Hedge funds, long-term opportunities, and optimal lockups

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Central idea

1. Many hedge funds restrict investors' ability to redeem their investments
   - Lockup periods, redemption windows, redemption notifications, fees,...
2. The illiquidity view: used to match the illiquidity of the assets (Cherkes, Sagi, and Stanton 2009) (Aragon 2007)

We propose a complementary rational for lockup contracts

- Managers with locked capital can invest more aggressively in long-term opportunities

1. Build a model where investors optimal liquidation decisions and manager short-termist behavior are self-reinforcing
2. Lockups alleviate this distortion and create value for both managers and investors
3. Model predictions about lockup maturity can be use to recover the importance of these long-term opportunities for hedge funds

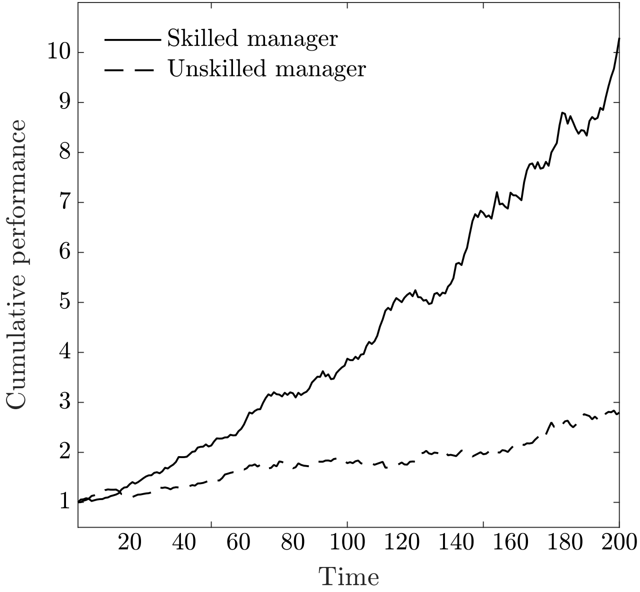
Intuition

1. Investors learn from performance to decide if manager has skill
   - withdraw if perceives manager to be unskilled
2. Skilled manager chooses how much to invest in a profitable long-term trade
   - the more aggressively it invests, the lower is the fund short-term performance even as expected returns are higher

$\Rightarrow$ Pursuing the long-term trade increases the odds of fund liquidation before the long-term trade pays off

3. Skilled manager shuns the long-term trade to manage the fund liquidation risk
   - reduces the fund expected returns
   - increases investors response to short-term performance
   - increases the fund liquidation risk, feedback loop

Intuition



Skilled manager
Unskilled manager
Cumulative performance
Time
1
2
3
4
5
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80
100
120
140
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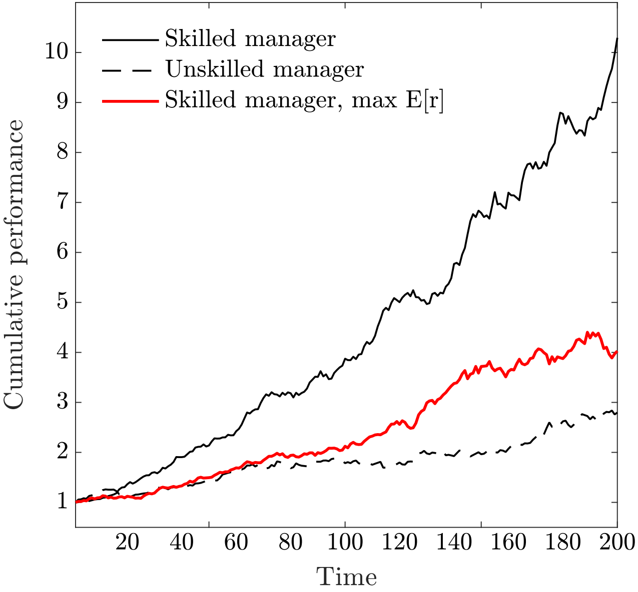
200

