



Hedge Fund Replication: Why Precision Matters

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Markov Processes International (MPI)

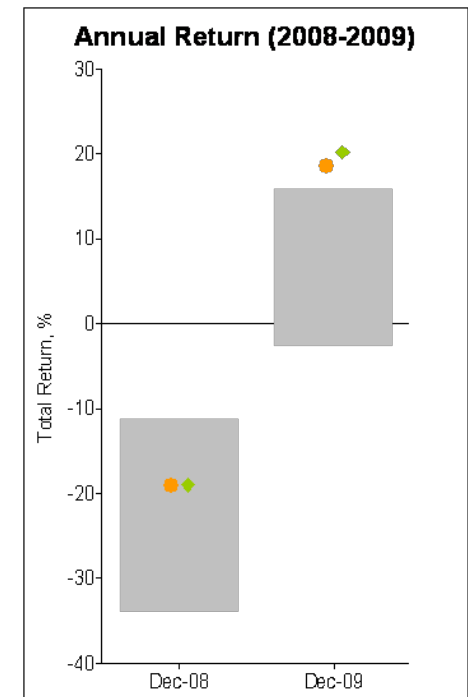
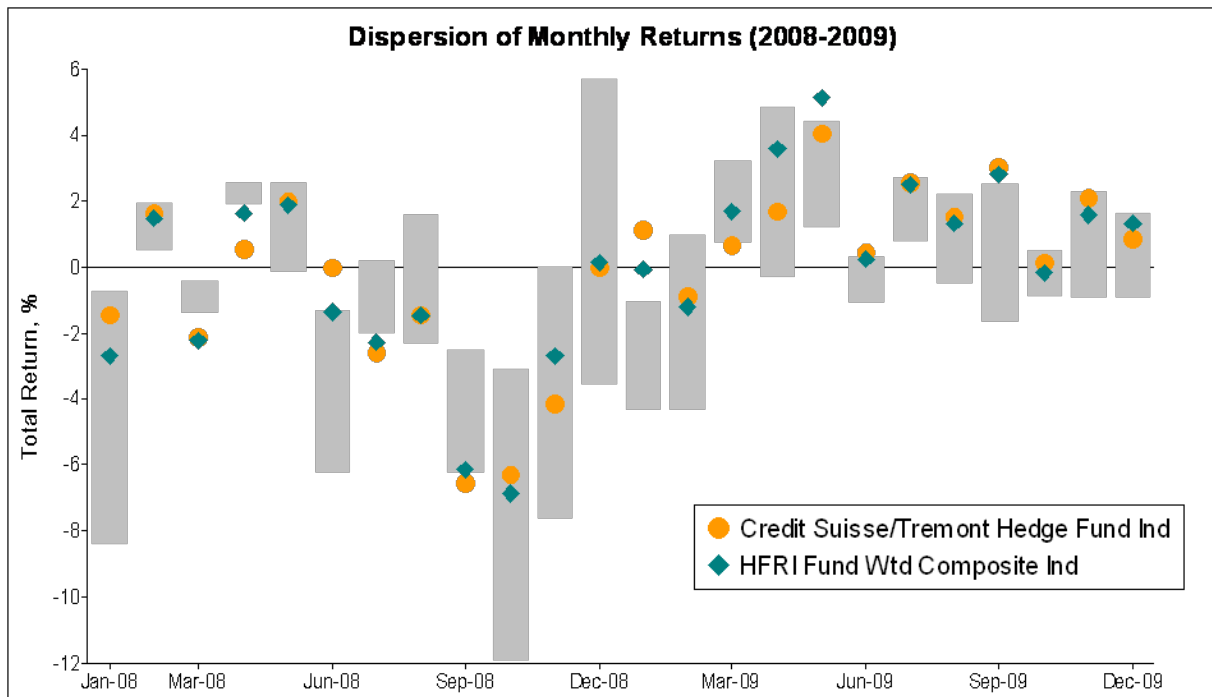
Hedge Fund Replication Forum
EDHEC-Risk Alternative Investment Days
February 8, 2010
London

- **Replication products performance review**
- **Sources of tracking error**
- **Factor models**
- **Where and why precision is crucial:
Applications and case studies**
- **Summary**

- **Performance tracking**
 - Methods: Factor models; market factors
 - Intend to match systematic risk exposures
 - Intend to deliver close index tracking
- **Synthetic generic strategies**
 - Rule-based
 - Not intended to track an index
- **Payout distribution replication**
 - Focus on shape of distribution
 - Not intended to track an index

Replicator Performance Overview 2008-09

- Wide dispersion of monthly results*
- Little consistency
- What are the measures of success?



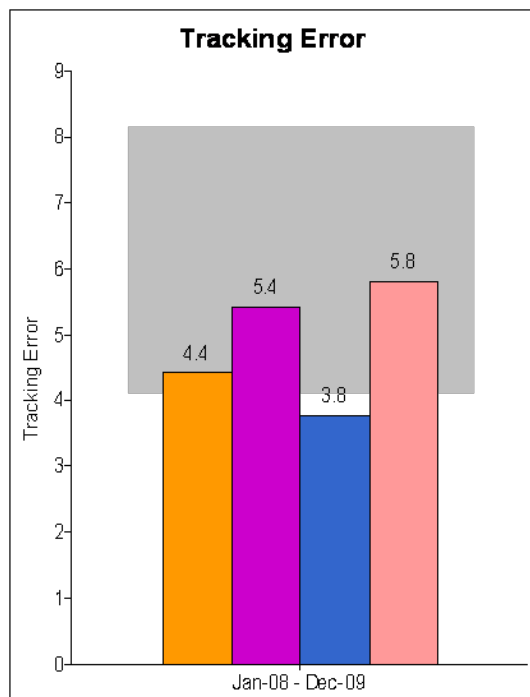
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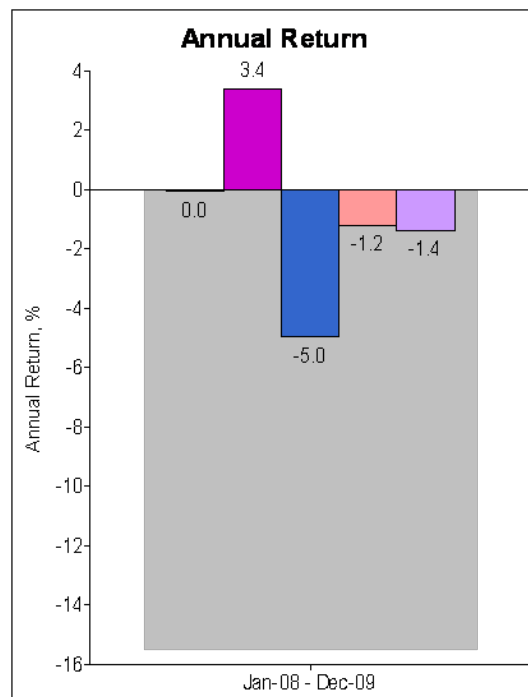
* Based on 9 investment products with a tracking mandate. Contains both index (gross) and actual product (net fees) data. Contains both actual and backtested data. Products may have different tracking benchmarks.

