Lecture 10: Hedge Funds (Part 1)

In this lecture, we will discuss various issues related to the hedge fund industry, such as

- Hedge fund compensation
- Limits to arbitrage
- Funds of funds
- Market-neutral strategies
- Hedge fund performance

What Are Hedge Funds?

- Used to be: "Unregulated pools of money for the rich"
- Hedge funds have essentially been defined by their freedom from SEC regulation, until recently
  - No investment constraints on shorting, leverage, derivatives holdings, etc.; little disclosure
  - Could not advertize until recently
  - Why no regulation?

- Some regulation was adopted in 2004, but lasted only until June 2006
  - These regulation changes affected return misreporting by funds (Dimmock and Gerken, 2015)
- But the era of unregulated hedge funds is over
  - Role of hedge funds in the 2007-9 financial crisis?

- The 2010 Dodd-Frank bill imposed new regulations
  - All large hedge funds must register with SEC
  - New disclosure and reporting requirements
  - New rules on derivatives trading
  - Leaving many details to regulators $\Rightarrow$ uncertainty

- Organizational form: Usually a limited partnership (L.P.), run by a general partner
  - Limited number of "rich" investors
    - Minimum net worth, minimum investment
    - Originally wealthy individuals, but increasingly popular among pension funds, endowments
- *Master-feeder structure* is typical
  - All trading takes place in the **master** fund
  - Investors invest in a feeder fund whose sole purpose is to invest in the master fund
- **Feeder** funds are tailored to investors' needs, e.g.,
  - Tax treatment
    - U.S. taxable investors may prefer a feeder fund registered in the U.S.
    - Foreign investors and tax-exempt U.S. investors may prefer an offshore feeder fund registered in tax havens (e.g., Cayman Islands, British Virgin Islands, Bahamas, Bermuda)
  - Currency denomination
    - Offer exposure to the desired currency
  - Risk
    - Offer desired level of volatility

- Employ aggressive investment strategies
  - Unadulterated exposure to active management
  - Seek arbitrage opportunities, market inefficiencies
  - Long-short positions, derivatives, leverage
  - We will discuss specific strategies next week
- So why are they called "*hedge*" funds?
  - The prototypical hedge fund is hedged with respect to the main risk in the market
  - In the *bond* market, where hedge funds often go after yield spreads, you want to be "hedged" with respect to changes in *interest rates*
    - Go both long and short, and ensure that your overall position has *zero duration*
  - In the *stock* market, where hedge funds often go after alphas, you want to be "hedged" with respect to movements the aggregate stock *market*
    - Go both long and short, and ensure that your overall position has *zero beta*
  - In the *derivatives* market, where hedge funds go after pure mispricing, you can be *fully* hedged
    - Take a position in the underlying asset that *dynamically replicates* the derivative security
    - Ensure that your overall position has *zero delta*

Compensation

- How much do CEOs and celebrities get paid?
  - In 2011, James Dimon of JP Morgan Chase, earned $23 million; Brian Moynihan of Bank of America Merrill Lynch, earned $8.1 million
  - From the *2011 Forbes Celebrity 100 Power List*:
    * Lady Gaga: $90 million
    * Jay Leno: $32 million
    * Brad Pitt: $20 million
    * Angelina Jolie: $30 million
    * Tiger Woods: $75 million
    * LeBron James: $48 million
    * Roger Federer: $47 million
    * Lionel Messi: $32 million
- How much do hedge fund managers get paid?
  - 2011 income (from *Absolute Return Magazine*):
    * Ray Dalio (Bridgewater): $3.9 billion
    * Carl Icahn (Icahn Capital Mgt): $2.5 billion
    * James Simons (Rennaissance): $2.1 billion
    * Ken Griffin (Citadel): $700 million
    * Steven Cohen (SAC): $585 million
  - Total pay of top 25 managers in 2011 was $14.4 billion, down from $25.3 billion in 2009

- Hedge fund managers earn two types of fees:
  1. Flat management fee
     - Fraction of assets under management (e.g., 2%)
  2. Performance-based *(incentive)* fee
     - Fraction of profits (e.g., 20%)
  - This is a "2/20%" compensation scheme
  - Traditionally, the fees have been 1-2/15-20%, but many exceptions
- Do fund managers always receive the incentive fee?
  - No. Only if the fund's net asset value (NAV) exceeds the "high watermark" (usually the NAV at which a performance fee was last paid)
  - Managers must recoup any prior losses

