Asset Management: Engineering Portfolios for Better Returns

by Eugene F. Fama Jr.

Editor's Note: As consultants, we are looking for a methodology which we can use to construct our client's portfolios which is better than the conventional methodology of guessing which managers or asset classes will have excess returns. The Fama-French Three-Factor and Five-Factor models have become the most widely used portfolio construction tools in the industry. They are used by firms such as SEI, Smith Barney, and Lockwood Financial Group, and provide a useful framework within which we can manage factors in a more reliable way than the old methodology of managing asset classes. We have asked Eugene Fama Jr., vice president of Santa Monica-based Dimensional Fund Advisors, to explain the Fama-French Three-Factor Model.

The most certain of financial concepts is that risk and return are related. Systematic differences in returns must relate to differences in risk. After all, who would invest in stocks if they expect the same return as Treasury bills? Investors expect markets to compensate them for increased uncertainty and an increased chance of loss–and prices reflect their expectation.

Economists are unable to document any reliable way to add to returns without taking additional risk. How a plan is exposed to risk –what overall asset classes it holds and in what proportions–determines how well the plan performs relative to other plans. The structure decision is therefore the most crucial investment decision.

Researchers have known for a while that increased returns come from increased risk, but until recently they didn't know a lot about risk. Because risk means uncertainty, the risk-return relationship is hard to quantify–if we knew how and when risk is rewarded, it wouldn't be risk. Structuring portfolios is daunting in such conditions. It's hard to allocate assets effectively without knowing what risks are out there and how much reward we can expect for taking them.

Economists rely on models–approximations of reality–to characterize and predict the relationship between risk and return. The latest and most effective of these models is the three-factor model of Eugene Fama of the university of Chicago and Kenneth French of Yale University. The model identifies three independent dimensions of equity returns and allows us to measure their role in returns.

This is a powerful tool for consultants. It allows us to measure manager performance and style – to pinpoint whether a manager adds returns in excess of returns due to risk. Unlike traditional attribution methods, it allows us to create an expected return based on exposure to the factors. Finally, it specifies the factors the market rewards with higher returns. We can design portfolios to outperform traditional management, and to outperform the market as a whole.

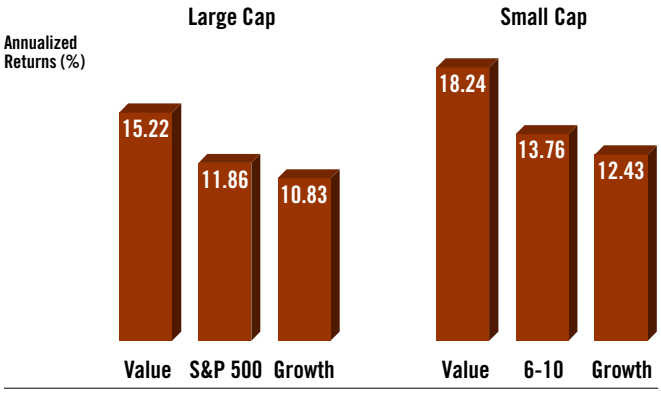
Where Returns Come From

Fama and French tested many variables in their search for traits that explained differences in returns. These variables included company size, leverage, price/earnings, price/cash flow and price/book value. They sorted the stock market on each of these variables to see if it created a pattern in returns–to see if stocks ranked by a fundamental variable also fell into rank by historical performance. They concluded that almost all the variables they tested relate to returns. Two of the factors, however, seemed to do the job of all the factors together. Specifically, portfolios consisting of small companies or those with relatively high book-to-market (BtM) ratios have superior rates of return.

The next step was to test these variables to find out if they are factors in returns. Just because a certain fundamental characteristic aligns with past performance does not mean the fundamental represents a risk factor the market compensates with systematic returns. This is where models come in. The litmus test for identifying factors in returns is a simple asset pricing model, as developed by William Sharpe in the early 60s. Fama and French tested their factors in a revamped version of Sharpe's beta model. They found that three factors–the extra risk of stocks versus fixed income (or the "market factor"), the extra risk of small cap stocks over large cap stocks (the "size effect") and the extra risk of high BtM stocks over low BtM stocks (the "BtM effect")–seem to explain virtually all the differences in portfolio performance.

