Mathematica

Capital Management, LLC

Bio

Bio

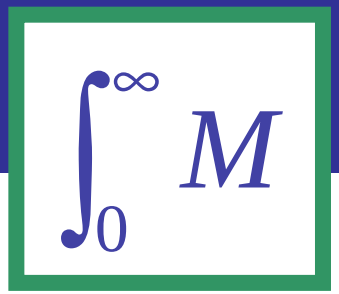
Shahram Tajback, CFA - Founder and Managing Director of Mathematica Capital Management, LLC., which was formed in April of 2002.

Prior to founding Mathematica Capital Management, Mr. Tajback was a Portfolio Manager for Zurich Scudder Investments, from 1996 to 2002. During his career with Zurich Scudder, he was the Lead Portfolio Manager of the following funds: Scudder Swiss Equity Fund, IG Scudder Canadian All Cap Fund, Scudder Canadian Equity Fund, Scudder Canadian Small Company Fund, Kemper Quantitative Equity Fund, Scudder International Value Fund and the Scudder Pathway Series of Funds. Before leaving the firm, he was managing over $1.40 billion in assets.

Before joining Zurich Scudder, Mr. Tajback worked at BARRA and Reuters, building data, return and risk models, from 1992 to 1996.

Mr. Tajback worked as a Principal for Unilog Consulting from 1984 through 1990, where he analysed European financial companies.

Mr. Tajback holds a Ph.D. in Engineering and Numerical Methods from the Ecole Nationale des Ponts et Chaussees, Paris, France. He received an MBA from the Haas School of Business at the University of California, Berkeley, with a focus on finance. Mr. Tajback is a Charted Financial Analyst. He also holds NASD series 7 and 63.



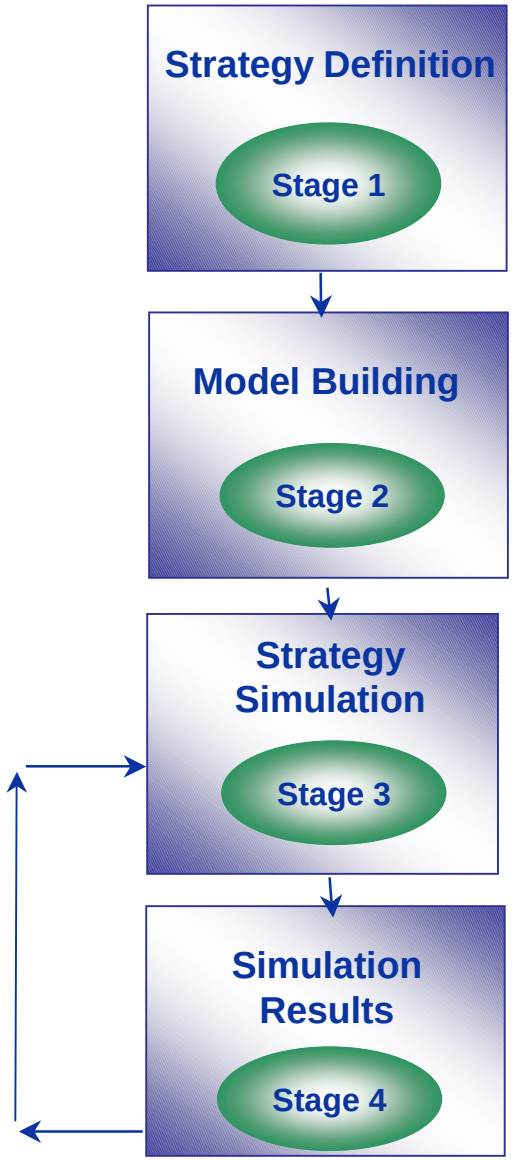
Simulation Tempering Optimism:
Calibrating Forecast Tracking Error (TE)

Presentation By Shahram Tajback, Ph.D., CFA

Northfield Information Services Conference

May 5 - 7, 2002

Investment Strategy - Process Overview



- Evaluate range of possible bets to generate sustainable alpha strategy
- Construct an alpha model using select variables.
- Conduct alpha model simulations in an optimal portfolio construction framework (Northfield).
- Resulting forecast (ex-ante) TE vs. realized TE is fine-tuned to achieve desired level of realized TE.

Stage1- Strategy Definition: Where Can We Get The Alpha?

- A return model

$$\tilde{r}_p(t) = X \bullet \tilde{f}(t) + \tilde{u}_p(t)$$

Where:

$\tilde{r}_p$ = **Excess return portfolio P**

X = **Exposure Matrix**

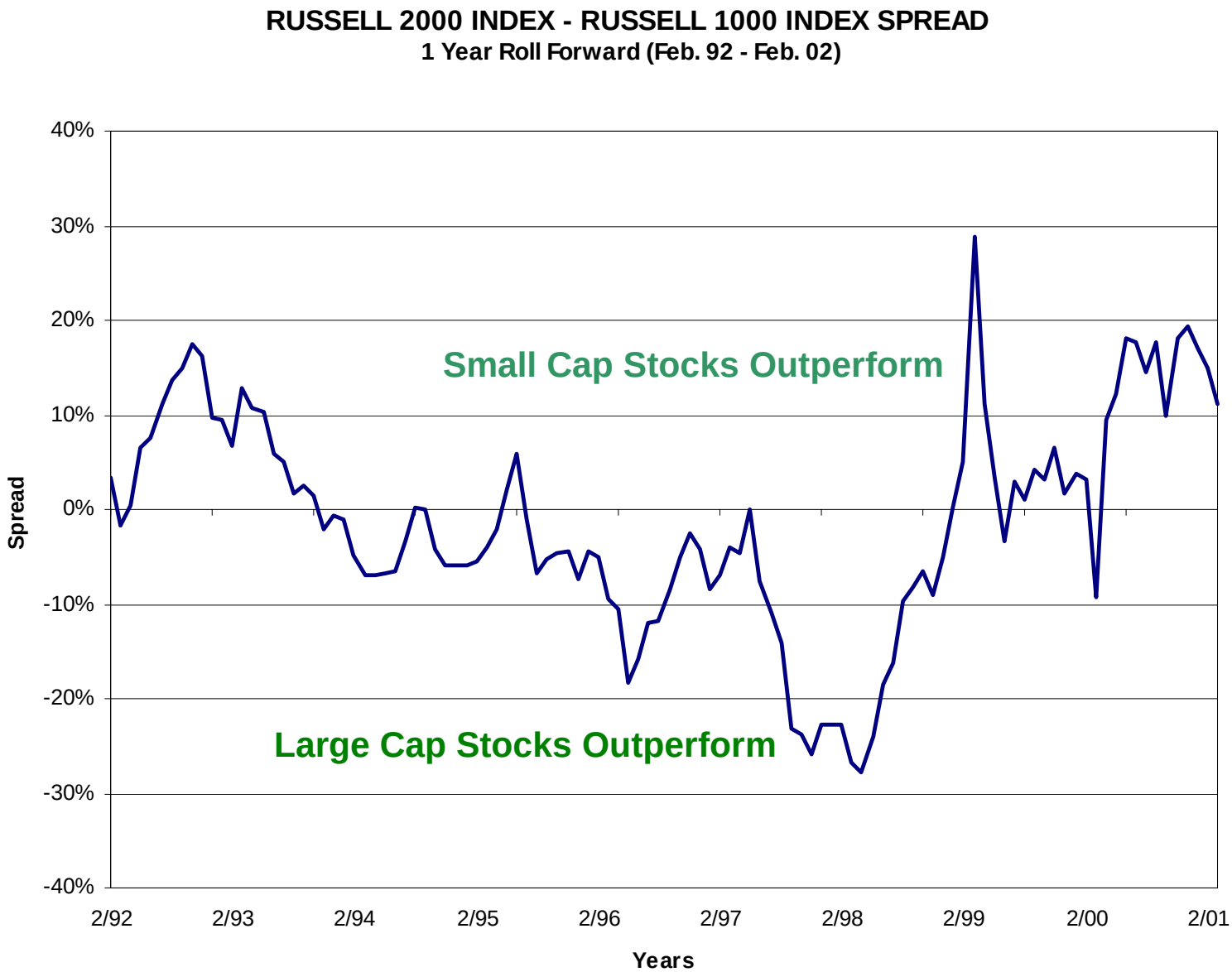
$\tilde{f}$ = **Factor return**

$\tilde{u}_p(t)$ = **Residual returns portfolio P**

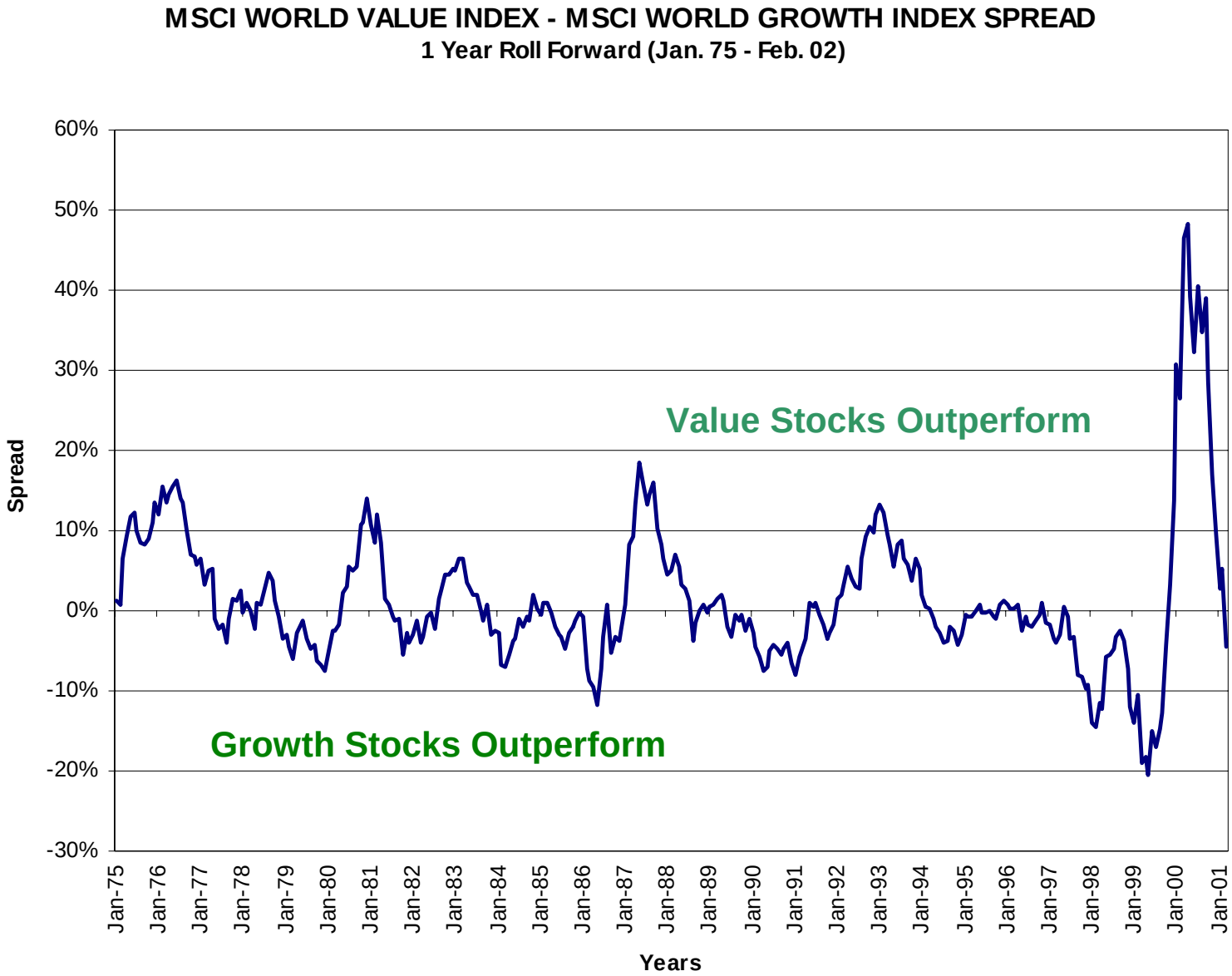
$= \alpha_p + \varepsilon_p(t)$

- By definition, residual returns are uncorrelated with the factors (they are random).