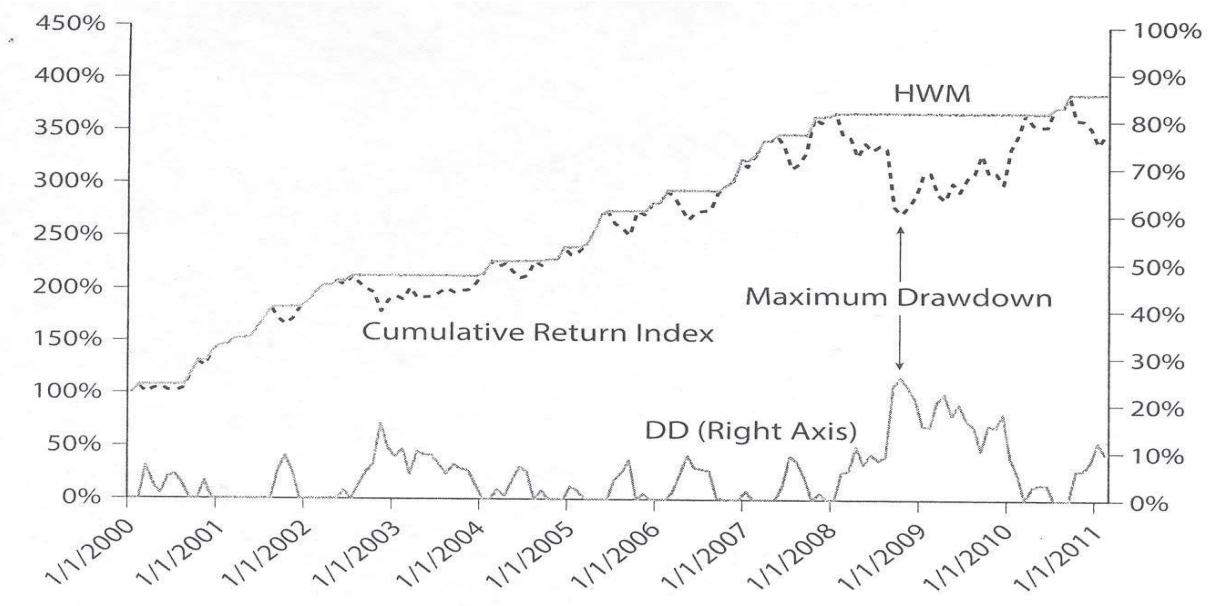


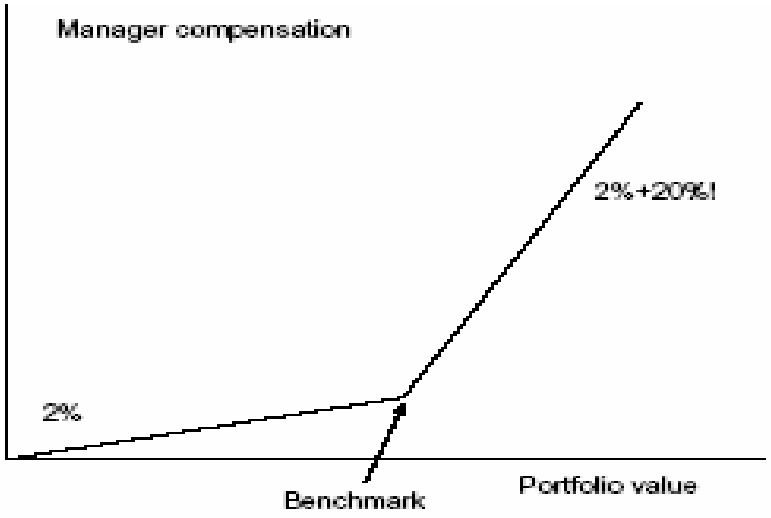
Figure 2.1. A hedge fund strategy's high water mark (HWM) and drawdown (DD).

- This performance-based fee system is *unique*
  - Mutual funds cannot charge incentive fees, by law
- This performance-based fee system is *asymmetric*
  - Fund managers collect incentive fees for gains, but they do not have to rebate fees for losses
  - BNAV: the beginning NAV (high watermark)
    ENAV: the fund's ending NAV
  - Incentive fee payoff (for a 20% incentive fee):

$$\text{Max } [0.20(ENAV - BNAV), 0] =$$

$$0.20\times \text{ Max } [ENAV - BNAV, 0]$$

  - This is 20% of a *call option*!



  - The option's strike price is the high watermark
  - Each new investment in the fund comes with its own high watermark, so the manager really holds a portfolio of call options

- How can hedge funds increase the value of this option?
  - By increasing the volatility of the fund
- What if any mechanism mitigates gambling?
  - As general partners, the fund managers must invest a chunk of their *own wealth* in the fund
  - Reputation
    - But failed managers don't drive cabs (a "mulligan industry": LTCM, Amaranth, Peloton, etc.)
  - High watermarks
    - But managers often simply choose to shut down funds far below their high watermark

- High fees drag down hedge fund performance
- Goetzmann, Ingersoll, and Ross (2003) find that the present value of future fees is usually 10-20% of the amount invested, and could be as high as 33%! Also find that $\alpha \geq 3\%$ compensates investors for these fees.

- Why do some hedge funds turn away new investment?
  - Difficult to earn high returns when you are large
  - Good investments have limited capacity
  - The most successful funds tend to be closed

• Hedge fund fees from French (2008):

Table 4 – Assets Invested in Hedge Funds and Funds of Hedge Funds, 1991 to 2007, and Hedge Fund and Fund of Fund Fees, 1996 to 2007

Assets Invested are in billions of dollars and are measured at the beginning of the year. The total for All Hedge Funds is from Hedge Fund Research (HFR). I use HFR's categorization of funds and the U.S. weight among all developed equity markets to estimate the U.S. Equity-Related Hedge Fund assets. The estimate of U.S. Equity-Related Fund of Fund assets assumes funds of funds invest proportionately among hedge fund categories. All but the last column of fees are value-weight averages of individual fund fees computed using the HFR database and are in percent. The last column is in billions of dollars. The management fee (Mgmt Fee) is a fixed percent of assets in the fund. The Quoted Performance Fee is a fraction of the fund's profits. The Actual Performance Fee is measured relative to the beginning of year assets. The appendix describes how the actual performance fee is computed. Averages of the annual fees (and standard errors) are reported for 1996 to 2007 and 2000 to 2007.