What does this mean and why do we care? As planners and consultants, this result suggests that performance versus the market or versus the next guy depends almost entirely on the amount of stocks in general, the amount of

Exhibit 1
Research Results: 1964-1997



	Large Cap			Small Cap		
	Value	S&P 500	Growth	Value	6-10	Growth
Standard Deviation	17.54	15.89	17.13	23.96	25.10	27.08

small cap stocks and/or high BtM stocks you hold. If you overweight safer large cap low BtM (or "growth") stocks, your expected return is lower. If you overweight riskier small cap high BtM (or "value") stocks, your expected return is higher.

Why Book-to-Market?

Most people agree that the stock market is riskier than T-bills and that small stocks are riskier than large stocks. The notion that high book-to-market stocks are riskier and have greater returns than low book-to-market stocks is tougher to accept. What's so special about book-to-market? It's just a fundamental measure. On the surface, there's no economic reason book-to-market should relate to differences in returns.

The short answer is that there is nothing special about book-to-market. It does not describe risk. However, sorting stocks by BtM also seems to sort them by their true underlying source of risk–the level of their distress. The key to book/market lies in the denominator, market price. High book/market stocks are lower-priced stocks. This is usually because the stock is a poor earner, which makes it riskier. Riskier means higher returns. The connection between BtM and returns makes sense when we focus on the denominator, the market price.

The Nobel Prize awarded to Merton Miller in 1990 recognized his pioneering research into the cost of capital. When markets work, the cost of capital to a company equals the expected return on its stock. This is a simple but profound notion. Companies seeking capital come to the marketplace with earnings prospects. Investors supplying capital want the highest return with the least risk. Prices for new stock or bond issues represent the clearing price satisfying each party. Prices change in the secondary market in response to new developments, but no matter how far removed from the initial offering, they always reflect the risk of the underlying capital venture.

The cost of debt capital is easy to measure–a bond issue priced to yield 7% to the investor represents a 7% cost of debt capital to the issuer. No such precision is available for computing the cost of equity capital, so economists use asset-pricing models to develop reasonable estimates.

Suppose Microsoft and Apple Computer each go to the bank for a loan. Which company will have to pay the higher interest rate? Apple will–its future is uncertain and the bank will need to be paid to take the extra risk. Apple therefore pays a higher cost for its capital.

The stock market works the same way. The market expects a higher return for Apple stock than for Microsoft stock. This induces investors to purchase Apple even though Microsoft seems to have better earnings prospects (it seems safer). Put differently, if the two companies had the same expected return, no one would buy Apple. This doesn't mean Apple will always outperform Microsoft (remember, if we know for sure what'll happen, it isn't risk). We have to conclude the market will set Apple's price at a discount, so the expected return is higher–otherwise we'd be assuming Microsoft were riskier. This is an example, in any case. In practice, we always want to hold broadly diversified portfolios to capture the true factors in returns and minimize the noise in individual stock returns.

The Flavors of Risk

Fama and French identified three independent sources of risk in stock market returns. For these risks to be truly independent, we expect them to manifest themselves differently. If the return differences could all be explained by a shared source of risk like standard deviation we'd be back to a single-factor model.

Let's suppose there are different sources of equity risk. What if you only care about one of them, standard deviation? In this case the jargon would dub you a mean-variance-preferenced investor. If the only risk you fear is

fluctuation of returns, you should use a mean-variance optimizer, and the optimizer will tell you to overweight value heavily. This is a perfectly legitimate approach. However, very few investors care only about standard deviation.

If you care only about standard deviation, you don't care about tracking drift. You don't mind if the market is going strong for several months and your portfolio is flat, or negative. You don't care if your portfolio is dominated by bank stocks and has no technology stocks. You don't care if your portfolio has the same negative return of 2% every quarter for two years. That portfolio has a standard deviation of zero.

