ECO 199 – GAMES OF STRATEGY
Spring Term 2004 – March 25
MORAL HAZARD – INCENTIVE PAYMENTS

EXAMPLE (Ch.9, Sec.4, pp.277-80) – MANAGERIAL BONUSES

Value of successful project = $600K
Success Probability = 0.8 if high effort
0.4 if low effort (was 0.6 in book)

Manager's outside opportunity = $100K
$-equivalent of his cost of making high effort = $50K

Owner's Surplus or profit
= 0.8 * 600 - 100 - 50 = 330 if high effort
0.4 * 600 - 100 = 140 if low effort
So high effort is better

HYPOTHETICAL IDEAL (called “First-Best” in economics)

No Info asymmetry – Effort directly observable
Owner offers manager a contract
“Make high effort and I will pay you $150K (plus a little)”

But if not directly observable and contractible,
must use scheme based on some observable indicator
This should be statistically correlated with effort
General idea: Contract to manager has base salary plus
a bonus if the observable indicator of success is favorable
Will consider various cases of varying difficulty
incentive schemes may not attain first-best
payoff lower than would be with full information

CASE 1 – Success itself is observable

Basic salary = s Bonus for success = b
Manager's expected payoff
if high effort: $s + 0.8 * b - 50$
if low effort: $s + 0.4 * b$
So to induce high effort, need $s + 0.8 * b - 50 \geq s + 0.4 * b$
This is called the Incentive compatibility condition / constraint (IC)
$(0.8-0.4) * b \geq 50$ or $b \geq 125$
Also need the individual rationality (IR) or
participation condition / constraint (PC):
$s + 0.8 * b - 50 \geq 100$ or $s + 0.8 * b \geq 150$

When these conditions are met (manager is making high effort),
owner's expected payoff = $0.8 * 600 - s - 0.8 * b$
To max this, he wants to keep s and b as small as possible
Solution: b = 125, and then $s = 150 - 0.8 * 125 = 150 - 100 = 50$
Then owner's expected payoff = 480 - 50 - 100 = 330
First-best is attained

In the book, low effort gave probability of success 0.6
High effort made less difference (only 0.8 - 0.6 = 0.2)
to probability of getting bonus
So needed larger size of bonus to motivate high effort
$(0.8-0.6) * b \geq 50$ or $b \geq 250$
Then the IR/PC constraint gave $s = 150 - 0.8 * 250 = - 50$
Negative salary can be interpreted as:
(1) manager puts up capital (equity stake or partnership)
(2) manager is fined on failure
But these may be infeasible or illegal
Then had to keep s = 0, over-fulfilling IR/PC, and
owner's expected payoff = $480 - 0 - 0.8 * 250 = 280 < 330$
If owner' outside opportunity between 280 and 330, he may
not implement worthwhile project: first-best was not achieved
This was the cost of the information asymmetry

Now go back to probabilities 0.8, 0.4 of success

Case 2 – Success not directly or immediately observable
Must use some other observable indicator
statistically related to actual success but with errors
(eventually what matters is statistical relation to effort)

Probability table relating true success to indicator		Indicator of success	
		Good	Bad
Actual success	Yes	0.75	0.25
	No	0.30	0.70

Bonus b paid if indicator is good. Probabilities of this:
with low effort: 0.4 * 0.75 + 0.6 * 0.3 = 0.30 + 0.18 = 0.48
with high effort: 0.8 * 0.75 + 0.2 * 0.3 = 0.60 + 0.06 = 0.66
The IC is (0.66 - 0.48) * b $\geq$ 50 or b $\geq$ 50/0.18 = 278
(Both types of errors reduce the probability difference,
so need bigger bonus to motivate high effort)
and IR/PC is s + 0.66 * b $\geq$ 150

Even if the owner keeps b at its smallest value, b = 278,
to keep the manager's total expected payment down to 150
requires s = 150 - 0.66 * 278 = - 33
If this is infeasible, letting s = 0 and over-fulfilling IR/PC
reduces the owner's expected payoff to
0.8 * 600 - 0.66 * 278 = 480 - 183 = 297 < 330
It is in the owner's interest to find indicators of success
that are as accurate as possible

Case 3 – Simultaneous projects (multi-tasking)

Two projects. Each if successful yields 600 to owner
Probabilities of success of each are 0.4 if low effort, 0.8 if high
Success of the two is statistically independent of each other
Same manager works on both
Manager's outside opportunity is now 200

