

Hedge Fund Risk and Factor Models

Christopher C. Finger Daniel Straumann
RiskMetrics Group, Geneva

What are we trying to achieve?

- › Describe consistently the risk of portfolios of alternative and conventional investments, allowing for varying levels of transparency.
- › Funds of Hedge Funds
 - How to aggregate funds with full, partial, and no position transparency?
- › Pension funds
 - How to aggregate individual positions, managed accounts, and hedge fund allocations?
- › Consistency means...
 - Use a common data frequency.
 - Take advantage of risk forecasting capabilities.
 - Articulate sources of risk (equity, interest rates, volatility, managers).
 - Stress test across common risk factors (interest rate shift, equity sell off, fall in implied volatility)
- › Automate and standardize to the extent possible.

Modeling from hedge fund return data

- › Well known data issues, but sometimes, it is all we have!
- › Why not model HF returns directly, statistically?
 - Monthly horizon means giving up good conditional forecasting models.
 - Cannot talk about sources of risk or stress test.
 - No meaningful aggregation with conventional positions
- › What about hedge fund indices?
 - Daily data does exist. How well do they describe risk?
 - Aggregation with conventional positions is more straightforward.
 - Limited (strategy-based) means to attribute risk
 - No ability to stress test
- › Where possible, we would like asset-based factors that ...
 - Describe the risk of HF returns well,
 - Can be produced at a daily frequency, and
 - Link to standard risk factors.

Other applications

- › Monitor managers
 - Surprising positions
 - Actual versus reported strategy
- › Portfolio construction
 - Neutralize or bet on styles or factors
- › Performance benchmarking
 - Realistic alpha estimation

Linear factor model

$$r(t) = \alpha + \beta_1 f_1(t) + \dots + \beta_n f_n(t) + \varepsilon(t)$$

HF return in period t HF systematic return Factor weight Factor realization in period t Specific HF return in period t

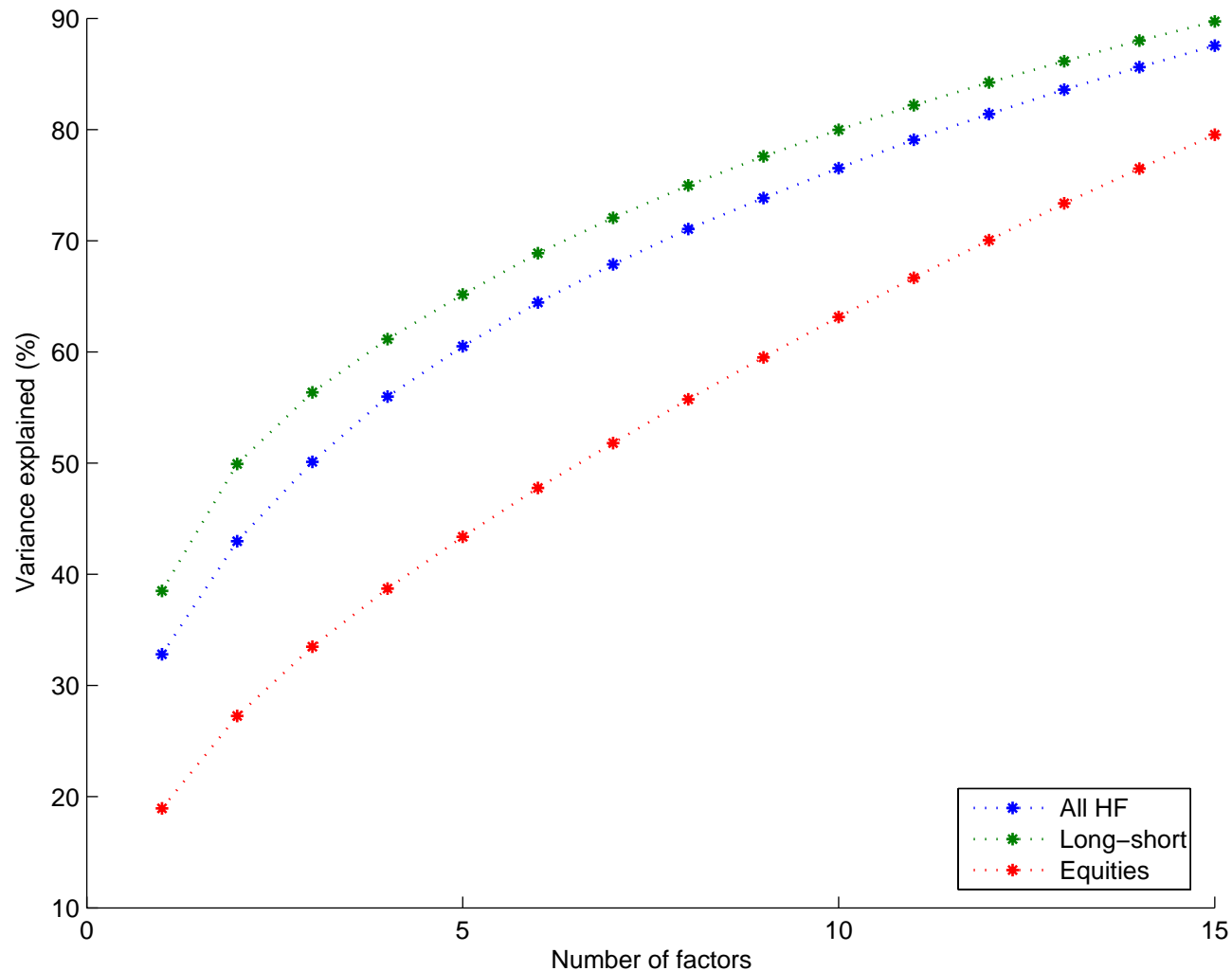
- › Factors can be
 - Statistically derived from the universe of hedge fund returns
 - Hedge fund indices
 - Conventional indices or securities
 - Dynamic, but systematic strategies on conventional investments
 - Asymmetric or symmetric with respect to the broad market
 - Gaussian or non-Gaussian
 - Etc.
- › Risk can be characterized ...
 - As hedge fund specific (specific return, statistical factors, HF indices)
 - Directly as conventional risks (conventional indices and securities)
 - Indirectly as conventional risks (eg impact of an exchange rate move on a strategy)

Examples

- › Look at two sets of hedge fund returns (data source?)
 - Universe (how many funds)
 - Long-short equity only (how many funds)

- › Ask some questions ...
 - How many factors are there?
 - How does this compare to the equity market?
 - How well do HF indices do at describing these factors?
 - Are there differences in how “representative” different index sets are?
 - How well do traditional equity factors do?
 - What is missing?
 - What other asset-based factors are useful?

Principal component analysis – how much can statistical factors tell us?



What are the main statistical factors related to?

> Correlation of first three principal components to EDHEC indices, 2000-2005

Factor 1	Factor 2	Factor 3
-77% Short Selling	-26% Emerging Markets	-30% Global Macro
8% CTA Global	-16% Long/Short Equity	-25% Funds of Funds
32% Fixed Income Arbitrage	-11% Event Driven	-23% CTA Global
45% Convertible Arbitrage	-11% Relative Value	-13% Long/Short Equity
62% Equity Market Neutral	-9% Distressed Securities	-11% Emerging Markets
71% Global Macro	6% Funds of Funds	-2% Distressed Securities
73% Merger Arbitrage	15% Merger Arbitrage	4% Fixed Income Arbitrage
76% Distressed Securities	32% Convertible Arbitrage	14% Event Driven
83% Emerging Markets	37% Fixed Income Arbitrage	17% Equity Market Neutral
84% Relative Value	38% Global Macro	21% Short Selling
93% Event Driven	40% Short Selling	39% Merger Arbitrage
94% Funds of Funds	44% Equity Market Neutral	43% Relative Value
94% Long/Short Equity	80% CTA Global	50% Convertible Arbitrage

Which indices work best?

- › Compare
 - HFRI – investable, monthly liquidity, monthly data
 - EDHEC – investable, combination of indices such as HFRI
 - HFRX – investable, daily liquidity, daily data
- › Using daily data is desirable, but ...
- › Reactions to using daily indices:
 - *We like them because they are representative.*
 - *We don't like them because they are not representative.*
- › But what do we mean by representative?
 - For benchmarking, calculation of alpha
 - For description of variation in returns

How different are monthly and daily indices?

