Incentive Pay

Worker Motivation

- Work effort is often not directly observable
- Workers may be motivated to exert effort by:
  - intrinsic sense of achievement, purpose, camaraderie, or duty
  - extrinsic reward for output
  - reciprocity between employers and employees
  - prospect of promotion
  - threat of punishment or dismissal
  - reputation concerns

Incentive Contracts

- Pay is tied to performance (rather than hours)
- Examples: share contracts in agriculture, sales commission, bonuses and options tied to performance, contingency fees
- The assumption is that effort is unobservable but output (performance) is observable
- The basic idea is to design a contract which ties pay to performance to induce the worker to provide effort

Principal-Agent Model

- Output (x) is determined by worker effort (e) and some random factor (u):

$$x = qe + u$$

  - q is the marginal product of effort
  - u is a random variable with $\mathrm{E}[u] = 0$ and $\mathrm{Var}[u] = \sigma^2$

- The firm designs a contract $W(x)$ which ties the worker's pay to the observed output

- For simplicity consider a linear contract:

$$W(x) = \alpha + \beta x$$

  - α is the "base pay"
  - βx is the "performance pay" (which is variable because the worker can choose different effort levels and because of the random factor)

Worker's Decisions

- The worker takes the contract (α and β) as given, and decides
  - whether to accept the contract or not
  - if so, how much effort to exert
- The worker cares about two things:
  - his utility from the pay received (r is the degree of the worker's risk-aversion):

$$EU(W(x)) = \mathrm{E}[W(x)] - r\mathrm{Var}[W(x)]$$

  - his cost of exerting effort:

$$C(e) = c_0 + c_1 e + c_2 e^2$$

- $W(x) = \alpha + \beta(qe + u)$. So the worker chooses e to maximizes

$$(\alpha + \beta qe) - r(\beta^2\sigma^2) - (c_0 + c_1 e + c_2 e^2)$$

Optimal Effort Choice

- The first-order condition is

$$\beta q - c_1 - 2c_2 e = 0$$

- This gives

$$e^*(\beta) = \frac{\beta q - c_1}{2c_2}$$

- A higher β induces a higher e^*: $\partial e^*(\beta)/\partial \beta = q/(2c_2) > 0$
- A contract with a high value of β is a high-powered incentive contract

The Firm's Constraints

- Profits are:
$$\Pi = x - W(x) = -\alpha + (1-\beta)(qe+u)$$
- The firm is risk-neutral. It wants to maximize
$$\mathrm{E}[\Pi] = -\alpha + (1-\beta)qe$$
- The firm does not observe effort, so it cannot directly choose e. But we can think of the contract as recommending a certain level of e, as long as the worker is willing to follow this recommendation. This is the incentive compatibility constraint.
- The contract must also be acceptable to the worker—i.e., better than the reservation utility u_0 that the worker can get from his outside option. This is the participation constraint.

Contract Design Problem

- The contract design problem can be written as:

$$\begin{aligned} \max_{\alpha,\beta,e} \quad & -\alpha + (1-\beta)qe \\ \text{subject to} \quad & e = e^*(\beta) \\ & (\alpha + \beta qe) - r(\beta^2\sigma^2) - (c_0 + c_1 e + c_2 e^2) = u_0 \end{aligned}$$

- Use the participation constraint to eliminate α, and directly substitute $e^*(\beta)$ for e:

$$\max_{\beta} \quad qe^*(\beta) - \left(c_0 + c_1 e^*(\beta) + c_2 (e^*(\beta))^2\right) - r(\beta^2\sigma^2) - u_0$$

  - blue term is expected net output
  - red term is risk-premium
  - last term is the opportunity cost of work

Incentive-Insurance Tradeoff

- First-order condition is

$$(q - c_1 - 2c_2 e^*(\beta)) \frac{\partial e^*(\beta)}{\partial \beta} - 2r\beta\sigma^2 = 0$$

  - blue term is incentive effect, equal to net marginal product of effort times the effect of performance-pay sensitivity on effort
  - red term is insurance effect, equal to the effect of pay-performance sensitivity on the risk premium

- A higher-powered incentive contract is good for incentive but bad for insurance. The optimal contract balances this tradeoff

Optimal Contract

- We can use the formula $e^*(\beta) = (\beta q - c_1)/(2c_2)$ to solve the optimal β:

$$\beta^* = \frac{q^2}{q^2 + 4rc_2\sigma^2}$$

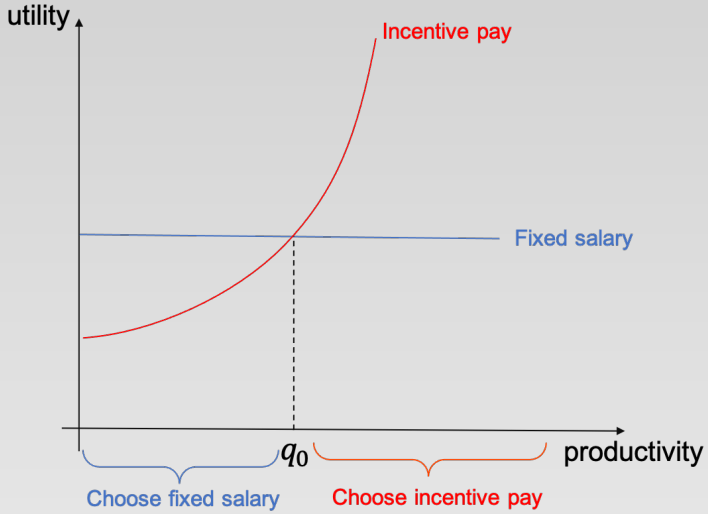
- Then use the participation constraint to recover α^*
- The optimal contract offers higher-powered incentives when
  - marginal product of effort is high
  - worker's risk-aversion is low
  - performance is not variable
  - sensitivity of marginal cost to effort is low
- If worker is not risk-averse, $\beta^* = 1$. This is the same as making the worker a residual claimant. Since he bears all the costs and benefits from increased effort, he chooses the efficient effort level.