	Assets Invested			Fees									
	All	U.S. Equity-Related		U.S. Equity-Related Hedge Funds				Funds of Hedge Funds				Hedge Fund plus Fund of Fund	
	Hedge Funds	Hedge Funds	Funds of Funds	Mgmt Fee	Performance Fee Quoted	Actual	Total	Mgmt Fee	Performance Fee Quoted	Actual	Total	Percent	Dollars
1991	38.9	8.3	0.4										
1992	58.4	14.1	4.8										
1993	95.7	24.9	9.6										
1994	167.8	39.8	17.9										
1995	167.4	38.6	17.2										
1996	185.8	46.2	14.0	1.07	17.00	2.53	3.59	1.04	10.81	2.75	3.79	7.38	2.2
1997	256.7	72.4	14.8	1.08	17.44	4.32	5.41	1.02	10.47	2.92	3.95	9.35	4.5
1998	367.6	126.5	25.5	1.07	17.92	2.20	3.27	1.04	12.36	0.26	1.31	4.58	4.5
1999	374.8	141.4	28.6	1.02	17.93	5.01	6.03	1.06	9.62	2.14	3.20	9.23	9.4
2000	456.4	176.1	29.4	1.12	18.26	2.21	3.33	1.05	8.94	0.33	1.38	4.72	6.3
2001	490.6	203.3	34.6	1.22	18.72	1.07	2.30	1.09	7.84	0.21	1.30	3.59	5.1
2002	539.1	243.4	46.3	1.23	18.90	0.89	2.12	1.08	7.61	0.19	1.27	3.40	5.8
2003	625.6	253.1	83.7	1.24	18.95	2.59	3.83	1.12	7.26	0.81	1.93	5.76	11.3
2004	820.0	313.4	112.1	1.20	18.87	1.80	2.99	1.10	7.25	0.58	1.67	4.66	11.2
2005	972.6	348.1	128.4	1.19	18.80	1.83	3.03	1.06	7.40	0.38	1.44	4.47	12.4
2006	1105.4	372.8	133.1	1.16	18.62	2.73	3.89	1.05	7.44	0.70	1.74	5.63	16.8
2007	1464.5	458.6	205.4	1.20	18.84	3.07	4.27	1.04	7.04	0.64	1.67	5.95	23.0
1996-2007				1.15	18.36	2.52	3.67	1.06	8.67	0.99	2.05	5.73	
				(0.02)	(0.19)	(0.35)	(0.33)	(0.01)	(0.51)	(0.29)	(0.29)	(0.57)	

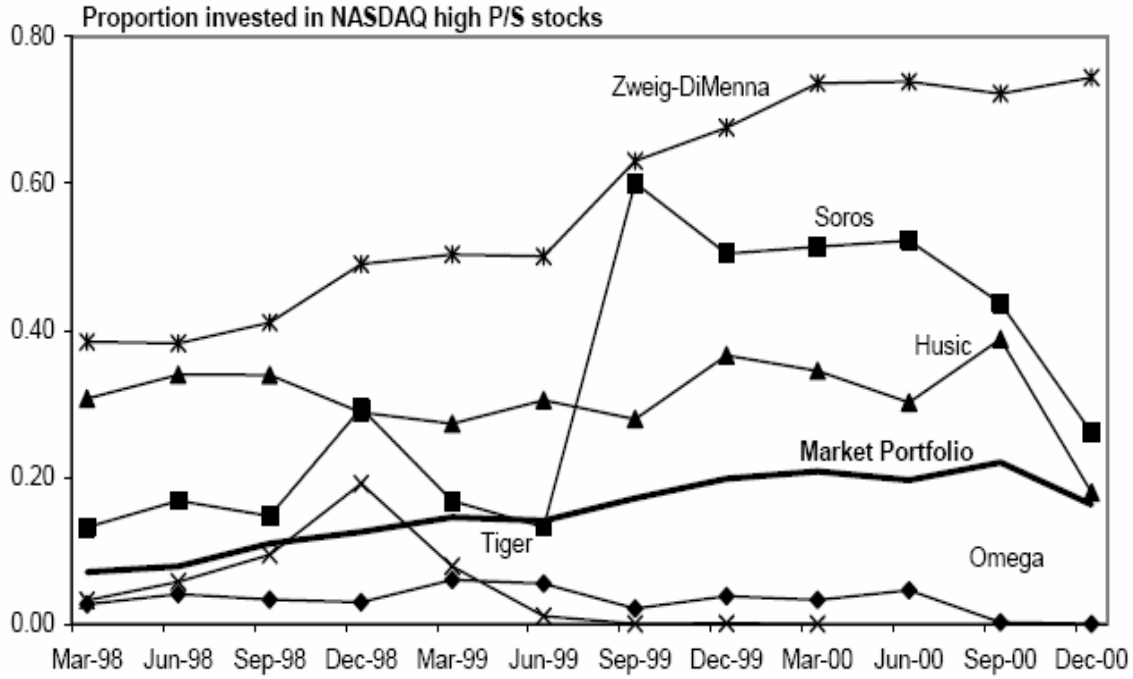
– Note: "2/20" is really more like 1.2/18.4

– Average total annual fee paid to hedge funds in 1996–2007 was 3.67% of assets under management

– Downward pressure on fees after the financial crisis

Restrictions on Withdrawals

- Investors must give notice of intent to withdraw
  - "Lock-up" periods can be long (even 2-3 years)
- What is the purpose of such restrictions?
- **Limits to arbitrage**
  - Hedge funds use mostly other people's money
  - Investors infer manager skill by observing returns
  - Bad returns $\Rightarrow$ Investors withdraw money
  - They may withdraw precisely when the fund's positions are most attractive!
    - E.g., mispricing deepens in a convergence trade
  - **Example:** Julian Robertson (Tiger) and tech stocks



