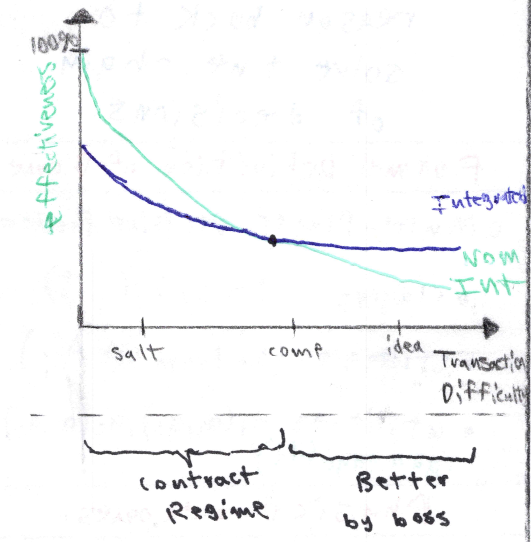
Non-Integrated vs. Integrated Transactions



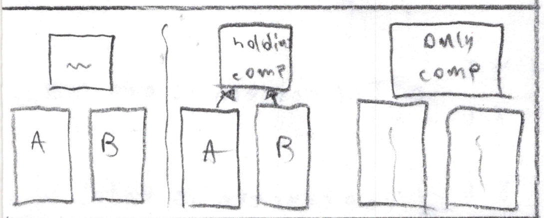
Key Points:

- Effectiveness measures what % of value creation you reap, rather than put towards safeguards

→ with integrated structure you'll never get 100%

* More complex the good / Transaction the more effective an Integrated structure is

Types of organizations



Fundamentals of Agency Theory

simplest organization { o One Boss, o one agent

ex. shareholder = principal, CEO = "Agent"

What is an Economic Model

→ simplified description of reality where

- o Assumptions are explicit
- o robust within environment of interest

Basic Principal-Agent Problem

o Incentive → "cash-payment for a measured outcome"

14.26 Summary Sheet

- o rewards → outcomes that people care abt
- o effort → actions people won't take w/o rewards
- o incentives → link reward & effort

Primary Model Vars.

1. (y) agent's contribution to firm value
2. (a) Action taken by agent to increase firm value
3. (ε) events in production process beyond agent's control — noise

Contracts

• (w) is agent's wage, a linear function of output

$$\text{wage} = s + (b * y)$$

↳ s = salary
↳ b = bonus rate
↳ y = output

Payoffs

o Principal Payoff (Profit)

$$\Pi = y - w$$

o $c(a)$ → dollar amount compensating agent for action $\boxed{a}$

o Agent's payoff: $U = w - c(a)$

Event Timing

1. Principal & Agent sign compensation contract ($w = s + by$)
2. Agent chooses action (a), but principal does not observe
3. Events (ε) occur beyond control
4. Action & noise determine output $\boxed{y}$
5. Output observed by the Principal & Agent
6. Agent receives compensation

Risk-Neutral Agent Response

o Agent chooses action that maximizes

$$\max_{a} \; s + (b * a) - c(a)$$

→ higher bonus rate $\boxed{b}$, stronger incentive to work more

Necessity of performance Measures

o $\boxed{y}$ not that easily countable

o replace $\boxed{y}$ → p

↳ where p is "alternate performance measure"

→ Dichotomy of $\boxed{p}$ & $\boxed{y}$ makes interesting problems

Multi-Task Agency Model

Technology of production { $y = f_1 a_1 + f_2 a_2 + \varepsilon$

Technology of Performance Measure { $p = g_1 a_1 + g_2 a_2 + \phi$

contract { $w = s + bp$

Payoffs { agent: $U = w - c(a)$; Principal: $\Pi = y - w$

where,

$$c(a_1, a_2) = \tfrac{1}{2} a_1^2 + \tfrac{1}{2} a_2^2$$

solution

- agent chooses $\boxed{a_1}$ & $\boxed{a_2}$ to maximize

$$\max_{a_1, a_2} \; s + b(g_1 a_1 + g_2 a_2) - \tfrac{1}{2} a_1^2 - \tfrac{1}{2} a_2^2$$

1st order optimization → $a_i(b) = b * g_i$

Does paying for [p] increase [y]

- $y = a_1 + \varepsilon$ { $p = a_1 + \phi$ (agent wants to choose a)
- $y = a_1 + a_2$ { $p = a_1$
- $y = a_1$ { $p = a_1 + a_2$ (e.g. a_2 = facetime)
- $y = a_1 + \varepsilon$ { $p = a_2 + \varepsilon$ (mis-aligned incentives)

Good performance measure: $Cov\left(\frac{\partial y}{\partial a}, \frac{\partial p}{\partial a}\right) > 0$