Sarcasm aside, investors care about a lot more than just standard deviation. Questions from clients will reveal their true risk preferences, and the above concerns are not unusual. In fact, the Fama-French model proves investors care about other risks besides just standard deviation.

Using the Three-Factor Model in Practice

Because the Fama/French model is an asset-pricing model, it can perform a number of useful functions:

- Calculate expected returns based on factor exposure.
- Analyze manager styles and success.
- Analyze proposed portfolios and reallocations.
- Analyze contributions of additional asset classes

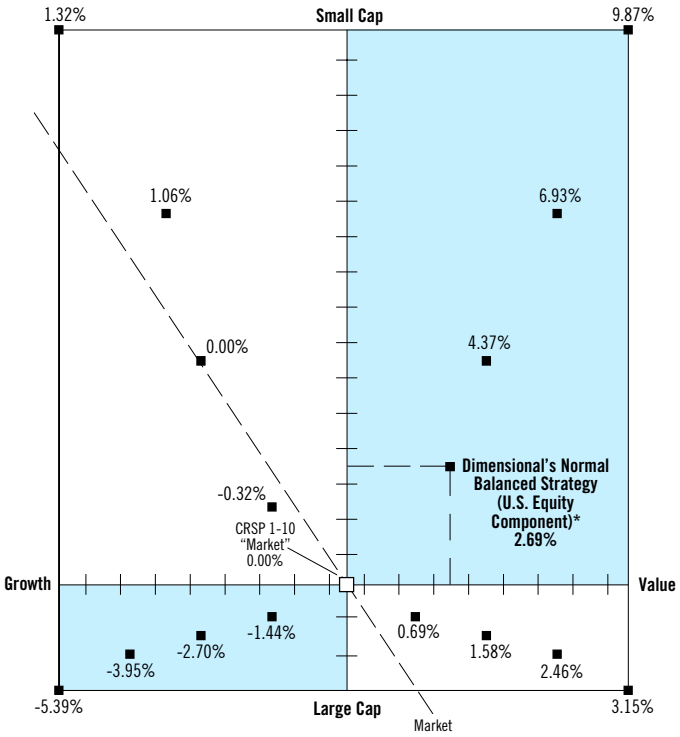
We focus here on the first two.

Expected Returns Based on Factor Exposure

The model allows us to calculate the way portfolios take different types of risk and calculate their expected returns based on these risks. Exhibit 2 shows how we plot portfolios for their factor exposures. The crosshair has two dimensions, size along the vertical axis and BtM along the horizontal axis. The axes represent "exposures" to the two factors. Portfolios that take a lot of size risk plot higher along the size axis and portfolios that take a lot of BtM risk plot farther right along the BtM axis. Because all equity portfolios take similar market risk, we don't need a third axis for beta. The market sits at the crosshairs. All portfolios are plotted relative to the market.

As an example, the plot shows one of Dimensional's suggested balanced equity strategies. The portfolio is

Exhibit 2
Three-Factor Model
Estimated Expected Return Premiums over Market



Annual Fama-French Data (1964-1995)
Market minus T-Bill = 5.55 **Size Effect =** 3.73 **BtM Effect =** 5.34
Example Asset:
Beta = 1.01 **Size Loading =** .26 **BtM Loading =** .31

Example Calculation:		
Beta × (Average Market minus T-Bill)	1.01 × (5.55)	**5.61**
Size Loading × (Average Size Effect)	+ .26 × (3.73)	**0.97**
BtM Loading × (Average BtM Effect)	+ .31 × (5.34)	**1.66**
Minus Market Excess Return	-	**5.55**
Estimated Expected Annual Return Over Market		**2.69**

"tilted" away from a simple market portfolio by increasing exposure to small cap and value stocks. The monthly simulated returns of this portfolio were run through the three-factor model and the results are shown. This (equity) portfolio has a beta of 1.01, a size exposure of 0.26 (which makes sense because the portfolio is one-third small cap) and a BtM exposure of 0.31. The portfolio is plotted at 0.26 on the size axis and 0.31 on the BtM axis. The table to the left of the chart demonstrates how to calculate this portfolio's expected return. Each percent exposure from the regression result is multiplied by historical average return. The expected returns due to each factor are totaled and the market return is subtracted out, to show the return as an expected premium over the market. In this case, the suggested balanced strategy is expected to produce returns that on average exceed the market by 269 basis points per year to compensate for the additional small cap andvalue exposures.