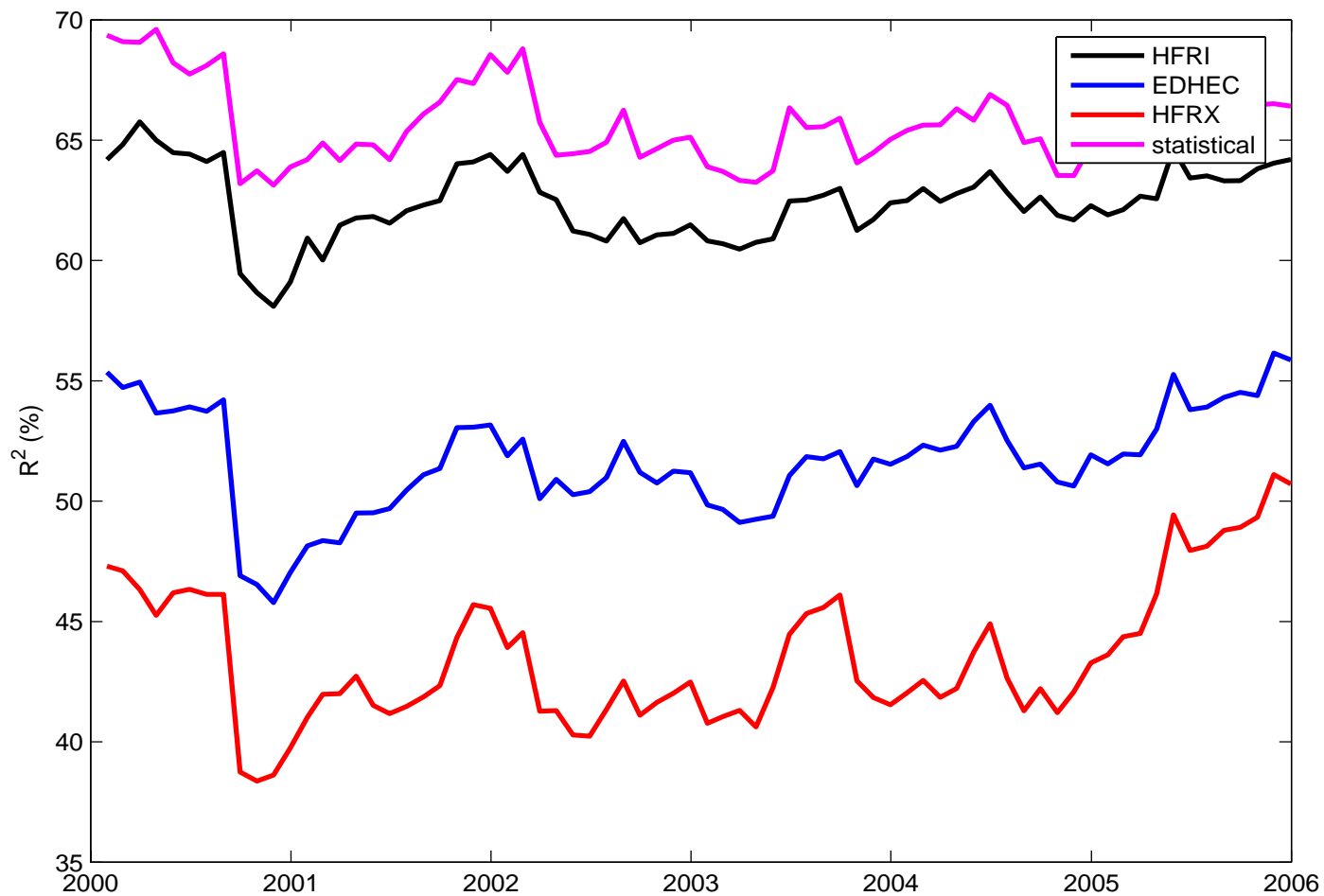
HFR indices, 2000-2005

		<u>Mean</u>	<u>SD</u>	<u>Corr</u>
Equity hedge	Daily	13.1%	7.9%	87.5%
	Monthly	12.7%	9.7%	
Macro	Daily	11.9%	8.8%	70.3%
	Monthly	9.1%	6.3%	
Merger arb	Daily	6.9%	3.9%	89.0%
	Monthly	7.8%	4.0%	
Relative value arb	Daily	7.1%	4.1%	75.8%
	Monthly	8.5%	3.3%	
Equity market neutral	Daily	2.3%	3.7%	44.2%
	Monthly	6.4%	3.2%	
Event driven	Daily	8.7%	6.6%	89.9%
	Monthly	11.2%	6.9%	
Convertible arb	Daily	6.6%	4.1%	86.5%
	Monthly	8.7%	3.7%	
Distressed	Daily	9.7%	5.9%	79.6%
	Monthly	11.3%	6.0%	

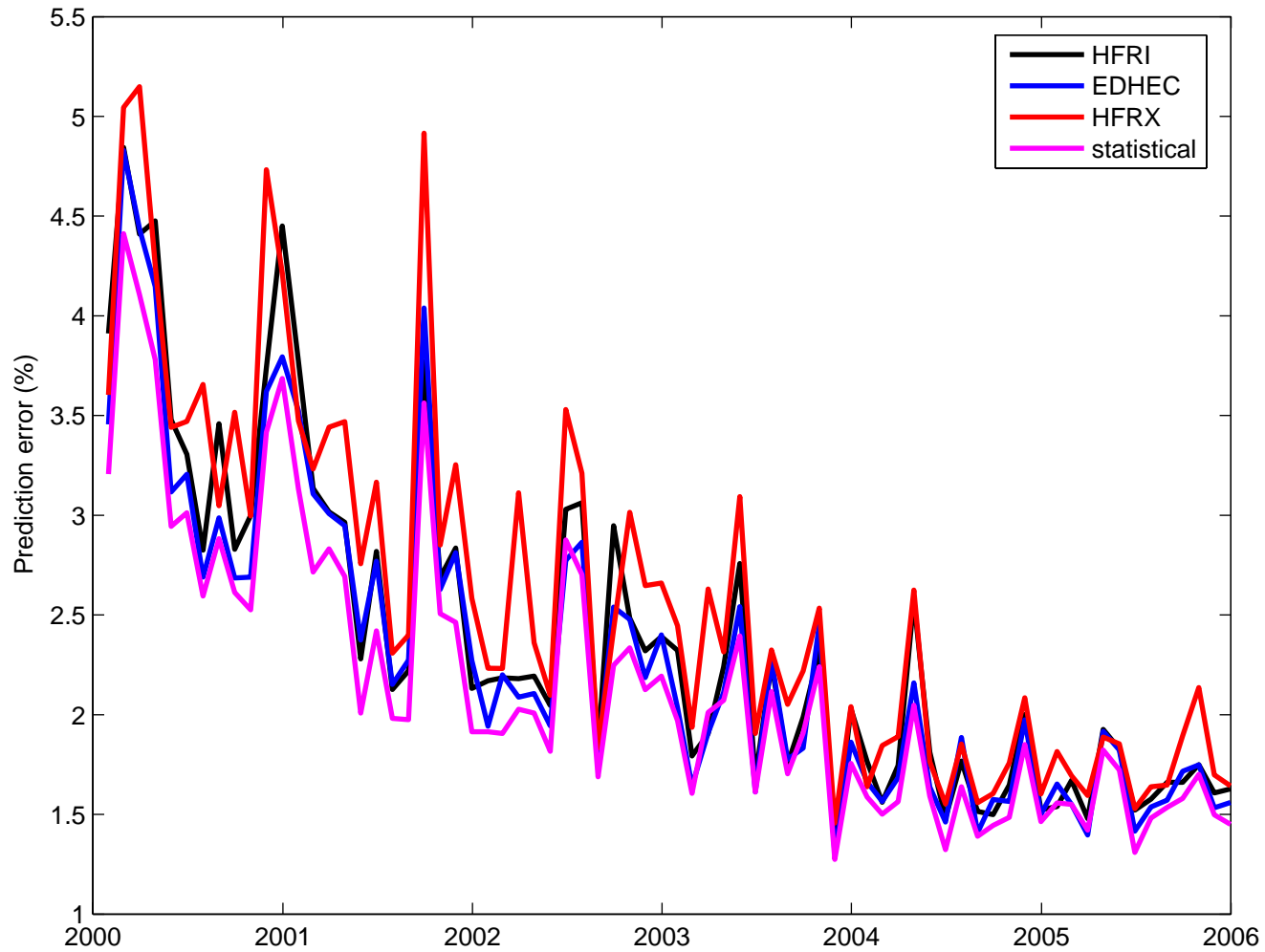
Look at out-of-sample performance

- › Look at funds in the combined Barclay database with history for 2000-2005 (~1200 funds)
- › For each set of indices, perform the following exercise:
 - Regress HF returns on indices over last 24 months.
 - Assume perfect foresight on indices, and forecast next month's HF return.
 - Compute error versus realized HF return.
 - Average errors (out-of-sample residuals) across all HF.
 - Track errors through time.
- › If different indices are equally forecastable, then the sizes of out-of-sample residuals tell us which indices are best for risk estimates.