Elemental Cos(θ) Model

- $y = f_1 a_1 + f_2 a_2$; $p = H$ or L (Binary now)
- $\pi = y - w$
- $U = w - c(a_1, a_2)$ • $w = s + b 1_{(p=H)}$
-
- Agent has outside opportunity worth $\boxed{V_0}$

Solution

step 1: labor maximization (agent)

$$\max_{a_1, a_2} s + b(g_1 a_1 + g_2 a_2) - \frac{1}{2}(a_1^2 + a_2^2)$$

$\rightarrow a_i(b) = b g_i$

step 2: Agent bonus Maximization

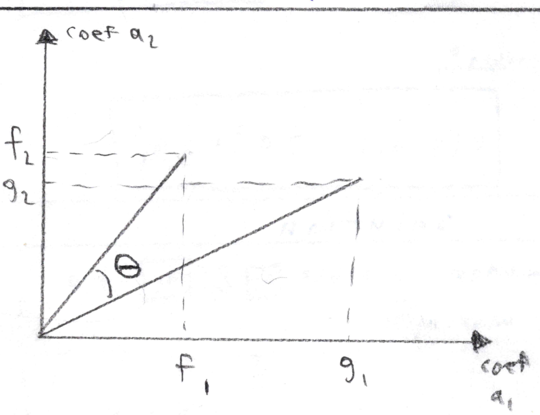
$\max_{s,b} \Rightarrow$ choose $\boxed{s} = \boxed{V_0}$

$$\max_b \; y - c(a_1, a_2)$$

$\Downarrow$

$$\boxed{b^* = (f_1 g_1 + f_2 g_2)(g_1^2 + g_2^2)}$$

Graphical interpretation of sol



$$\boxed{b^* = \frac{\|f\|}{\|g\|} * \cos(\theta)}$$

Variations on Problem

example 1: Manipulation

- $y = f * e$
- $p = e + m$
- $w = s + bp$
- $c = (\frac{1}{2}(e^2 + \lambda m^2))$

$\rightarrow \max_{e,m} E(w) - c(e, m)$

$\rightarrow \max_b E(y) - c(e, m)$

Example 2: Principal Principle

- $y = a_1 + a_2$
- $p = g_i a_i + m_i$
- Actor chooses a_i, m
- Principal Receives $\boxed{y}$

$\rightarrow$ pays $w_i = s_i + b_i p_i + (B_i p_i p_j)$

$\rightarrow \max_b E(a_i) - c(a_i, m_i)$

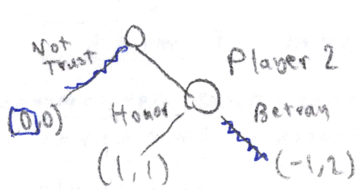
$\Rightarrow$ actor w/ lower g_i should be principal

Dynamic Games w/ Complete info

1. Player 1 chooses action a_1 from set A_1
2. Player 2 observes Player 1's choice then chooses a_2 from set A_2.
3. Each Player receives payoffs

→ Money useful metric to capture utility of Payouts

Example



* To solve, we must reason back to solve the chain of decisions

Formal Definition of Game

o Multi-Player Decision Problem

- players $i = 1, 2, (\ldots?)$
- strategies (a_i from set A_i)
- utilities $u_1(a_1, a_2), u_2(a_1, a_2)$ (aka payoffs)

Physical outcomes

Row \ Column	Sust	Not
Sust	Sust, Sust	Sust, Not
Not	Not, Sust	Not, Not

Possible utilities for Row: (supposing sustainable is costlier)

8 4 / 6 2 → Top concern is total S

4 2 / 8 6 → Top concern is own cost

8 6 / 4 2 → Top concern is total S, 2nd is identity

8 4 / 4 6 → Top preference: solidarity 2nd is total S

→ utilities reveal player's preferences

Best-Response

→ Given i's belief about what his opponent will play we say a strategy is best response if it gives at least as high utility as does any other strategy

Q

Nash Equilibrium

A profile of strategies is a Nash Equilibrium if each player's strategy is a best response to other player's strategy

criteria

$u_1(p,r) \geq u_1(q,r)$

$\boxed{\&}$

$u_2(p,r) \geq u_2(p,s)$

Specific Games

Game 1.5: Stag Hunt

column

		L	R
Row	T	(2,2)	(0,1)
	B	(1,0)	(1,1)

→ No dominated strategy for either Player

* 2 Pareto-Ranked Nash Equilibria

Game 1.8: Dating Game

(2,1)	(0,0)
(0,0)	(1,2)