Replicator Performance Overview 2008-09

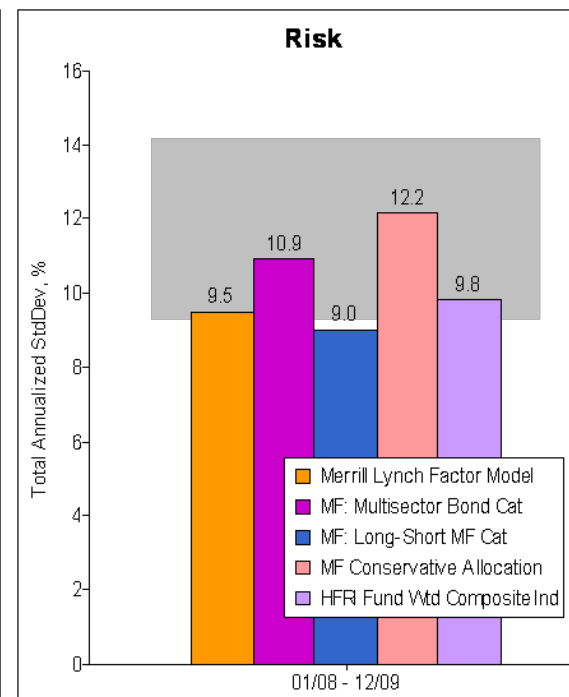
- Good results, bad results?
- Average Bond and Long/Short mutual funds* offer better results... without attempting to replicate



Created with mpi Stylist (Data: Morningstar)



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* Using Morningstar US mutual fund category averages. Tracking error is computed vs. HFR1 Fund Wtd Composite Index

Key measures of success

- Information Ratio (IR) or t-stat if aim to outperform
- Tracking Error (TE), R^2 if aim to track, RMSE if aim to replicate
- The rest of measures are secondary (abs return, SR, etc.)
- Why both replicators and academics avoid displaying TE?

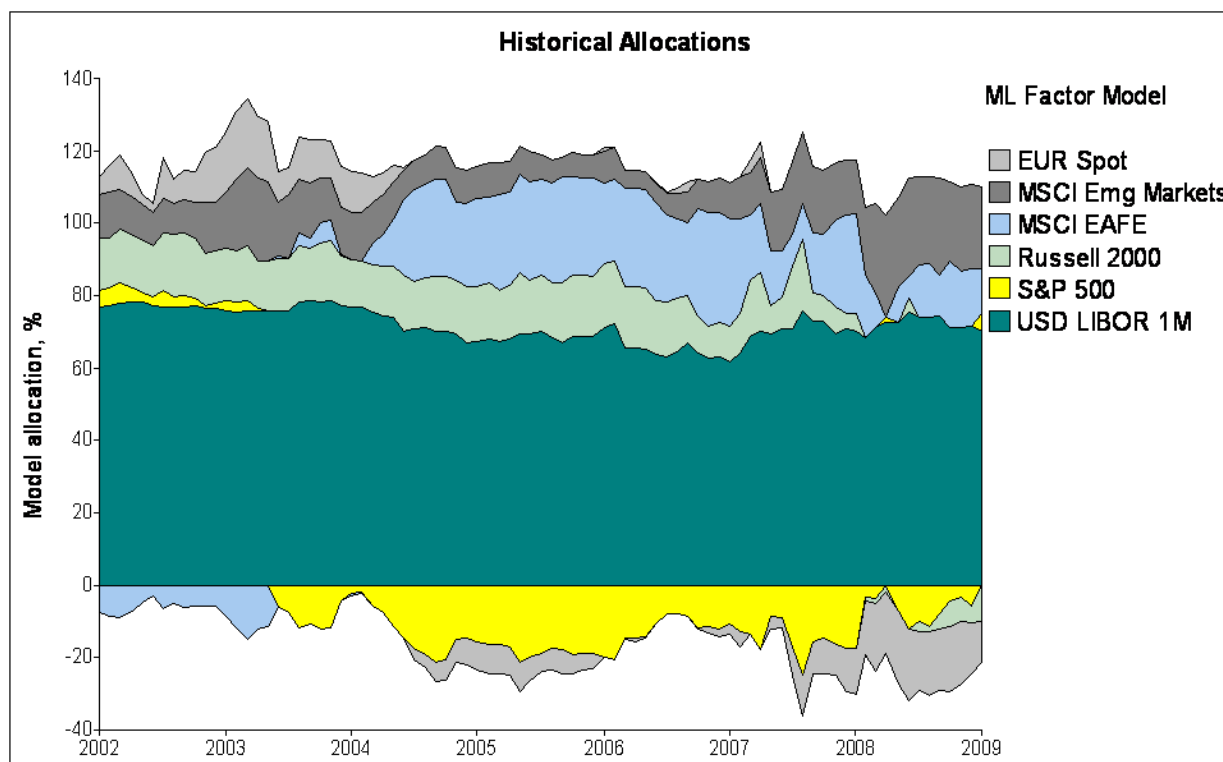
Main sources of Tracking Error

- Estimation model
- Factors (either missing or wrong factors)
- Lagged data (“rear-view” plus reporting lag)
- Monthly data (vs. weekly or daily)
- Trading inefficiency
- Target (choice of benchmark)

TE Source: Estimation Model

Typical methodologies

- “Black Box”
- Static “rolling” regressions (like the one below)



