Illiquidity in Intermediary Portfolios: Evidence from Large Hedge Funds

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Introduction

Motivation

- Illiquidity is a well-established explanatory factor for the cross-section of asset returns
- Yet, virtually all measures of illiquidity rely on data from *trades*: price impact per volume, short-term reversals, etc.
- How does one measure the return premium associated with deeply illiquid assets that trade infrequently (or not at all)?

  (*Khandani & Lo, 2011* use smoothing)

Research Questions

- In this paper, we estimate the illiquidity premium through portfolios of marginal investors in illiquid markets: **hedge funds**

- The nature of hedge funds as intermediaries leads to additional empirical questions:

  1. How important is illiquidity for the cross-section of hedge fund returns?

  - Portfolio illiquidity
  - Investor share illiquidity
  - Investor share illiquidity *conditional* on portfolio illiquidity

  2. Who ultimately captures the illiquidity premium, the hedge fund manager or fund investors?

Implications for Financial Stability

- The answers to these questions have important implications for financial stability:

  1. The size of the illiquidity premium is informative about the importance of illiquidity risk

  2. If funds' returns are heavily dependent on the illiquidity premium, it may suggest high exposure to illiquidity risk

  3. Investors are likely better able to hedge illiquidity risk, so who ultimately bears the risk may matter for fund behavior during stress

Answers

1. The illiquidity premium is big:

- 3.4% per year between funds in 5^{th} and 95^{th} percentiles of illiquidity
- 56 basis points per year per one additional log-day of illiquidity

2. Illiquidity is important:

- Portfolio illiquidity explains 27–39% of alpha
- Investor share illiquidity explains 54-80% — evidence of value of manager discretion

3. The premium is shared: about 70–80% is passed to fund investors

- We offer an economic argument based on theories of “limits to arbitrage” that rationalize these findings

An Economic Argument

An Economic Argument

- Theories of limits to arbitrage suggest that potentially diversifiable risks may be priced in specialized markets
- Examples of such risks from the literature include: prepayment risk on MBS, shocks to intermediary capital
- We argue illiquidity risk is a priced risk for the fund manager $\iff$ cannot be diversified
- First, who will hold illiquid assets?
  - Can't be public funds because of regulations
  - Can't be individual investors — required rates of return are too high, expertise is too costly
- Must be private funds: **hedge funds**, pension funds, endowments

An Economic Argument

1. Hedge funds by construction are **intermediaries**
   - Implies possible principal-agent problems (opacity, risk)
   - To alleviate, managers invest substantial amounts of personal wealth in the fund
2. Forced assets sales arise from shocks to funds' primary funding sources:
   - **A)** Redemptions by investors
   - **B)** Margin calls on leveraged positions

- **1. & 2.** $\Longrightarrow$ managers cannot fully diversify illiquidity risks

An Economic Argument: Empirical Predictions

- If managers can't fully diversify illiquidity risk, they have two options:
  1. Pass risk through to the fund investors in the form of share restrictions
  2. Charge higher fees as explicit compensation for risk

- If *all* illiquidity risk is **passed through to investors**:
  1. Portfolio illiquidity will be positively correlated with investor share restrictions
  2. Illiquidity premium should be entirely in net-of-fee returns (not gross returns)
  3. Portfolio illiquidity will be *negatively* associated with fees

An Economic Argument: Empirical Predictions

- To see this, consider the following reduced-form model of gross-of-fee fund returns:

$$E[R_j^{gross}] = \alpha_j + \lambda L_j + \gamma' \beta_j$$

  - L_j is a measure of illiquidity, λ is the illiquidity premium
  - β_j are risk factor loadings

- Further, assume managers charge a management fee $(\pi_{j,0})$ and an incentive fee $(\pi_{j,1})$

$$\implies \quad E[R_j^{net}] = (1 - \pi_{j,1})\big(\alpha_j + \lambda L_j + \gamma' \beta_j\big) - \pi_{j,0}$$

Empirical Predictions: All Risk Passed to Investors

- If all illiquidity risk is passed to investors:

$$\implies \quad \frac{\partial E[R_j^{net}]}{\partial L_j} = \lambda$$

(competition will make it so)

$$\implies \frac{\partial \pi_1}{\partial L_j} = -\pi_1 \frac{\lambda}{E[R_j^{gross}]} < 0$$