Intuition



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Skilled manager, max E[r]
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Time

Lockups

1. A Lockup makes liquidation less sensitive to short-term performance
    - liquidation less sensitive to short-term performance
    - skilled manager can pursue the long-term trade more aggressively
    - breaks the feedback loop
    - the fund is more valuable
2. Lockups are costly to investors
    - entrench bad managers
    - illiquidity costs

    $\Rightarrow$ reflected in premium investors demand to be locked up
3. Optimal lockup maturity strikes a balance between
    - the higher expected return
    - entrenchment and illiquidity costs

Model (without lockup)

Timeline

1. a manager is born with reputation $P_0^i \in [0, 1]$ for being skilled
2. offer contract to investors (performance fee m)
3. if attracts capital, starts trading until fund is liquidated
4. time runs continuously
   - managers decide how much to allocate to the long-term trade
   - investors observe performance and decide whether to liquidate
   - outside investors search for managers and compete for fund space

Investment opportunities

The skilled manager has a maximum scale of 1 unit of capital

The long term trade

$$x_t^i(\lambda dt + \xi dN_t), \text{ with } x_t^i \in [-1, 1]$$

- Crash dN_t is Poisson with intensity δ, $1/\delta$ is the horizon of the trade
- λ is the crash premium, the carry of the strategy
- Size of crash $\xi < 0$ controls the profitability of betting on the crash:
  - if $\lambda + \xi\delta > 0$, $x_t = +1$ short-term "sell crash risk"
  - if $\lambda + \xi\delta < 0$, $x_t = -1$ long-term "buy crash insurance"
- Skilled manager chooses x_t^g, unskilled sells crash risk $x_t^b = 1$
- Portfolio x_t cannot be observed by investors

The selection strategy

- earns abnormal returns α^i, with $\alpha^g > \alpha^b = 0$
- exposed to idio vol σ during normal times and ω during crashes

Investors

- Investors use fund returns to update beliefs about their manager type
  - form beliefs about skilled managers' portfolio $E^I[x_t^g]$.
  - beliefs P_t about manager type are evolve consistently with Bayes' rule.
- Invest with the fund if $P_0 > \underline{P}$ (will endogenize later)
- Liquidate the fund as soon as $P_t \leq \underline{P}$

Learning

Represent investors beliefs as $p_t = log(\frac{P_t}{1-P_t})$, then they evolve as

$$dp_{t+} = \frac{E^I[dR_t^g - dR_t^b]}{\sigma^2}\left(dR_t^i - E^I\left[\frac{dR_t^g + dR_t^b}{2}\right]\right) + \frac{E_+^I[dR_{t+}^g - dR_{t+}^b]}{\omega^2}\left(dR_{t+}^i - E_+^I\left[\frac{dR_{t+}^g + dR_{t+}^b}{2}\right]\right) dN_t .$$

substituting for the return dynamics dR_{t+}^i:

$$dp_{t+} = \frac{\alpha^g + (E^I[x_t^g] - 1)\lambda}{\sigma^2}\left(dR_t^i - \frac{\alpha^g + (E^I[x_t^g] + 1)\lambda}{2}\right) + \frac{(E^I[x_t^g] - 1)\xi}{\omega^2}\left(dR_{t+}^i - \frac{(E^I[x_t^g] + 1)\xi}{2}\right) dN_t .$$

manager expected to sell crash risk $E^I[x_t^g] \to 1$

$\to$ investors learn *more* from short-term returns, less from crash returns!