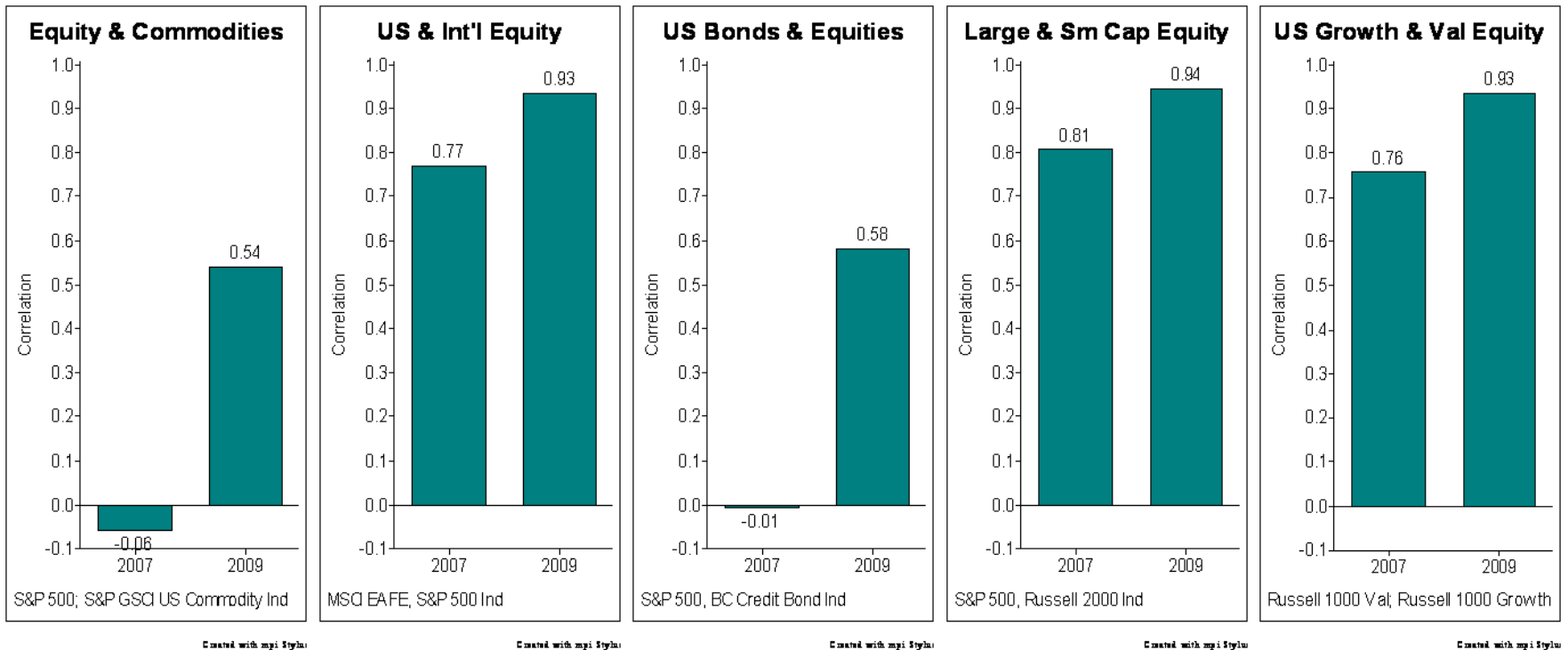
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MERRILL LYNCH HFRI REPLICATION FACTOR MODEL. SOURCE: <http://gmi.ml.com/factormodel/>
(EUR weights negated for consistency)

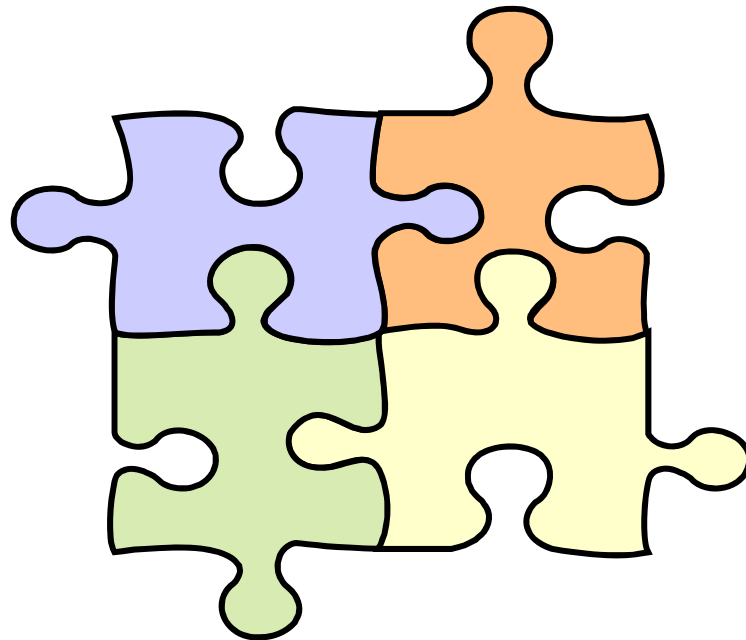
Factor issues

- Factor sets: from equity to fixed-income dominant
- Non-diversified set of factors magnifies L/S bets
- Why equity-only factors worked so far for some?

Factor Correlations: 2 years ending in 2007 and 2009



Factor Models



Not All Factor Models Are the Same

Static regression model limitations

- Unable to detect rapid changes in allocations
- Very sensitive to data errors
- Not applicable to funds with limited history 12m or less
- *Spurious correlations* effect: unstable/unrelated exposures

Nonlinear models and factors

- Difficult to interpret, justify and invest
- Require yet more data

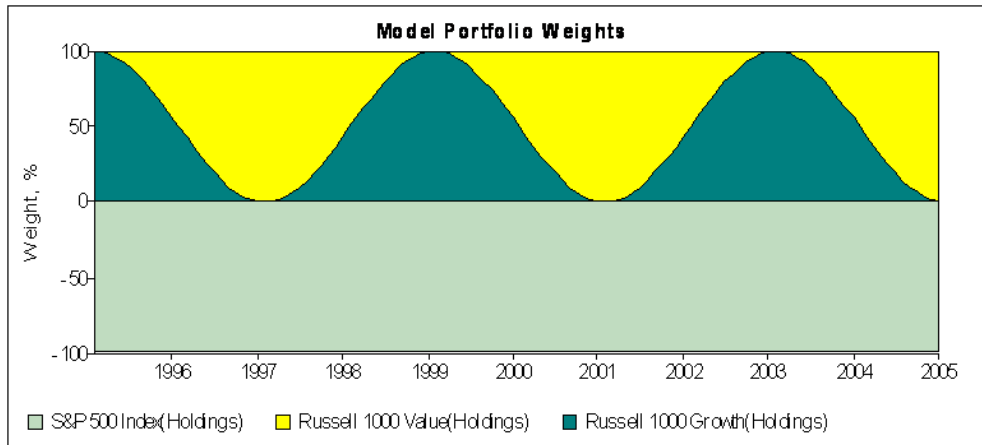
Dynamic models

- True dynamic analysis: no rolling window gimmick
- Allows for more factors
- Kalman filter limitations

