Trading Strategy Study Group

Talk 1 Introduction

Alex Zhongyi Zhang

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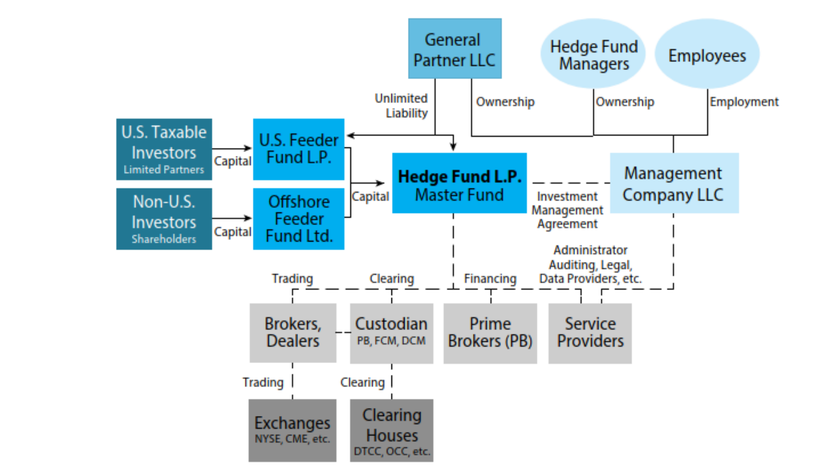

Figure: master-feeder hedge fund structure

Excessive Return:

$$R_t^e = \alpha + \beta R_t^{M,e} + \epsilon_t \tag{1}$$

Here β measures the tendency to follow the market.

$$E(\text{market-neutral excess return}) = \alpha$$

Taking into accord of risks, we have *Sharpe Ratio*:

$$SR := \frac{E(R - R^f)}{\sigma(R - R^f)} \tag{2}$$

Q:What if I care more about market exposure.
A: Information Ratio:

$$IR = \frac{\alpha}{\sigma(\epsilon)} \tag{3}$$

If the fund needs to beat a bench mark.[1]

$$IR = \frac{E(R - R^b)}{\sigma(R - R^b)} \tag{4}$$

How about Taking leverage?
alpha-to-margin ratio:[2][3]

$$\text{AM} = \frac{\alpha}{\text{margin}} \tag{5}$$

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[1] the *tracking error* is the difference between strategy and benchmark's returns.
[2] Leverage is $\frac{1}{\text{margin}}$, eg, a 10% margin with 3% α gives 30% AM.
[3] The AM is the investment managment equivalent of the return of equity(ROE) measure from corporate finance.

The AM ratio is the reward per unit of risk (IR) multiplied by the extent to which the strategy can be leveraged, namely the risk per unit of margin equity:

$$\mathrm{AM} = \frac{\sigma(\epsilon)}{margin} \times \mathrm{IR}$$

In general, the denominator indicate the risks an investor is willing to take, eg, in risk-adjusted return on capital (RAROC), which is defined as $\frac{E(R-R^f)}{\text{economic capital}}$, the denominator, economic capital, is the amount of capital that you need to set aside to sustain worst-case losses on the strategy with a certain confidence. Hence, the denominator is the crash risk instead of day-to-day swings.

Similarly, The Sortino ratio (S) uses downside risk:

$$\frac{E(R - R^f)}{\sigma^{downside}}$$

Sharpe Ratio increase with power of $1/2$. Since $E(ER^{annual}) = ER \times n$ and $\sigma^{annual} = \sigma \times \sqrt{n}$.

TABLE 2.1. PERFORMANCE MEASURES AND TIME HORIZONS

Measurement horizon	Sharpe ratio	Loss probability
Four years	2	2.3%
Year	1	16.0%
Quarter	0.5	31.0%
Month	0.3	39.0%
Trading day	0.06	47.5%
Minute	0.003	49.9%

We notice that when looking at a minute level, the probability of losing money is very close to 50%. So one should stare at his/her trading monitor less often!

