Managerial Incentives, Capital Reallocation, and the Business Cycle

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Introduction and Motivation

Capital reallocation is procyclical. - Question

- What makes it hard to reallocate or redeploy capital in bad times?

Countercyclical reallocation frictions due to agency problems

- Costly to induce less productive managers to declare that capital should be reallocated.
- More costly to do so in bad times when ...
  - ... expected compensation is low (since incentive cost are then borne by the investor).
  - ... managers require more compensation to relinquish control (because outside options are worse).

Consistent with empirical facts

- Capital reallocation procyclical.
- CEO turnover and compensation remarkably procyclical.

Stylized Facts

Capital reallocation and the business cycle

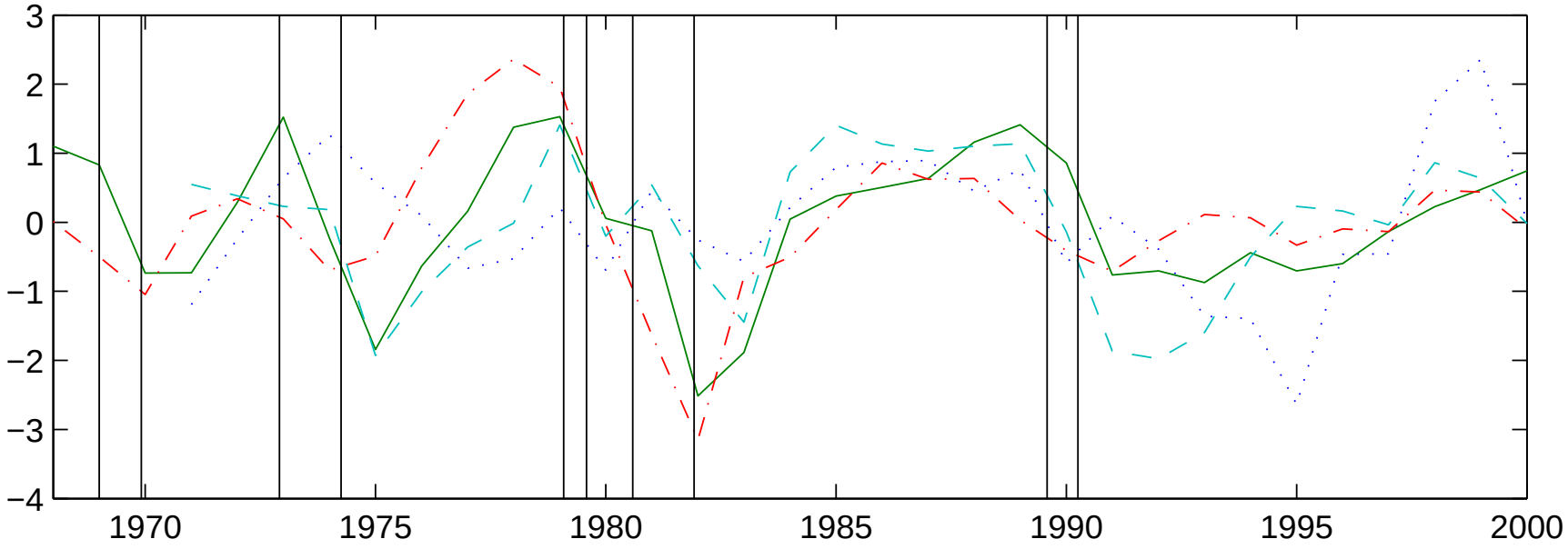
- Capital reallocation is procyclical: correlation of (HP-filtered) capital reallocation and output is 0.64. (See Eisfeldt and Rampini (2006)).
- Related evidence: Maksimovic and Phillips (2001) and literature on merger waves (e.g., Holmström and Kaplan (2001)).

CEO turnover, executive compensation and the business cycle

- New stylized fact:
  - Data from Bebchuk and Grinstein (2005) and Kaplan and Minton (2006).
  - Correlation between CEO turnover and output is 0.82.
  - Correlation between executive compensation and output is around 0.9.