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The manager problem

- The skilled manager chooses position x_t^g while taking as given investors beliefs $E^I[x_t^g]$

$$G(P_t) = \max_{\{x_s^g\}_{s \geq t}} E_t^g \left[\int_t^\tau e^{-r(s-t)} m dR_s^g \right], \text{where } P_\tau \leq \underline{P}$$

- represent problem recursively (for intuition focus on $\omega \approx 0$ case)

$$\max_{x_t^g} x_t^g \left(\underbrace{m(\lambda + \delta\xi)}_{\substack{\text{compensation} \\ <0}} + \overbrace{G_p^i \frac{\alpha^g + (E^I[x_t^g] - 1)\lambda}{\sigma^2} \lambda}^{\substack{\text{short-term liquidation risk} \\ >0}} \right) + \delta \ldots$$

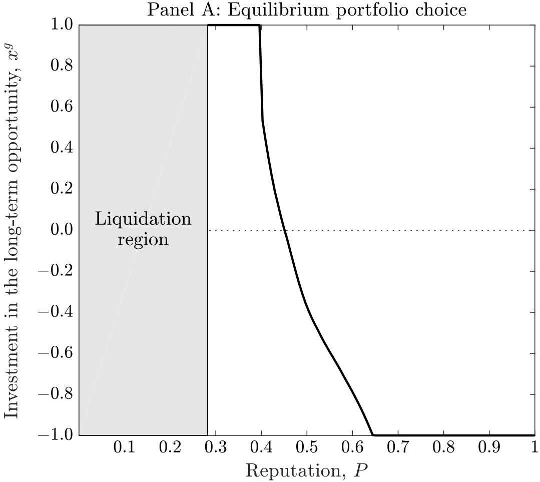
- Compensation incentives tells the manager to pursue long-term strategy, liquidiation concerns to pursue short-term strategy
- intensity of liquidation concerns depend on
  - how close is fund liquidation (G_p maximum at $\underline{P}$)
  - how investors expect the manager to invest $E^I[x_t^g]$
- in equilibrium $E^I[x_t^g] = x_t^g \rightarrow$ feedback-loop

Calibration

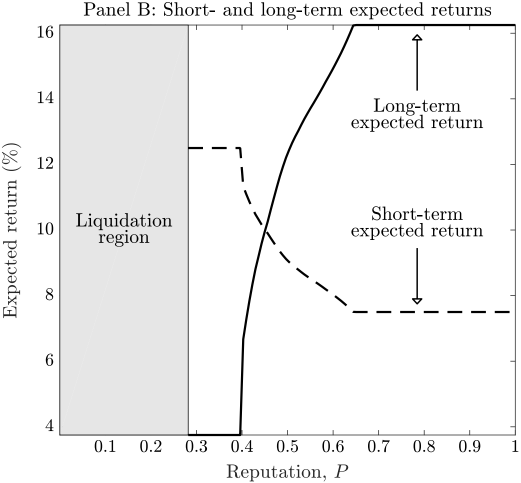
- calibrate most numbers to hedge fund data
- estimate profitability of long-term trade from distribution of lockups

Parameter	Notation	Value
Risk-free rate	r	1%
Fund fees		
Performance fee	m	20%
Fund risks		
Idiosyncratic fund volatility	σ	10%
Crash volatility	ω	7.5%
Long-term long-term trade		
Carry	λ	2.5%
Crash intensity	δ	0.5
E[r] of the long-term trade	$-(\lambda + \delta\xi)$	5%
Security selection abilities		
Skilled manager's alpha	α^g	10%
Unskilled manager's alpha	α^b	0%
Outside offers		
Arrival rate	ϕ	1
Illiquidity cost	ν	1%

Optimal portfolio (open fund)

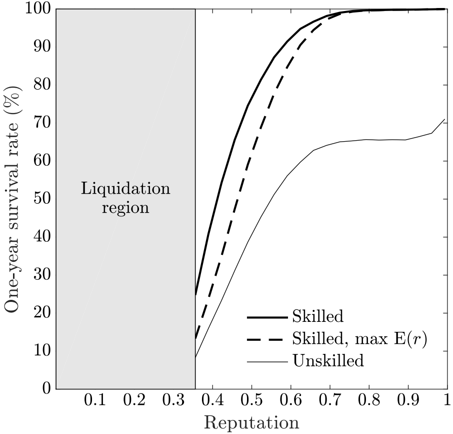


Optimal portfolio: Expected returns (open fund)



