

ABACUS ANALYTICS

Equity Factors and Portfolio Management:

Alpha Generation Versus Risk Control

Berry Cox

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The Return Generating Process for Equities: 4 Components of Returns

$$R_t = \alpha + \beta_t^M \times M_t + \beta_t^I \times I_t + \beta_t^F \times F_t + \varepsilon_t \quad \text{where}$$

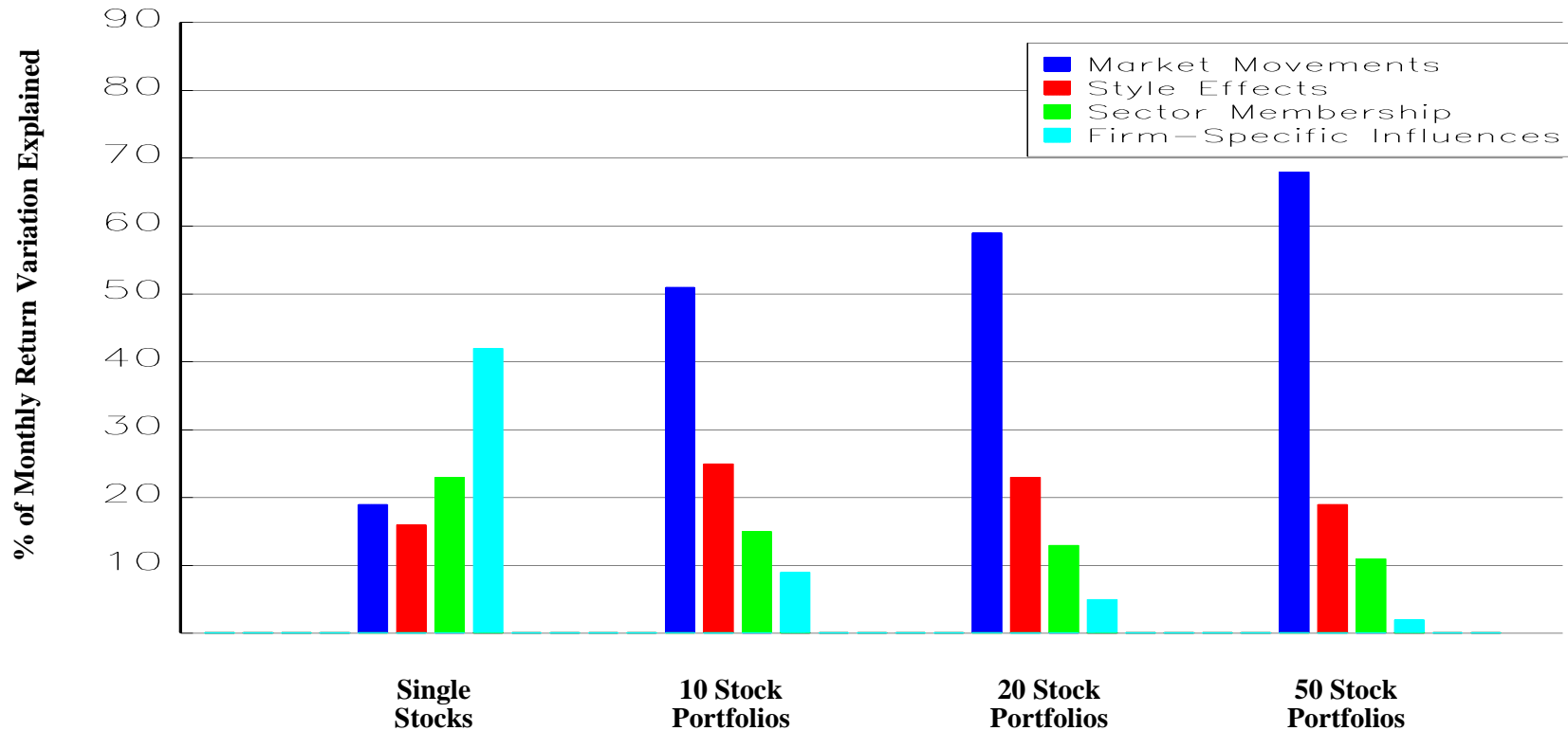
R_t = Nx1 vector of stock returns in month t
 α = 1x1 average return to all stocks (market drift)
 β_t^M = Nx1 vector normalized market betas
 M_t = 1x1 return on the S&P 500 in month t
 β_t^I = NxP matrix of 0-1 industry membership dummies
 I_t = Px1 vector of industry returns unrelated to F and M
 β_t^F = NxK matrix of normalized factor exposures
 F_t = Kx1 vector of systematic factor returns in month t
 ε_t = Nx1 vector of firm-specific returns

