Reflections on Agency Models

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Conference in Honor of Paul Milgrom

November 5-6, 2009

Outline of talk

1. Dynamic agency – (since HM ’87)

2. Multitask agency – (since HM ’91)

3. Looking ahead

Dynamic Agency

HM ’87 motivation

- Canonical effort model all about informativeness of performance measures
- Intuitive solution (eg. sufficient statistic, RPE), but overly sensitive to likelihoods
- Mirrlees knife-edge example

$$y = \mu + \epsilon, \epsilon \sim N(0, \sigma^2)$$

- What does it take to get simpler – say linear – incentive scheme?

HM '87 recap

- Agent chooses drift of Brownian process for *t* in [0,1]; contingent on history Y^t

$$dY_t = \mu_t dt + \sigma dZ_t$$

- Exponential utility *u* at end-of-period

$$u(I(Y^1) - \int_0^1 c(\mu_t)dt)$$

- Stationary problem. Solution linear in time aggregates. Optimal to implement constant drift.

Recent dynamic agency models

Two directions:

- Generalization: Schattler-Sung, Sung ‘95, Williams ‘09, Sannikov ’08, Adrian-Shin ‘08, Garrett-Pavan ‘09

- Specialization: *DeMarzo-Sannikov ’06*, ‘08, *Edmans-Gabaix ’09*, Edmans et al ’09,….

- Main theme: agent choices tailored to deliver tractable models with more economic content

DeMarzo-Sannikov JoF '06

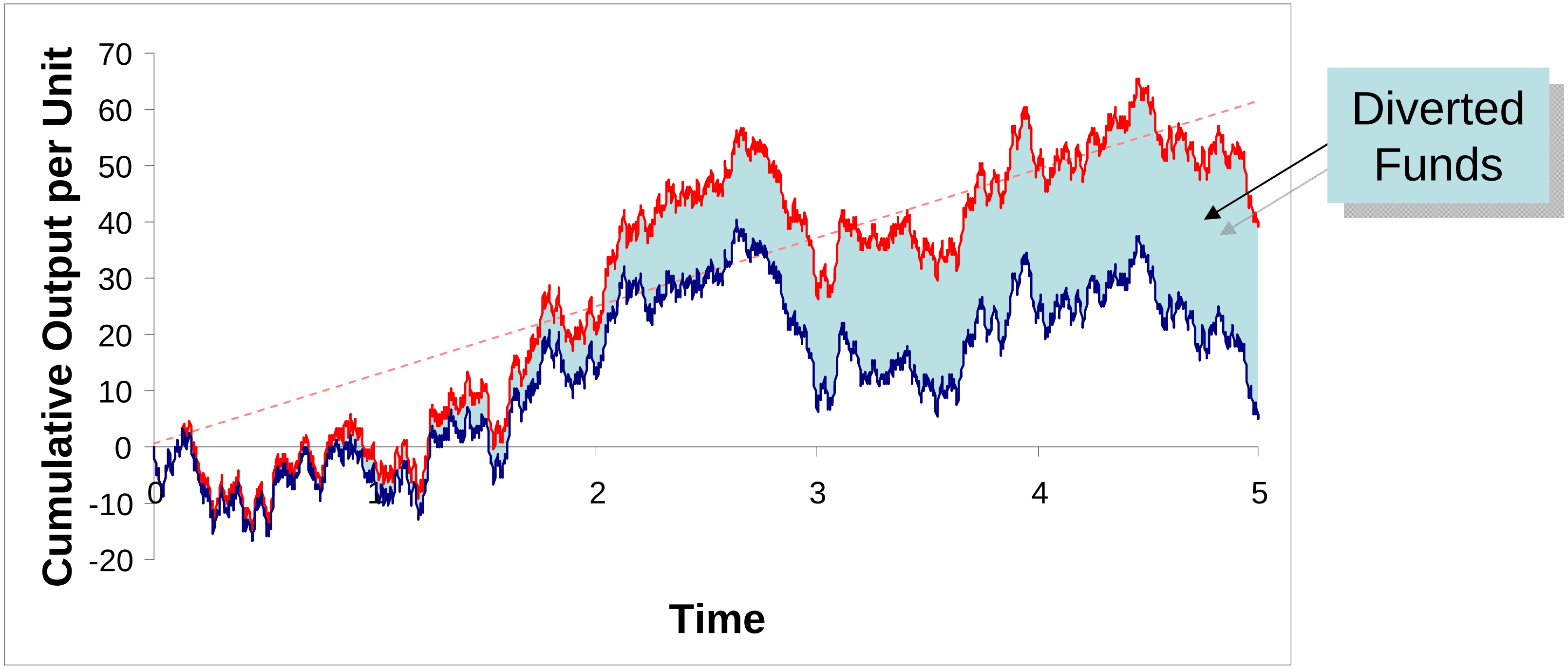
Setting:

