NORTHFIELD modeling financial markets worldwide

Equity Factor Timing and Kiddie (Bumper) Bowling

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Introduction

- Relatively few equity investment strategies try to generate alpha by "timing" factor returns by forecasting period by period returns to equity factors.
- In such a strategy, any factor which explains security covariance may potentially be useful, as opposed to the traditional approach to generating abnormal returns by creating exposure to risk premia (factor returns with persistent positive mean).
- Successful factor timing strategies may arise from factors with zero means, but with predictable serial properties.

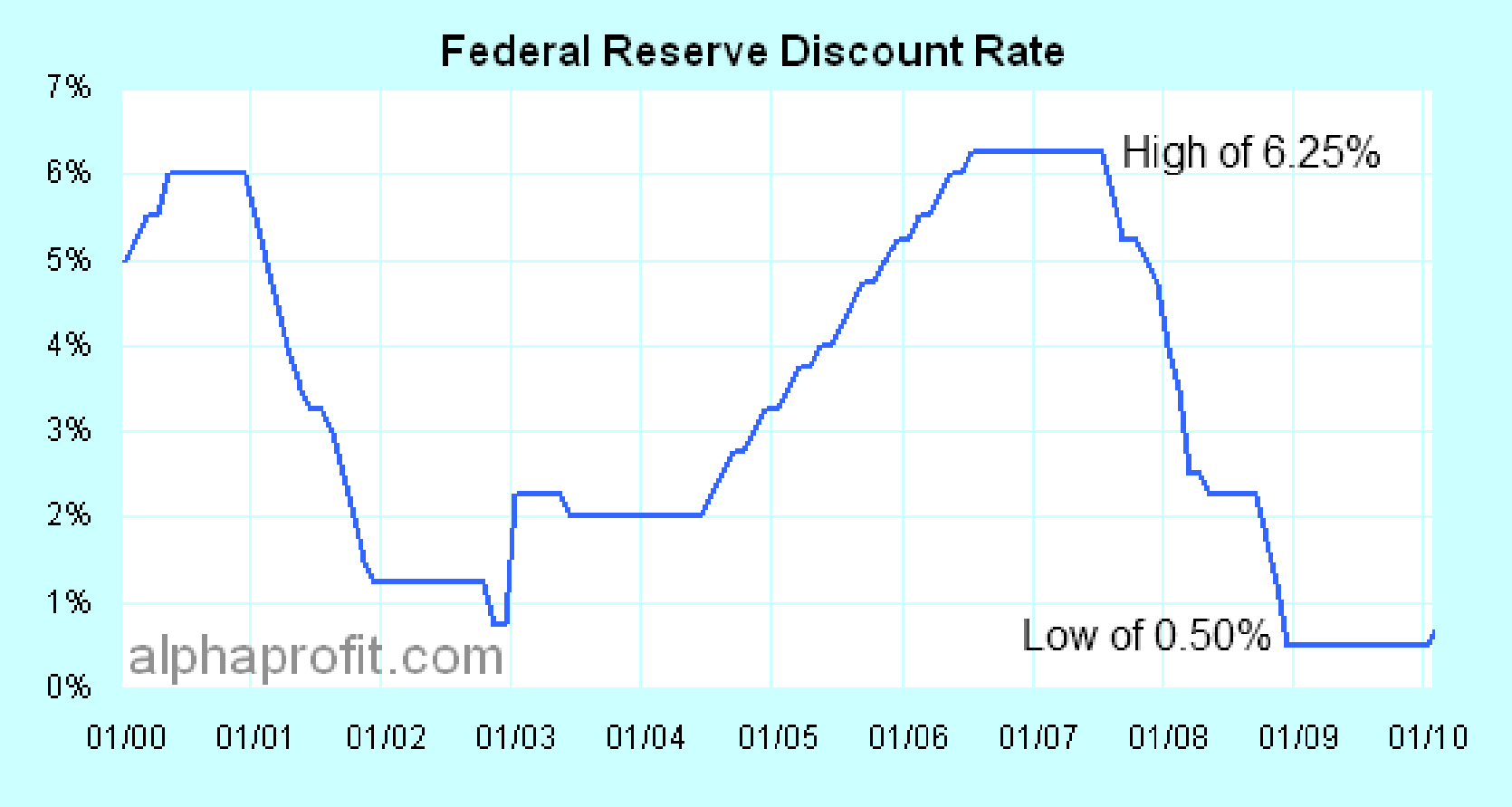
Presentation Outline

- Semantics: Defining factors for risk, return and timing
- An obvious illustration
- Traditional theoretical motivation
  - CAPM and APT
- Typical approach to factor identification
  - A unsurprising example
- The ignored influence of risk reducing factors
  - Negative beta factors
  - Cointegration
- A proposed functional form for “kiddie bowling”
  - Empirical examples

Semantics

- Within the context of linear factor models, we will use four terms to differentiate our usage for a given factor
  - Risk factors are the broadest category. Risk factors are the set of factors that explain (and hopefully predict) the covariance across asset returns over time. *Some may reduce risk in a multi-period context.*
  - Equilibrium factors are the subset of risk factors where a "risk premium" is presumed to exist. The returns to these factors are persistently positive as compensation to investors for the risk undertaken under specific economic theories (e.g. CAPM)
  - Timing factors where the variations in the factor returns have predictable serial properties irrespective of the mean return
  - Alpha factors are those factors that explain the differences in the cross-section of mean asset returns over time, without any explanatory power over the covariance of the returns.

An Inspirational Illustration of "Kiddie Bowling"



Properties of the Discount Rate Series

- We can quite reasonably define the Federal Reserve discount rate as an influential factor in financial markets
  - The changes in the discount rate are the factor "returns"
  - We observe strong positive serial correlation. Most of the time, up moves are followed by up moves, and down moves are followed by down moves. This effect is highly statistically significant under Wald-Wolfowitz test.