$\alpha + \beta^M \times M$	$\beta^I \times I$	$\beta^F \times F$	ε
General Market Movements	Industry Membership	Exposure to Systematic Factors	Firm-Specific Return
<p>This portion of returns is attributable to general market movements. It consists of a market drift term, α, which is the return that all stocks earn just for being a stock that month, plus the incremental return associated with the stock's <i>normalized</i> beta. Here, β^M is the normalized coefficient from a 60 month market model regression.</p>	<p>A portion of a stock's monthly return flows from its industry membership. Industry related returns are estimated as the coefficients, I, of the 0-1 dummy variable matrix β^I encoding industry membership. $\beta^I \times I$ equals the returns attributable to industry membership after controlling for market movements and factor exposures.</p>	<p>Returns from systematic factors arise from characteristics such as P/E, volatility, momentum, growth orientation, and capitalization. They are estimated as the coefficients, F, of the factor exposure matrix β^F. The NxK β^F contains, for each of the N stocks, the normalized exposures or <i>betas</i> to the K different systematic factors.</p>	<p>This portion of monthly return is <i>unrelated</i> to general market moves, industry membership, or systematic factors. ε is therefore unique or specific to the company. Firm specific returns are calculated as the residuals in the cross-sectional regression that relates monthly stock returns to the other systematic factors.</p>



The Portfolio Management Process: The Relative Importance of the Active Bets

Percentage of Monthly Returns Explained by Systematic Factors





Systematic Factors and Active Portfolio Management

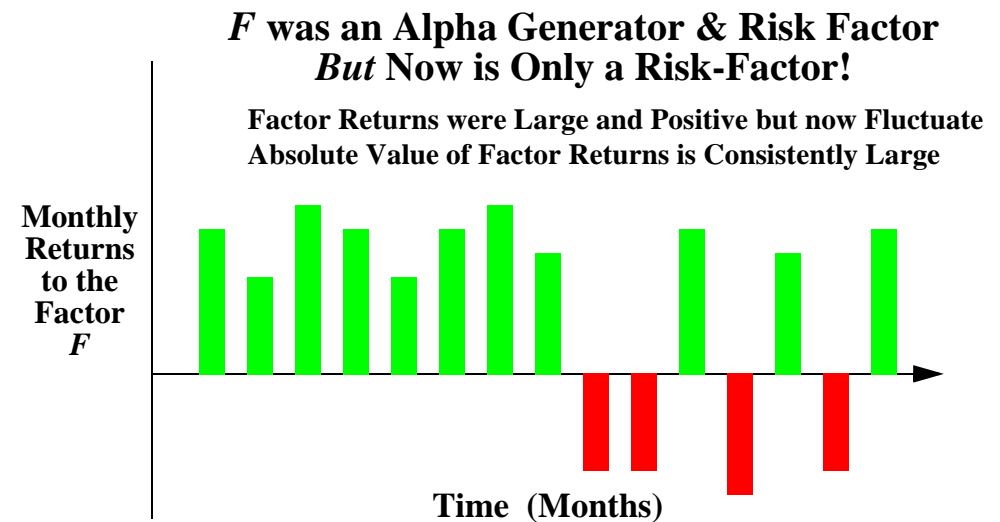
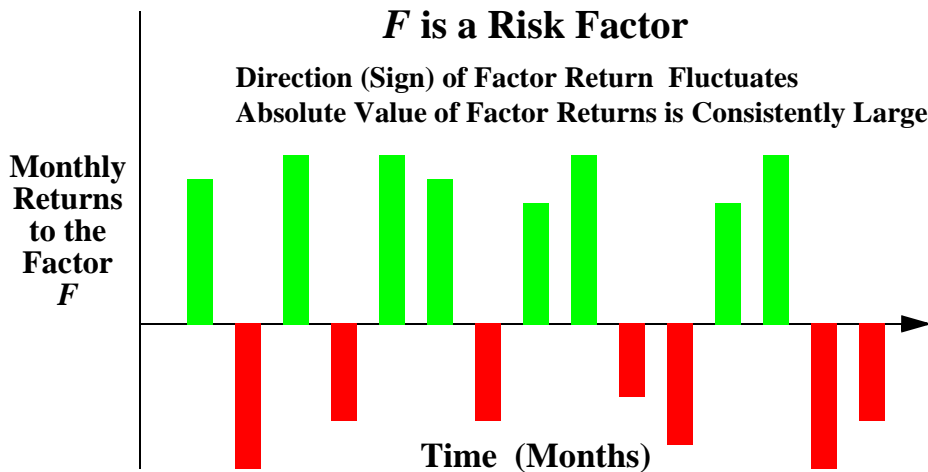
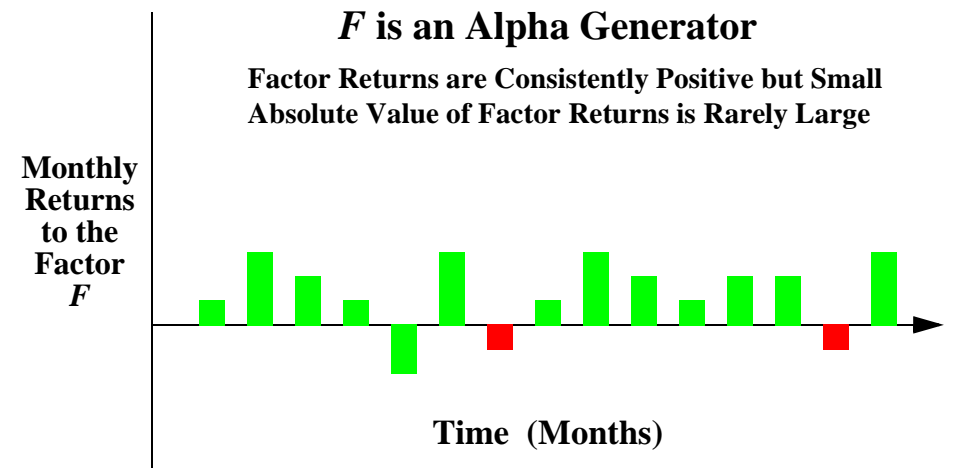
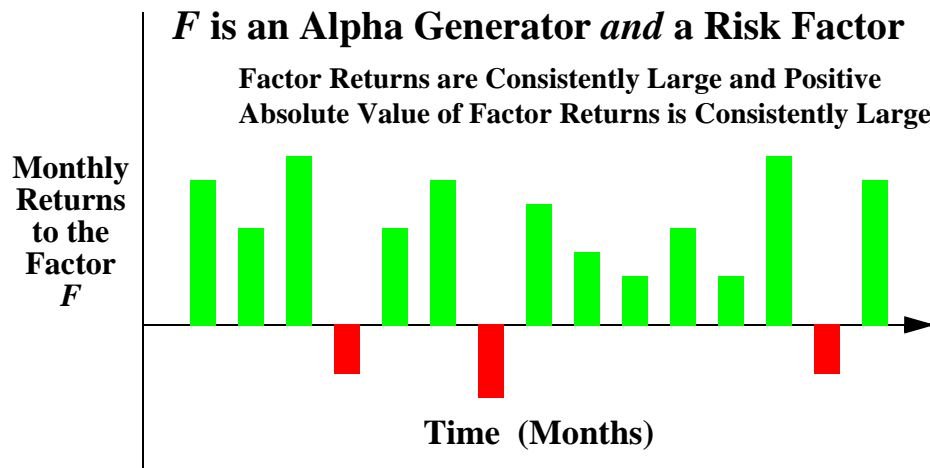
- Performance Attribution
 - (1) Which Factors are Driving Current Returns
 - (2) What Alpha Strategies are Working
 - (3) What Risk-Factors are Influencing Returns (Correlations)
 - (4) Sector-Style Interactions

