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## Fama-French Three Factor Model Part I

by Frank Armstrong

The Fama-French Three Factor Model provides a highly useful tool for understanding portfolio performance, measuring the impact of active management, portfolio construction and estimating future returns. The Three Factor Model has replaced Capital Asset Pricing Model (CAP-M) as the most widely accepted explanation of stock prices in the aggregate and investor returns.

### CAP-M: A First Cut at the Problem

To review, and greatly oversimplify, CAP-M established the relationship between risk and reward. The market would set stock prices, and investors achieve returns directly related to risk. Said another way, investors would drive down the price of stocks until the expected return for owning them compensated them for the risk that the stock exhibited.

CAP-M explains stock performance, or investor returns as the sum of:

- The zero risk return
- The market premium
- A return for individual security risk proportional to its volatility relative to the market (Beta)
- The impact of management (Alpha)
- Random Error

So, stocks with higher volatility relative to the market would command lower prices and achieve higher expected returns. As an example, suppose we had a stock (or a portfolio of stocks) that was 20% more volatile than the market, and that the treasury bill yielded 3% and the S&P 500 return was 11%. Market premium was then the difference between the T-bill and market or 8%. Beta is 0.2 times the market premium or 1.6%

3.00	The zero risk return
8.00	The market premium
1.60	Beta (0.2 X 8.0)
	Alpha
	Random Error
<b>12.60</b>	<b>Expected Total Return</b>

The market will adjust the price of the stock to the point where an investor can expect a 12.20% average return.

Had the stock (or a portfolio with a Beta of 1.2) returned, for instance, 13.20% then the unexplained difference (Alpha) would have been presumed to be due to management impact. In that case, Alpha would be presumed to be 0.60%. (Let's be real here. A portfolio manager that happened to have a higher than expected return is hardly going to

attribute it to random error! Of course not. He is going to claim that the result was due to his superior skill and cunning.)

CAP-M uses a single factor (proportional market risk) to explain pricing and asset returns. It's an elegant theory, and a remarkable breakthrough in finance that won its creator, William Sharpe, the Nobel Prize in Economics in 1990. But, it didn't do a very good job of explaining the observed market returns, especially if a portfolio strayed very far from the center of the market. Small company and value companies had persistently higher returns than CAP-M could explain.

These anomalies presented problems that made a generation of economists buggy. Prices and performance just didn't fit the model very well. A related problem for investment professionals was that investment managers with small and/or value exposure could claim lots of Alpha that they didn't deserve. After all, you don't create added value by holding a portfolio that could be indexed. Additionally, CAP-M simply wasn't much use in portfolio construction.

### **A Better Mouse Trap: The Fama-French Three Factor Model**

The Three Factor Model takes a different approach to explain market pricing. Fama-French found that investors are concerned about three separate risk factors rather than just one. Actually, they found that in the real world, investors care about lots of different risks. But, the risks that have systematic prices attached to them and that in combination do the best job of explaining performance and pricing are market, size and value.

Investor returns are the mirror image of a firm's cost of capital. Even in the secondary market, the cost of a firm's capital is best estimated by the price of their securities. Small firms must pay more for capital when borrowing or issuing securities in the capital markets. Distressed firms (value), those that have poor prospects, bad financial performance, irregular earnings and/or poor management must also pay more for capital. Small firms and distressed firms have lower stock prices to compensate investors for these risks. Fama-French found that most appropriate measurement of value ? the one with the most explanatory power ? was the ratio of the stock's adjusted Book value to its Market price (BTM). Stocks with high BTM are value stocks.

So, everybody that buys any traded stock (or portfolio of stocks) takes market risk. If your portfolio holds all traded stocks in the weighted proportion of the total market, that's the end of the story. But, if your portfolio differs in its makeup in average size or on the growth-value spectrum of the market, then you will have a different result. There are additional premiums for accepting a portfolio either larger or smaller than the market, and/or with a tilt toward growth or value different than the market. (These risks are sometimes called a priced risk, because we can identify additional return for accepting them.)

Fama-French defined the size premium as the difference in returns between the largest stocks and the smallest stocks in the CRSP database. They defined the value premium as the difference in returns between the stocks with the 30% highest Book to Market Ratios (BTM) and the 30% lowest BTM.

So, the formula becomes the sum of:

- The zero risk return
- The market premium (Beta)
- Size Premium
- Value Premium
- The impact of management (Alpha)

- Random Error

In a particular time frame, none of these market factors is necessarily positive. However, over longer periods the premiums are persistent and generous. Value is more persistent than size but both are worthy of the investor's attention.

