Forced Liquidations, Fire Sales, and the Cost of Illiquidity

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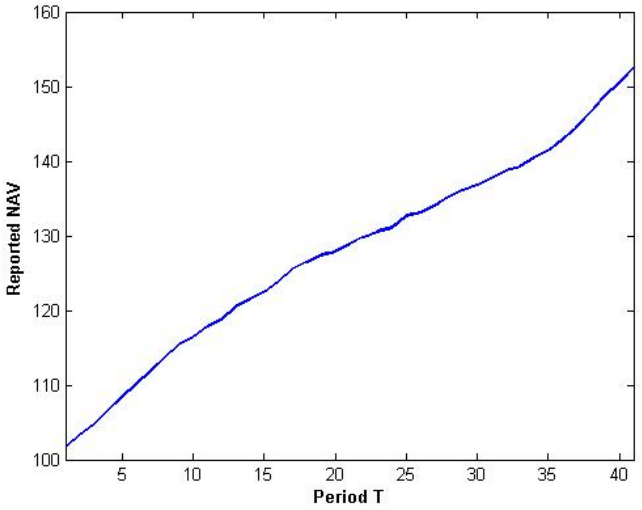
Once Upon a Time…

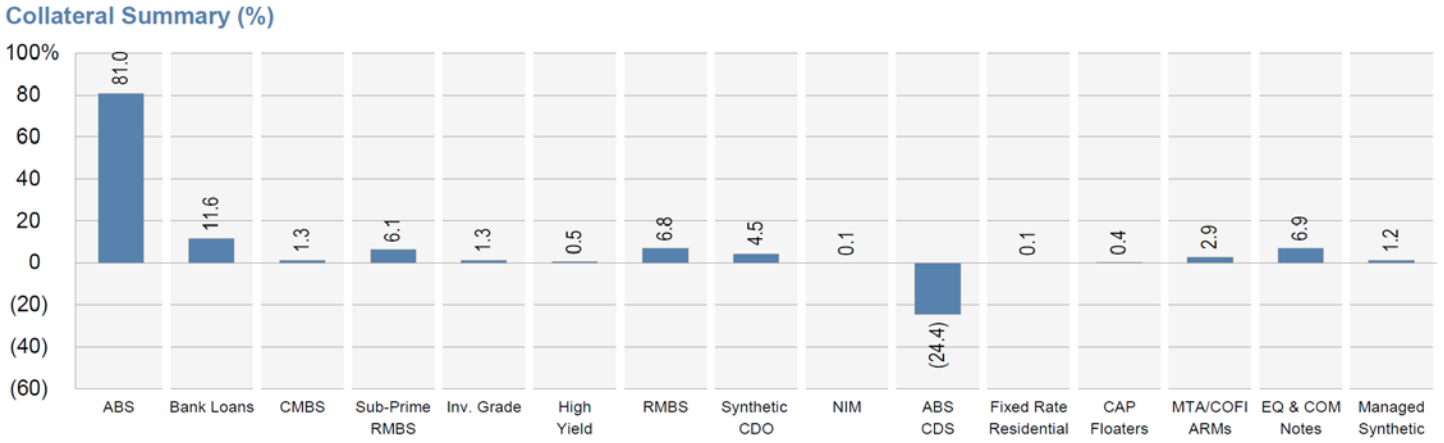
There was an (almost) magical hedge fund with high returns and low volatility…



Ratings Distribution	%
AAA	76
AA	14
A	0
Below A	10

Comprised of low risk assets…

Once Upon a Time…



But subprime mortgage delinquencies grew, and the value of securities held by the fund dropped…

Once Upon a Time…

The Prime Brokers for the fund asked for more cash collateral…

The fund tried to liquidate assets in a declining market to meet the collateral calls…

But asset values continued to decline quickly while collateral requirements continued to rise…

Once Upon a Time…

The fund failed even though its parent company attempted to stabilize it with a substantial cash injection…

Investors were returned 9¢ on the dollar…

And the managers lived happily ever after…

Portfolio Construction

Typical approach is to diversify across securities and strategies, using the common “currencies”

- Return
- Volatility
- Correlation

Consequences

- Looking for low correlation and low volatility
- Low volatility and correlation often an “accounting artifact”
- Drawn to securities with limited price discovery

Investors tend to believe in a “liquidity premium” that compensates them for illiquidity

Liquidity in Portfolios

Lo, et al (2003)

- Add liquidity as additional constraint in mean-variance optimization

Seigel (2008); Leibowitz & Bova (2009)

- Consider liquidity in determining portfolio weights

Ang, et al (2011)

- Optimal liquidity policy with market frictions

Kinlaw, et al (2013)

- Liquidity as a shadow allocation in the portfolio

Serial Correlation & Liquidity

Illiquid portfolios tend to exhibit a high degree of positive serial correlation (Weisman (2003); Getmansky et al (2004))

Methods: Scholes & Williams (1977); Geltner (1993); Getmansky, et al (2004); Bollen & Poole (2008); Anson (2010); Anson (2013)

The Geltner Method:

$$\sigma = \sqrt{\left(\frac{1 - \rho_{s(1)}^{o2}}{(1 - \rho_{s(1)}^{o})^2} \right) \sigma_o^2}$$

Adjust the time series for serial correlation

Decode the performance to adjust volatility and correlations

Illiquidity: The Cost is Ignored

Primary Question: Are under-reported volatility and correlation a benign consequence of illiquidity or is there more to it?

