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Multifactor Investing

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People who attend my lectures on Fama and French's multifactor model often request copies of my slides. Rather than distribute just the slides, it seems sensible to include text explaining the ideas. That way conference participants won't have to reconstruct the argument from memory and a pile of graphs.

The Model's Key Benefit

For most financial advisors, the three-factor model is not a useful selling tool. Few sales calls afford time for a lesson in multiple regressions (understatement, right?). The real advantage of the model is that it gives the advisor himself a framework for his investment strategy. It identifies the sources of risk that compensate investors with premium returns. This clarifies decisions. Portfolios are based on research and rational expectations rather than hunches. The model also promotes a belief system. In a world where — let's face it — 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. It has had a revolutionary effect on Dimensional Fund Advisors at a key time in the history of the investment industry. Often, when industries grow, division of labor causes firms to specialize more and more. For example, a single company used to make an entire car. Now a single company might make only the car's radiator hose. The investment business has

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*Dimensional Fund Advisors Inc. The comments of Samuel Adams, David Booth, David Butler, Truman Clark, Robert Cornell, Robert Dintzner, Eugene Fama, Ken French, Rex Sinquefield, Christopher Sullivan, Weston Wellington and Daniel Wheeler are gratefully acknowledged.

been following an opposite pattern. As the pension industry grows, plan sponsors are reducing the number of managers they hire.[1] Managers who offer multiple asset classes are replacing managers who specialize in a single asset class. This means the sponsor has fewer manager relationships, so he wants these relationships to be productive. Today, a manager is hired for the quality of his advice as well as the quality of his product line. A clear, consistent overall strategy is crucial.

How the Model Helped Dimensional Fund Advisors

Dimensional started as a boutique manager of small capitalization ("small cap") stocks. The niche was specific and unique. The firm believes markets are efficient and its small cap product was the only passive product of its kind. It was also one of the only products backed by the latest academic research. Throughout the eighties, as managers of multiple asset classes began to dominate the industry, Dimensional's academic directors set to work creating new products. The firm introduced fixed income, international, and other asset class strategies, all backed by research and all consistent with a belief in rational pricing and market efficiency.

In 1990, Fama and French began their groundbreaking work on the dimensions of stock returns.[2] This led to Dimensional's value strategies and the three-factor model as a consulting tool. The model provided guidelines for assembling the product line into portfolios. It also enhanced the firm's ability to consult with clients. Dimensional enjoyed unprecedented asset growth. Simultaneously, the firm developed its Financial Advisor Services, which further enhanced its ability to discuss multiple asset class portfolios.

In a sense, managers like Dimensional have evolved to resemble financial advisors. Advisors form portfolios of multiple asset classes based on client risk parameters. Their job requires them to recommend strategy and evaluate performance.

Advisors can experience the growth Dimensional experienced using the Fama-French model. Just as it did for Dimensional, the model can give advisors the latest investment technology and help them form a consistent philosophy. It can help make an advisor indispensable to his or her clients.

Asset Pricing Models

Single-Factor Market Model

In 1990, Fama and French sought to determine which economic traits describe the variation in stock returns. What sources of risk does the market systematically reward with higher returns? Prior to the Fama-French research, academics and investors typically believed a single factor model did the best job.[3] The idea, for which Bill Sharpe won the Nobel prize in 1990, has intuitive appeal. It suggests

that investors are rewarded for the amount of risk they take relative to their greater opportunity set, that is, all the other things they could have invested in. In the realm of U.S. equities, this means the entire stock market. So the expected return for a subset of the market (in other words, any U.S. stock portfolio) is proportionate to the subset's market risk.

Let's illustrate this with an example. Suppose you hold a portfolio of small cap stocks. In the past, when market returns were "up" by 1.00, let's say on average your small stock portfolio returns were up by 1.20. When market returns were down by 1.00, let's say on average your small stock portfolio returns were down by 1.20. In other words, when the market moved, the average movement of your returns was 20% more. This portfolio would be said to have a "beta" on the market of 1.20. The single-factor model's estimate for your expected return would be 120% of the market's average historical return. If a manager over- or under-performed this estimate, his "excess return" would be deemed his "alpha". Alpha is any return that isn't due to common variation with the factor(s). It is therefore the amount by which a portfolio outperformed an index of its exact risk exposure. Because it measures the return that couldn't have been "indexed", alpha is often used to measure a manager's skill, or value-added. Active managers are paid lots of money to achieve alphas.

The single-factor model is grounded in an elegant theory. The rationale is sensible. It's a great model in every respect except for the fact that it doesn't work. It did a decent job when the world of investments was mostly managed versions of the market, but the further portfolios got from the market, the less the model explained their returns. The small stock portfolio mentioned above is a good example. Around 1984, small stocks had a historical beta of about 1.20, as in the example. The market had average annual returns of 13.8% in the following period, 1984-1990. Our expectation based on the single-factor model would be for small cap stocks to return about 16.6% (=13.8% x 1.20) over this period. But, in fact, small cap stocks returned only 3.9% per year on average. A crude estimate of alpha for the small stock portfolio is the return they got minus the return they were expected to get, or 3.9% - 16.6% = -12.7%. Since alpha is used to evaluate a manager's skill in his objective, even index managers of small cap stocks earned huge negative alphas (-12.7% per year) over this period. It wasn't due to inadequate management (an index portfolio isn't "managed" in the classic sense). It was due to an inadequate model.

Three-Factor Model

Fama and French were the latest in a series of academics who attempted to find a model to replace the CAPM. They tried many variables in their search for the traits that bring higher returns. Price/earnings, leverage, cash flow, book/market and size were among these variables. They concluded that three factors together — the classic market beta, firm size (market capitalization) and book-to-market

(BtM) — do the best job explaining returns. Alphas go to zero for indexed portfolios using these factors. In academia, this is taken as evidence that the factors are "risk factors", sources of risk the market seems to reward over the long run. The stock market is riskier than Treasury bills, therefore the market has an expected premium over Treasury bills. Small cap stocks are riskier than large cap stocks so they have an expected premium.[4] High book-to-market stocks are riskier than low book-to-market stocks so they have an expected premium.

Most people readily agree that the stock market is riskier than the bill market 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. It doesn't matter so much what accounting measure we use to "scale" these lower prices. Fama and French use book value. Earnings over price works too. Another way to think of it is that high book/market ratios suggest the market (denominator) values the stock less than the stock's accountants (numerator), compared to lower book/market 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 begins to make sense when we focus on the denominator, the market price.

How to Beat the Market

In addition to pinpointing the sources of stock returns, Fama and French found another interesting result: adding size and BtM factors to a single-factor model causes the market betas of stock portfolios to hover around 1.00. All stock portfolios have about the same beta. You will not outperform another stock portfolio by taking more market risk. Differences between portfolios are largely due to different exposures to size and BtM factors. When beta itself differs, it's usually due to a non-stock component in the portfolio, such as fixed income, causing interest rate sensitivity. If you have a higher beta than the market it usually means you are less interest rate sensitive and if you have a lower beta it usually means you are more interest rate sensitive. If you are all equity, you get the full shot of market risk and return. This means the only way to beat or underperform the next guy, and the market itself, is to take more or less size and/or BtM risk. If your goal, for instance, is a higher expected return than the market, the only systematic way to achieve it is by overweighting small cap stocks, high BtM stocks or both relative to their market proportions.