Advanced dynamic models

- No normality assumption
- Adaptive calibration: automatically selects parameters and factors
- Cross-validation prevents overfitting
- Applicable to funds with very short histories

Model Hedge Fund



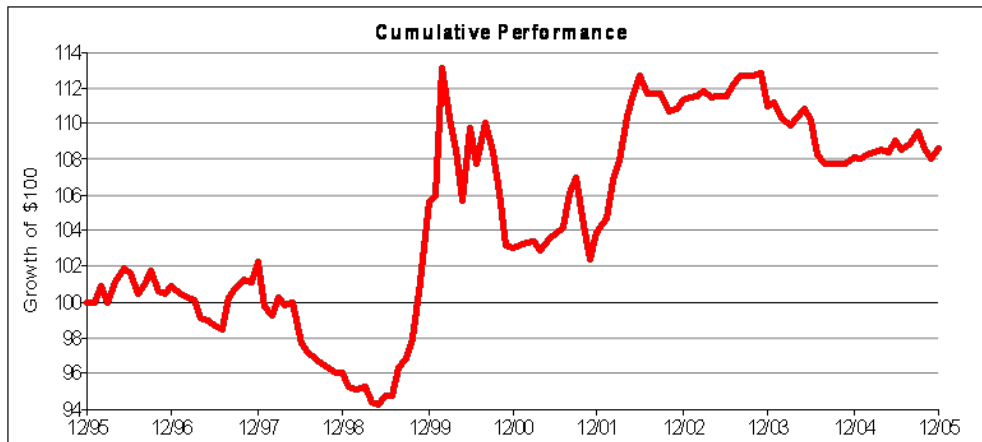
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Hypothetical style rotation strategy

- Long R1000 Value (yellow)
- Long R1000 Growth (teal)
- Short S&P 500 Index

Compute composite returns
(no noise and no model
error)

Analyze the fund using the
same three indices and
rolling window regressions



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Source: Markov, M., Muchnik, I., Krasotkina, O., and V. Mottl. "Dynamic Analysis of Hedge Funds." *The 3th IASTED International Conference on Financial Engineering and Applications*. October 2006, Cambridge, USA

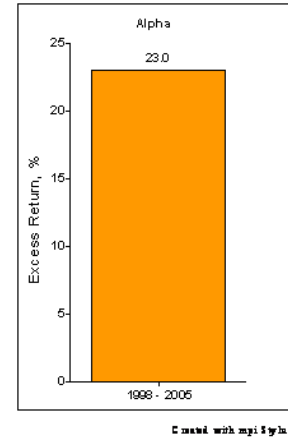
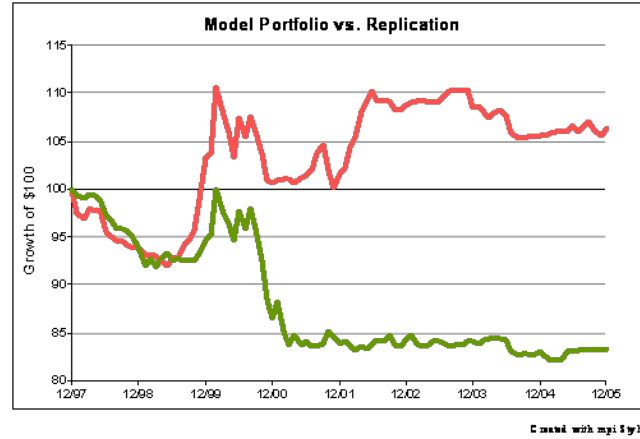
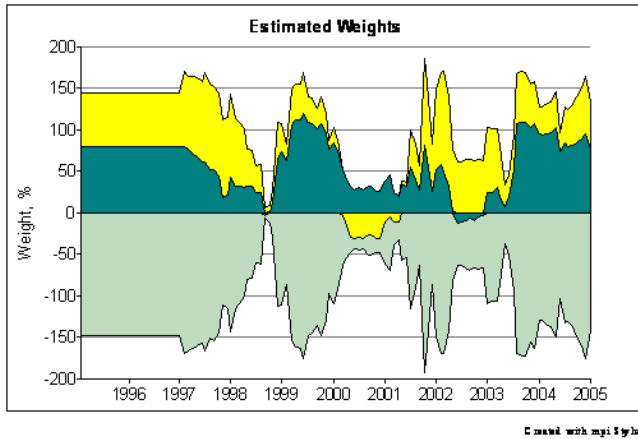
Model Hedge Fund In-Sample Analysis

Estimated exposures

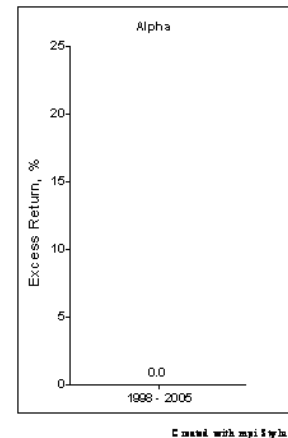
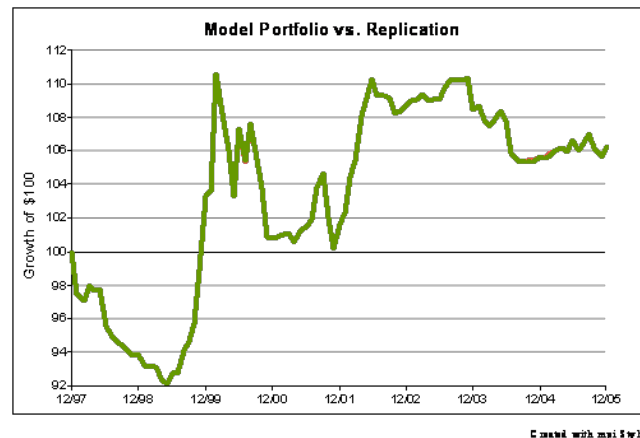
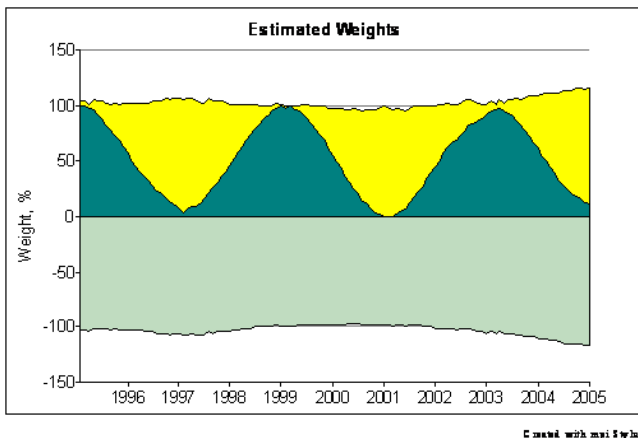
Performance Tracking