What should concern you most as an investor?

We argue that simply adjusting for serial correlation fails to measure or capture the core risk and cost of illiquidity that investors should care about: forced liquidations and “fire sales”

Causes of Illiquidity

A mismatch between the funding of an underlying investment and the horizon over which the investment can be sold

Leverage/Financing: (Garleanu & Pedersen (2009); Brunermeier & Pedersen (2009); Office of Financial Research (2013))

- Including swaps, futures, margin

Contractual terms: (Ang & Bollen (2010))

- Gates, lock ups, notice periods

Network factors:(Battacharya, et al (2013); Gennaioli, et al (2012); Boyson, et al (2010); Mitchell, et al (2007); Chen, et al (2012); Schmidt, et al (2013))

- Common service providers (custodians, prime brokers, securities lending counterparties)
- Unanticipated strategy correlation
- Common investors

Liquidity & Reality

The true value of the portfolio assumed to follow a discrete Brownian motion:

(One step change) = (Trend Ret) + (Shock)

$$N_t - N_{t-1} = N_{t-1}\mu\triangle t + N_{t-1}\sigma\varepsilon_t\sqrt{\triangle t}$$

Illiquidity induces “conservative pricing”

$$r_t^o = \frac{\lambda(N_t - R_{t-1})}{R_{t-1}}$$

Bayesian process of adjusting some proportion of the distance between prior period’s valuation and what it’s perceived to be worth in the current period (Quan and Quigley (1991))

Liquidity & Reality

The observed (reported) return is a function of:

- The trend rate of return
- The realized volatility
- The under/over-valuation of the prior period

$$r_t^o = \frac{\lambda(N_{t-1}(1+\mu\triangle t) - R_{t-1}) + \lambda(N_{t-1}\sigma\varepsilon_t\sqrt{\triangle t})}{R_{t-1}}$$

Liquidity & Reality

The expected observed return is:

$$E[r_t^o] = \frac{\lambda(N_{t-1}(1 + m\triangle t) - R_{t-1})}{R_{t-1}}$$

As λ decreases, portfolio returns become increasingly determined by prior period under/over-valuation; we would expect returns to become increasingly serially correlated.

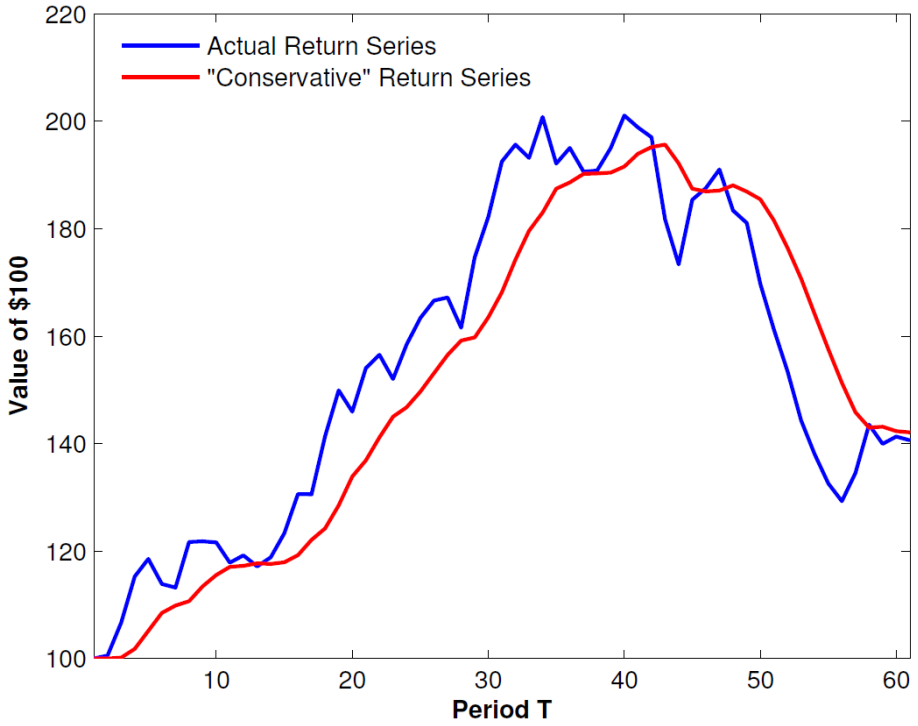
A quick, approximate estimate of λ is obtained from the first order autocorrelation of $r_t{}^o$

$$\lambda \approx \left(1 - \rho_{s(1)}{}^o\right)$$

(Not the only method for deriving this prior: common sense "sanity checks" also useful…)

Smoothed Value

How are N_t (true value) and R_t(reported value) related?



