

# Relative Performance Evaluation and Managerial Outside Options

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- Relative Performance Evaluation (RPE)
  - Performance relative to a benchmark [Holmstrom (1982)]
- RPE for executives:
  - Filtering aggregate uncertainty from executive compensation
  - Benchmark: industry or market performance
  - Little or no empirical evidence (RPE puzzle)

- Theory:
  - Hedging by executives: Garvey and Milbourn (2003)
  - Softening competition: Salas Fumas (1992)
  - Participation constraint: Oyer (2004)
  - Technology: Celentani and Loveira (2006)
- Empirics: vast!
  - Rajgopal, Shevlin and Zamora (2006)

- Principal-agent problem (optimal contracting)
- Moral hazard with hidden effort
- Limited commitment
- Aggregate shocks affect
  - firm's technology
  - managerial outside options

- Principal needs a manager to operate a stochastic technology mapping effort to outcomes
- The distribution of outcomes depends on managerial effort (unobservable) and an aggregate outcome (observable)
- Manager has an outside option with value depending on the aggregate outcome

1. Aggregate outcome  $y_A$  is realized according to a distribution described by  $p$ . The outcome determines the manager's reservation utility  $\underline{V}(y_A)$
2. The principal offers the manager a contract recommending an effort  $a$  and specifying compensation scheme  $w$  mapping outcomes to wages
3. If the manager rejects, both parties enjoy their reservation utilities. If the manager accepts, (s)he exerts some effort  $a'$  unobservable by the principal
4. An outcome  $y$  is realized according to a distribution conditional on  $y_A$  and  $a'$  described by  $\pi(\cdot, a', y_A)$
5. The principal pays  $w(y)$  to the manager

- **Assumption 1.** Two possible levels of effort, two possible outcomes
- **Notation:**
  - $\underline{\pi}$  is the probability of low outcome conditional on low effort
  - $\bar{\pi}$  is the probability of low outcome conditional on high effort
- **Assumption 2.**  $\underline{\pi} > \bar{\pi}$  [stochastic dominance and strong monotonicity of the likelihood ratio]
- **Assumption 3.** Given a contract  $(a, w)$  and an outcome  $y$  :
  - the manager's utility is  $v(w) - a$ , where  $v$  is twice continuously differentiable, strictly increasing and strictly concave.
  - the principal's utility is  $y - w(y)$

# Model

## Principal's problem

$$\max_{a, w(\cdot)} \sum_y (y - w) \pi(y, a, y_A) \text{ s.t.}:$$

$$a \in A \tag{F}$$

$$\sum_y (v(w) - a) \pi(y, a, y_A) \geq \underline{V}(y_A) \tag{IR}$$

$$a \in \arg \max_{a' \in A} \sum_y (v(w) - a') \pi(y, a', y_A) \tag{IC}$$



# Model

Marginal effect of aggregate outcome on (agent's utility of consuming) the wage

- Low effort

- $\frac{\partial V}{\partial y_A}$

- High effort (if marginal effect is the same for both distributions)

- $\frac{\partial V}{\partial y_A} + k \frac{\partial \bar{\pi}}{\partial y_A}$

- $k := \frac{\bar{a}-a}{\bar{\pi}-\pi}$  (additional disutility of high over low effort divided by its relative contribution to the probability of success)

- $k$  is the (minimum) utility premium incentivizing high effort

- **CASE 1.** The distribution of individual outcomes does not depend on the aggregate outcome
- **CASE 2.** The distribution of individual outcomes depends on the aggregate outcome:
  - positively for a pro-cyclical firm
  - negatively for a counter-cyclical firm

- **VRU** (Varying Reservation Utilities)
  - Pro-cyclical outside option value:  $\frac{\partial V}{\partial y_A} > 0$
- **CRU** (Constant Reservation Utilities)
  - Manager's reservation utility equals  $E_p \underline{V}$  for any aggregate outcome