  - However, the series is also *stationary* with only modest variation in the long term mean, volatility and autocorrelation. The series does not extend to extreme values in either direction. We can confirm stationarity via the Dickey-Fuller test.
  - If we transform the series to log(discount rate) under the "wobbly" assumption that interest rates should be positive, these conditions are satisfied over the very long term (i.e. through the high rates in the late 1970s and 1980s).

Today's Questions

- The behavior of the discount rate obviously has a discernable trend which reverses when the cumulative sum (level) of the changes reaches boundary values.
  - Boundaries are not known in advance (i.e. today we have negative interest rates in many countries).
- Given this example, is it reasonable to assume that this behavior exists in many macroeconomic times series that could serve as factors in equity models?
  - Does this structural behavior exist in other factors that are commonly used to describe equity market behavior (e.g. size, growth, valuation)?
- What is a tractable functional form for this process that we can apply easily to other factor time series?

Equilibrium Factors

- Theoretical models posit that there must be a relationship between expected returns and some particular representation of risk.
  - Sharpe (1962), Ross (1980)
  - If you take risk you get have the expectation of being rewarded with higher returns.
  - The theoretical derivation of these all equilibrium models contain lots of assumptions that don't hold up in the real world (e.g. no transaction costs).
  - Most importantly, *CAPM and APT are single period models that do not account for compounding of returns*
  - Many of today's fashionable strategies such as "smart beta" (aka "smart marketing") are variations on the theme of equilibrium factors, while trying to exploit plausible factor risk premia.

Traditional Quant View of Factor Returns

- We next want to illustrate how typical quant investors investigate factors as a way to add return to their portfolios.
  - Our data set will be the monthly factor returns from Northfield US Fundamental for the twelve continuous value factors (beta, 11 style factors) from January 1989 through December 2013.
  - We segment the data into five year periods (e.g. 1989-1993, etc.). Within each period we calculate the monthly mean return, standard deviation and annualized information ratio for each of the twelve factors.
  - We will correlate the vector of information ratios for each of five year periods with the comparable vector of information ratios for the prior five year period to see if the factor return/risk tradeoffs are stable over time.