- Risk Control
 - (1) Decomposing Portfolio Variance
 - (2) Explaining Unexpected Tracking Error
 - (3) Systematic versus Idiosyncratic Risk
 - (3) Identifying Risk Maximizing Positions

- Alpha Generation:
 - (1) Identifying Reliable Alpha-Generating Factors
 - (2) Optimal Weights for Multi-factor Alpha Strategies
 - (3) Forecasting Factor Returns
 - (4) Sector/Industry/Macro Specific Investing



Alpha Generation Versus Risk Control: What Do The Factor Returns Look Like Across Time?





Systematic Factors in U.S. Equity Returns: General Categories

Potential Alpha Generators and Risk-Factors	
Traditional Value	Price/ Earnings, Price / Book, Price / Sales
Relative Value	Industry Relative Price Ratios Industry Relative Ratios Versus Past Averages
Historical Growth	Historical Growth in Sales, Earnings and Cash Flows
Expected Growth	Expected Earnings Growth Rates from I/B/E/S, First Call and Zacks
Profit Trends	First and Second Order Changes in Profit Margins, Asset Turnover, Overhead Ratios
Price Momentum	Price Performance Over the Past 6 - 12 Months (Trend Following Behavior)
Price Reversal	Price Performance Over the Past 1-4 Weeks (Trend Reversing Behavior)
Earnings Momentum	Revisions in Earnings Estimates Recent Earnings Surprises
Accelerating Sales	Second Order Change in Recent Sales
Small Size & Neglect	Premiums for Small and Neglected Stocks (Note Premiums are now Discounts)

Risk-Factors Only	
Price Volatility	Price Volatility and Idiosyncratic Risk Market Risk (Beta)
Market Liquidity	Bid-Ask Spreads Share Turnover
Skewness of Returns	Investor Preferences for Skewed Distributions
Financial Leverage	Debt / Assets (Market & Book) Interest Expense Coverage
Earnings Risk	Variability of Historical Earnings and Sales Analyst Uncertainty About Future Earnings
Institutional Sponsorship	Change in Institutional Ownership Intensity of Analyst Coverage
Currency Risk	Price Sensitivity to Exchange Rate Movements
Other Macro Factors	Sensitivity to Yield Curve Changes, Inflation Shocks, and Economic Acitivity



