Swedroe: Battle Of New Factor Models

August 07, 2015

Larry Swedroe

In their groundbreaking paper, "Digesting Anomalies: An Investment Approach," Kewei Hou, Chen Xue and Lu Zhang proposed a new four-factor asset pricing model that goes a long way toward explaining many of the anomalies neither the Fama-French three-factor nor subsequent four-factor models could explain.

The study, which was published in the March 2015 issue of The Review of Financial Studies, covered the period 1972 through 2012.

The authors called their model the *q*-factor model. Specifically, their four factors are:

- The market excess return (beta)
- The difference between the return on a portfolio of small-cap stocks and the return on a portfolio of large-cap stocks
- The difference between the return on a portfolio of low-investment stocks and the return on a portfolio of high-investment stocks
- The difference between the return on a portfolio of high return-on-equity

(ROE) stocks and the return on a portfolio of low ROE stocks

Profitability Predicts Stock Returns

In their study, Hou, Xue and Zhang provided the theoretical underpinnings for the investment and profitability factors. They write: "Intuitively, investment predicts stock returns because given expected cash flows, high costs of capital mean low net present values of new projects and low investment, and low costs of capital mean high net present values of new projects and high investment. Profitability predicts stock returns because high expected cash flows relative to low investment must mean high discount rates. The high discount rates are necessary to offset the high expected cash flows to induce low net present values of new projects and low investment."

Among their important findings was that the investment and profitability (ROE) factors are almost totally uncorrelated, meaning they are independent, or unique. In addition, the authors found that the alphas of the value (HML) and momentum (UMD) factors in the *q*-factor model are small and insignificant.

These two factors, and the role they play, have been replaced by the investment and ROE factors. They also found that the *q*-factor model outperforms the Fama-French three-factor and four-factor models in its ability to explain most anomalies. In fact, most anomalies become insignificant at the 5 percent level of statistical significance. In other words, "many anomalies are basically different manifestations of the investment and ROE effects."

Not A Perfect Model

The authors did acknowledge, however, that "the *q*-factor model is by no means perfect in capturing all the anomalies." As with all models, even the *q*-factor model is flawed, or wrong. If a model were perfect, it would be called a law (like we have in physics).

But the fact that models are flawed doesn't mean they're absent of value. Think about it this way: Financial models aren't cameras that provide us with a perfect picture of

the way financial markets work; they are engines that advance our understanding of how markets operate and how prices are set.

And it certainly does seem that this new model has advanced our understanding of how markets set prices.

Fama & French Examine The Q-Model

Professors Eugene Fama and Kenneth French—in their paper, "A Five-Factor Asset Pricing Model," which appears in the April 2015 issue of The Journal of Financial Economics—took a close look at a new five-factor model.

Their objective was to determine whether two new factors—profitability (RMW, or robust-minus-weak profitability) and investment (CMA, or conservative-minus-aggressive investment)—added explanatory power. In other words, if Fama and French knew in 1993 (when they constructed their original three-factor model) what they know today, which model would they have chosen? Following is a summary of their findings:

- While a five-factor model doesn't fully explain the cross section of returns (there are still anomalies), it provides a good description of average returns.
- The model's main problem is its failure to explain the low average returns on small stocks that invest a lot despite low profitability. The Fama-French three-factor model, it turns out, has the same problem explaining the poor performance of small growth stocks.
- A four-factor model that excludes the value factor (HML) captures average returns as well as any other four-factor model considered. A five-factor model (including HML) doesn't improve the description of average returns over that of the four-factor models, because the average HML return is captured by the exposure of HML to other factors. Thus, in the five-factor model, HML is redundant for explaining average returns.

'Redundant Factor'

Fama and French did note that "while the five-factor model doesn't improve the description of average returns of the four-factor model that drops HML, the five-factor model may be a better choice in applications. For example, though captured by exposures to other factors, there is a large value premium in average returns that is often targeted by money managers."

Thus, "in evaluating how investment performance relates to known premiums, we probably want to know the tilts of the portfolios toward each of the factors." They added: "For explaining average returns, nothing is lost in using a redundant factor."

Importantly, Fama and French further found that the five-factor model performs well. They write: "Unexplained average returns for individual portfolios are almost all close to zero."

Large Stocks & Low Profitability

One of the authors' more interesting discoveries is that "the lethal combination for microcaps is low profitability and high investment; low profitability alone doesn't appear to be a problem."

However, Fama and French found that this problem does not hold for large stocks with low profitability and high investment. Passive portfolios can benefit from this knowledge by simply screening out stocks with these characteristics.

