Finding Proxy Holdings for a Hedge Fund with Undisclosed Holdings + An Empirical Study of Style distributions among Hedge Funds

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Agenda

- Discussion of Northfield's approach to proxying hedge funds.
  - largely a reworking of ideas presented by Dan diBartolomeo in 2002
  - Some new findings regarding style analysis & heteroskedastic returns
- An empirical study of style distributions among a sample set of hedge funds

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Proxying Hedge Fund Holdings

- A common problem in the hedge fund industry is the need to analyze a hedge fund where the holdings of the fund are not disclosed.

- We will illustrate a procedure for estimating proxy holdings for a fund where the true underlying holdings are unknown.

  – Using a combination of returns based style analysis and portfolio optimization,

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Define the Objective

- Our proxy portfolio is not meant to be a guess at the true underlying portfolio, but rather an efficient estimate of:
  - The typical style bets of the fund
  - The degree of portfolio concentration
  - The balance between asset specific and factor risks.
- Our objective is only to form an appropriate risk measurement proxy for a fund with undisclosed holdings
- We should be able to use this proxy portfolio as a representation of the fund in asset allocation procedures
- We are not (yet) addressing return smoothing (Lo) or short volatility strategies (Bondarenko)

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We Walk From Where We Stand

- We assume we have at least a return history for the fund

- Given what you do know about the hedge fund, if anything, select a set of market indices that should encompass the probable set of securities held.

  – For example, if you know it's an equity long/short fund you don't need to include bond indices in the spanning set of indices.

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Let's Start with Analyzing Style

- Using Northfield's ART or comparable application, run a returns-based style analysis of the fund.

- If necessary, return data on the subject fund can be imported into ART using daily, monthly or quarterly periodicity

- ART has an extensive database of hedge funds, unit trusts and market indices.

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Style Analysis Output

By running the style analysis, we get three pieces of information:

– Observed volatility of the subject hedge fund during chosen sample period

– The "style" exposures of the subject fund (growth, value, etc.) expressed as percentages of the different indices that best mimic the fund's return behavior over time.

– The relative proportion of risk coming from style factors and from fund specific risk.

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Needed Refinements of Style Analysis

- For hedge funds, we need to be able to allow short positions in the portfolio of spanning indices while controlling gearing within rational limits

- Computations of the confidence intervals so that we can tell if the style analysis is telling us anything meaningful.
  - Lobosco, Angelo and Dan DiBartolomeo. "Approximately The Confidence Intervals For Sharpe Style Weights," Financial Analyst Journal, 1997, v53(4,Jul/Aug), 80-85.

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Needed Refinements of Style Analysis

- Hedge funds may change character more rapidly than traditional funds.
- We need to make the analysis more responsive to behavior changes in the fund analysis
  - What we're really worried about is a fund that has changed style recently
- One is to use Kalman filtering as put forward in:
  - Swinkels, Laurens and Peter Van Der Sluis, "Returns based Style Analysis with Time Varying Exposures", ABP Working Paper, 2001
  - For traditional long only "style analysis", Kalman filtering requires use of MCMC
- Less complex approach
  - Plot the absolute value of the residual across the sample
  - Exponential weight until the slope is not statistically significantly positive

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Two More Key Refinements

- Use CUSUM based methods to determine the optimal "look-back" period for the style analysis
  - Do we want to look at fund style over the last 3 years, 5 years, 32 months, etc.
- CUSUM is an optimum statistic to determine the change in the mean of a process
  - Was adapted for the purposes of monitoring external asset managers by the IBM pension fund
- Forthcoming paper by Bolster, diBartolomeo and Warrick summarized in our February 2005 newsletter
  - http://www.northinfo.com/documents/192.pdf
- We need to adjust for heteroscedasticity.
  - More on this later

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Selecting the Spanning Indices