Systematic Factors in U.S. Equity Returns: Alpha Generators

Category	Description of Individual Factor
Traditional Value	Price / Leading 12 Month Earnings (Weighted Avg of FY1 and FY2) Price / Trailing 12 Month Sales Price / Trailing 12 Month Cash Flow Price / Book Value Leading Dividend Yield
Relative Value	Industry Relative Price / Trailing Sales - Current Spread vs. 5 Year Avg Industry Relative Price / Trailing Earnings - Current Spread vs. 5Yr Avg Industry Relative Price / Trailing Cash Flow - Current Spread vs. 5Yr Avg Industry Relative Price / Trailing Sales Industry Relative Price / Forward Earnings Industry Relative Price / Trailing Cash Flow
Historical Growth	Consecutive Quarters of Positive Changes in Trailing 12 Month Cash Flow Consecutive Quarters of Positive Change in Quarterly Earnings 12 Month Change in Quarterly Cash Flow 3 Year Average Annual Sales Growth 3 Year Average Annual Earnings Growth Slope of Trend Line Through Last 4 Quarters of Trailing 12M Cash Flows
Expected Growth	5 Year Expected Earnings Growth (First Call & I/B/E/S Consensus) Expected Earnings Growth: Fiscal Year 2 / Fiscal Year 1 (First Call & IBES)
Profit Trends	Consecutive Qtrs of Declines in (Receivables+Inventories) / Sales Consecutive Qtrs of Positive Change in Trailing 12M Cash Flow / Sales Consecutive Qtrs of Declines in Trailing 12 Month Overhead / Sales Industry Relative Trailing 12 Month (Receivables+Inventories) / Sales Industry Relative Trailing 12 Month Sales / Assets Trailing 12 Month Overhead / Sales Trailing 12 Month Earnings / Sales

Category	Description of Individual Factor
Small Size	Log of Market Capitalization Log of Stock Price Log of Trailing 12 Month Sales Log of Total Assets
Accelerating Sales	3 Month Momentum in Quarterly Sales 6 Month Momentum in Trailing 12 Month Sales Change in Slope of 4 Quarter Trend Line through Quarterly Sales
Earnings Momentum	Change Since Last Report in Current Quarter (Q1) Estimate / Price 4 Week Change in Leading 12 Month Consensus Estimate / Price 8 Week Change in Leading 12 Month Consensus Estimate / Price Last Earnings Surprise / Current Price Last Earnings Surprise / Standard Deviation of Quarterly Estimates (SUE)
Price Momentum	Slope of 52 Week Trend Line (20 Day Lag) Percent Above 260 Day Low (20 Day Lag) 4/52 Week Price Oscillator (20 Day Lag) 39 Week Return (20 Day Lag) 51 Week Volume Price Trend (20 Day Lag)
Price Reversal	5 Day Industry Relative Return 5 Day Money Flow / Volume 10 Day MACD - Signal Line 14 Day RSI (Relative Strength Indicator) 14 Day Stochastic 4 Week Industry Relative Return Last Month's Residual Return from CAPM Model



Systematic Factors in U.S. Equity Returns: Risk-Factors Only

Category	Description of Individual Factor
Price Volatility	90 Day Price Volatility
	60 Month Market Risk (Beta Coefficient from 60 Month CAPM)
	60 Month Residual Risk (Regression Error from 60 Month CAPM)
	90 Day Market Risk (Beta Coefficient from 60 Month CAPM)
	90 Day Residual Risk (Regression Error from 60 Month CAPM)
Market Liquidity	20 Day Average Bid-Ask Spread / Price
	20 Day Average Turnover (Volume / Shares Outstanding)
	20 Day Volume / 20 Day Price Volatility (%)
Institutional Sponsorship	Analyst Coverage
	6 Month Change in Analyst Coverage
	Percentage of Months with Positive Increases in Analyst Coverage
Skewness of Returns	90 Day Skewness of Returns
	90 Day Co-Skewness of Returns with the S&P 500

Category	Description of Individual Factor
Earnings Risk	Coefficient of Variation: Last 8 Quarters of Trailing 12 Month Sales
	Coefficient of Variation: Last 8 Quarters of Trailing 12 Month Cash Flow
	Mean Absolute Deviation around 12 Quarter Trend Line in T12 Sales
	Mean Absolute Deviation around 12 Quarter Trend Line in T12 Earnings
	T24 Month Extraordinary Items + Discontinued Operations / Sales
Financial Leverage	Analyst Uncertainty (Standard Deviation of FY1 Estimates / Mean FY)
	Long-Term Debt / (Market Value Equity + Total Debt)
	Total Debt / (Market Value Equity + Total Debt)
	Total Debt / (Book Value Equity + Total Debt)
	Industry Relative Total Debt / (Market Value Equity + Total Debt)
Currency	Industry Relative Cash Flow / Interest Expense
	Sensitivity to Exchange Rates (Trade Weighted US Dollar)
Other Macro Risks	Sensitivity to 30 Year T-Bond Yields
	Sensitivity to Yield Curve Slope (30 Yr T-Bond - 6 Month T-Bill Yields)
	Sensitivity to Credit Risk Premiums (AA Corp - 30 Year T-Bond Yields)
	Sensitivity to Inflation Shocks (FIBER Leading Index - Inflation)
	Sensitivity to Economic Activity (FIBER Leading Index - Econ Growth)