Figure 1: Capital Reallocation and the Business Cycle

GDP and acquisitions (dashed), sales of property, plant, & equipment (dash dotted), and existing home sales (dotted). Source: Eisfeldt and Rampini (2006).



- Capital reallocation is procyclical.
- In contrast: benefits to capital reallocation, measured by cross sectional dispersion of productivity measures, seem countercyclical.

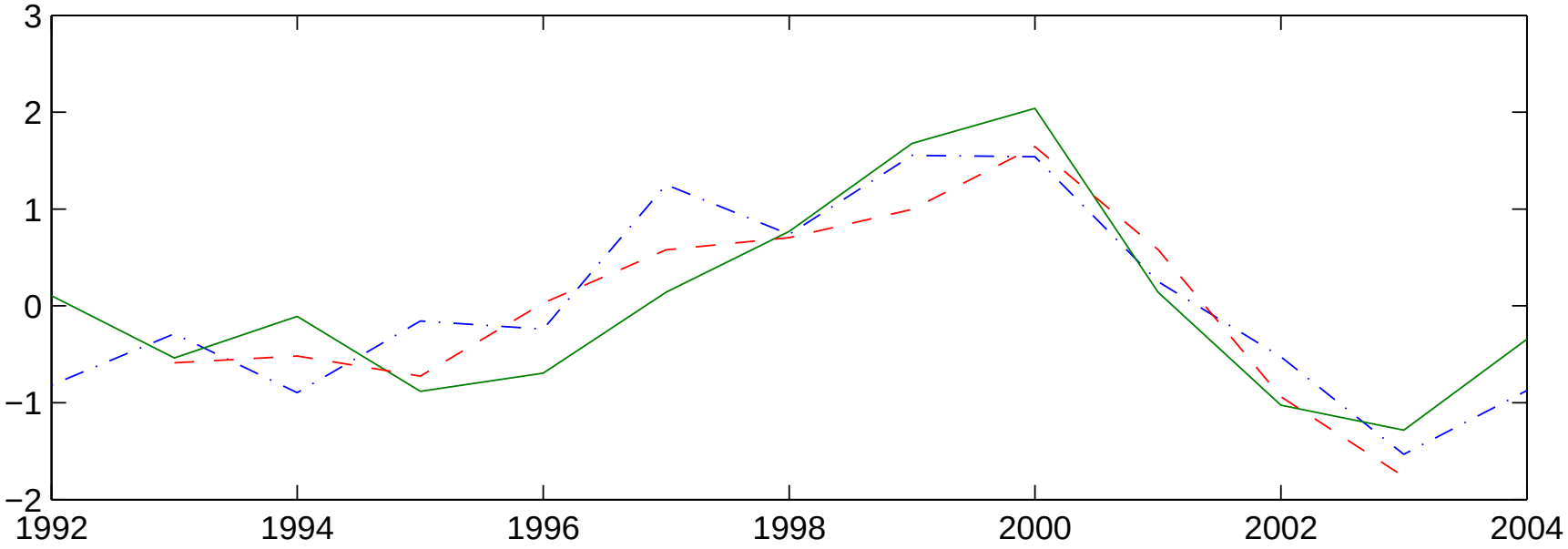
Table 1: CEO Turnover, Executive Compensation, and the Business Cycle

Panel A: Correlation with Output		
CEO Turnover	0.818	
	(0.158)	
Executive Pay	CEO only	Top 5 Executives
S&P 1500	0.912	0.918
	(0.062)	(0.061)
Large firms (S&P 500)	0.911	0.921
	(0.070)	(0.058)
Medium firms (Mid-Cap 400)	0.831	0.881
	(0.093)	(0.099)
Small firms (Small-Cap 600)	0.736	0.701
	(0.135)	(0.207)

Panel B: Correlation with CEO Turnover		
Executive Pay	CEO only	Top 5 Executives
S&P 1500	0.927	0.931
	(0.056)	(0.051)
Large firms (S&P 500)	0.913	0.913
	(0.061)	(0.063)
Medium firms (Mid-Cap 400)	0.946	0.963
	(0.041)	(0.038)
Small firms (Small-Cap 600)	0.778	0.821
	(0.161)	(0.150)

Figure 2: CEO Turnover, Executive Compensation, and the Business Cycle

CEO turnover and executive compensation over the business cycle. Solid line denotes GDP, dash dotted line denotes CEO Turnover, and dashed line denotes mean compensation for the top 5 executives in firms that belong to the S&P 1500 index.



