A Screen for Fraudulent Return Smoothing in the Hedge Fund Industry

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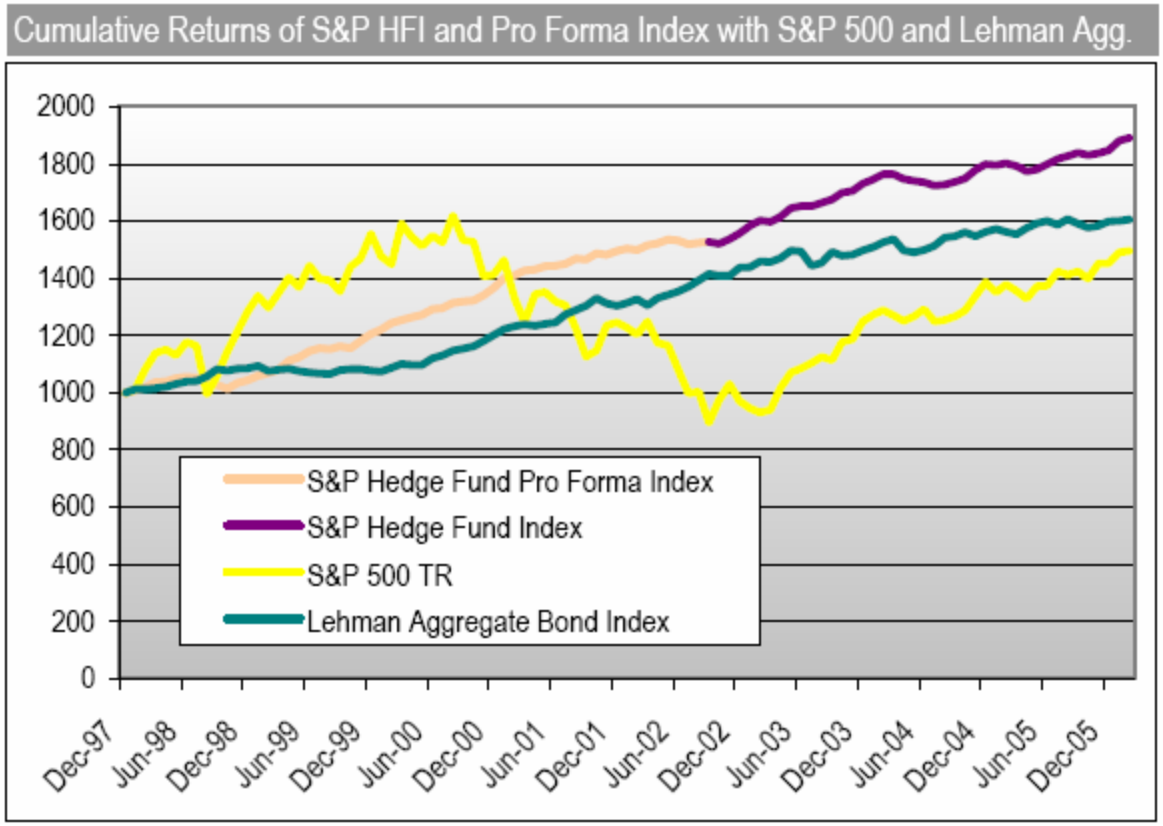
Historical performance



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Hedge fund men admit fraud charge

The founder and chief executive of US hedge fund Bayou Group have pleaded guilty to a fraud which allegedly cost investors millions of dollars.

Hedge funds can make money even when markets fall

Chief executive Samuel Israel and the fund's head of finance Daniel Marino admitted to defrauding investors by misrepresenting the value of the fund.

They admitted reporting false rates of return on the fund as well as creating a phoney accounting firm as a cover.

Bayou is the latest in a growing number of frauds involving hedge funds.

These funds are largely unregulated and traditionally serve institutions and wealthy investors.

In the last five years, US regulators have unearthed 51 cases involving hedge fund advisers who have defrauded investors to the tune of $1bn (£830m).