U.S. Equity Risk Models: Model Specifications

Type	Factor Category	VENDOR AND RISK MODEL					
		Salomon RAM	Wilshire	BIRR	Vestek	BARRA E3	Northfield Fundamental
Firm Specific Market Related	Price Reversal		CAPM Residual			Relative Strength, α	Relative Strength
	Price Momentum					Volatility Composite	52 Week H-L/H+L
	Price Volatility					Trading Activity	Share Turnover
	Market Liquidity						
	Skewness of Returns						
	Market Capitalization		Log of Market Cap		Log of Market Cap	$\ln(\text{Cap}), \ln(\text{Cap})^3$	Log of Market Cap
Firm Specific Fundamental	Earnings Momentum		Earnings Revision			Growth Composite	
	Expected Growth					Growth Composite	EPS Growth Rate
	Historical Growth		Earnings Torpedo				
	Profit Trends						
	Traditional Value		E/P, Book/Price		E/P, Price/Book	E/P Composite, B/P	E/P, Book/Price
	Relative Value						
	Financial Leverage					Leverage Composite	Debt / Equity
	Earnings Risk					Earnings Variability	σ^2 Around Trend
Dividend Yield					IAD Yield	Trailing 12M Yield	
Sponsorship							
Sensitivity to Macro Factors	Market Movements	APT Residuals	CAPM Beta	APT Residuals	Two Factor Beta		
	Yield Curve Level	20Yr T-Bond Yields			15-20 Yr Treasuries		
	Yield Curve Slope	TBond - TBill Yields		Time Horizon Risk			
	Credit Premiums	AA Corps - TBonds		Confidence Risk			
	Inflation Shocks	ARIMA Forecast		Inflation Risk			
	Economic Activity	Industrial Production		Business Cycle Risk			
	Exchange Rates	FED USD Index					Currency Sensitivity



Evaluating Alpha Generators and Risk Factors: Three Dimensions of Performance

Alpha Generators	
Criterion	Property of F (Signed)
Profitability	F Is Large Across Time and for Many Stocks
Breadth	F is Large For Many Stocks
Reliability	F is Large Often

Overall Strength...

Strength Across Stocks...

Strength Across Time...

Risk-Factors	
Criterion	Property of $Abs\ Value\ F $
Explanatory Power	$ F $ Is Large Across Time and for Many Stocks
Reach	$ F $ is Large For Many Stocks
Consistency	$ F $ is Large Often



What Makes a Good Alpha Generator? Four Properties to Guide the Search

Performance Criterion	Description of the Property
Profitability	The defining characteristic of an alpha-generator is its <i>profitability</i> . The more profitable an alpha generator, the more return it generates for a given level of factor exposure. We measure profitability as the performance spread between portfolios of high and low exposure stocks. Profitability partly reflects the alpha generator's <i>breadth</i> and <i>reliability</i> as described below.
Breadth	<i>Breadth</i> refers to the number of stocks for which the alpha generator is predictive. The greater the factor's breadth, the more likely it is that stocks with high factor sensitivities will outperform when the factor return is positive. Alpha generators with good breadth will forecast winners (and losers) across most sectors and size groups.
Reliability	The <i>reliability</i> of an alpha generator refers to its frequency of success. The more reliable the factor, the more often its returns are positive. Alpha generators with the same profitability can have different reliability characteristics, with some repeatedly delivering small returns and others occasionally delivering substantial returns.
Symmetry	For alpha generators, we consider four dimensions of performance <i>symmetry</i> : long-short, bull-bear, big-small, and inter-sector. The respective indicators compare the factor's performance in long versus short positions, bull versus bear markets, large versus small stocks, and across sectors.

