Lecture 5: The Risk-Incentive Trade-Off

Compensation in Organizations

Jacob Kohlhepp

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Recalling Performance Pay Results

Theorem 1

When wages depend only on output, effort is e_p which solves

$$c'(e_p) = \frac{1}{1 + r\sigma^2 c''(e_p)}$$

and $\beta_p = c'(e_p), \alpha_p = \bar{u} - \beta_p e_p + r\beta^2\sigma^2/2 + c(e_p)$.

- Focus on: $c'(e_p) = \frac{1}{1+r\sigma^2 c''(e_p)}$
- As σ^2 rises, β_p falls
- Incentives/performance pay/bonuses decrease with noise/luck/randomness.
- This is the risk-incentive trade-off.
- e_p also generally falls, although this is harder to prove.

Trade-Off is (in some sense) Theoretically Robust

- The model we solved is a very special type of principal-agent model.
- We could allow for nonlinear wages, general output, etc.
- However, even when we do this, we still find that risk aversion reduces incentives and effort.

Profit

- The level of effort is tied to total surplus/efficiency.
- As effort rises and goes to e^*, total surplus/efficiency rises.
- Therefore, since e_p falls with σ^2, profit should fall.
- To see this very clearly, let's derive profit when $c(e) = e^2/2$.
- Remember: $e_p = \beta_p = \frac{1}{1+r\sigma^2}$ in this case!

Profit Under Performance Pay and $c(e) = e^2/2$

$$
\begin{aligned}
\pi_p &= e_p - c(e_p) - \frac{r\beta_p^2\sigma^2}{2} - \bar{u} \\
&= \frac{1}{1+r\sigma^2} - \frac{1}{2(1+r\sigma^2)} - r\sigma^2 \frac{1}{2(1+r\sigma^2)} - \bar{u} \\
&= \frac{1}{1+r\sigma^2}\left(1 - \frac{1}{2(1+r\sigma^2)} - r\sigma^2 \frac{1}{2(1+r\sigma^2)} - \bar{u}\right. \\
&= \frac{1}{1+r\sigma^2}\left(1 - \frac{1+r\sigma^2}{2(1+r\sigma^2)}\right) - \bar{u} \\
&= \frac{1}{1+r\sigma^2}\left(\frac{2(1+r\sigma^2)}{2(1+r\sigma^2)} - \frac{1+r\sigma^2}{2(1+r\sigma^2)}\right) - \bar{u} \\
&= \frac{1}{1+r\sigma^2}\left(\frac{1+r\sigma^2}{2(1+r\sigma^2)}\right) - \bar{u} \\
&= \frac{1}{2}\frac{1}{1+r\sigma^2} - \bar{u}
\end{aligned}
$$

Performance Pay vs. Some Alternative Method

- Suppose the firm can use performance pay or some alternative with profit π_{alt}.
- It will choose performance paif if:

$$\pi_p = \frac{1}{2}\frac{1}{1 + r\sigma^2} - \bar{u} \geq \pi_{alt}$$

- As σ^2 rises, performance pay becomes less likely.
- This is a testable implication of the risk-incentive trade-off.

Table of Contents

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

Discussion

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

- Setting is medical group practices.
- At time of article, 61% of physicians worked in group settings.
- In these groups, physicians are co-owners making decisions together, including fees and resource allocations.
- Physicians have specialties but demand can be highly variable across specialties (exmaple?)
- Data shows how much compensation depends on output (1-10), size of group, price of an office visit, and a measure of physician risk aversion.

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

- Concern: self-reported measure of risk aversion may just reflect what physician experiences rather than what they “want.”
- Alleviated: risk aversion measure is negatively correlated with performance pay measure.
- 10% increase in incentives leads to 3.5% more visits.
- Price decreases demand (why is this a good sign?)

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

- Varying risk aversion variable across full range alters ofice visits by over 877 per year.
- The most risk averse physicians make about $11,582 less than the least risk averse.
- This is 10% of mean income.
- It is a measure of the efficiency loss of partnerships.

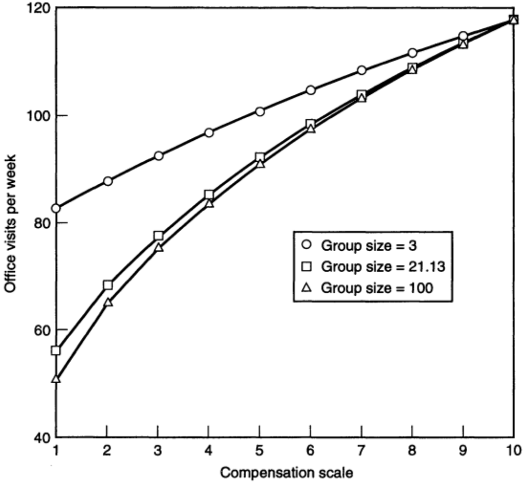
“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

TABLE 2 Instrumental Variable Estimates of the Individual Physician-Demand Function (7a). Dependent Variable: ln(office visits).