Guilty pleas

Samuel Israel, who founded Bayou in 1996, told the federal court that he knowingly sent false quarterly and annual statements and bogus newsletters to investors.

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Registration with SEC under Investment Advisers Act Effective 2/1/06

- "In the last five years, the Commission has brought 51 cases in which…hedge fund advisers have defrauded hedge fund investors…" (2005 Final Rule)
  - Damages of at least $1.1 billion
- Registration requirement includes safeguards against fraud:
  - Detailed set of internal controls
  - Compliance officer
- Requiring registration may also deter fraud by facilitating inspections

Arguments against SEC rule

- May chill hedge fund industry and reduce liquidity provided to financial markets (Alan Greenspan)
- Sophisticated investors able to perform due diligence and make informed decision already
- SEC still won't be able to prevent fraud (Cynthia Glassman and Paul Atkins)
  - Limited resources
  - Risk-based screen to target funds for examination not yet developed

This paper

- SEC registration requirement may indicate a desire for a more activist role

- This raises several important and related questions

  1. Can the SEC screen hedge funds for suspicious activity?

  2. Does fraud leave a detectable footprint?

  3. Do existing data provide enough statistical power to accurately identity the footprint?

Outline

1. Review existing research and explain our contribution
2. Design a specific filter for suspicious returns
3. Document the statistical properties of the filter
4. Apply the filter to a set of actual hedge funds

Existing academic evidence

- Getmansky, Lo, and Makarov (JFE 2004)

Asset Returns:

$$R_t = \mu + \beta\Lambda_t + \varepsilon_t, \quad \mathrm{E}\left[\Lambda\right] = \mathrm{E}\left[\varepsilon\right] = 0$$

$$\mathrm{Var}\left[R\right] = \sigma^2$$

Observed Returns:

$$R_t^O = \theta_0 R_t + \theta_1 R_{t-1} + \ldots + \theta_k R_{t-k} \quad \text{where}$$

$$\theta_j \in \left[0,1\right] \quad \text{for} \quad j = 0,\ldots,k$$

$$1 = \theta_0 + \theta_1 + \ldots + \theta_k$$

Existing academic evidence

- Getmansky, Lo, and Makarov (JFE 2004)

$$R_t^O = \theta_0 R_t + \theta_1 R_{t-1} + \ldots + \theta_k R_{t-k} \quad \text{where}$$

$$\theta_j \in [0,1] \quad \text{for} \quad j = 0,\ldots,k$$

$$1 = \theta_0 + \theta_1 + \ldots + \theta_k$$

$$\mathrm{E}\left[R_t^O \right] = \mu$$

$$\mathrm{Var}\left[R_t^O \right] = \sigma^2 \sum_{j=0}^{k} \theta_j^2$$

$$\mathrm{Cov}\left[R_t^O, R_{t-m}^O \right] = \begin{cases} \sigma^2 \sum_{j=0}^{k-m} \theta_j \theta_{j+m} & \text{if} \quad 0 \le m \le k \\ 0 & \text{if} \quad m > k \end{cases}$$

Existing academic evidence

- Getmansky, Lo, and Makarov (JFE 2004)

$$R_t^O = \mu + \sum_{j=0}^{k} \theta_j \eta_{t-j}$$

- Document significant θ_1 and θ_2 using MLE
- No way to distinguish among alternative explanations of serial correlation
  - Illiquid assets and stale prices
  - Marking assets to model conservatively
  - Managerial smoothing

Our contribution (1)

- We expect a conditional smoothing algorithm
  - Manager has more of an incentive to smooth losses than gains
    - Gains fully reported to maximize current management fee
    - Gains fully reported to keep up with competition
    - Fraud cases often involve overvaluation of assets (underreporting losses) not undervaluation of assets (underreporting gains)
  - Similar to accounting literature on managed earnings, e.g. Chandar and Bricker (JAR 2002)
  - Results in a number of asymmetries in statistical footprint that distinguishes fraud from other causes of serial correlation