Analyzing Portfolios

The crosshair "map" is a universe of opportunities. A portfolio can land anywhere on the plot and it's easy to calculate its expected return. The amount by which actively-managed portfolios historically outperformed or underperformed this expectation constitutes their "alpha". The model compares a manager to an indexing of his precise factor exposures, rather than to a benchmark that may or may not reflect what he invested in. A small cap manager, for instance, may overweight value stocks relative to his benchmark, the Russell 2000 Small Cap Index. As a result, he outperforms it. Judged against the benchmark, he had a premium return that he uses to justify a premium fee. But if the extra return was simply compensation for taking additional systematic (value) risk, why should he get credit? The job of an active manager is to provide additional returns that can't be achieved through indexing. In this example, the model would place him somewhere to the right of the Russell 2000 along the value spectrum. We should insist he outperform that benchmark before crediting him with a premium return. Active manager fees are supposed to pay for smart stock selection, not addi-tional returns that are compensation for taking additional risk.

The diagonal dotted line in Exhibit 2 shows the set of points at which the size and BtM factors cancel each other out. All points along this line have the same expected return as the market, because the expected return gain from increased small cap exposure is canceled out by the expected return loss from increased growth exposure, and so on. If you want to beat the market, you should position your portfolio to the right of the dotted line. All points left are expected to underperform the market.

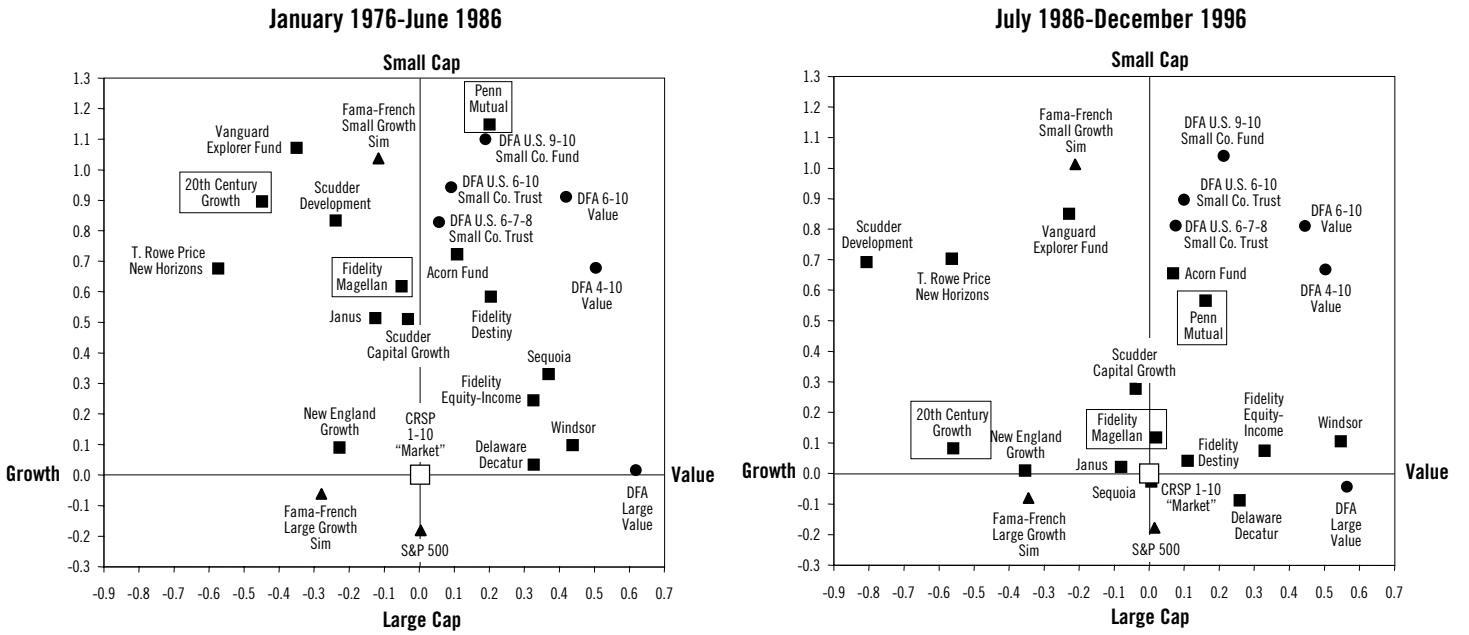
Is Alpha Everything?