### LOW EFFORT:

- CASE 1 and CASE 2:
  - CRU: Compensation **does not depend** on aggregate outcome
  - VRU: Compensation **increases** in aggregate outcome

### HIGH EFFORT:

- CASE 1:
  - CRU: Compensation **does not depend** on aggregate outcome
  - VRU: Compensation **increases** in aggregate outcome
- CASE 2:
  - CRU:
    - [Counter-cyclical] Compensation **increases** in aggregate outcome
    - [Pro-cyclical] Compensation **decreases** in aggregate outcome
  - VRU:
    - [Counter-cyclical] Compensation **increases** in aggregate outcome (more than under CRU)
    - [Pro-cyclical] Compensation **increases/decreases** in aggregate outcome **if** the increase in reservation utilities **dominates/is dominated** by the increase in the probability of success weighted by  $k$

- Does aggregate outcome affect optimal effort?
  - Both low and high effort more costly under VRU than under CRU
  - Increase in  $\underline{V}$  reinforces low effort, while decrease in  $\underline{V}$  reinforces high effort
    - locally for a wide class of utility functions (CARA, most CRRA)
    - globally for log-utility

# Illustration 1. Model with continuous-valued shocks

## Timing

1. Aggregate shock  $\eta$  observed
2. Manager's reservation utility  $\underline{V}(\eta)$ ,  $\underline{V}'(\eta) \geq 0$ , observed
3. Optimal contracting:  $a, w(\cdot)$
4. Manager exerts effort  $a'$ , unobserved by the principal
5. Idiosyncratic shock  $\varepsilon$  correlated to  $\eta$  realized, unobserved by the principal
6. Firm's outcome  $y$  is realized and  $w(y)$  is paid to the manager

# Illustration 1. Model with continuous-valued shocks

## Assumptions

- $v(w) = -e^{-rw}$
- $y = g(a) + \eta + \varepsilon, g'(a) > 0$
- $\varepsilon, \eta$  jointly normal (correlation  $\rho$ )
  - $\rho > 0$  for pro-cyclical firm
  - $\rho < 0$  for counter-cyclical firm
- $w_I(y) = \alpha + \beta y$



# Illustration 1. Model with continuous-valued shocks

## Results

- $\beta^* = \frac{\log\left(\frac{V(\eta)+\underline{\alpha}}{V(\eta)+\bar{\alpha}}\right)}{r(g(\bar{\alpha})-g(\underline{\alpha}))} > 0$
- CRU: aggregate shocks affect the intercept, but not the slope. The effect on the intercept is proportional to the slope
  - $\frac{\partial \alpha}{\partial \eta} = -\beta^* \left(1 + \rho \frac{\sigma_\varepsilon}{\sigma_\eta}\right)$ 
    - [Pro-cyclical] negative effect
    - [Counter-cyclical] ambiguous effect (it may become positive if the individual shock is sufficiently noisy and sufficiently correlated to the aggregate shock)
- VRU: aggregate shock also affects the slope and positively so. The effect on the intercept is ambiguous for both pro- and counter-cyclical firms

# Illustration 1. Model with continuous-valued shocks

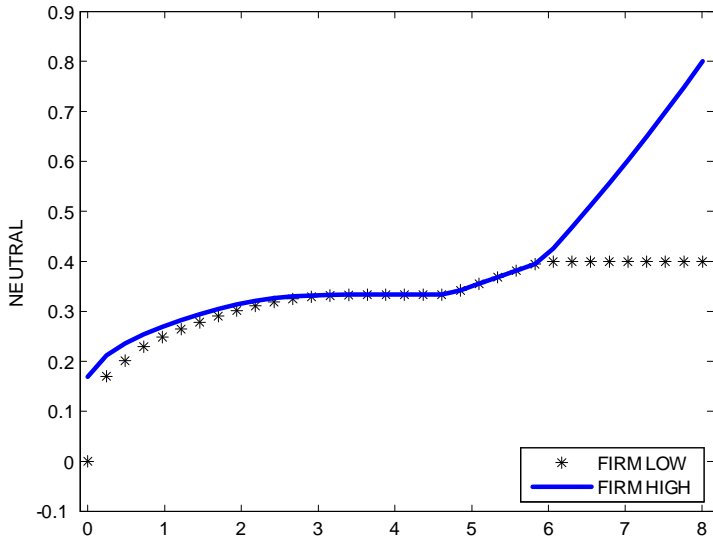
## Results (continued)