- That is, the incentive fee is negatively related to illiquidity
- And,
  1. Share restrictions highly correlated with portfolio liquidity
  2. Entire illiquidity premium found in net returns : $\frac{\partial E[R_j^{net}]}{\partial L_j} = \lambda$

Empirical Predictions: All Risk Retained by the Manager

- If *all* illiquidity risk is **retained by the manager** (on-demand redemptions):

  1. Portfolio illiquidity and investor share restrictions will be uncorrelated

  2. Illiquidity premium will be zero for net-of-fee returns

  3. The incentive fee will be positively related to illiquidity

- Why? In this case:

$$\frac{\partial E[R_j^{net}]}{\partial L_j} = 0$$

$$\implies \frac{\partial \pi_1}{\partial L_j} = (1 - \pi_1)\frac{\lambda}{E[R_j^{gross}]} > 0$$

Empirical Predictions: Risk is Shared

- Finally, if managers retain some but not all of the illiquidity risk:

  1. Portfolio illiquidity and investor share restrictions will be positively correlated

  2. Illiquidity premium will shared by the manager and investor

  - And $\frac{\partial E[R_j^{net}]}{\partial L_j} / \frac{\partial E[R_j^{gross}]}{\partial L_j}$ will determine the pass-through rate

  3. The incentive fee will be positively related to illiquidity

- Note: implies investor share restrictions and incentive fees are positively correlated (counter-intuitive!)

Data

Data: Form PF

- Dodd-Frank mandated enhanced regulatory reporting for private funds with the goals of investor protection and systemic risk assessment.
- This mandate is primarily implemented in *Form PF*, through a joint rulemaking in 2011 between the SEC and CFTC.
- Advisers with more than $1.5B in hedge fund assets provide detailed **quarterly** data on each of their *Qualifying Hedge Funds*, those with $> \$500M$ in net assets (some smaller funds report quarterly though)
- Includes gross and net assets, returns, asset class exposures, portfolio liquidity, financing term structure, investor share restrictions, types of borrowings, counterparty exposures and creditors, and more

Summary Statistics

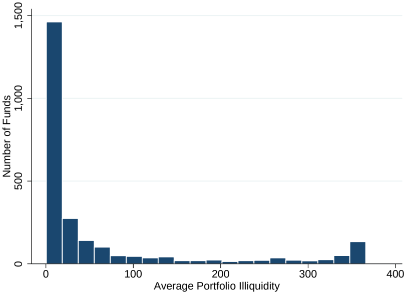
Variable	Mean	Std. Dev.	25th Percentile	50th Percentile	75th Percentile	Obs.
NAV ($Billions)	1.14	2.21	0.17	0.51	1.16	2,550
GAV ($Billions)	2.06	7.13	0.25	0.69	1.74	2,550
GAV /NAV	3.46	38.78	1.01	1.17	1.68	2,550
Monthly Obs./Fund	35.76	20.99	16.00	44.00	57.00	2,550
Quarterly Obs./Fund	10.64	6.39	5.00	10.00	17.00	2,550
Strategy						
Equity						808
Multi-strategy						328
Credit						227
Relative Value						217
Event Driven						191
Macro						161
Managed Futures						58
Other						560

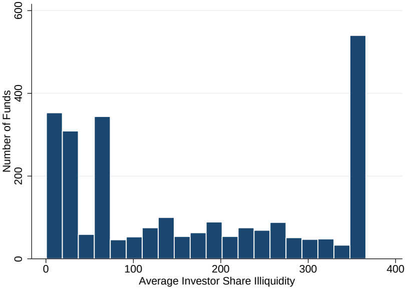
Illiquidity

Measuring Portfolio & Investor Illiquidity

- Form PF asks funds what fraction of their portfolio can be sold w/out price impact in:
    - 0-1 days
    - 2-7 days
    - 8-30 days
    - 31-90 days
    - 91-180 days
    - 181-365 days
    - $>$ 365 days
- Asks same question for fraction of investor shares that can be liquidated in those horizons
- We define L_p and L_s as weighted-average values of portfolio and investor share illiquidity