- CEO turnover and executive compensation are remarkably procyclical!

Literature

Capital reallocation

- New investment: Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Rampini (2004).
- Reallocation of assets: Shleifer and Vishny (1992), Eisfeldt (2004), Rhodes-Kropf and Viswanathan (2004).
- Reallocation of funds: Holmström and Tirole (1998), Caballero and Krishnamurthy (2001), Gorton and Huang (2004).

Related

- Incentives for sharing bad news early.
  - Harris and Raviv (1990), Levitt and Snyder (1997), Povel (1999), Hertzberg (2003).
- Incentives in intra-firm resource allocation.
- Golden parachutes and severance pay.
- Corporate governance and the business cycle.

Model: Roadmap

Within period contracting problem

- Managers have private information about specific productivity of capital under their control and receive private benefits.
- Bonuses required to get managers to reveal bad news early.
- Reallocation is costly when bonuses are borne by investor.

Dynamic general equilibrium business cycle model

- In good times, when expected compensation is high, cash bonuses are financed by productive managers; but in bad times, these are borne by investors.
- Implication:
  - In bad times, less reallocation; capital more illiquid.
  - Endogenous total factor productivity (TFP).

Incentives for Relinquishing Control

Environment

- 3 within period dates: 0, $\frac{1}{2}$, 1, or, "spring", "summer", and "fall".
- Representative Investor
  - Preferences: $u(c)$ over date 1 consumption.
  - Technology: Access to continuum of identical production technologies. Each requires initial investment k plus one manager.
  - Endowment: Endowed with $K = k$ units of capital (for now). Hence, hire measure one managers to manage measure one of projects.
- Managers:
  - Continuum of managers with unobservable reservation utility $v \in [0, \infty)$.
  - If $\bar{m}$ managers hired, reservation utility of marginal manager is $v(\bar{m})$ where v is increasing and convex in $\bar{m}$.
  - $K = k \Rightarrow \bar{m} = 1$.
  - Managers receive private benefits b per unit of capital under their control at date 1.

Incentives for Relinquishing Control (Cont'd.)

Timing

- Date 0 (Spring): Managers hired, promised $v(\bar{m})$.
- Date $\frac{1}{2}$ (Summer):
  - Managers learn productivity a_H (probability π) and a_L otherwise (i.i.d. across managers); make announcement.
  - Investor chooses reallocation; capital after reallocation $k_{\hat{s}}$.
- Date 1 (Fall):
  - Output is produced. Output for manager of type s who announces $\hat{s}$ is $a_s k_{\hat{s}}$ and output is *observable*.
  - Dividend and/or bonus payments are made.
  - Managers obtain private benefits $bk_{\hat{s}}$.
  - Managers ad investor consume.

Figure 3: Timeline for 3 Date Economy

0	1/2	1
"Spring"	"Summer"	"Fall"
• Investor hires $\overline{m}=1$ managers	• Managers realize a_H w.p. π or a_L w.p. $(1-\pi)$ • Investor chooses and implements reallocation	• Output is produced • Bonuses are paid to managers and managers realize private benefits • Investor consumes

Contracting Problem

Representative agent's problem

- The representative investor solves:

$$\max_{k_H,k_L,d_H,d_L,d_{LH},d_{HL}} u(c)$$

subject to a participation constraint for the marginal manager (PC)

$$\pi\{(a_H+b)k_H-d_H\}+(1-\pi)\{(a_L+b)k_L-d_L\}\geq\bar{v},$$

two incentive compatibility constraints,

$$(a_s+b)k_s-d_s\geq(a_s+b)k_{\hat{s}}-d_{\hat{s}s},\quad\forall s,\hat{s}\in\{H,L\},s\neq\hat{s}$$