- Risk neutral entrepreneur (agent) and investor (principal)
- Initial investment $K > 0$; agent has no money
- Time is continuous. Cumulative cash flow Y_t evolves as

$$dY_t = \mu dt + \sigma dZ_t$$

- $\mu > rK$ (project has positive NPV stream)
- Investor doesn't observe cash flow. Relies on report $\hat{Y}_t$
- Agent can divert cash flow for private benefit $\lambda < 1$ per $

Realized (red) and reported (blue) cash flow



Contracting and payoffs

- Full commitment contract (τ, I) – termination rule τ, agent payment I_t as function of reported cash flow history.
- Outside options: R (agent), L (principal). Inefficient to terminate, but running out of cash will force it.
- Optimal to prevent diversion (truth-telling constraint binds)
- Agent's payoff (discount rate γ)

$$W_0 = E[\int_0^\tau e^{-\gamma s} dI_s + e^{-\gamma \tau} R]$$

- Principal's payoff (discount rate $r < \gamma$) is

$$b_0 = E[\int_0^\tau e^{-rs}(d\hat{Y}_t - dI_s) + e^{-r\tau} L]$$

Continuation utilities

- $\{W_t, b(W_t)\}$ continuation utilities for agent, principal

- By Martingale Representation Theorem the agent's continuation utility satisfies

$$dW_t = \gamma W_t dt - dI_t + \beta(\hat{Y})(d\hat{Y}_t - \mu dt)$$

Sensitivity to report depends on full history

Solution – key steps

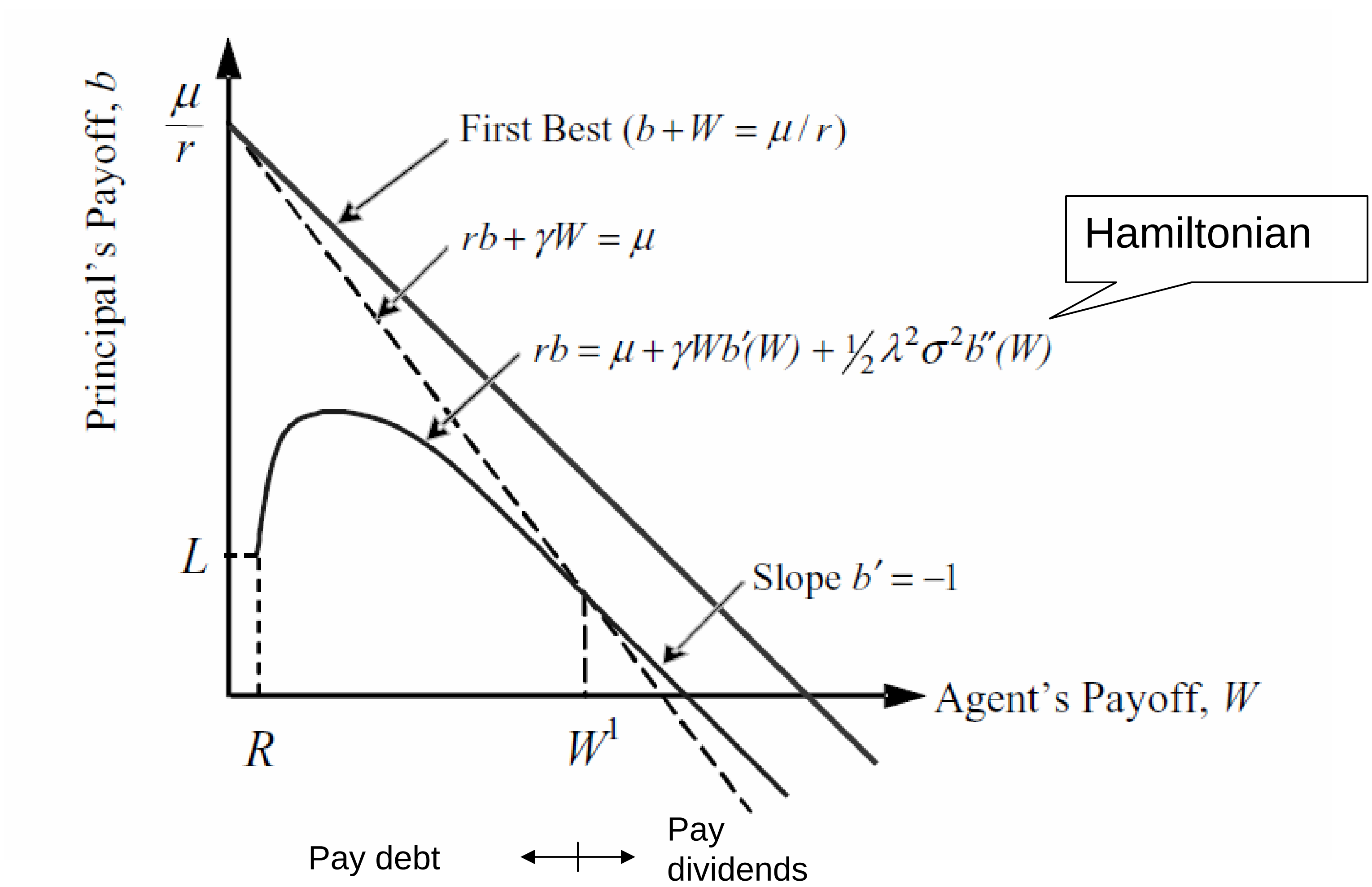
- To prevent diversion $\beta_t \geq \lambda$
- Optimal to minimize probability of inefficient termination by setting $\beta_t = \lambda$ (minimizes volatility of *W*)