Reputation, survival, and optimal portfolio choice

- Absent the threat of liquidation, skilled managers would maximize expected returns
- They distort their portfolios to enhance short-term returns and to ensure survival



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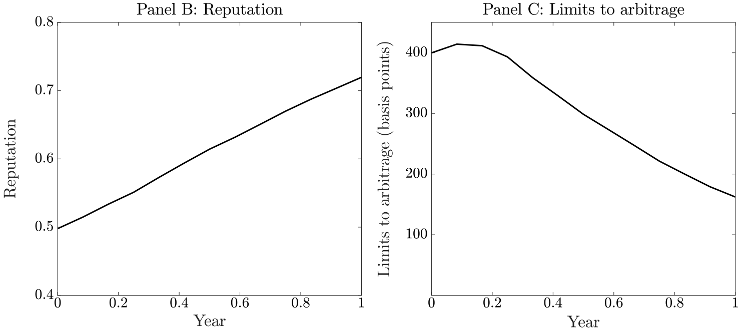


- Limits to arbitrage is persistent

Lockups

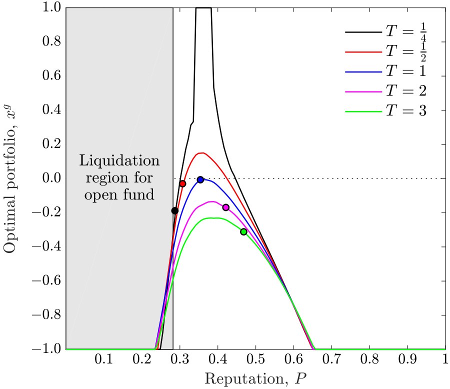
1. A lockup contract restricts redemption until the lockup expires
   - Poisson with intensity 1/T, T is maturity of contract
2. investors shares become liquid, cash out when $P_t < \underline{P}_0$
3. lockup renewed if fund attracts locked capital
   - requires reputation to be high enough $P_t \geq \underline{P}_1$
4. solve system of hjb's

$$
\begin{aligned}
rG(P_t, l_t = 0) &= \max_{x_t^g} E_t^g[mdR_t^g] + E[dG], && (1) \\
rG(P_t, l_t = 1) &= \ldots + \frac{1}{T}\Big[G(P_t, l_t = 0) - G(P_t, l_t = 1)\Big], && (2)
\end{aligned}
$$

with boundary conditions
$(1)G(\underline{P}_0, l_t = 0) = 0, (2)G(P, l_t = 0) = G(\underline{P}_1, l_t = 1), \forall P \geq \underline{P}_1$

Optimal portfolio with lockups

- Lockups reduce the threat of liquidation, manager valuation less sensitive to track-record $G_p \downarrow$, focus on expected returns



- If your reputation is already low, a small boost in reputation will not help you $\Rightarrow$ aggressively bet on a crash

The cost of lockup provisions

1. Investors bears the cost of lockups
   - downside risk of getting stuck with bad manager
   - upside limited; managers that do well attract new capital
   - illiquidity; require a illiquidity premium to be locked up

   $\Rightarrow$ manager internalizes because reflected in lower fees
2. Model the market for skill to endogenize management fees and investment thresholds $\underline{P}_1$ and $\underline{P}_0$
   - new investors search and compete for fund access with intensity ϕ
   - equilibrium offer: $V(P_t, 1) - 1$ for locked up shares if $P_t \geq \underline{P}_1$, and $V(P_t, 0) - 1$ for liquid shares if $P_t \in [\underline{P}_0, \underline{P}_1)$ and $l_t = 0$.
   - equivalent to paying a management fee of $f_t = \phi[V(P_t, l_t) - 1]^+$
3. We solve for $V(P_t, l_t = 1)$, $\underline{P}_1$,$V(P_t, l_t = 0)$, and $\underline{P}_0$:

$$
\begin{aligned}
V(P_t, 0) &= \max_{\underline{P}_0} E_t^l \left[\int_t^\tau e^{-r(0)(s-t)}((1-m)dR_s^i - f_s ds) + e^{-r(0)(\tau-t)} 1 \right], \\
V(P_t, 1) &= \max_{\underline{P}_1} E_t^l \left[\int_t^\tau e^{-r(T)(s-t)}((1-m)dR_s^i - f_s ds) + 1_{\tau = \widetilde{T}} e^{-r(T)(\tau-t)} V(P_t, 0) \right].
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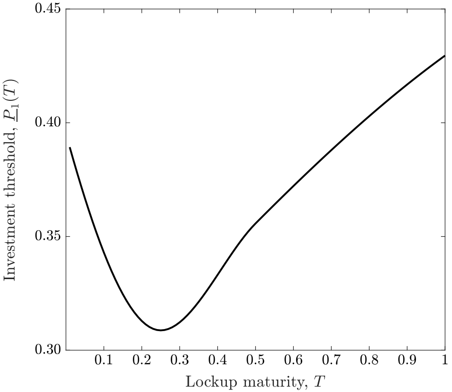
$$

Investment thresholds as a function of lockup maturity

- Minimum reputation to raise capital with a lockup of T years



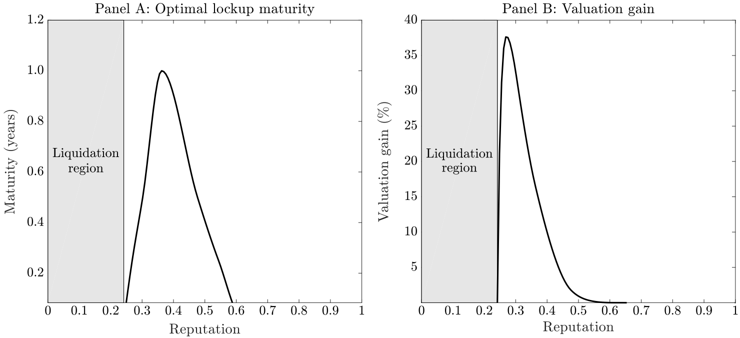
- Long contracts require high reputation
- investment threshold initially threshold decreases with maturity
  - stronger decline when long-term opportunity is more profitable

  $\Rightarrow$ delegation friction too severe when contracts too short

Optimal lockup choice

- Focus on pooling equilibrium, choice that maximize the value for skilled manager

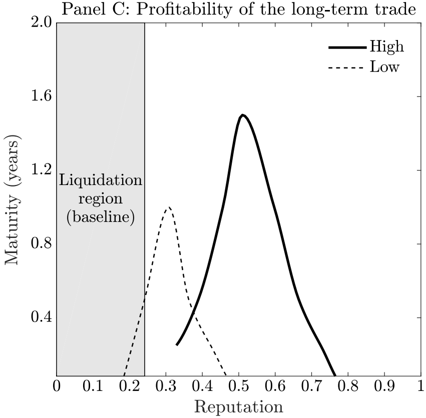
$$\max_{T} G(P_0, l_0 = 1), \text{subject to } P_0 \geq \underline{P}_1(T),$$



- Optimal lockups are hump-shaped in reputation
  - Managers will low reputations are unable to attract long-term capital
  - Managers will high reputations do not really need it

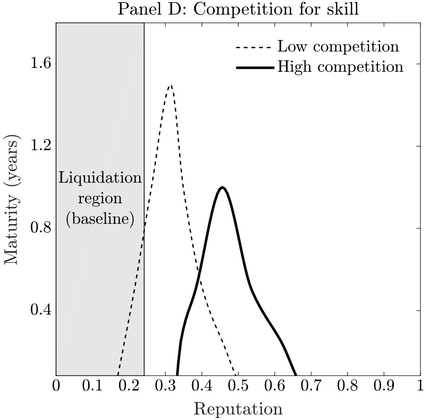
Optimal lockup choice: long-term trade profitability

