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A New Four-Factor Investing Model

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For about three decades, the working asset pricing model was the capital asset pricing model (CAPM), with beta—specifically market beta—being its sole factor. Then, in 1993, the Fama-French three-factor model—which added size and value—replaced the CAPM as the workhorse model.

By eliminating two major anomalies (the outperformance of small stocks and of value stocks), it improved the model's explanatory power from about two-thirds of the differences in returns of diversified portfolios to more than 90%. Thus, it was a major advance.

In 1997, momentum was added as a fourth factor. It too improved the explanatory power of the asset pricing model by eliminating another large anomaly. The next major advance came from Robert Novy-Marx in 2012.

In his paper, "The Other Side of Value: The Gross Profitability Premium," he proposed a fifth factor, which also improved the model's explanatory power while eliminating another important anomaly—the outperformance of stocks with higher profitability.

Since then, what might be called the "battle of the factor models" has occurred, with parsimony considered a major virtue—the fewer factors needed, the better. Kewei Hou, Chen Xue and Lu Zhang—authors of the October 2012 study, "Digesting Anomalies: An Investment Approach"—proposed a new four-factor model, the q-factor model. It included market beta, size, investment and profitability, and went a long way to explaining many anomalies.

In 2015, Eugene Fama and Kenneth French proposed a new five-factor model, using their original three factors and adding somewhat different definitions of investment and profitability.

Mispricing Factors

Robert Stambaugh and Yu Yuan, authors of the January 2016 paper "Mispricing Factors," add to the literature by proposing another four-factor model that includes two "mispricing" factors in addition to the factors of market beta and size. The authors note: "Factor models can be useful whether expected returns reflect risk or mispricing."

By incorporating these mispricing factors, they are better able to accommodate 11 well-known anomalies. These anomalies, which represent violations of the Fama-French three-factor model, are:

1. *Net Stock Issues:* Net stock issuance and stock returns are negatively correlated. It's been shown that smart managers issue shares when sentiment-driven traders push prices to overvalued levels.

2. *Composite Equity Issues*: Issuers underperform nonissuers, with composite equity issuance defined as the growth in the firm's total market value of equity minus the stock's rate of return. It's computed by subtracting the 12-month cumulative stock return from the 12-month growth in equity market capitalization.

3. *Accruals*: Firms with high accruals earn abnormally lower average returns than firms with low accruals. Investors overestimate the persistence of the accrual component of earnings when forming earnings expectations.

4. *Net Operating Assets*: The difference on a firm's balance sheet between all operating assets and all operating liabilities, scaled by total assets, is a strong negative predictor of long-run stock returns. Investors tend to focus on accounting profitability, neglecting information about cash profitability, in which case, net operating assets (equivalently measured as the cumulative difference between operating income and free cash flow) captures such a bias.

5. *Asset Growth*: Companies that grow their total assets more earn lower subsequent returns. Investors overreact to changes in future business prospects implied by asset expansions.

6. *Investment-to-Assets*: Higher past investment predicts abnormally lower future returns.

7. *Distress*: Firms with high failure probability have lower, rather than higher, subsequent returns.

8. *O-Score*: An accounting measure of the likelihood of bankruptcy. Firms with higher O-scores have lower returns.

9. *Momentum*: High (low) recent (in the past year) past returns forecast high (low) future returns over the next several months.

10. *Gross Profitability Premium*: More profitable firms have higher returns than less profitable ones.

11. *Return on Assets*: More profitable firms have higher expected returns than less profitable firms.

The Process

Stambaugh and Yuan construct their two mispricing factors by average rankings within two clusters of anomalies whose long/short return spreads exhibit the greatest co-movement. Anomalies one through seven are in the first cluster of factors, and anomalies eight through 11 are in the second.

They then average a stock's rankings with respect to the available anomaly measures within each of the two clusters. Thus, each month, a stock has two composite mispricing measures.

The authors constructed their mispricing factors by applying a 2×3 sorting procedure—sorting all stocks by P1 (and then P2) and assigning them to three groups, using as breakpoints the 20th and 80th percentiles of the combined NYSE, AMEX and Nasdaq universe.

They chose 20th and 80th percentile breakpoints rather than at the 30th and 70th percentiles because mispricings tend to occur more in the extremes of the deciles. They then created value-weighted portfolios. Combining these

two factors (P1 and P2) with the market and size factors creates a four-factor model.