Strategy Definition:
Examining Factor Bets – US Small Cap vs. Large Cap



Strategy Definition:
Examining Global Factor Bets – MSCI Value vs. Growth



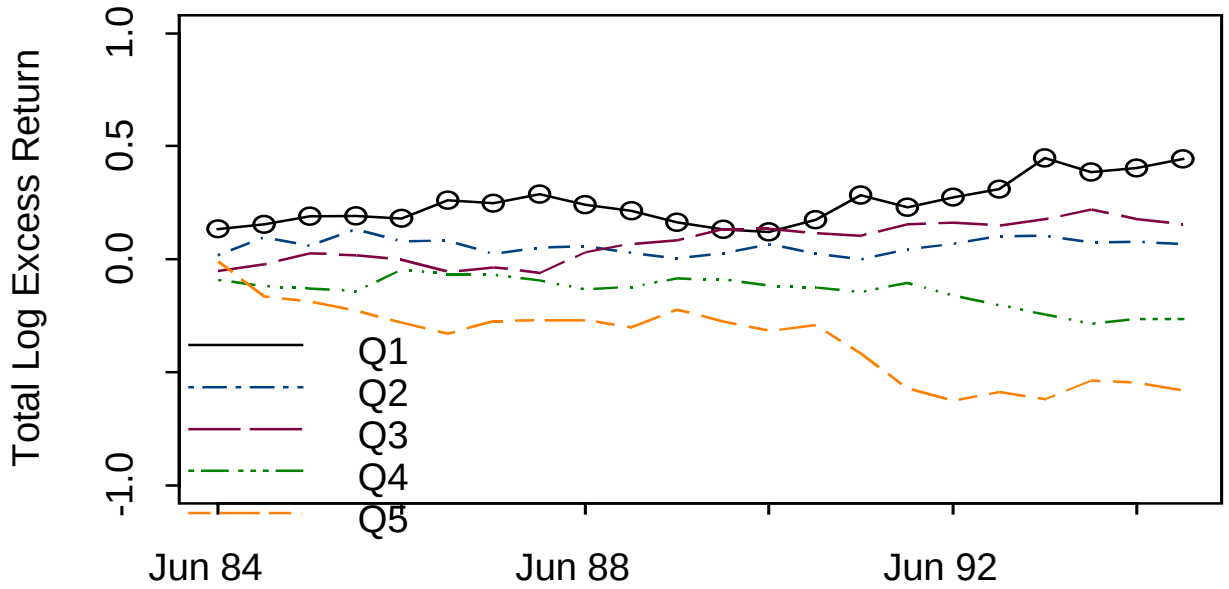
Strategy Definition:
Strategy Selection For Building The Model

- Factor bets could be great, but can be painful if the timing is wrong.
- By definition, stock specifics are un-correlated. Therefore, by making only stock specific bets, the duration or period of pain or gain should be relatively short.
- Conclusion ➔ *No factor bets built into final portfolio*. Only stock specific bets.
- Investment universe: US large cap market (MSCI US).

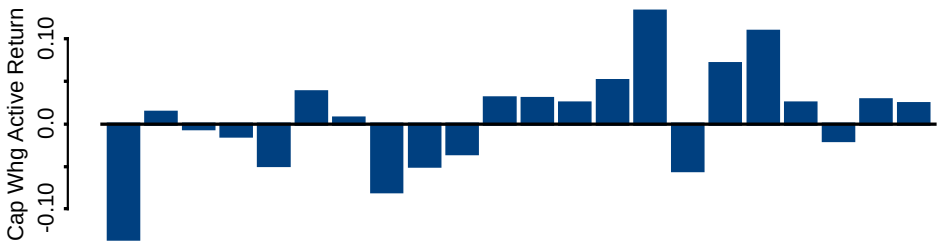
Stage 2- Model Building: Variable Selection Criteria For The Alpha Model

- To avoid data mining, the historical period is divided into two sub-periods: in-sample period (1984-1994) and out-of-sample period (1995-2002).
  - Variable testing is done only in the in-sample period.
  - Out-of-sample data is held out to validate in-sample results.
- A set of 45 variables are considered such as: P/E, momentum, etc.
  - Tested variables should make economic or theoretical sense.
- Based on the value of each variable, we categorize the universe of stocks into five equally sized portfolios.
  - strong buy, buy, hold, sell, strong sell

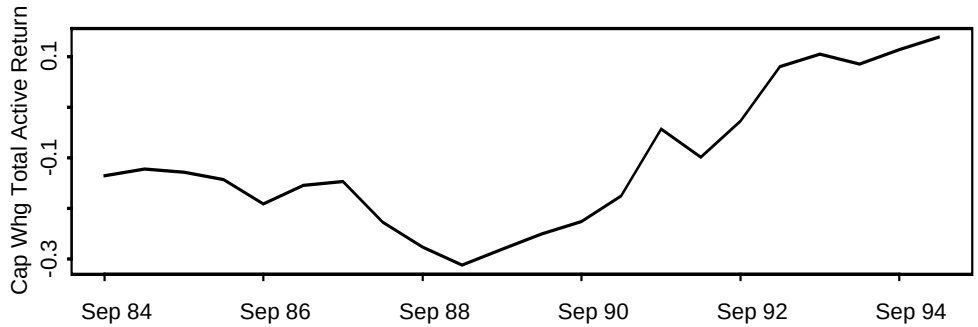
Model Building:
Variable Testing - US Market Momentum Variable



Country: US Factor Testing 1 factor: for Variable: Q.score Thu Jan 17



STD Act Ret= 8.53 % , Trimmed mean= 0.69 % , MEST= 0.62 %



Variable = Q.score , Active Cap Whg IR= 0.15 , Last 5 yr IR= 1.03

Model Building:
Neutralizing Variables To The Risk Factors

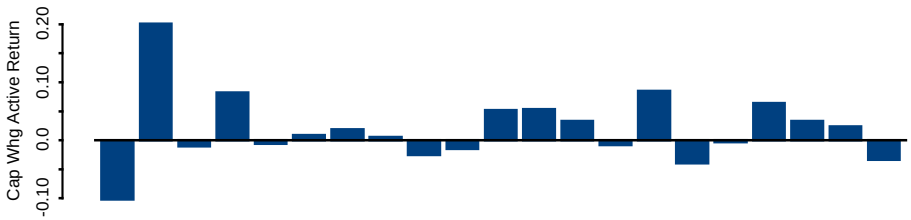
- In order to bet exclusively on the stock specific alpha, we must measure the value of each variable ex-risk factors. This is to neutralize the correlation between alpha variables and risk factors.

- We measure the neutralized value of each variable by eliminating the risk factor effect from the variables.

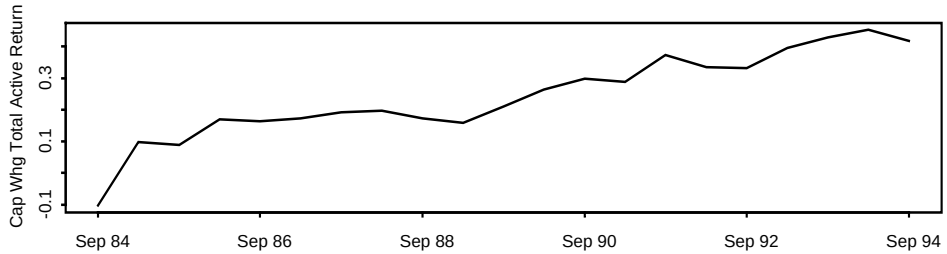
- We then select and combine the variables with the greatest value to create the alpha forecasting model.

Model Building:
Factor Analysis – Neutralizing Variables To The Risk Factors

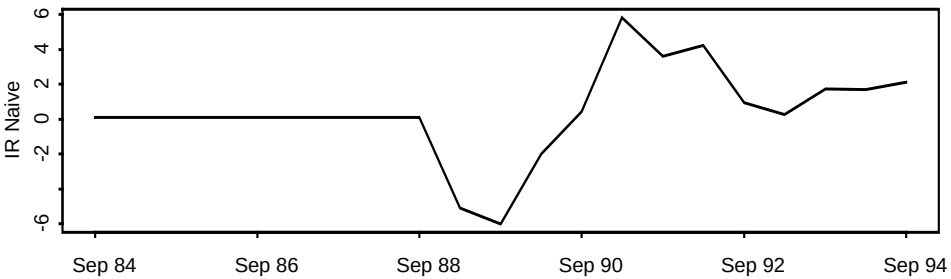
Country: US Factor Testing ir for Variable: Fyumd Thu Jan 17



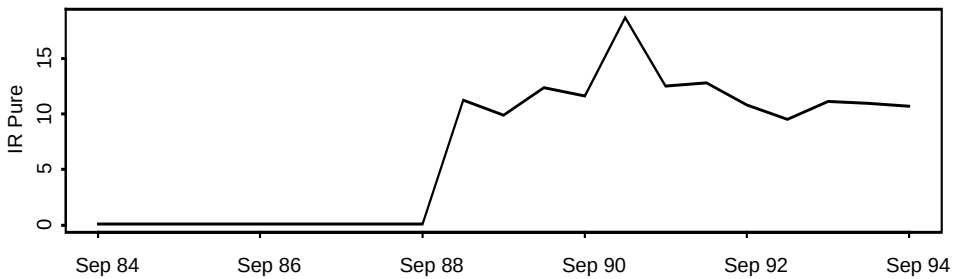
STD Act Ret= 8.54 % , Trimmed mean= 1.44 % , MEST= 1.49 %



