Hedge Funds go for a Haircut

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“Haircut”

The asset allocation problem

- Create portfolios consisting of several assets
- That will have low volatility
- …and high returns
- (e.g. Stocks and Bonds)

- Takes the correlation between assets into account

Mean Variance Optimization

- Pioneered by Harry Markowitz (1950s)
- Inputs:
  - The (historical) returns of each asset
  - The (historical) volatility numbers for each asset
  - Matrix of correlations between assets
- Output:
  - The efficient frontier – for any given volatility it gives the portfolio with the largest return

Hedge Funds grow in importance

- There are now over 6000 hedge funds in existence
- The TASS database has more than 2600 funds with at least $10 million under management
- Hedge funds collectively have $618.6 Billion under management (Reuters May 9, 2003)

Incorporating hedge funds into a portfolio

- How much of the investor's capital should be in a hedge funds (or in a portfolio of HF)?
- Many funds have:
  - High historical returns
  - Low historical volatilities
  - Superior performance than stocks or bonds on a risk adjusted basis
- A "naïve application" of the mean variance approach
  - Would place the majority of the assets into the hedge fund class
  - Does not capture some of the risks specific to hedge funds

Ad-hoc solution

- Constrain the allocation to hedge funds to a “reasonable” level, say 20%
- This level is partly based on market consensus (what others are doing) without any theoretical foundation

Risks in HF

- Historical volatility measures underestimate the volatility of a fund that trades illiquid assets or takes nonlinear risks
- Some funds tend to generate consistently positive returns while taking a small risk of a large loss (Fung & Hsieh, 1997)
- Hedge fund indices can be misleading for a number of reasons: survivorship bias, return dispersion within a given category, variable leverage, etc.

Liquidity Risk

- HF typically have an initial lockup period
- A one year lockup is common; this means that an investor cannot withdraw money until December 31 of the calendar year after initial investment
- In this case, the lockup period is between 1 and 2 years
- During that time, the manager can change strategy, modify leverage or suffer a large drawdown
- To a limited extent, the probability of a drawdown is predictable, since it increases as investors withdraw money, forcing a manager to liquidate at bad prices

Goal – obtain a liquidity haircut

- **Step 1:**
  - We analyze the incentive clause to the HF manager (by extending a paper by Goetzmann, Ingersoll & Ross, 2001)
  - Our approach realistically models how a manager can optimally vary leverage
- **Step 2:**
  - The investor holds a portfolio of a liquid fund and a HF, with similar risk and reward characteristics
  - The investor tries to maximize his risk adjusted return
- **Cat and mouse game**
  - If the investor had unrestricted liquidity in the HF, he could rebalance
  - Since he does not, he has to account for this by decreasing return or increasing volatility
  - The appropriate haircut can be calculated using Longstaff's method (1999)