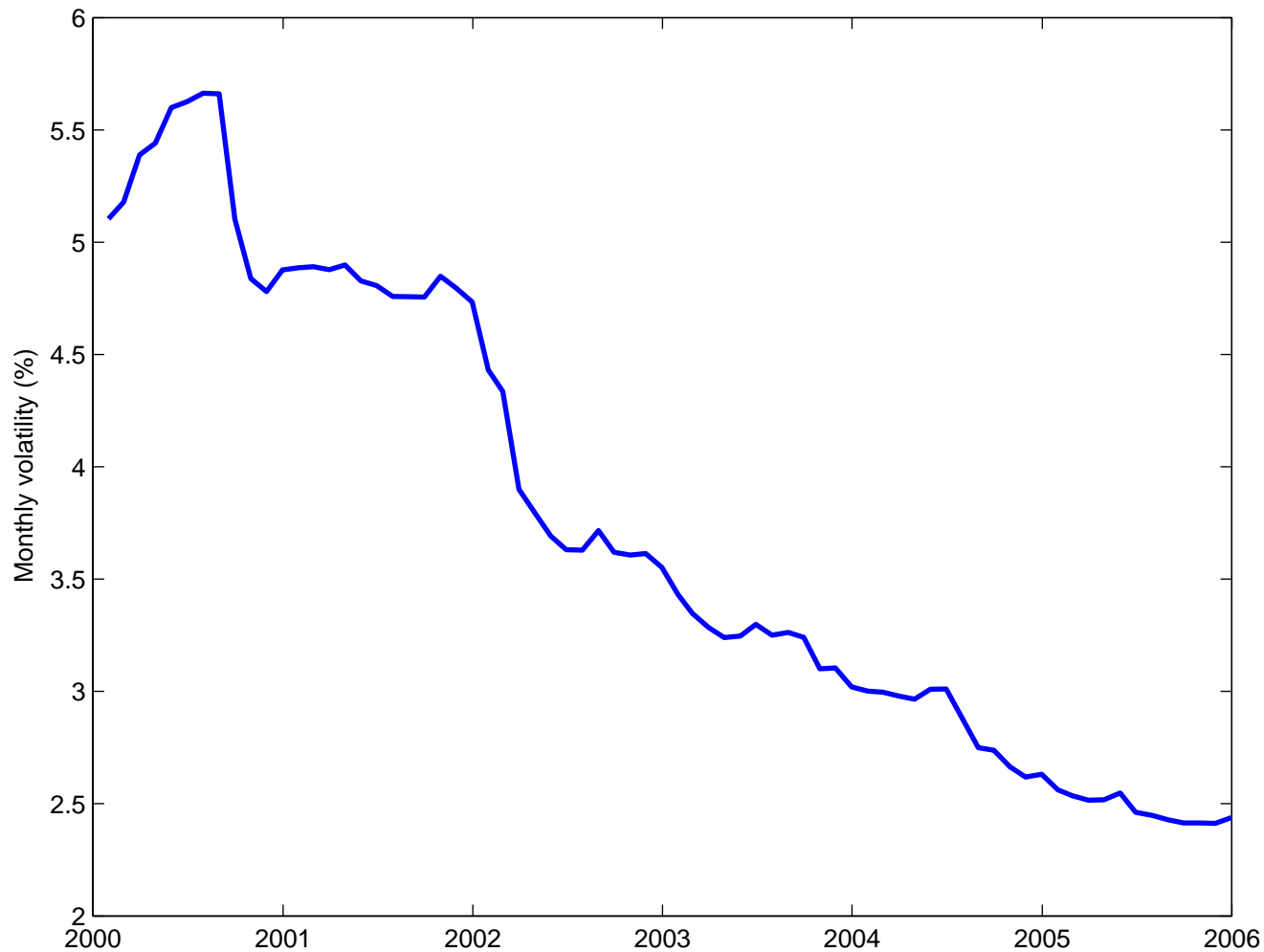
Average goodness-of-fit in sample



Out-of-sample residuals



Average HF volatility

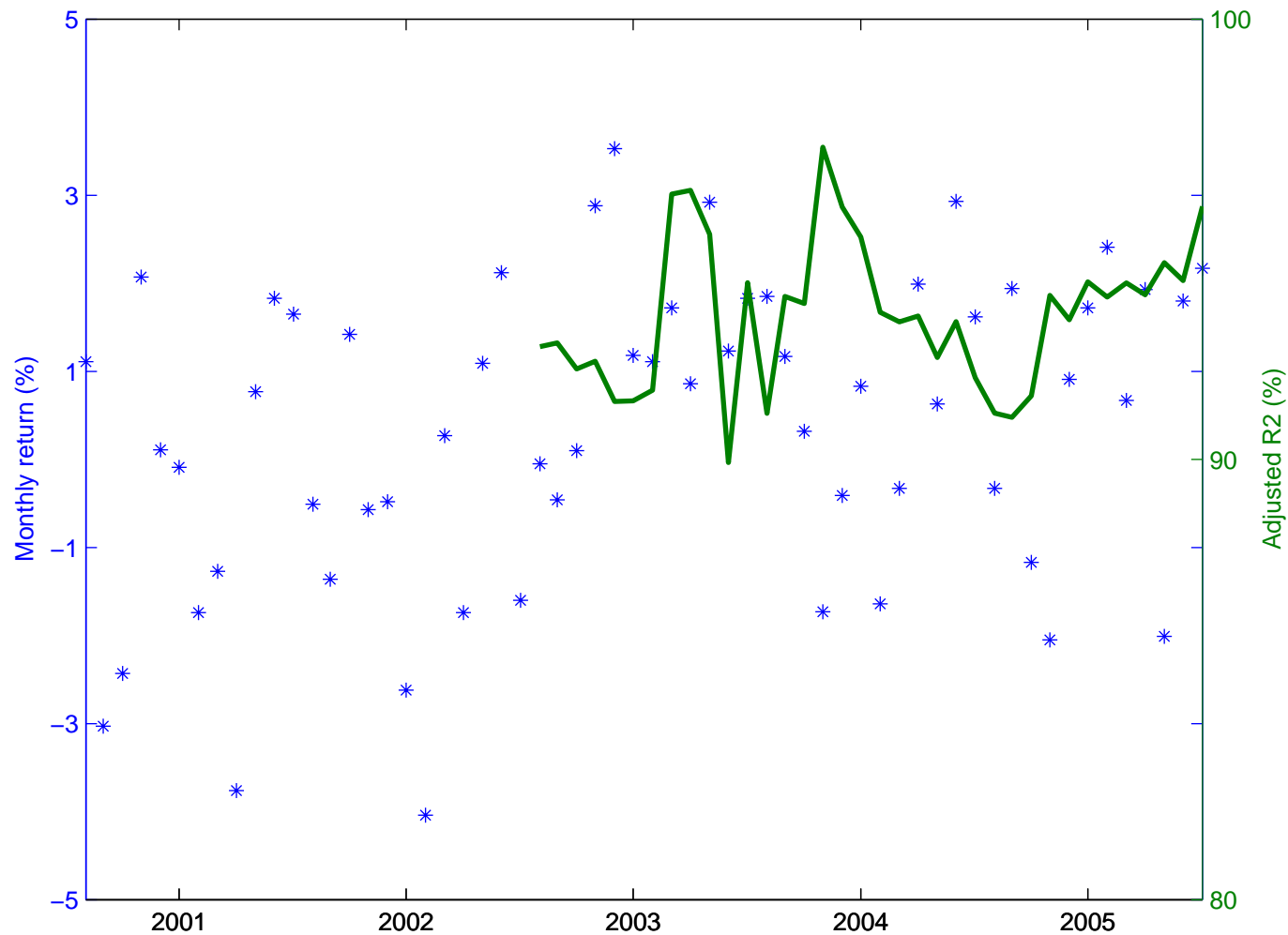


Long/short equity funds

- › Define long/short broadly (most equity funds other than merger arbitrage)
- › Start with traditional equity factors for the US (*Base*)
 - The market
 - SMB – performance of small- over large-cap stocks
 - HML – performance of growth over value stocks
- › Investigate the explanatory power of three other groups:
 - *Global*: Non-US markets
 - › Market indices for Europe, Japan, EM
 - *Style*: Richer set of US factors
 - › Similar factors based on momentum, liquidity, dividend yield
 - *Volatility*: Option-related factors
 - › Introduction of asymmetric dependence, and dependence on volatility