It's important to note that size and value risks are different than the market risk, but do not necessarily add total risk to the portfolio (at least as measured by standard deviation). So, a portfolio tilted away from the center of the market will act differently from the market, but will not necessarily have more risk.

The further you tilt the portfolio, the less it will look like the more commonly reported indexes. So, an investor that can't stand having different performance than his neighbor's ought not to tilt his portfolio very far, even if doing so might increase his total performance over the long haul. His mental tracking error against the nightly news might make the portfolio unsuitable for him.

Investment advisors understand that they can get fired for looking too different from everybody else. So, they tend to gravitate toward the center of the market. The Wall Street default strategy is "Don't stand out, don't get fired." Unfortunately, that strategy stands little chance of systematically achieving returns above market.

In general, small stocks do add volatility to a portfolio, but value stocks do not. Under Modern Portfolio Theory these risks may be partially offset by mixing asset classes with low correlations to existing assets. For instance, foreign small stocks have a very low correlation to US stocks, adding a diversification benefit that actually reduces risk at the portfolio level.

Going back to our theoretical portfolio, suppose that it was tilted strongly toward both small and value. The calculation for expected return might look like this:

3.0	The zero risk return
8.0	The market premium (Beta)
1.0	Size Premium
1.5	Value Premium
	The impact of management (Alpha)
	Random Error
<b>13.5</b>	<b>Total Expected Return</b>

When a portfolio is measured using this model, the vast majority of returns are explained. Alpha just about completely disappears when a portfolio measurement accounts for the average size and value weights of the holdings. No longer can portfolio managers claim credit for unexplained excess results that occur simply because they held a portfolio tilted toward small or value.

The disappearance of Alpha should bode poorly for the job tenure of active managers. After all, who would pay for excess performance that could simply be obtained by engineering an index portfolio with a strategic tilt toward small or value? In the Air Force we used to joke that there was always that 10% of the troops that didn't get the word. In the investment world, it appears that we have 90% of the troops that haven't gotten the word! Investors continue to pursue active management in spite of the overwhelming evidence that it can't add value consistently. Hope springs eternal, and may trump both common sense and an avalanche of evidence!

Actual results vary depending on timeframe. The various premiums do not show up like clockwork. If they did, they wouldn't be risk factors. There may be long periods where premiums go negative for any or all three factors. For instance, during the period from 1995 to 2000, market premium was huge while small and value premiums were negative. Since 2000 market premium has been negative, while small and value premiums were large. So, the example

? tilted? portfolio underperformed the broad domestic market during the first period, and outperformed it during the second. These time frames demonstrate a real world example of tracking error against widely reported indexes even with a superior strategy that paid off over the entire period but that appeared to under-perform during the first half.

While this is part of the normal investment process, short-term experience may obscure the value of a solid long-term strategy. Never the less, over the long haul, each of these factors has been remarkably stable in every economy in the world where we can obtain data, and in every long term time period. So, we have real world evidence coupled with advanced economic theory supporting the existence, persistence and strength of the various premiums.

### **Strategic Implications for Portfolio Construction**

One of the strategic implications of CAP-M is that the ultimate equity portfolio (measured in terms of maximum return per unit of risk) is the global portfolio. In other words, equity investors should strive to own their proportional share of all the world's traded stocks. Single factor models yield simple solutions.

Under the Three Factor Model, the result isn't quite so tidy. Investors must now decide how much of each of the three factors they are willing to hold when they construct their portfolios. They must manage the tradeoffs between the three factors to suite their own appetite for the various risks.

The good news here is that investors can now build portfolios with expected returns significantly higher than the global equity portfolio. By identifying the true priced sources of risk that generate returns, and managing their exposure to fundamental risk factors through passive structural portfolio engineering techniques they can obtain these additional benefits at dramatically lower costs.

These increased expected returns do not rely on any magic performance by an active manager. They can be economically achieved by building a portfolio of index funds that rely solely on exposure to risk factors that over time have demonstrated persistent strong positive premiums. This process takes a long step forward in turning investment management from voodoo science into a real discipline.

**Coming up:** Our next paper will demonstrate how three factor regression analysis can be applied to real mutual fund results to explain their performance, and used to increase expected returns when designing a portfolio.

Read [Fama-French Three Factor Model Part II](#)

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