The Cost of Capital is Paid to the Investor

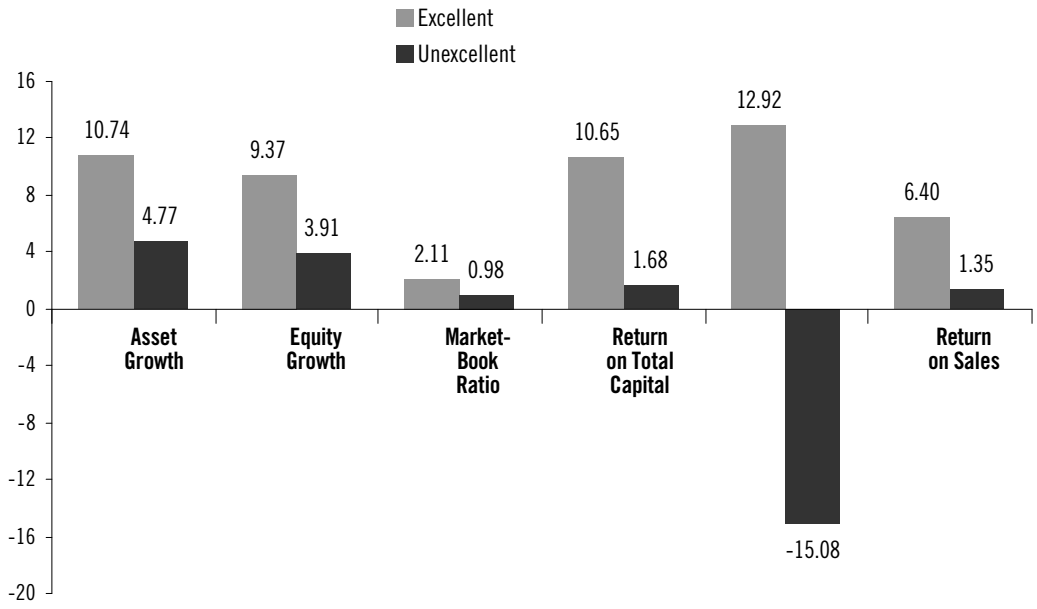
In Search of Unexcellence

In 1987 Michelle Clayman published a study that illuminates the value story.[5] She based the study on a book by Tom Peters and Bob Waterman called *In Search of Excellence*.[6] Peters and Waterman's book was a *New York Times* bestseller, not a financial economics text. It was a sort of entrepreneur's bible, describing the successes of 29 companies so armchair moguls across the country could take a lesson on what makes a company "excellent". The primary criterion for inclusion was profitability, but Peters and Waterman also included companies for warm-and-fuzzy criteria, like whether they used Far Eastern management strategies and the like. Clayman visited the book from an academic angle. She made a value-weighted portfolio of the 29 stocks Peters and Waterman examined. She called this portfolio the "Excellent Companies". Next, for comparison, she compiled the 29 worst companies based on the same criteria: companies with terrible profitability, Dark Ages management and the like. She called these the "Unexcellent Companies".

Exhibit 1 shows the economic health of the two portfolios based on their fundamental measures. Peters, Waterman, and Clayman all seem correct as to what an excellent (or unexcellent) company is. The excellent companies are

Exhibit 1

Excellent vs. Unexcellent Company Ratios
U.S. Companies
January 1981–December 1985

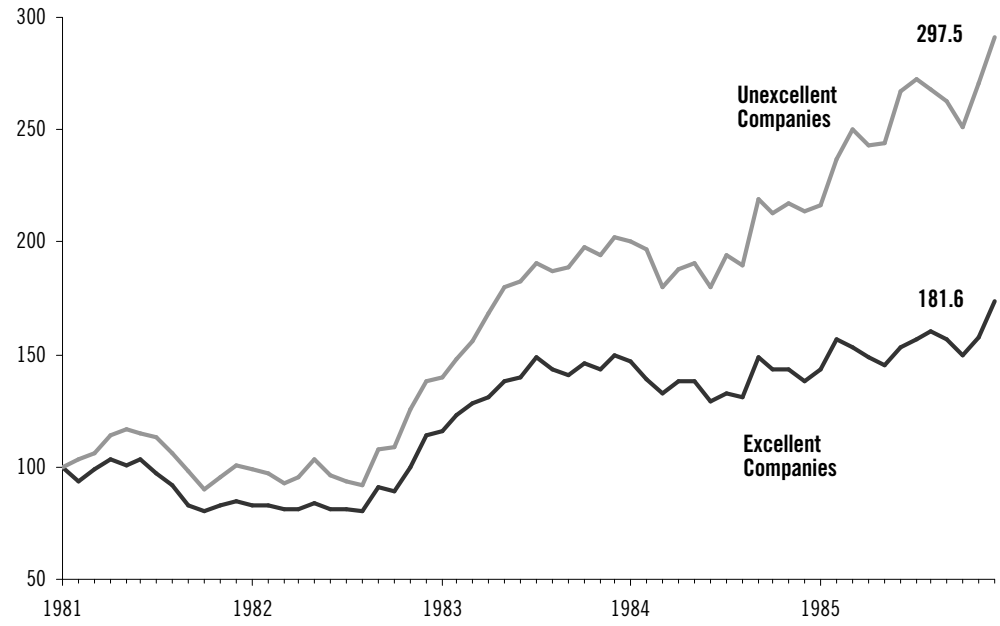


stronger and healthier than the unexcellent companies by every economic measure. Their return on assets shows a huge disparity. A modern day example of an excellent company would be a company that has prospered economically, like Microsoft. An example of an unexcellent company would be a company that has floundered economically, like Woolworth. (We might call financially healthy stocks "growth" and financially distressed stocks "value".)

Exhibit 2 shows the investment return of the excellent companies vs. the unexcellent companies. It may seem counter-intuitive, but the unexcellent companies outperform the excellent companies.

Exhibit 2

Excellent vs. Unexcellent Company Portfolio Returns
U.S. Companies
January 1981–December 1985



If someone asks for a hot stock tip, they rarely expect you to recommend Woolworth or its ilk. They want you to tell them the next Microsoft. They expect you to name an excellent company. Maybe this mentality comes from our experiences in the work force. A healthy company is a nicer place to work than a distressed company. Perhaps we associate the well-being of our human capital with the well-being of our investment capital so we tend to think healthy stocks are stronger investments than distressed stocks.

Which Side are You On?

This is where Merton Miller comes in. In 1990, when William Sharpe won the Nobel prize for the single-factor model, Miller, a Director of Dimensional, shared the prize. The award recognized Miller for his research into the "cost of capital".[7] When markets work, the cost of capital to a company is the expected return on its stock. This is a simple but profound notion. It means that companies use stock, like bonds, to fund operating capital. The return on the stock, even several hands down from the initial offering, reflects the current riskiness of the capital venture. It is the rate it costs the company to get capital.

Here's an example: if you are a bank and Microsoft and Woolworth approach you for a loan, who will have to pay the higher interest rate? Woolworth will, to compensate you for the risk of its financial distress. The story applies to stocks as well. The market expects a higher return from Woolworth stock than from Microsoft stock. This induces investors to purchase Woolworth even though Microsoft is safer. If the two companies had the same expected return, no one would buy Woolworth. As a stock investor, you are in the bank's shoes in the above example, not Woolworth's or Microsoft's. Microsoft may be the better place to work, but Woolworth has the higher expected investment return.

Here's an interesting aside. People who work at growth companies like Microsoft make good livings and often wind up as financial-advisor clients. These people are especially strong candidates for value stock portfolios. Value stocks diversify their human capital. In other words, suppose the market suddenly favors value stocks over growth stocks. A growth company employee holding a growth stock portfolio gets a double-whammy. The economic force that causes his shares to plummet is the same economic force that puts him out of work. If he has a value portfolio, he may have more time to find another job.

The Fama/French Value Strategies

Dimensional's live value strategy is not based on the unexcellent portfolio in Clayman's study. Clayman's paper is included in this discussion to illustrate the general principle of distressed stock investing. Fama and French find that value and growth defined by book-to-market are the strongest forms of value and growth. The value portfolios are structured the way Dimensional structures its other portfolios: to maximize exposure to the risk factor and diversify that exposure as much as possible. This means holding far more than the 29 names Clayman examined.