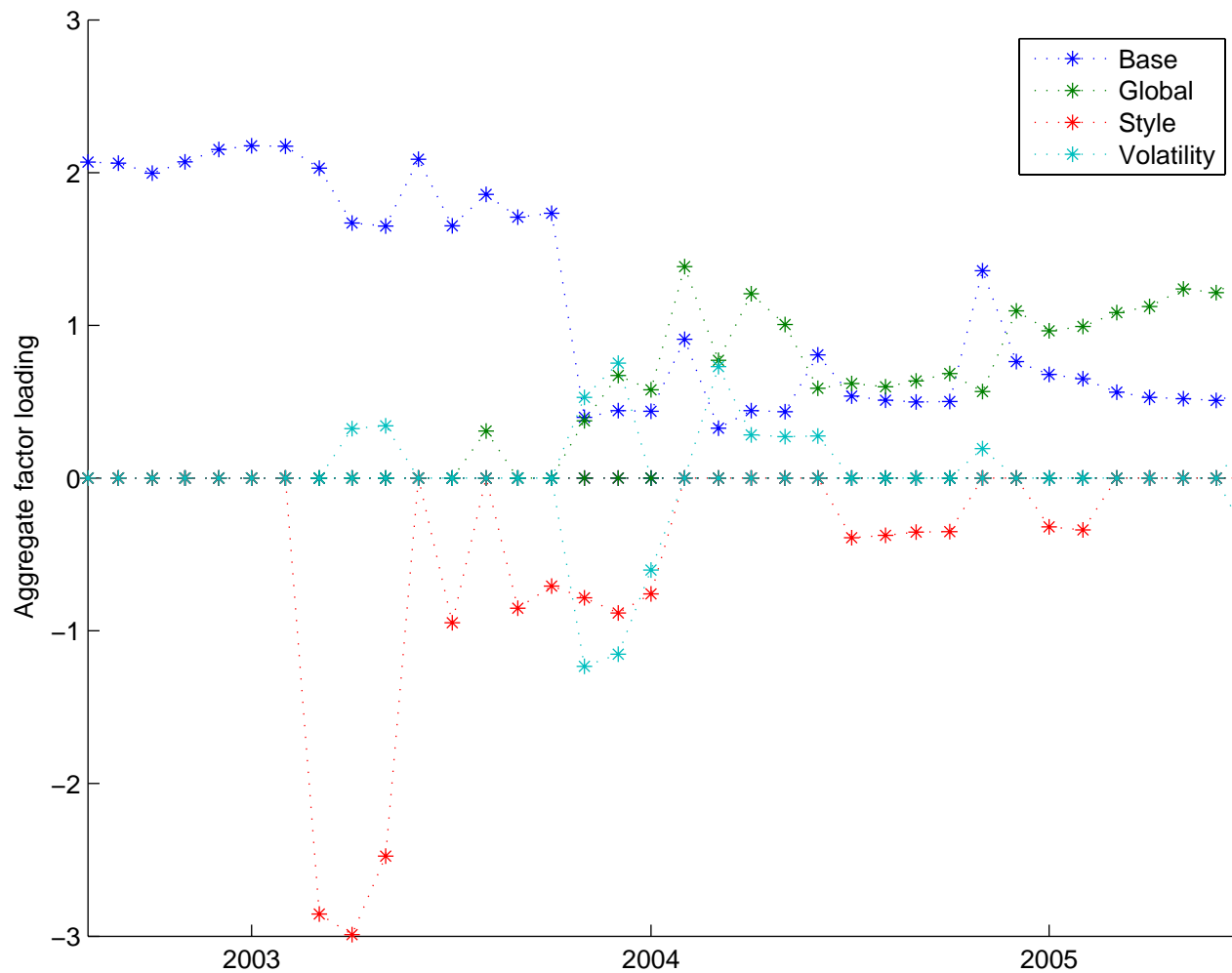
EDHEC Long/Short Equity Index

Returns and goodness-of-fit



EDHEC Long/Short Equity Index

Aggregate exposure to factor groups



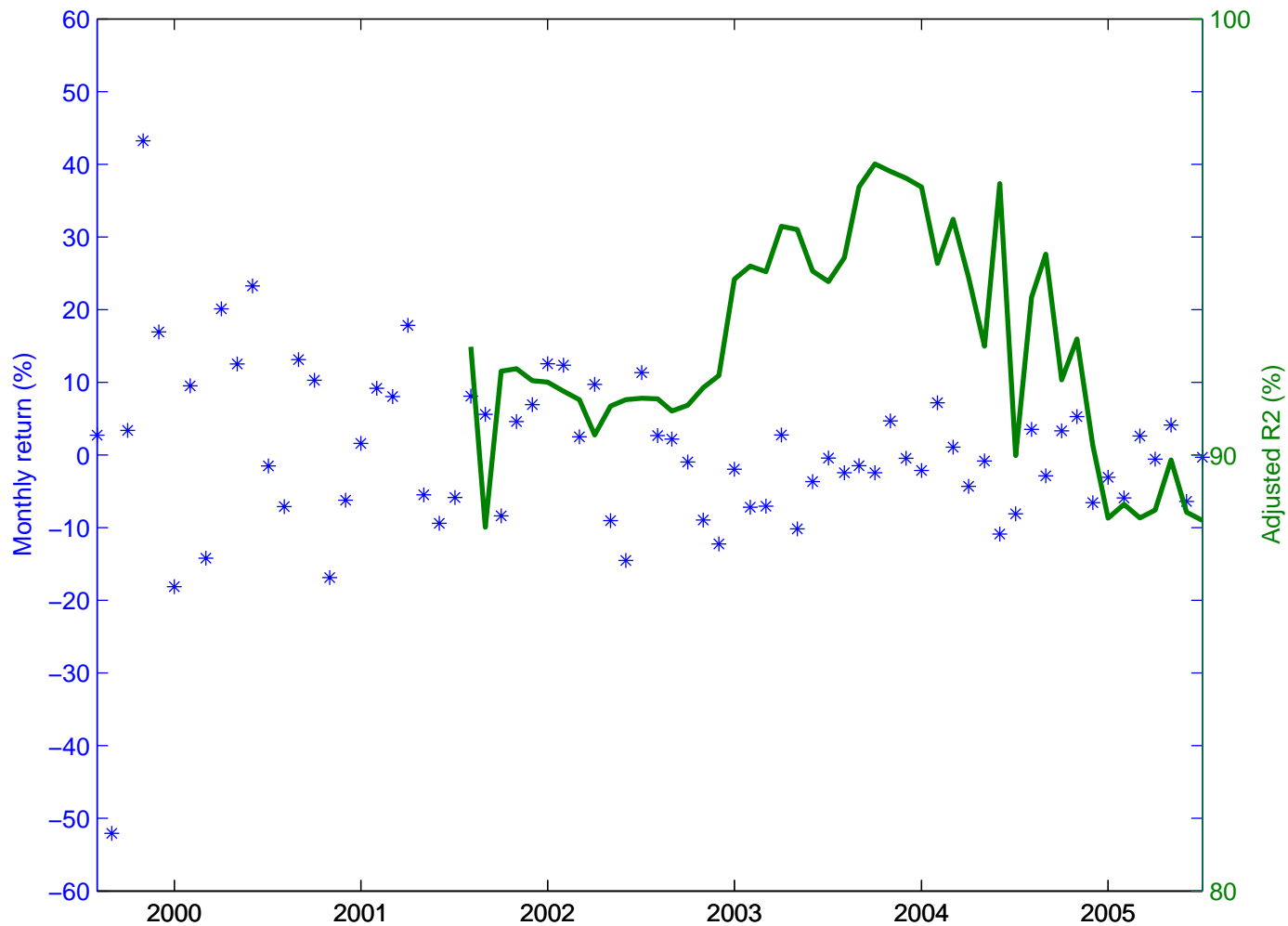
EDHEC Long/Short Equity Index

Detail of Global factor exposures



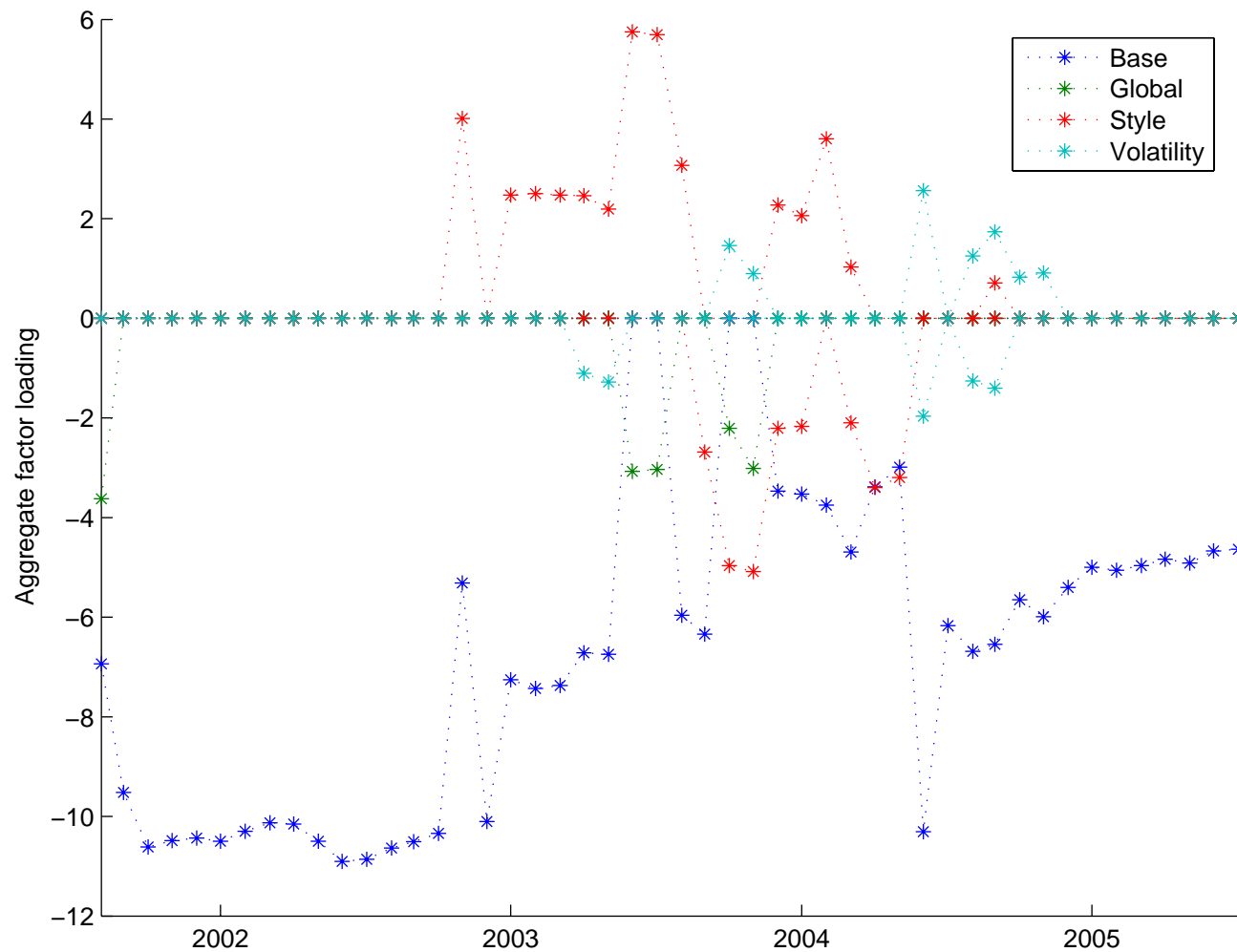
Equity short bias fund

Returns and goodness-of-fit



Equity short bias fund