Histograms: Portfolio and Investor Share Illiquidity





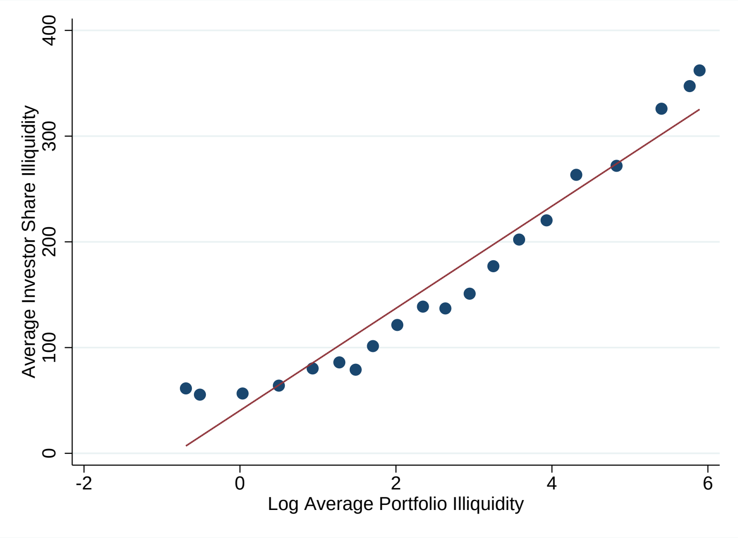
Summary Statistics

	Pct. Obs.	Portfolio Illiquidity ($\overline{L}_p$) Mean	Median	SD.	Investor Illiquidity ($\overline{L}_s$) Mean	Median	SD.
All	100.0	64.5	12.1	107.0	165.1	135.5	137.6
Equity	31.7	23.9	6.3	52.8	123.0	76.2	106.7
Multi-strategy	12.8	59.2	23.0	88.9	173.2	171.9	129.4
Event Driven	7.5	91.2	41.3	106.9	254.5	283.6	115.3
Relative Value	8.5	44.8	12.4	74.8	155.0	135.5	130.5
Credit	8.9	105.4	26.6	127.9	220.6	250.8	139.6
Macro	6.3	7.0	2.9	12.6	75.2	60.5	80.3
Managed Futures	2.3	*	*	*	*	*	*
Other	22.0	135.6	55.7	147.3	218.5	315.3	159.6

Testable Hypothesis #1

- If managers pass illiquidity risk to fund investors, portfolio illiquidity and share restrictions should be highly correlated

Portfolio vs. Investor Illiquidity



Illiquidity Regressions

Illiquidity Premium and Hedge Fund Performance

Estimated Alphas

Measure alpha through two-stage Fama-MacBeth approach:

- **First Stage:** estimate betas from time-series regressions (fund-by-fund)
- Use standard factor models: Fama-French-Carhart (FF), Fung-Hsieh (FH), and FH plus Pastor Stambaugh (FH+PS)
- One measure of alpha, $\beta_{\mathbf{0},\mathbf{i}}$: intercept from first stage regression

Estimated Alphas

- **Second Stage (illiquidity):**

w/ out illiquidity

$$R_{i,t} = \gamma_t' \beta_i + (a_{i,t}),$$

$$E[R_{i,t}] = \widehat{\gamma}' \beta_i + \widehat{\alpha}_i$$

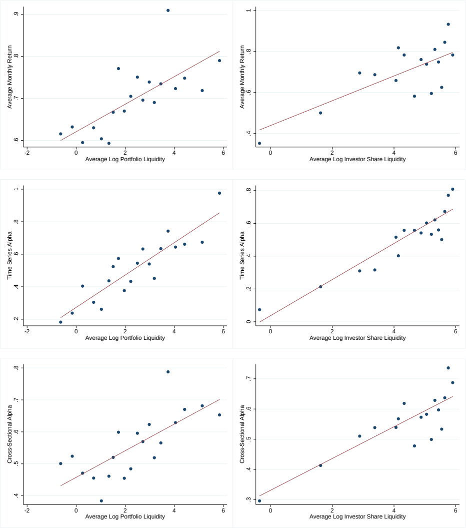
w/ illiquidity

$$R_{i,t} = \lambda_t \log(L_{i,\ell,t}) + \gamma_t' \beta_i + (a_{i,t}^{\ell}),$$

$$E[R_{i,t}] = \widehat{\lambda} E_i[\log(L_{i,\ell,t})] + \widehat{\gamma}' \beta_i + \widehat{\alpha}_i^{\ell}$$

- $\ell = p,\ s$ for portfolio or investor share illiquidity
- $\widehat{\lambda}$ is illiquidity return premium
- $\widehat{\alpha}_i^{\ell}$ and $\widehat{\alpha}_i$ are average pricing errors