	Least Squares	Random Effects
Independent variables		
Constant	5.24***	5.05***
	(11.65)	(8.32)
Ln(incentive variable)[a]	.41***	.38***
	(5.35)	(4.29)
Ln(hours of nonphysician personnel)	.12***	.16**
	(3.27)	(2.36)
Ln(price)[a]	−.47***	−.49**
	(−2.71)	(−2.36)
Examining rooms	−.00006	.0000015
	(−.0003)	(.35)
Experience	.04***	.035***
	(6.61)	(6.17)
Experience, squared	−.001***	−.001***
	(7.63)	(−7.36)
Foreign medical graduate	−.18***	−.15**
	(2.85)	(−2.09)
Subspecialty	−.14***	−.14***
	(−3.32)	(−3.33)
Pediatrics	.10**	.12*
	(1.95)	(1.96)

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

INCENTIVES AND PHYSICIAN PRODUCTIVITY: SMALL, MEDIUM, AND LARGE GROUPS



Note: Evaluated at mean values.

“Moral hazard and risk spreading in partnerships” (Gaynor and Gertler 1995)

TABLE 5 Tradeoff Between Moral Hazard and Risk Spreading
Estimates of the Effect on an Increase in the Importance of Regularity of Income[a]

Source of Effect[b]	Annual Change	Office Visits Percent Change	Value[c,d]	Percent of Annual Income[c,d,e]
Incentive variable	−1,232.3	−28.4%	−$16,266.36	−14.5%
Compensation scale	−1,237	−28.5%	−$16,328	−14.6%
Group size	+5.61	+.13%	+$74.05	+.066%
Nonphysician inputs	+95.1	+2.04%	+$1,255	+1.12%
Total	−877.4	−20.36%	−$11,582	−10.38%

[a] Effect of change in importance of regularity of income from 1 to 4.
[b] Evaluated at the means.
[c] Calculated based on a 50-week year.
[d] Calculated based on a mean price of $13.20 per office visit in the data.
[e] Calculated based on a mean annual gross income for physicians of $111,900 in 1978 (Glandon and Shapiro, 1980).

“Is a Higher Calling Enough? Incentive Compensation in the Church” (Hartzell, Parsons, Yermack 2010)

- Recall the setting: Methodist ministers whoa re rotated but have their pay set by their congregation.
- The paper shows evidence that Methodist ministers pay is consistent with pay for performance.
- Ministers get more pay for adding more people to their church.
- Let’s focus on the portions related to the risk-incentive trade-off.

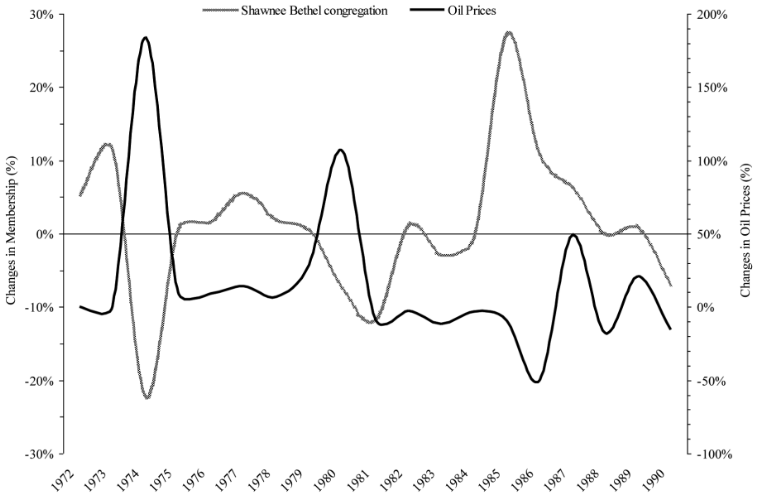
“Is a Higher Calling Enough? Incentive Compensation in the Church” (Hartzell, Parsons, Yermack 2010)

- The paper actually tests the risk-incentive trade-off two ways:
  - By estimating how volatile each church location’s membership is over 43 years.
  - By comparing oil-driven locations vs. non-oil drivne locations
- Both methods have problems (they are not the core result of the paper).
- But both point towards the existence of the risk-incentive trade-off.