Performance fee

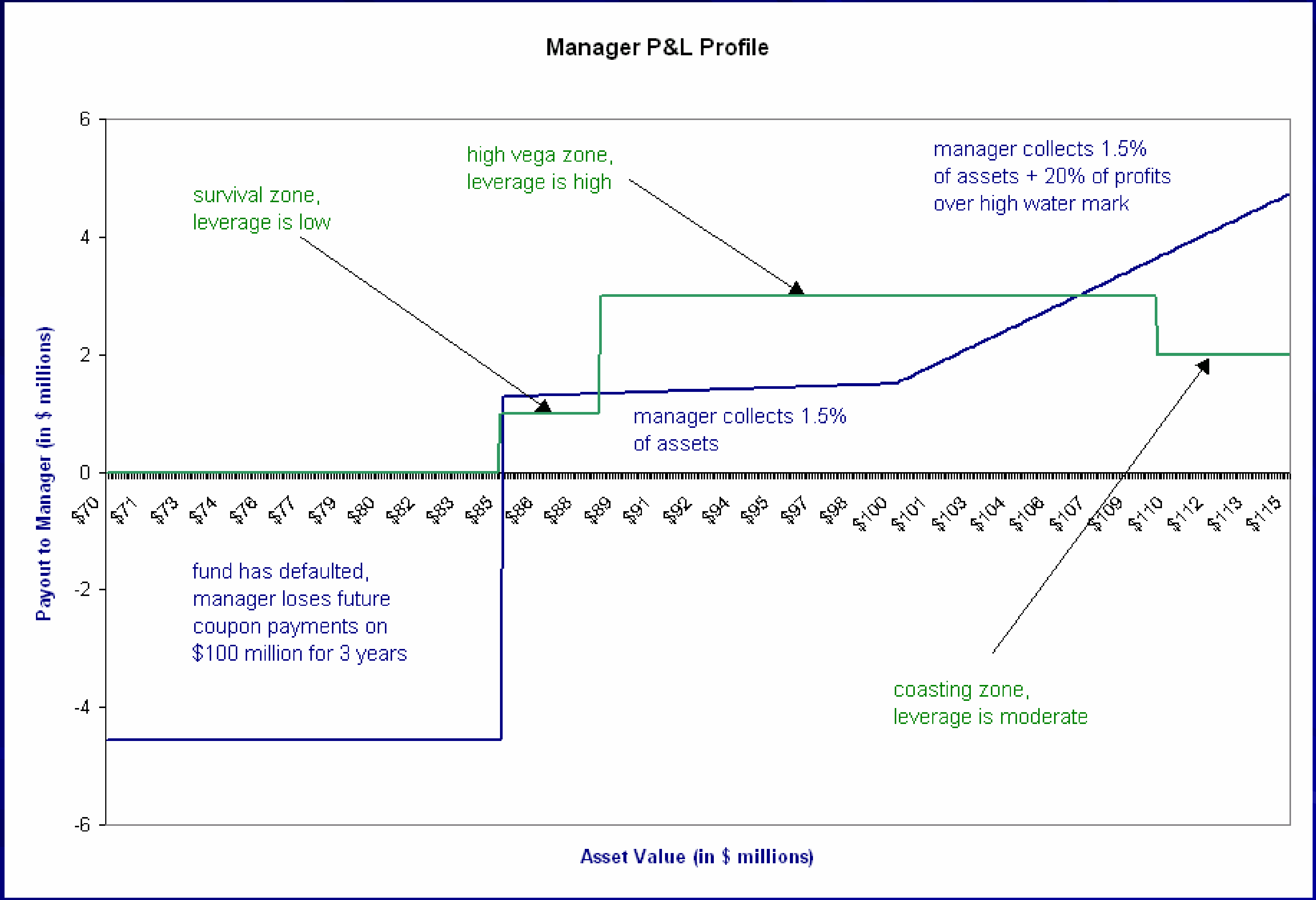
- At time T, the HF manager collects a performance fee of p max (S(T) – H(t),0)
- Here, *p* is the performance fee (e.g. 20%)
- *H(t)* is the most recent high water mark
- *S(T)* is the asset value of the fund at *T*

Leverage

- A manager can increase leverage (by borrowing and investing more money in the strategy), up to a threshold (usually specified in the offering document)
- Higher leverage → Higher expected return and higher volatility
- Since the manager is long a call option type structure, there is an incentive to increase leverage near the high water mark (where “gamma” is largest)

HF fee

- HF collects two fees
  - Management fee (fixed %-age of assets)
  - Performance fees
- A typical HF may collect 1.5% of the assets + 20% of performance over the high water mark
- The HF manager has a position similar to a risky convertible bond, in the following sense
- Receives an annual coupon + upside participation if above the conversion level
- Similar to a convertible bond, if the asset level drops too much, investors may withdraw and the manager no longer receives a coupon (default case)