Construction

Dimensional created a small cap value portfolio and a large cap value portfolio based on Fama and French's methodology. To segregate the small cap stocks

from the large cap stocks, every NYSE stock is ranked by market cap and the resulting list is divided into ten groups, each with an equal number of names. These are called "size deciles". All AMEX and NASDAQ stocks are included in the appropriate NYSE decile based on their size. The smallest five deciles (6-10) are deemed small cap, and the largest five deciles (1-5) are deemed large cap.

To segregate the value stocks from the growth stocks, every NYSE stock with available book data on Compustat is ranked by BtM and the resulting list is divided into ten groups, each with an equal number of names. These are called "BtM deciles". All AMEX and NASDAQ stocks are included in the appropriate NYSE decile based on their BtM ratios. The highest three deciles (8-10) are deemed value and the lowest three deciles (1-3) are deemed growth. All the stocks in the value group that fall in the larger half of NYSE size are eligible for the Large Cap Value Portfolio and all the stocks in the value group that fall into the smaller half of NYSE size are eligible for the Small Cap Value Portfolio.

Dimensional does not currently offer growth portfolios because the market itself is dominated by growth stocks. Most investment portfolios are similar to the market. Dimensional believes they should be tilted further toward value and small cap. A growth strategy with a lower expected return than the market would be counterproductive to this goal. It would be like "riding the brakes".

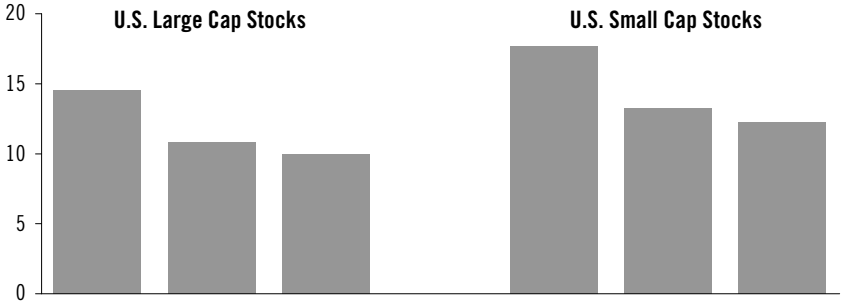
You may have noticed that Fama and French divide the whole market of stocks into small and large, but only take the top and bottom thirds of the market (by BtM) to determine value and growth. This is because the BtM effect seems stronger historically than the size effect. A finer BtM subdivision therefore has greater potential to explain the variation in returns. There are additional benefits, as well. As mentioned above, investors accept the idea of small cap stock risk more readily than the idea of value risk. They might be hesitant to invest large portions of their portfolio in a value strategy. Dimensional's value strategies are more concentrated. An investor can commit half the dollars he commits to a typical value strategy (which divides the market in half by value and growth) and achieve the same increase to his plan's expected return.

Performance

Exhibit 3 shows historical returns and standard deviations for the Fama-French strategies. The chart is divided into two groupings, large cap on the left and small cap on the right. Each grouping shows the result for value, neutral (or "market") and growth. You'll notice the returns for the neutral strategies (S&P 500 for large cap, U.S. 6-10 All Stocks for small cap) are similar to the returns for the growth strategies, part of the reason Dimensional thinks market strategies are growth-dominated.

Exhibit 3

Historical Returns: Quarterly Data
January 1964–December 1995



	Large Value Strategy	S&P 500 Index	Large Growth Strategy	Small Value Strategy	CRSP 6-10 Index	Small Growth Strategy
Annualized Compound Return (%)	14.57	10.92	9.97	17.74	13.24	12.30
Annualized Standard Deviation	15.66	15.56	17.96	22.26	24.18	26.60

There has been a size effect. The three small cap bars are taller than their large cap counterparts by 3%-4% annually. They also have higher standard deviations. This increased volatility explains the beta of 1.20 mentioned earlier. We also observe a BtM effect. The value bars are taller than the growth bars for both small and large cap size groups by about 4%-5% annually. The value standard deviations are not higher than the growth standard deviations. They are slightly lower. Did someone say "free-lunch?" This result seems to fly in the face of rational expectation! How can a portfolio with lower volatility have a higher return? Aren't risk and return supposed to be related?

The Flavors of Risk

This brings up a tricky aspect of the research. Let's review. Fama and French identified three independent sources of risk in stock market returns. For these risks to be truly independent, we expect them not to manifest themselves the same way. 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 concerns above are not unusual. In fact, the Fama-French model proves investors care about other risks besides just standard deviation.

But Is This Real?

The Fama-French study fell under scrutiny and criticism from researchers when it was first published. It was such a short time period (1963-1990), and only included U.S. stocks. It could've been a fluke. Some believed the BtM effect existed, but was the result of mispricing rather than compensation for risk.[8] The market saw their lousy earnings and guessed value stocks were poorer investments than they actually were. In so doing, it assigned them erroneously low prices; it "undervalued" them. When the stocks bounced back, the market was surprised, value investors pleasantly so. Fama and French argued that the three-factor model, discussed in the next section, was due to risk. Whether you believe the value effect is the result of systematic mispricing (market inefficiency) or rational risk compensation (market efficiency), the conclusion is the same. You should have value in your portfolio. Dimensional prefers the argument that value is risk, because systematic mispricing is too weak an idea to build portfolios around. If the market guessed wrong in the past, why wouldn't it learn from its mistake and guess correctly in the future? You don't want to stake your investment strategy on the idea of a chaotic, irrational market replicating its mistakes in the future.

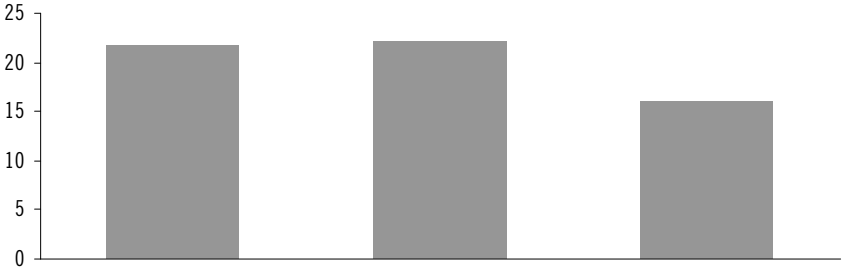
The second big criticism of Fama-French is that it is the result of *data dredging*.[9] I'll try to illustrate what this means and why it's a concern. In most sciences, observation can lead to theory and then further observation can confirm the theory. For instance, the apple falls on Newton's head, he figures out why, then he proves the theory with scientific tests. In economics, observation isn't supposed to lead to theory. The theory is supposed to come first. If it makes sense, you back it up with evidence. The Fama-French research came from examining the evidence with no theory in hand. Data dredging happens at the stage of examining the evidence. Scores of academics across the country routinely spin the data tapes at the Center for Research in Security Prices searching for some pattern in the returns.

With all those academics poring through the data, what are the chances one or two won't find a pattern randomly? It's like the "thousandth-monkey principle". If you have infinite monkeys sitting at typewriters slamming away randomly at the keys, one may type a Shakespeare play, provided there are enough monkeys. The monkey didn't think up the play, he just typed it.

Exhibit 4 disproves the data dredging criticism. The size and BtM effects Fama and French observed in the U.S. happen in every observable market outside the U.S.[10] Small cap outperforms large cap (represented by EAFE on this chart) and value outperforms growth (also EAFE, due to data availability). The standard deviations follow the U.S. pattern. Small cap has a higher standard deviation than large cap, but value had a slightly lower standard deviation than growth. If it were a fluke or just the time period and region that caused Fama and French's result, why would we see identical results everywhere else in the world?