    * Tiger was betting against tech stocks
    * Tiger was liquidated in March 2000, just when tech stock prices were beginning to tumble!
    * Figure from Brunnermeier and Nagel (2004), who obtain quarterly hedge fund stock holdings data from SEC 13F filings
      · The 13F reporting requirements apply also to hedge funds
  – **Example:** The 2008 financial crisis
    * Hedge funds sold almost 30% of their portfolios in the second half of 2008, mostly involuntarily due to massive redemptions and margin calls (Ben-David, Franzoni, and Moussawi, 2012)
    * Investors redeemed promptly, fearing that hedge funds would limit future redemptions

- Hedge fund investments are often *illiquid*
  – Withdrawals often translate into costly liquidation
- Hedge funds are becoming more creative, raising funds that cannot be withdrawn easily
  – Issuing bonds (Citadel, December 2006, $500m)
  – IPO (Fortress, February 2007)
  – Selling direct stakes (DE Shaw, March 2007)

Lack of Transparency

- Hedge funds are generally very secretive
  - They do not have to (and rarely do) reveal their strategies, positions, or even leverage
- Is this good or bad?
- Tradeoff between two competing objectives:
  - Investors like transparency so they can better understand the manager's investment philosophy and preclude manipulation or even outright fraud
  - Hedge fund managers often invest in strategies that have limited capacity; transparency might lead to increased flow of capital into those strategies, eroding the opportunity to add value

Investing in Hedge Funds

- Why invest in hedge funds?
  - Increase return
  - Reduce risk
  - Exposure to dynamic strategies

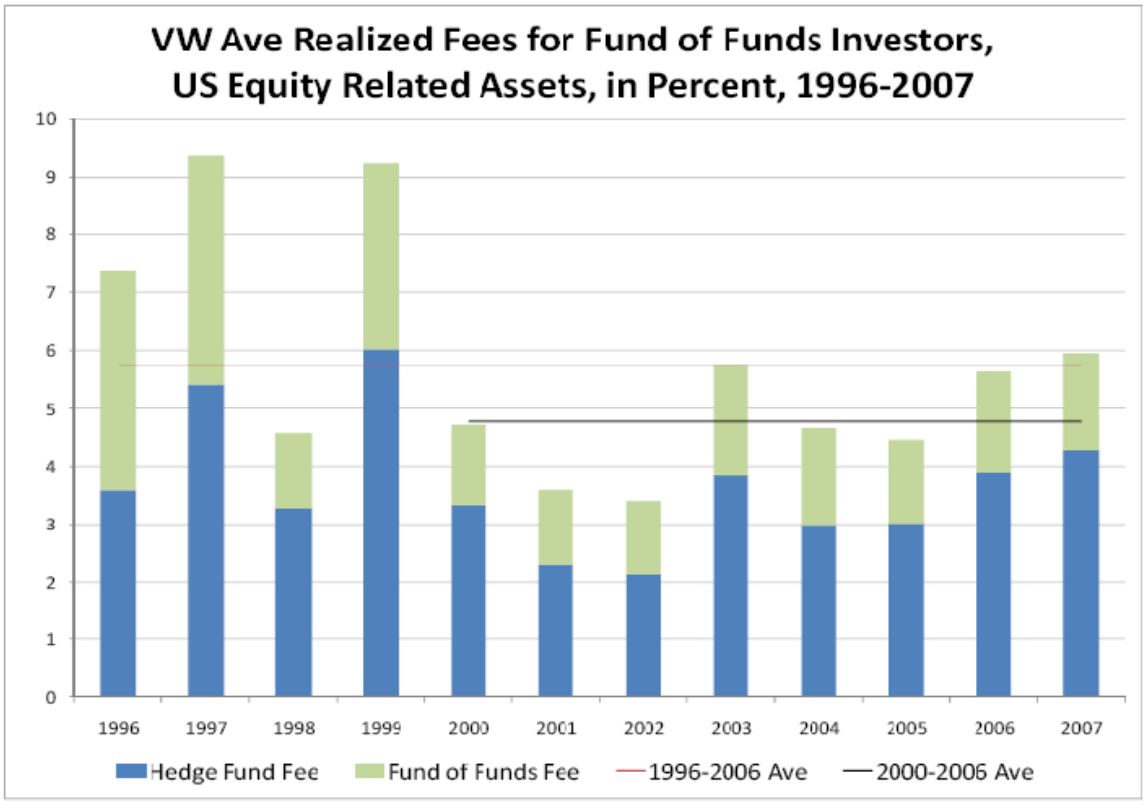
Funds of Funds

- Funds that hold shares in other hedge funds
- Funds of funds (FOFs) account for almost half of all hedge fund assets
  - FOFs grew fast for a long time, but their assets shrank by about 30% in 2008
- What are the advantages of investing in an FOF?
  1. Diversification across hedge funds
  2. Professional oversight of fund operations
  3. Access to funds that are closed
  4. Lower minimum investment amounts
- Any disadvantages?
  1. Double-paying of those fat hedge fund fees (You pay a fee on the FOF's after-fee return)
  2. Are you really getting diversification?

1. Value-weighted average fees in 2007 (French, 2008):
   - Management fee: 1.0% for FOFs, 1.2% for HFs
   - Incentive fee: 7.0% for FOFs, 18.8% for HFs
     * Investors in FOFs pay both!
     * They better be getting something in return

- In 2007, the value-weighted average of total fees paid
  - to FOFs was 1.7% of assets under management
  - to HFs was 4.3% of assets under management,

  so FOF investors' total fees were 6% per year



- Do HFs + FOFs generate enough value to justify such high fees?
  - We will look at performance later

- Moreover, investors in FOFs sometimes pay incentive fees even when the FOF underperforms
  - Perversely, this is due to diversification! Why?
  - Some funds held by the FOF do well, others poorly
  - Even if the FOF as a whole underperforms, you still pay an incentive fee on the constituent hedge funds that did well!
  - The more diversified the FOF, the greater is the chance that this happens
  - "Deadweight cost" of diversifying across hedge funds

2. Gains from diversification are limited
   - Hedge funds as a *new asset class*?
     * Not in a traditional sense
     * They trade existing assets, don't create new ones
     * Although they do not provide diversification across *assets*, they do across *dynamic strategies*
       $\Rightarrow$ I'm happy to call them a new asset class
   - Some hedge fund bets cancel out:
     * Fund 1 is long A short B, fund 2 long B short A
     * This is not diversification, just expensive folly! (You'll pay 20% fee to one of the two funds!)
     * Do not combine such funds in a portfolio!