Manager P&L Profile
survival zone,
leverage is low
high vega zone,
leverage is high
manager collects 1.5%
of assets + 20% of profits
over high water mark
manager collects 1.5%
of assets
fund has defaulted,
manager loses future
coupon payments on
$100 million for 3 years
coasting zone,
leverage is moderate
Payout to Manager (in $ millions)
6
4
2
0
-2
-4
-6
$70 $71 $73 $74 $76 $77 $79 $80 $82 $83 $85 $86 $88 $89 $91 $92 $94 $95 $97 $98 $100 $101 $103 $104 $106 $107 $109 $110 $112 $113 $115
Asset Value (in $ millions)

HF manager’s strategy

- If S(t) ~ H(t)
  – The manager increases leverage
- If S(t) >> H(t)
  – The manager will reduce leverage and “coast”, to lock in a profit for the year
- If S(t) << H(t)
  – Reduce leverage as the fund is close to liquidation. Further withdrawals may force the manager to close the fund and lose management fees for several years (e.g. three years)
  – Smaller managers may increase leverage in this case

Investor’s Strategy

- Longstaff calculates an illiquidity premium using a portfolio with two assets
  - Money market account
  - A stock
- In the benchmark case – the investor can shift money and rebalance as needed
- In the illiquid case, the investor is locked in and is forced to choose static allocation weights
- The illiquid case will always have a lower expected utility
- The difference in utility numbers is the “liquidity premium”

HF Complication

- HF's expected return and volatility are a function of the level of assets as compared to the high water mark
- If the expected return and volatility of the HF never changed, the investor will increase allocation after a draw down (re-balance)
- HF investors DO NOT behave like that
- They withdraw after a drawdown
  - The HF is considered more dangerous
  - The investor is worried that others may withdraw, triggering a sell-off in illiquid securities and further drawdown – better to withdraw early
  - Organizational risk: key employees may leave if performance is poor (since bonuses will be low)

Numerical simulation rules

- If S(t) >> H(t)
  - Leverage is moderate
  - Vega is small and positive
- If S(t)~H(t)
  - Leverage is high
  - Vega is large and positive
- If S(t) << H(t)
  - Leverage is small
  - Vega is negative (with large absolute value)
- If S(t) is below default level, the HF is liquidated and the investor receives a %-age of his holdings

- Thus, drift and volatility are level dependent
- For simplicity, we assume leverage is a step function of S(t)-H(t)