Hartzell, Parsons, Yermack 2010: Direct Computation of Volatility

- Idea: use the entire time series of 43 years to compute the standard deviation of membership changes.
- In our performance pay model, this is a proxy for σ^2 if we assume that effort does not change much over time.
- The authors classify a church as "High Volatility" if the church's standard deviation is above the median.
- "High Volatility" churches pay on average $10.75 less per new member than the rest.
- This is 50% less "bonus" (β)
- One issue: perhaps at volatile churches the value of a member is just less (the coefficient on e is smaller) so they use lower incentives.

Hartzell, Parsons, Yermack 2010: Oil Booms



Hartzell, Parsons, Yermack 2010: Oil Booms

- Idea: use oil booms as proxy for volatility.
- This is “better” because oil booms are an exogenous or external factor impacting attendance.
- Boom and bust clearly bring people in and out (direct cyclical effect).
- But also, as a town gets richer from oil, attendance may also drop.

Hartzell, Parsons, Yermack 2010: Results

Table 7
Pay-Performance Sensitivity and Risk Factors

Dependent Variable	Δ(Total Comp.)	Δ(Total Comp.)	Δ(Total Comp.)
Δ(Members$_{t-1}$)	\$22.63***	\$18.48***	\$23.44***
	(4.61)	(3.16)	(4.57)
Δ(Members$_{t-1}$) × High Volatility	−\$10.75***		−\$8.45**
	(4.16)		(3.92)
Δ(Members$_{t-1}$) × Oil Driven		−\$8.06**	−\$5.67*
		(3.57)	(3.36)
Δ(Members$_{t-1}$) × Average Membership × 10^{-3}	−3.29**	−1.90**	−3.09***
	(1.36)	(.93)	(1.18)
Observations	15,760	15,758	15,758
R^2	.062	.062	.063
Year fixed effects	Yes	Yes	Yes
Number of church clusters	698	696	696

Table of Contents

“The Tenous Trade-off Between Risk and Incentives” (Prendergast 2002)

TABLE 1
THE TRADE-OFF OF RISK AND INCENTIVES FOR EXECUTIVES

Authors	Measure of Risk	Result
Lambert and Larcker (1987)	Volatility of returns	–
Garen (1994)	Volatility of returns	0
Yermack (1995) (options only)	Variance of returns	0
Bushman et al. (1996)	Volatility of returns	0
Ittner et al. (1997) (full sample)	Correlation of financial and accounting returns	0
Aggarwal and Samwick (1999)	Volatility of returns	–
Core and Guay (1999)	Idiosyncratic risk	+
Conyon and Murphy (1999)	Volatility of returns	0
Jin (2000)	Idiosyncratic risk	–
Core and Guay (in press)	Volatility of returns	+
Oyer and Shaefer (2001)	Options grants	+

“The Tenous Trade-off Between Risk and Incentives” (Prendergast 2002)

The amount sharecroppers keep (β) is positively associated with noise (σ^2).

TABLE 2
THE TRADE-OFF OF RISK AND INCENTIVES FOR SHARECROPPERS

Authors	Measure of Risk	Result
Rao (1971)	Variance of profits	+
Allen and Lueck (1992)	Coefficient of variation in yield	+
Allen and Lueck (1995)	Coefficient of variation in yield (within crop)	+

“Incentive Contracting and the Franchise Design.” (Lafontaine and Slade (2001))

TABLE 3
RISK AND THE DECISION TO FRANCHISE

Authors	Industry	Result
Martin (1988)	Panel across sectors	+
Norton (1988)	Restaurants and hotels	+
Lafontaine (1992)	Many sectors (business format franchising)	+
Anderson and Schmittlein (1984)	Electronics components	0
John and Weitz (1988)	Industrial firms	0

Table of Contents

Choosing What to Do

- Our model assumes the worker only chooses e.
- But what if the worker also chooses what to exert effort on.
- For this discussion assume the firm can measure effort.
- What if also the worker knows the benefit of each activity, but the firm does not?

Supporting source: “The Tenous Trade-off Between Risk and Incentives” (Prendergast 2002)

Choosing What to Do

- The firm has two choices: (1) choose what the agent can do and specify an effort based wage (2) let the agent choose and specify an output based wage.
- We can get the right effort from (1), but the firm might choose the wrong activity.
- We will get the wrong effort from (2) but the worker will choose the right activity (why?)
- The key observation is that the maximum of random variables generally depends on variance.

Supporting source: "The Tenous Trade-off Between Risk and Incentives" (Prendergast 2002)

Choosing What to Do

- For two normal random variables with mean 0 and variance σ^2 we have:

$$E[\max\{\epsilon_1, \epsilon_2\}] = \frac{\sigma}{\pi}$$

- So “delegation” using performance pay $w(y)$ (option 2) becomes better relative to effort-based pay and command and control (option 1) when variance is larger.