Table 1. Actual vs. reported profits from currency options trading at NAB

	Monthly actual profit/(loss)	Monthly reported profits	(Under)/Overstatement of reported profits	Cumulative overstatement of portfolio value
2002 October	8,946	974	(7,972)	0
November	3,365	3,365	0	0
December	2,837	2,837	0	0
2003 January	2,792	3,678	886	886
February	2,559	2,650	91	977
March	2,774	1,797	(977)	0
April	(10)	2,567	2,577	2,577
May	(1,292)	4,372	5,664	8,241
June	3,390	4,558	1,168	9,409
July	12,556	7,165	(5,391)	4,018
August	(169)	1,323	1,492	5,510
September	(34,780)	1,761	36,541	42,051
October	13,871	5,774	(8,097)	33,954
November	3,993	7,421	3,428	37,382
December	(49,106)	5,272	54,378	91,760

Our contribution (2)

- We carefully document the small sample properties of the statistical screen
  - Type I error means falsely rejecting the null hypothesis → examining a fund that does not feature conditional serial correlation
  - Type II error means failing to reject the null hypothesis → failing to examine a fund that does feature conditional serial correlation
    - If the screen has low power, then the SEC will not be able to accurately screen funds for examination

The model

$$R_t = \mu + \beta\Lambda_t + \varepsilon_t$$

$$R_t^O = \left(\theta_0\left(1 - I_t\right) + \psi_0 I_t\right)R_t + \left(\theta_1\left(1 - I_{t-1}\right) + \psi_1 I_{t-1}\right)R_{t-1}$$

$$I_t = 1 \quad \text{if} \quad R_t \geq c$$

$$I_t = 0 \quad \text{if} \quad R_t < c$$

- Manager reports a fraction ψ_0 of asset returns in current month if they are high, else he reports θ_0
- Conditional smoothing generates conditional serial correlation
- Prediction not found in other explanations of smoothed returns

Estimation

$$R_t^O = a + \left(b_1^- \left(1 - I_{t-1}\right) + b_1^+ I_{t-1} \right) R_{t-1}^O + \eta_t$$

$$I_t = 1 \quad \text{if} \quad R_t \geq c$$

$$I_t = 0 \quad \text{if} \quad R_t < c$$

- We derive analytic expressions for b_1^- and b_1^+
- Model predicts $b_1^- > b_1^+$