- For each fund we need to select the right set of spanning indices
- Over a universe of funds, some indices will be significant lots of funds, some indices will be significant to only a few funds
- Use what we know about the fund strategy to manually select a set of "likely suspects"
- Start with a large list of indices. Iteratively run the analysis dropping out the least statistically significant.
  - Easy to get fooled because T stats on indices improve as we drop correlated but less significant indices
- Start with a short list of indices representing major asset classes
  - Run analysis, drop insignificant asset classes. Replace remaining indices with sub-indices. Rerun analysis and again drop out insignificant indices

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Now Let Us Start to Form Holdings

- Take the constituents of our spanning indices and form a portfolio of these constituents weighted by results of the style analysis.
- If our style analysis said the fund behaved like 50% the S&P 500 and 50% EAFE
- We would form a portfolio that was 50% the weighted constituents of the S&P 500 and 50% EAFE.
  - At this point, we should have a portfolio that has the right "style" exposures to match our fund
- However, these two indices together have about 1600 stocks.
- The resulting portfolio would be far too diversified to represent a typical hedge fund.
  - It is likely to have far lower risk than a real hedge fund portfolio.

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Let's Refine the Proxy Holdings

Now we'll consider portfolio volatility
- Load the proxy portfolio into the Optimizer as both the benchmark and the starting portfolio.
  - In our example, our version starting portfolio/benchmark would have 1600 stocks.
- We must reduce the number of positions such that the overall risk of the portfolio approximates the observed risk of the subject fund.
  - We can do this by running an optimization while using the "Maximum number of Assets" parameter.
- With a little trial and error, we can find the portfolio that matches the benchmark (and the subject fund) in style.
  - We reduce the diversification to the point where the expected volatility of the proxy portfolio matches the observed volatility of the subject hedge fund.

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Check the Balance Between Factor and Asset Specific Risks

- We now load the refined (reduced number of positions) proxy portfolio into the Optimizer as the portfolio with a cash benchmark.

- By running a risk report, we can determine how much of:
  - the expected risk of the refined proxy portfolio arises from factor bets
  - Arises from asset specific risk.
  - If this is a reasonable match to the subject fund (from the style analysis) we're done.

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Changing the Balance Between Factor and Asset Specific Risks

- If we find we don't have the appropriate balance between factor and asset specific risks
  - Repeat the process of "refining" the proxy portfolio
  - In addition to defining the Max Assets parameter, we can change the Optimizer's degree of risk tolerance for factor and asset specific risk
  - Again with a little trial and error, we can find risk acceptance parameter values that bring the relative proportions of factor risk and asset specific risk into line with our analysis of the subject fund

- We now have our proxy portfolio

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We're Done

- We've been recommending this procedure to clients for several years, with no negative feedback

- Enhancements such as exponential weighting and CUSUM improve the accuracy of the process

- Once the proxy holdings have been formed, use these as the constituents of a "Composite Asset" and proceed with normal risk analysis procedures

- Coverage of the HEDGEFUND.NET database is being added to our EE risk model using a "production" version of this technique

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The Heteroscedasticity Adjustment

- An easy experiment
  - Take a 9 year sample period from 1998 through 2006
  - Make up a return stream for a hypothetical hedge fund whose returns are equal to the S&P 500 for 1/3 of the 9 years, equal to the FTSE Europe for 1/3 of the 9 years, and equal to the Merrill Lynch Global High Yield for 1/3 of the 9 years
  - The expected style weights should be 1/3 S&P 500, 1/3 FTSE Europe and 1/3 MLGHY
- Generally WRONG!