Variable = Fyumd , Active Cap Whg IR= 0.47 , Last 5 yr IR= 0.58



STD of IR Naive = 373.51 % Average Naive IR= 0.4201 , Last IR = 2.1297

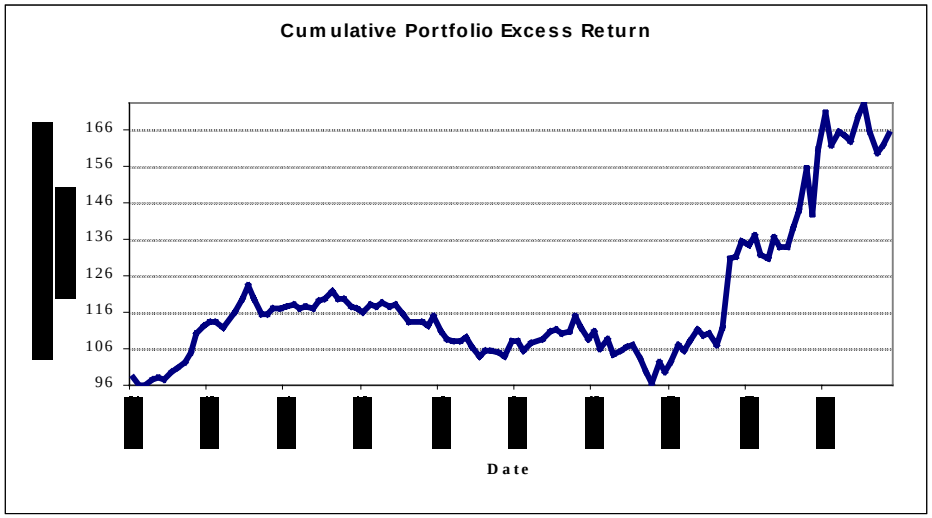


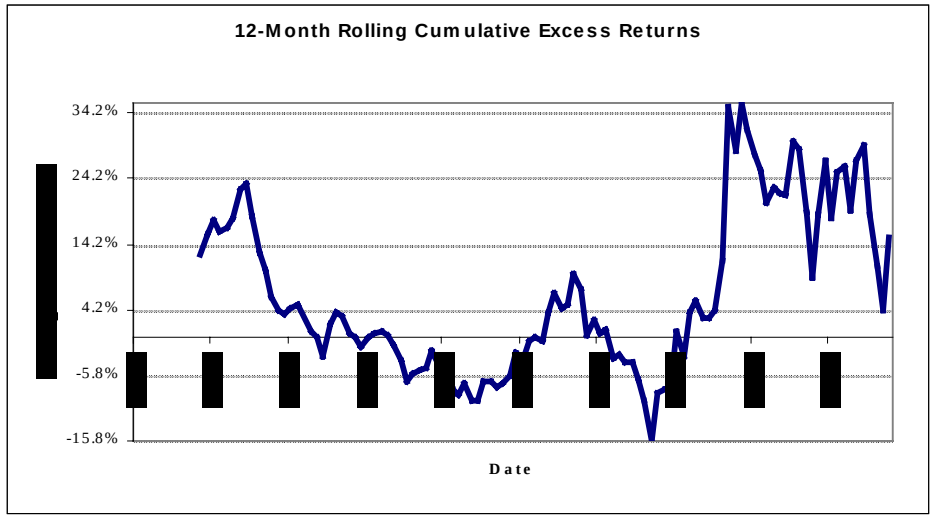
STD IR Pur= 879.66 % Avg InIR= 8.27 Last IR= 10.73 Avg Pur IR= 6.82 Last PIR= 10.72

Model Building: Model Analysis

- Selected variables are combined to create a multi-variable model to perform the following analysis:
  - Portfolio analysis to categorize the universe of stocks into five equally sized portfolios
    - strong buy, buy, hold, sell, strong sell.
  - In and out-of-sample analysis of total returns, active returns and other statistics.
  - Downside performance analysis.
  - Variable correlation, etc.

Model Building:
Performance of the Model





Annualized Avg. Active Return:	**5.6%**
Annualized Realized Active Volatility:	**11.0%**
Avg. Turnover:	31.45%
Total Return/Risk Ratio:	0.51

Stage 3- Strategy Simulation: Back To The Future …

- Using Northfield on Factset, we turn the clock backwards ten years to January 1992. Ten years younger, we start managing the portfolio using our model and constraints.
- In January 1992, we target the systematic and specific RAP to capture the desired level of TE.
- We measure the performance of the portfolio after a month, then rebalance the portfolio. Individual asset alphas are calculated monthly and included in the optimizer.
- The process is repeated monthly for the next ten years.
- Beginning January 1993, we start measuring the rolling 12 month realized TE.

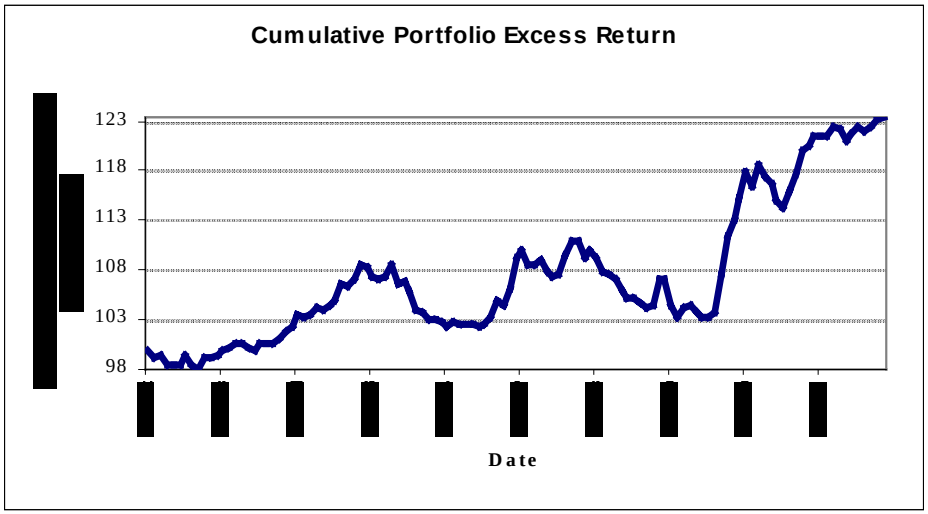
Strategy Simulation:
Portfolio Construction – Risk Parameters

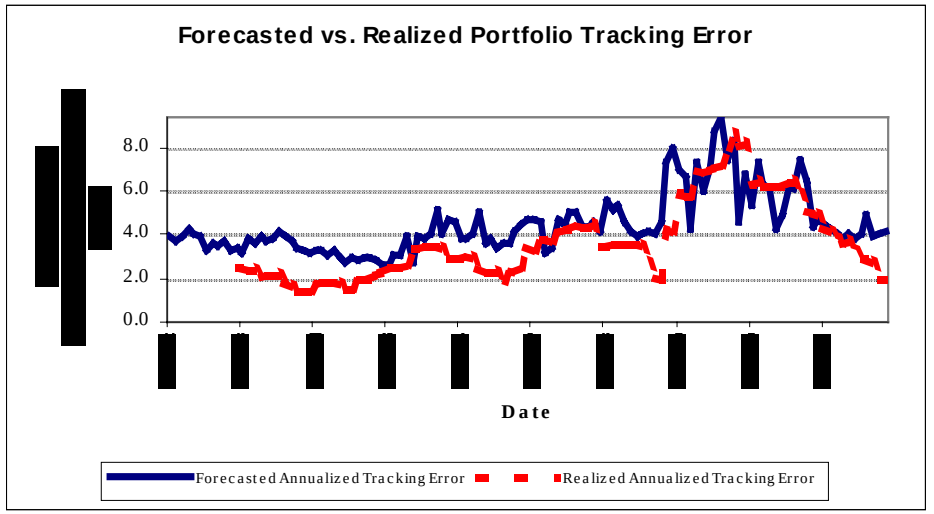
- Using Northfield on Factset, we select a set of risk aversion parameters (RAP) to get a forecast tracking error (TE) of 4.0%

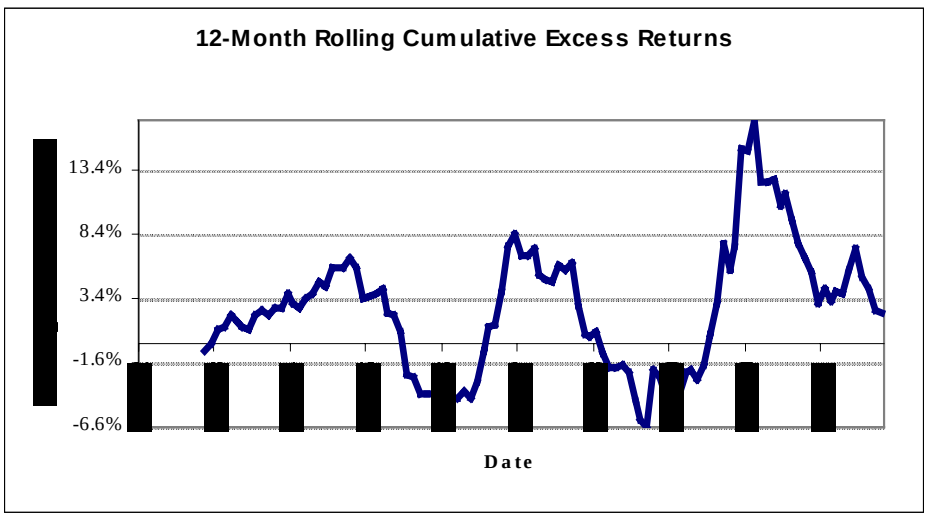
- Eliminate the majority of factor bets by selecting a low RAP for factor risk (0.3) and a higher RAP for stock specific risk (300), for example.