Structure determines the vast majority of investment returns. The way you position your portfolio on the crosshair map will largely determine your return. The amount of return typically due to alpha from stock selection or timing is negligible. Yet active managers typically focus on alpha and are less concerned with how consistently and strongly they expose their portfolios to the risk factors. They typically fail to provide reliable exposure to the factors and they typically fail to provide reliable alphas.

Paint a Perfect Picture

Exhibit 3 shows regression results for several popular active managers from the Morningstar database. I ran their returns through the model, with no information about their market caps or BtM ratios. The plot shows the managers with the period (1976-1995) broken in half. On

Exhibit 3
Three-Factor Model: Manager Profiles



the left we see the managers' average exposures for the first half of the period (1976-1985) and on the right we see the managers' average exposures for the second half of the period (1986-1995). Look how the positions shifted over time.

20th Century Growth spent the first half of the period, on average, as a growth fund with a small cap (Russell 2000-like) size. In the second half it was still a growth fund, but a market-sized growth fund. Pennsylvania Mutual used to be microcap in size but moved to a midcap (S&P 400) size in the latter half of the period. Even Magellan went from a neutral midcap fund to looking exactly like the market.

Funds tend to migrate towards the market. We can speculate why. The market is still the general benchmark they're compared to and they don't want to be too different. Also, as funds get more and more popular, they often increase the size of their holdings to accommodate new investment dollars. Whatever the reason, the market seems to have a "tractor beam" sucking managers towards it over time. When they move enough, it constitutes nothing less than a change of asset class.

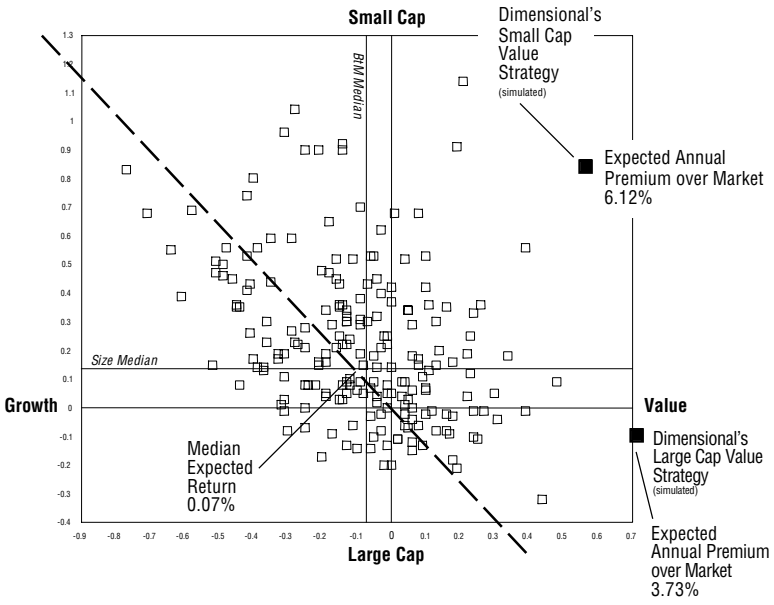
The days when managers should make asset class decisions are long gone. When you hire a small cap manager, it's because you want small cap in your plan. As a consultant, you decide what amount of small cap or value risk fits your client's preference and investment horizon. If you hire a small cap manager who changes to a large cap manager, he's usurping the biggest part of your responsibility. Structuring an investment portfolio is like making a painting: you combine different factors to create an overall picture. Managers are most useful for the vivid, consistent way they deliver the factors. If one day you squeeze the cadmium red tube and green comes out, how can you paint the picture you want?