- $b'(W) \geq -1$ (transferring *dW* in cash always possible)
- Assuming *b* is concave, the payment to agent therefore

$$dI = \max(W - W^1, 0)$$

- W^1 is reflecting boundary (agent down brought back to boundary through cash transfer).

Utility Possibility Frontier



Implementation

- Optimal policy can be implemented with following capital structure:
  - Give agent fraction λ of equity (rescinded at termination)
  - Provide firm with finite credit line at interest rate γ (the agent's discount rate)
  - Issue LT debt (console) paying interest r (market rate)
- Let agent decide on dividends and debt repayments. Liquidate when firm runs out of cash.
- Agent's optimal policy: pay back debt (LT and credit line) before paying any dividends. Any excess cash paid out as dividends.

Comments

- Diversion, risk neutrality plus interest rate differentials give stark (but not unrealistic) results.
- Could let agent save (at lower rate than discounting) without altering result.
- Analysis more tractable than discreet time analog (DeMarzo-Fishman '03). Comparative statics. Asset prices.
- Method involves "guessing" solution.
- Often reverse engineering. No criticism – on the contrary

Edmans-Gabaix '09

- Goal: get "simple" rules without Exp-Norm assumptions.
- T periods
  - Both P and A observe output sequence $\{r_t\}$

$$r_t = e_t + \eta_t$$

  - Agent chooses effort e_t *after* observing η_t

- Payoffs
  - Principal pays $c(r_1, ...r_T)$ to agent at T
  - Principal risk neutral. Agent's utility at T

$$E[u(v(c) - \Sigma_t g(e_t))]$$

One period problem

- Assume $v(c)=c$ and T = 1.
- After observing η the agent maximizes

$$u(c(e+\eta)-g(e))$$

- Assume η has interval support. Then only scheme that implements e^* for all η is

$$c(r) \quad = \quad g'(e^*)r+K$$

- Doesn't depend on utility function u!!