Manager's extra cost of making high effort on only one is 50
and that for high effort on both is 50 + 50 + k = 100 + k
k > 0 – especially difficult to put high effort on both: substitutes
k < 0 – synergies in effort on the two; they are complements

If effort directly observable and contractible, owner can get effort
both low: 0.4 * 600 + 0.4 * 600 - 200 = 280
1 high / 1 low: 0.8 * 600 + 0.4 * 400 - 200 - 50 = 470
both high: 0.8 * 600 + 0.8 * 600 - 200 - 100 - k = 660 - k
So high effort on both is best so long as k < 660 - 470 = 190

Successes directly observable; bonuses b_1 , b_2 for the two tasks
ICs for inducing high effort on both must now
deter the manager from slacking on either or both projects:

$$s + 0.8 * b_1 + 0.8 * b_2 - 100 - k \geq s + 0.4 * b_1 + 0.8 * b_2 - 50$$
$$s + 0.8 * b_1 + 0.8 * b_2 - 100 - k \geq s + 0.8 * b_1 + 0.4 * b_2 - 50$$
$$s + 0.8 * b_1 + 0.8 * b_2 - 100 - k \geq s + 0.4 * b_1 + 0.4 * b_2$$

or

$$0.4 * b_1 \geq 50 + k , \quad 0.4 * b_2 \geq 50 + k ,$$
$$0.4 * (b_1 + b_2) \geq 100 + k$$

If k > 0, then satisfying the first two guarantees the third
So owner will keep $b_1 = b_2 = 125 + 2.5 * k$
And the IR/PC will give

$$s + 0.8 * (250 + 5 * k) - 100 - k = 200 \quad \text{or} \quad s = 100 - 3 * k$$

This is worse than if the agent's choice was "both or neither":
The third IC above gives $b_1 + b_2 \geq 250 + 2.5 * k$; then IR/PC is

$$s + 0.8 * (250 + 2.5 * k) - 100 - k = 200 \quad \text{or} \quad s = 100 - k$$

So now the possibility of s < 0 is higher

General result - Implementing good incentives in multi-task contexts
is harder if the tasks are substitutes
Conversely, it can be easier if they are complements
Example - teaching vs. research in universities, subst's or compl's?
This has implications for design of institutions –
try to group together complementary tasks

SUMMARY OF INCENTIVE SCHEMES

1. General situation – an "agent" performs action,
   a less-informed "principal" devises incentive scheme
   Typically consists of salary + outcome-dependent bonus
   Optimal design presents tradeoff
   Higher bonus motivates better effort by agent,
   but involves extra cost to principal
   - in our examples, over-fulfilling IR/PC to keep salary ≥ 0
   - in others, higher salary to compensate agent for risk

2. Total payment determined by participation condition
   i.e. by the manager or worker's outside opportunity
   Strength of incentive (spread between payment for
   good vs bad observation of indicator of success)
   determined by incentive compatibility condition

OTHER REMARKS ON MORAL HAZARD

1. Agent's risk-aversion
   Need spread between payments for good and bad
   outcomes to achieve incentive-compatibility
   But this creates risk for agent, so must offer
   higher average for participation
   Trade-off between risk and incentives

2. Multiple tiers of agency – Collusion at lower tiers
   Middle manager should be given incentive
   to enforce scheme designed for lowest level
   May imply need for weaker incentives to lowest level

3. Multiple owners (principals) with imperfectly aligned
   or conflicting objectives
   Then the agent's incentives (sticks or carrots) coming from any
   one principal can be offset by those offered by other principals
   Result – weak incentives in the aggregate
   Especially important in politics and public sector

OTHER WAYS TO COPE WITH MORAL HAZARD

1. Repeated relationships
   (1) If luck at different times is independent, then
   average output is accurate measure of average effort
   (2) Career concerns – use promotion or raises
   to achieve more early effort

2. Comparison with others
   if luck component is correlated across people
   then the ranking of your outcome is accurate
   indication of the ranking of your effort
   so prizes for best performances good incentives

3. The cost of coping with moral hazard depends on
   the agent's outside opportunity
   (1) Hire "motivated agent" who gets
   direct payoff from better outcome
   This may be easier in public sector, non-profits
   than in commercial firms
   (2) A given strength of incentive is consistent with
   different total expected payment to agent; can use
   "Carrot" – especially high reward for good outcome
   "Stick" – severe punishment for bad outcome
   Which to use depends on agent's outside opportunity
   So principal try deliberately to get agent
   who has poor alternative opportunity
   but such an agent may have low productivity
   Or take steps to worsen alternatives of prospective workers
   Stalinist policies!