Subtleties of Risk Management for Long/Short Portfolios

Dan diBartolomeo

Northfield Information Services, Inc.

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Major Points

- Hypothesis: Hedge funds and long/short portfolios have particular characteristics that makes risk management both more important and more difficult than traditional portfolios
- A lot of portfolio activity is based on anticipation of, or response to “news”
- Numerous quantitative methods already exist to address most of these issues

Here a Few Differences

- Leverage
- Short Positions
- High Frequency Trading
- Illiquid Positions
- Taxable Investors
- Non-linear Factor Behavior
- Multiple Asset Class Multiple Countries

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Leverage Effects

- Traditional investor utility function of Levy and Markowitz assumes:
  - single period model with known parameters
  - investor is trying to maximize the expected value of wealth at the end of time
  - Bankruptcy risk is not an issue
  - Parametric assumptions
- Derived as a two term Taylor series expansion of log wealth utility
- For leverage accounts, “bankruptcy” risk is real, whether by investors withdrawing or removal of prime broker facility

Leverage Effects II

- VAR is inadequate, addresses only the risk of bankruptcy today
- Wilcox (2001) demonstrates that higher order terms matter much more for levered investors
  - Proposes to redefine utility as maximizing growth of discretionary capital (above the a floor on wealth)
- Kritzman and Rich (2001) propose a measure of “first passage” risk.
  - Analytically treat the problem like a knock-out option Risk is the probability of hitting the floor. You don’t get up again

Short Positions: Kritzman Again

- Multiple period compound returns have a lognormal distribution. With long only positions the skew is in the investors favor
  - Ten percent per period for 2 periods = 21% gain
  - Negative 10% per period for 2 periods = 19% loss
- With short positions, the skew is reversed
  - The 21% gain is now a 21% loss
  - The 19% loss is now a 19% gain
- As a short position goes bad, it becomes a larger portion of the portfolio

High Frequency Trading

- Higher frequency stock returns are “wilder” than longer term returns
  - Distributions have kurtosis
  - Returns are mean reverting (Lo & MacKinlay
- Strategies are often driven by anticipation of, or rapid response to “news”
  - Totally unanticipated versus partially anticipated events
- If returns have serial properties (are not IID) then simple scaling of volatility from one periodicity to another is improper

Problems of Illiquid Securities

- Many hedge funds own illiquid securities without dealing with the associated risks
  - Remember David Askin? LTCM?
- Suggestion: Estimate cost of liquidating the entire portfolio in T periods. Use as a metric for liquidity risk
  - Lo and Bertsimas (1998) estimate for equities
  - Research also relates to optimal execution sequencing
  - SmartExecution.com

Hedge Funds Often Have Taxable Investors

- The problem of unrealized capital gains
  - Finding the balance between deferring gains to reduce current tax liability and locking up the portfolio with lots of unrealized gains it will be hard to trade out of
  - Formulating policy of fair distribution of tax responsibility between past and current investors
  - diBartolomeo (2001)
- After tax returns have a truncated dispersion relative to pre-tax returns
  - How do we set volatility risk policies with a mixed investor base

Non-Linear Factor Behaviors

- Second order factor returns are common
  - diBartolomeo and Warrick (2001)
- With long only portfolios, second order factor returns still impact the portfolio but to a reduced degree
- For long/short portfolios, second order effects cancel and the portfolio has no return process in operation
  - Consider a momentum strategy.
  - High momentum does well, negative momentum does well, the middle does poorly. Nothing happens.
  - Consider the reverse. Still nothing happens

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Anticipated Versus Unanticipated Events

- Abraham and Taylor, “Pricing Currency Options with Scheduled and Unscheduled Announcement Effects on Volatility”, Managerial and Decision Science 1993
- Kwag, Shrieves and Wansley, “Partially Anticipated Events: An Application to Dividend Announcements”, University of Tennessee Working Paper, March 2000
- Ederington and Lee, “Creation and Resolution of Market Uncertainty: The Importance of Information Releases, Journal of Financial and Quantitative Analysis, 1996
- Vast majority of news events are anticipated