Exhibit 4

Historical Returns: Quarterly Data
January 1975–December 1995



	International Large Cap Value Strategy	International Small Cap Strategy	International Large Cap Stocks (EAFE)
Annualized Compound Return (%)	21.76	22.11	16.10
Annualized Standard Deviation	18.46	20.74	18.68

Portfolio Analysis using the Model

Because the Fama and French model is an asset-pricing model, investors can perform the classic portfolio analyses of asset-pricing models. These include analyzing manager styles and successes, profiling portfolios and calculating expected returns based on past exposure to the factors as well as present exposure. Candidate portfolios

and reallocations can be analyzed for their expected effects as well. Because of the increased explanatory power the three-factor model provides over the single-factor model, these applications are done with greater accuracy than before.

The Models, Again

Exhibit 5 reviews the models. The single-factor model proposed that a portfolio's expected return is the portfolio's percent sensitivity to the market factor (the amount by which the market of U.S. stocks beat Treasury bills) times the historical average market premium. If your portfolio bounces around to within 80% of the market premium's fluctuations, you have a beta of 0.80 and your expected return is 80% of the market's historical average premium over bills. Any return your portfolio

Exhibit 5

The Models

Single-Factor Model

$R(t) - RF(t) = a + b[RM(t)-RF(t)] + e(t)$

average expected return minus T-Bill	=	excess return	+	average beta [market return] minus T-Bill

Average explanatory power (R2) for Fama-French equity benchmark universe.

- **Explains 70% of the variability of returns.**

Three-Factor Model

$R(t) - RF(t) = a + b[RM(t)-RF(t)] + sSMB(t) + hHML(t) + e(t)$

average expected return minus T-Bill	=	average excess return	+	sensitivity to beta [market return] minus T-Bill	+	sensitivity to size [small stocks minus big stocks]	+	sensitivity to BtM [high BtM minus low BtM]

- **Explains 95% of the variability of returns.**

Five-Factor Model

$R(t) - RF(t) = a + b[RM(t)-RF(t)] + sSMB(t) + hHML(t) + tTerm(t) + dDef(t) + e(t)$

average expected return minus T-Bill	=	average excess return	+	sensitivity to beta [market return] minus T-Bill	+	sensitivity to size [small stocks minus big stocks]	+	sensitivity to BtM [high BtM minus low BtM]	+	sensitivity to term risk [LT Govt minus T-bills]	+	sensitivity to default risk [LT Corp minus LT Govt]
								Equity				Fixed Income

*Quote lifted from Robert N. Peres, Investment Advisor magazine, December 1994.

achieves above or below this expectation constitutes its alpha. The single-factor model explains about 70% of returns for a cross-section of equity portfolios of various sizes and styles. The farther you get from the market, the less it explains.

The three-factor model is similar. It simply adds a size factor (the amount by which small cap stocks beat large cap stocks) and a distress factor (the amount by which high BtM stocks beat low BtM stocks) to the market factor. Any return your portfolio achieves above or below the sum of expected returns due to all three factors constitutes its alpha. The three-factor model explains upward of 95% of returns for a cross-section of equity portfolios of various sizes and styles. Unlike the single-factor model, it continues explaining returns the farther a portfolio gets from the market.

"For people whose brains aren't sufficiently stretched by the three-factor model"*, Fama and French propose a five-factor model.[11] This is simply the equity factors from the three-factor model, plus two additional fixed income factors. The term factor (the amount long-term government bonds beat Treasury bills) measures sensitivity to the risks of extending fixed income maturities. The default factor (the amount long-term corporate bonds beat long-term government bonds) measures sensitivity to the risk of purchasing lower quality instruments. These two factors describe the risks of fixed income investing. The only systematic way to take more risk and increase returns is by going into longer maturities and/or junkier quality. All five factors together do a good job describing balanced portfolios and stock/bond hybrid strategies like convertible bonds or interest-sensitive utility stocks.[12]

The Price per Unit of Risk

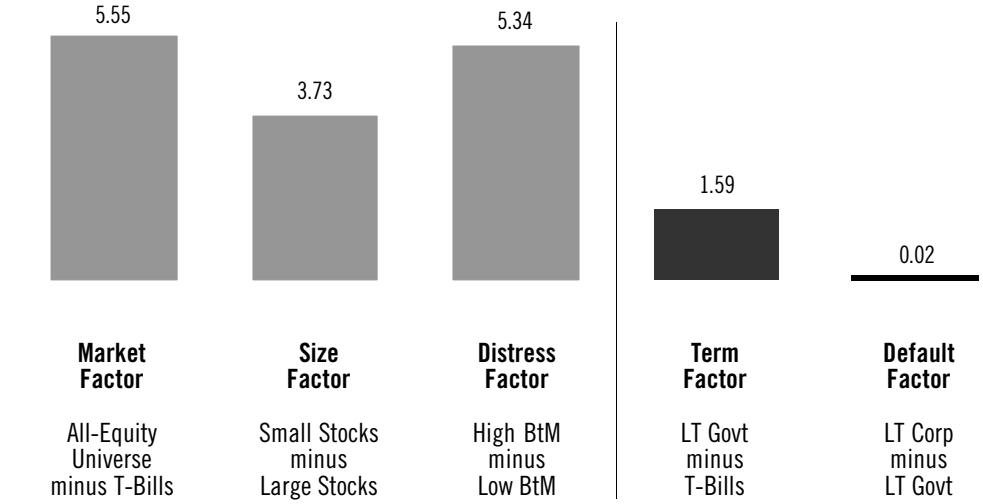
Exhibit 6 describes the historical average returns for each of the five risk factors. This is the amount of return you can expect for taking a "unit" of each type of risk. A unit of risk simply means a beta, or sensitivity, of 1.00 on a factor. It means your portfolio experiences every nuance in the fluctuation of the factor. Suppose you have a portfolio of the smallest cap, most distressed stocks. Let's say this portfolio fluctuates one-to-one with the small cap and value premia. Your expected return on size will be 1.00 x 3.73% (the historical size premium). Add to this your expected return on value, 1.00 x 5.34% (the historical value premium). Finally, add 1.00 x 5.55% (the historical market premium — remember all equity portfolios take about a unit of market risk). Your expected return is the sum of all three, 3.73% + 5.34% + 5.55% = 14.62%. This is the expected premium over the Treasury bill rate (which is about 4%-5% currently).

If you hold the market, forget the size and value premia. Your expected return is about 5.55% per year over T-bills. The market expected return, as mentioned, is a "gimme". Any diversified portfolio of stocks gets it. Your true equity investment decision is the amount of small cap or value stocks you hold.

Exhibit 6

The Five Factors: Average Annual Returns (%)

January 1964–December 1995



This chart illustrates another interesting point. The equity factors pay 4% - 6% per risk unit a year but the fixed income factors pay almost nothing. If your goal is to pursue returns, don't bother taking a lot of fixed income risk. Keep your fixed income short and high-quality to dampen portfolio volatility. This will allow you to "spend" the extra risk units among the three stock factors, where the expected return payoff is five times as big.