- Can funds of funds pick the best hedge funds?
  - Historically, the Sharpe ratios of FOFs have been lower than the Sharpe ratios of individual hedge funds, on average
  - Probably due to higher fees

- How do we form an optimal portfolio of hedge funds?
  - Difficult question
  - Blind mean-variance optimization not advisable
    1. Hedge funds are about more than just mean and variance (more on this later)
    2. Mean-variance optimization recommends combining funds with negatively correlated returns
       * But these could be precisely the kind of funds whose bets cancel out!
       * Need to find funds with low correlations whose bets do not cancel out
       * Moreover, correlations are often higher in "bad times" than in "good times"
    3. Short return histories $\Rightarrow$ imprecise estimation

Market-Neutral Strategies

- A prototypical market-neutral strategy:
  - Go *long* stocks with positive alphas ($\alpha > 0$)
  - Go *short* stocks with negative alphas ($\alpha < 0$)
  - Maintain *zero beta*
- **Example:** Two stocks, A and B.

$$\begin{aligned} R_{A,t} - R_f &= \alpha_A + \beta_A(R_{M,t} - R_f) + \epsilon_{A,t} \\ R_{B,t} - R_f &= \alpha_B + \beta_B(R_{M,t} - R_f) + \epsilon_{B,t} \end{aligned}$$

  - Combine stocks A and B in a portfolio P:

$$R_{P,t} = w_A R_{A,t} + w_B R_{B,t}$$

  - Choose the weights w_A and w_B in such a way that the portfolio's alpha and beta are

$$\begin{aligned} \alpha_P &= w_A\alpha_A + w_B\alpha_B > 0 \\ \beta_P &= w_A\beta_A + w_B\beta_B = 0 \end{aligned}$$

  - Is this always possible?
    - Not if $w_A + w_B = 1$; in that case, the weights are determined from the beta equation, and the alpha inequality may or may not be satisfied
    - But it is always possible if there is a third asset (e.g., T-bill), so that $w_A + w_B$ need not be one
    - See Assignment 10

Unit-Cost vs. Zero-Cost Portfolios

- Two types of portfolios:
  - A *unit-cost* portfolio: The weights sum to one
  - A *zero-cost* portfolio: The weights sum to zero
    - This portfolio is "self-financing"
- We usually normalize the zero-cost portfolio so the positive (negative) weights add up to 100% (-100%)
  - The return on a zero-cost portfolio is the difference between the returns on two unit-cost portfolios
  - **Example:** Long 100% in S&P, short 100% in T-bill $\Rightarrow$ zero-cost portfolio with return $R_M - R_f$
  - The sum of any two zero-cost portfolios is also a zero-cost portfolio
- Zero-cost portfolios require no capital outlay
  - This is true only in a frictionless market
  - In the real world, you have to put up some collateral for the short position, and the interest rate you earn on that collateral may be lower than the interest rate you could earn elsewhere
- You can turn a zero-cost portfolio into unit-cost by adding ("overlaying") a unit-cost portfolio
  - E.g., 100% in T-bills or 100% in the market

- **Example:** You expect stock i to outperform stock j. You want to go long i and short j, but your fund is supposed to provide market exposure. So you overlay the long/short strategy with the market, producing a unit-cost portfolio with return

$$(R_i - R_j) + R_M$$

- This is called *equitization* of a long/short strategy
  - Also called a "portable alpha" strategy
- **Example:** Fama-French portfolios HML and SMB are typically viewed as *excess* returns
  - For HML, go long 100% in H (value), short 100% in L (growth), and invest 100% in the T-bill
    $\Rightarrow$ Your excess return is HML:

$$\text{HML} = (H - L) + R_f - R_f$$

  - Recall that in the Fama-French model, we have *excess* market return plus SMB and HML

- Zero-cost portfolios make *leverage* easy
  - **Example:** \$100 in the market, \$1000 long in stock i, \$1000 short in stock j $\Rightarrow$ Your return is

$$10(R_i - R_j) + R_M$$

  - Popular among hedge funds

Investing in Market-Neutral Hedge Funds

- Suppose you currently hold the market index (M), and consider adding a market-neutral hedge fund (H)
  - Market neutrality $\Leftrightarrow \text{Cov}(R_M, R_H) = 0$
- Portfolio P that combines M and H has return

$$R_{P,t} \;=\; w_H R_{H,t} + (1 - w_H) R_{M,t}$$

- What w_H gives the highest Sharpe ratio for P?

$$w_H = \frac{E_H/\sigma_H^2}{E_H/\sigma_H^2 + E_M/\sigma_M^2},$$

where E_i is the expected *excess* return on asset i, and σ_i is asset i's volatility