- Other results:
  - An increase in the mean of the individual shock decreases the intercept proportionally to the slope.
  - An increase in the dispersion of the individual shock that is exactly matched by an increase in the dispersion of the aggregate shock increases the intercept (intuition: the agent needs to be compensated for the increase in the idiosyncratic risk)
  - If only the dispersion of the aggregate shock increases, deviations from its mean bring less information about individual shocks and the principal uses less relative performance evaluation in agent's pay. In particular, the principal of a pro-cyclical firm decreases the agent's fixed pay less following a high aggregate shock and increases it less following a low aggregate shock.

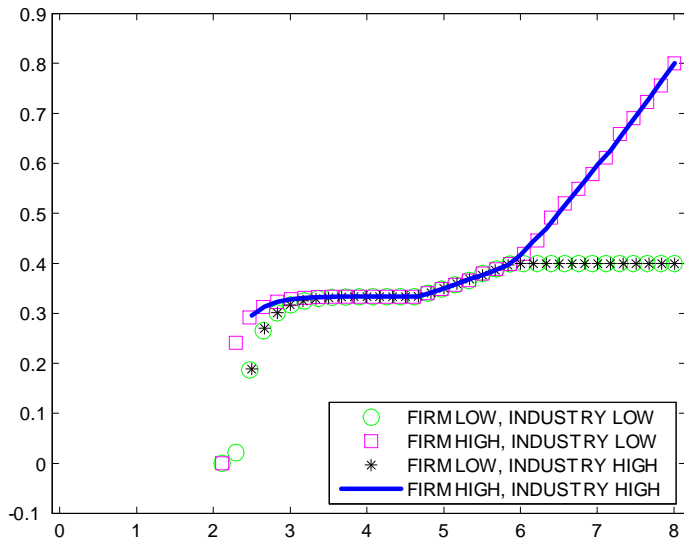
# Illustration 2. Dynamic model

## Outline

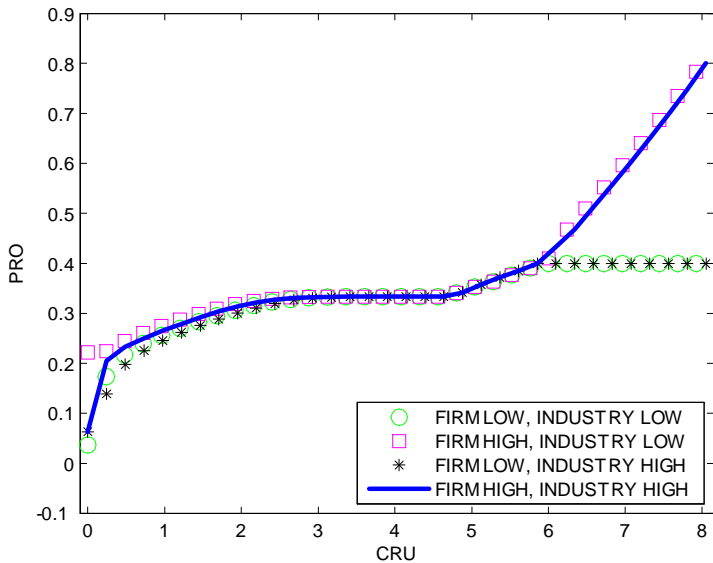
- Repeated agency problem with hidden actions and no long-term commitment
- Stationary on the Cartesian product of aggregate outcomes and agent's continuation utilities
- Two- or three-step recursive algorithm