Comments on the Traditional Analysis

- Of the twelve continuous variable factors, nine of the twelve show at least marginal statistically significant risk premia.
  - The information ratio vectors are highly correlated with the information ratio vector for the prior period. Relationships are predictable with relatively infrequent observation (every five years). The Kendall W coefficient is highly significant.
  - The widely used Book/Price variable appears insignificant when in the presence of other valuation variables such as Dividend Yield. This is intuitive to us, as during most of the sample period dividends were more highly taxed than capital gains, therefore requiring greater return for the same risk.
  - Dividend Yield and Revenue/Price were of the same sign in all periods. Our Relative Strength momentum variable is positive on average but in near-monotonic decline across periods.
  - *Unsurprisingly, well documented themes such as "small size", "value", "quality" (low debt and predictable earnings, and "low volatility" all appear positive.*

Traditional Analysis Annualized IR

Start	1989	1994	1999	2004	2009		
End	**1993**	**1998**	**2003**	**2008**	**2013**	**Mean**	**Stdev**
Beta	0.77	0.79	0.11	-0.11	1.07	0.52	0.5
Earnings/Price	1.03	0.12	1.16	1.35	-0.21	0.69	0.69
Book/Price	1.37	0.3	0.37	-0.67	-0.63	0.15	0.84
Dividend Yield	1.47	0.47	0.88	0.52	0.51	0.77	0.42
Trading Activity	-0.18	0.32	-0.22	-1.07	-0.1	-0.25	0.51
Relative Strength	3.39	1.37	0.59	0.6	-0.13	1.16	1.35
Log of Market Cap	-0.84	0.49	-0.86	-0.75	-1.02	-0.6	0.61
Earnings Variability	0.06	-0.69	-0.86	-0.67	-0.93	-0.62	0.39
EPS Growth Rate	-0.17	-0.4	-0.49	0.56	0.52	0	0.5
Revenue/Price	0.48	0.81	0.03	0.5	1.53	0.67	0.56
Debt/Equity	0.13	-0.63	-0.38	-0.87	-0.31	-0.41	0.38
Price Volatility	-0.56	-0.82	0.03	-1.21	-1.4	-0.79	0.56
Correlation		0.64	0.42	0.63	0.57		

Risk Reducing Factors By Fama and French

- FF five factor model
  - Mkt-RF (market risk premium)
  - SML (small minus large)
  - HML (high book/price minus low book/price)
  - RMW (robust minus weak profitability)
  - CMA (conservative minus aggressive capital investment)
- Annual Data from 1964 through 2014
- All style factors returns are calculated “raw” and are not orthogonal to the market return

Factor Data Summary Statistics

	RP	SMB	HML	RMW	CMA	RF
Mean	6.62	3.96	4.87	3.08	4.17	4.27
St Dev	17.92	14.25	13.64	9.36	9.74	2.61
Skew	-0.65	0.53	-0.24	-0.37	0.36	-0.14
Kurtosis	-0.16	1.18	0.64	0.99	0.14	-0.70
Pearson	1.00	0.24	-0.29	-0.27	-0.36	-0.22
Geometric	5.01	2.95	3.94	2.64	3.70	4.24

Getting Alpha from Zero Alpha Factors

- We make each of the FF factors less interesting by demeaning the series so that the mean factor return is zero. Each also has a high volatility so looks really bad as an alpha factor

- But CMA has a large negative covariance with market risk premium which reduces portfolio volatility and increases geometric mean returns

	RP	RP+SMB	RP+HML	RP+RMW	RP + CMA
Mean	6.62	6.62	6.62	6.62	6.62
St Dev	17.92	20.01	19.15	17.86	17.05
Skew	-0.65	-0.30	-0.54	-0.56	-0.36
Kurtosis	-0.16	-0.01	-0.18	0.60	-0.10
Geometric	5.01	4.62	4.79	5.03	5.17