Figure 1. Analytic difference between conditional betas

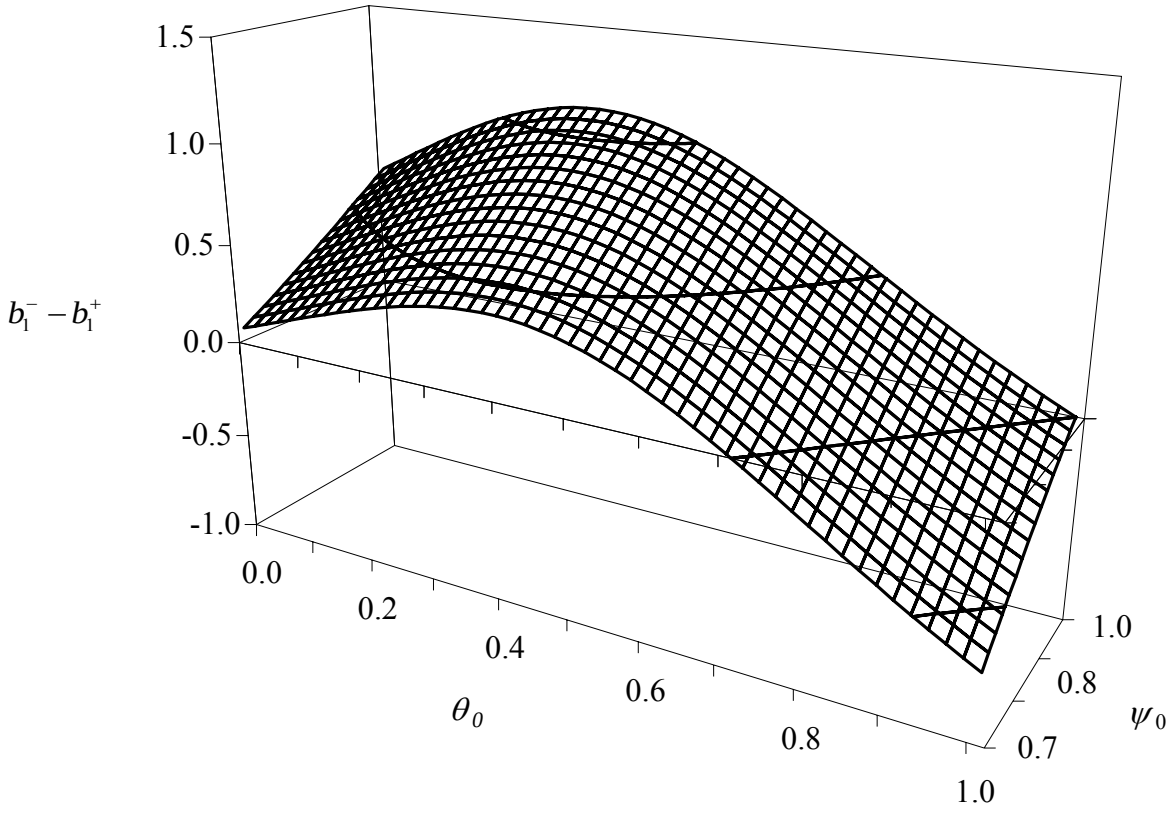
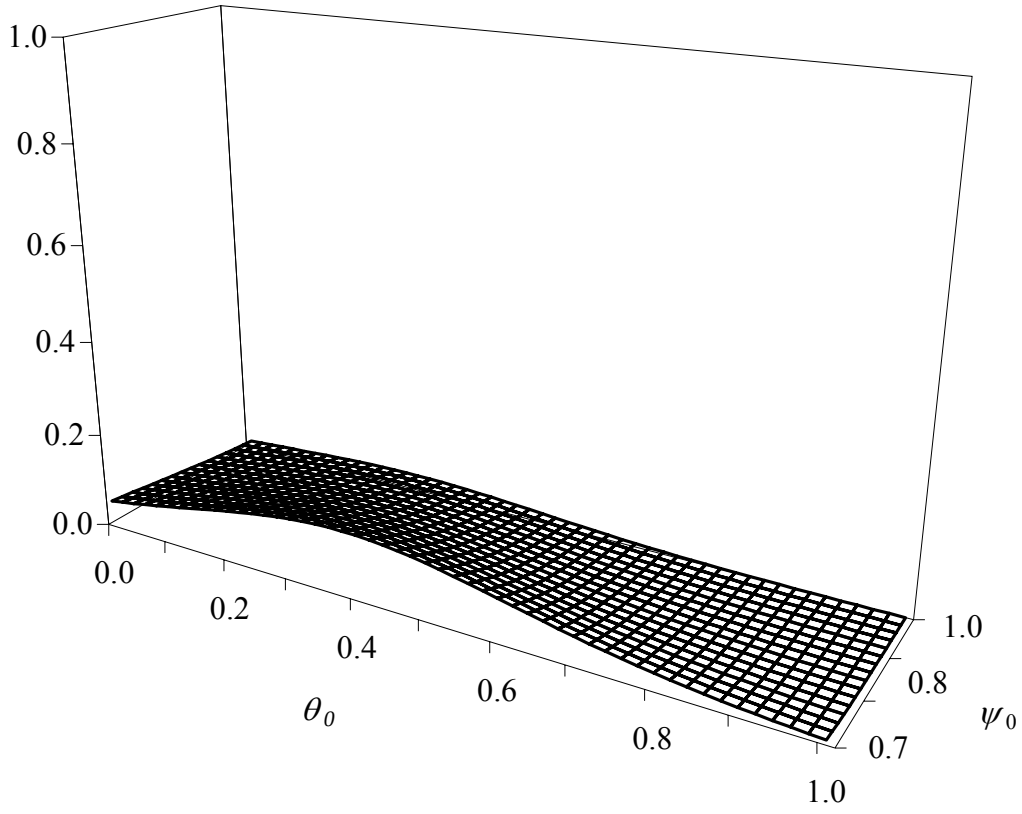