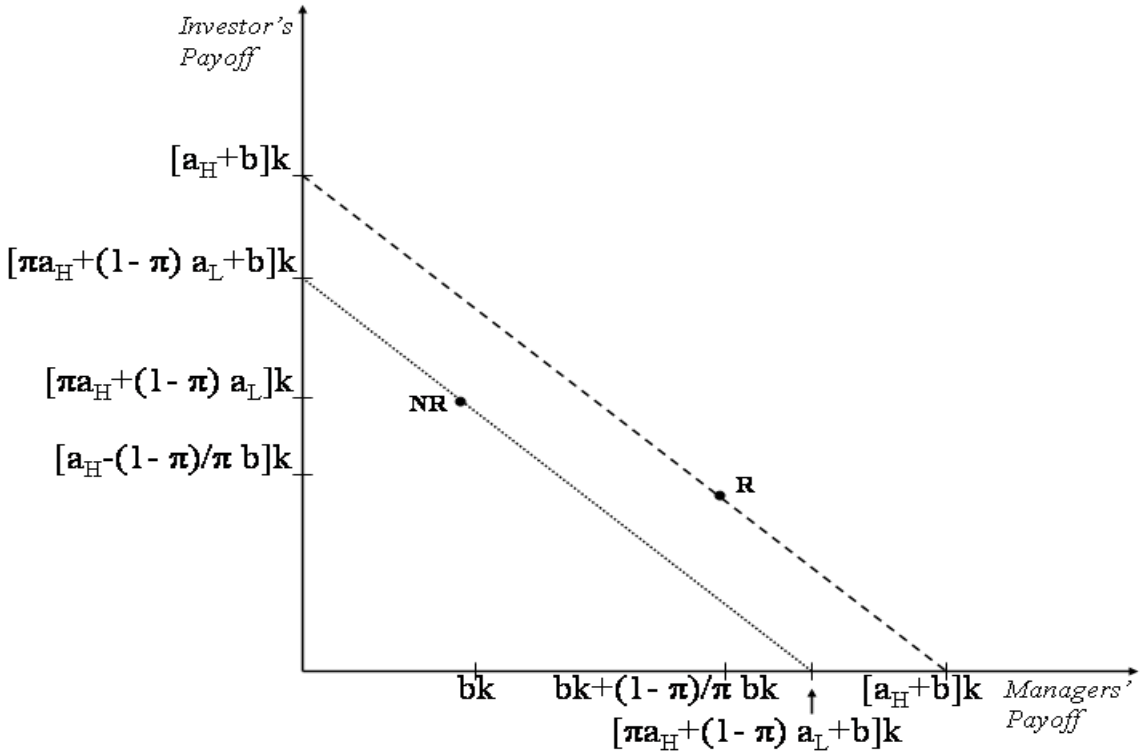
two resource constraints,

$$\begin{aligned}\pi d_H+(1-\pi)d_L&\geq c\\ k&\geq\pi k_H+(1-\pi)k_L,\end{aligned}$$