Alphas vs. Portfolio and Investor Share Illiquidity



Alphas and Mean Average Pricing Errors

Fama-French-Carhart	Mean	10^{th}	25^{th}	50^{th}	75^{th}	90^{th}	St. Dev
α_i^{FF}	0.54	0.01	0.26	0.53	0.81	1.08	0.44
α_i^{s}	0.11	-0.45	-0.17	0.12	0.40	0.63	0.46
α_i^{p}	0.33	-0.19	0.06	0.31	0.59	0.85	0.44
$\lvert\alpha_i^{FF}\rvert$	0.58	0.13	0.29	0.53	0.82	1.08	0.38
$\lvert\alpha_i^{s}\rvert$	0.36	0.05	0.14	0.29	0.50	0.76	0.30
$\lvert\alpha_i^{p}\rvert$	0.43	0.07	0.17	0.38	0.61	0.87	0.34
Fung-Hsieh + Pastor-Stambaugh							
α_i^{FH+PS}	0.56	0.06	0.31	0.55	0.80	1.07	0.42
α_i^{s}	0.26	-0.25	0.02	0.25	0.51	0.75	0.42
α_i^{p}	0.41	-0.10	0.18	0.40	0.65	0.91	0.42
$\lvert\alpha_i^{FH+PS}\rvert$	0.59	0.15	0.33	0.56	0.80	1.07	0.37
$\lvert\alpha_i^{s}\rvert$	0.38	0.06	0.16	0.32	0.54	0.77	0.31
$\lvert\alpha_i^{p}\rvert$	0.48	0.11	0.24	0.43	0.65	0.92	0.34
FH + PS GLM Liquidity (θ_0)							
$\alpha_i^{\theta_0}$	0.57	0.11	0.35	0.56	0.81	1.06	0.41
$\lvert\alpha_i^{\theta_0}\rvert$	0.61	0.19	0.37	0.56	0.81	1.07	0.35

Testable Hypothesis #2

- Whoever holds the illiquidity risk — managers or investors — should be compensated with higher returns

- Recall second stage model:

$$R_{i,t} = \lambda_t \log(L_{i,\ell,t}) + \gamma_t' \beta_i + (a_{i,t}^{\ell}),$$

$$\widehat{\lambda} = \frac{1}{T} \sum_t \lambda_t$$

- $\widehat{\lambda}_{net}^p / \widehat{\lambda}_{gross}^p \Rightarrow$ pass-through of illiquidity premium to investors

Estimated Portfolio Illiquidity Return Premium

- We estimate $\widehat{\lambda}^p_{gross} = .0467 \implies$ 0.56% per year per log-day of illiquidity
- 5th-95th percentile return difference: 3.4% per year
- $\widehat{\lambda}^p_{net} = .0362$
- $\widehat{\lambda}^p_{net}/\widehat{\lambda}^p_{gross} = 77\%$
  - 77% of portfolio illiquidity return premium passed to fund investors

Estimated Investor Share Illiquidity Return Premium

- $\widehat{\lambda}^s_{gross} = .0632 \implies$ 0.76% per year per log-day of illiquidity

- $\widehat{\lambda}^s_{net} = .0454, \;\; \widehat{\lambda}^s_{net}/\widehat{\lambda}^s_{gross} = 72\%$

  - 72% of investor share illiquidity return premium passed to fund investors

- But this may largely comprise portfolio illiquidity

Estimated Investor Share Illiquidity Return Premium

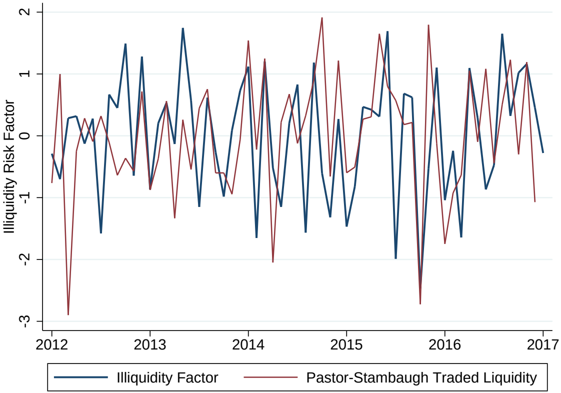
- To identify value of share restrictions *beyond* those needed to match illiquidity of the assets, estimate:

$$R_{i,t} = \lambda_t^{s|p} \log(L_{i,s,t}) + \lambda_t^{p|s} \log(L_{i,p,t}) + \gamma_t' \beta_i + (a_{i,t}^{p,s})$$