Another intriguing finding is that with this new model, just as the well-known value factor isn't required to explain the variation in returns of diversified portfolios, momentum isn't needed either.

Returning to the question, "Knowing what they know today, which model would they have chosen?," Fama and French concluded that (since HML seems to be a redundant factor, at least in the sense that its high average return is fully captured by

its exposure to other factors) in "applications where the sole interest is abnormal returns our tests suggest that a four-factor model that drops HML performs as well as (no better and no worse than) the five-factor model. But if one is also interested in measuring portfolio tilts toward value, profitability, and investment, the five-factor model is the choice."

A Retort

In a January 2015 study, "A Comparison of New Factor Models," Hou, Xue and Zhang compared the performance of the Fama-French (FF) five-factor model with that of their *q*-factor model, both on theoretical and empirical grounds.

They found that the *q*-model provides a better fit with economic theory and the empirical data. They note that while the profitability factor in the FF five-factor model is related, it's defined differently in the *q*-factor model. The ROE factor in the *q*-model is from monthly sorts on ROE, while RMW in the FF five-factor model is derived from annual sorts on operating profitability.

Hou, Xue and Zhang explain why this difference is important. They write: "Benchmark construction of the *q*-factor model is motivated from the neoclassical *q*-theory of investment, which says that ROE forecasts returns to the extent that it forecasts future ROE. Because the most recently announced quarterly earnings contain the latest information on future ROE, it seems most efficient to use the latest earnings data in our monthly sorted ROE factor. In contrast, the annually formed RMW seems less efficient because it is based only on earnings from the last fiscal year end."

In the *q*-factor model, the investment factor is based on annual sorts, as is the CMA factor in the FF five-factor model.

Different Sort Sizes

The authors were also careful to observe that the sorts used to construct the factors

are different. They explain: "The *q*-factors are constructed from a triple (2×3×3) sort on size, investment-to-assets, and ROE, whereas the new FF RMW (robust-minus-weak profitability) and CMA (conservative-minus-aggressive investment) factors are from double (2×3) sorts by interacting size with operating profitability and investment."

Empirically, they found that from January 1967 to December 2013, in the *q*-factor model, the size, investment and ROE factors earned, on average, 0.34 percent, 0.44 percent and 0.57 percent per month (*t*-stat = 2.51, 5.12 and 5.21), respectively.

In the FF five-factor model, the SMB, HML, RMW and CMA factors earned, again, on average, 0.28 percent, 0.37 percent, 0.27 percent and 0.36 percent (*t*-stat = 2.02, 2.63, 2.58 and 3.68), respectively.

The authors also found that "the five-factor model cannot capture our investment and ROE factors, leaving alphas of 0.12 percent (t = 3.24) and 0.45 percent (t = 5.44), respectively. However, the *q*-factor model does capture the HML, RMW, and CMA returns, with tiny alphas of 0.04 percent, 0.04 percent, and 0.02 percent, respectively (t-statistics all less than 0.5). As such, RMW and CMA are noisy versions of the *q*-factors."

Empirical Outperformance

They also found that "the *q*-factor model outperforms the FF five-factor model empirically. Across a list of 36 high-minus-low anomaly deciles, which earn significant average returns with New York Stock Exchange (NYSE) breakpoints and value-weighted returns, the average magnitude of the alphas is 0.20 percent per month in the *q*-factor model. This estimate is lower than 0.36 percent in the five-factor model and 0.33 percent in the Carhart (1997) model, which adds a momentum factor, UMD, to the FF three-factor model. Seven out of 36 high-minus-low alphas are significant in the *q*-factor model, in contrast to 19 in the five-factor model (21 in the Carhart model)." And they further found that the *q*-model outperformed the FF

five-factor model in small-cap stocks.

The creators of the *q*-factor model concluded: "Empirically, the *q*-factor model outperforms the five-factor model, especially in capturing price and earnings momentum and profitability anomalies. The relative performance of the *q*-factor model is robust to several perturbations of our test design, including breakpoints and return-weighting schemes in forming testing portfolios, as well as alternative factor constructions. In all, we conclude that the FF five-factor model is in essence a noisy version of the *q*-factor model."

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 single-factor capital asset pricing model. Mark Carhart moved the needle further by adding momentum as a fourth factor. And the authors of the *q*-theory have made further significant advancements, which in turn motivated the development of the competing FF five-factor model.

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

Larry Swedroe is the director of research for The BAM Alliance, a community of more than 140 independent registered investment advisors throughout the country.