as well as non-negativity and limited liability constraints

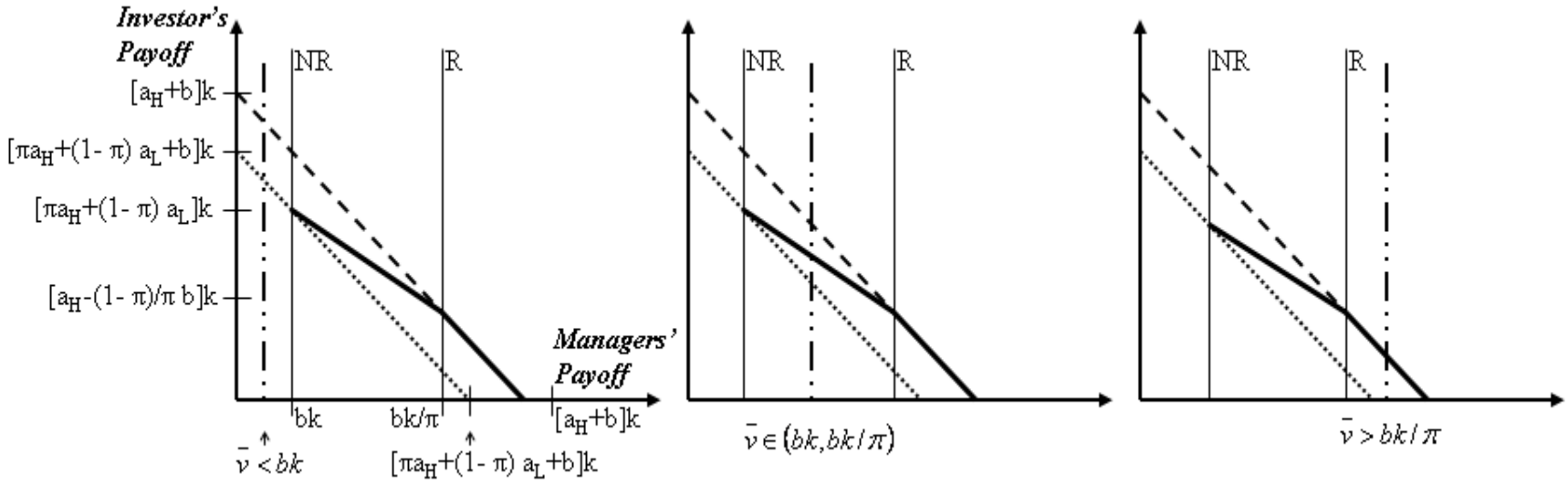
$$\begin{aligned}k_s&\geq 0,\quad\forall s\in\{H,L\}\\ a_sk_s-d_s&\geq 0,\quad\forall s\in\{H,L\}\\ a_sk_{\hat{s}}-d_{\hat{s}s}&\geq 0,\quad\forall s,\hat{s}\in\{H,L\},s\neq\hat{s}.\end{aligned}$$

Figure 4: Payoffs to Managers and the Investor (Ignoring PC)