$\mu = 5\%$
$\sigma = 25\%$
$\lambda = 0.25$

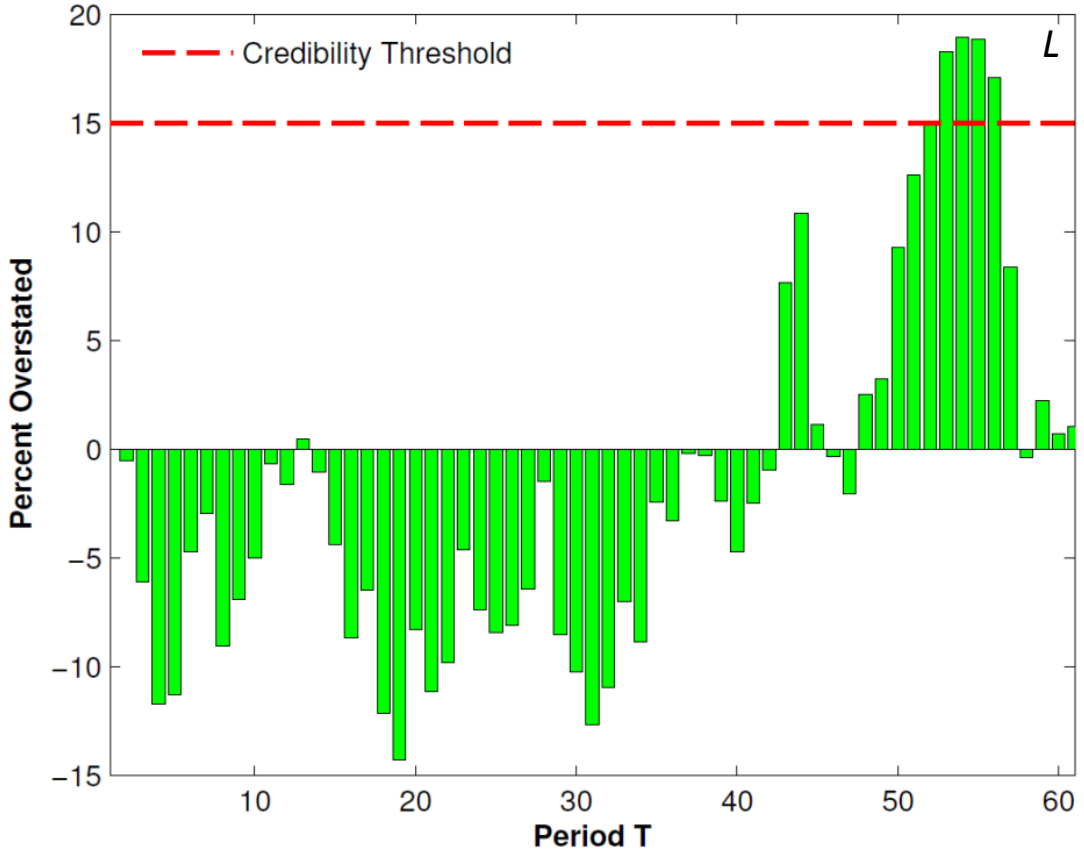
Smoothed Value

Illiquidity systematically drives under/over-valuation

Under-valuation not so critical, over-valuation more of an issue:

- Interested third parties will not allow a portfolio valuation to exceed a rational tradable value by more than a “reasonable” margin
- Prime brokers that extend credit, monitor reported valuations as assets serve as collateral
- We refer to this margin as the “credibility threshold” (*L*)
- *L* effectively determined by the first interested third party such as Prime Brokers or investors to act; *NOT THE MANAGER*

Smoothed Value



Smoothed Value

Exceeding the credibility threshold triggers forced behavior (selling)

May result in a large single period loss governed by:

- The portfolio overvaluation $(R_t - N_t)$
- A liquidation penalty (P)

Such losses relatively frequent and tend to be larger than conventional data-dependent methods such as VaR or CVaR

The magnitude and frequency (not the timing) are reasonably predictable, and can be priced by formalizing the basic structural dynamics

Barrier Option Framework

Simulate the "true" value of portfolio using discrete BM which is a function of:

- Observed volatility
- Observed trend rate of return
- The valuation lag which can be estimated using $\lambda \approx (1 - \rho_{s(1)}{}^{o})$