- This overturns our earlier result and suggests a positive relationship between risks and performance pay!

- CEOs, franchising, etc. requires making complex decisions with situation-specific knowledge.

Supporting source: “The Tenuous Trade-off Between Risk and Incentives” (Prendergast 2002)

Favoritism in Performance Evaluations

- It is typically supervisors, not firms, that measure output via performance evaluations.
- But it is is costly for supervisors to give employees they like bad performance evaluations.
- And the cost grows when more is on the line: that is when β is higher!
- Therefore stronger incentives (higher β) makes supervisors less truthful about employee performance.
- Example: If you and I are good friends at work, I want you to make more money.

Source “Uncertainty and Incentives” (Prendergast 2002)

Favoritism in Performance Evaluations

- But suppose a firm (not the supervisor) uses performance evaluations for two things:
  1. To encourage effort (as in our model).
  2. To allocate the worker to the right job (not in our model).

Favoritism in Performance Evaluations

- How does favoritism impact goal 1 (encouraging effort)?
- Suppose a supervisor's favoritism for a person is given by K that just adds to their reported output: $\tilde{y} = K + y = K + e + \epsilon$.
- When $K > 0$ there is biased towards the person, when $K < 0$ they are biased against the person.
- The supervisor and the worker know K exactly.
- From the firm's perspective the supervisor's favoritism for a person is given by a random variable K that just adds to their reported output: $\tilde{y} = K + y = K + e + \epsilon$.
- Suppose on average favoritism is unbiased ($E[K] = 0$) and independent of everything else.

Favoritism in Performance Evaluations

- Then for fixed effort and wages, the worker will receive:

$$w(\tilde{y}) = \alpha + \beta\tilde{y} = \alpha + \beta(K + e + \epsilon)$$

- From the perspective of the worker, favoritism is known and just shifts utility by a constant:

$$E[w(\tilde{y})] = E[\alpha + \beta(K + e)] + E[\beta\epsilon] = \alpha + \beta e = \beta K$$

$$Var(w(\tilde{y})) = Var(\alpha + \beta(K + e)) + Var(\beta\epsilon) = 0 + \beta^2\sigma^2$$

- From the perspective of the firm, profit is:

$$\pi = E[y - w(\tilde{y})] = E[e + \epsilon - \alpha - \beta(K + e + \epsilon)] = e - \beta e - \alpha$$

  where K has dropped out entirely because the firm is risk neutral.

- Therefore the firm can easily account for favoritism in the wage.

Favoritism in Performance Evaluations

- But when performance evaluations are used for goal 2 (allocation) there are big problems.
- When a supervisor reports a biased evaluation $\tilde{y} \neq y$, the firm cares about whether bias is positive or negative.
- Otherwise they may accidentally assign the worker to a task they are actually bad at doing!
- As β rises, $\tilde{y}$ becomes more biased.
- Then $\tilde{y}$ becomes less useful for allocating talent.
- This is a new tension between encouraging effort and allocating people, and it is real (e.g. talent hoarding).

Favoritism in Performance Evaluations

- How does this impact the risk/incentive trade-off?

Favoritism in Performance Evaluations

- How does this impact the risk/incentive trade-off?
- In this context, we can think of σ^2 as measuring how much output reflects true talent.
- The higher σ^2, the less output tells us about talent.
- But if σ^2 is high, even if there is no bias ($\tilde{y} = y$) performance evaluations are useless for allocating talent!
- Therefore goal 2 does not matter, and we have a potential positive correlation between risk and incentives!

Deciding When to Investigate

- In our model, we assumed output is always known.
- In reality, output is only sometimes monitored.
- Further, it is monitored more often when people suspect slacking/shirking/cheating.
- Consider a model where a supervisors chooses whether to launch an investigation.
- If no investigation, the worker gets a wage equal to expected output (so a flat salary)
- If investigated, they get actual output.

Source “Uncertainty and Incentives” (Prendergast 2002)

Deciding When to Investigate

- When deciding to investigate, the supervisor gets a signal or impression of output.
- There is some cost to investigation (laying it out here is beyond the scope of this class)
- The supervisor investigates if the expected benefit of doing so is great enough.
- In this setting, greater performance pay (β) is needed to encourage effort when noise is greater, because we also need to encourage investigations.
- Intuitively, noise makes workers think they can get away with it.
- this also generates a positive link between risk and incentives.

Source "Uncertainty and Incentives" (Prendergast 2002)