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Performance Analysis of Market and Factor Timing in Active Equity Management

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Introduction

- It is routine for quantitative strategies to be analyzed based on the per-period active returns associated with "factor bets" that are present in the portfolio strategy.
- Routine factor-based attributions are done on a period-by-period basis (day, month) and then aggregated over time to make statistical assertions such as "your low P/E tilt added X basis points per month of return over the sample period".
- To fully understand the implications of such results, we really need to get even further granularity in the analysis. We need to understand whether holding active factor exposures constant would have produced a better or worse result, as opposed to having factor exposures vary over time.
- *Frequently the alpha contribution of factor timing is negative even when the alpha contribution for factor tilts is positive.*
- Opposing signs on the alpha contribution of factor tilts and factor timing is often to be expected when viewed in the "portfolio dynamics" framework proposed by Sneddon (*Journal of Investing*, 2008) whenever transaction costs are non-zero.

Touring the Academic Factor Zoo

- Quantitative strategies are mostly based on "factor anomalies" all of which purportedly violate the "efficient market hypothesis" (Fama, *Journal of Finance*, 1970) in some way.
  - This led to the well-known Fama-French model which has grown from four to six factors over thirty years.
- The history of academic equity research suggests that there are hundreds of such anomalies, *when trading costs are assumed to be zero,* but several recent papers suggest that many purported anomalies are redundant and not statistically significantly different from others.
  - Feng, Giglio and Xiu (NBER, 2019)
  - Bessembinder, Burt, and Hrdlicka (SSRN, 2023)
- Chen and Zimmerman (2022) have created a website with free access to factor return histories on a large number of supposed factor anomalies (i.e. the "factor zoo"). Open Source Asset Pricing (openassetpricing.com)
- Novy-Marx and Velikov (SSRN, 2023) provide a free website for academics to test factor strategies for the US equity market inclusive of simple trading costs, Assaying Anomalies (psu.edu).
  - I recently spoke to Velikov about this kind of site encouraging "data mining" in academic papers.

A Key Catch

- Obviously when we talk about strategies based on factors, we need to distinguish whether we are talking about a parsimonious set of orthogonal factors.
- If factor returns are not orthogonalized by controlling for correlated variables, it is essentially impossible to determine whether the outcomes associated with any factor definition are statistically significant.
- In academic research it is common to test new factors net of the effect of the well known Fama-French factors but *ignore the fact that the reported Fama-French factor returns are not orthogonalized relative to one another.*
- In addition, the returns are typically measured as quintile return spreads where the actual magnitude of portfolio factor exposure (i.e. expressed as the *Z-score of a unit normal distribution*) can vary *randomly* through time.

Active Return Contributions

- In analyzing quantitative strategies, we routinely define the "return impact" of a factor in a given time period (day, month) as the *active exposure (net of benchmark) times the orthogonalized factor return.*
- Time series variation in the active factor exposure Z-score may arise from three sources over any multi-period sample of observations:
  - It may be accidental based on portfolio construction rules like "quintiles"
  - It may be intentional "timing" of factor returns
  - It may be unintentional because trading costs prevent us from changing our portfolio enough to have exactly the portfolio active exposures we want to have.
- We want our return attribution process to *measure the incremental return impact of each of these three influences.*

Super Simple

- If we have a time series of factor return impacts, calculate:
  - Active exposure Z-score in each period times the orthogonalized factor return
  - Just calculate the time series average of the active Z-score.
  - Replace the periodic factor exposures with their average.
  - Calculate what the factor return impacts would have been if the active factor exposure had been held constant.

- If the sum of the factor return impacts assuming constant active exposure is higher/lower than the sum of the factor return impacts with the real time varying exposures, the timing effect is positive or negative.

- Over our nearly four decades in business with hundreds of clients, I know only a handful who were mindful of this issue. Other affected clients shall remain anonymous to protect the guilty.