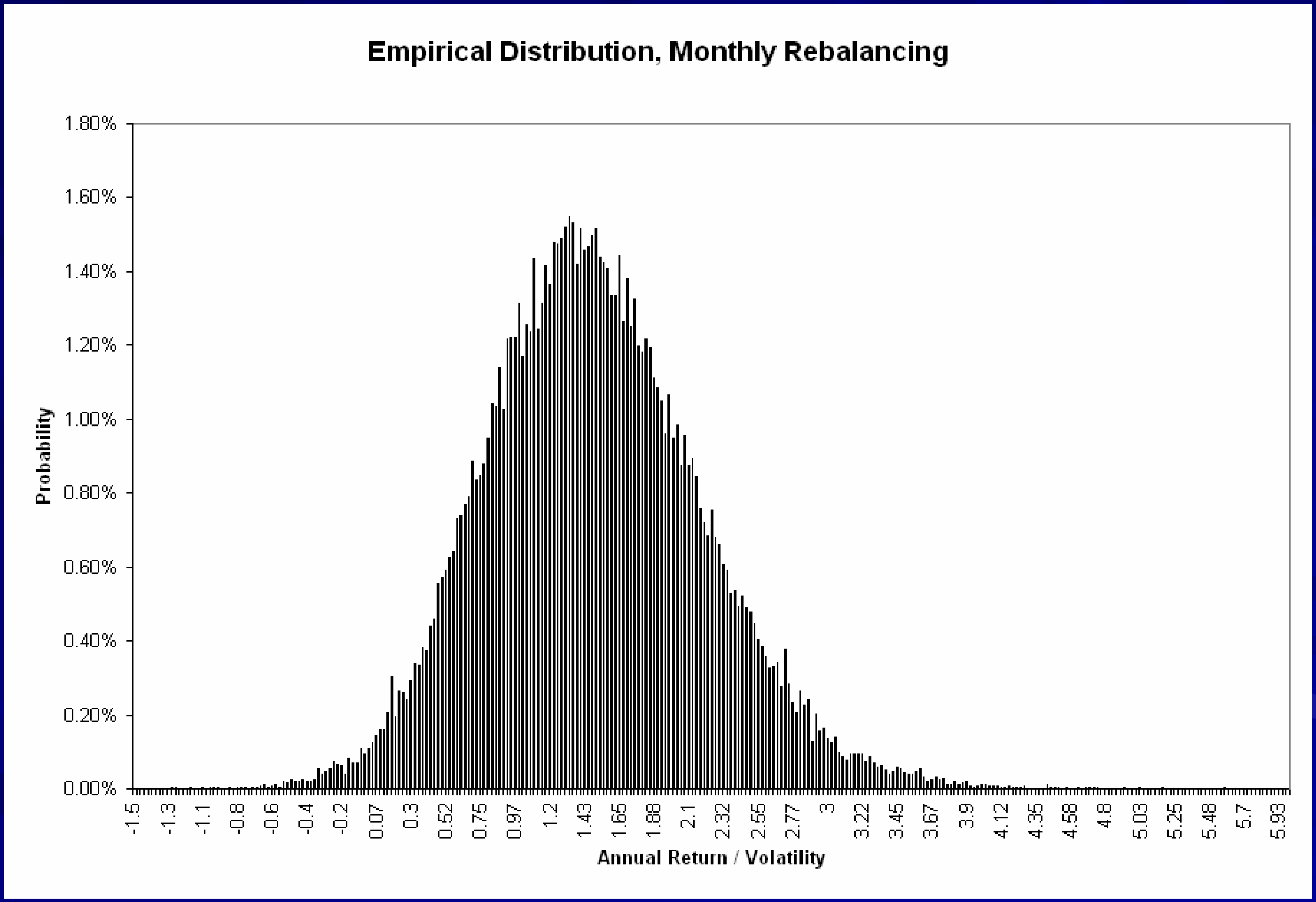
Numerical example

- The investor's utility is a simple information ratio, *Return/Volatility*
- The investor can select a portfolio consisting of
  - A hedge fund
  - A mutual fund
- Return = 10%, Volatility = 10%, Correlation = 0
- Two year window, monthly rebalancing, 40000 simulations

Manager's leverage

- HF manager modifies his leverage once a month
  – If assets drop below 85, there is a liquidation and the investor receives 50% - or 42.50
  – If assets rise above 110, the manager uses moderate leverage: return = 10%, volatility = 10%
  – If assets fall below 88.75 (75% of the distance to default), the manager reduces leverage: return= 5%, volatility = 5%
  – If assets are between 88.75 and 110, the manager increases leverage: return = 20%, volatility = 20%