- Question: *What is the ex-ante return and what is the ex-ante TE?*

Stage 4- Simulation Results:
Stock Bets (Factor RAP = 0.3, Stock Specific RAP = 300)

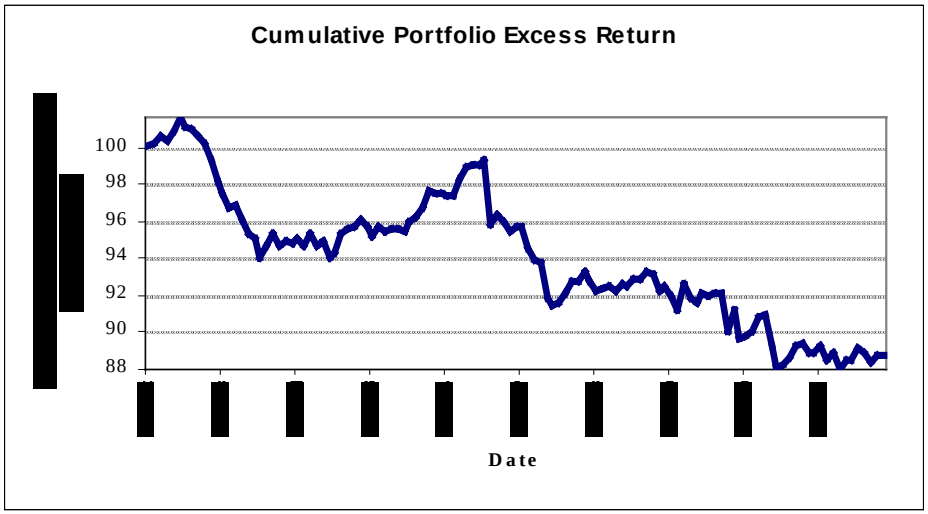


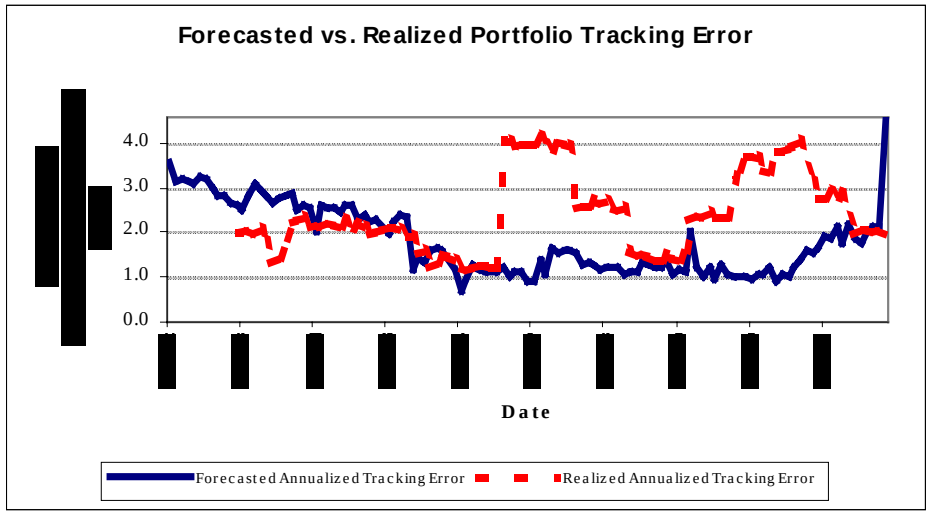


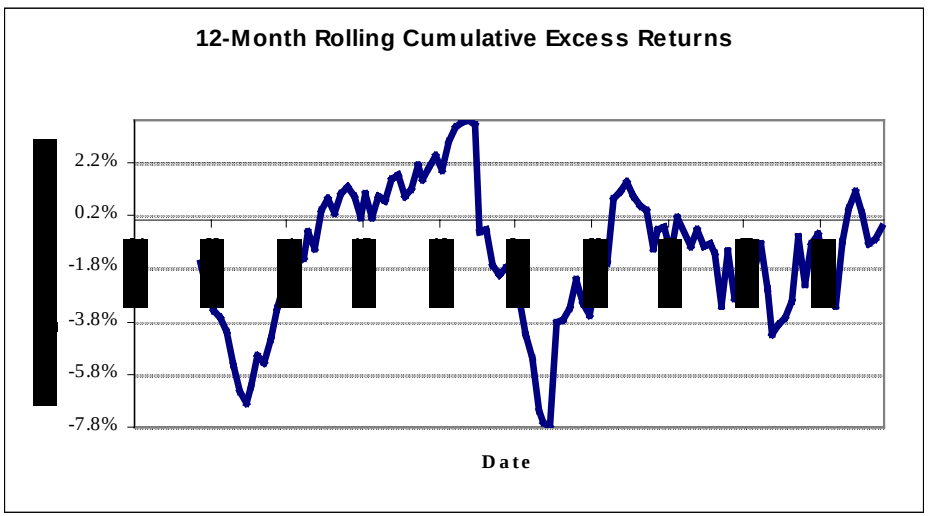


Annualized Avg. Active Return:	2.19%
Annualized Realized TE:	**4.03%**
Avg. Forecast Factor Risk:	0.17%
Avg. Forecast Stock Specific Risk:	4.43%
Avg. Forecast TE:	**4.44%**
Total Return/Risk(IR) Ratio:	0.5

Simulation Results:
Factor Bets (Factor RAP = 300, Stock Specific RAP = 0.3)

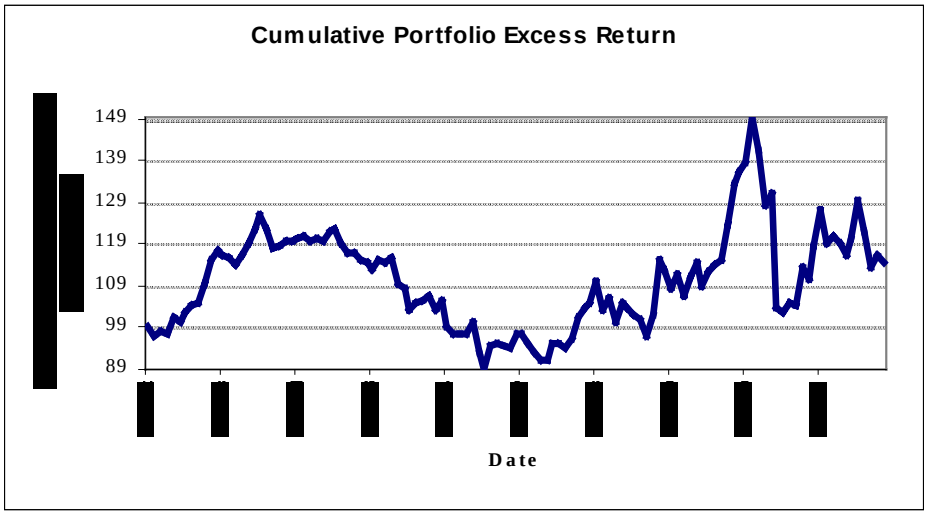


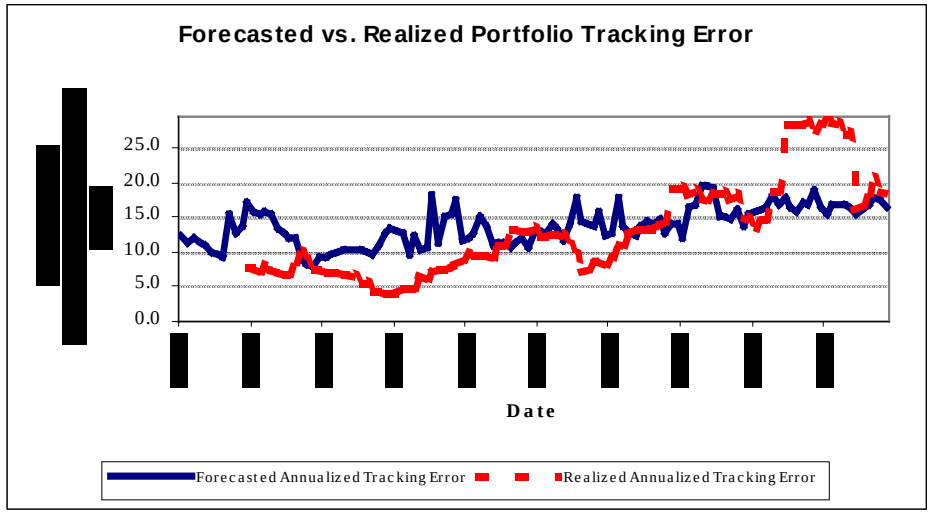


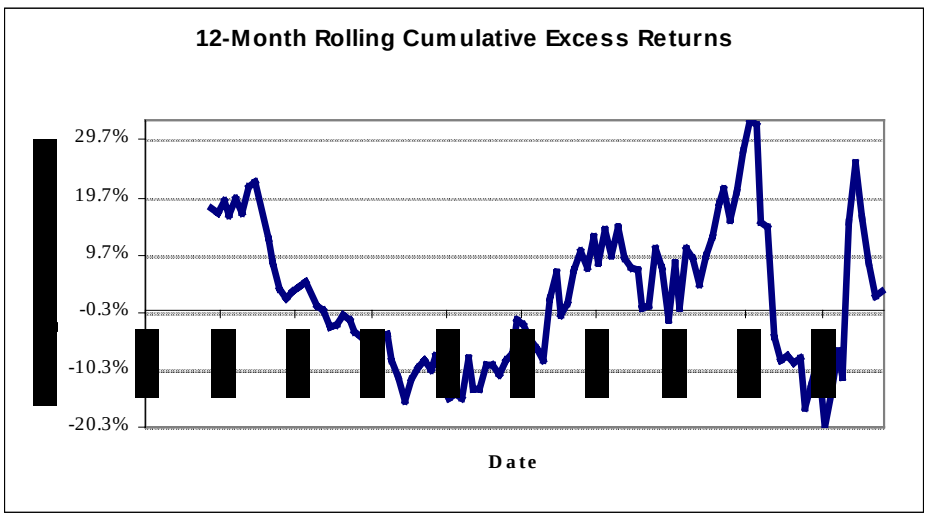


Annualized Avg. Active Return:	-1.15%
Annualized Realized TE:	**2.52%**
Avg. Forecast Factor Risk:	1.87%
Avg. Forecast Stock Specific Risk:	0.60%
Avg. Forecast TE:	**1.89%**
Total Return/Risk(IR) Ratio:	-0.6

Simulation Results:
Both Factor & Stock Specific Bets (RAP = 300/300)