- Higher profitability of the long-term trade leads to longer maturities



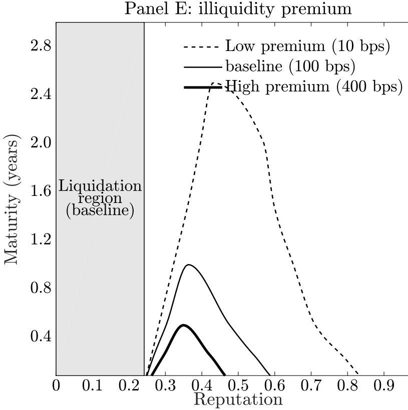
Optimal lockup choice: competition for skill

- Less competition for managers leads to longer maturities



Optimal lockup choice: illiquidity premium

- Lower illiquidity costs leads to longer maturities



Implied distribution of reputation skill

- Hedge funds not subject to Investment Company Act of 1940
  - Management of report returns, backfill bias, incubation bias, survivorship bias, liquidation bias, self-reporting bias,. . .
  - Drawing inferences about skill difficult
- In the model lockup maturities and attrition rates depend on managers' reputations
  - Draw indirect inferences through the model to complement direct estimates of the importance of long-term opportunities

Calibration

- Managers' reputations drawn from $\mathcal{B}(a, b)$
- Estimates the profitability of long-term trade ξ, and reputation distribution parameters a and b to match:
  1. Fraction of funds that fail within the first year (Brown et all 1999)
  2. The distribution of lockups in the HFR database (Aragon 2007)

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Implied distribution of skill

Moment or parameter	Data	Baseline	Counterfactually long lockups
		Moments	
First-year attrition rate	18%	17.88%	18%
Distribution of lockups			
Less than 3 months	65.17%	65.70%	55.70%
Between 3 and 12 months	20.71%	20.18%	20.80%
At least 12 months	14.12%	14.12%	23.50%
		Estimated distribution of skill	
Profitability of the long-term trade		5%	8%
Average skill		7.1%	9.15%
skill standard deviation		3.64%	5.73%
Limits to arbitrage			
New manager		1.38%	2.5%
Two years		0.65%	1.14%

Limits to arbitrage and optimal lockups

- The short maturity of lockup contracts in the data implies sizable delegation friction
  - long term opportunity is about 1/3 of the total manager skill (5%/15%)
  - average new skilled entrant leaves approximately 1.5% basis points in expected returns on the table
- Illiquidity cost of 1% is conservative (based on debt markets)
- Strategies with longer lockups (event-driven arbitrage) can be exposed to substantially larger distortions

Conclusions

- Managers can put assets into a trade that will pay off massively at some point in the future
  - But being in this trade is costly in the short run
- If investors learn from returns, skilled managers may get liquidated even if they are doing the right thing
- Managers distort investment decisions to manage liquidation risk
- Threat of liquidation limits arbitrage
- Lockups alleviate—but not eliminate—this delegation friction
- Draw inferences about distribution of skill and limits to arbitrage based on optimal lockups and attrition rates

Appendix

Equilibrium

Assume that investors and managers play the equilibrium that maximizes expected returns.

(1) Skilled managers' portfolio choices are optimal given investors' beliefs, liquidation policies, and outside offers.

(2) Investors' beliefs about skilled managers' portfolio choices are consistent with skilled managers' portfolio choices.

(3) Investors' beliefs about managerial skill are consistent with Bayes' rule on the equilibrium path.

(4) Current investors' liquidation policies are optimal given competing investors' bidding behavior, and their beliefs about skilled managers' portfolio choices and the manager's likelihood of being skilled.

(5) Skilled managers' portfolio choices maximize expected returns subject to conditions (1) through (4).