High Water Mark and Drawdown

A hedge fund's high water mark (HWM) is the highest price Pt (or highest cumulative return) it has achieved in the past:

$$\mathrm{HWM}_t = max_{s \leq t} P_s$$

The drawdown is the cumulative loss since losses started. The percentage drawdown since the peak (i.e., the HWM) is given by

$$\mathrm{DD}_t = (\mathrm{HWM}_t - \mathrm{P}_t)/\mathrm{HWM}_t$$

High Water Mark and Drawdown

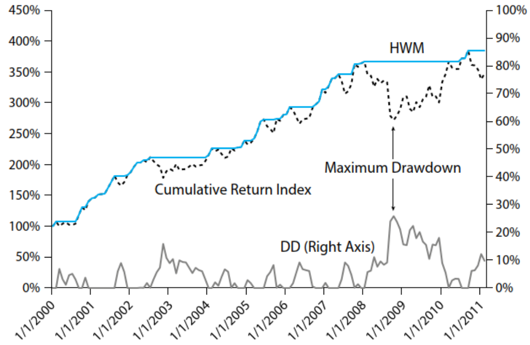

Figure 2.1. A hedge fund strategy's high water mark (HWM) and drawdown (DD).

profit sources

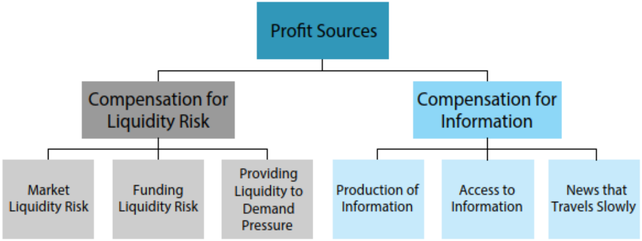

Figure 3.1. The main sources of profit for hedge fund strategies.

Information

- Production of Info. By studying performance of companies, buying and shorting stocks. Might even create info directly by talking with company management.
- Access to Info. Collect proprietary info on company performance by doing market research. Grey area is insider trading.
- Behavioral finance and limits of arbitrage. Market might underreact or overreact to news. Thus could trade on trends and momentum.

Liquidity Risks

- Market Liquidity Risk. For il-liquid securities, might incur large losses when trying to unwind one's position.
- Funding Liquidity Risk. If fund takes high leverage, it might not be able to sustain throughout the life cycle of the bet due to margin requirements, in which case it might be force to unwind positions.
- providing liquidity to demand pressure. Sometimes when news of a merger-acquisition happens, there is universal demand on long/short, one could provide liquidity and take opposite position on similar stocks.

Backtest

Following components:

- Universe. The universe of securities to be traded.
- Signals. The data used as input, the source of the data, and how the data are analyzed.
- Trading rule. How you trade on your signals, including how frequently you review them and rebalance your positions, and the sizes of your positions.
- Time lags. To make the strategy implementable, the data used as input must have been available at the time it is used. For instance, if you use the gross domestic product (GDP) for any year, you must account for the fact that this number was not available on January 1 the following year; it is released with a delay. Also, if you use the closing price as a signal, it is not realistic to assume that you can trade at that same closing price (although academics often do). It is more prudent to assume that the trade is put on with a time lag, for example, using the closing price one or two days later.

Backtest rules

Two general rules apply:

- Portfolio rebalance rule.
- Enter-exit trading rule.

Most importantly, we need to prevent Data Leaks! Eg., not using adjusted GDP/CPI data for back-testing the trading rules when they first come out; or to use SP 500 stocks that become irrelevant due to companies going in and out of the list etc.

Therefore, Out of sample test is very important.

Regression

metatheoremAny predictive regression can be expressed as a portfolio sort, and any portfolio sort can be expressed as a predictive regression.