Two period problem

Date 2: $u(c(r_1, r_2) - g(e_1) - g(e_2))$

Implementing e_2^* for all η : $c(r_1, r_2) \quad = \quad g'(e_2^*)r_2 + k(r_1)$

Date 1: $E[u(k(r_1) - g(e_1) + g'(e_2^*)r_2 - g(e_2^*))]$ =
$E[\hat{u}(k(r_1) - g(e_1))]$

Another one-period problem: $k(r_1) \quad = \quad g'(e_1^*)r_1 + K$

T-period solution for implementing deterministic path:

$$c \quad = \quad \Sigma_t g'(e_t^*)r_t + K$$

Implementing max effort

- Assume that there is a maximum level of effort, e^{max} and that the value of effort is so high in second best that e^{max} will be optimal to implement in each period regardless of η. Then **optimal incentive scheme linear in aggregate output.**

- In general, *v(c)* is linear and *c* convex

$$E[u(v(c) - \Sigma_t g(e_t))]$$

- "Max effort" powerful, but often unreasonable (Garrett-Pavan '09)

Dynamic “incentive account”

- Edmans-Gabaix-Sadzik-Sannikov ’09 studies variant with geometric returns and CRRA utility (with periodic consumption)
- Additional constraints: (i) manipulation (ii) hidden saving
- Second-best (log-linear incentive) can be implemented using “incentive account”
  - earnings placed in escrow; “invested” in equity and cash
  - fixed percentage of balance can be withdrawn each period (prevents manipulation)
  - continuously rebalanced to keep proportion of equity fixed (to maintain LT incentives)

Multitask Agency

Single task

$$x = e + \epsilon$$

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

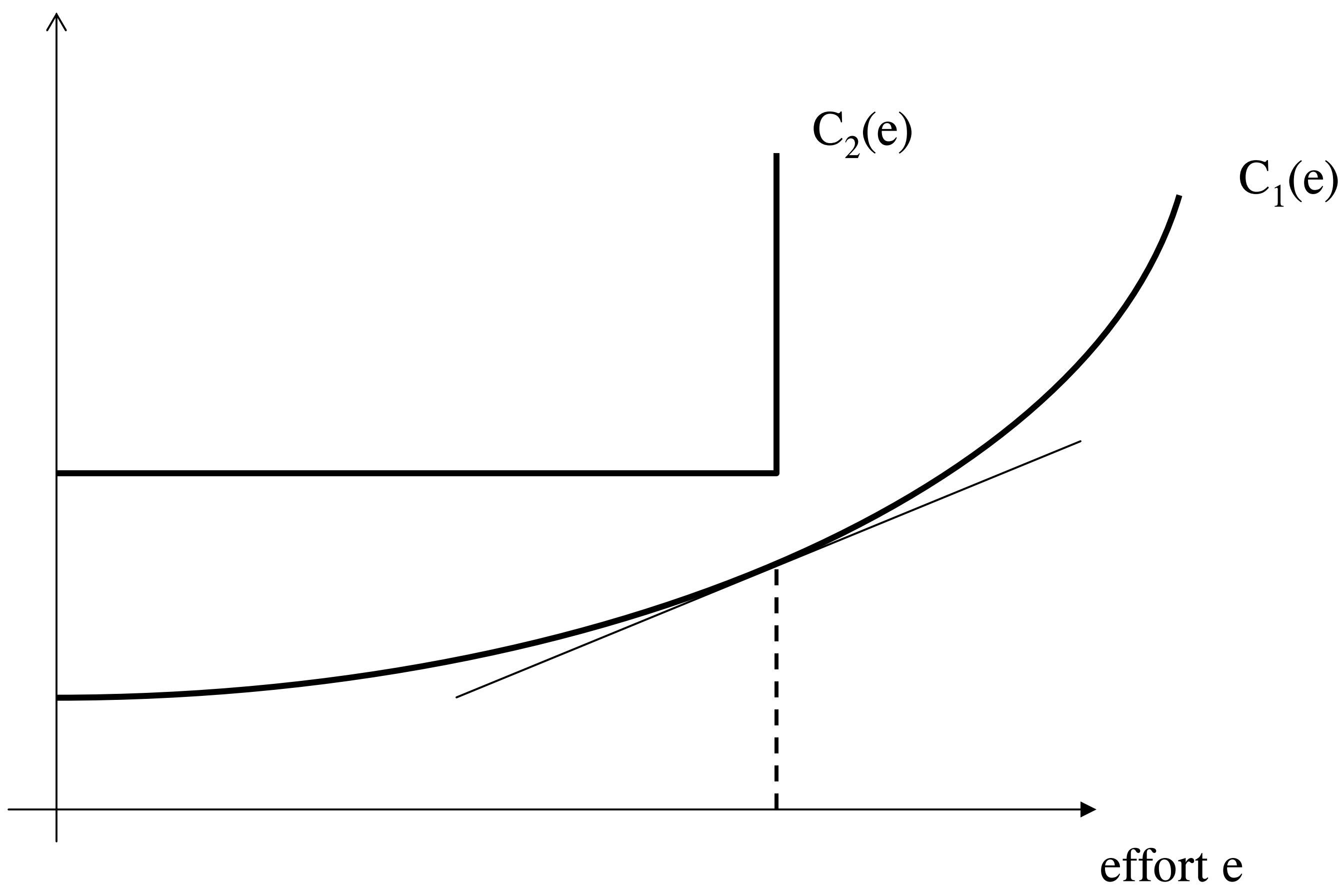
$$TS = e - C(e) - \frac{1}{2} r\sigma^2\alpha^2$$