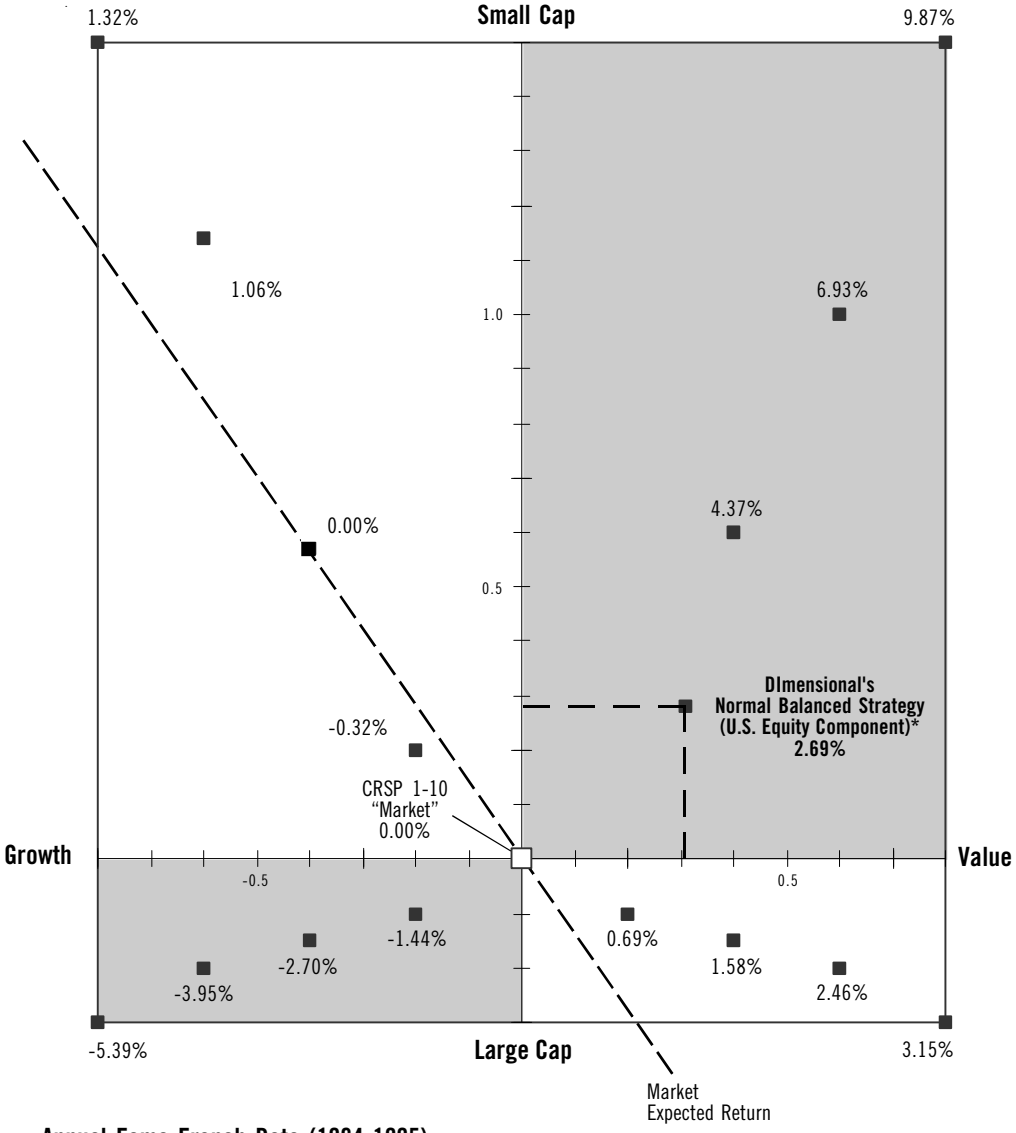
Profiling Portfolios

The model allows us to calculate the way portfolios take different types of risk and calculate their expected returns based on these risks. Exhibit 7 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.

For example's sake, the plot shows Dimensional's recommended balanced equity strategy. This portfolio is comprised of twice as much large cap as small cap in size, and half value, half neutral in BtM. The monthly simulated returns of this portfolio were run through the three-factor model and the results are shown. This (equity)

Exhibit 7

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 minusT-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**

portfolio has a beta around 1.00 (1.01, to be exact), 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 times the respective factor's historical average return, shown earlier in Exhibit 6. 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 recommended balanced strategy is expected to outperform the market by 269 basis points per year to compensate for its additional small cap and value exposures.

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". Except for the fact that the marketplace uses them, performance benchmarks are rendered obsolete by this technology. 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 his large fee. But if the extra return was simply compensation for taking additional systematic (value) risk, why should he get credit? His job is to provide additional returns that can't be indexed, which is exactly what his alpha *is* in the three-factor model. In this example, the model would place him somewhere to the right of the Russell 2000 along the value spectrum and expect him to have outperformed *that* position before crediting him with a premium return. Active manager fees are supposed to pay for smart stock selection, not additional returns that are compensation for taking additional risk.

Various arbitrary points are plotted in Exhibit 7 and the expected returns for those points are shown. The farther up and to the right of the market you go, the higher your expected return. The lower and farther left you go, the lower your expected return. The diagonal dotted line 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.[13] Yet

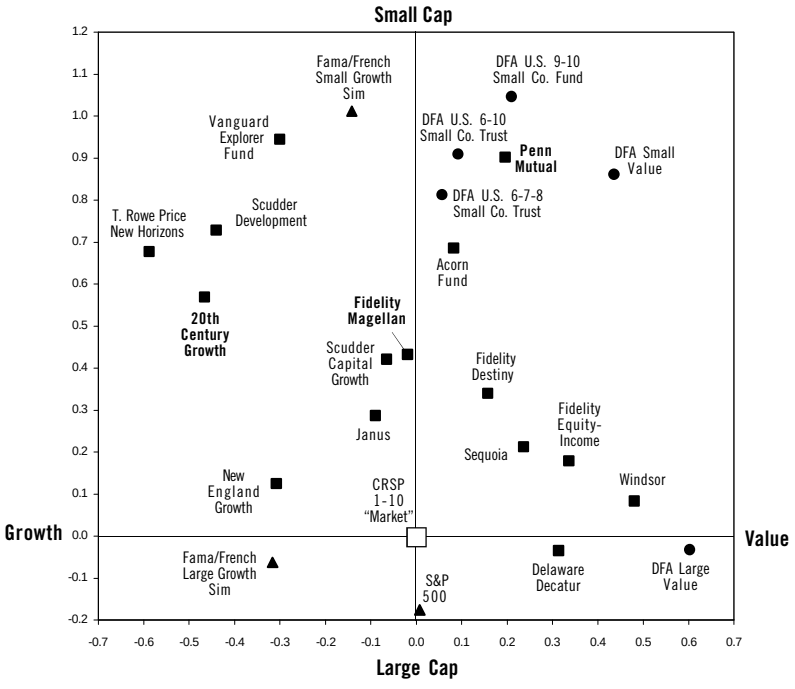
active managers focus more on alpha and are less concerned with how consistently and strongly they expose their portfolios to the risk factors. This would be okay, except they typically fail to provide reliable exposure to the factors *and* they typically fail to provide reliable alphas.

It makes sense that alpha is key in the world of plan sponsors, where a plan hires so many managers it ends up with a portfolio that looks just like the market. If most managers fail to achieve alphas, a plan sponsor might as well buy a market index fund. The only other possible benefit of hiring so many managers is the safety of having the plan's eggs in several baskets instead of one.

Exhibit 8 shows regression results for the active managers financial advisors ask about most often. These managers all have data going back to 1976 on Morningstar. I ran their returns through the model, with no information about their market caps or BtM ratios. The plot reflects the managers' average exposures to the factors from 1976 to 1995.