Alpha Estimate

Rolling Regressions: 24-month window



Dynamic Style Analysis (DSA)



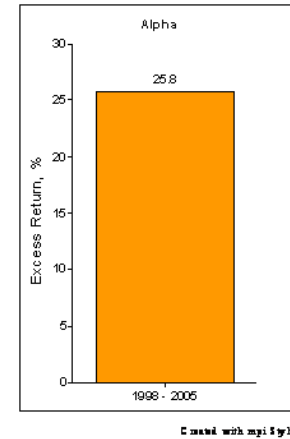
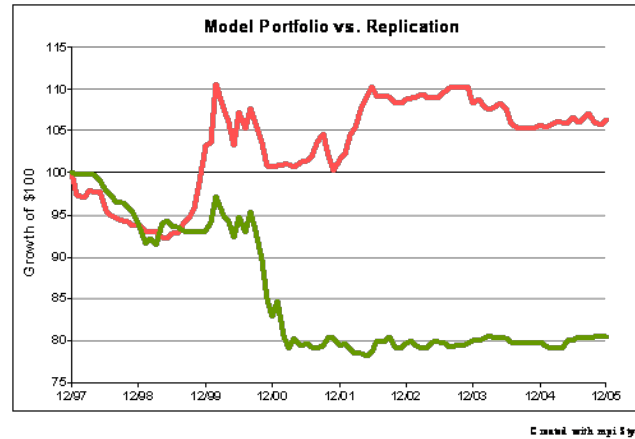
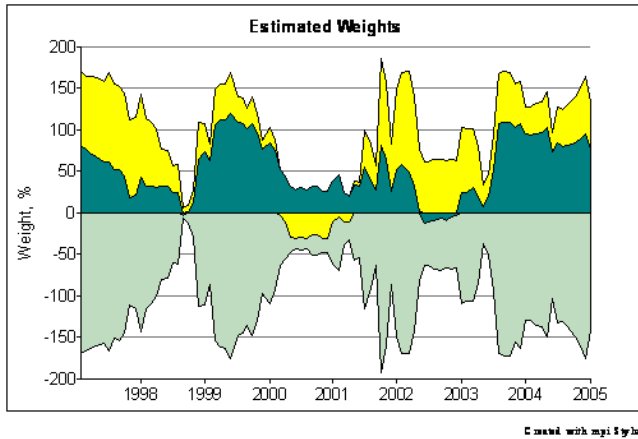
Model Hedge Fund Replication

Estimated exposures

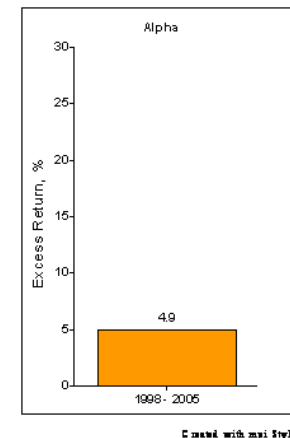
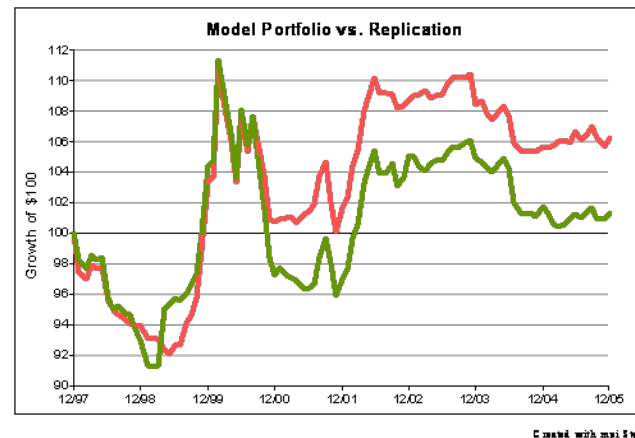
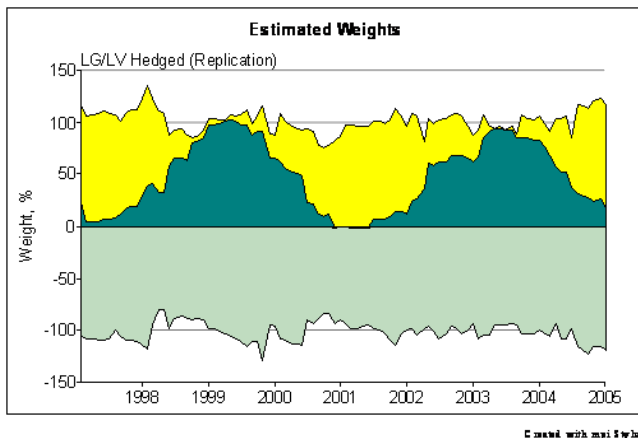
OOS Performance Tracking

Alpha Estimate








Rolling Regressions: 24-month window



Dynamic Style Analysis (DSA)