Aggregate exposure to factor groups



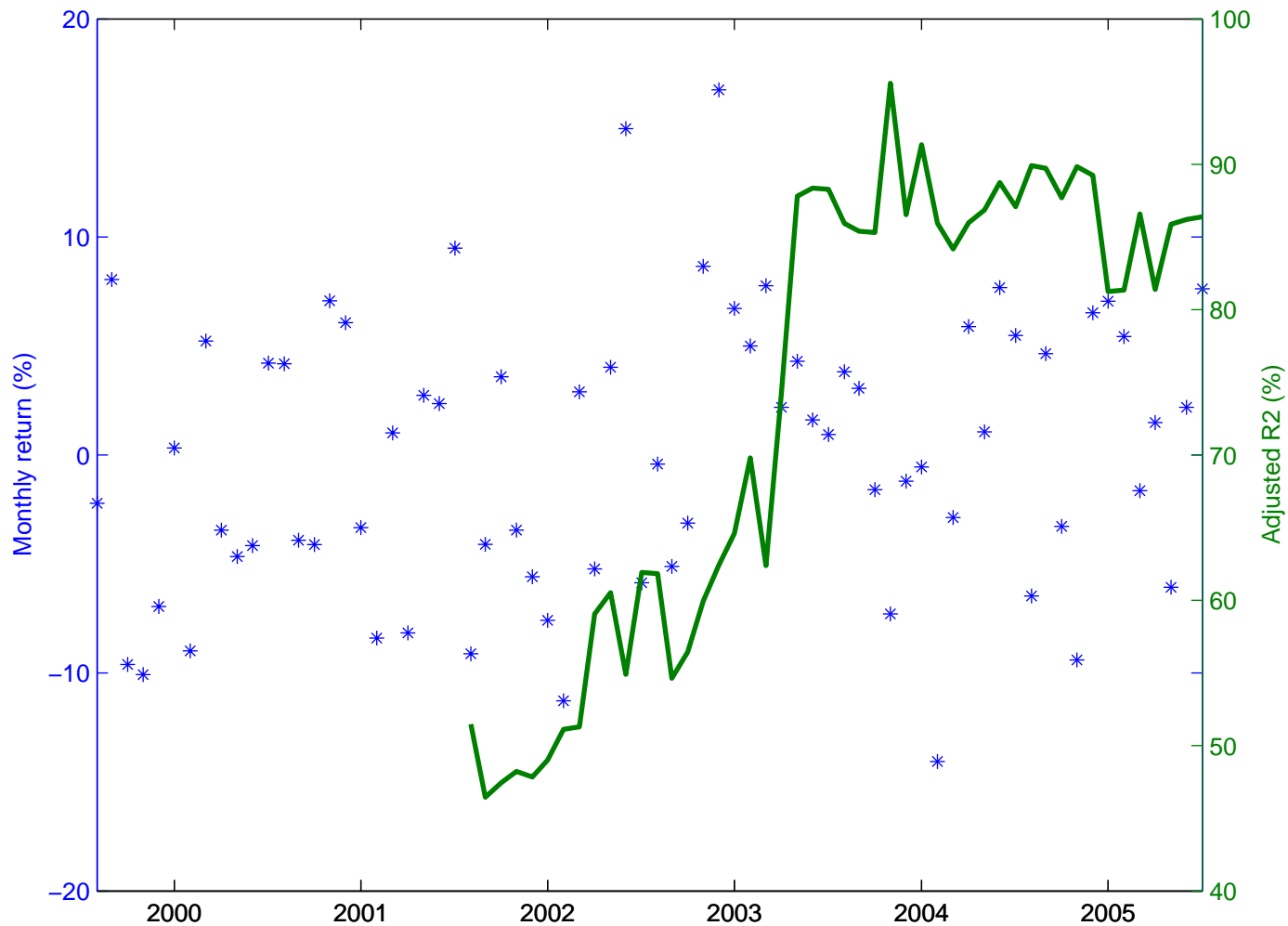
Equity short bias fund

Detail of Base factor exposures



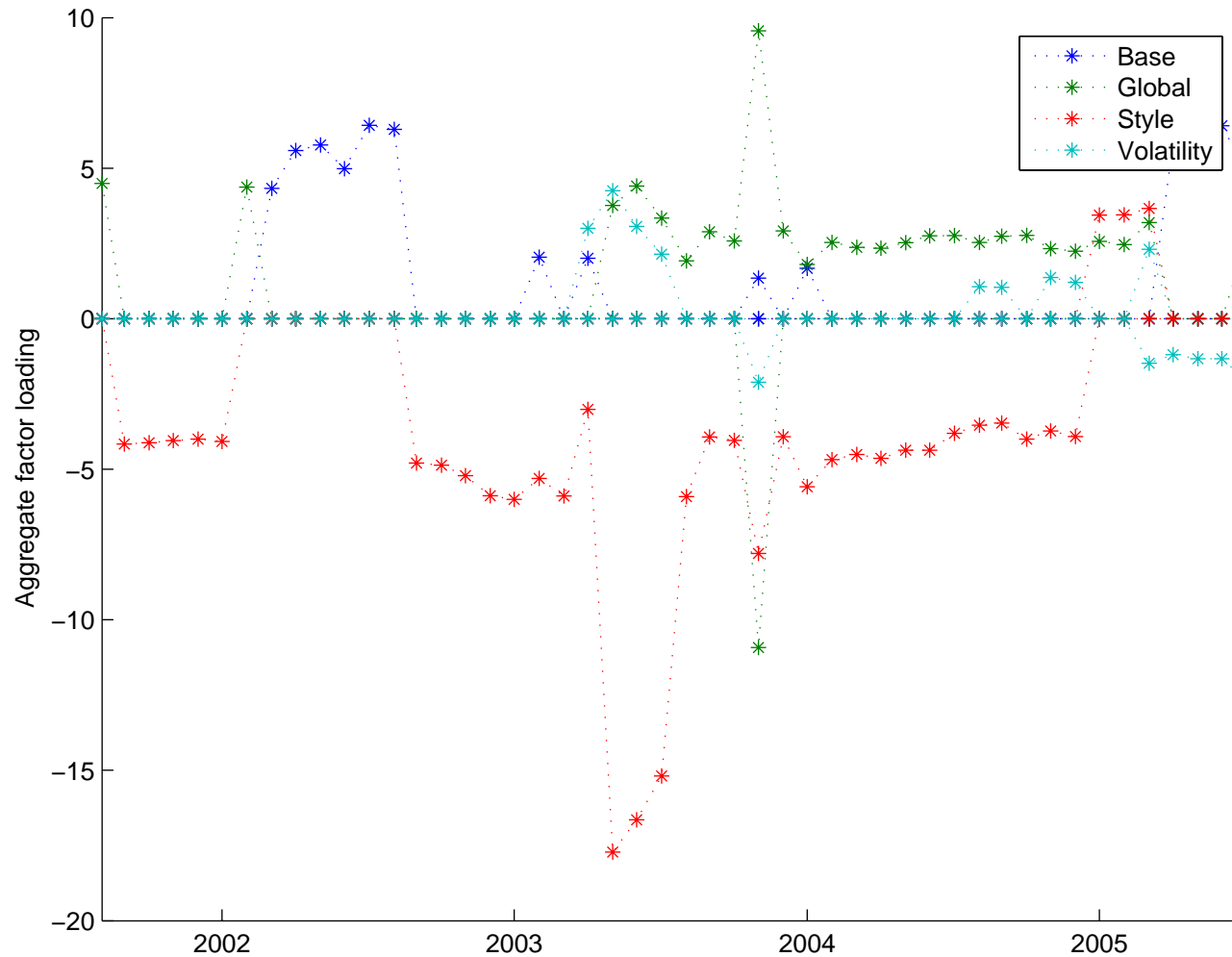
Equity long bias fund

Returns and goodness-of-fit



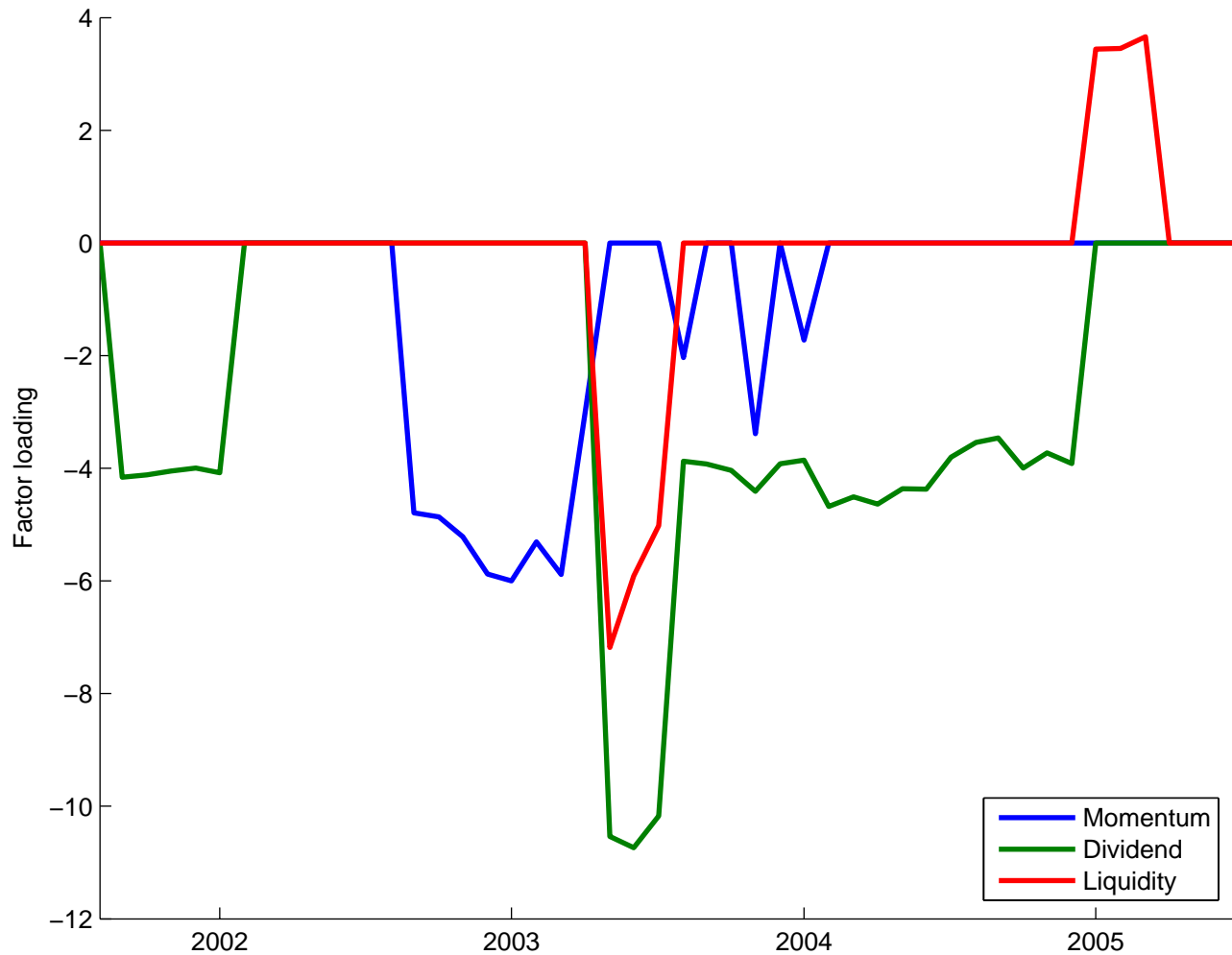
Equity long bias fund

Aggregate exposure to factor groups



Equity long bias fund