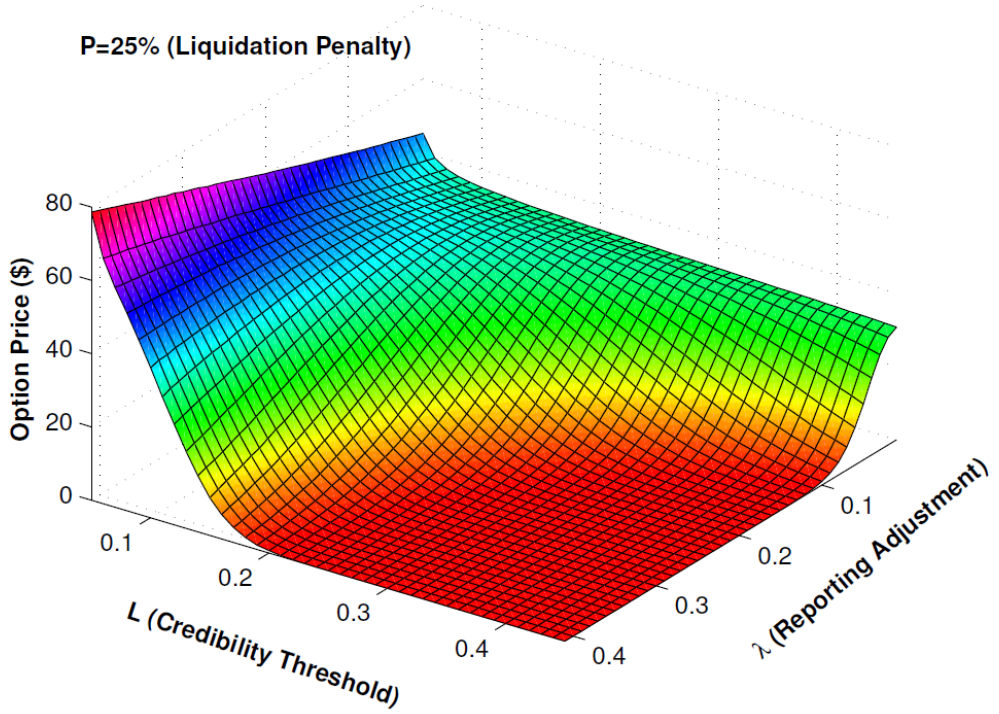
Calculate the individual period differences between the two processes (true & reported processes)

When the difference exceeds the assumed credibility threshold apply a payout equal to the over-reporting and the penalty: $(R_t - N_t) + (P)$

Simulate 100k times and calculate the mean NPV of all the one-year paths (including those which do not cause liquidation)

This naturally translates into a "haircut" against the observed return and represents a de facto price for investing in a less liquid portfolio