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A Curious Result

	SE	α	R^2	S&P	FTSE	MLGHY
FTMLSP	6.63	2.87	0.67	11.65	28.66	59.69
FTSPML	5.49	-3.43	0.85	39.9	43.44	16.65
MLFTSP	6.61	-5.33	0.75	5.54	58.01	36.44
MLSPFT	6.89	-2.16	0.71	23.85	37.59	38.56
SPFTML	5.79	-0.74	0.87	64.04	34.39	1.56
SPMLFT	7.29	8.7	0.71	53.46	0	46.54

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What's Going On

- The results are order dependent
  - The style analysis process, like a regression is minimizing the sum of squared residuals
  - The volatility of markets is different across the three sub-periods, and the more volatile periods are counted more heavily
  - Averaged across all six possible combinations we get our expected result of 1/3, 1/3, 1/3
- The more volatile periods do count for more in the returns experienced by investors
- For characterizing manager style and estimating the likely holdings of a fund, we want to neutralize this effect, so we need to weight the observations to adjust for heteroskedasticity

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What's Going On (cont'd)

- Reinforces the need for careful selection of a sample period
  - CUSUM

- Points to areas for further development
  - GLS approaches to fitting the constrained regression
    - De Silva, Sapra and Thorley, FAJ, 2001
  - observation period selection to minimize heteroskedasticity in returns?

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Let's Look at Some Data

- Northfield has done style analysis on more than 100 hedge funds that are available to Asian private clients
- Period is 2001-2006, except for a few funds that start in 2002
- The following are the average and standard deviation of the tracking error, alpha and r^2 of the fund's returns vs. the minimum tracking error fund weights.

Statistic	Mean	Standard Deviation
Tracking Error	3.36	2.31
Alpha	-0.94	4.53
r^2	0.68	0.15

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What Does this Mean?

- **Tracking Error** shows the mismatch between the fund's returns and the best-fit of the style indices.
  - This tracking error can be due to either security selection or changing the asset class exposures over time.
  - The level of tracking to the "best-fit" indices is actually lower than typical for most mutual funds.
- **Alpha** represents the manager's skill minus the fee.
  - Given the relatively high fees for hedge funds, the mean alpha actually represents a reasonably high level of skill.
- r^2 shows that, on average, the spanning indices explain about 2/3rd of the variance in the fund's returns.

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Mean and Standard Deviation of Style Weights – 100 Hedge Funds

Index	Mean Weight	Std. Dev.	Index	Mean Weight	Std. Dev.
Citi 3 Month Treasury Bill	74.21	19.09	Russell 1000 Value	-0.69	12.10
Lehman Treasury	0.16	15.07	Russell 1000 Growth	-11.61	10.93
Lehman Mortgages	1.52	12.63	Russell 2000 Growth	-0.15	7.84
Lehman US Corp Invest Grade	-7.30	11.68	Russell 2000 Value	-0.84	8.64
Lehman US Corp High Yield	0.02	11.32	S&P/Citi BMI.G Asia Pacific	2.14	11.71
Merrill Convertibles	16.48	15.85	S&P/Citi BMI.G Europe	-2.84	10.91
Citi European WGBI USD	8.06	16.34	S&P/Citi BMI.V Asia Pacific	-2.02	10.66
Citi Japanese Gov Bd USD	-5.79	11.85	S&P/Citi BMI.V Europe	0.20	9.38
Lehman Emerging Markets	1.29	10.84	S&P/Citi EMI World xU.S.	18.27	14.28
Goldman Sachs Commodity	0.39	3.14	S&P/IFCI Composite USD	8.50	11.40

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Comments on Style Weights

- **The standard deviations listed represent the cross-sectional variation of factor exposures**
  - Even if the average exposure is close to zero, its possible for some funds to have a high and significant exposure to an index, other funds large negative and significant exposure to the index
- **Citi 3 Month Treasury Bill** (74.21±19.09) shows the extent to which the manager was market neutral.
  - If the weight is 100%, then the manager is market neutral with the short rebate invested in t-bills.
- **Lehman Treasury** (0.16±15.07) can show a number of different fixed income strategies such as:
  - The yield curve carry trade: lend long and borrow short to pick up the time premium. The coefficient would be positive and the coefficient on cash would be less than zero.
  - Short volatility: a negative weight on treasury bonds and a positive weight on mortgage backed bonds indicates a likely short interest rarte volatility strategy.

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Comments on Style Weights, Continued

- **Lehman Mortgage Backed** Sec (1.52±12.63) A short interest rate volatility strategy if it has a positive weight and the treasury bond has a negative weight of about the same magnitude.