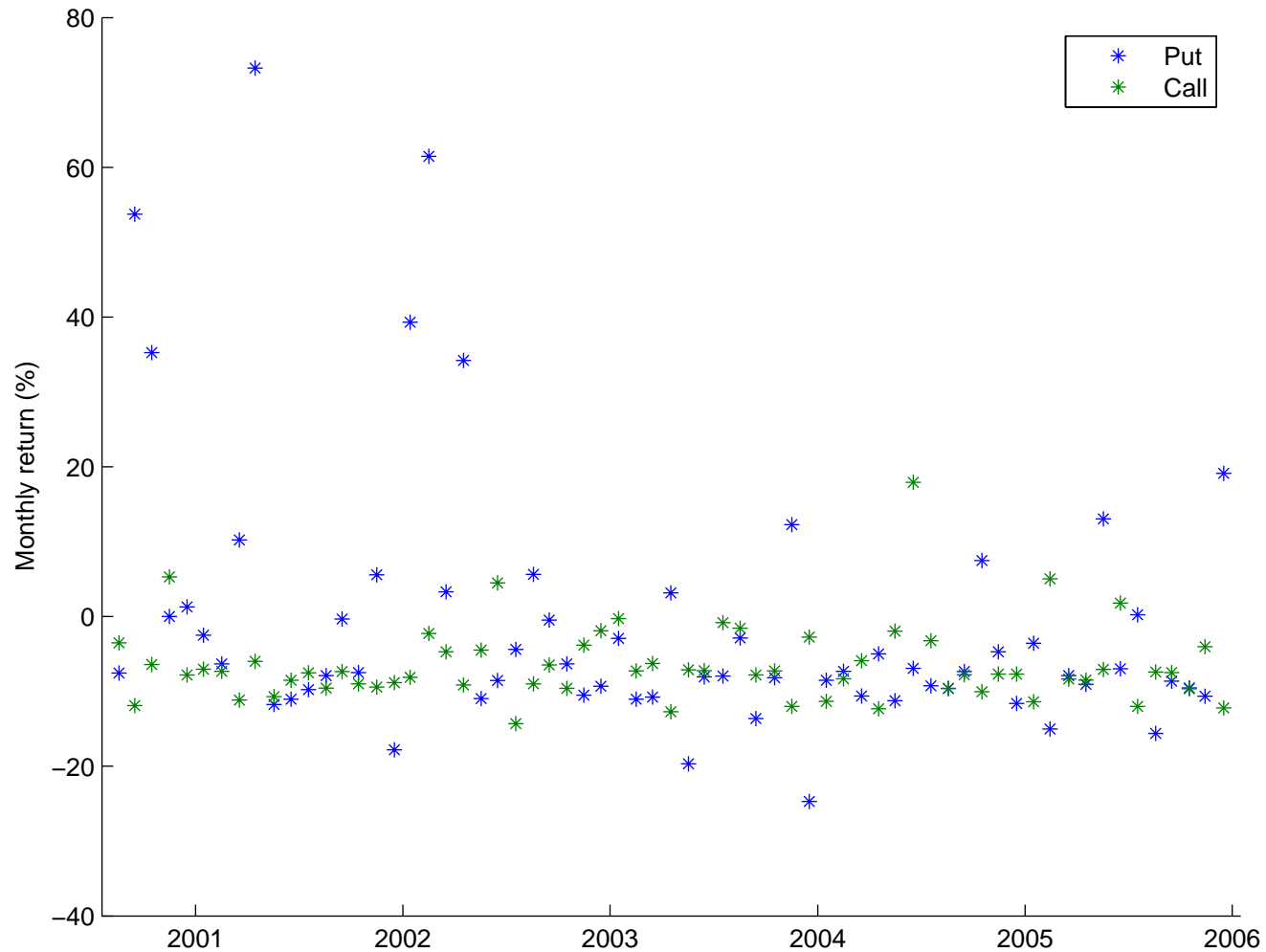
Detail of Style factor exposures



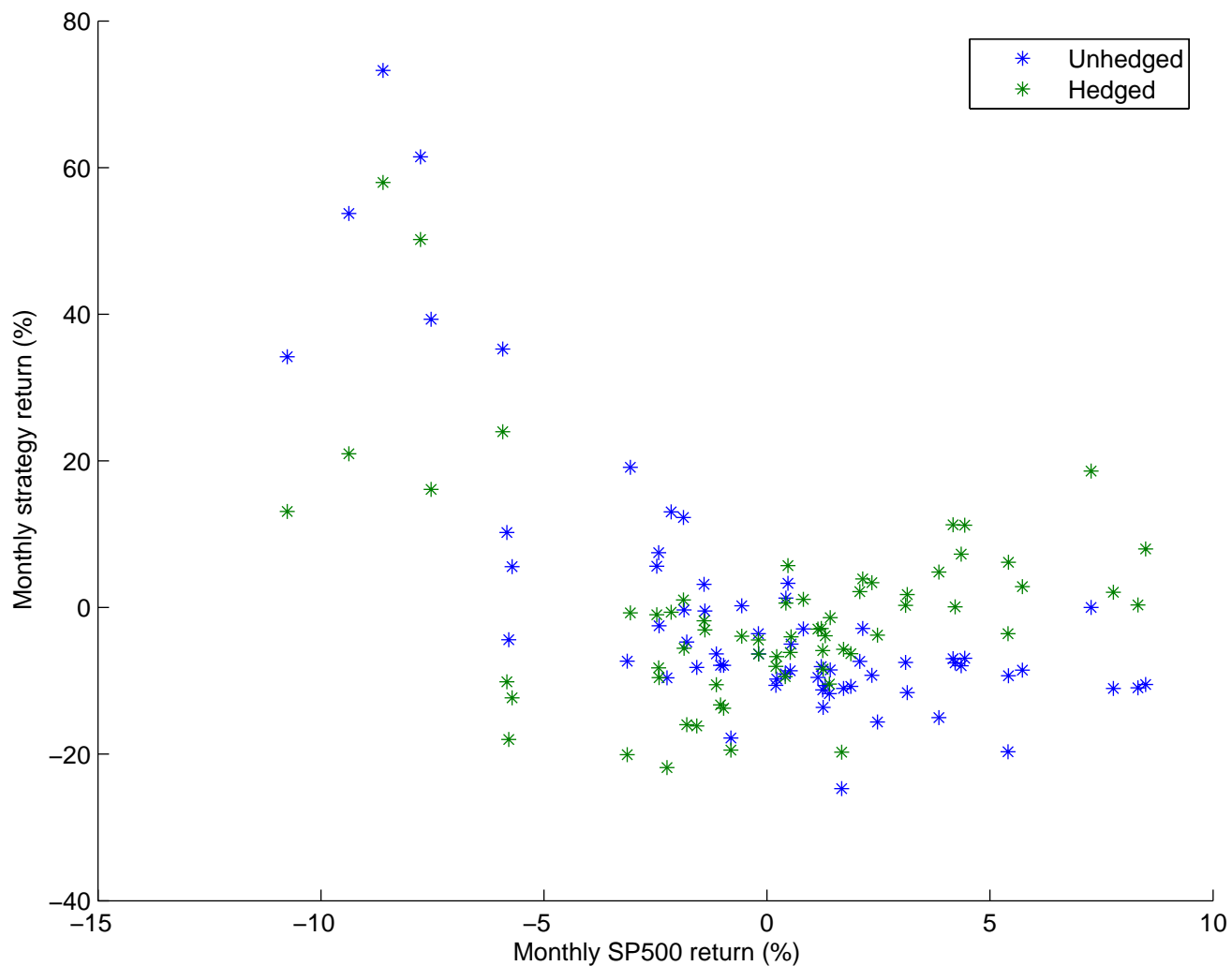
What about option-based factors?

- › All options based on S&P 500.
- › Factors
 - VIX – levels and changes
 - Realized (trailing n month) volatility
 - Option trading strategy
- › Option trading strategy consists of
 - Each week, buy n-month option on the index
 - › ATM/OTM, Call/Put/Straddle, Hedged/Unhedged