→ 2 Nash equilibria

Game 1.6: Prisoners' Dilemma

- One Nash Equilibrium
  - ↳ Pareto-Inefficient

Tournaments

Relational contract

o shared understanding of parties' roles & rewards from collaboration

→ Not enforceable

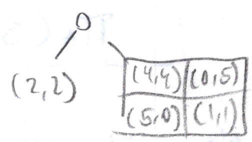
(*) Equilibrium of repeated game

Repeated Games

→ People interact over time, threats & promises of future behavior influence current behavior

Module 1 Review

LARB



Two-Stage Game

• Prisoner's Dilemma to be played 2-times

	L_2	R_2
L_1	1,1	5,0
R_1	0,5	4,4

→ outcome of 1st play observed

⇓ evolves to sum of two payoffs

2,2	6,1
1,6	5,5

→ still a prisoner's dilemma

(no punishment for deviation from global optimal strat)

Module 3 : 14.26 cheat sheet

Game w/ Punish

1,1	5,0	0,0
0,5	4,4	0,0
0,0	0,0	3,3

⇓

2,2	6,1	0,0
1,6	7,7	0,0
0,0	0,0	3,3

o middle selection reflects belief that middle option if achieved in 1st stage 3,3 played

→ otherwise (1,1)

BUT, would we really ever go for $\boxed{L}$, when we have right

Infinitely Repeated Games

Key Point: moves in 1st period can become part of 2nd stage equilibrium

Trigger strategies

o infinite horizon

⇒ initially will trust, but will deviate forever after if you do

Do you Deviate?

⇓

Depends on interest Rate

Decision boils down to 2-time paths:

$$\left(1+\frac{1}{r}\right)C > D+\frac{1}{r}P$$

"present value"

Modelling Rational contracts

Player 1: play Trust until player 2 plays betray; thereafter play not trust

player 2:

message | can't be punished

"

can't be trusted

Formalization

• Nash Equilibrium

o strategy pair (s_1, s_2)

o s_i is i's best response to s_j

• Present Value

→ interest Rate

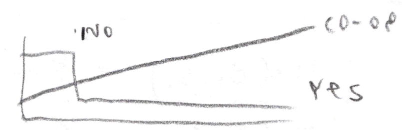
• Betray vs Trust

Yes if $C+\frac{1}{r}C > D+(\frac{1}{r})P$

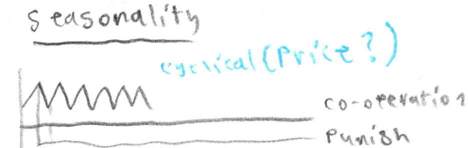
NO if other

Alterations to infinite horizon

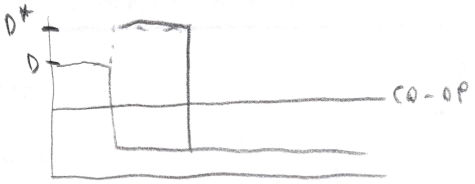
1. Trends



2. Seasonality



$\boxed{3}$ Permanent shock



∘ Defection payoff goes $D \to D^*$ w/ some probability

Expected present value used to determine if trust holds

Adaptation

(A) Timing

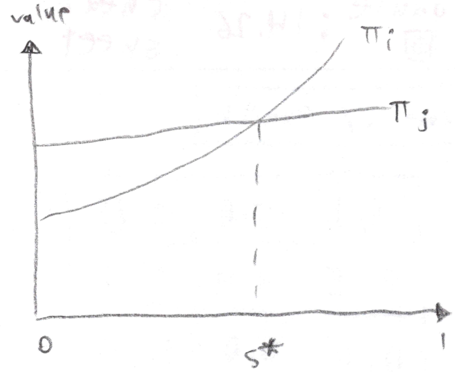
1. Asset ownership/control rights designed $\boxed{g}$
2. ___
3. state realized $\boxed{(s)}$
4. Ex-post decision made
5. Payoffs

Timing of Relational Adaptation

Once & for all:

0. choose Gov. structure — control to i
1. "Retainer" — j can pay i (R_t)
2. state — $s_t \sim f_s(t)$ on $[0,1]$
3. ex-post decision — $d_t \in D$
4. Payoffs

$$\boxed{\begin{array}{l} \pi_i(d_t, s_t) + R_t \\ \pi_j(d_t, s_t) - R_t \end{array}}$$



$\boxed{\text{First-Best Decision Rule}}$

$$\left\{ \begin{array}{l} d_j^*(s) \text{ for } s < s^* \\ d_i^*(s) \text{ for } s > s^* \end{array} \right\}$$

⇒ can't be achieved in one-shot game

Repeated Rel'n. Adaptation

Q1: If party $\boxed{i}$ has control for what values of r can FB be achieved in repeated game

Q2: who should have control to achieve first-best in repeated game at highest r

Suppose A promises $\boxed{d^{FB}}$:

& B promises $\boxed{R}$

→ A has control over $d \in D$

∘ who's player 1

∘ what happens after renege

∘ what are trigger strategies

* what values of $\boxed{r}$ are trigger strats in Equilibrium

Key point: two parties want 2 things in different states

■ Promises kept

∘ $E(\pi_A) = R + \int_{s=s^*}^{1} \pi_A(s) f(s)\,ds$

∘ $E(\pi_B) = -R + \int_{0}^{s=s^*} \pi_B(s) f(s)\,ds$

■ After renege

∘ $E(\pi_A) = \int_0^1 \pi_A(s) f(s)\,ds$

∘ $E(\pi_B) = 0$

→ A's max renege temptation

$$\boxed{\pi_A(s^*)}$$

→ B's willingness to participate

$$\boxed{-R + \int_{s=0}^{s^*} \pi_B(s) f(s) \geq 0}$$

→ A willing to implement first-best Decision

$$\boxed{(R) + \frac{1}{r}\left(R + \int_{s^*}^{1} \pi_A(s) f_s\,ds\right) \geq R + \pi_A(s^*) + \frac{1}{r}\int_0^1 \pi_A(s) f_s\,ds}$$

→ greatest moment of temptation occurs after $\boxed{R}$ and stands to gain $\pi_A(s^*)$

→ Maximum B willing to pay to $\boxed{R}$

$$= \boxed{\int_0^{s^*} \pi_B(s) f(s)\, ds}$$

→ maximum $\boxed{r}$ for A to implement FB decision

$$\frac{1}{r}\left[\int_0^{s^*} \pi_B(s) f(s)\, ds + \int_{s^*}^{1} \pi_A(s) f(s)\, ds\right] - \int_0^1 \pi_A(s) f(s)\, ds \ge \pi_A(s^*)$$

or

$$\boxed{\frac{V^{FB} - V_A^{SP}}{\pi_A(s^*)} = r_A > r}$$

∘ If critical case holds, All else holds

who gets control

∘ $\pi_B(1) > \pi_A(s^*)$ → $\boxed{A}$ gets control

→ b/c magnitude of defection temptation lowest w/ A

∘ $V_B^{SP} < V_A^{SP}$ → $\boxed{B}$ gets control

→ because spot payoff smaller for B

⇒ want to give control to agent who gets us first best when $\boxed{r}$'s high, agents impatient

Rule: give control to agent w/ highest critical $\boxed{r}$

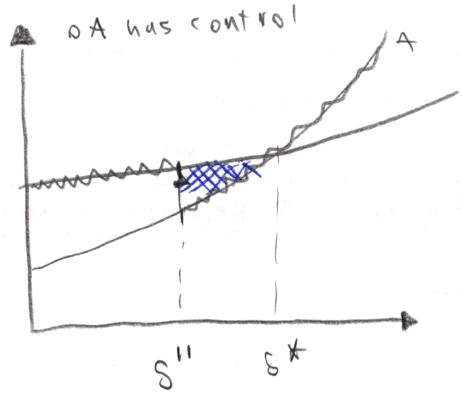
"Second-Best"

what if $\boxed{r > \max(r_a, r_b)}$

control to both would result in betrayal

→ worse than 1st best

⇒ Better than spot



Lost best joint utility picking second-best

→ Basically redetermine critical $\boxed{s}$ to make it acceptable to $\boxed{A}$

→ control decision still on same criteria

Discretionary Bonuses

→ given relational contract bonus $\boxed{b}$

Agent problem:

$$\max_a \; s + (a \cdot b) - c(a)$$

Principal's Profit $\left\{ V(b) = L + a'(b)[H-L] - c(a'(b)) - w_a \right.$

Formalization of Problem

• Production

$y = H$ or L

$\text{Prob}(y = H \mid a) = a$

• Payoffs

$P: \pi = y - w \quad \{ A: U = w - c(a)$

→ discount at rate r

• First-Best Constraint

a^{FB} solves $\max_a L + a \cdot (H - L) - c(a)$

• Timing

1. P proposes (s, B)
2. A accepts
3. A chooses action $\boxed{a \ge 0}$
4. P & A observe $\boxed{y}$
5. P decides whether to pay bonus

• (relational contract)

⇒ P pays $w = s$ if $y = L$

P pays $s + B$ if $y = H$

Q: Is relational contract self-enforcing

Solving Discretionary Bonus Problem

- if relative contract self-enforcing (a believes B will be paid)