  - This solution is a special case of the matrix formula for the tangency portfolio that we used earlier:

$$V = \begin{bmatrix} \sigma_H^2 & 0 \\ 0 & \sigma_M^2 \end{bmatrix}, \;\; V^{-1} = \begin{bmatrix} \frac{1}{\sigma_H^2} & 0 \\ 0 & \frac{1}{\sigma_M^2} \end{bmatrix}, \;\; E = \begin{bmatrix} E_H \\ E_M \end{bmatrix},$$

    so the optimal weights are proportional to

$$w \;=\; \begin{bmatrix} w_H \\ w_M \end{bmatrix} \;\propto\; V^{-1}E \;=\; \begin{bmatrix} E_H/\sigma_H^2 \\ E_M/\sigma_M^2 \end{bmatrix}$$

  - Scale the weights to sum to one $\Rightarrow$ above formula
  - See Assignment 10

- If portfolio P is computed optimally (as above), its Sharpe ratio is given by

$$S_P = \sqrt{S_M^2 + S_H^2}$$

  - You have seen this formula before; more generally, S_H is replaced by the information ratio of fund H
  - In this case, since fund H has zero beta, its Sharpe ratio and its information ratio are identical!

- If you currently hold the market, when are you willing to put some money into a market-neutral fund?

$$w_H > 0 \;\Leftrightarrow\; E_H > 0$$

  - If the fund's expected excess return is positive
    - That is, if the fund's alpha is positive

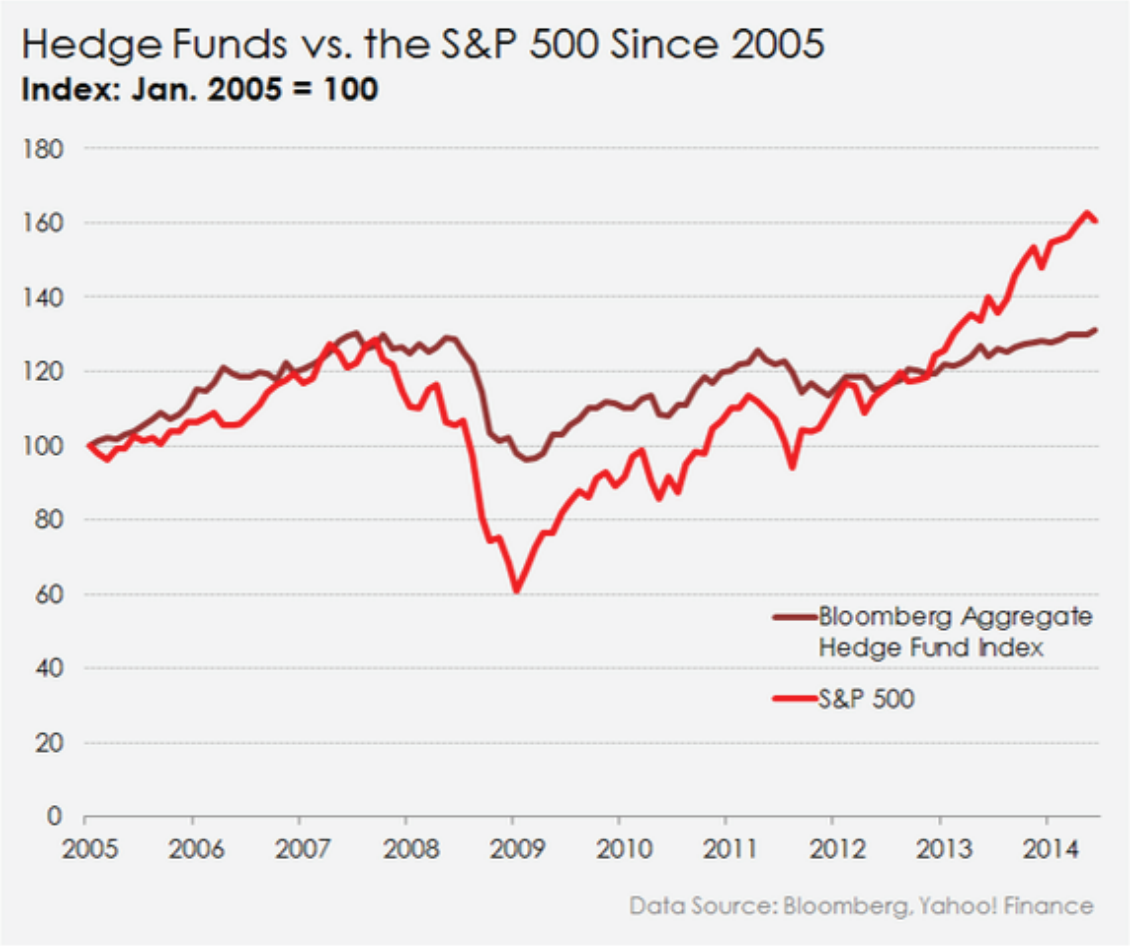
- Note: Cash (T-bill) is the relevant benchmark here
  - If a market-neutral fund outperforms the T-bill, it is worth adding to a diversified equity portfolio

- Assuming $E_M = 8\%$ and $\sigma_M = 20\%$, the optimal amount to invest in a market-neutral hedge fund is

	Expected excess fund return (E_H)						
σ_H	0.1%	0.5%	1%	2%	3%	4%	5%
5%	16.67	50.00	66.67	80.00	85.71	88.89	90.91
10%	4.76	20.00	33.33	50.00	60.00	66.67	71.43
20%	1.23	5.88	11.11	20.00	27.27	33.33	38.46

Hedge Fund Performance

- Hedge fund data providers:
  Hedge Fund Research (HFR), CS/Tremont, Altvest, Mar-Hedge, Van-Hedge, Hennessee, FRM/MSCI
- Hedge fund index performance:



- Compare average performance and volatility
- Note the correlation between the two series

- CS/Dow Jones hedge fund index returns in % per year, 1996-2014:

Strategy	Mean	Std	Corr w/ S&P500	Skew	Kurt	Autocorr
All Hedge Funds	8.6	7.1	59	-0.2	6.3	17
Convert Arb	7.3	6.8	37	-2.8	20.0	55
Ded Short Seller	-6.4	16.7	-77	0.8	4.7	8
Emerg Markets	8.4	13.1	60	-1.3	10.7	26
Eq Mkt Neutral	4.8	10.2	31	-11.9	165.3	7
Event Driven	9.2	6.3	63	-2.3	13.6	36
Fix Inc Arb	5.3	5.6	32	-4.6	36.2	53
Global Macro	10.9	8.9	24	-0.1	8.0	5
L/S Equity	9.7	9.6	67	-0.0	6.6	18
Managed Futures	6.1	11.4	-5	0.1	2.7	3
Multi-Strategy	8.4	4.9	43	-2.0	11.5	44

  - Significant exposure to the market
    - Patton (2007) finds that 1/4 of "market-neutral" funds exhibit significant exposure to market risk
  - Negative skewness, high kurtosis ("left tail risk"?)
  - High autocorrelation in returns
    - Return smoothing via own pricing of illiquid holdings (Cassar and Gerakos, 2011)

- Correlation matrix for Lipper TASS HF categories:

Category Correlations 1996-2014	Convertible Arbitrage	Dedicated Short Bias	Emerging Markets	Equity Market Neutral	Event Driven	Fixed Income Arbitrage	Global Macro	Long/Short Equity Hedge	Managed Futures	Multi-Strategy	Fund of Funds	All Single Manager Funds
Convertible Arbitrage	1.00	-0.41	0.63	0.55	0.77	0.69	0.23	0.61	-0.08	0.66	0.63	0.69
Dedicated Short Bias	-0.41	1.00	-0.57	-0.25	-0.60	-0.17	-0.15	-0.74	0.03	-0.53	-0.55	-0.66
Emerging Markets	0.63	-0.57	1.00	0.41	0.78	0.47	0.40	0.78	0.05	0.71	0.85	0.88
Equity Market Neutral	0.55	-0.25	0.41	1.00	0.59	0.46	0.18	0.49	0.04	0.54	0.46	0.52
Event Driven	0.77	-0.60	0.78	0.59	1.00	0.58	0.32	0.80	0.01	0.75	0.81	0.86
Fixed Income Arbitrage	0.69	-0.17	0.47	0.46	0.58	1.00	0.32	0.37	0.03	0.49	0.50	0.50
Global Macro	0.23	-0.15	0.40	0.18	0.32	0.32	1.00	0.33	0.55	0.43	0.54	0.51
Long/Short Equity Hedge	0.61	-0.74	0.78	0.49	0.80	0.37	0.33	1.00	0.09	0.74	0.84	0.94
Managed Futures	-0.08	0.03	0.05	0.04	0.01	0.03	0.55	0.09	1.00	0.23	0.29	0.24
Multi-Strategy	0.66	-0.53	0.71	0.54	0.75	0.49	0.43	0.74	0.23	1.00	0.83	0.83
Fund of Funds	0.63	-0.55	0.85	0.46	0.81	0.50	0.54	0.84	0.29	0.83	1.00	0.94
All Single Manager Funds	0.69	-0.66	0.88	0.52	0.86	0.50	0.51	0.94	0.24	0.83	0.94	1.00

Data Issues

- Hedge fund managers voluntarily choose to report their performance; *self-reporting* leads to biases
- Main biases in hedge fund index data
  - *Backfill bias*
    - When a fund starts reporting, its entire return history is usually added to the database
    - Only funds with good returns start reporting!
    - Index performance is biased upward
    - Bias about 1.4% per year (Fung & Hsieh, 2000)

- *Extinction bias*
  - A fund may choose to stop reporting, usually because of poor performance
    - Why boast about being a loser?
  - But sometimes also because they close
    - In which case performance tends to be good

- *Survivorship bias*
  - Some databases do not include dead funds
    - Dead funds tend to underperform
  - Average fund performance is biased upward
  - Bias estimated to be about 2-3% per year (Liang 2000, Amin & Kat 2003, Brown et al 1999)

- Incorrect fund categorization
  - Funds can identify their own categories
  - Which category will make me look best?

- Constituent weightings
  - Some indexes equal-weight funds, which overstates returns relative to value-weighting

- Bias estimates based on the Lipper TASS HF database (Getmansky, Lee, and Lo, 2015):

From 1996 to 2014	# fund-months	Annualized Mean	Annualized Volatility	Skewness	Kurtosis	Maximum DD	ac(1)	Box-Q(3) p-value
Naive Estimate	351364	12.6%	5.9%	-0.25	4.41	-14.9%	0.28	0.00003
Remove Survivorship Bias	927690	9.7%	5.6%	-0.22	4.96	-15.0%	0.26	0.00009
Remove Backfill Bias	195816	11.5%	8.1%	-0.54	9.02	-19.9%	0.32	0.00000
Remove Both Biases	505844	6.3%	6.3%	-0.50	5.72	-20.5%	0.25	0.00056

Hedge Fund Performance Persistence

- Early studies find no persistence
- Jagannathan, Malakhov, and Novikov (2010) find persistence in hedge fund performance, after accounting for the key biases in reported returns
  - A hedge fund that outperformed its benchmark by 1% over the past 3 years outperforms its benchmark by 0.56% in the following 3 years, on average
- Kosowski, Naik, and Teo (2007) find persistence in hedge fund performance using Bayesian alphas