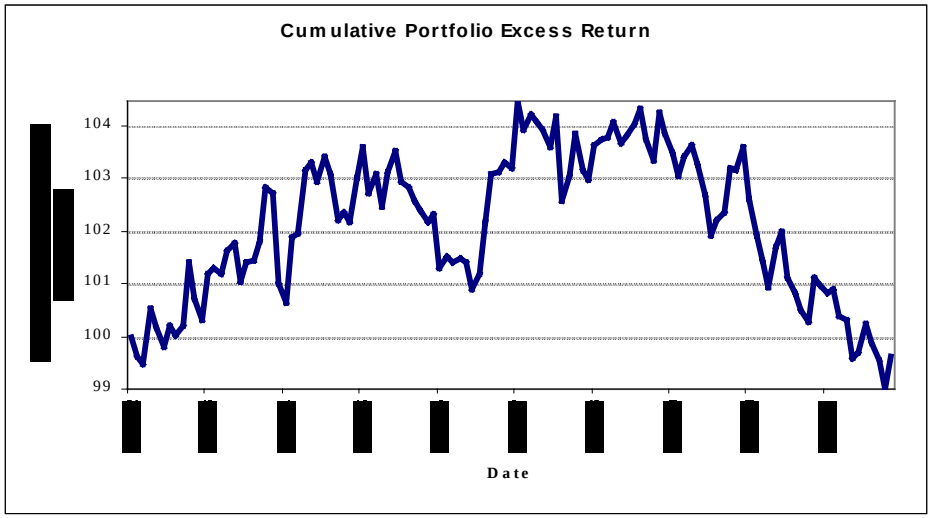


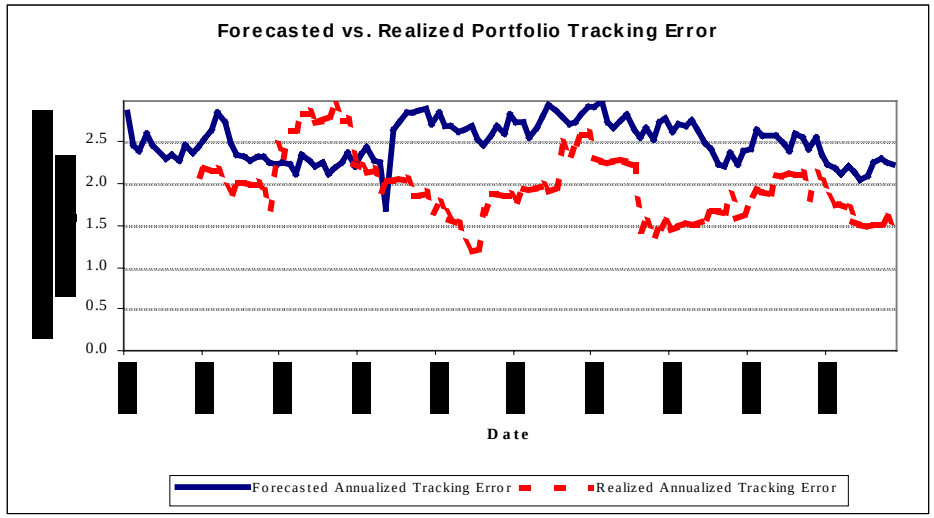


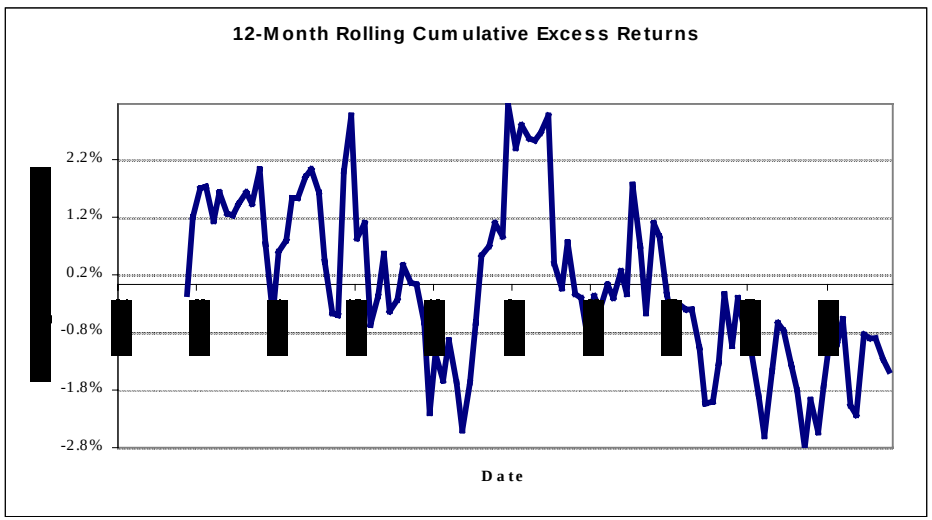


Annualized Avg. Active Return:	2.47%
Annualized Realized TE:	**14.47%**
Avg. Forecast Factor Risk:	6.88%
Avg. Forecast Stock Specific Risk:	12.20%
Avg. Forecast TE:	**14.01%**
Total Return/Risk(IR) Ratio:	0.17

Simulation Results:
A Case Where a Working Model Stops Working When Specific Factors Are Neutralized …

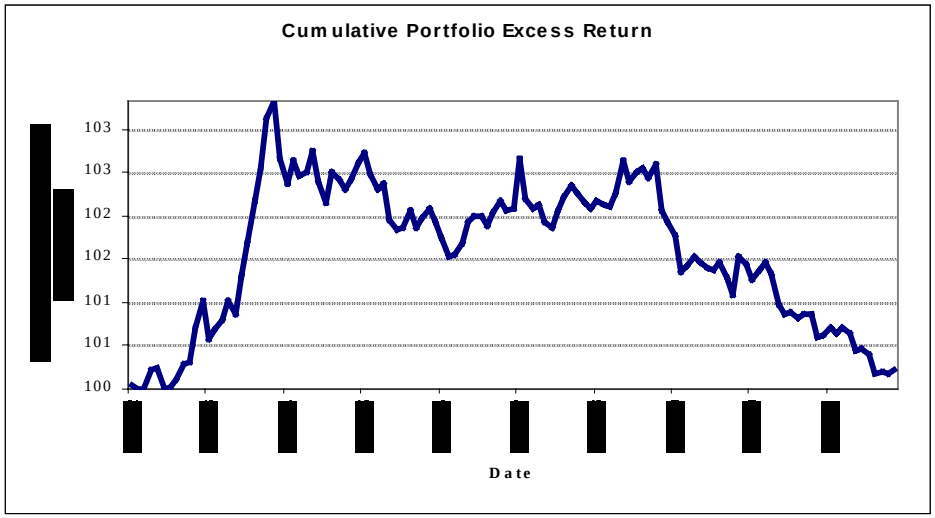


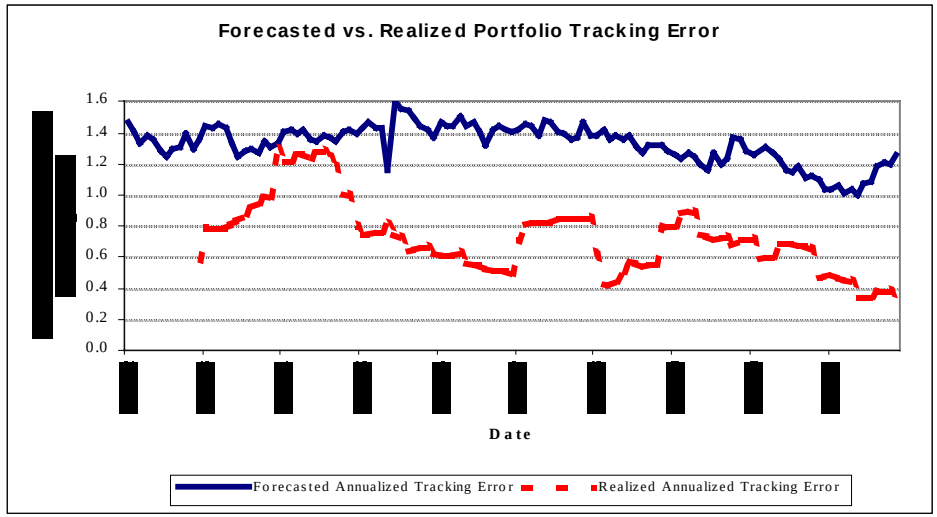


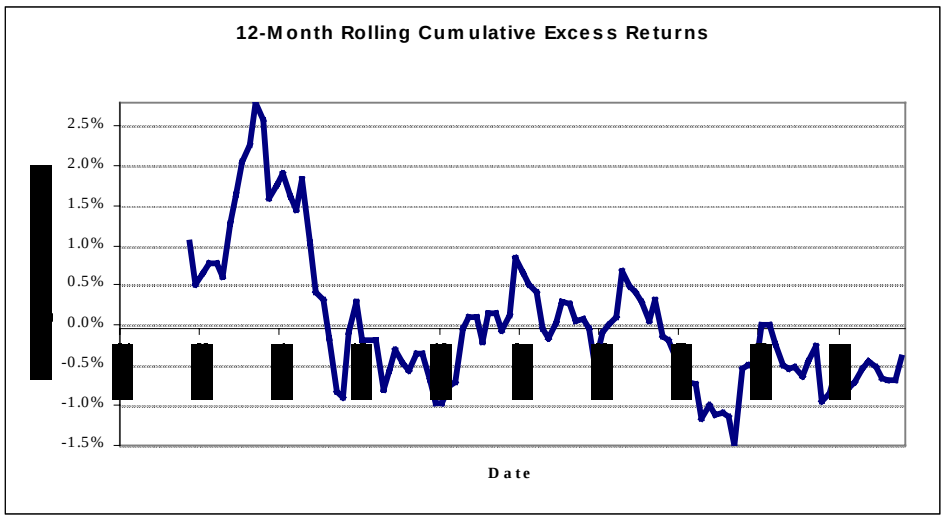


Annualized Avg. Active Return:	-0.06%
Annualized Realized TE:	**1.96%**
Avg. Forecast Factor Risk:	0.66%
Avg. Forecast Stock Specific Risk:	2.43%
Avg. Forecast TE:	**2.51%**
Total Return/Risk(IR) Ratio:	-0.03

Simulation Results:
Calibrating Forecast TE to Realize a Desired level of TE
Example of calibrating forecast TE (RAP = 3/7)