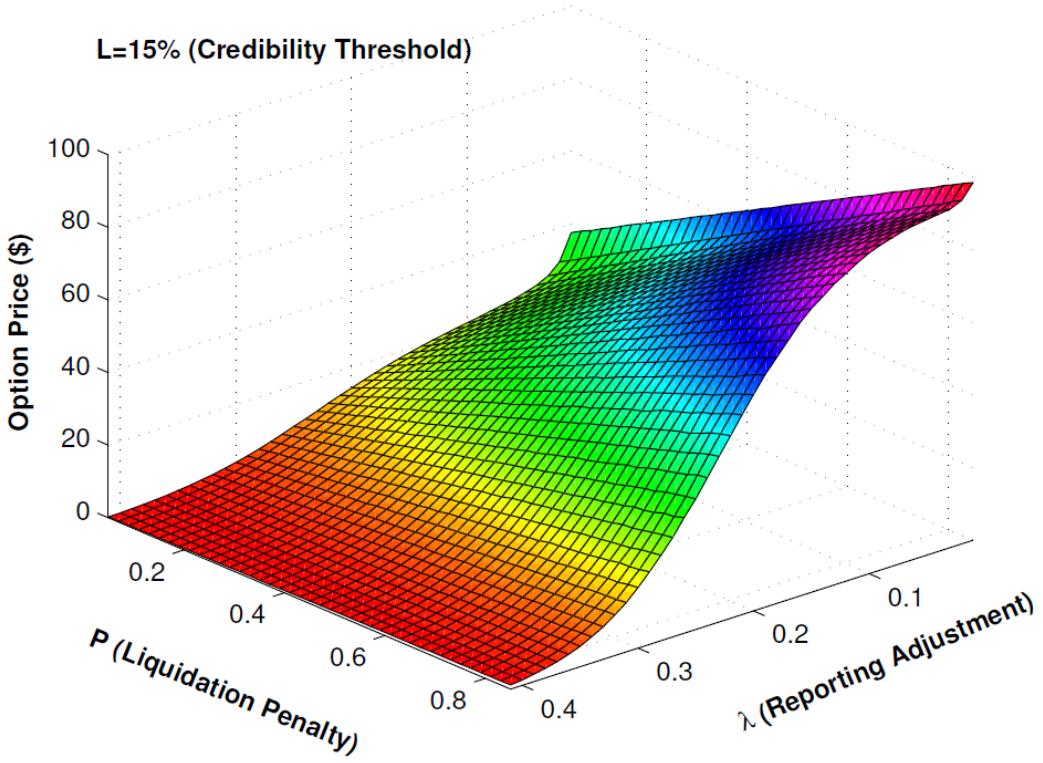
Option Value: L & λ



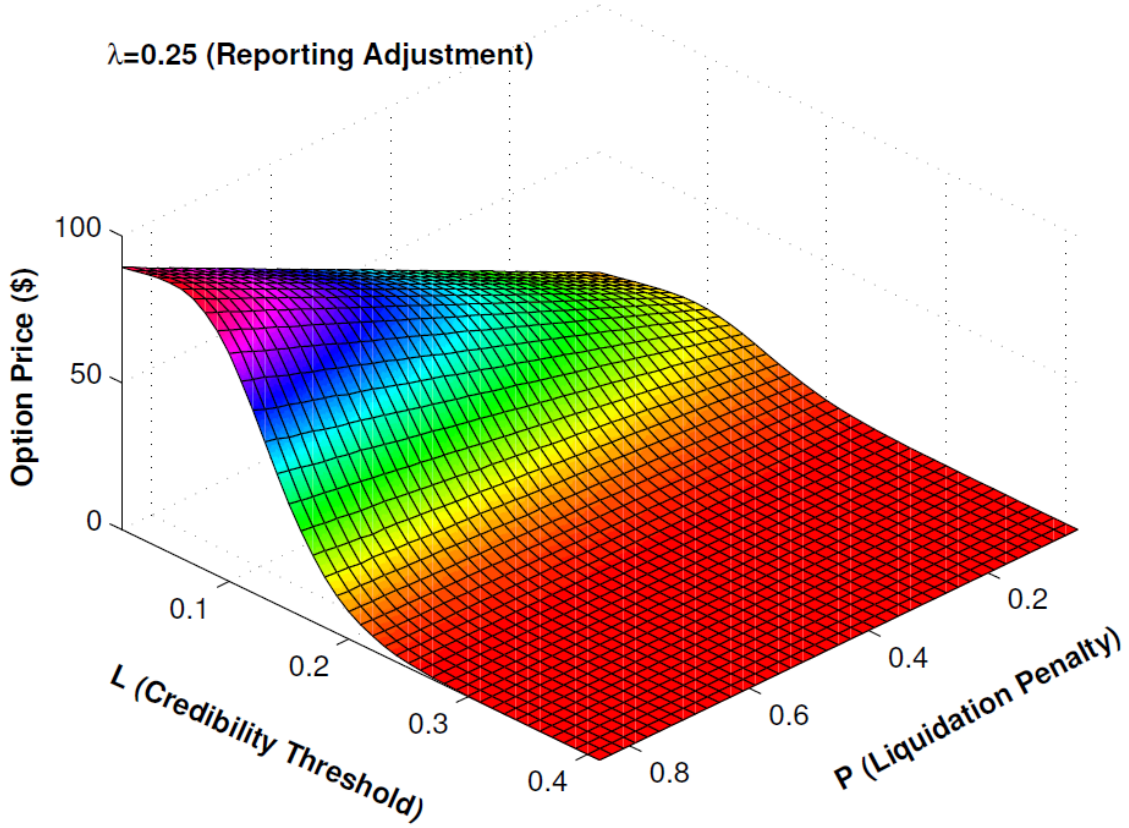
$\mu = 6\%$
$\sigma = 12\%$
$\lambda = 0.25$
$r_f = 2\%$
$L = 15\%$
$P = 25\%$

Option Value = $15.54
Implied Adjusted Return = -9.54%

Option Value: P & λ



Option Value: P & L



Option Sensitivities

Model Parameter	Direction	Option Value (Cost)
Serial Correlation	⇧	⇧
Liquidation Penalty	⇧	⇧
Credibility Threshold	⇧	⇩
Mean Return	⇧	⇩
Volatility	⇧	⇧
Interest Rate	⇧	⇩
Frequency of Mark	⇧	⇩

Additional Considerations

The option value is not a liquidity premium, rather it is the calculated cost of price smoothing an illiquid portfolio when combined with a triggering event, that may result in an abrupt sale into a declining market

When the portfolio is illiquid, managers generally do not have the flexibility to avoid these dynamics

Parameter Considerations

In cases of fraud or collapse, transactions in the secondary market for hedge funds have an average discount to NAV of 49.6% (Ramadorai (2008))

JPMorgan (2012)

- Hedge funds expected return 5% to 7%
- Hedge funds expected volatility 7% to 13%

- Private equity expected returns 9%
- Private equity expected volatility 34.25%

Are these sufficient returns given the volatility?

Pricing Liquidity in Alternative Investments (Indices)

Table 1: First Order Serial Correlation of Select HFRI Hedge Fund Indices

HFRI Index	Serial Corr	"Estimated" λ
Fixed Income–Convertible Arbitrage	58%	0.42
Distressed/Restructuring	53%	0.47
Multi–Strategy	50%	0.50
Fixed Income–Corporate	48%	0.52
Emerging Markets: Russia/Eastern Europe	38%	0.62

Measured serial correlation for most of these lie in the 50% to 60% range

Managers are typically reflecting less than 50% of the true change in the value of their portfolios

Depending on assumptions concerning other parameters, the option value could be quite significant!