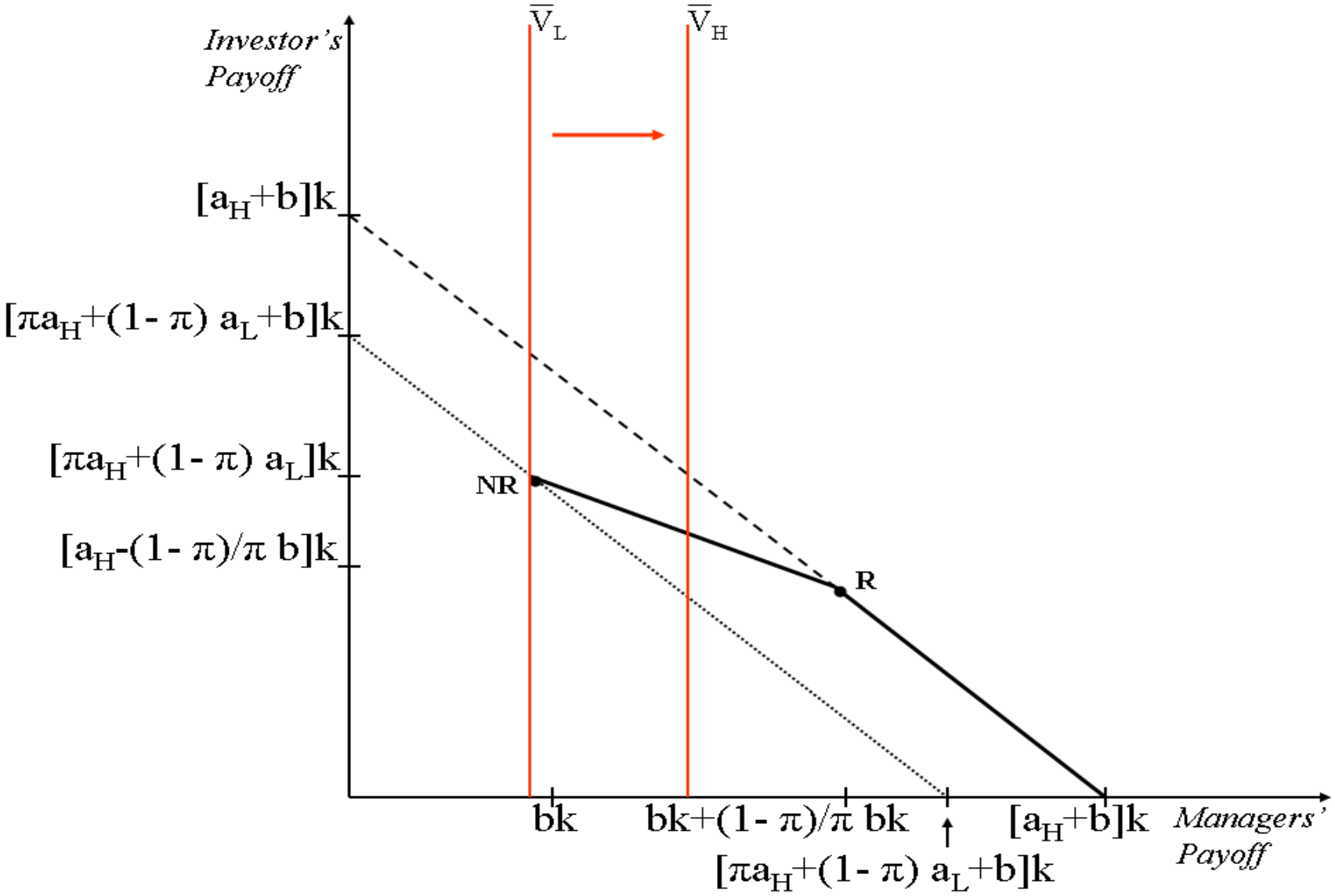
- Since constraints are linear, if participation constraint doesn't bind, there is either no or full reallocation depending on parameters.
- Interesting case:
  - No reallocation if participation constraint doesn't bind.

Figure 4': Payoffs to Managers (x Axis) and the Investor (y Axis)



- Reallocation varies with expected compensation when participation constraint binds.

Figure 4": Payoffs to Managers and the Investor When PC Binds



Contracting Problem: Intuition

Mechanism

- An increase in $\bar{v}$ requires an increase in expected compensation, which is costly to investors.
- Good news: high expected cash compensation of managers means that payments to high productivity managers can be reduced when then get more capital to deploy (with the associated private benefits).
- As $\bar{v}$ increases ...
  - ... incentive costs borne by high productivity managers.
  - ... fraction of capital reallocated increases.
  - ... amount of capital deployed at high productivity increases.

Capital Reallocation and the Business Cycle

Dynamic problem

- Dynamic consumption/investment problem determines amount of capital to managed, hence number of managers hired and $\bar{v}$.
- Study business cycle properties of reallocation, CEO turnover, and compensation.
- Punch line: When productivity is low it is too expensive to get managers to release assets and reallocation and CEO turnover drops.

Environment

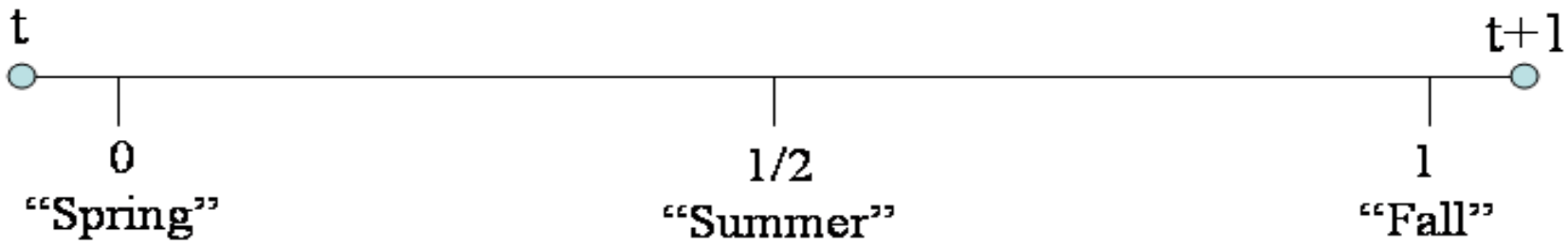
- Discrete time, infinite horizon, $t = 0, 1, 2, ...$
- Within period problem essentially unchanged.
- Call dates $0, \frac{1}{2}, 1 =$ "spring", "summer", "fall".
- Investor preferences $E\left[\sum_{t=0}^{\infty} \beta^t u(C_t)\right]$
- State variables: output Y_{t-1}, capital K_{t-1}, aggregate productivity Ω_t