- $\widehat{\lambda}_{gross}^{s|p} = .1198$
- $\widehat{\lambda}_{net}^{s|p} = .0929$

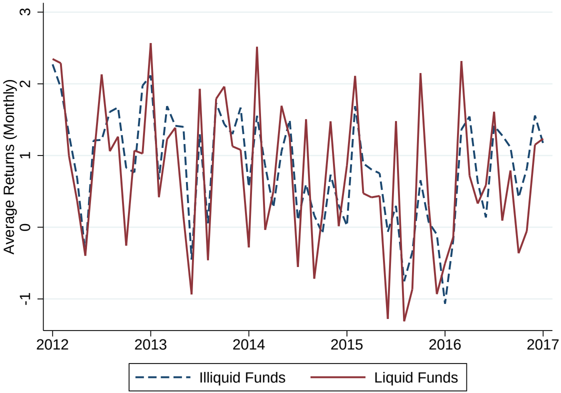
- An additional log-day of share illiquidity, *holding portfolio illiquidity fixed*, earns 1.45% per year

Is This an Illiquidity Risk Factor? No.



- 32% correlation with Pastor-Stambaugh (2003) traded factor
- But, Fama-MacBeth with illiquidity factor has no explanatory power

Is This Just Return Smoothing? Also No.



- Illiquidity premium shows up in gross (raw) returns
- Regress alpha on illiquidity and first-order autocorrelation coefficient (ρ_i), coefficient on ρ_i is negative and significant

Fees

Testable Hypothesis #3

- If managers retain some illiquidity risk, they must be compensated with higher fees (to capture some of illiquidity premium)

- Pass-through rate $\neq 100\%$ suggests manager capture some of the premium

- But! If managers all charge “2 and 20”, then by construction they capture 20% of the illiquidity premium

- Need to know whether the *rate* of fees charged is associated with illiquidity

Illiquidity and Fees

	Avg. Fee	Avg. Fee	Avg. Fee	Avg. Fee
$a_i^{p,g}$	1.315***	1.312***	0.818***	0.802***
	(0.112)	(0.110)	(0.122)	(0.121)
$\overline{\log}(L_p)$		0.183***	0.126***	0.138***
		(0.027)	(0.027)	(0.027)
$\% \ r_{i,t} > 0$			2.880***	2.806***
			(0.354)	(0.351)
Avg. Leverage				0.070***
				(0.017)
Size Controls	Yes	Yes	Yes	Yes
Strategy Controls	Yes	Yes	Yes	Yes

- Illiquidity associated with average (total) fee, but only through incentive fee
- Association between leverage and incentive fee may indicate compensation for financing liquidity risk

Conclusion

- We argue illiquidity is an undiversifiable risk for fund managers
- This can explain:
  1. The correlation between portfolio and investor illiquidity
  2. The correlation between the incentive fee and illiquidity
  3. The correlation between leverage and the incentive fee
- Implications for financial stability:
  1. Illiquidity premium is large $\Rightarrow$ illiquidity risk is important
  2. Illiquidity premium explains significant amount of hedge fund alpha $\Rightarrow$ funds may be highly exposed to illiquidity risk
  3. Much of the risk is passed to fund investors, who can better diversify it $\Rightarrow$ may promote financial stability

Appendix

Table: Measures of Liquidity

	(1) $\overline{L}_p$	(2) $\overline{L}_p$	(3) $\log \overline{L}_p$	(4) L_p	(5) L_p
$\overline{L}_s$	0.498*** (0.012)	0.452*** (0.012)	0.009*** (0.000)		
L_s				0.438*** (0.016)	0.045** (0.019)
Constant	-17.812*** (2.541)	6.570 (5.874)	1.397*** (0.103)	2.620 (7.683)	50.373*** (4.978)
Strategy Dummies	No	Yes	Yes	Yes	Yes
Leverage Controls	No	Yes	Yes	Yes	Yes
Size Controls	No	Yes	Yes	Yes	Yes
Time FE	No	No	No	Yes	No
Fund FE	No	No	No	No	Yes
Adjusted R^2	0.411	0.468	0.527	0.446	0.007
Observations	2550	2550	2550	26972	26972

Back