Figure 2. Analytic residual serial correlation



Implementation

$$R_t^O = a + \left(b_1^- \left(1 - I_{t-1}\right) + b_1^+ I_{t-1} \right) R_{t-1}^O + \eta_t$$

$$I_{t-1} = 1 \quad \text{if} \quad \mu + \beta \Lambda_{t-1} \geq c$$

$$I_{t-1} = 0 \quad \text{if} \quad \mu + \beta \Lambda_{t-1} < c$$

- Redefine indicator variable
- Fitted value of factor model can be interpreted as unbiased estimate of asset return *or*
- as the return of non-discretionary assets

Table 4. History lengths of CISDM funds

	Live Funds				Dead Funds			
	#	25th	50th	75th	#	25th	50th	75th
Hedge Funds								
E-D	139	48	78	108	85	36	53	86
G Emerging	96	50	73	94	41	30	42	69
G Established	288	40	67	96	258	38	53	92
G International	37	62	88	120	21	47	59	73
G Macro	46	43	79	104	53	36	48	73
Long Only	12	63	80	92	12	32	48	78
M-N	344	36	63	89	175	36	55	72
Sector	108	42	54	88	52	32	47	64
Short-Sellers	20	51	79	86	8	34	61	66
Fund of Funds	425	43	71	108	151	35	55	74

Size analysis of conditional serial correlation

- For each fund, find best single-factor model:

$$R_t^O = \mu + \beta^O \Lambda_t + \varepsilon_t$$

- Simulate 20 asset return histories for each fund:

$$R_t^A = \mu + \beta^O \Lambda_t^E + \xi_t$$

- Construct unconditionally smoothed returns:

$$R_t^S = 0.5 R_t^A + 0.5 R_{t-1}^A$$

- Ask econometrician to estimate conditional serial correlation:

$$R_t^S = a + b_1^+ R_{t-1}^S + b_1^- \left(1 - I_{t-1}\right) R_{t-1}^S + \eta_t$$

Table 7. Size analysis of conditional serial correlation

		Known Factor			Unobservable Factor		
		Months			*Months*		
	#	120	60	36	120	60	36
Hedge Funds							
E-D	210	0.02	0.02	0.02	0.02	0.02	0.02
G Emerging	137	0.04	0.04	0.03	0.04	0.04	0.03
G Established	534	0.02	0.02	0.02	0.02	0.02	0.02
G International	58	0.02	0.02	0.03	0.02	0.02	0.02
G Macro	92	0.02	0.02	0.02	0.03	0.02	0.02
Long Only	24	0.04	0.01	0.01	0.04	0.02	0.02
M-N	511	0.01	0.02	0.01	0.02	0.02	0.01
Sector	160	0.01	0.01	0.01	0.01	0.02	0.02
Short-Sellers	25	0.01	0.02	0.01	0.01	0.02	0.01
Fund of Funds	567	0.02	0.01	0.01	0.02	0.01	0.01

Power analysis under controlled conditions

- As before, find best single-factor model:

$$R_t^O = \mu + \beta^O \Lambda_t + \varepsilon_t$$

- And simulate 20 asset return histories for each fund:

$$R_t^A = \mu + \beta^O \Lambda_t^E + \xi_t$$

- Construct conditionally smoothed returns:

$$R_t^S = \left(0.5\left(1 - I_t\right) + I_t\right) R_t^A + 0.5\left(1 - I_{t-1}\right) R_{t-1}^A$$

- Ask econometrician to estimate conditional serial correlation

$$R_t^S = a + b_1^+ R_{t-1}^S + b_1^- \left(1 - I_{t-1}\right) R_{t-1}^S + \eta_t$$