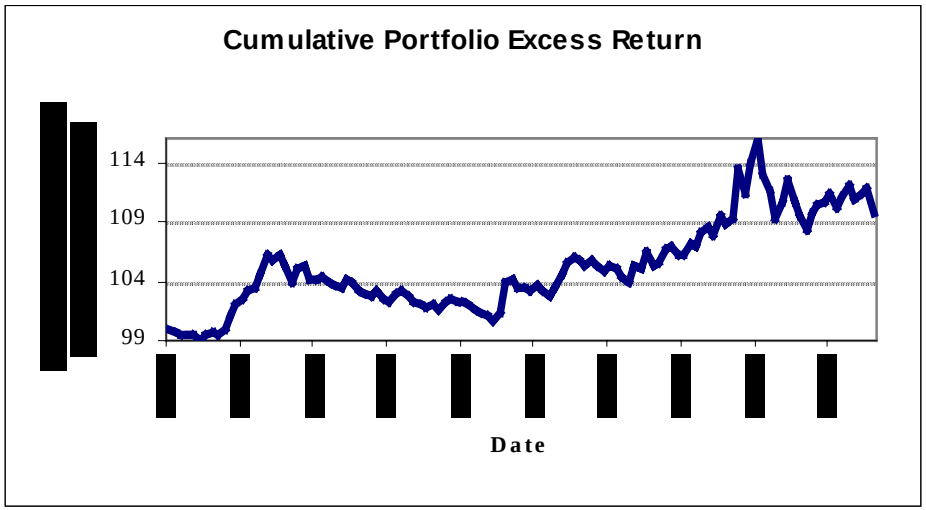


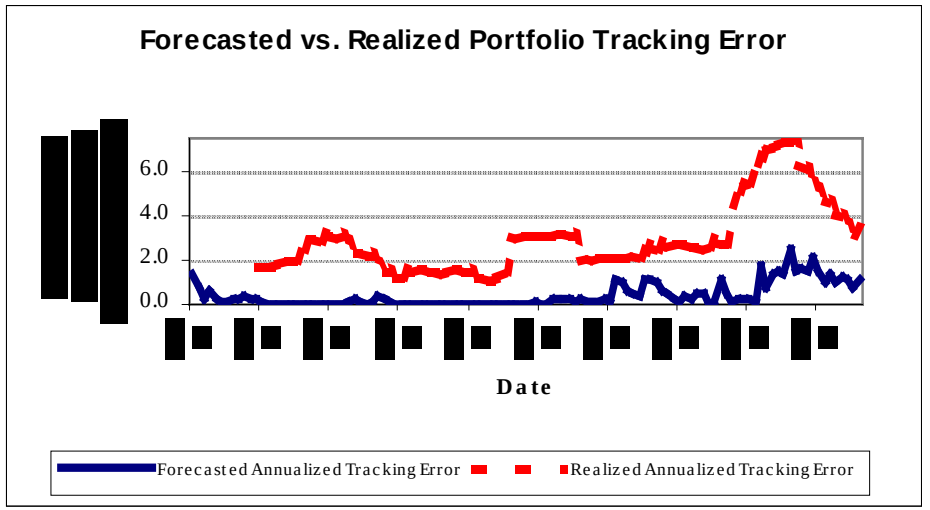


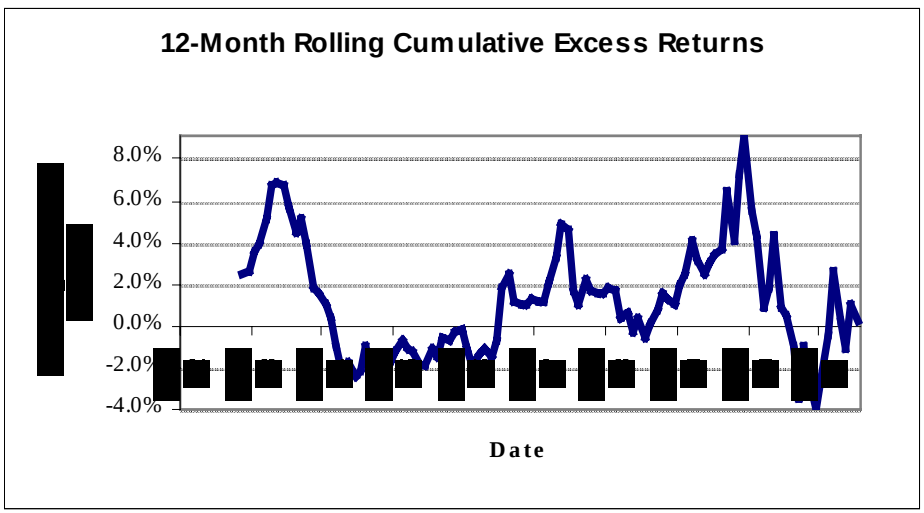


Annualized Avg. Active Return:	0.03%
Annualized Realized TE:	**0.75%**
Avg. Forecast Factor Risk:	0.53%
Avg. Forecast Stock Specific Risk:	1.22%
Avg. Forecast TE:	**1.33%**
Total Return/Risk Ratio:	0.04

Simulation Results:
Calibrating Forecast TE to Realize a Desired level of TE Where Forecast TE is Always Greater Than Realized TE

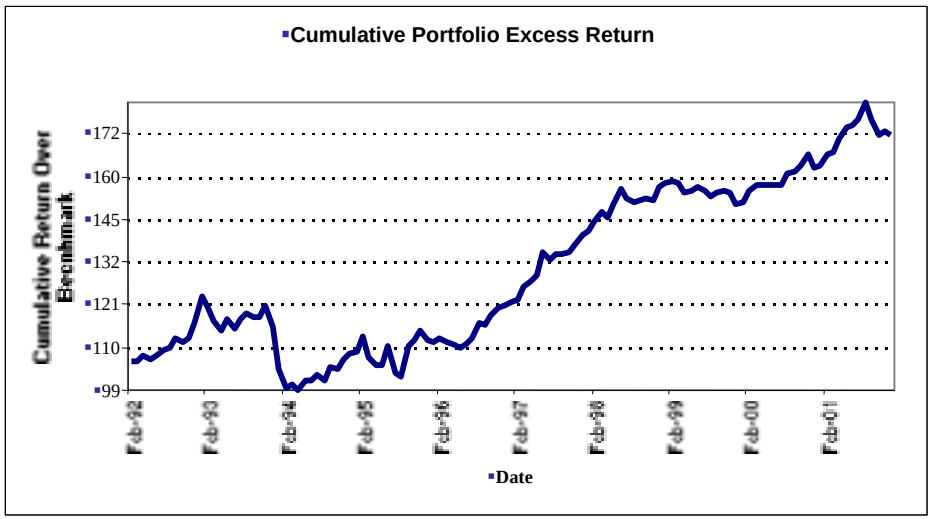


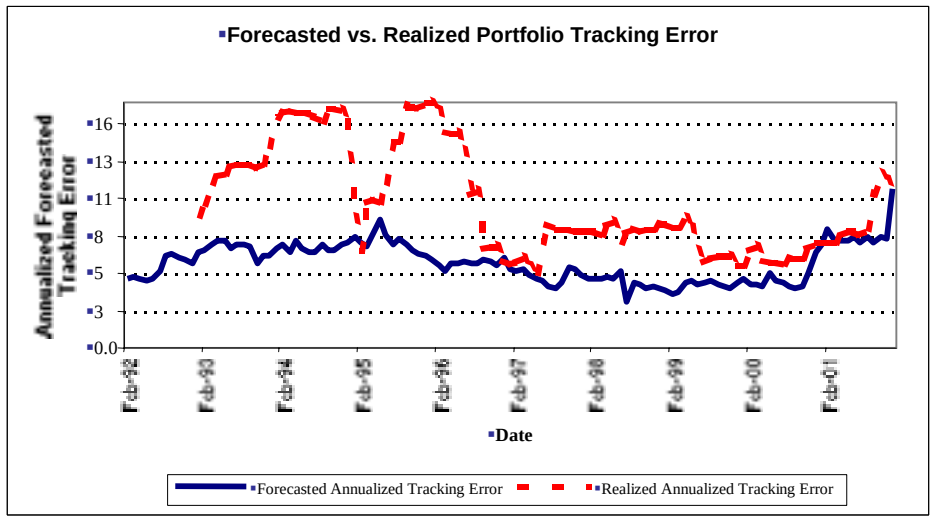


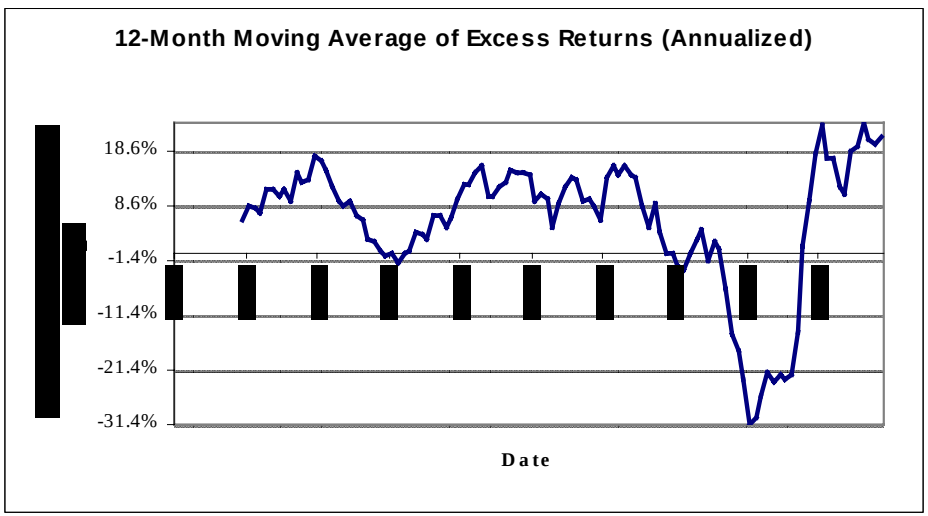


Annualized Avg. Active Return:	1.06%
Annualized Realized TE:	**3.26%**
Avg. Forecast Factor Risk:	0.21%
Avg.Forecast Stock Specific Risk:	0.63%
Avg. Forecast TE:	**0.67%**
Total Return/Risk Ratio:	0.33

Simulation Results:
European Stocks Using NorthField Global Model (Factor RAP = 0.3, Stock Specific RAP = 300)