$\boxed{a^*(B)}$ solves $\max_a \; s + a * B - c(a)$

- IR constraints

1) Agent Utility constraint

$$\boxed{V_0 \leq EU(s,B) = s + a^*(B) \cdot B - c(a^*(B))}$$

2) Principal Profit constraint

$$\boxed{\pi_0 \leq E\pi(s,B) = (L-s) + a^*(B) \cdot (H-L-B)}$$

* constraint governing if principal pays

$$(H-s-B) + \frac{1}{r} \cdot E\pi(s,B) >$$

$$(H-s-0) + \frac{1}{r}\pi_0$$

$$\boxed{rB < E\pi(s,B) - \pi_0}$$

Inequality in terms of value to both parties

$$\boxed{rB < V(B) - V_0}$$ * sufficient inequality

$V(B) = E[y] - c[a]$

$V_0 = U_0 + \pi_0$

FB & SB w/ Bonuses

- First-Best Bonus

$B^{FL} = H - L \rightarrow \boxed{a^*(B) = a^{FB}}$

- Second-Best Bonus

$B^{SB}(r)$ is largest B solving $\boxed{V(B) - V_0 = rB}$

- None { Does not exist $\boxed{B}$ s+ $V(B) - V_0 \geq rB$

Neighboring Environments

- can control be designed?
  - → No or Yes
- When might there be payments
  - → at any time!

Formal & Relational contracts

Model:

$Pr(y=1) = a_1$

$Pr(p=H) = a_1\cos(\theta) + a_2\sin(\theta)$

cost of effort $k(a_1^2 + a_2^2)/2$

agents outside oppurtunity: $\boxed{H}$

First-Best

- $a_1 = 1/K$
- $a_2 = 0$
- Total surplus $= 1/(2K)$

Spot Contract Case

$$\boxed{w = s + b \cdot 1_{\{p=H\}}}$$

$U = s + b[a_1\cos(\theta) + a_2\sin(\theta)] - \text{cost}$

$a_1 = \left(\frac{b}{k}\right)\cos(\theta)$, $a_2 = \left(\frac{b}{k}\right)\sin(\theta)$

$b^* = \cos(\theta)$

Three Lenses on organizational Processes

1. Formal
   - → organizations are Machines
   - → Parts must fit well
   - → action through Planning
2. Political
   - → organizations are contests
   - → action through power
3. Cultural
   - → Organizations are institutions
   - → action through habit

Team Theory

- 1st economic theory of internal organization
- cost of gathering, communicating, processing info

⇒ organization is rational individual

Communication & Decision making

- Project value { $y = 0$ or 1
- Signal to $i = 1,2$ { $s_i = G$ or B
- Implementation cost $\boxed{c}$

Assume

$Pr(y=1 \mid G,G) > c > Pr(y=1 \mid B,B)$

→ $\boxed{Pr(y=1, G, B)}$?

Hierarchy: Unanimity to accept, optimal if $P(y=1|G,B) < c$

Polyarchy: Unanimity to reject, optimal if $P(y=1|G,B) > c$

Imperfect communication

Model:

1. state of world $s \in S$ realized from $\boxed{s \sim f(s)}$
2. Player 1 Privately observes s
3. Player 1 chooses (c, m)
4. Player 2 observes $\boxed{m}$ w/ probability $\boxed{p}$, nothing w/ $\boxed{(1-p)}$
5. Player 2 chooses $d \in R$
6. Payoff

$$\boxed{V_i(s,c,d) = -\phi(c-s)^2 - \beta(d-c)^2}$$

→ team-theoretic payoffs (same for both)

→ messages costless

Takeaway: the more accurate player $\boxed{2}$ can guess d, the more they both benefit

Simulated Run-Through

- Player 1 chooses $\boxed{m = c}$
- If $\boxed{m}$ does not arrive Player 2 chooses $\boxed{d^* = E(c)}$

Player $\boxed{1}$ chooses c to maximize

$$\boxed{-\phi(c-s)^2 - \beta(1-p)(E(c)-c)^2}$$

b/c $\boxed{p}$ % of time can choose $d = c$

$$\boxed{c^*(s) = [\phi s + \beta(1-p)E(c)] / [\phi + \beta(1-p)]}$$

$$E(c) = [\phi E(s) + \beta(1-p)E(c)] / [\phi + \beta(1-p)]$$

Plug back in

- comparitive statics on ϕ & p

Knowledge Hierarchies

- Different problems require different skills to be solved

→ index problems $\boxed{Z}$ skills by z

- learning one skill teaches nothing about other

Key: Problems arrive randomly w/ $P(z)$

- Value of solving any problem is $\boxed{1}$ for any z
- Cost of training is $\boxed{c}$ per skill
- workers can be trained on any skill

→ * will be optimal to train one worker in some, and another in others

- Each worker has total time $\boxed{T}$

→ workers can solve or help

Assumption on Processing times

- When Problem $\boxed{z}$ arrives, a worker with skill set $\boxed{S_i}$ Knows if they can solve