Example: Emerging Market liquidity option: 13.52%
Observed return: 17.3%, Liquidity-adjusted return: 3.78%

Pricing Liquidity in Alternative Investments (Funds)

Morningstar- CISDM Hedge Fund Database (contains both live and dead funds)

- Eliminated CTAs and Fund of Funds
- At least 24 months of return history
- Autocorrelation of 0.01 or higher
- Eliminate the last 3 months of data for each manager

3,554 hedge funds

$r_f = 5\%$ $L = 15\%$ $P = 25\%$

$\overline{\mu} = 11.79\%$ $\overline{\sigma} = 13.88\%$ $\overline{\rho_{s(1)}{}^{o}} = .2032$

Average Option value was 5.52%

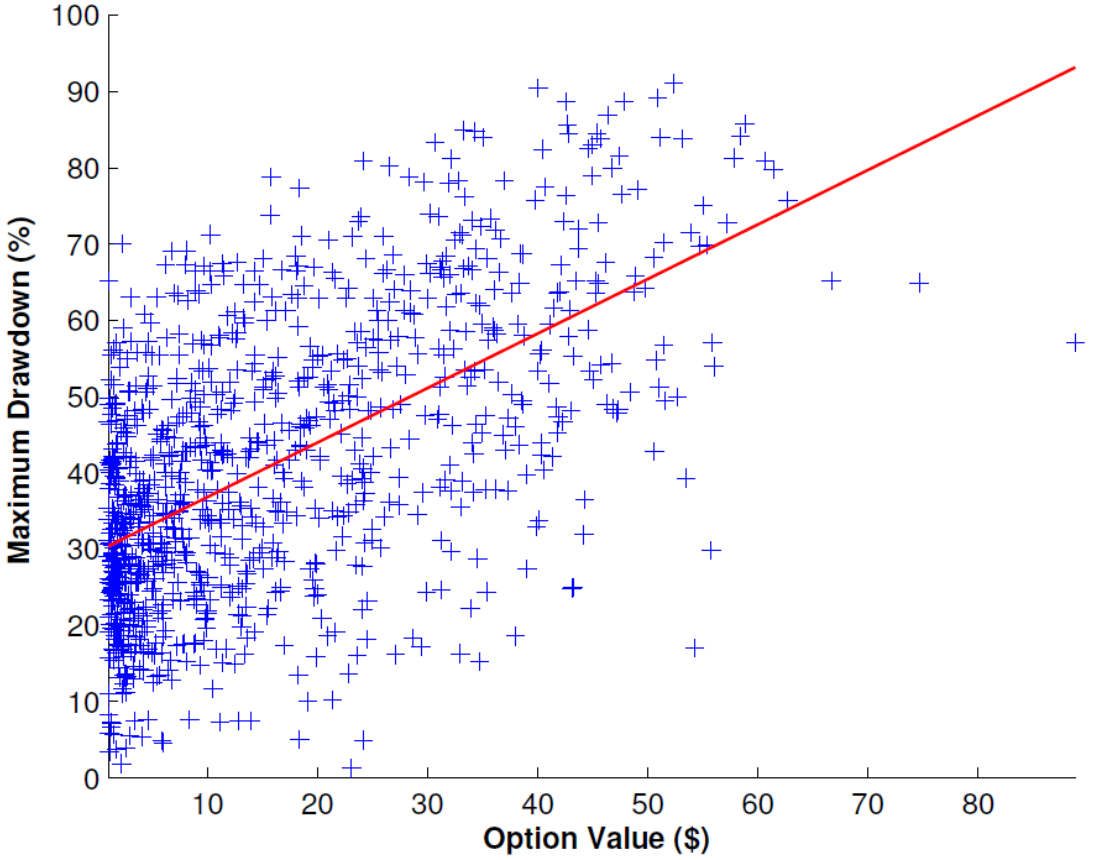
Implying an average Liquidity-adjusted mean return of 6.27%

Pricing Liquidity in Alternative Investments (Funds)

Table 2: Select Hedge Fund Performance and Adjusted Performance

Fund Name	Annualized Return	Serial Correlation	Option Value	Adjusted Annual Return
Deephaven Credit Opportunities	1.88%	0.42	$1.32	0.56%
Bridgewater Partners	3.58%	0.20	$8.21	-4.62%
Thames River European A (EUR)	6.76%	0.03	$1.28	5.47%
Thames River Property Growth & Income (EUR)	7.24%	0.43	$1.64	5.60%
Glenrock Global Partners (BVI), Inc.	7.42%	0.11	$1.01	6.40%
Everest Capital Intl.	8.31%	0.27	$9.34	-1.03%
Rocker Partners	9.42%	0.09	$7.46	1.96%
Alta Partners L.P. (Onshore)	11.13%	0.64	$1.67	9.46%
Rainbow Global High Yield (USD)	16.03%	0.28	$14.31	1.71%
Marathon Emerging Markets	16.20%	0.23	$20.05	-3.85%
Bear Stearns Asset Backed Securities LP	24.86%	0.60	$2.24	22.61%
Okumus Opportunity A	27.53%	0.04	$36.48	-8.95%
Viaticus	31.22%	0.05	$33.03	-1.81%
Lancer Offshore	33.63%	0.16	$9.68	23.95%
Galleon Omni Technology (B)	40.25%	0.13	$45.76	-5.50%
Infinity Emerging Opportunities	74.16%	0.12	$88.80	-14.64%