- **Lehman US Corp Invest Grade** (-7.30±11.68) A credit spread strategy if it has a positive weight and the treasury bond has a negative weight.
  - Could indicate a portfolio of credit default swaps.
  - Combining investment grade bonds, high yield bonds, convertible bonds and equities can indicate a capital structure arbitrage strategy.

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Comments on Style Weights, Continued

- **Lehman High Yield (US Corp)** (0.02±11.32) This would indicate a credit spread strategy with lower quality credits.
  - This could also be implemented with credit default swaps at much lower transaction costs and
- **Merrill Convertibles** (16.48±15.85) This is the classic convertible arbitrate strategy.
  - The positive weight on convertibles balanced by a short position in domestic equities.
- **Citi European WGBI** (8.06±16.34) A bet on the Euro
  - or an exposure to European time premium. We would need to include short-term European index to investigate this.

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Comments on Style Weights, Continued

- **Citi Japanese Gov Bond** (-5.79±11.85) This negative weight represents the carry trade:
    - Borrow in Yen and invest it in a higher yielding market. This violates forward rate parity, but seems to work and many people think it will continue to work.
- **Lehman Emerging Markets** (1.29±10.84) Emerging market bonds have a premium yield, but this has decrease remarkably over the last few years.
- **Goldman Sachs Commodity** (0.39±3.14) 2003-2005 have been good for commodities, particularly energy, but:
    - Not many hedge funds with significant exposure to this index.

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Comments on Style Weights, Continued

- **Russell 1000 Value** (-0.69±12.10) Value stocks outperformed growth stocks over this period
  - a large cap relative value strategy is long this index and short growth index.
  - In convertible arbitrage strategies, this weight would be negative.
- **Russell 1000 Growth** (-11.61±10.93) Value stocks outperformed growth stocks over this period
  - a large cap relative value strategy would be short this and long value index.

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Comments on Style Weights, Continued

- **Russell 2000 Growth** (-0.15±7.84) Small cap stocks outperformed large cap stocks over this period –
  - a small cap tilt would be long this index and short large cap growth index.
  - a relative value strategy might usE small cap stocks.
- **Russell 2000 Value** (-0.84±8.64)) Small cap stocks outperformed large cap stocks over this period
  - a small cap tilt would be long this index and short the large cap growth index.
  - a relative value strategy might also be employed using small cap stocks.

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Comments on Style Weights, Continued

- **S&P/Citi Asia Pacific** Growth (2.14±11.71) Unlike US stocks, many hedge funds showed a distinct growth tilt in Asia.

- **S&P/Citi Europe Growth** (-2.84±10.91) This weight would show a European growth tilt.

- **S&P/Citi Asia Pacific Value** (-2.02±10.66)) This weight would show an Asian value tilt.

- **S&P/Citi Europe Value** (0.20±9.38) This weight would show a European value tilt.

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Comments on Style Weights, Continued

- **S&P/Citi Small Cap World except U.S.** (18.27±14.28) This weight is surprisingly large.
  - Since this is the second best return over the study period, it shows that the hedge fund managers, on the whole,
  - Could this weight be a proxy for something else?
- **S&P/IFCI Composite USD!** (8.50±11.40) This is the third highest average weight and the highest return.