It Takes a "Structured" Manager

It's often the structured managers who discover important asset classes. Active managers, in their search for alpha, don't address the structure issue because they strive to add returns without taking commensurate risk. Structured investing is the strategic opposite. It's about earning a return based on your willingness to take risk.

Active managers don't seem to identify all the risk dimensions and they don't seem diligent about delivering the risk dimensions they manage to identify. Exhibit 4 shows every Morningstar manager with at least seven years of data for their entire available history run through the model. The Fama-French Value indexes are virtually alone in the smallest and most value-tilted regions of the map. Active managers have not identified or delivered true value strategies.

Exhibit 4
Three-Factor Model: Manager Profiles
All Morningstar Equity Funds (203)
January 1976-September 1994



This isn't surprising. An active manager's primary directive, hardwired into his psyche, is to pick winners. Value investing is about investing in earnings-distressed companies. Picking the big potential earners from the value stock universe is similar to picking the almost-large small cap stocks. It dilutes the effect. The poorest earners have the highest costs-of-capital and therefore the highest expected returns. A portfolio of value stocks with bright prospects is a growth-biased portfolio. Active managers have the additional disadvantage of being able to buy whatever they want. They aren't forced by a strict, disciplined charter to stay within a certain size range or certain levels of distress. They have more personal accountability because of this freedom. They have to explain the ugly stocks in their value strategies. Some of these stocks are hard to look in the eye, and harder to justify to an investment committee long steeped in the notion that big earners get higher returns.

Factor Trade-offs

The plotting template from Exhibit 2 is superimposed over the managers in Exhibit 4. Remember the diagonal dotted line where every point has the same expected return as the market? Notice how that line slices through the "cloud" of active managers? It's a loose fit, but the shape is distinct.

Fama and French presented their research in 1990 and this chart plots managers back to 1976. But Fama and French did not invent value investing any more than Benjamin Franklin invented electricity. They simply discovered the risks people have always cared about. Managers who were willing to take one type of risk would trade off against the other type. If a manager was willing to buy small cap stocks, he'd typically want the robust, big-earning small cap stocks. If he were willing to buy distressed stocks, he'd want the largest, most entrenched distressed stocks. It seems the managers instinctively traded-off between the two risk factors long before Fama and French published their findings.

A Powerful Tool for Practicing Advisors

For most financial advisors, the three-factor model is not a useful selling tool. The real advantage of the model is that it gives the advisor a framework for his investment strategy. It identifies the sources of risk that compensate investors with premium returns. The trade-off between factors is simpler in a multifactor world than managing asset classes the old way. Investors have to decide how much of each type of risk they are willing to tolerate, and structure their portfolios to achieve the risk exposures in the most effective manner. Before the model, they had to decide amongst a Byzantine array of managers and asset classes. Managers and asset classes are interchangeable when the central problem is managing three simple factors.

This clarifies decisions: portfolios are based on research and rational expectations rather than hunches. The model promotes a belief system. In a world where most investors are guessing which managers or asset classes will have excess returns, a strong opinion backed by the best technology is a competitive advantage. Questions and problems are answered using a consistent philosophy. This increases self-confidence as well as client confidence. Clients grow to rely on your opinion.

The model can enhance your business profoundly. A clear, consistent overall methodology is not only sound investment strategy, but also a powerful consulting advantage.