GARCH Models & Variations

- Chowdury, “Stock Return Volatility and World War II: Evidence from GARCH and GARCH-X Models”, International Journal of Finance and Economics, 1997
- Chong, Ahmad and Abdullah, “Performance of GARCH Models in Forecasting Stock Market Volatility”, Journal of Forecasting, 1999
- BARRA risk models
- RiskMetrics risk services

Implied Volatility

- Ederington and Guan, “Is Implied Volatility and Informationally Efficient and Effective Predictor Future Volatility”, University of Oklahoma Working Paper, January 1998
- Shu, Vasconellos and Kish, “The Information Content of Implied Volatility: An International Investigation of Index Options”, Lehigh University Working Paper, April 2001
- Malz, “Do Implied Volatilities Provide Early Warning of Market Stress?”, *Riskmetrics* Working Paper, February 2000

Malz's Point

- Scenario #1, asset with price of $1 today. Two future states each with 50% probability, $.90 or $1.10. Implied volatility is 10% per period
- Scenario #2, asset with price of $1 today. Three future states: $.90 (p = .45), $1.10 (p=.45) and $.50 (p =.1). Implied volatility is 17.75%, a 78% increase

Other Interesting Literature

- Corrado & Su, “Implied Volatility Skews and Stock Returns, Skewness and Kurtosis Implied by Stock Option Prices”, European Journal of Finance 1997
- Baturek, Chowdury and Mac, “Implied Volatility Versus GARCH”, Managerial Finance 1995
- Jiltsov, “Implied State Price Densities: Predictive Power, Stability and Information Content”, London Business School Working Paper, September 1999
- Ederington and Guan, “Measuring Implied Volatility: Is an Average Better?”, University of Oklahoma Working Paper, August 2000

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Implied Volatility Dominates GARCH

- Events that are anticipated in time have distinct time series patterns of trading activity. Hull Trading study on earnings announcement days
  - In anticipation of events, volume and volatility dry up. People wait for the news
  - GARCH models follow the volatility trend and reduce expected volatility going into the event
  - Event day is volatile (factor of 9 intra-day) and GARCH vastly increases volatility estimate for the day after the event, but its too late, the game is over
  - Implied volatility gets it right> Option traders aren't dumb
- Bill Gates gets hit by a bus
  - Remember Jiltsov

The Short Term Model

- Take 250 trading days of returns for US stocks
- Correct for serial correlation and heteroskedaticity
- Estimate blind factors using iterated factor analysis
- Use implied volatility to adjust factor and specific variances
  - This a tricky bit, requiring cross-sectional regressions with constrained coefficients
- Implied volatility data on individual stocks is suspect due to thin trading

Model Nuances

- Conditional mean variance estimation
- Adjust factor and security specific variances for serial correlation, see Parkinson (1980)
- Make factor and security specific variances consistent with observed extreme values

Volatility Estimates on an Airline Portfolio

- 42 stocks, capitalization weighted
- 9/10, 9/17,11/30 Some Key Dates
- 589, 2755, 1145 Factor Variance
- 98, 161, 177 Specific Variance
- 26, 54, 35 Total Risk

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Driven by Noise?

	31 August	30 September
P&C Insurance	13.04	16.87
Manufacturing	20.88	19.38
Foods	11.56	11.31

Dealing with Multiple Asset Types in Multiple Markets

- Approach 1: use separate models of separate markets and combine with a grand covariance matrix
  - We see this as problematic
  - Has some advantages
- Parsimonious model of EE
  - The “atomic” security approach
  - inspired by Arrow and Debreu

Conclusions

- Hedge funds and long/short portfolio have some properties that make risk management both more necessary and more complex
- Techniques exist to handle most of the risk and liquidity related problems exist
- An increasing body of literature supports analytical use of implied volatility in forecasting changes in market risk and their magnitude
- Integrating implied volatility into asset management models is practical but not trivial