 - Reinvest option payoffs into fund
 - Maintain constant level of leverage (option premium as proportion of capital)
 - Mark-to-market daily, compute returns monthly
 - Implied volatility and asymmetry
- › In regressions on individual hedge funds, which factors are chosen most often?

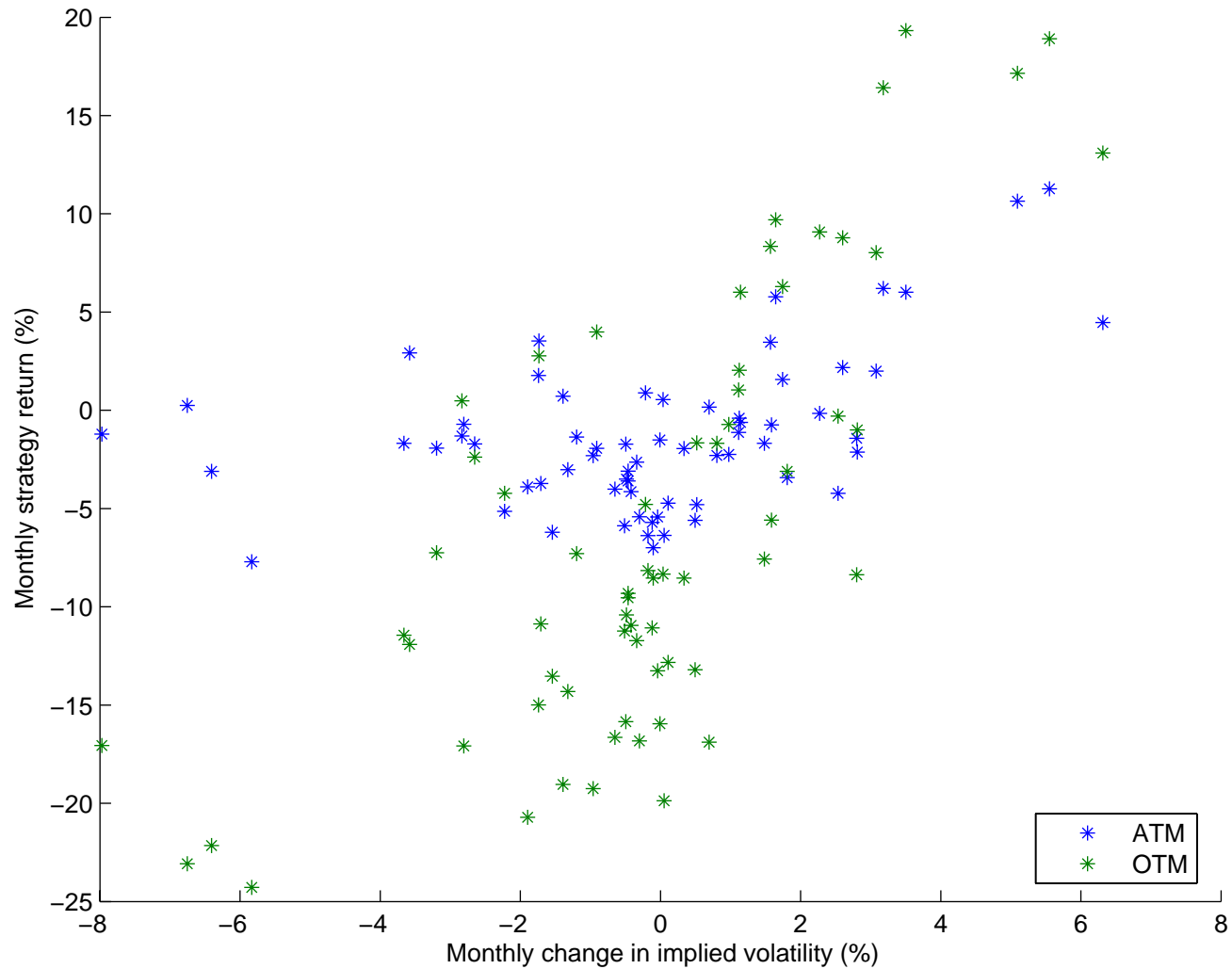
Returns on at-the-money option strategies