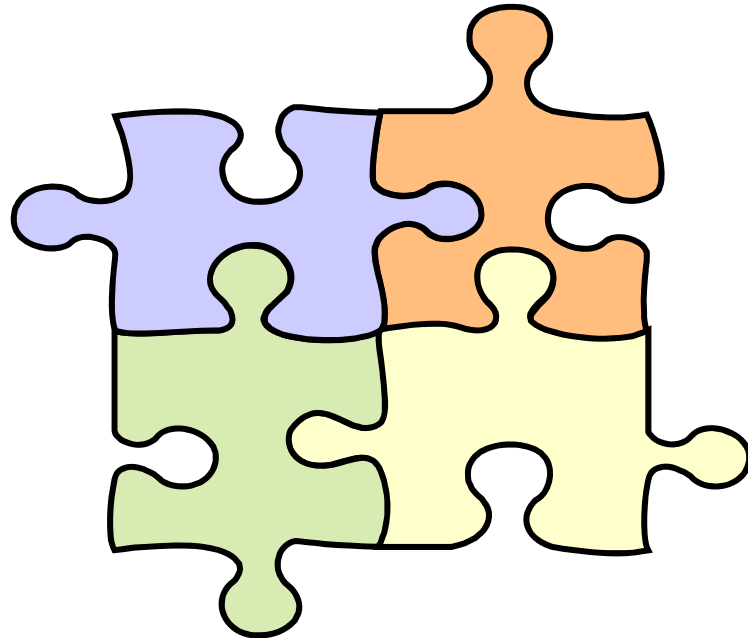
Applications of Replication Techniques

	Rule-Based	Tracking (Factor)	Payout Replication
Product development			
Benchmarking Perf. measurement			
Due diligence, monitoring, surveillance			
Risk management			

Applications of Replication Techniques

	Scope	Precision requirements
Product development	Limited	Low
Benchmarking Perf. Measurement	Broad	Medium
Due diligence, monitoring, surveillance	Broad	High
Risk management	Broad	High

Application to Hedge Fund Risk Management



HF investors' allocation and risk management decision barriers

- Little transparency
- Performance numbers reported monthly
- Liquidity provisions further delay response

HF investors receive less information yet have greater need to understand risks

- Leverage, derivatives, exotic strategies
- Potential headline risks

Knowing daily/weekly HF performance could allow investors

- Plan redemptions/contributions in a timely manner
- Activate hedging strategies
- Get piece of mind (during market stress)

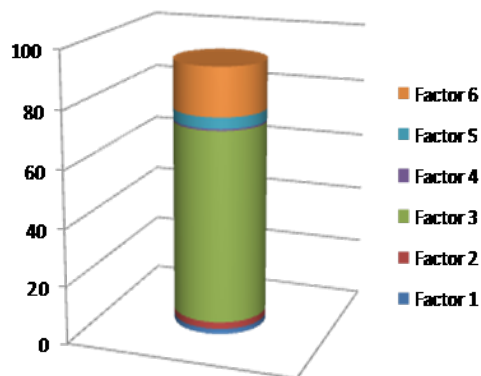
Source: Li, D., Markov, M., Wermers, R., "Monitoring Daily Hedge Fund Performance When Only Monthly Data is Available."
Working paper, Available at SSRN: <http://ssrn.com/abstract=1362265>, November 2009

Daily Monitoring Hedge Funds Using Monthly Data

Monthly:

- Estimate the most current factor weights using monthly data

Step 1 | Monthly Analysis

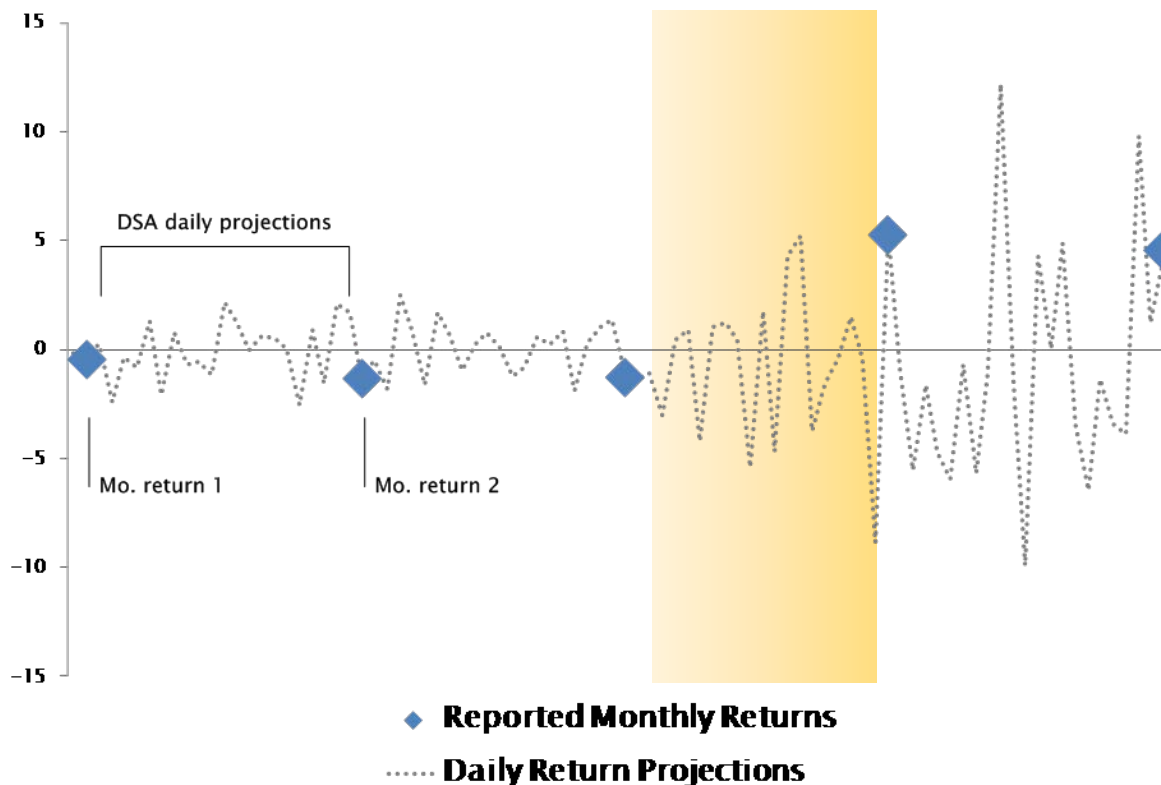


- Obtain latest fund NAVs
- Select market factors with daily prices and liquidity
- Perform dynamic analysis on selected factors using monthly data

Daily:

- Use factor weights and daily close (or intra-day) factor values to estimate daily NAVs, returns and VaR for each day during month data

Step 2 | Daily Projections



How we tested it

- Data: daily HF NAVs (HFRX, L/S Mutual Funds)
- Models: static OLS (window), dynamic (DSA)
- Factors: generic style/sector/bond/cash/EAFE, F-F(4)/EAFE
- Estimation: use monthly HF data to project daily HF returns
- Testing: actual daily returns compared with projected; focus on TE