Exhibit 8

Three-Factor Model: Manager Profiles
January 1976–December 1995



Index	Alpha	Expected Return Over Market
DFA Small Value	0.14	5.44
DFA 9-10 Fund	-0.04	4.88
DFA 6-10 Trust	-0.03	3.90
Pennsylvania Mutual	-0.02	3.84
Small Growth Sim	-0.07	3.38
DFA Large Value	-0.05	3.34
DFA 6-7-8 Trust	-0.01	3.34
Windsor	-0.03	2.87
Fidelity Destiny	0.19	2.77
Acorn Fund	0.19	2.49
Fidelity Magellan	0.60	2.17
Fidelity Equity-Income	0.09	1.85
Scudder Cap Growth	0.00	1.54
Vanguard Explorer	0.02	1.15
Delaware Decatur	-0.08	0.93
20th Century Growth	0.45	0.89
Sequoia	0.41	0.57
Scudder Development	0.24	0.05
Janus Fund	0.27	-0.13
T. Rowe Price Horizon	0.16	-0.57
S&P 500 Index	0.01	-0.62
New England Growth	0.28	-0.67
Large Growth Sim	0.02	-1.96

Grey Box in table indicates significant result (t-stat greater than 2.0).

Everything lands about where expected based on what we know about the managers. Dimensional's 9-10 strategy, which includes only the tiniest two deciles, plots higher and slightly more towards value (because tinier stocks tend to be more distressed) than Dimensional's 6-10 strategy, which includes the lower half of the deciles. The S&P 500 plots below the market, because it contains some of the heftiest stocks, and the CRSP All-Stocks Index used for the market includes all the small companies. 20th Century Growth has been midcap (about S&P 400 in size) with a strong growth tilt since 1976. Pennsylvania Mutual was small cap with a mild value tilt. Fidelity Magellan was midcap with a neutral value-growth exposure relative to the market.

The table to the right of the plot ranks the managers in order of expected return. The smallest cap value managers have the highest expected returns and the largest cap growth managers have the lowest expected returns. The alpha displays the amount the manager has beaten this expectation — the amount that could not have been delivered by an index fund.

Let's take an example. Suppose you indexed Fidelity Magellan's position. It wouldn't be hard. You'll notice the fund falls about halfway on the size axis between Dimensional's 6-10 Portfolio and the S&P 500 Index. A 50%/50% portfolio of 6-10 and S&P 500 would approximate Magellan's average factor exposures. Magellan would have clobbered such a portfolio by approximately 60 basis points per month (the amount of the alpha) over this period.

Magellan had the largest alpha of any fund over this period, and its story is legend. What's more interesting is the fact that most of the other managers didn't score alphas, especially since this "study" is fraught with bias. Remember, these are the managers advisors ask about most (*selection* bias). Advisors don't ask about lackluster, obscure funds. These funds also go back to 1976 (*survivor* bias). Staying in business that long requires good performance because lousy performance leads to business failure and deletion from the database. If you bought a portfolio of all the stocks around today that existed fifty years ago, you'd probably be paying someone to read this for you instead of reading it yourself.

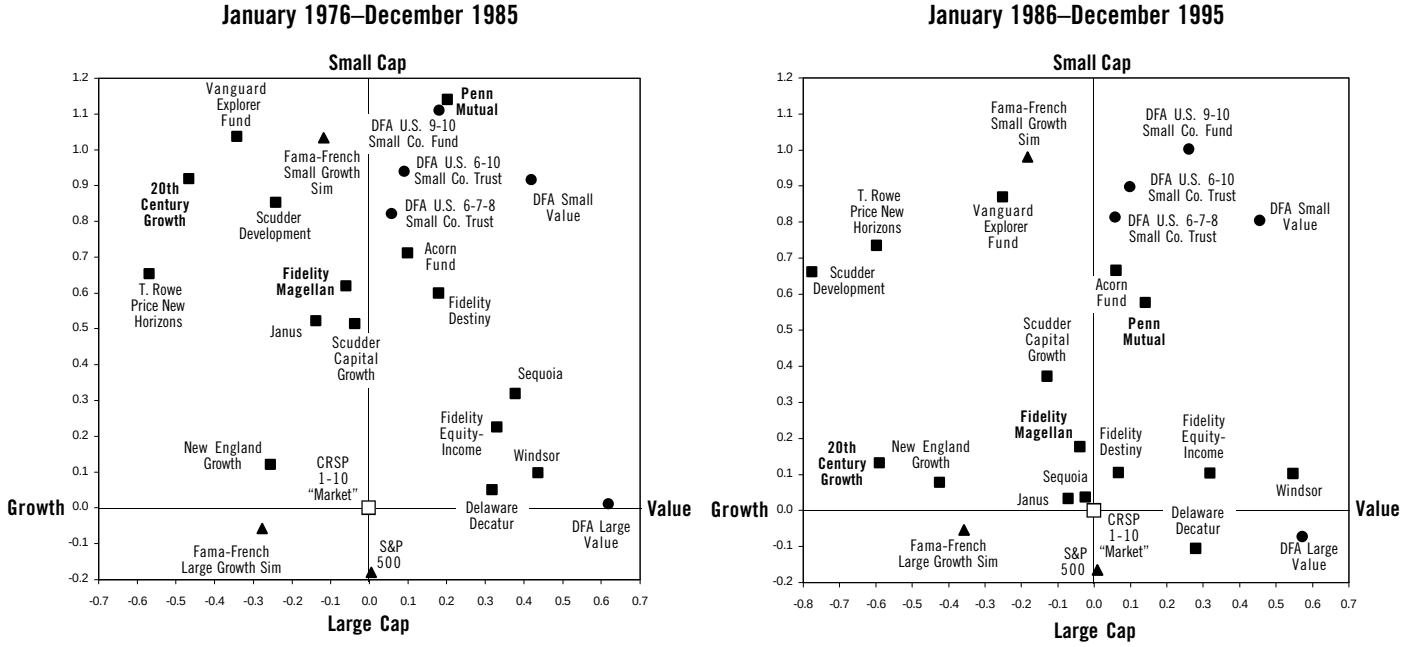
Given that the biases favor the managers, it's amazing there are only four significant alphas (with t-stats over 2.00 in absolute value). They should all have outperformed their factors. Actually, a broader, "survivor-free" database produces a random distribution of alphas.[14] Active managers seem to perform about as well as expected by chance. Besides, it's easy to find past winners and hard to find future winners. Even Magellan, with its huge alpha, missed out on much of the 1996 stock market rally by timing out of stocks. As investors, it behooves us to focus our energy on portfolio structure instead of picking winners.

Paint a Perfect Picture

Active management is a bad way to achieve alpha and a worse way to achieve structure. Exhibit 9 shows the managers from exhibit 8, but with the period (1976-1995) broken in half. On 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. Let's check the funds we discussed in exhibit 8.

Exhibit 9

Three-Factor Model: Manager Profiles



20th Century Growth spent the first half of the period, on average, as a growth fund with a small cap (6-10) size. In the second half it was still a growth fund, but a market-sized growth fund. Pennsylvania Mutual used to be microcap (9-10) in size, like the 9-10 strategy, 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 financial advisor, 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?