→ takes $\boxed{P}$ to do so

- " " similar, worker Knows if they can help with it

→ takes $\boxed{H}$ to do so

Case 1: workers trained in Disjoint sets

- Some have skill set $\boxed{S_1}$
- Else, $\boxed{S_2}$

- Firm can solve problem z if $\boxed{z \in S_1 \cup S_2}$

$\boxed{N}$ → # of problems firm will consider

$\boxed{\alpha}$ → fraction of <u>w</u> workers w/ skill set S_1

* <u>Maximize</u> expected number of problems solved

→ <u>Set</u> each workers expected time

<u>S_1's Time</u>

$N \Pr(S_1) P + \boxed{\alpha W T}$

<u>S_2 Time</u>

$(1-\alpha) W T$

<u>Firm's expected output:</u>

$\boxed{N * \Pr(z \in S_1 \cup S_2)}$

Module $\boxed{4}$: Summary Sheet

Three Lenses on Org. Processes

Formal → organizations are machines

- An organization is a mechanical system crafted to achieve a defined goal.

=> Action comes through Planning

Political → organizations are contests

- an organization is a social system encompassing diverse, contradictory interests.

=> Action comes through

Cultural → organizations are institutions

- A symbolic system of meaning, value, & routines. In formal norms exert strong influence.

=> action comes through habit

Team Theory

- 1st economic theory of internal organization
- common interests → no shirking, lying

Organization as rational individual

Model 1 (communication & Decision Making)

- Project Value ($Y = 0$ or 1)
- signal to $i = 1,2$ ($s_i = G$ or B)
- Implementation cost c
- Assume $\boxed{\text{Prob}(y=1|G,G) > c > \text{Prob}(y=1|B,B)}$

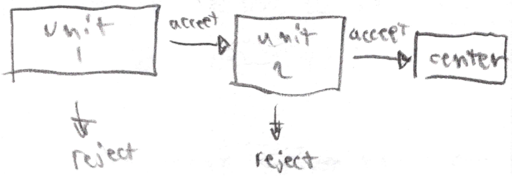
Q: $Pr(y=1|G,B) > c$ $\boxed{?}$

Comm^n & D-M

Building a circuit w/ 2 kinds of components

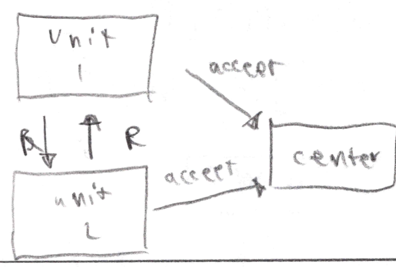
Hierarchy: Unanimity to Accept

optimal if $P(y=1|G,B) << c$



Polyarchy: Unanimity to reject

optimal if $P(y=1|G,B) > c$



Imperfect Communication

$\boxed{1.}$ state of world $\boxed{s \in S}$ realized: $s \sim f(s)$ on $\mathbb{R}$

$\boxed{2.}$ Player 1 observes $\boxed{s}$

$\boxed{3.}$ Player 1 chooses (c, m)

$\boxed{4.}$ Player 2 observes m w/ probability $\boxed{p}$, but not w/ $\boxed{1-p}$

$\boxed{5.}$ Player 2 chooses $\boxed{d \in \mathbb{R}}$

$\boxed{6.}$ Payoffs:

$$\boxed{U_i(s,c,d) = -\phi(c-s)^2 - \beta(d-c)^2}$$

- Adaptation vs. coordination
- Team-theoretic payoffs
- Messages costless but imperfect

Imperfect comm. (Play-Through)

- Player 1 chooses $\boxed{m=c}$
- If m does not arrive then Player 2 chooses $\boxed{d^* = E(c)}$
- Player 1 chooses $\boxed{c}$ to maximize

$$\boxed{-p\phi(c-s)^2 - \beta(1-p)(E[c]-c)^2}$$

⇒ maximize utility outcome

→ $$c^*(s) = [\phi s + \beta(1-p)E[c]] / [\phi + \beta(1-p)]$$

* weighted avg of adaptation $\boxed{c=s}$ & coordination $c = E[c]$

- $$E[c] = [\phi E(s) + \beta(1-p)E(c)] \Big/ [\phi + \beta(1-p)]$$

→ $$c^*(s) = E(s) + (\phi/[\phi/\phi + \beta(1-p)]) \cdot (s - E[s])$$

comparative statics

ϕ → weight on adaptation

β → weight on coordination

p → probability weight

Knowledge Hierarchies

- different problems require different skills to be solved

→ index problems by $\boxed{z}$

(problem $\boxed{z}$ requires skill $\boxed{z}$)