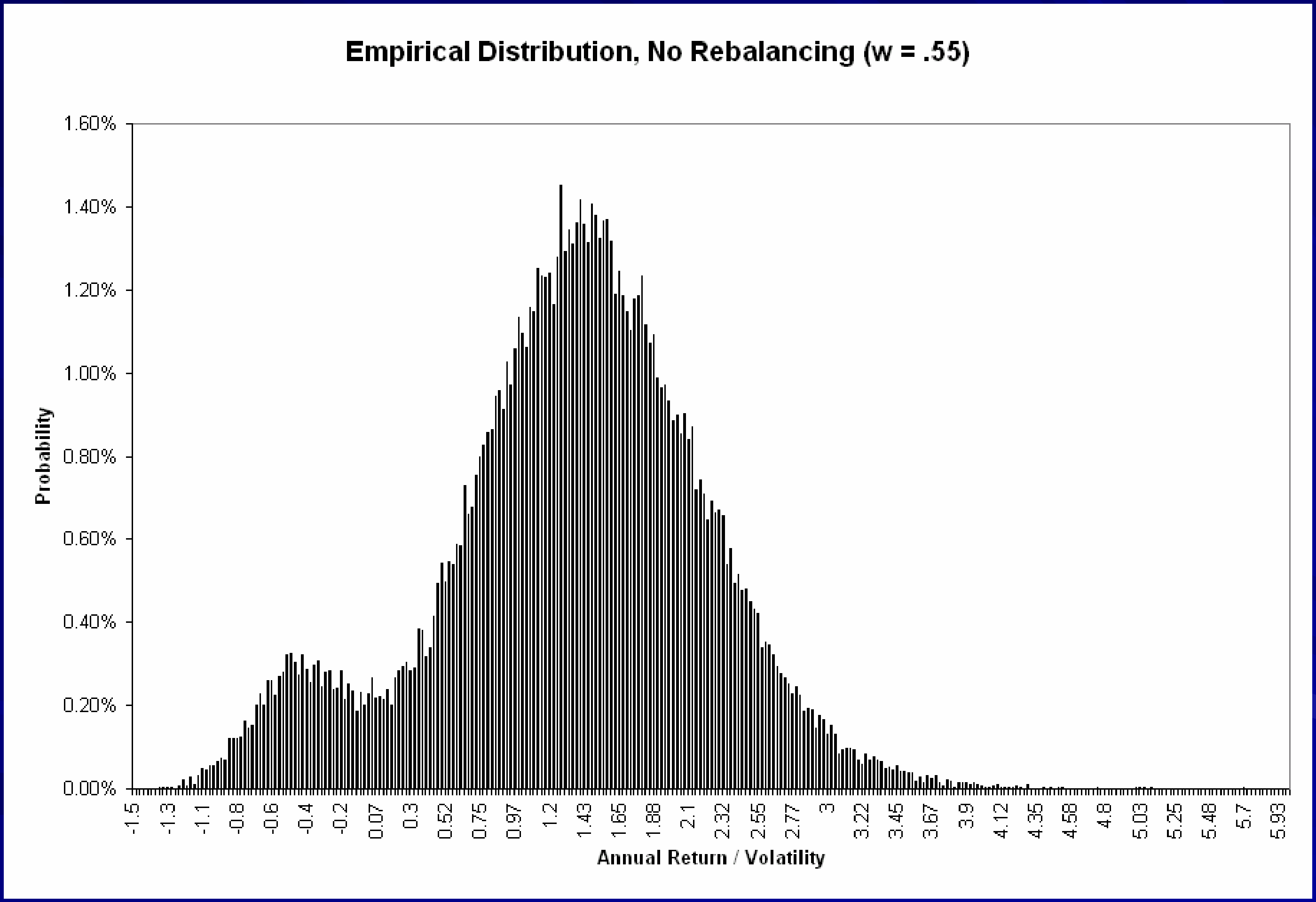
Benchmark Simulation (monthly rebalancing)



Simulation

- The HF manager's assets are 100
- The investor chooses 67% in the mutual fund and 33% in the HF
- If, over time the assets drop below 88.75, the return is 5%. The expected volatility is larger than 5% since there is a positive probability of default
- We incorporate the default probability into our simulation by calculating the volatility of the mixture of a normal distribution and a Dirac distribution at the recovery level
- The expected utility is approximately 1.5

No rebalancing



No rebalancing

- We first calculate the optimal static allocation
- Find the optimal allocation to be 55% mutual fund and 45% hedge fund
- We create a histogram of simulated information ratios, which turns out to be bimodal
- The information ratio is about 1.3
- …or 10% smaller than in the rebalancing case

Conclusion

- We should increase the volatility of the HF by 10% to account for the liquidity haircut
- Thus, if a hedge fund has a historical volatility of 10% and a 1 year lockup, we should raise the volatility to 11% before we decide upon an allocation

Remarks

- It is dangerous to characterize HF by historical return, volatility and correlation numbers
- Many fund-of-fund managers are already used to mean variance models for traditional assets and are reluctant to change technologies
- Our work enables them to