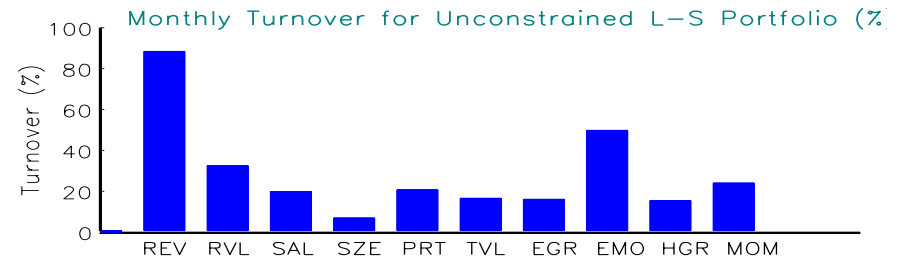
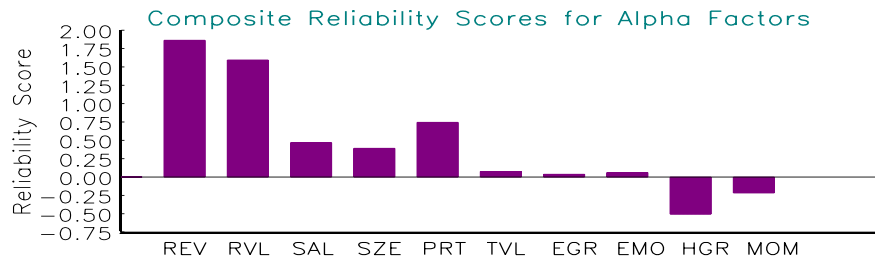
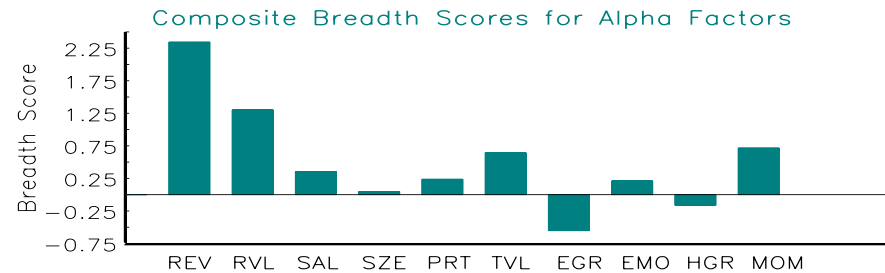
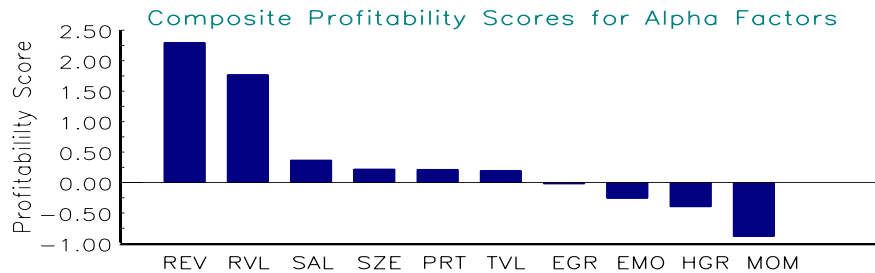


Evaluating Alpha-Generators: Performance Statistics

Criterion	Performance Statistic
Profitability	Average Across Time: Cross-Sectional Correlation Coefficient (IC) (Factor Exposures & Base Model Residuals)
	Average Across Time: Spearman Rank Correlation (Factor Exposures & Base Model Residuals)
	Sharpe Ratio: Decile 10-1 Performance Spread for Sector Neutral Decile 10-1 Performance Spread
	Sharpe Ratio using Pure Play Factor Returns (Coefficient from Pure Play Regression)
	Downside Sharpe Ratio: Pure Play Factor Returns Adjusted by the Semi-Standard Deviation
Breadth	Average Across Time: T Statistic from Pure Play Regression (Cross-Sectional)
	Average Across Time: Percent of Sectors for Which the Sector Information Coefficient is Positive
	Average Across Time: Ordering Accuracy of Rankings Across Factor Deciles $\sum (Decile_x - Decile_{x-1}) > 0 / 9$
	Average Across Time: Advance-Divide Breadth Indicator $(\% \text{ Advancers in } 9-10 - \% \text{ in } 1-8 + \% \text{ Dwn } 1-2 - \% 3-10)/2$
	Percent of Sectors for Which the Decile 10-1 Sharpe Ratio is Greater than 1
Reliability	Percent of Months Unconstrained Decile 10-1 Performance Spread is Positive
	Percent of Months Sector-Neutral Decile 10-1 Performance Spread is Positive
	Percent of Months Size-Neutral Decile 10-1 Performance Spread is Positive
	Percent of Months Pure Play Factor Return is Positive
	Percent of Months T Statistic from Pure Play Regression is Greater than 1
Symmetry	Long-Short Symmetry: Sharpe Ratio Decile 10 - Sharpe Ratio Decile 1
	Bull-Bear Symmetry: Sharpe Ratio Up Months - Sharpe Ratio Down Months (Deciles 10-1)
	Large-Small Symmetry: Sharpe Ratio S&P 500 - Sharpe Ratio S&P 600 (Deciles 10-1)
	Coefficient of Variation: Sector Specific Sharpe Ratios Based on Decile 10-1 Performance Spread
Miscellaneous	Monthly Turnover