Table 8. Power analysis under controlled conditions

		Known Factor			Unobservable Factor		
		Months			*Months*		
	#	120	60	36	120	60	36
Hedge Funds							
E-D	210	0.81	0.53	0.33	0.77	0.44	0.25
G Emerging	137	0.84	0.56	0.32	0.78	0.46	0.24
G Established	534	0.79	0.50	0.31	0.74	0.43	0.23
G International	58	0.84	0.55	0.34	0.76	0.44	0.23
G Macro	92	0.84	0.54	0.34	0.75	0.41	0.23
Long Only	24	0.77	0.46	0.29	0.76	0.41	0.24
M-N	511	0.86	0.59	0.38	0.77	0.45	0.25
Sector	160	0.80	0.49	0.32	0.76	0.43	0.25
Short-Sellers	25	0.79	0.48	0.28	0.76	0.44	0.23
Fund of Funds	567	0.77	0.48	0.30	0.74	0.43	0.25

Power analysis under actual conditions

- For each fund, use optimal multi-factor model
- Simulate 20 asset return histories by reordering residuals but leaving factor observations unchanged
- Construct conditionally smoothed returns:

$$R_t^S = \left(0.5\left(1-I_t\right)+I_t\right)R_t^A + 0.5\left(1-I_{t-1}\right)R_{t-1}^A$$

- Ask econometrician to estimate conditional serial correlation:

$$R_t^S = a + b_1^+ R_{t-1}^S + b_1^- \left(1-I_{t-1}\right)R_{t-1}^S + \eta_t$$

Table 10. Power analysis under actual conditions

	#	5%	10%	20%
Hedge Funds				
E-D	210	0.36	0.45	0.56
G Emerging	137	0.37	0.47	0.59
G Established	534	0.28	0.38	0.51
G International	58	0.35	0.45	0.57
G Macro	92	0.27	0.36	0.47
Long Only	24	0.39	0.48	0.61
M-N	511	0.28	0.37	0.49
Sector	160	0.26	0.36	0.49
Short-Sellers	25	0.36	0.48	0.60
Fund of Funds	567	0.35	0.45	0.58

How many funds feature conditional serial correlation?

- About 4.4% of the sample at a 5% two-sided significance level
- More than the 2.5% expected under the null hypothesis
- Of 53 SEC fraud cases, we could obtain returns for 18 of them
- 5/18 or 28% feature significant conditional serial correlation
- What are the properties of the flagged funds?

Table 13. Cross-sectional analysis of red-flagged hedge funds

	Coefficient	p-value	Coefficient	p-value
Constant	-2.4207	0.0000	-2.5149	0.0000
ln(Cfvol)	0.2203	0.0287	0.3326	0.0201
Cfmu	-4.9885	0.0021	-5.7388	0.0316
E[r]			12.0490	0.2597
Fee			-0.1135	0.4847
Incent			0.0127	0.3005
Live			-0.2937	0.1656
ln(Size)			0.0025	0.9082
Audit			-0.1846	0.5595
Age			0.0035	0.1552
ln(wait)			0.1077	0.0672
LR statistic		8.9597		15.2337
Probability(LR stat)		0.0113		0.1238
McFadden R-squared		0.0113		0.0177
# obs		3,649		2,058
# obs red-flagged		177		110
Frequency		0.0485		0.0534

Conclusions

- Statistical procedures may be available to detect fraud
- Power is an issue – approximately 33% under average conditions
  - Can be viewed as a relatively low-cost but low-power screen
  - Analogous to IRS screens for fraud
- Power may be increased by running a battery of tests using alternative managerial algorithms

Note: Don’t cheat in China

CNNmoney

China executes bank staff for fraud

Part of Beijing's intense crackdown on white-collar crime ahead of IPOs, state-owned agency says.

September 14, 2004: 12:58 PM EDT

BEIJING (Reuters) - China executed four people, including employees of two of its Big Four state-owned banks, for fraud totaling $15 million, the state Xinhua news agency said Tuesday.