Option Values vs Drawdowns



The Poster Child

The (almost) magical fund: Bear Stearns High-Grade Structured Credit Strategies

$\mu = 12.4\%$ $\sigma = 1.5\%$ $\lambda = 0.3635$

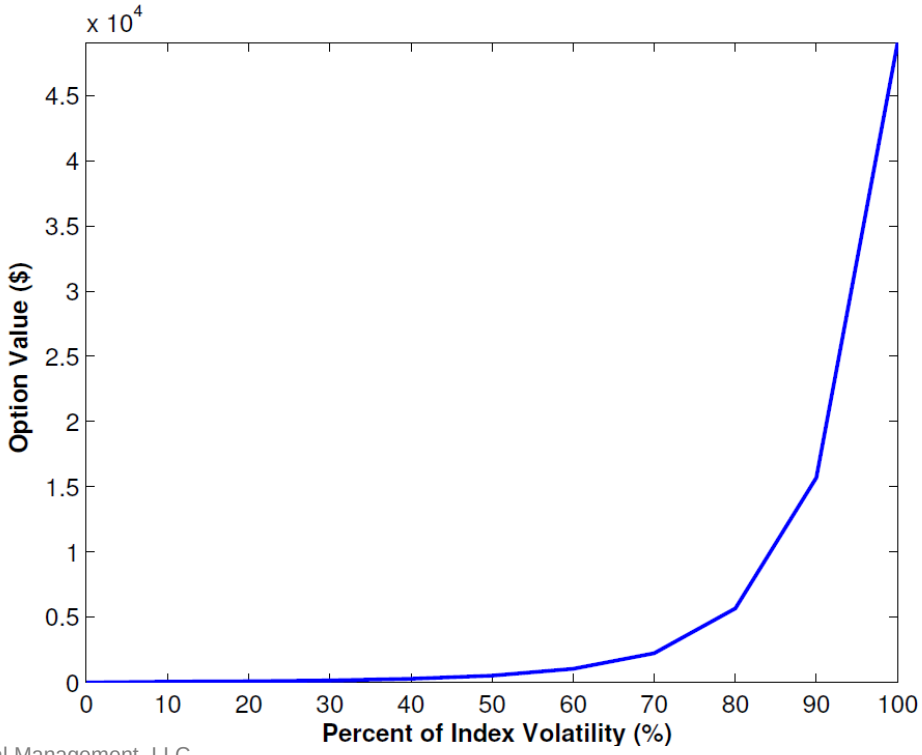
Option value close to $0, but…

The standard deviation for the HFRI Fixed Income–Asset Backed Index: 4.03%

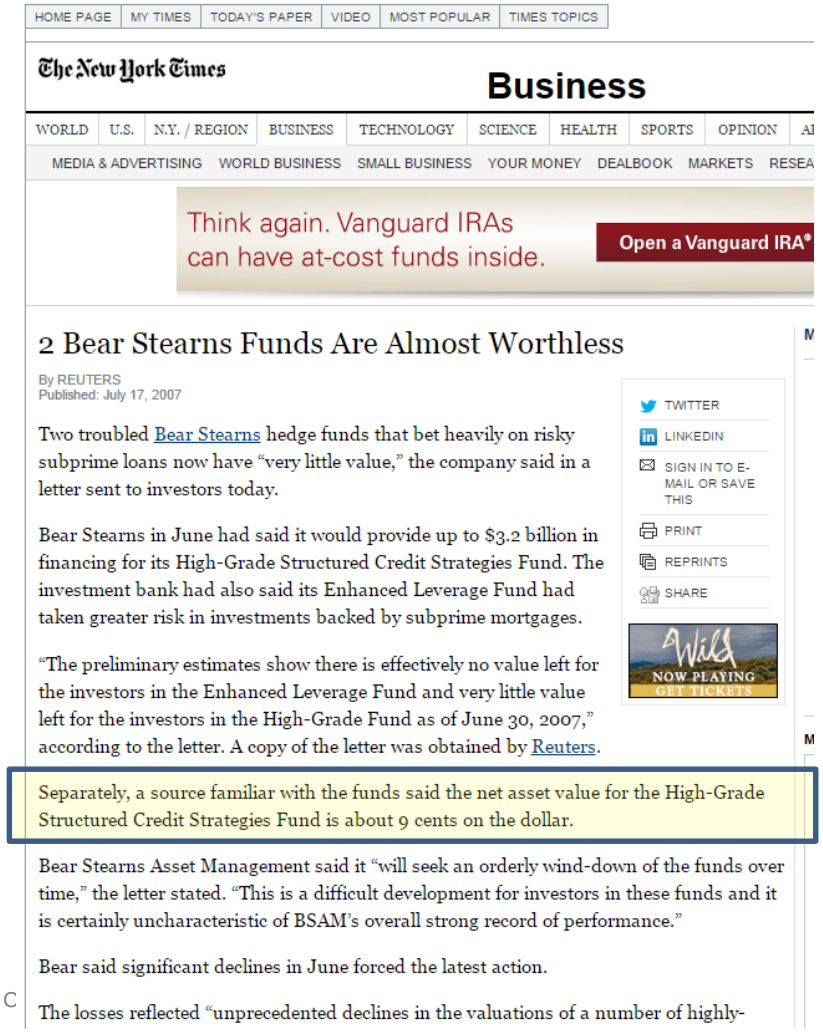
The Bear Stearns Fund was showing ≈ 1/3 of the index volatility