→ nearby values of $\boxed{z}$, are not necessarilly related problems

* Problems arrive randomly, but w/ different probabilities $\boxed{f(z)}$

- Assign z so that more likely problems have smaller $\boxed{z}$

□ value of solving any problem is $\boxed{1}$

→ cost of training a skill is $\boxed{C}$

→ will be optimal to train workers on range of skills

workers | [that encompasses whole range of tasks]

- Each worker has total time $\boxed{T}$

p → work on problems

h → help others w/ problem

$$t_h + t_p = T$$

Processing time

If worker can solve it, takes time $\boxed{P}$

if not, takes $\boxed{H}$

Two-Skillset Generalization

→ some workers have skills et $\boxed{S_1}$ & others disjoint set $\boxed{S_2}$

$\boxed{N}$ = # of problems firm will consider

$\boxed{\alpha}$ = fraction of W workers w/ skillset S_1

→ maximize expected # of problems solved

suppose $\boxed{S_1}$ "answers phone" & $\boxed{S_2}$ helps

S_1's Time $\{ N \cdot Pr(S_1)\, P + N[1-Pr(S_1)]\, Pr(z \ni S_2 \mid z \ni \sim S_1)\, P = \boxed{\alpha\, WT}$

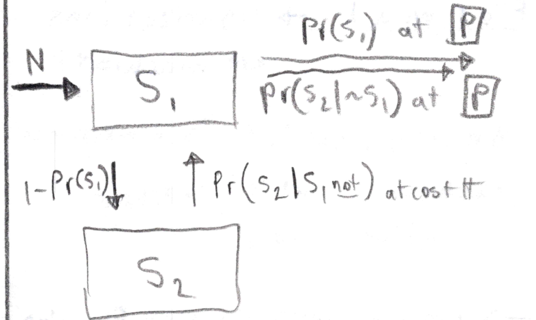
S_2's Time $= N[1-Pr(S_1)]\, Pr(z \ni S_2 \mid z \ni S_1)\, H = (1-\alpha)\, WT$

Firm's Expected Output $\{ \boxed{N \cdot Pr(z \ni S_1 \cup S_2)}$

$$\boxed{S_1 : \alpha = (NP/WT) * \{Pr(S_1) + Pr(S_2)\}}$$

$\boxed{S_2 :}$

Pictorially



Solving

Recognize $\boxed{\alpha = \left(\frac{NP}{WT}\right) \cdot \{Pr(S_1) + P(S_2)\}}$

= solve for $\boxed{N}$

Total Output

$$\boxed{WT\{Pr(S_1) + Pr(S_2)\} / (Pr(S_1)H + P \cdot \{Pr(S_1) + Pr(S_2)\})}$$

suppose **Both** Answer Phone & Help

- choose $\boxed{N}$ # of problems
- choose $\boxed{\alpha}$ fraction of W workers w/ skillset S_1
- Choose $\boxed{\beta}$ fraction of N problems arriving to $\boxed{S_1}$ workers

$S_1 \| (\beta N Pr(S_1))P + \beta N[1-Pr(S_1)]\, Pr(z \in S_2 \mid z \in \sim S_1)\, P + (1-\beta) N[1-Pr(S_2)]\, Pr(z \in S_1 \mid z \in \sim S_2)\, H = \alpha\, WT$

1. Problem to S_1, S_1 can solve
2. Problem to S_1, S_1 solved w/ help
3. Problem to S_2, S_1 helps on

- Analagous as before
  solve for $\boxed{d}$ & $\boxed{N}$

Output $\mid wT\{Pr(S_1)+Pr(S_2)\} / \boxed{D}$

→ output will be less than before

suppose: All workers receive identical training

- $N \to \infty$
- optimal output $=0$

Takeaway: Majority handles majority of problems

→ management handles exceptions

Real Organizations

- Decision Theory predicts relevant info will be gathered & analyzed prior to decision-making

→ organization is not a rational Being

Formal vs. Real Authority

- Superior often "rubber-stamps" a subordinate's proposal
- Shareholders → Board of Directors → CEO

- why and how would actor w/ formal authority cede real authority

A: other actor has better info & similar preferences

The Model

- $\boxed{3}$ potential projects $(k=1,2,3)$
- Benefits B_k to $\boxed{P}$, b_k to $\boxed{A}$
- one project has $B_k = b_k = -\infty$
- other Payoffs are

$B_k = B$ or 0 $\quad (B>0)$

$b_k = b$ or 0 $\quad (b>0)$

* Alignment Probability $\} \ \boxed{\alpha}$

w/ $Pr(\alpha) \to (B,b)$ or $(0,0)$

w/ $Pr(1-\alpha) \to (B,0)$ or $(0,b)$

$\boxed{\text{Info}}$ & $\boxed{\text{Control}}$

- A pays $\boxed{C_A(e)}$ for soft info

→ $Pr(e)$: A learns of all own payoffs

→ $Pr(1-e)$: A learns nothing

- P pays cost $C_P(E)$ for soft info

→ $Pr(E)$: P learns all own payoffs

→ $Pr(1-E)$: P learns nothing

- $\boxed{P}$ Formal authority ✓
- $\boxed{A}$ formal authority ?