Factors To Reduce Long Term Uncertainty

- The econometric literature is extensive with respect to the concept of "cointegration"
  - This is a situation where you can combine two or more non-stationary time series and the resultant series is stationary (the distributional parameters like mean and standard deviation are constant across time)
  - What you would like is a set of factors that when combined with your portfolio would make the resultant return series be cointegrated
- Related papers and presentations on our website
  - http://www.northinfo.com/Documents/573.pdf
  - http://www.northinfo.com/Documents/59.pdf

Kiddie Bowling: Defining A Functional Form

- We want to predict future returns for *any* prescribed set of factors.
  - We have illustrated that the traditional view of factor risk premia has merit. Therefore our expectation for the next period should be related to the average factor return in the past.
  - We have also illustrated that for long term investors, expected factor returns should be credited with their impact on geometric mean portfolio returns, via negative covariance with the market factor.
  - Our conception of the "kiddie bowling" model requires that we assume trends persist most of the time (positive serial correlation), while reversals of the trend occur when the cumulative value of factor returns reach extreme *(but not easily defined)* levels. *Occasionally the serial correlation is amplified.*

Proposed Functional Form of the Model

$$E[F_t] = U_{t-1} + k_{t-1}(F_{t-1} - U_{t-1}) +/- ((1-p[Z_{t-1}])(M_{t-1}) - p[Z_{t-1}](M_{t-1}))$$

$$E[L_t] = E[F_t] - Cov[(F,R)_{t-1}]/200$$

E[ ] = the expectations operator

F_t = the % return on factor F during period t

U_{t-1} = the average % return on factor F from the start to period t-1

k_{t-1} = the correlation coefficient (F_t, F_{t-1}) from the start to period t-1

COV = the covariance operator

P = normal cumulative density function operator

Z_{t-1} = (average[$F_{t-n \text{ to } t-1}$] - U_{t-1}) / StDev [$F_{1 \text{ to } t-1}$]

M_{t-1} = % mean absolute value of F to period t-1 – U_{t-1}

L_{t-1} = geometric equivalent expectation of F_{t-1}

R = % return on the market factor

A Pretty Clean Formulation

- Numerous papers and presentations (including mine) have been very critical of the concept of "back-testing"
- To minimize potential bias, all expected values are formulated out of sample. We will ignore in-sample explanatory power.
- All parameters have "textbook" meanings outside the context of the model. Nothing is "fitted" to the specifics of the data set. The choice of 12 month input for parameter n within the Z-score was arbitrary.
- An increasingly large value for n switches the sign on the "kiddie bowling" term from positive to negative. We could split the third term into short term and long term components for even more explanatory power, but I wanted to minimize overfitting.

Fun Results

Information Coefficient
January 1994 through October 2016

	MA + AR(1)	MA + AR+KB	RSquared
Beta	0.16	0.25	0.06
Earnings/Price	0.18	0.30	0.09
Book/Price	0.07	0.20	0.04
Dividend Yield	-0.05	0.22	0.05
Trading Activity	0.12	0.26	0.07
Relative Strength	0.12	0.37	0.14
Log of Market Cap	0.03	0.30	0.09
Earnings Variability	-0.07	0.38	0.14
EPS Growth Rate	-0.16	0.32	0.10
Revenue/Price	0.20	0.28	0.08
Debt/Equity	0.14	0.27	0.07
Price Volatility	0.09	0.22	0.05
Average	0.07	**0.28**	**0.08**

Conclusions

- While investment strategies based on presumptions of factor risk premia are commonplace, active strategies based on timing factor exposures are rare.
- We've shown that the factors of our US Fundamental Model illustrate the common observed behaviors. More importantly, we show a high degree of stability in the relative information ratios over 25 years divided into five 5 year samples.
- Negative covariance between a factor return and the market factor return can reduce risk, increasing geometric returns relative to arithmetic returns
- Some factor returns do exhibit positive serial correlation on a month to month basis. The predictive power is modest relative to the magnitude of risk premia for most of the test data series.
- Adding the "kiddie bowling" term to the prediction equation was universally very helpful with the test series. Some series exhibit the expected behavior similar to the Federal Reserve discount rate. Other series exhibit the opposite behavior.