Different Ways to Induce Worker Effort

- The optimal contract induces effort level $e_0 = (\beta^* q_0 - c_1)/(2c_2)$ from a worker with productivity q_0
- This contract is costly because the firm has to pay the worker a risk premium to compensate for his variable pay
- Suppose the firm instead pay workers a fixed salary and induce the same effort level e_0 by other methods (such as increased monitoring, or efficiency wages, to be discussed later). These other methods are also costly
- Whether performance pay or fixed salary is preferably depends on which method of inducing effort is cheaper
- But it also depends on the selection effect.

Selection Effect

- Suppose the cost of inducing effort e_0 from a worker with productivity q_0 using incentive pay is the same as the cost of inducing e_0 using fixed salary with monitoring
- Workers have different productivity q. Their net utility under these two payment schemes are shown here



- Workers with $q > q_0$ prefer incentive pay. Workers with $q < q_0$ prefer fixed salary
- Performance pay system attract better workers!

Safelite Glass Corporation

- Lazear (2000) studies the switch from fixed pay to performance pay at Safelite Glass Corporation, the largest installer of automobile glass in the U.S.
- During 1994 and 1995, glass installers were shifted from an hourly wage schedule to a piece rate schedule
- On average installers were paid about $20 per unit installed. At the time that the piece rates were instituted, the workers were also given a guarantee of approximately $11 per hour. If their weekly pay came out to be less than the guarantee, they would be paid the guaranteed amount
- Productivity could have been raised by requiring a higher minimum level of output under a time-rate system, coupled with a wage increase. However, since workers have different preferences, such a change might not be acceptable to all workers and might induce massive turnover. The firm therefore adopted a piece rate system, which allowed those who wanted to work more to earn more, but also allowed those who would accept lower pay to put forth less effort

Effects of Piece Rate

- Average output (units per worker per day) increased from 2.70 to 3.24
- Standard deviation of output increased from 1.42 to 1.59
- Regression results (dependent variable is log output)

	(1)	(2)	(3)	(4)	(5)
piece rate	0.368	0.197	0.313	0.202	0.309
tenure			0.343	0.224	0.424
time since piece rate			0.107	0.273	0.130
new regime					0.243
worker fixed effect	no	yes	no	yes	no
time fixed effect	yes	yes	yes	yes	yes

Detailed Analysis

- Other things also change during the switch to piece rate. Controlling for time effects (column (1)) gives an estimate of 0.368, which corresponds to approximately a 44 percent gain in productivity
- Controlling for worker effects (column (2)) gives an estimate of 0.197. This difference-in-differences estimate implies a 22 percent increase in productivity. This is a pure incentive effect
- The difference between 0.368 and 0.197 can be interpreted as a selection effect
- The selection effect is substantial

Detailed Analysis, Continued

- The positive coefficients on "tenure" (columns (3) to (5)) indicate that there is significant learning on the job.
- The positive coefficients on "time since piece rate" indicate that the effect of piece rate grows over time. If the effects were due to the Hawthorne effect, then the longer the worker were on the program the smaller would be the effect of piece rates on productivity.
- The "new regime" variable (column (5)) is set to 1 if the worker was hired after January 1, 1995, by which point almost the entire firm had switched to piece work. Workers hired under the new regime were more productive than those hired under the old regime, holding tenure constant.
- The worker fixed effects estimated from the regressions above are indicators of worker ability. The median fixed effect for those who leave no later than two months after the start of the piece rate system (the leavers) is 0.15. The median fixed effect for those who stay beyond the initial two months (the stayers) is 0.22

Other Effects

- The average pay-per-worker went up by 10.6% increase. This is under half the increase in per-worker productivity. 92% of workers experienced a pay increase.
- One defect of paying piece rates is that quality may suffer. In the Safelite case, most quality problems show up rather quickly in the form of broken windshields. Since the worker at fault can be easily identified, there is one easy solution: the installer is required to reinstall the windshield on his own time. Customer satisfaction went up after the introduction of performance pay.

Why Don't We See Incentive Pay Everywhere?

- There are other ways of inducing workers to exert effort
- Incentive pay exposes workers to risks
- Sometimes the risks are too large for any worker to bear, even if he is not risk-averse.
  - pay can be variable but it cannot be too low. There is a limited liability constraint which puts a lower bound on pay
- Measuring output is hard!
  - Safelite switched to piece rate only after installing an expensive IT system for inventory control and reduced installation lags
  - Sears introduced sales commission for its auto-repairs workers; Sears workers were incentivized to mislead customers into doing unnecessary repairs, resulting in a scandal and loss of reputation for Sears

Tradeoffs

- Output is multi-dimensional. Some aspects are easier to measure than others.
- Incentive pay based on easy-to-measure aspects of output causes workers to ignore difficult-to-measure aspects
  - quantity-quality substitution
  - sometimes the solution is to offer low-powered incentives to prevent this kind of substitution
- Workers perform many different tasks; some tasks are easier to measure than others
  - low-powered incentives may prevent workers from focusing only on the easy-to-measure tasks
- Team production requires incentivizing all workers in the team. But you cannot make everybody a residual claimant.
  - making A's pay more sensitive to output means making B's pay less sensitive—there is an incentive-incentive tradeoff