0$, $\rho\left(0\right) = \frac{1}{2}$, and $\rho'\left(\Delta\left(\mu_t\right)\right) > 0$.
- Probability of becoming selfish from motivated is $1 - \rho\left(\Delta\left(\mu_t\right)\right)$

Socialization

- Given random matching of workers to firms

$$\mu_{t+1} = N \left\{ \mu_t^2 + 2\mu_t \left(1 - \mu_t\right) \rho \left(\Delta \left(\mu_t\right)\right) \right\} + (1 - N) \mu_t.$$

- Rewrite as

$$\mu_{t+1} - \mu_t = N\mu_t \left(1 - \mu_t\right) \left[2\rho \left(\Delta \left(\mu_t\right)\right) - 1\right].$$

- Thus the sign of the change is determined by $\rho \left(\Delta \left(\mu_t\right)\right) \gtrless 1/2$ or equivalent $\Delta \left(\mu_t\right) \gtrless 0$.

Dynamics

- Recall that by assumption

$$0 > \theta + c - \gamma > -\varepsilon. \qquad (2)$$

- This is the *anomie* condition where motivated workers are demoralized under incentive pay

- In the contracting equilibrium, the probability that any type of worker is employed is N.

- Therefore, the expected payoffs of a selfish and motivated worker are:

$$
\begin{aligned}
U\left(C^*, \mu, s\right) &= -\left(1 - N\right)\varepsilon \\
U\left(C^*, \mu, m\right) &= \Delta\left(\mu\right) - \left(1 - N\right)\varepsilon
\end{aligned}
$$

- The payoff difference between motivated and selfish workers:

$$\Delta\left(\mu\right) = N\left[\theta + \left\{1 - G\left(\frac{2c}{1-\mu^2}\right)\right\}\left(c - \gamma\right)\right].$$

Dynamics

- $\Delta(\mu)$ is increasing in μ.
- Expected payoff to being motivated agent is greater when there are more motivated workers around since firms offer more fixed wage opportunities.
- Define $\hat{\mu}$ from

$$\theta = \left(1 - G\left(\frac{2c}{(1-\hat{\mu}^2)}\right)\right)[\gamma - c].$$

- Then $\Delta(\mu) \geq 0$ for all $\mu \geq \hat{\mu}$ and if $\mu < \hat{\mu}$, then $\Delta(\mu) < 0$.

Dynamics

- Our key result:

Proposition

For $\mu_t < \hat{\mu}$, $\lim_{t-\infty}\mu_t = 0$ and for $\mu_t > \hat{\mu}$, $\lim_{t-\infty}\mu_t = 1$.

- Thus there is a "tipping point" around $\hat{\mu}$
- Extent of worker motivation either increases or decreases over time depending on which side of the tipping point the starting point is
- Thus the economy naturally has multiple steady states: $\mu = 1$ or $\mu = 0$.

1. Welfare and nature of rewards

Implications

1. Welfare and nature of rewards
2. Structure of production

Welfare

Proposition

In the long-run economies based on intrinsic motivation will have higher welfare and similar income levels to those which rely on incentives.

- Aggregate surplus when the fraction of workers is μ is:

$$
\begin{aligned}
S\left(\mu\right) = {} & N\mu\left[\theta - \gamma\left\{1 - G\left(\frac{2c}{1-\mu^2}\right)\right\}\right] - \left(1-N\right)\varepsilon \\
& + \frac{N}{2}\left\{\mu^2 \int_{2(c+z)}^{\frac{2c}{(1-\mu^2)}} \pi g\left(\pi\right) d\pi + \int_{\frac{2c}{(1-\mu^2)}}^{\Pi} \pi g\left(\pi\right) d\pi\right\}.
\end{aligned}
$$

Welfare

- Comparing welfare at the limit points:

$$S(1) = N\theta + \frac{N}{2}E(\pi) - (1-N)\varepsilon$$

$$S(0) = \frac{N}{2}E(\pi) - (1-N)\varepsilon.$$

- Thus $S(1) - S(0) = N\theta > 0$
- This is because we allow motivated workers to earn θ.

Structure of Production

Proposition

Consider two distributions of productivity A and B where the first dominates the second in a first order sense, i.e.

$$G^A(\pi) \leq G^B(\pi) \text{ for all } \pi \in [2[c+z], \Pi].$$

then the threshold fraction of motivated individuals for economy A, $\hat{\mu}^A$ will be everywhere above the threshold fraction of individuals in economy B, $\hat{\mu}^B$.

- Thus more productive economy is likely to have less intrinsic motivation all else equal.
- So technological change can lead to a move towards an economy dominated by selfish individuals.

Concluding Comments

- We have put forward a framework for studying cultural dynamics when there is endogenous motivation due to workplace socialization
- Contracts and labor allocation is endogenous
- Allows us to think about a range of issues
- Part of a wider agenda to understand situations where preferences and institutions interact.