Table 1. Daily Projections for HFRX EH (2007-2008)

	Estimation Model	36 Month RBSA 6-index		DSA 6-index		Fama-French-Carhart		Fama-French-Carhart & EAFE	
		1M	2M	1M	2M	1M	2M	1M	2M
2007	Daily TE (bps)	28	27	24	28	41	56	40	45
	Daily Corr.	0.85	0.83	0.90	0.85	0.84	0.80	0.88	0.80
2008	Daily TE (bps)	45	47	33	41	103	127	61	76
	Daily Corr.	0.84	0.83	0.87	0.88	0.83	0.70	0.83	0.84

Source: Li, D., Markov, M., Wermers, R., “Monitoring Daily Hedge Fund Performance When Only Monthly Data is Available.” Working paper, Available at SSRN: <http://ssrn.com/abstract=1362265>, April 2009

Testing Accuracy of Daily Projections

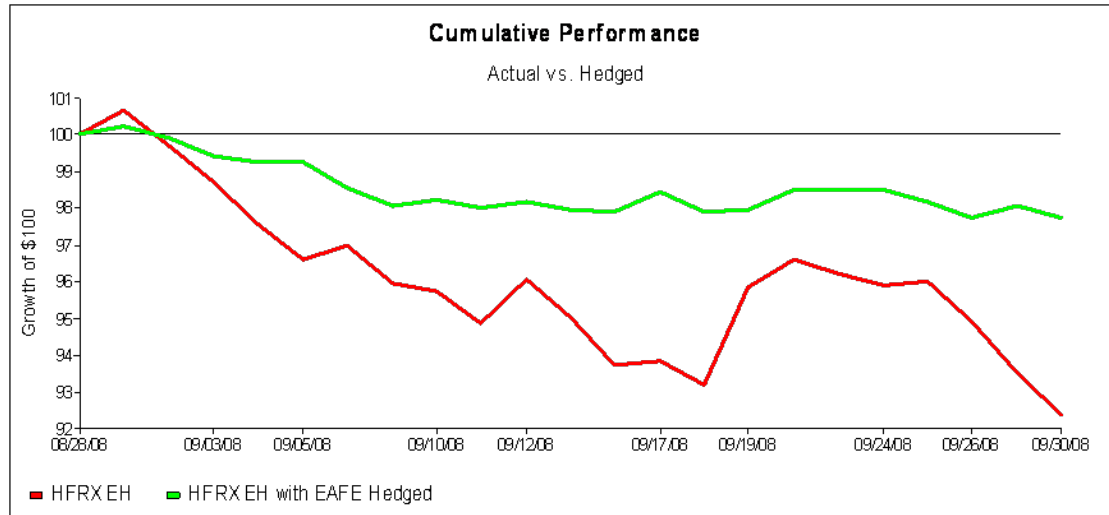
Table 2. Daily Projections for L/S Mutual Funds (2007-2008)

Fund	Year 2007							Year 2008							
	Daily			Weekly				Daily			Weekly				
	TE,%	Corr.	Benchmark TE,%	TE,%	Corr.	Benchmark TE,%	Annual Turnover	Fund	TE,%	Corr.	Benchmark TE,%	TE,%	Corr.	Benchmark TE,%	Annual Turnover
1	0.49	0.71	0.38	1.05	0.56	0.70	262	1	0.50	0.65	0.50	1.66	0.77	0.98	242
2	0.24	0.92	0.09	0.38	0.93	0.34	1697	2	0.49	0.99	0.23	0.21	0.98	0.52	1248
3	0.28	0.68	0.14	0.32	0.76	0.40	172	3	1.02	0.65	0.46	1.07	0.85	0.74	71
4	0.41	0.94	0.31	0.81	0.91	0.57	33	4	1.34	0.89	0.41	1.26	0.95	0.66	38
5	0.70	0.08	0.37	0.54	0.56	0.65	529	5	0.88	0.20	0.31	2.07	0.36	0.56	712
6	0.11	0.76	0.12	0.15	0.75	0.40	89	6	0.25	0.72	0.13	0.89	0.89	0.51	
7	0.31	0.79	0.26	0.31	0.87	0.51	191	7	0.63	0.79	0.41	0.90	0.83	0.61	
8	0.05	0.85	0.16	0.12	0.90	0.40	40	8	0.46	0.99	0.27	0.70	0.92	0.56	44
9	0.17	0.55	0.08	0.05	0.75	0.35	609	9	0.37	0.52	0.17	0.30	0.69	0.46	574
10	0.23	0.87	0.18	0.18	0.87	0.45	94	10	0.72	0.90	0.37	0.78	0.94	0.74	86
11	0.29	0.99	0.24	0.29	0.81	0.46		11	0.60	0.85	0.35	1.26	0.87	0.61	
12	0.27	0.92	0.22	0.49	0.64	0.43	93	12	0.79	0.84	0.37	2.40	0.84	0.68	124
13	0.40	0.76	0.21	0.75	0.66	0.49	72	13	0.72	0.79	0.23	0.52	0.86	0.44	138
14	0.34	0.92	0.11	0.36	0.92	0.39	105	14	0.61	0.96	0.23	1.17	0.95	0.48	175
15	0.24	0.89	0.17	0.31	0.69	0.43	59	15	0.93	0.79	0.29	0.99	0.94	0.68	59
16	0.36	0.77	0.30	0.90	0.85	0.59	178	16	1.24	0.86	0.79	2.56	0.80	1.09	220
17	1.03	0.22	0.36	1.20	0.11	0.62	2110	17	3.06	0.14	1.09	6.05	-0.06	1.54	2121
mean	0.35	0.74	0.22	0.48	0.74	0.48	396	mean	0.86	0.74	0.39	1.46	0.79	0.70	418
median	0.29	0.79	0.21	0.36	0.76	0.45	139	median	0.72	0.79	0.35	1.07	0.86	0.61	157
EW Port.	0.15	0.95	0.09	0.24	0.95	0.27		EW Port.	0.27	0.96	0.19	0.49	0.94	0.43	