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Annualized Returns vs. Average Weights
2001-2005
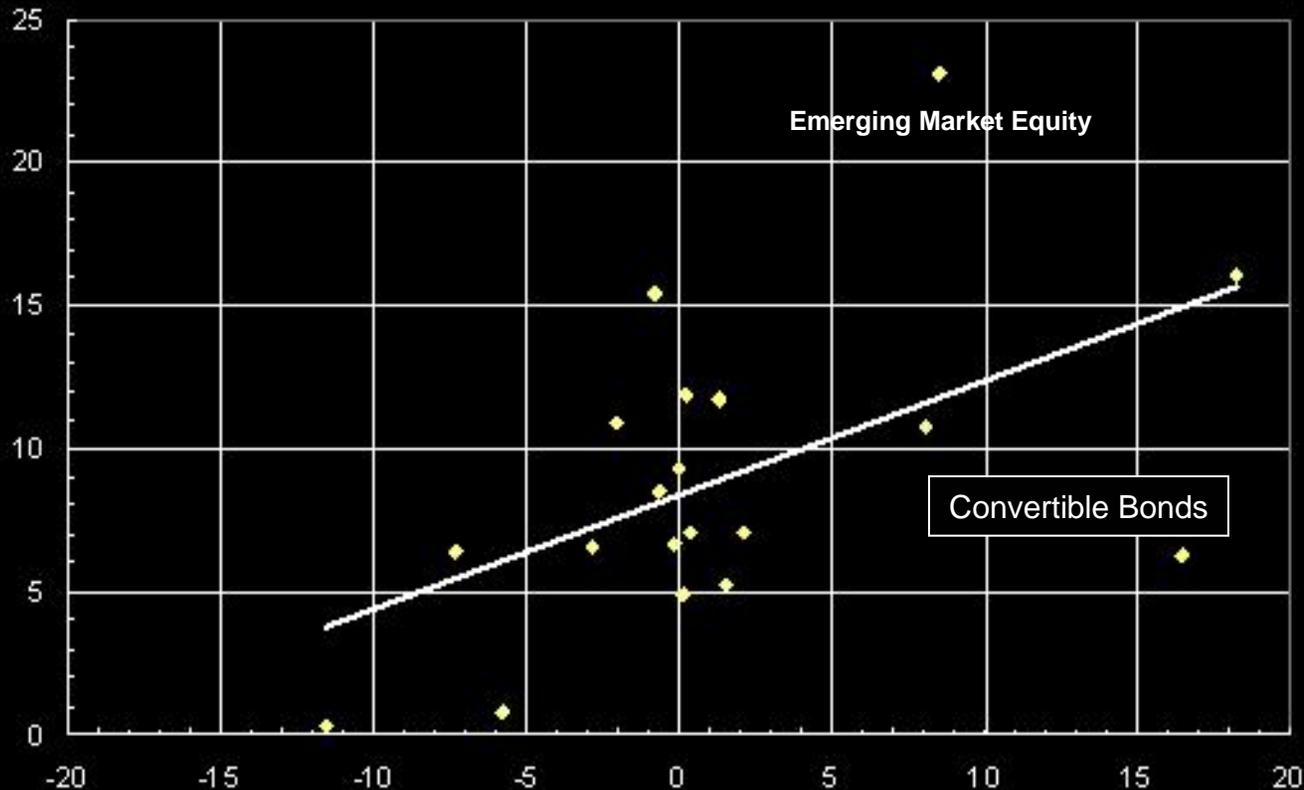
These Hedge Fund Managers show significant asset class picking skills over this time period, although explanatory power is low

A Refinement for Domestic Long/Short & Market Neutral

- A number of the "best" (highest Sharpe ratio for the last five years) hedge funds use a "twist" style:
  - Long Large Cap Value
  - Short Large Cap Growth
  - Short Mid Cap Value
  - Long Mid Cap Growth
  - Long Small Cap Value
  - Short Small Cap Growth
- In other words, you generally favor growth but you also can pick the mid-cap stocks that will eventually become large cap.
- To pick this up, you need to substitute the large, mid cap indices for the Russell 1000 indices.

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Output of Style Analysis for a Market Neutral Fund

But the Tracking Error and the error on the weights are high

Let's Look at Global Eurodeposits, Bonds and Stock

The tracking error is much lower, but the only significant weight is for the 3-month Euro Eurodeposit. Stocks are **not a good proxy** for this fund.

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Let's Try a Different Fund

The likely strategies for this fund:
1. A credit spread strategies, perhaps done with credit default swaps
2. Growth vs. Value – in which case this manager guessed wrong!
3. A bet on emerging markets