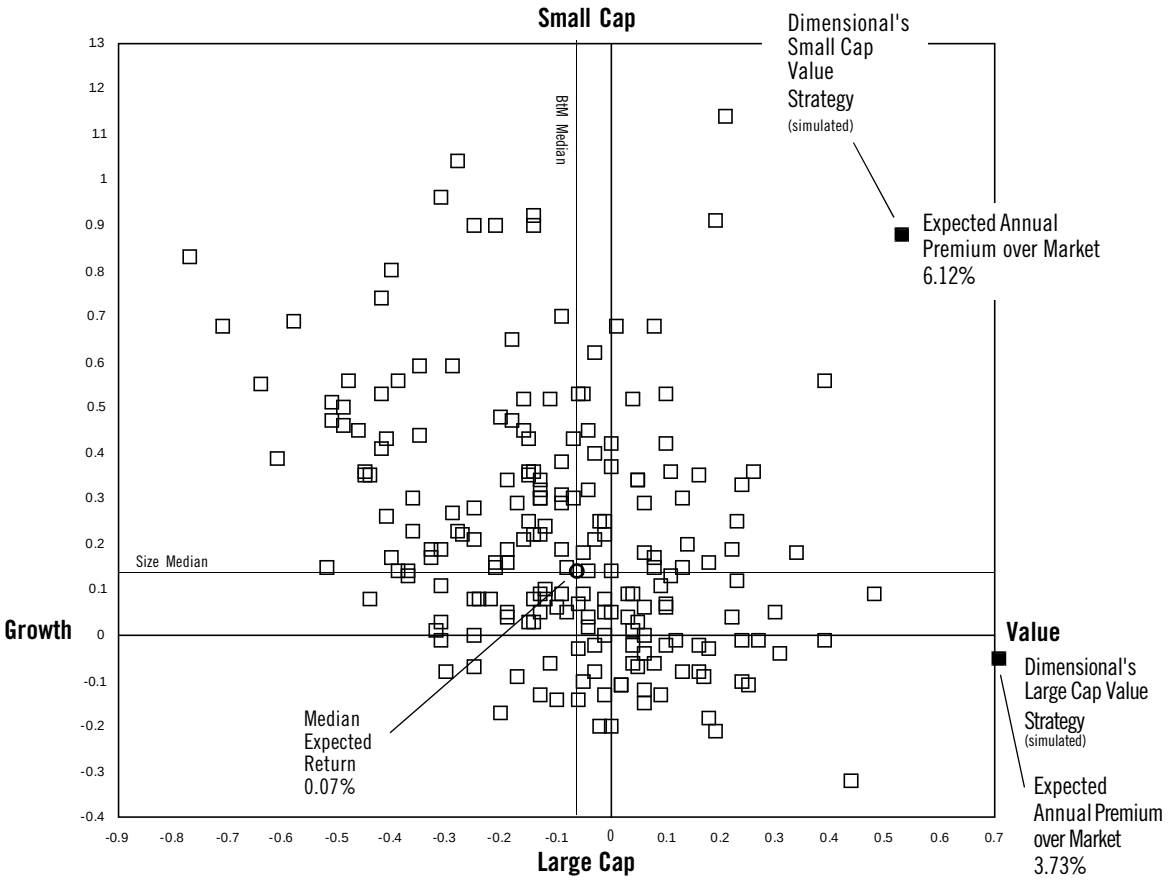
It Takes a "Passive" Manager

It's often the passive 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. Dimensional built its relationship with academics to develop and refine its ability to identify the dimensions of risk. The firm offered its International Small Cap Strategy more than ten years ago and only now in 1996 are numerous international small cap funds and an index emerging from the active management arena. 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 10 shows every Morningstar manager with at least seven years of data for their entire available history run through the model. The Fama-French series' 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 10

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 picking losers. 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

Exhibit 11

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

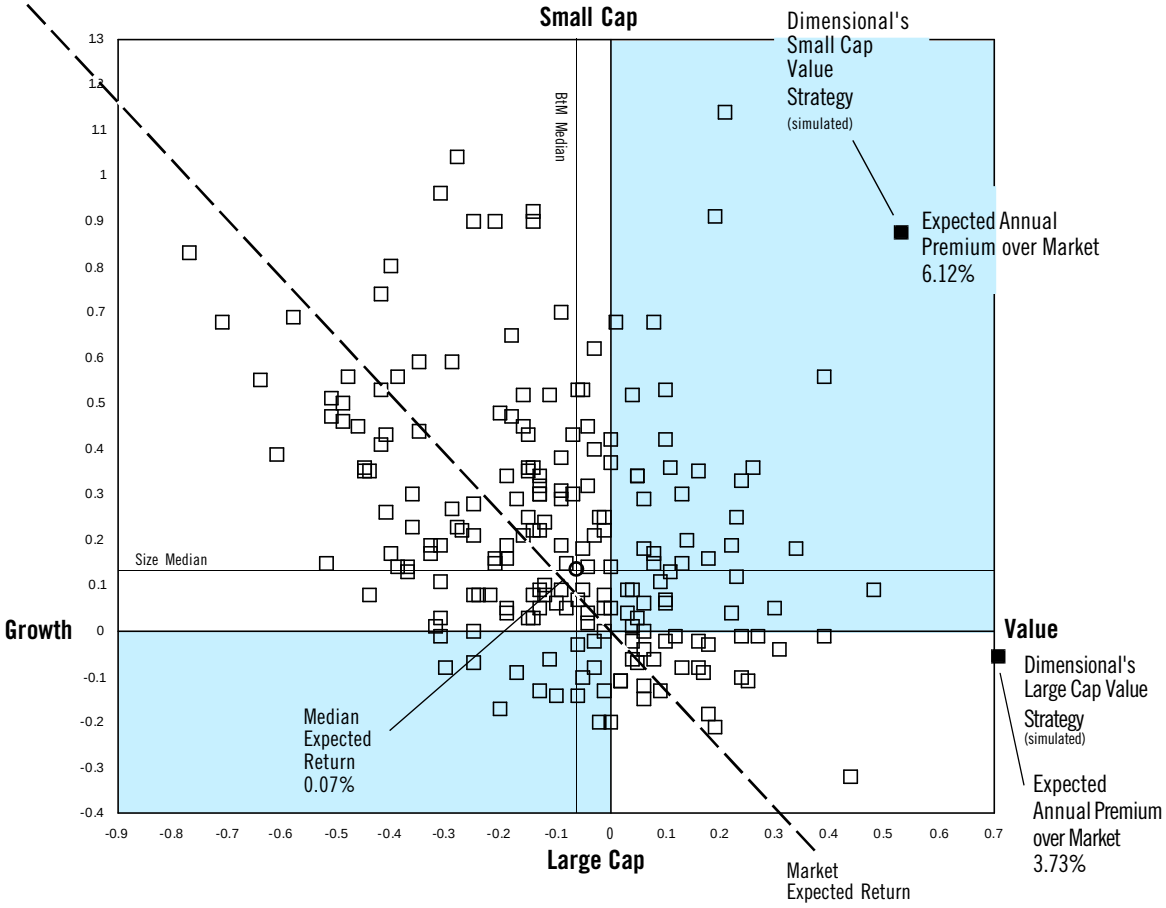


Exhibit 11 shows the same chart as exhibit 10, but with the plotting template from exhibit 7 superimposed. Remember the diagonal dotted line where every point has the same expected return as the market? Notice how that line slices through the "cloud" of active managers? It's a loose fit, but the shape 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.

Managing Factors

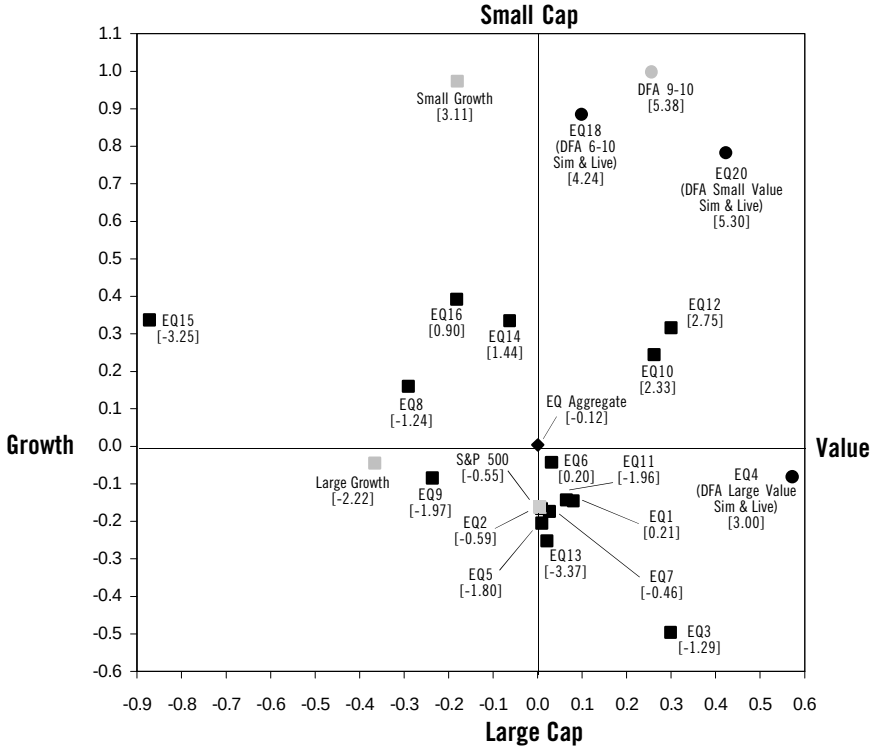
The trade-off between factors is simpler in a multifactor world than managing asset classes the old way. Investors have to decide how much of each type of risk they are willing to tolerate, and structure their portfolios to achieve the risk exposures in the most effective manner. Before the model, they had to decide amongst a Byzantine array of managers and asset classes. Managers and asset classes are interchangeable when the central problem is managing five simple factors.