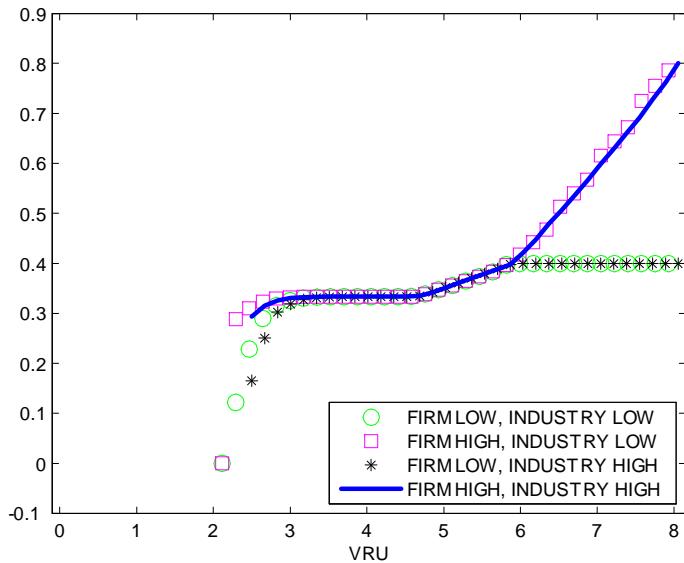
## Neutral, CRU



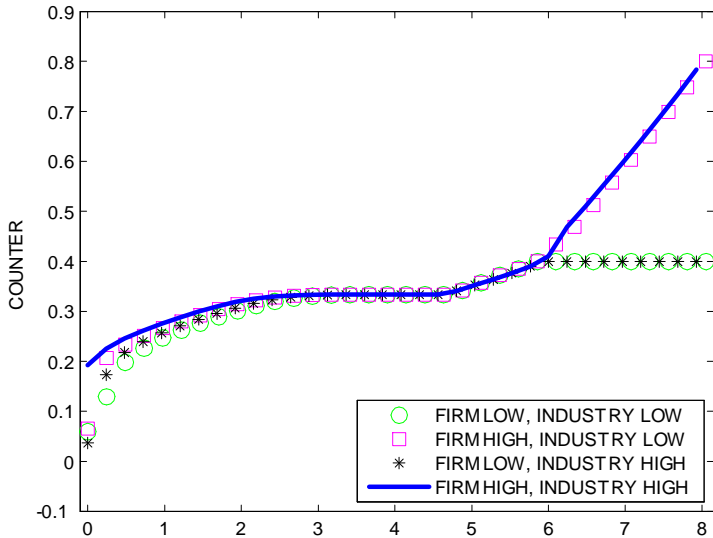
## Neutral, VRU



Pro, CRU

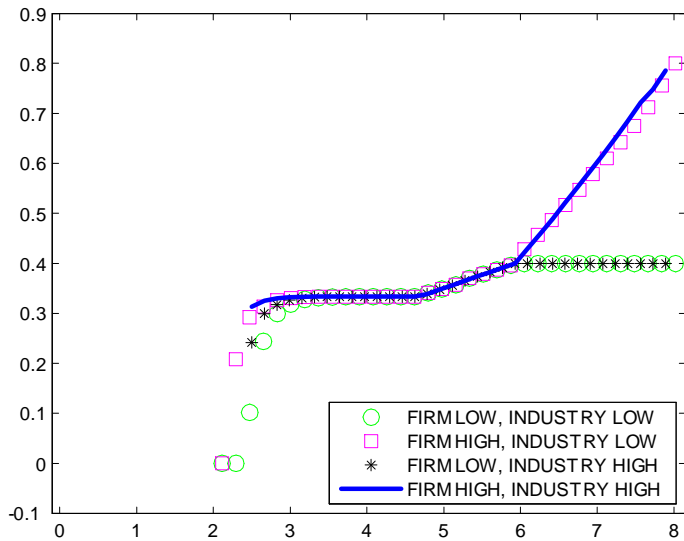


## Pro, VRU

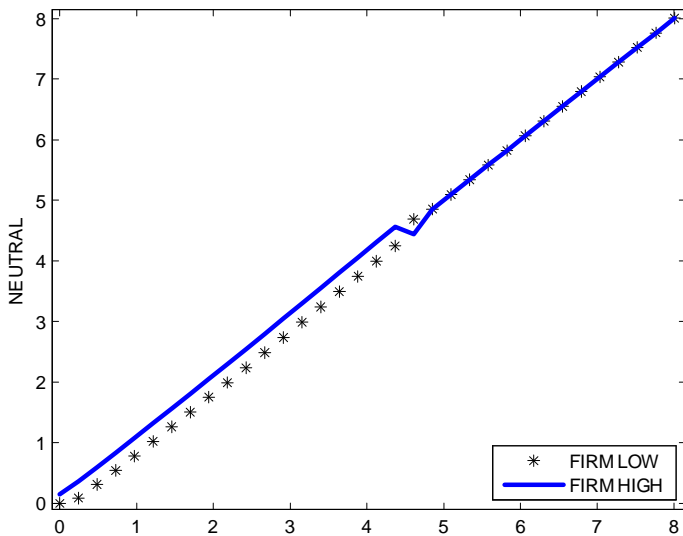