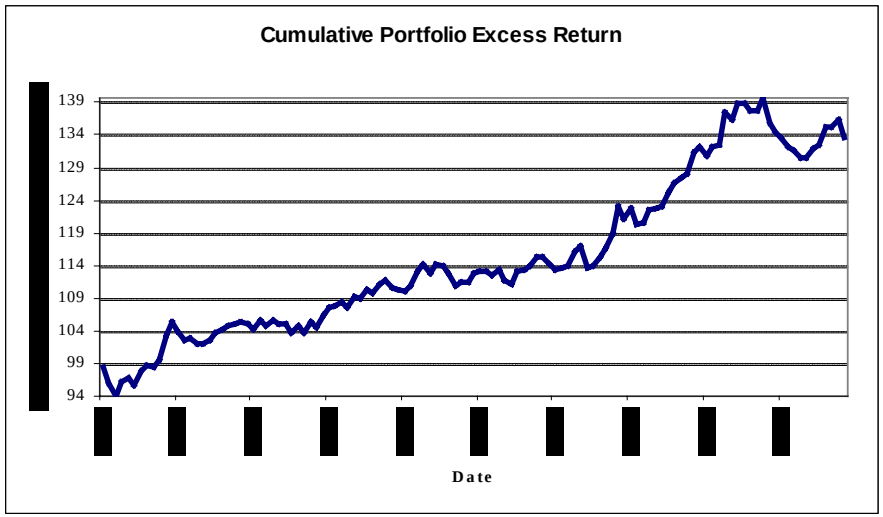


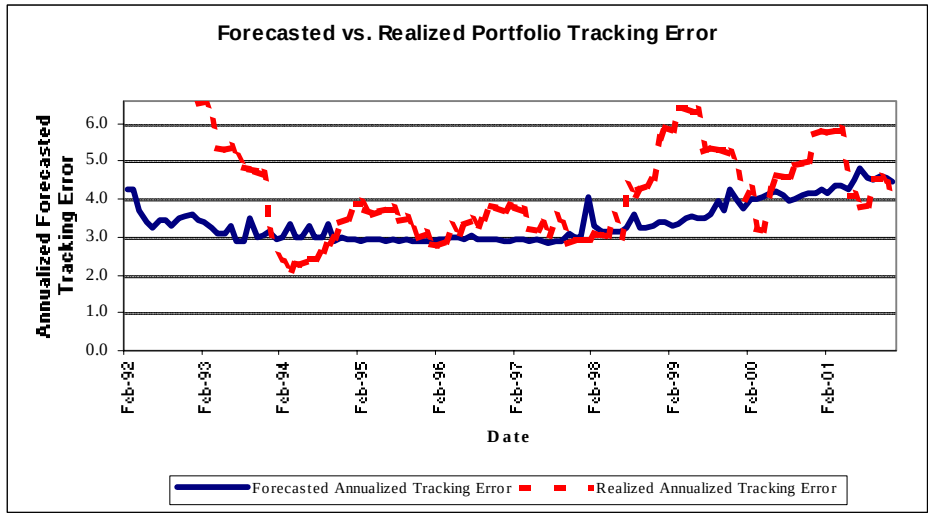


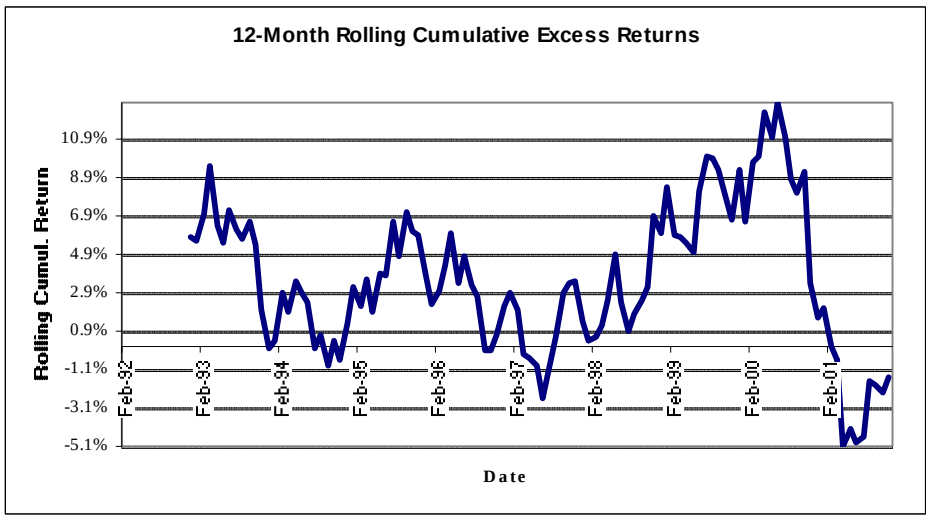


Annualized Avg. Active Return:	6.66%
Annualized Realized TE:	**9.59%**
Avg. Forecast Factor Risk:	0.08%
Avg. Forecast Stock Specific Risk:	5.18%
Avg. Forecast TE:	**5.18%**
Total Return/Risk Ratio:	0.69

Simulation Results:
Calibrating TE Long – Short Funds (RAP = 0.25/0.25)

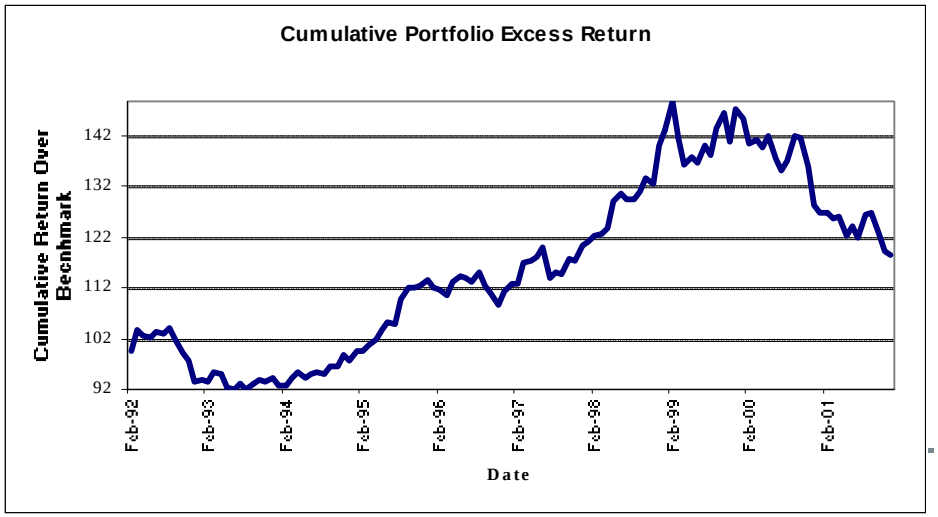


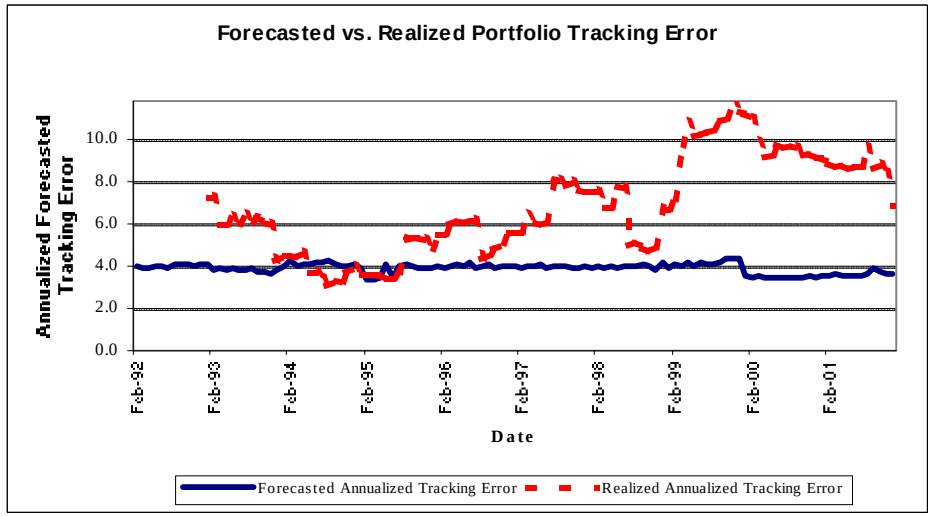


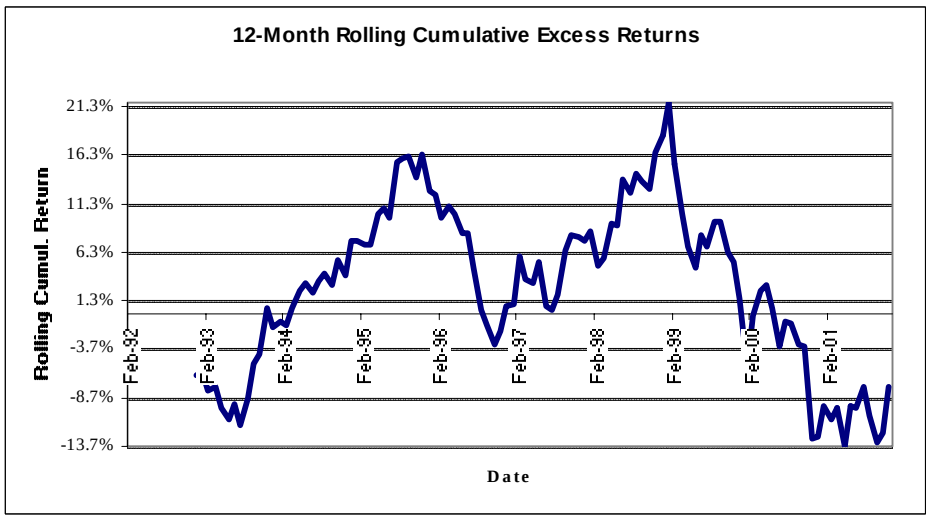


Annualized Avg. Active Return:	3.05%
Annualized Realized TE:	**4.35%**
Avg. Forecast Factor Risk:	0.68%
Avg. Forecast Stock Specific Risk:	3.38%
Avg. Realized TE:	**3.41%**
Total Return/Risk Ratio:	0.70

Simulation Results:
Long – Short Funds (RAP = 2.5/2.5)