The Poster Child

As the fund's volatility approached the index volatility, the option cost exploded



The Poster Child



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2 Bear Stearns Funds Are Almost Worthless

By REUTERS
Published: July 17, 2007

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Two troubled Bear Stearns hedge funds that bet heavily on risky subprime loans now have "very little value," the company said in a letter sent to investors today.

Bear Stearns in June had said it would provide up to $3.2 billion in financing for its High-Grade Structured Credit Strategies Fund. The investment bank had also said its Enhanced Leverage Fund had taken greater risk in investments backed by subprime mortgages.

"The preliminary estimates show there is effectively no value left for the investors in the Enhanced Leverage Fund and very little value left for the investors in the High-Grade Fund as of June 30, 2007," according to the letter. A copy of the letter was obtained by Reuters.

Separately, a source familiar with the funds said the net asset value for the High-Grade Structured Credit Strategies Fund is about 9 cents on the dollar.

Bear Stearns Asset Management said it "will seek an orderly wind-down of the funds over time," the letter stated. "This is a difficult development for investors in these funds and it is certainly uncharacteristic of BSAM's overall strong record of performance."

Bear said significant declines in June forced the latest action.

The losses reflected "unprecedented declines in the valuations of a number of highly-

Summary & Conclusion

Adjusting for serial correlation fails to measure or capture the core risk and cost of illiquidity: forced liquidations and “fire sales”

A barrier option model provides a straight-forward method of combining priors about the market to price this core risk

BIOGRAPHIES

RICHARD LINDSEY, PhD is a Managing Partner of Windham Capital Management and Co-Chief Investment Officer for Windham Liquid Alternatives. Previously, he served as the Chief Investment Strategist, Liquid Alternatives for Janus Capital. In this role he developed and co-managed the liquid alternative strategies and was also a member of the Janus Capital Group Global Allocation Committee. Prior to joining Janus in August 2012, Dr. Lindsey was a principal of the Callcott Group, LLC, a quantitative consulting group, where he was responsible for directing research activities and advisory services. For eight years Dr. Lindsey was president of Bear, Stearns Securities Corporation and a member of the Management Committee of The Bear Stearns Companies, Inc. Before joining Bear Stearns, Dr. Lindsey served as the Director of Market Regulation for the U.S. Securities and Exchange Commission and as the Chief Economist of the SEC. He was a finance professor at the Yale School of Management before joining the SEC. Dr. Lindsey has also served on several corporate boards including, The Investment Fund for Foundations (TIFF), the Options Clearing Corporation, the International Securities Exchange, and Strike Technologies. Dr. Lindsey has done extensive work in the areas of portfolio construction, risk management, and the trading of securities. He has held the positions of Visiting Academic at the Nikko Research Institute in Tokyo, Japan, and Visiting Economist at the New York Stock Exchange. He holds a bachelor of science degree in chemical engineering from Illinois Institute of Technology, an MS in chemical engineering from Berkeley, an MBA from the University of Dallas, and a Ph.D. in finance from the University of California, Berkeley. He is a Fellow of the Courant Institute, the Chairman of the International Association for Quantitative Finance as well as an Executive Vice President of the Quantitative Group for Finance.

ANDREW B. WEISMAN is a Managing Partner of Windham Capital Management and Co-Chief Investment Officer for Windham Liquid Alternatives. Mr. Weisman has more than 25 years of experience as a portfolio manager of alternative investment strategies. Prior to joining the Investment Manager in 2016, Mr. Weisman was the Chief Investment Officer of Janus Capital's Liquid Alternative Group from 2012 to 2016. Prior to joining Janus Capital, he was Chief Executive Officer or WR Managed Accounts, LLC from 2008 to 2012, and Managing Director and Chief Portfolio Manager for the Merrill Lynch Hedge Fund Development and Management Group from 2005 to 2008. Mr. Weisman has a Masters in International Affairs/International Business from Columbia University's School of International and Public Affairs, and a BS in Philosophy/Economics from Columbia University and has completed all of the course work and comprehensive exams toward a PhD from Columbia University's Graduate School of Business. In 2002 he was awarded the Bernstein Fabozzi/Jacobs Levy Award for outstanding article published in the Journal of Portfolio Management. In 2016 he was awarded the Roger F. Murray Prize (First Place) by the Institute for Quantitative Research in Finance. President of the Society of Columbia Graduates.