Evaluating Hedge Fund Performance

- Standard performance measures:
  - Sharpe ratio: If investing all of your wealth
  - Alpha: If adding the fund to a diversified portfolio
- For a zero-beta (market neutral) fund, alpha-based information ratio and the Sharpe ratio coincide!
  - Recall that cash is the appropriate benchmark for a truly market-neutral strategy
- Hedge funds are usually not trying to beat a benchmark but instead deliver a high absolute return
  - So they are often evaluated on an *absolute* basis
- Many hedge funds look attractive (some very attractive) based on their alphas and Sharpe ratios
- But these performance measures seem less appropriate for hedge funds than for mutual funds
  - Mutual funds follow relatively "static" strategies (largely buy-and-hold, with relatively low turnover)
  - Hedge funds deploy *dynamic* trading strategies
- Dynamic strategies often have *option-like returns*
- If you want to maximize your Sharpe ratio, you want a return distribution that is *left-skewed*

- **Example:** A "money machine" that can fool investors using alpha or Sharpe ratio:
  - Write/sell uncovered out-of-the-money put options
  - Selling insurance against drops in the market index
  - Most of the time, you simply collect the premiums
  - Once in a while, the market drops sharply, the puts are exercised against you, and you lose big
  - But tsunamis don't hit every year! You may be able to go on for years making money, undetected
  - Investors should not pay a 2/20% fee for this!
  - See Assignment 10
- The option-like exposure may not be so explicit
  - One popular strategy: *Trend following*
    - Buy as stock prices rise, sell as they fall
    - This is how you dynamically replicate an option!
    - Fung and Hsieh (2001) find nonlinearities in the returns of trend-following hedge funds
  - Another popular strategy: *Risk arbitrage*
    - Bet on M&A deals to go through
    - You often lose a lot when the market drops, as if you were selling naked index put options
    - Mitchell and Pulvino (2001) find that risk arbitrage returns have positive betas in downmarkets but zero betas in upmarkets

- Hedge funds seem prone to rare, spectacular disasters
- **Example:** The Art Institute of Chicago vs. Integral
  - In 2001, The Art Institute of Chicago lost some $40 million invested with a hedge fund called Integral
  - Integral boasted "the highest Sharpe ratio in the business," and that it could not lose capital unless stocks "fell in value by more than 30%"
  - Integral's strategy involved a "complicated system of puts and calls"
  - In September 2001, Integral lost 90% of its capital
- **Example:** Victor Niederhoffer, a hedge fund legend
  - Earned 32% compound annual return in 1982–1997
  - Believed the stock market would never drop by more than 5% in one day; wrote naked out-of-the-money put options on stock index futures
  - When the stock market plummeted by 7% on October 27, 1997, his funds were wiped out
- **Example:** LTCM (discussed next week)
- **Example:** Bernie Madoff
  - See Gregoriou and Lhabitant (2009)
- **Example:** Eifuku

- **Example:** Amaranth
  - Lost $6.4 billion in September 2006
    - Biggest hedge fund blow-up ever!
  - Losses concentrated in natural gas futures trades of Brian Hunter's group
  - Big losing trade:
    - Long March 2007 contract
    - Short April 2007 contract
  - Biggest mistakes:
    - Inadequate risk management
      - E.g., excessively concentrated portfolio
    - Illiquidity
      - In 2006, Amaranth held up to 80% of the open interest in NYMEX's most active natural gas futures contracts
  - JPMorgan and Citadel bought Amaranth's energy book in September 2006, earned handsome profits
  - See Chincarini (2008)

- Given the lack of disclosure in hedge funds, it is difficult for investors to detect this type of behavior

How can we detect option-like strategies?

- Look for nonlinearities in fund returns
  - Add "dynamic" benchmarks to "static" ones
- One approach: Recall the market timing regressions
  - E.g., Treynor and Mazuy (1966):

$$R_{P,t} - R_{f,t} = \alpha + \beta(R_{m,t} - R_{f,t}) + \gamma(R_{m,t} - R_{f,t})^2 + \epsilon_t$$

  - Option-like strategies should have $\gamma \neq 0$

    $\gamma > 0 \Rightarrow$ like buying put options

    $\gamma < 0 \Rightarrow$ like selling put options
- Another approach: Agarwal and Naik (2004)
  - Add *option-based benchmarks*: Payoffs on at-the-money and out-of-the-money European call and put options on the S&P 500 index

$$\begin{aligned} R_{P,t} - R_f &= \alpha + \beta_0(R_{M,t} - R_f) \\ &+ \beta_1 \text{Max}(R_{M,t} - k_1, 0) + \beta_2 \text{Max}(R_{M,t} - k_2, 0) \\ &+ \beta_3 \text{Max}(k_3 - R_{M,t}, 0) + \beta_4 \text{Max}(k_4 - R_{M,t}, 0) \end{aligned}$$

  - "Our results show that a large number of equity-oriented hedge fund strategies exhibit payoffs resembling a short position in a put option on the market index, and therefore bear significant left-tail risk, risk that is ignored by the commonly used mean-variance framework."

- Jurek and Stafford (2015) refine this approach
  - Replace linear regression by nonlinear replication (double nonlinearity)
- Additional benchmarks seem relevant
  - The credit/default spread
  - Market variance: Bondarenko (2004) argues that hedge funds exhibit systematic variance risk
  - Market liquidity

- **Case study:** AQR's DELTA strategy

- Some other interesting empirical findings:
  - Hedge funds with higher incentive fees perform better (found by several research papers)
  - Larger funds with greater inflows have poorer future performance, consistent with decreasing returns to scale (Agarwal, Daniel, and Naik, 2004)
  - There is a positive performance-flow relation, High returns $\Rightarrow$ High flow, just like for mutual funds (Agarwal, Daniel, and Naik, 2004)