Stambaugh and Yuan's approach was motivated by the fact that "anomalies in part reflect mispricing and that mispricing has common components across stocks, often characterized as sentiment. A mispricing interpretation is consistent with evidence that anomalies are stronger among stocks for which price-correcting arbitrage is deterred by greater risks and impediments." This is often referred to as limits to arbitrage.

Results

Their study covers the period 1967 through 2013. Following is a summary of their findings:

- A four-factor model with two "mispricing" factors, in addition to market and size, accommodates a large set of anomalies better than notable four- and five-factor alternative models.
- Their four-factor model's overall ability to accommodate a wide range of anomalies exceeds that of both the four-factor q-model from Hou, Xue and Zhang and the five-factor model from Fama and French. The Fama-French five-factor model leaves all but one of the 11 anomalies with economically and statistically significant alphas. The q-factor model does somewhat better, leaving seven anomalies with significant alphas. Of the nine positive alphas in the four-factor anomaly model, all but one are lower than any of the corresponding alphas for the other models. The sole exception is the return on assets anomaly, for which the q-model produces a smaller alpha. That is unsurprising, given that the q-model includes a profitability factor. In addition, only two of the four-factor anomaly model t-statistics exceed 2.0 (a third has a t-statistic of 1.90) and the alphas for the asset growth and distress anomalies flip to negative values (with t-statistics of -1.96 and -1.03).
- The relative performance of the models was similar when they expanded the universe of anomalies to the larger set of 73 anomalies examined previously by Hou, Xue and Zhang.
- Both the q-model and the four-factor anomaly model do a good job of pricing the factors in the Fama-French five-factor model. In contrast, the Fama-French model doesn't perform well in explaining the returns of the anomaly-based model, and doesn't fare as well in explaining the returns of the q-model.
- Short-leg betas (loadings on the anomalies) are generally larger in absolute magnitude than their long-leg counterparts. This is consistent with a limits-to-arbitrage argument for persistent mispricing—there is more uncorrected overpricing than uncorrected underpricing. Given that many investors are less willing or able to short stocks than to buy them, overpricing resulting from high investor sentiment gets corrected less by arbitrage than underpricing resulting from low sentiment.
- Arbitrage asymmetry is consistent with the relationship between investor sentiment and anomaly returns. The short leg of the long/short anomaly spread is significantly more profitable following high investor sentiment, whereas the long-leg profits are less sensitive to sentiment.
- Replacing book-to-market with a single composite mispricing factor (anomalies one through 11), rather than by clusters, produces a better-performing three-factor model (superior to the Fama-French three-factor model).
- Their size factor reveals a small-firm premium of 46 basis points per month, nearly twice the premium of 25 basis points implied by the familiar size factor in the Fama-French three-factor model. This result is consistent with the findings from the 2015 study "Size Matters, If You Control Your Junk." The study's authors found that the size premium becomes substantially greater when controlling for other stock characteristics potentially associated with mispricing.
- In a test of robustness, their results were basically the same when they split the time period into two basically equal subperiods.

Implications

Stambaugh and Yuan note that because higher idiosyncratic volatility (IVOL) implies greater arbitrage risk, mispricings should get corrected less among stocks with high IVOL. That's exactly what they found, providing

further support for their results.

For investors, it's important to note that the authors' finding that there is more uncorrected overpricing than uncorrected underpricing doesn't mean a mutual fund would have to short a stock that's overpriced to benefit. It can benefit by avoiding purchasing the overpriced stocks, creating a filter to screen out stocks with the characteristic that creates the mispricing.

Thus, passively managed long-only mutual funds can put this knowledge to work. Dimensional Fund Advisors (DFA) is likely the most well-known firm that has long used screens to eliminate certain stocks from its eligible buy list. (Full disclosure: My firm, Buckingham, recommends DFA funds in constructing client portfolios.)

Summary

Through their research, financial economists continue to advance our understanding of how financial markets work and how prices are set. The Fama-French three-factor model was a significant improvement on the CAPM. Mark Carhart moved the needle further by adding momentum as a fourth factor. And the creators of the q-factor model made further significant advancements, which in turn motivated the development of the competing Fama-French five-factor model.

Now we have a new four-factor model that incorporates anomalies and appears to have greater ability to explain the differences in returns of diversified portfolios than some prominent alternatives.

The competition to find superior models is what helps advance our understanding not only of the markets, but of our understanding about which factors to focus on when selecting the most appropriate investment vehicles and developing portfolios.

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The Quest for Alpha (2011)

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