Observations

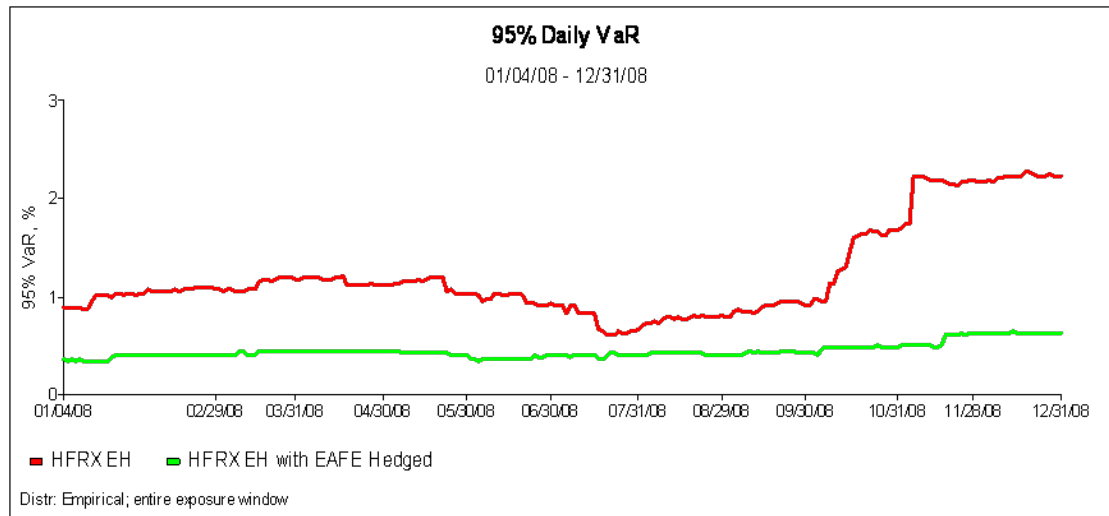
- High turnover doesn't necessarily mean high TE (funds #2,9)
- About 50% of daily TE is attributed to using monthly data for estimation vs. daily ("Benchmark TE")
- Weekly aggregation improves tracking, daily discrepancies cancel out
- EW portfolio of all funds has 15/27bp daily TE due to diversification; many FoF can be monitored

Hedging



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Estimating Daily VaR



Created with mpi Stylis

Proposed framework

- Outlines important steps in estimation of daily HF “proxies”
- Outlines steps in testing accuracy, sets benchmarks
- Provides tools to accurately attribute replication results

Applications of replication techniques

- Go far beyond a handful of tracker products
- Provide decision support to risk managers in limited transparency environment
- Enable timely investment decisions by investors

At the same time, “a must” framework for any product replicator

- Provides more data for model testing
- Provides more data to identify hidden factors
- Provides more data for identifying trading issues and risk analysis

Precision is crucial in Risk Management applications

Hedge Fund Due Diligence Framework

Forensic analysis of hedge fund returns

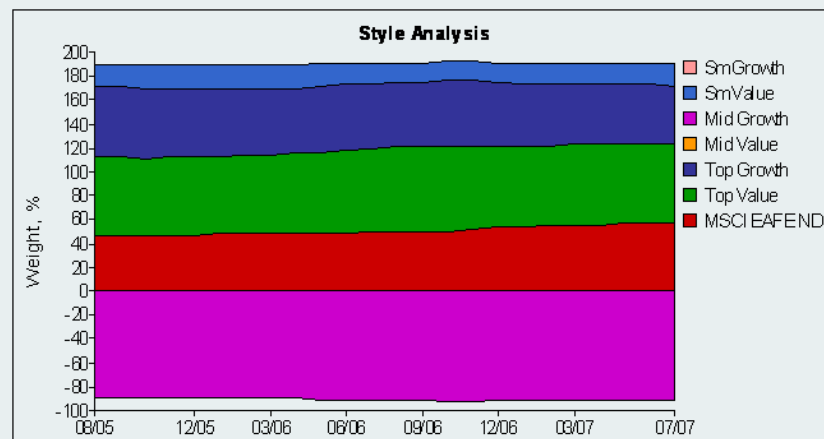
- Reconcile performance with strategy
- Identify performance drivers
- Assess level of leverage
- Identify major timing decisions
- Understand skill: Alt Beta vs. Alpha
- Analyze outliers
- Detect red flags

Decisions

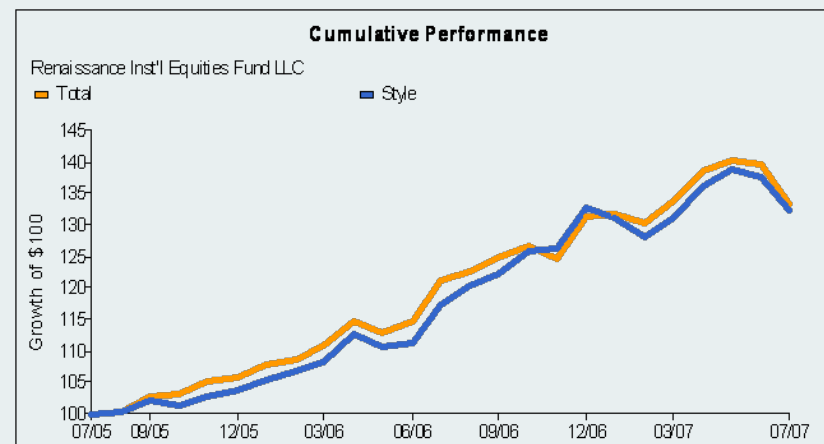
- Returns are “for real”?
- Worth the fees?
- Worth the risk?

Precision is crucial in Due Diligence

Renaissance RIEF Fund



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Industry's focus is on replicating hedge fund indexes

- Pro:
 - Easy: diversification makes it easier to replicate
 - Cheap: fund due diligence is not required
 - Safe: move with the crowd
- Con:
 - Replicating *average* hedge fund performance is not the best
 - Index is over-diversified; most funds you don't want to replicate
- Issues:
 - High dispersion, unacceptable TE

Alternative approach

- Replicate investment *ideas*
- Replicate *selected funds* or a target groups of funds
- Requires precision techniques

- Replication products continue to have significant dispersion of performance results
- Inadequate models and factors could lead to even wider dispersion if market factors start diverging
- However, proper estimation and calibration tools could greatly improve replicator product performance
- Advanced dynamic analysis techniques have an edge over traditional approaches and could lead to new applications
- Therefore, applications of replication techniques go beyond investment product creation
- However, applications to risk management and due diligence of hedge funds require better precision



Thank You

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- **Jordan Drachman**, *Director and Head of Research, Alternative Beta Strategies Group, Credit Suisse*
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