$$\alpha = C'(e(\alpha))$$

$$\alpha^* = \frac{1}{1 + r\sigma^2 C''}$$ ← **Key**

Two ways to provide incentives for single task: reward performance and change opportunity cost

The role of opportunity cost



Many instruments

- Explicit and implicit pay
  - Reduce incentives on substitute tasks (low-powered incentives for balance); opposite for complements

- Job design
  - Bureaucratic rules (exclude “distracting” tasks, use objective criteria)
  - Task allocation (delegate decision rights, split up conflicting tasks)
  - Vary intensity of monitoring/communication
  - Promotion rules

- Allocation of ownership (outsourcing)

How should one design **incentive systems**?

"Multitask Lab" (HM '94)

$e = (e_1, \ldots e_n)$; $B(e)$ – P's benefit; $C(e)$ – A's cost

$$
\begin{aligned}
e &= (e_1, .., e_n) \\
x_i &= f_i(e) + \epsilon_i \\
s(x) &= \Sigma \alpha_i x_i + \beta
\end{aligned}
$$

Special ca… …ed on '92) – misalign…

$$
\begin{aligned}
B(e) &= f_1 e_1 + f_2 e_2 \\
Ce) &= e_1^2/2 + e_2^2/2 \\
x &= g_1 e_1 + g_2 e_2 \\
\alpha &= \frac{||f|| \cos\theta}{||g||}
\end{aligned}
$$

Theoretical applications

- Private vs public ownership (Hart et al '97)
  - Effort into cost reduction and improved quality
  - Private ownership puts excessive weight on cost reduction relative to quality enhancement
- Missions (Dewatripont et al '99)
  - Attention/monitoring affects incentives through reputation
  - Narrow vs broad tasks; types of officials
- Advocates (Dewatripont-Tirole '99)
  - Using advocates removes conflicting incentives for information collection