P-Formal Authority

- P informed → chooses B
- P uninformed, but A informed → chooses b

Expected Payoffs:

$U_P = EB + (1-E)e\alpha B - C_P$

$U_A = E\alpha b + (1-E)eb - C_A(e)$

*Note: if neither informed stick to status quo $(0,0)$

→ w/ probability $\boxed{(1-E)e}$ A has real authority

- Best responses for $\boxed{P}$ & $\boxed{A}$
  - $\max_E EB + (1-E)e\alpha B - C_P(E)$
  - $\max_e E\alpha b + (1-E)eb - C_A(e)$
- suppos functional cost forms

$C_P = (K/2)E^2$

$C_A = (m/2)e^2$

$\Rightarrow \boxed{E = B(1-\alpha e)/K}$

$\boxed{e = (1-E)b/m}$

use to solve for $\boxed{E^*}$ $\boxed{e^*}$

Empowerment

Timing of one-shot game:

1. Principal offers (s, y^*) to agent

s = salary

$y^* \to$ promise to implement $y \geq y^*$

2. agent accepts (s,y) or rejects (U_0, π_0)

3. If Accept, A chooses $a \in [0,1]$ at cost $\boxed{c(a)}$

- P does not observe $\boxed{a}$
- Project delivered w/ probability $\boxed{a}$

$c(0) = 0$, $c'(0) = 0$

$\Rightarrow c'(a) \to \infty$ as $a \to 1$

* certainty of completion carries high price

4. P & A observe a project if it $\boxed{\text{exists}}$ & payoffs $\boxed{(x, y)}$

- $x > 0$

$y_L < y_M < 0 < y_H$ w/ probs a_L, a_M, a_H

5. If Project exists, principal chooses whether or not to implement

6. if implemented $\begin{cases} \pi = y - s & U = x + s - c(a) \end{cases}$

If not $\begin{cases} \pi = -s & U = s - c(a) \end{cases}$

- P will **ONLY** implement $\boxed{y_H} \to \boxed{A}$ chooses a_H

solving $\max_a \; s + a_H a x - c(a)$

result of one-shot game

→ unwilling to give high effort if low-chance of implement

Repeated Game Scenario

can $\boxed{y^* = y_M}$ in repeated-game

- In one-shot, P will not do $y < 0$

$\Rightarrow$ Agent's effort higher when y^* is lower

- Let $\boxed{a_{HM}}$ denote solution of

$$\max_a \; s + (a_M + a_H) a x - c(a)$$

- Agent will accept provided

$$s + a_{HM}(a_M + a_H) - c(a_{HM}) \geq U_0$$

Expected payoff to principal

$$\boxed{E[\pi_{HM}] = a_{HM}[a_M(x + y_M) + a_H(x + y_H)] - c(a_{HM}) - U_0}$$

Relational contract aspect

- will $\boxed{P}$ implement $\boxed{y_M}$?

$\square \; C_t + \frac{1}{r} E[C_T] \geq D_t + \left(\frac{1}{r}\right) E(P_t)$

$(y_M - s) + \frac{1}{r} E[\pi_{HM}] \geq -s + \left(\frac{1}{r}\right) \cdot \pi_0$

condition to not renege $\left\{ \boxed{\left(\frac{1}{r}\right)[V_{HM} - V_0] \geq -y_M} \right.$

positive #

→ principal always tempted to renege

Influence Activities

- Care what decisions are taken

→ care what decision makers believe

→ P wants $d_P^*(s)$

→ A wants $d_A^*(s)$, can influence

$$\boxed{\sigma = s + a_\sigma + \varepsilon}$$

→ A distracted from $y = a_y$

Influence (Model)

$\boxed{1.}$ Nature determines state $\boxed{S}$

$\Rightarrow \boxed{s \sim N(m, h)}$

$\boxed{2.}$ Agent chooses "lobbying" $\boxed{\lambda}$ at cost $K(\lambda)$

$\boxed{3.}$ Principal observes signal

$$\boxed{\sigma = s + \lambda + \varepsilon}$$

$\boxed{4.}$ Principal chooses decision $\boxed{d}$

$\boxed{5.}$ Parties receive payoffs

$$\boxed{U_i(s, d)}$$

Key points

- s not observed by $\boxed{P}$ or $\boxed{A}$
- λ not observed by P

Key Questions

- ☐ How will Principal update belief $f(s \mid \sigma)$
- ☐ What decision $\boxed{d}$ will Principal choose given belief
- ☐ What lobbying λ will agent choose