A Little More Sophistication

- Early research into "factor exposure variation" assumed that the only factor that mattered were market returns and that all time series variation in portfolio beta was the result of intentional market timing.
- Treynor and Mazuy (Harvard Business Review, 1966) proposed a variation of the CAPM to test for market timing.

$$R_t = \alpha + \beta * (R_{mt} - R_{ft}) + c * (R_{mt}-R_{ft})^2 + \varepsilon_t$$

- The model estimates the coefficients by time series regression.
  - The "stock picking" ability of the manager is measured by α.
  - The market timing ability of the manager is measured by C, which captures whether variation in instantaneous beta (above or below b) adds return.
- The same formulation can be used for any single factor by replacing β with the active factor exposure in Z-score form and replacing the market return premium for each period with the orthogonalized factor return. The α would capture any return associated with other factors in a multi-factor context.

Cross Factor Return Impacts

- While the algebra of a multi-factor factor return attribution for one period is just a dot product, the attribution of cumulative return impact to multiple factors has no calculation standard on which there is universal agreement.
  - A two factor (A and B) model for two periods using decimal returns should be sufficient to illustrate. For period 1 we have $R_1 = A_1 + B_1$ and for period 2 we have $R_2 = A_2 + B_2$

$$R_{12} = (1 + A_1 + B_1) * (1 + A_2 + B_2) - 1$$

$$R_{12} = (1 + A_2 + B_2) + (A_1 + A_1A_2 + A_1B_2) + (B_1 + B_1A_2 + B_1B_2) - 1$$

$$R_{12} = (A_1 + A_2 + A_1A_2) + (B_1 + B_2 + B_1B_2) + (A_1B_2 + B_1A_2)$$

- There are many different approaches to apportioning the cross-factor effects (purple) back to factors A and B. We have our own that allocates based on the average absolute value of A and B, which is tractable for many factors and many time periods.

Factor Timing with Transaction Costs

- For quantitative factor strategies, intentional increases or decreases to various factors will be driven by *signals* that embed factor return expectations into security returns.
- In the presence of transaction costs, your optimal portfolio is always a blend of the portfolio you would form if you were starting from cash, and the portfolio you held in the prior period.
  - The portfolio you held in the prior period used *the signals as they were in the prior period.*
  - *The prior portfolio was also influenced by the portfolio and signals from the next earlier period.*
- We use the term "portfolio dynamics" (Sneddon, JOI, 2008) to describe this inter-period chaining of portfolio signal and cost impacts.
  - The portfolio dynamics concepts are illustrated in DynamicsOfActivePortfolios.PDF (northinfo.com).
  - Many of the analytical conclusions are confirmed in Baldacci, Beneviste, and Ritter (SSRN, 2022)
  - We will soon introduce a new service, **Actionable Attribution** that captures these effects.

Factor Timing Across Style Factors

- If we believe that the orthogonalized factor return for a particular factor will be positive and we're right, the factor exposure of the portfolio to that factor may change in different ways depending on the nature of the factor.
  - For example, if we believed that the return to a "value" factor would be positive and we're right, then value stocks will be come a bigger part of our portfolio, but the "value exposure" of individual securities may become less (i.e. undervalued securities that outperform become overvalued).
  - On the other hand, a "momentum" factor having a positive return would both increase the weight of high momentum stocks in our portfolio, and further increase the exposure of the individual securities that were "high momentum exposure" at the start of the period.
- These kinds of results are very sensitive to how the factor returns are estimated, and whether major events (e.g. wars, pandemics) were included in the sample period
  - See diBartolomeo and Kantos (Journal of Asset Management, 2020).

Conclusions

- Most firms that purport to have a "style" have embedded factor exposures toward whatever factors they believe will provide positive orthogonalized return outcomes.
- While academic research suggests that hundreds of factor anomalies exist, many are redundant and most have no value net of trading costs.
- The direct return impact of these factor bets will be dependent on the active exposure to the chosen factors and be diluted by unintended bets on other factors.
- Time series variation in the active exposure of the chosen factors may arise accidentally from variation in security returns or intentionally from factor timing.
- Sub optimal active factor exposure may also arise from transaction costs *embedding a chain of influence of legacy portfolios (prior periods) in what we call portfolio dynamics.*
  - Different types of commonly used factors may embed different levels of dynamic effects.