## Counter, CRU

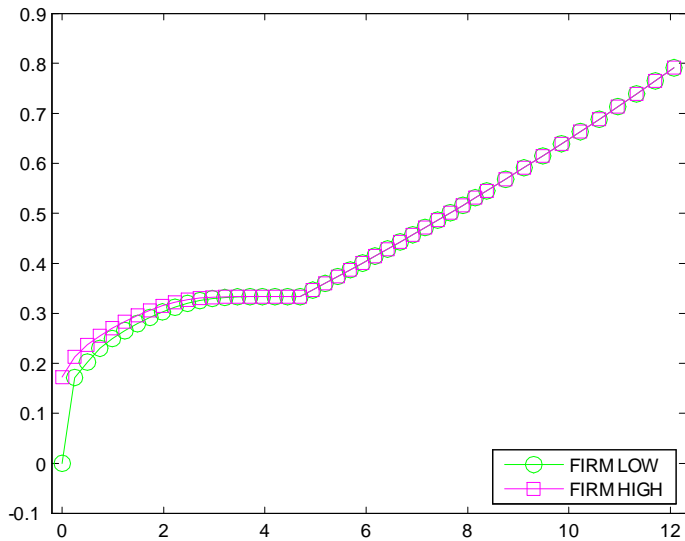




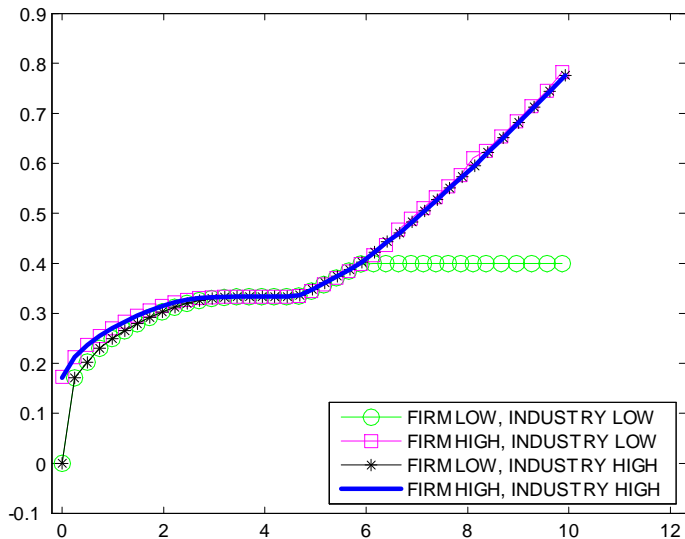
## Counter, VRU



## Neutral, CRU



## Neutral, CRU, uniform borrowing limit



Neutral, CRU, pro-cyclical borrowing limit