ATM put strategies versus SP500 returns

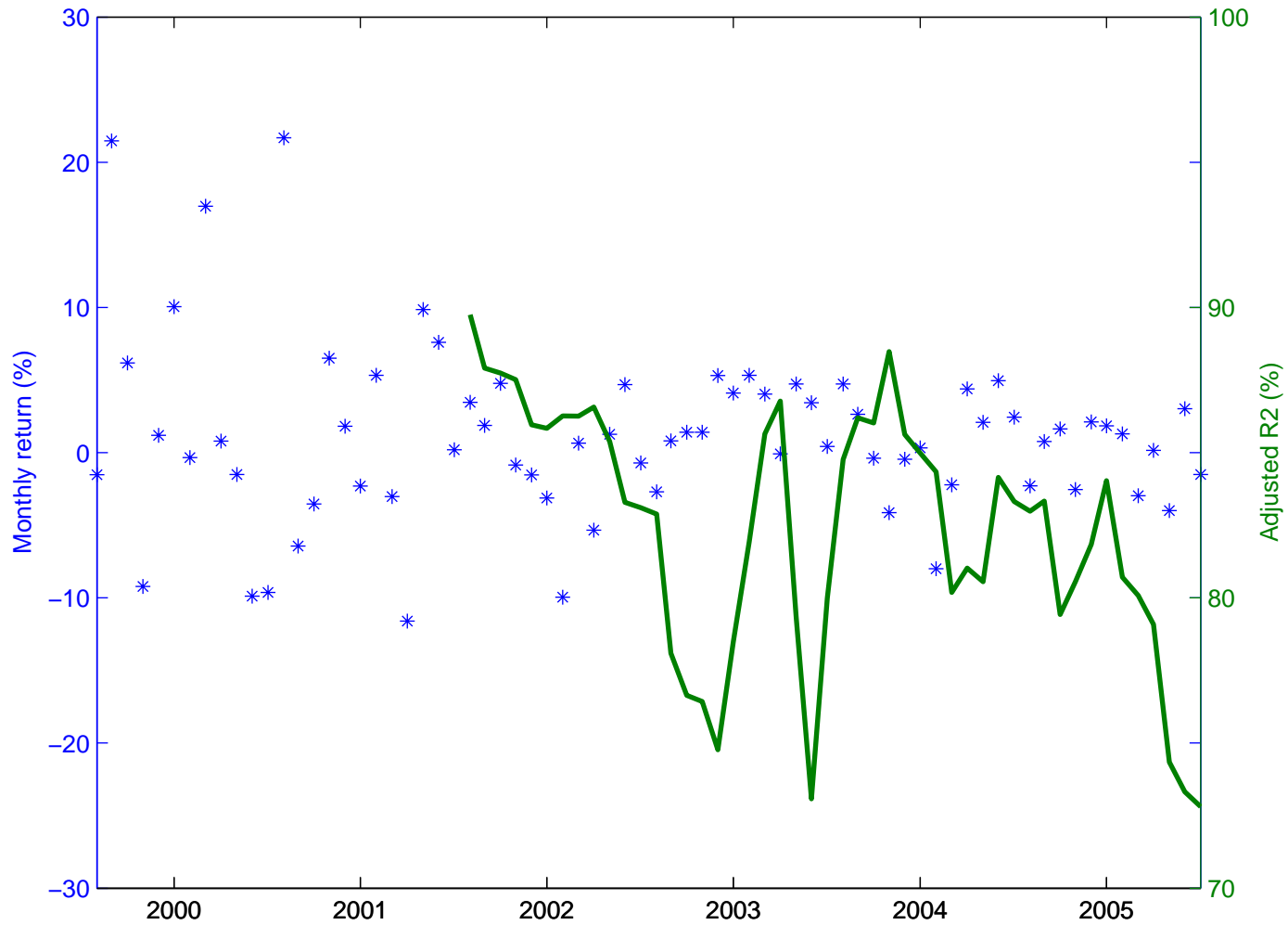


Sensitivity to volatility changes – hedged call strategies



Equity long/short fund

Returns and goodness-of-fit



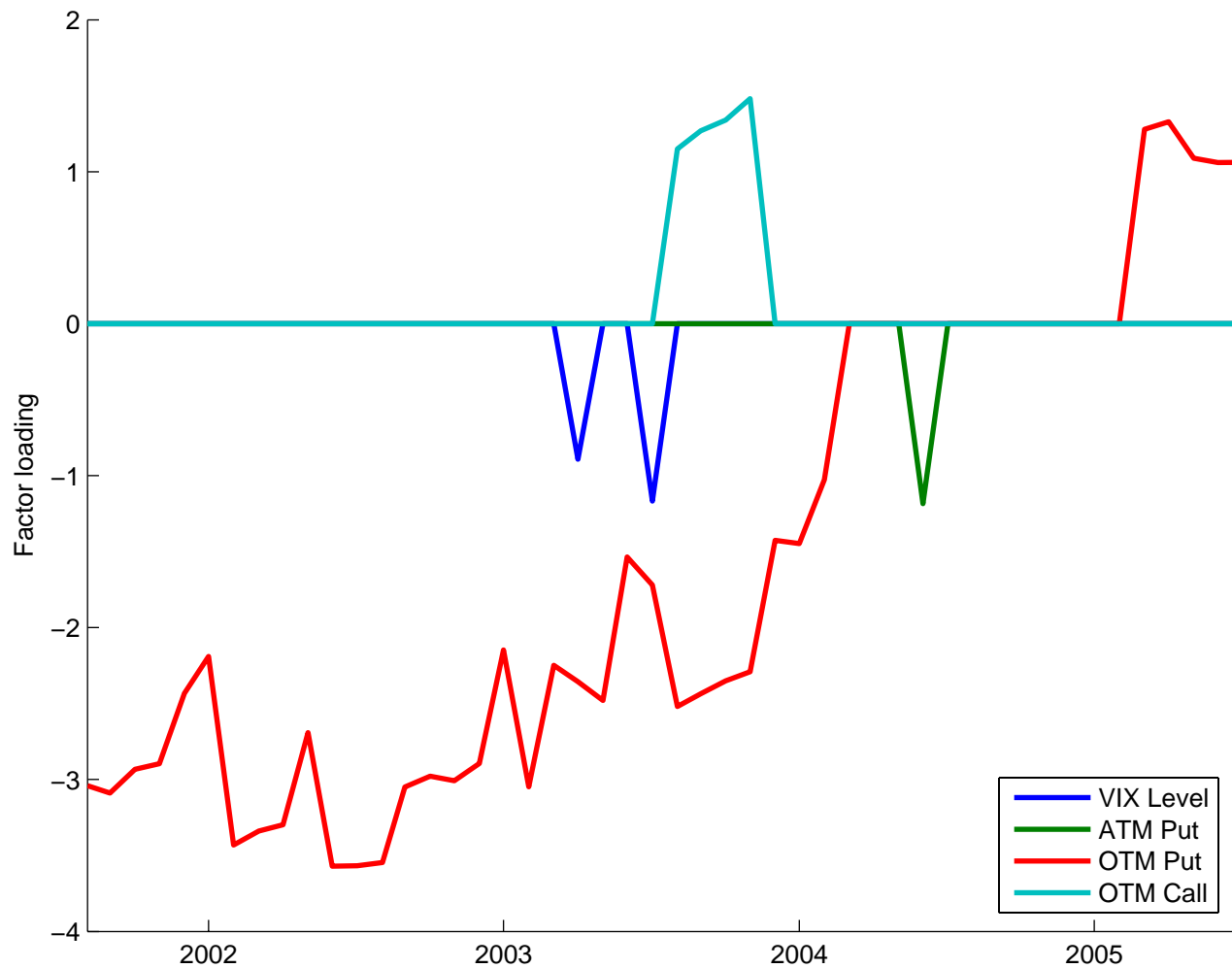
Equity long/short fund

Aggregate exposure to factor groups



Equity long/short fund

Detail of Volatility factor exposures



Proportion of regressions where each factor is chosen

Long/short equity funds, 2001-2005

BASE	<i>Market</i>	65%	35%	49%	42%	23%	27%	31%	31%
	<i>SMB</i>	28%	24%	18%	27%	16%	24%	17%	16%
	<i>HML</i>	21%	16%	20%	16%	14%	14%	16%	13%
GLOBAL	<i>Emerging Markets</i>		21%			20%	16%		20%
	<i>Europe</i>		10%			10%	9%		11%
	<i>Far East</i>		6%			6%	5%		7%
	<i>Pacific</i>		6%			6%	5%		6%
	<i>World</i>		10%			8%	7%		10%
STYLE	<i>Momentum</i>			13%		12%		12%	12%
	<i>Dividend Yield</i>			17%		15%		15%	14%
	<i>Liquidity</i>			10%		9%		9%	9%
VOLATILITY	<i>VIX level</i>				9%		8%	9%	11%
	<i>VIX changes</i>				6%		5%	6%	7%
	<i>Realized Volatility</i>				6%		7%	6%	6%
	<i>Put ATM unhedged</i>				6%		5%	5%	7%
	<i>Put ATM hedged</i>				1%		1%	1%	2%
	<i>Put OTM unhedged</i>				8%		7%	8%	8%
	<i>Put OTM hedged</i>				6%		6%	6%	8%
	<i>Call ATM unhedged</i>				9%		8%	8%	11%
	<i>Call ATM hedged</i>				1%		2%	2%	2%
	<i>Call OTM unhedged</i>				4%		4%	3%	3%
	<i>Call OTM hedged</i>				5%		5%	5%	4%

Proportion of regressions where at least one factor in a group is chosen

> Using only VIX and realized volatility

Base	80%	61%	61%	76%	43%	59%	56%	42%
Global		45%			42%	42%		39%
Style			41%		38%		40%	38%
Volatility				23%		20%	23%	20%

> Including option trading factors

Base	78%	58%	64%	64%	44%	51%	51%	49%
Global		48%			45%	39%		46%
Style			36%		32%		32%	30%
Volatility				50%		45%	48%	49%

Conclusions

- › Purely statistical factors are undesirable for describing risk.
- › Hedge fund indices
 - Allow some risk attribution.
 - Appear useful for describing risk.
 - Daily indices perform comparably to standard indices in out-of-sample tests on risk forecasting.
- › Across long/short equity funds, many types of factors are useful.
- › To capture volatility exposure, it is important to capture realistic return profiles.