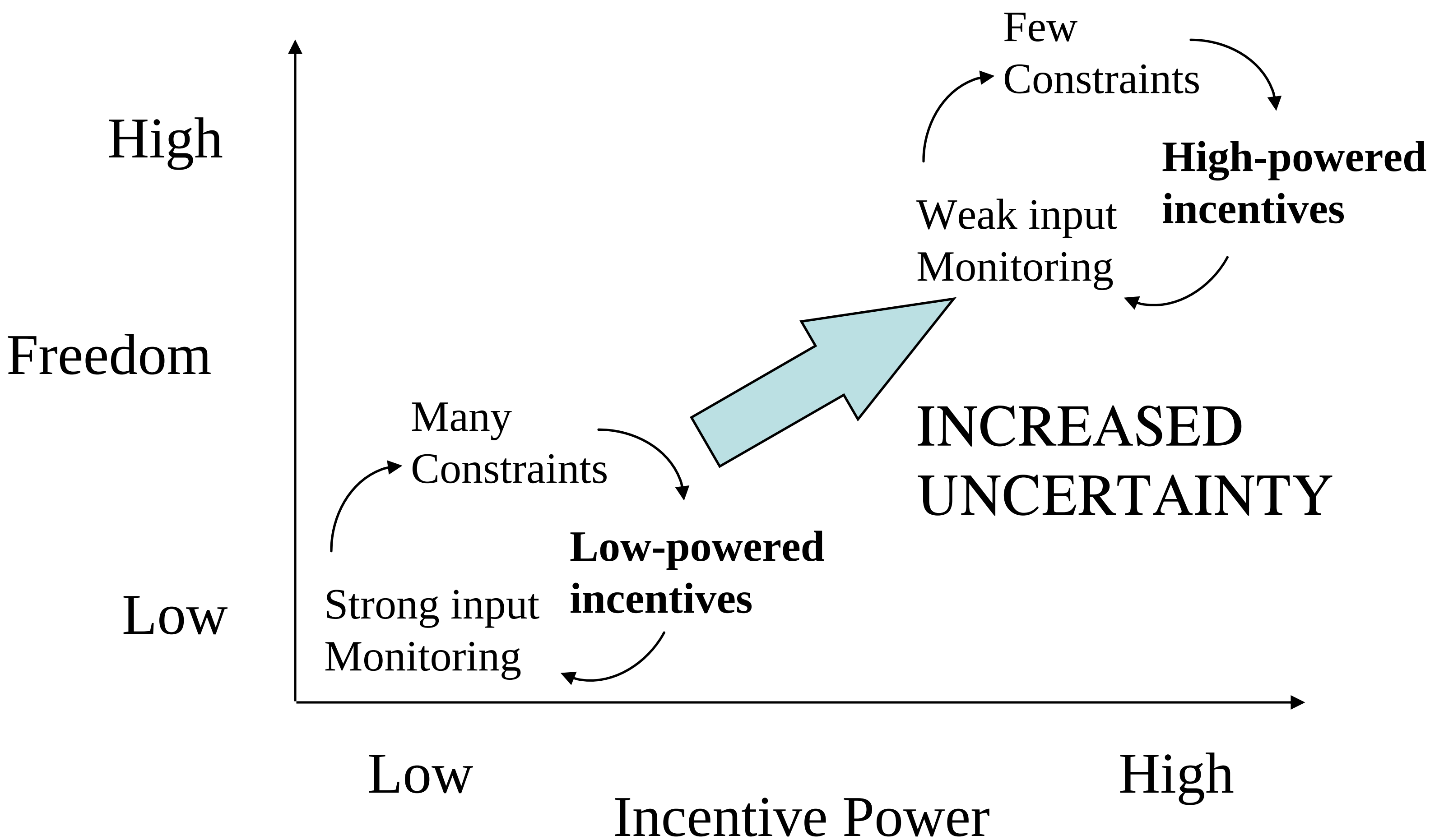
Direct evidence on multitasking

- Teaching
  - evidence on “teaching to test” surprisingly mixed; context matters; teachers matter (Podursky-Springer ’07)
- Manipulation
  - Non-linear incentives show strong evidence of strategic timing (Oyer ‘98)
  - Earnings management (higher accruals) when incentives stronger (Bergstresser-Philippon ’05)
- Complex jobs have less pay for performace (McLeod and Parent ’98)

Noise versus Uncertainty (Prendergast '99, '02)

- Standard agency trade-off: incentives versus risk. Should co-move negatively
- Often the other way around: higher risk associated with stronger incentive.
- Reconciliation: in standard agency models risk is measurement error. But there's also environmental uncertainty to deal with.
- Freedom to act on information requires stronger incentives

Co-movements with increased uncertainty



Co-movements in trucking (Baker-Hubbard '03)

- Activities: driving and servicing (cargo handling)
- Make-or-buy decision: Private or for-hire
  - Private carriers monitor; for-hire carriers also allocate time (search for backhauls, etc)
- How did new IT technology affect make-or-buy decision?

  (Two types of OBC: Trip recorders and EVMS)
  - Trip recorder adoption leads to more shipper ownership
  - EVMS adoption has less impact on shipper ownership than trip recorder adoption
  - Trip recorders have bigger effect on shipper ownership when services important (cargo handling)

Reflections on multitasking

- "Folly of hoping for A while rewarding B" identified problem, but failed to explore richness in response.
- Multitasking is really about managing multiple instruments. Non-financial incentives especially important
- Multitasking a framework, not a model. Price theory with a costly price. Tailoring model to context is critical (Hubbard-Baker '03, Lafontaine-Slade '96, Slade '97)
- To what extent do firm boundaries get determined by incentive considerations? Second-best applied to private sector problems (Holmstrom '99)

Looking ahead

- Are we building our theories on the right behavioral premises?
  - People motivated by more than money.
  - By what and how does it affect incentive/organizational design?
- How should we treat heterogeneity?
  - Very limited use of menus. Why?
- Do we have the design objective right?
  - People care a lot about fairness, not just efficiency
  - Current debate about CEO compensation
  - Personal experience: logic of maximizing total surplus and then dividing the pie doesn’t resonate.