The model presents solutions that would never have occurred in its absence. A summary of how Dimensional consulted with a large client using the three-factor model follows.

Exhibit 12

Three-Factor Model: Manager Profiles

Periods ending June 1995



Manager	a(%)	t(a)
EQ2	-0.01	-0.21
EQ3	-0.23	-0.52
EQ5	0.29	1.90
EQ6	0.00	0.05
EQ7	0.08	1.42
EQ9	0.02	0.14
EQ10	-0.13	-0.47
EQ11	0.26	1.72
EQ12	0.13	0.61
EQ14	0.01	0.05
EQ15	0.66	1.51
Equity Aggregate	0.00	0.03

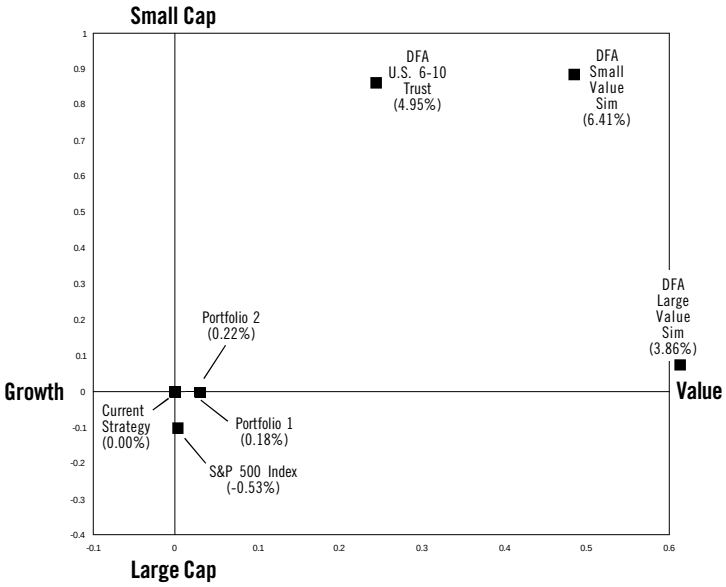
Expected annual premium over the market shown on plot in brackets.

Dimensional was one of 50 managers in the client's plan. The managers were spread across the map in size and value-growth orientations. Still, in spite of the number and range of managers, the client had managed to nail the market perfectly in its combined equity plan. It had a 1.00 loading on the market and 0.00 loadings on both size and BtM. This was deliberate. The client wanted a market portfolio in total and had a staff that analyzed the manager holdings and allocated the assets to achieve perfect market exposure.

Exhibit 13

Three-Factor Model: Candidate Reallocations

Periods ending June 1995



Fund	Market Factor (b)	Size Factor (s)	BtM Factor (h)	Expected Return*
Current Strategy	1.00	0.00	0.00	N/A
Portfolio 1	1.00	0.00	0.03	0.18
Portfolio 2	1.00	0.01	0.03	0.22
DFA 6-10 Trust	1.01	0.95	0.15	4.95
S&P 500 Index	1.00	-0.14	0.01	-0.53
DFA Sml Value	0.98	0.90	0.46	6.41
DFA Lrg Value	1.03	0.01	0.62	3.86

Portfolio 1: Move 6-10 Trust to 6-10 Small Cap Value
Portfolio 2: Move 20% of S&P 500 to Large Cap Value

Dimensional analyzed the client's managers. The results for some of the more interesting managers are shown in exhibit 12. Of the 50 managers, none had statistically significant alphas (not unusual) and seven approximated the S&P 500 in their factor exposures. Here were seven redundant S&P 500 index managers, for practical purposes, because they resembled the index and added no alpha. The client also had a large investment in Dimensional's 6-10 Small Company Strategy.

After reviewing the Fama-French research, the client decided he was mean-variance preferenced and believed the value story. He wanted to move all his 6-10 Small Company (neutral) Portfolio assets to the 6-10 Small Cap Value Portfolio. This seemed reasonable, if a little counter-intuitive. It seemed less than optimal to reallocate passive 6-10 assets, which are relatively strong diversifiers because of their small cap exposure, while ignoring so many redundant large cap managers. Dimensional analyzed the proposed change and suggested another option, shown in exhibit 13.

Portfolio 1 on exhibit 13 shows the proposed shift of all the 6-10 assets to Small Cap Value. The entire portfolio gains an additional BtM exposure of 0.03 and no additional size exposure (because both portfolios are deciles 6-10 in size). This translates to an expected return increase of 18 basis points per year over the current portfolio. Not bad for a multi-billion dollar plan.

Dimensional asked what would happen if, instead of moving the 6-10 assets, the client moved 20% of its S&P 500 exposure to *Large* Cap Value. This seemed appealing in light of the seven or so S&P 500 managers without alphas. The change is shown as Portfolio 2 in the exhibit. BtM exposure increases by the same amount as with the small cap shift, 0.03. In addition, the size exposure increases by 0.01 (because S&P 500 stocks are larger than large cap value market sized stocks). This translates to an expected return increase over the current portfolio of 22 basis points per year, a full four basis points over the small cap shift.

The S&P 500 transfer is preferable to the 6-10 transfer for a number of reasons. First is the advantage mentioned above: the size exposure increased in addition to the value exposure. Second, the S&P 500 managers were more redundant and typical to the overall plan than the 6-10 Portfolio. Transferring assets made more sense for diversification. Third, and most importantly, changes among large cap stocks are cheaper than changes among small cap stocks because of lower trading costs and management fees.

The client wanted to change his small cap portfolio. The model showed how he could accomplish the same impact for less cost using large cap assets, and increase his *small cap* exposure in the bargain. The desired goal was increased small cap value *factor* exposure, not increased small cap value *product* exposure. Before the model, it's hard to imagine the client or Dimensional would have identified this subtlety, or considered making the change using large cap stocks.

The Advantages of this Technology

By focusing our attention on factors instead of asset classes and managers, the model frees us to think of thrifty and imaginative solutions to complex portfolio problems. The client in the above example might not have considered how he was changing his combined U.S. equity portfolio. He just wanted to change the small cap piece. The model expanded his view to show the impact such a change would have over his entire portfolio. This freed him to think of a better way to achieve the same impact, and then some.

It would be hard to hire a consultant for this sort of advice. The model is more advanced than most professional consulting tools. In fact, we really can't underestimate its advantages. It provides the ability to view portfolio problems clearly and solve them, to measure manager factor exposures and performance. It also provides the research and framework to structure the strongest small cap and value investment products. Finally, it gives us guidelines to allocate these products effectively in a portfolio.

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