Performance of Alpha Generators: 60 Months: September 1998 - August 2003



Performance Summary: 60 Months: Sept 1998 – Aug 2003

Abbrv	Alpha Factor	COMPOSITE SCORES				RANKINGS (1-10)			
		Profitability	Breadth	Reliability	Turnover	Profitab	Breadth	Reliability	Turnover
REV	EQW Composite: Price Reversal	2.30	2.34	1.86	88	1	1	1	1
RVL	EQW Composite: Relative Value	1.77	1.30	1.59	32	2	2	2	3
SAL	EQW Composite: Accelerating Sale	0.37	0.36	0.47	20	3	5	4	6
SZE	EQW Composite: Small Size	0.22	0.05	0.39	7	4	8	5	10
PRT	EQW Composite: Profit Trends	0.22	0.24	0.74	21	5	6	3	5
TVL	EQW Composite: Traditional Value	0.19	0.64	0.08	17	6	4	6	7
EGR	EQW Composite: Expected Growth	-0.02	-0.55	0.04	16	7	10	8	8
EMO	EQW Composite: Earnings Momentum	-0.26	0.21	0.06	50	8	7	7	2
HGR	EQW Composite: Historical Growth	-0.39	-0.16	-0.51	15	9	9	10	9
MOM	EQW Composite: Price Momentum	-0.88	0.72	-0.22	24	10	3	9	4



What Makes a Good Risk-Factor? Four Properties to Guide the Search

Performance Criterion	Description of the Property
Explanatory Power	The defining characteristic of a risk-factor is its <i>explanatory power</i> , the factor's ability to explain the correlation structure of stock returns. The greater the factor's explanatory power, the greater the tendency for stocks with similar factor sensitivities to move together. A factor with high explanatory power frequently will generate large positive <i>or</i> negative returns.
Reach	The risk factor should influence the returns for <i>many</i> stocks. That is, factor sensitivities should be help explain correlations in most sectors and size groups. <i>Reach</i> measures the cross-sectional robustness of the risk factor. The greater the factor's reach, the greater the likelihood that a stock with high factor sensitivity will move when the market prices the factor (i.e. when the factor returns is strongly positive or negative).
Consistency	The risk-factor should be important across <i>time</i> . The more months in which the absolute value of the factor return is large (big positive or big negative returns), the greater will be its explanatory power over time. A <i>consistent</i> risk-factor will frequently create tracking error when managers diverge from the benchmark exposure to the factor.
Normality	The statistical properties of the factor exposures should resemble those of monthly stock returns, which are approximately <i>log-normally distributed</i> . Accordingly, the skewness of the distribution of the factor exposures should be close to zero, and the kurtosis close to three (tails of the distribution).

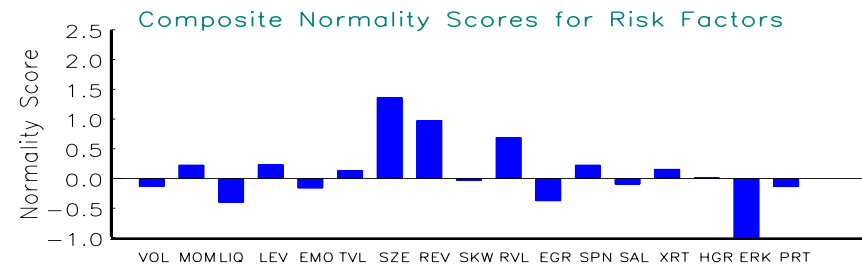
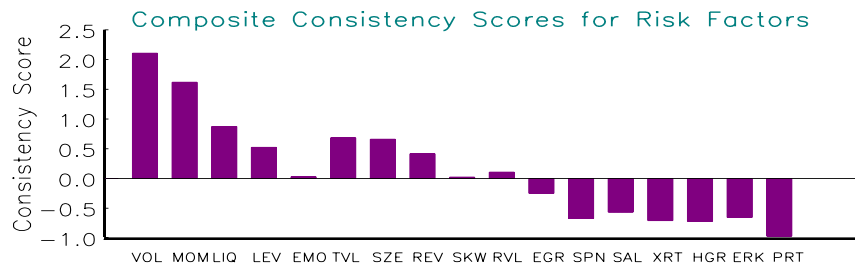
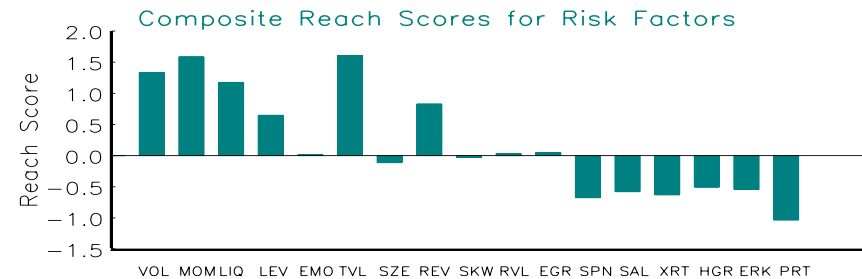
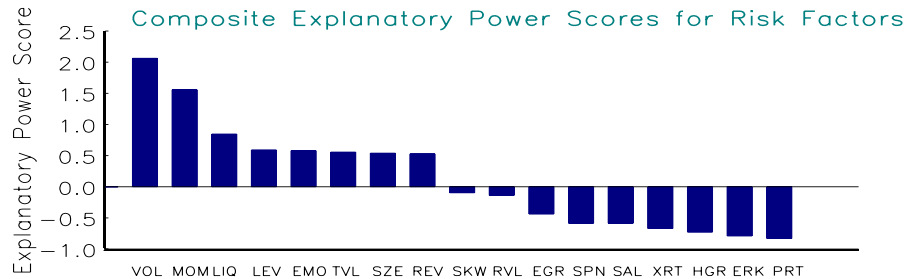