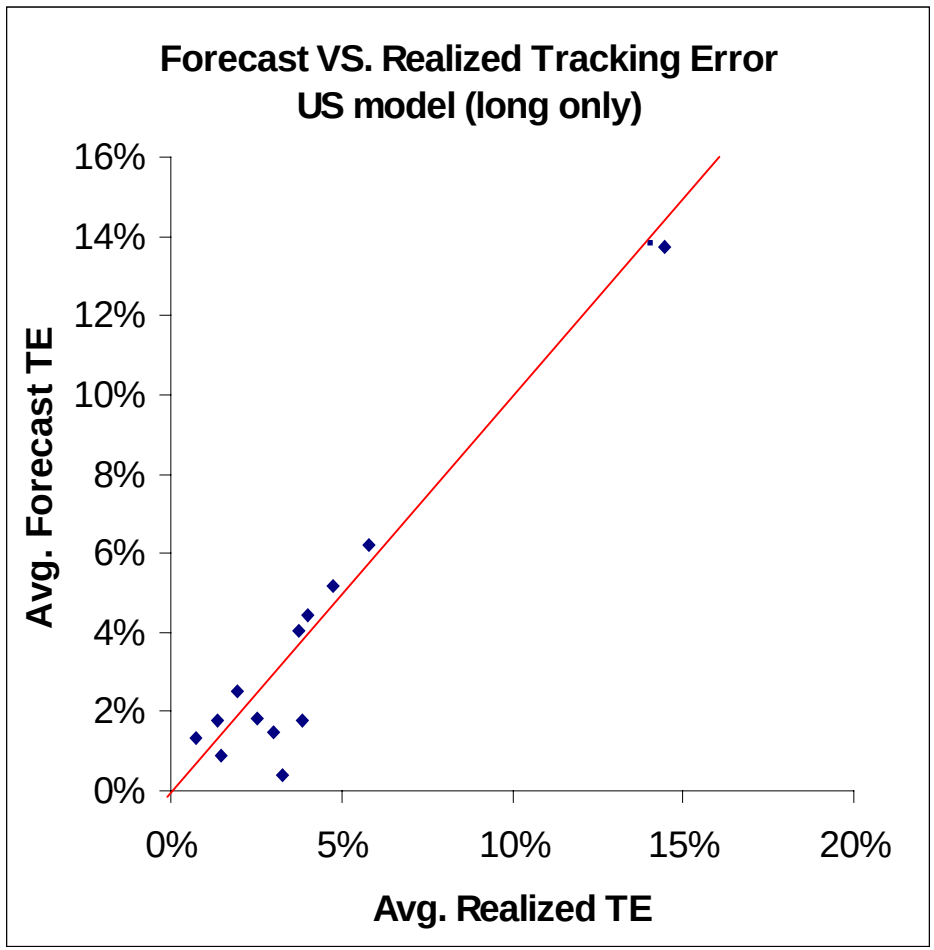


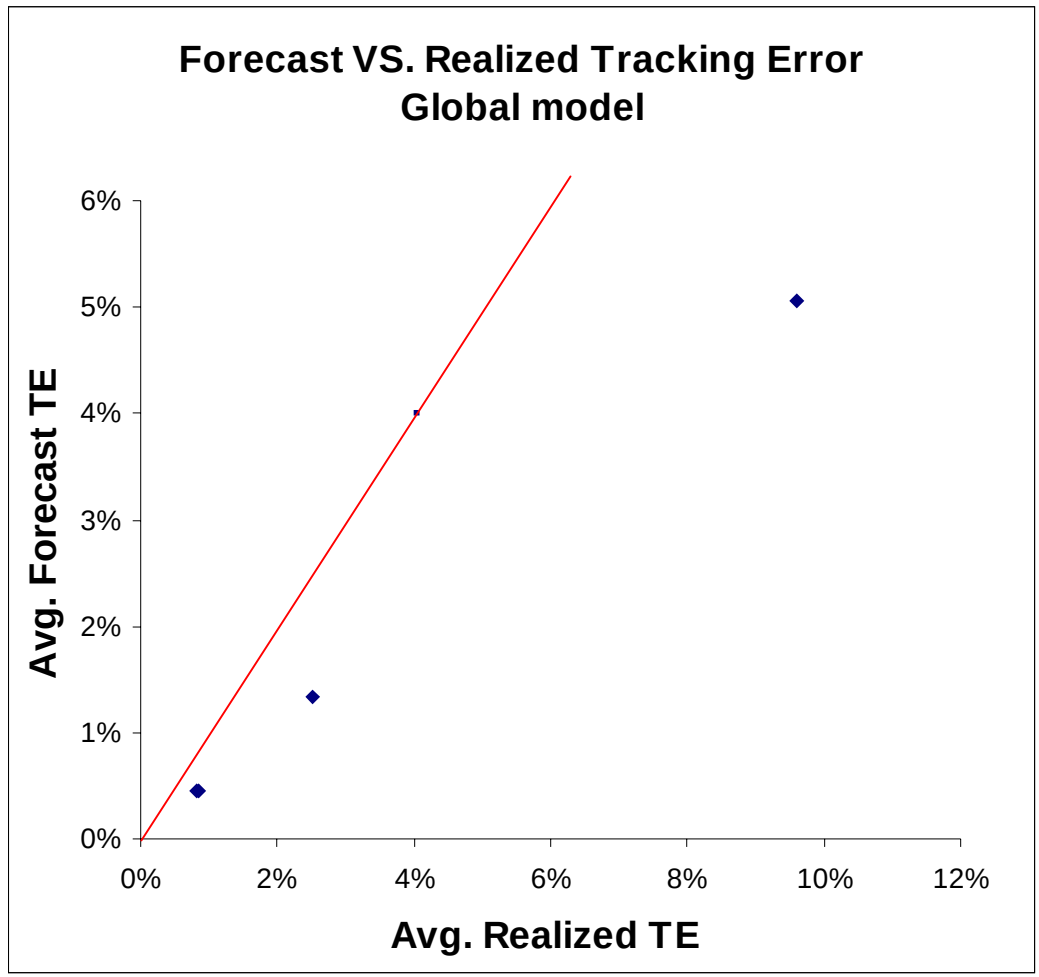




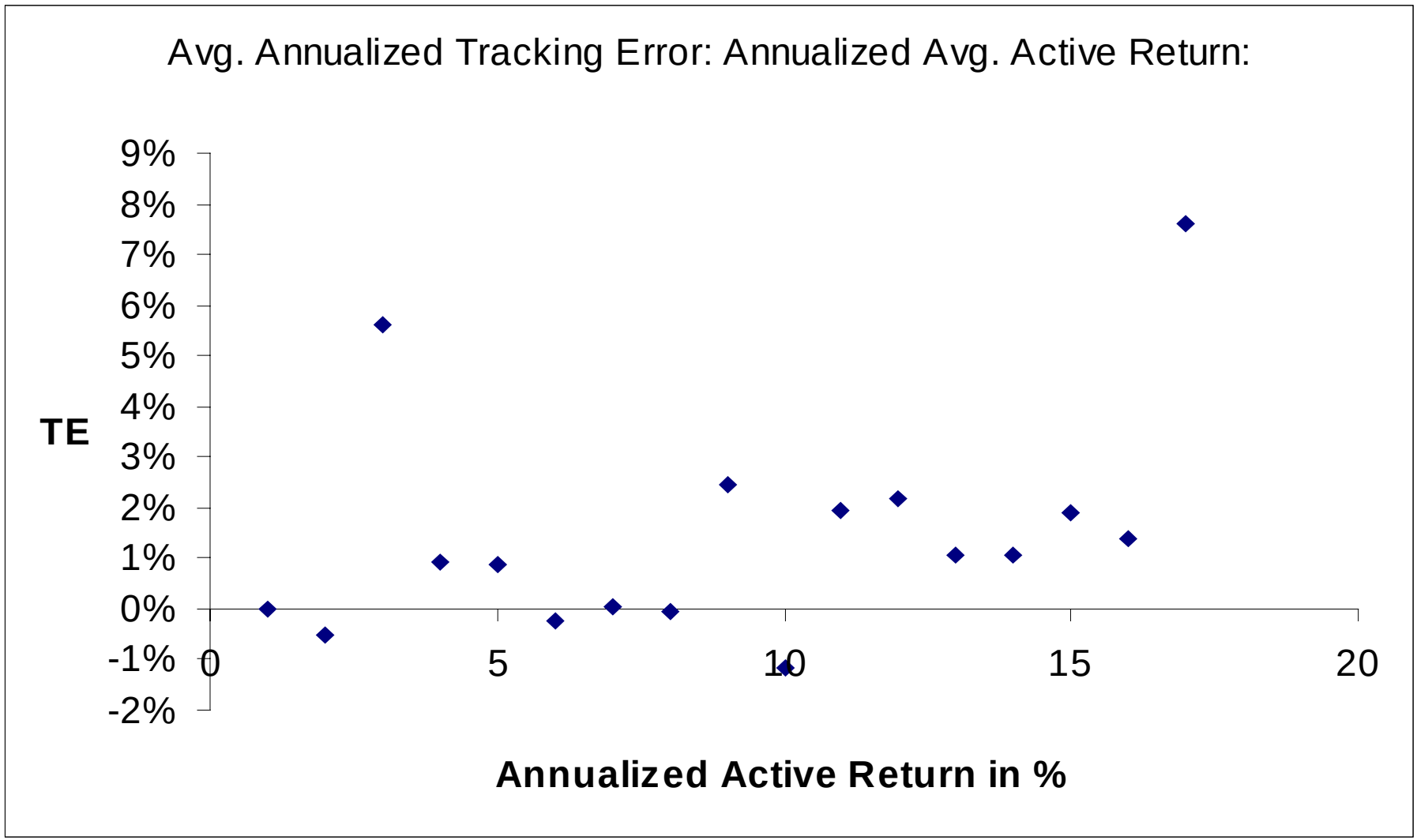
Annualized Avg. Active Return:	1.94%
Annualized Realized TE:	**7.36%**
Avg. Forecast Factor Risk:	0.70%
Avg. Forecast Stock Specific Risk:	3.84%
Avg. Forecast TE:	**3.90%**
Total Return/Risk Ratio:	0.26

Simulation Results:
Range of Average Annualized Tracking Error





Simulation Results:
Realized TE vs. Realized Return for different cases



Investment Strategy - Summary

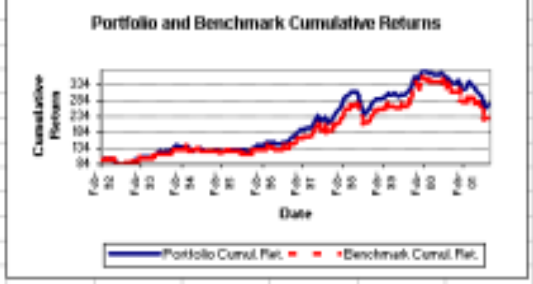
- To attain the desired level of alpha, the alpha model and risk model should both be tuned-in with the strategy (e.g. stock bets).
- The correlation between variables in the alpha model and factors in the risk model could impact the realized TE and return.
- Forecast TE vs. realized TE is dependent on the parameters of the optimization.
- Strategy simulations can assist in calibrating the forecast TE to achieve a desired level of realized TE.

Thank you for attending this year's Northfield Conference in beautiful Yosemite National Park.

Appendix: Example of a simulation output

Performance Results

Start Date:	2/29/1992
End Date:	9/30/2001
Annualized Avg. Total Return:	11.8%
Annualized Total Volatility:	17.6%
Annualized Avg. Active Return:	1.4%
Annualized Active Volatility:	3.0%
Average Number of Assets:	143.1



Northfield Optimization Results

	Portfolio
Avg. Factor Risk:	0.26%
Avg. Stock Specific Risk:	1.44%
Avg. Total Risk:	1.46%
Avg. Annualized Tracking Error:	1.46%
Avg. Beta:	0.99
Avg. Turnover:	9.76%

Return-to-Risk Ratio Measures

	Portfolio	Excess Returns
Total Return/Risk Ratio:	0.67	0.46
Best 12-Month Rolling Ratio:	3.97	2.78
Worst 12-Month Rolling Ratio:	-1.58	-2.51

Summary Statistics on Monthly Returns

	Portfolio Returns	Excess Returns
Mean	0.98%	0.12%
Standard Error	0.47%	0.08%
Median	0.97%	0.14%
Standard Deviation	5.07%	0.87%
Sample Variance	0.26%	0.01%
Kurtosis	42.46%	320.84%
Skewness	-28.08%	-53.57%
Range	27.43%	5.89%
Minimum	-15.20%	-3.02%
Maximum	12.24%	2.87%

Rolling Cumulative Return Metrics

	Portfolio Returns	Excess Returns
Best 12-Month Cumul. Return:	62.5%	8.0%
Worst 12-Month Cumul. Return:	-26.8%	-6.6%

Monthly Outperformance Figures

Month Portfolio Outperforms:	70
Months Portfolio Underperforms:	46
Outperform Percentage:	60.3%
Avg. Excess Return in Outperforming Months:	0.6%
Max. Consecutive Outperforming Months:	7
Max. Consecutive Underperforming Months:	6
Avg. Exc. Ret. in Up Markets:	-0.1%
Avg. Excess Ret. in Down Markets:	0.3%

Regression Portfolio Returns vs. Benchmark Returns

	Annualized Alpha	Beta
Coefficient:	1.79%	0.96
T-Stat:	1.87	63.35
Adjusted R-Sqr:	97.2%	

Hit Rate Statistics

Portfolio Hit Rate:	49.5%
Benchmark Hit Rate:	48.9%
Portfolio Excess Hit Rate:	0.5%