Capital Reallocation and the Business Cycle (Cont'd.)

Timing

- Spring:
  - Investor chooses consumption C_t and investment I_t.
  - Investor hires managers to manage aggregate capital: $K_t = K_{t-1}(1-\delta)+ I_t$, i.e., measure $\bar{m}_t = K_t/k$ of managers hired at expected compensation $v(\bar{m})$ which is increasing and weakly convex in m.
  - Managers live for one period; contracting problem hence same as before.
- Summer:
  - Managers observe their idiosyncratic productivity, $a_{s,t} = \omega_{s,t} + \Omega_t$, and announce it.
  - Investors reallocate.
- Fall:
  - Output is produced.
  - Managers obtain private benefits, get paid, and consume.
  - Investor carry their payoff over to spring to be consumed or invested then.

Figure 5: Timeline for Infinite Horizon Economy



- Investor begins the period with (Y_{t-1}, K_{t-1}) and realizes Ω_t,
- Chooses (C_t, I_t), consumes C_t and,
- Hires $\overline{m}_t$ managers

- Managers realize a_H w.p. π or a_L w.p. $(1-\pi)$
- Investor chooses and implements reallocation

- Output Y_t is produced
- Bonuses are paid to managers and managers realize private benefits

Investor's Problem

$$V(K_{-1}, Y_{-1}, \Omega) = \max_{C,I} u(C) + \beta E[V(K, Y, \Omega')]$$

subject to

$$\begin{aligned} Y &= A(\Omega, K)K \\ Y_{-1} &\geq C + I \\ K &= K_{-1}(1-\delta) + I \end{aligned}$$

where

$$\begin{aligned} A(\Omega, K) \equiv \Omega &+ \frac{v(K/k) - bk}{(1-\pi)bk/\pi} (\omega_H - (1-\pi)b/\pi) \\ &+ \left(1 - \frac{v(K/k) - bk}{(1-\pi)bk/\pi}\right) (\pi\omega_H + (1-\pi)\omega_L) . \end{aligned}$$

for $bk < v(K/k) < bk/\pi$,

$$A(\Omega, K) \equiv \Omega + (\pi\omega_H + (1-\pi)\omega_L)$$

for $v(K/k) \leq bk$, and

$$A(\Omega, K) \equiv \Omega + \omega_H - \frac{v(K/k) - bk}{k}$$

for $v(K/k) \geq bk/\pi$.

Implications for Productivity, Reallocation, and CEO Turnover

Implication for productivity

- From representative investor's standpoint, endogenous TFP $A(\Omega, K)$; determined by 3 elements:
  - Aggregate productivity shock, Ω
  - Fraction of capital reallocated to high productivity managers.
  - Share of output accruing to the investor relative to the managers.

Link between capital reallocation and managerial turnover

- Managerial compensation and managerial turnover inherit the cyclical properties of capital reallocation in our model!

Table 2: Parameter Values for Calibration

This table shows the parameter values, sources, and moments used for the calibration of the model: [BFK] Basu, Fernald, and Kimball (2006), [CP] Cooley and Prescott (1995), [FB] Friend and Blume (1975), [GL] Gabaix and Landier (2006), [KP] Kydland and Prescott (1982), [P] Prescott (1986), [TH] Tauchen and Hussey (1991).