Evaluating Risk-Factors: Performance Statistics

Criterion	Performance Statistic
Explanatory Power	Average Across Time: Absolute Value of Cross-Sectional Correlation Coefficient (IC) - Unadjusted Returns
	Average Across Time: Absolute Value of Sector-Neutral Decile 10-1 Performance Spread
	Average Across Time: Absolute Value of Return on Pure Play Factor Portfolio (Base Model)
	Average Across Time: R^2 of Pure Play Cross-Sectional Regression for Factor
	Average Across Portfolios: Tracking Error Reduction Achieved by Including Factor in Risk-Model
Reach	Average Across Time: Absolute Value of Cross-Sectional T Statistic from Pure Play Regression
	Average Across Time: Ordering Accuracy of Factor Decile Rankings: Max of $\sum (Decile_x - Decile_{x-1}) > 0$ or < 0
	Average Across Time: Percent of Sectors for Which the Sector IC is Greater than .1 or less than -0.1
	Average Across Time: Advance-Decline Reach Indicator
	Percent of Stocks for Which the Time Series Regression Coefficient for BxF is > 2
Consistency	Annualized Volatility of Sector-Neutral Decile 10-1 Performance Spread
	Annualized Volatility of Size-Neutral Decile 10-1 Performance Spread
	Annualized Volatility of Pure Play Factor Return
	Median Absolute Value of the T Statistic from the Pure Play Regression
	Percent of Months T Statistic from Pure Play Regression is Greater than 2.5 or Less Than -2.5
Normality	Average Across Time: Skewness of Cross-Sectional Factor Exposures
	Average Across Time: Kurtosis of Cross-Sectional Factor Exposures (Normal = 3)
	Average Across Time: % of Cross-Sectional Factor Exposures $> 2.5\sigma$ (Normal = .621%)
	Average Across Time: % of Cross-Sectional Factor Exposures $< -2.5\sigma$ (Normal = .621%)
	Average Across Time: Chi Square Confidence in Rejecting Normality of Factor Exposures



Performance of Risk-Factors: 60 Months: September 1998 - August 2003



Performance Summary

COMPOSITE SCORES

RANKINGS (1-17)

Abbrv	Risk Factor	Explanatory Power	Reach	Consistency	Normality	Power	Reach	Consistency	Normality
VOL	EQW Composite: Price Volatility	2.06	1.33	2.11	-0.13	1	3	1	12
MOM	EQW Composite: Price Momentum	1.56	1.59	1.62	0.23	2	2	2	5
LIQ	EQW Composite: Liquidity	0.85	1.17	0.87	-0.40	3	4	3	16
LEV	EQW Composite: Financial Leverag	0.59	0.65	0.52	0.23	4	6	6	4
EMO	EQW Composite: Earnings Momentum	0.58	0.01	0.03	-0.16	5	9	9	14
TVL	EQW Composite: Traditional Value	0.56	1.61	0.68	0.13	6	1	4	8
SZE	EQW Composite: Small Size	0.54	-0.11	0.66	1.36	7	11	5	1
REV	EQW Composite: Price Reversal	0.53	0.83	0.42	0.98	8	5	7	2
SKW	EQW Composite: Skewness	-0.09	-0.03	0.03	-0.03	9	10	10	10
RVL	EQW Composite: Relative Value	-0.14	0.04	0.11	0.69	10	8	8	3
EGR	EQW Composite: Expected Growth	-0.44	0.05	-0.25	-0.37	11	7	11	15
SPN	EQW Composite: Sponsorship	-0.59	-0.68	-0.67	0.23	12	16	14	6
SAL	EQW Composite: Accelerating Sale	-0.59	-0.58	-0.56	-0.09	13	14	12	11
XRT	EQW Composite: Currency Exposure	-0.67	-0.63	-0.71	0.15	14	15	15	7
HGR	EQW Composite: Historical Growth	-0.73	-0.50	-0.72	0.01	15	12	16	9
ERK	EQW Composite: Earnings Risk	-0.79	-0.55	-0.66	-1.05	16	13	13	17
PRT	EQW Composite: Profit Trends	-0.83	-1.03	-0.97	-0.14	17	17	17	13