1. A time series regression corresponds to a market timing strategy.
2. A cross-sectional regression corresponds to a security selection strategy.
3. A univariate regression corresponds to sorting securities by one signal; a bivariate regression corresponds to double-sorting securities by two signals, allowing you to determine whether one signal adds value beyond the other; and a multivariate regression corresponds to sorting by multiple signals.

Regression

To illustrate the points above. Let's look at a time series regression of the excess return R^e of a security, on a forecasting variable Fsay, the divident-to-price ratio:

$$R^e_{t+1} = a + bF_t + \epsilon_{t+1}$$

Note that the time subscript on the forecasting variable is the current time t, while the return on the left-hand side is of the future time t + 1, since we are trying to forecast returns with a signal we know in advance. The ordinary least square (OLS) estimate of the regression coefficient b is given by

$$\hat{b} = \frac{\sum_t (F_t - \bar{F}) R_{t+1}}{\sum_t (F_t - \bar{F})^2} = \sum_{t=1}^{T} x_t R_{t+1} \tag{6}$$

regression

The above equation can be seen as the cumulative return on a long–short timing strategy, where the trading position x is given by

$$x_t = k(F_t - \bar{F}) \tag{7}$$

We see that the timing trade is long in the security when the signal Ft is above its average value, Fr, and short in the security when the signal is below its average. The timing strategy is profitable when the regression coefficient is positive and unprofitable otherwise. This result shows the close link between a regression and a timing strategy—in fact, the regression coefficient is the average profit of a timing strategy!

regression

To illustrate the second point on cross sections, we look at forecasting variable F_t^i for every security i:

$$R_{t+1}^i = a + bF_t^i + \epsilon_{t+1}^i$$

We can run this regression across securities at any time t.

$$\hat{b}_t = \frac{\sum_i (F_t^i - \bar{F}_t) R_{t+1}^i}{\sum_i (F_t^i - \bar{F}_t)^2} = \sum_i x_t^i R_{t+1}^i \tag{8}$$

where the only difference from before is that now we are summing over securities i, not time t. This regression coefficient is the profit of a long–short security selection strategy, which is realized between time t and t + 1. The position in security i is

$$x_t^i = k_t (F_t^i - \bar{F}_t) \tag{9}$$

where $k_t = \frac{1}{\sum_i (F_t^i - \bar{F}_t)^2}$. Hence, this strategy selects a long position for securities with signals that are better than the average across securities at that time, and a short position for securities with low signals.

regression

The overall estimate of the regression coefficient $\hat{b}$ using the Fama–MacBeth (1973) method is simply the average of all the estimates for each time period:

$$\hat{b} = \frac{1}{T} \sum_t \hat{b_t}$$

The risk of the strategy is the volatility of the profits, namely, the volatility of the regression coeffs:

$$\hat{\sigma} = \sqrt{\frac{1}{T-1} \sum_t (\hat{b_t} - \hat{b})^2} \tag{10}$$

Therefore, the Sharpe ratio of the security selection strategy is

$$SR = \frac{\hat{b}}{\hat{\sigma}}$$

which corresponds to the t-stat of the regression estimate.

regression

For the 3rd point, we can regress returns on several trading signals, say, F and G:

$$R^i_{t+1} = a + b^F F^i_t + b^G G^i_t + \epsilon^i_{t+1}. \tag{11}$$

In this case, the regression coefficient b^F corresponds to the profit from trading on F, given that you are already trading on G. For instance, if a hedge fund already trades on G and considers whether to trade also on F, then it is not sufficient that F make money on average. The regression coefficient in the multivariate regression captures this marginal improvement. Whether a new signal adds value can also be analyzed by simply studying portfolios. In particular, if we double-sort securities by both F and G each period, then we can see whether securities with higher F values outperform securities with lower F values and almost the same value of G.

regression

As a final note, we want to point out that timing strategies are more susceptible to biases than security selection strategies. Indeed, the time series regression cor- responds to a “cheating” in-sample backtest, since the position size depends on the average forecasting variable over time Fr, but this average was not known at the beginning of the time period.