Parameter		Value	Source/Moment
Preferences			
β	discount rate	0.96	Implies annual interest rate of 4% as in [KP]
σ	rel. risk aversion	2	Estimated by [FB] using individual portfolio data
Technology			
δ	depreciation rate	0.1	Value from [KP]
Ω, $\Pi(\Omega'\|\Omega)$	agg. prod.	$\Omega = \bar{z}\exp(z)$	Functional form as in [CP]
		$z' = \rho z + \varepsilon$	AR(1) as in [CP]
		$\varepsilon \sim N(0, \sigma_\varepsilon^2)$	Normal innovations as in [CP]
		$\rho = (\rho_q)^4$, $\rho_q = 0.95$	Quarterly value from [CP] annualized
		$\sigma_\varepsilon^2 = \frac{1-\rho^2}{1-\rho_q^2}(0.007)^2$	Quarterly var. from [CP] annualized to match $var(z_t)$
		$\bar{z} = 0.4$	Implies $K/y \approx 2.5$ as in [KP] and [P]
ω_s, π	idio. productivity	$\pi = 0.5$	2 state approx. to normal distribution matching the
		$\omega_H = -\omega_L = 0.057$	cross-sectional std. dev. using data from [BFK]
k	capital/manager	1	Normalization (w.l.o.g.)
Private Benefits and Reservation Utility			
b	private benefits	0.2	Used to match reallocation/turnover rate of 3.1%
$v(K/k)$	res. utility	$v(K/k) = \nu K/k$	Assumed proportional to K consistent with [GL]
		$\nu = 0.05$	Normalization (w.l.o.g.)
Discretization			
K	state space	$[5 : 0.015 : 5.9]$	Bounds on state space not binding
z, Π	agg. productivity	8 states	Discretized using quadrature-based method from [TH]
			to match ρ and σ_ε^2

Table 3: Simulation Results

Panel A: Capital, Output, Investment, and Consumption	
Ratios	
$E[K]/E[Y]$	2.593
$E[I]/E[K]$	0.100
Standard Deviations	
$\sigma(\ln(Y))$	2.77%
$\sigma(\ln(I))$	4.59%
$\sigma(\ln(C))$	2.60%

Panel B: Reallocation, Compensation, and Turnover	
Ratios	
$E[R]/(E[I]+E[R])$	23.82%
$E[R]/E[K]$	3.11%
Correlation	
$\rho(\ln(R), \ln(Y))$	0.715
$\rho(\ln(\text{compensation}), \ln(Y))$	0.742
$\rho(\text{turnover}, \ln(Y))$	0.742

Recall:

- Stylized fact capital reallocation: reallocation/capital ratio of 23.89%, turnover rate of 3.14% and $\rho(\ln(R), \ln(Y)) = 0.64$ (see Eisfeldt and Rampini (2006)).
- Stylized fact CEO turnover: turnover rate (due to mergers & acquisitions) is 3.11% and $\rho(\text{turnover}, \ln(Y)) = 0.82$.

Extensions

Role of ex post outside options

- Suppose in summer managers have an ex post outside option of $\underline{v}$ per unit of capital released.
- If outside options deteriorate in recessions, reallocation becomes more costly.
- Bonuses have to compensate managers for the difference between what they can obtain by staying and their outside option. Lower outside options *increase* the required bonus.

Other extensions

- Moral hazard and performance bonuses: performances bonuses in addition to bonuses for downsizing.
- Private benefits depending on output: robustness.

Conclusions

Endogenous countercyclical reallocation frictions

- Managerial incentive problem implies countercyclical reallocation frictions.
- As a result ...
  - ... less capital reallocated in bad times.
  - ... capital on average less productively deployed in bad times; endogenous TFP.
- Consistent with empirical facts on capital reallocation and the (new) stylized fact that executive turnover (and compensation) is remarkably procyclical.

Models of countercyclical frictions

- Traditional focus on financing frictions over the business cycle.
- Other contracting frictions, e.g., incentives for redeployment of capital, additional amplification mechanisms.